MISSISSIPPI
STATE GEOLOGICAL SURVEY

WILLIAM CLIFFORD MORSE, Ph. D.
Director

BULLETIN 41

LAUDERDALE COUNTY MINERAL RESOURCES

GEOLOGY
By
V. M. FOSTER, M. Sc.

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

UNIVERSITY, MISSISSIPPI
1940

MISSISSIPPI

STATE GEOLOGICAL SURVEY

WILLIAM CLIFFORD MORSE, Ph. D.

DIRECTOR

BULLETIN 41

LAUDERDALE COUNTY MINERAL RESOURCES

GEOLOGY

BY

V. M. FOSTER, M. Sc.

TESTS

By

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

Prepared in cooperation with the Lauderdale citizens, the State Planning Commission, and the WPA as a report on O.P.465-62-3-275.

UNIVERSITY, MISSISSIPPI

1940

MISSISSIPPI GEOLOGICAL SURVEY

COMMISSION

STAFF

LETTER OF TRANSMITTAL

Office of the Mississippi Geological Survey
University, Mississippi
August 12, 1940

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

Gentlemen:

Herewith is Bulletin 41, Lauderdale County Mineral Resources—Geology by V. M. Foster, M.Sc.; Tests by Thomas Edwin McCutcheon, B.S., Cer. Engr.—the publication of which "in regular bulletin form" constitutes a partial fulfillment of the Mississippi Geological Survey's pledge, as sponsor, necessary to secure W.P.A. grants (projects 4419, 4598, 4847, and 6408) totaling $215,200.12.

The first two minor projects were merged into the third (4847). To secure the $106,193.12 Federal Funds it was necessary to agree to publish the ten county reports and to pledge $12,768.00. Of this amount, the State Legislature (1938) appropriated $3,640.00, leaving an unprovided balance of $9,128.00, which it became necessary for the ten counties, acting as co-sponsors, to raise. It is, with profound gratitude, therefore, that the State Geologist is able to report that the seven counties completely surveyed and the two counties partly surveyed raised, as co-sponsors, not only the balance of $9,128.00 but an amount more than $4,000.00 in excess of this balance—in short, the nine counties it was possible to survey cooperated with their State Geological Survey more than 100 percent.

Through the efficient leadership of Mr. E. P. McNeill, Secretary-Manager of the Meridian Chamber of Commerce, members of that organization, the Lauderdale County Board of Supervisors, the citizens of Meridian and of the county as a whole have cooperated to the fullest extent—to the end that not only did Lauderdale County more than meet her obligations but contributed to the success of the project as a whole.

Nor is the State Geologist unmindful of the excellent field work of Mr. V. M. Foster, one of his former undergraduate and graduate students in geology, now a member of the U. S. Geological Survey. It was known in advance by all geologists familiar with the region that Lauderdale County has been the battle ground of the various conceptions of members of the Mississippi Geological Survey and of the Alabama Geological Survey (not to mention members of the U. S. Geological Survey), because of its location as a border county between the two states. Not only so, but its geology is complex, complicated, and difficult to determine. Although Mr. Foster does not claim to have solved all geologic problems, the fact nevertheless remains that he has solved many of them and has added materially to the knowledge of pure geology as well as to the geology of the mineral resources of the county.

In previous reports, the State Geologist has expressed his appreciation of the splendid work of the State Geological Survey's Ceramic Engineer, Thomas Edwin McCutcheon, and his efficient staff, consisting of Alta Ray Gault, B.A., M.S., Physical Technician, Malcom Rogers Livingston, B.S.E., M.S., Chemical Technician, and Roy Mills, Potter Technician. These excellent workers have determined the properties of the clays and other minerals of Lauderdale County, as reported in the second part of this bulletin.

As, in the Seventeenth Biennial Report of the Mississippi Geological Survey, the State Geologist was able to express his appreciation of the cooperation of the W.P.A. state and district officials, so again is he in a position to repeat that appreciation of them—especially of Mr. Roland B. Wall, Miss Ethel Payne, Mrs. Amalie S. Fair, Mr. Felix J. Underwood, Jr.; Mrs. Mary Paine Harvey, Miss Aimee Reed, and Mr. Newton L. Crosby. In that report too, he expressed his appreciation of the cooperation and support of the State Planning Commission under the direction of Mr. L. J. Folse; and likewise of the Department of Chemistry and of the University of Mississippi as a whole.

Perhaps it will not be out of place to mention in this report the results of earlier press releases and the publication of the Yazoo County Mineral Resources Bulletin (39). These presented to the public the fact of the discovery of the Tinsley Dome, by Frederic Francis Mellen, a former undergraduate and graduate student of the State Geologist, the field geologist in charge of the survey of that county. In the press release on Tinsley Dome it was recommended that the structure be surveyed by geophysical methods, and, if these confirmed the surface evidence, then that it be drilled. The G. C. Woodruff No. 1 well on that structure was completed as the first commercial oil well in the State on August 28-29, 1939. Since that date, and as a direct result of this discovery well, oil has been discovered near Vaughan in the eastern part of Yazoo County, through the field work of Dr. Richard Randall Priddy, of the Kingwood Oil Co., now a member of the WPA-Mississippi Geological Survey. Since that date some 80 producing wells have been completed in Yazoo County. The production for the year has been estimated at 2,500,000 barrels valued at more than $2,000,000.00. With lease rentals and bonuses for signing the leases ranging from 25 cents an acre to 20 dollars an acre, other millions of dollars have flowed into the state.

In this connection it is interesting to recall that the Jackson dome was discovered by a former State Geologist, Dr. Eugene W. Hilgard, who described it in his Report on the Geology and Agriculture of the State of Mississippi in 1860, within a year of the drilling of the first oil well in the World on Oil Creek Pennsylvania in 1859—a pure geology discovery that preceded by 70 years the drilling of the first gas well in Mississippi in the Jackson Field. It is devoutly to be hoped, however, that the Alamucha structure, the Lauderdale and Lizelia structural areas, the areas of structural indications in the Tallahatta claystone, and the others described in this Lauderdale County Mineral Resources report will not have to wait so long for an adequate deep well test for oil and gas, and that at least some such test will prove as beneficial to Lauderdale County and to the State as have the Tinsley and Vaughan structures to Yazoo County and the State.

However, the State Geologist is still of the opinion that the clay and other non metallic minerals will eventually prove to be as valuable as the gas and oil fuels. The results of the tests of the clays and the minerals of Lauderdale County, recorded in this report, indicate that vast quantities of high grade clays are available for commercial utilization.

May revived business lead to the development of the Lauderdale County Mineral Resources.

Respectfully submitted,

William Clifford Morse,
Director and State Geologist

CONTENTS

GEOLOGY

TESTS

ILLUSTRATIONS

GEOLOGY

LAUDERDALE COUNTY MINERAL RESOURCES

GEOLOGY

V. M. FOSTER, M.Sc.

GENERAL

Lauderdale County, of which Meridian is the county seat, is located in the east central part of the state, lying between 32° 35′ 15″ and 32° 12′ 12″ north latitude and 88° 24′ and 88° 54′ 48″ west longitude. It has an area of approximately 708 square miles and is bounded by Kemper County on the north; Sumter and Choctaw Counties, Ala., on the east; Clarke County on the south; and Newton County on the west.

Figure 1.—Flatwoods topography near Sucarnoochee, Kemper County. October 10, 1938.

TOPOGRAPHY

The surface is that of a maturely dissected upland on which several well defined cuestas can be distinguished. The major streams have fairly broad valley flats bordered by one or more low terraces. Ponta, Toomsuba, and Alamucha Creeks, draining the northeastern corner of the county, follow an easterly course and form part of the Tombigbee-Alabama River system. Chunky, Tallahatta, Okatibbee, Long, Bucatunna, and Hurricane Creeks, on the other hand, drain southward into the Chickasawhay River.

In detail the topography reflects the underlying geology to a remarkable extent. The entire area lies within the Gulf Coastal Plain physiographic province and almost entirely within that topographic division known as the North Central Hills. In the extreme northeastern corner of the county, where the valley of Ponta Creek is cut into the Porters Creek clay, there is developed the typical plain-like topography of the Flatwoods. The major part of the county, on the other hand, is an upland underlain by alternating beds of sand and clay into which the streams have cut their valleys. Many of the streams tend to parallel the strike of the gently dipping strata, the more resistant of which now stand as cuesta-like ridges.

Figure 2.—Ackerman cuesta, looking east northeast up the back-slope from the fire tower 3.3 miles east of Lauderdale. October 13, 1938.

Four such cuestas may be distinguished in the county. The first of these, capped by the coarse basal sand of the Ackerman formation, extends from the Lauderdale-Kemper County line north of Lauderdale Village (Sec. 1, T.8 N., R.18 E.) to the Alabama line east of Lauderdale and northeast of Kewanee (Sec. 7, T. 8 N., R. 19 E. to Sec. 13, T. 7 N., R. 18 E). This is perhaps the most complex, and therefore the least distinct, of the four major cuestas. It is capped by the basal Ackerman sand, and its northeastern or scarp face is formed by the sands and sandy clays of the Naheola and Fearn Springs formations on which several minor cuesta-like ridges are developed. The Ackerman cuesta, furthermore, is cut across and obscured by Ponta Creek and several tributaries of Ponta and Toomsuba Creeks.

Extending from the Kemper County line northeast of Lizelia (Sec.1, T. 8 N., R. 16 E.) to the Alabama line east of Kewanee (Sec. 25, T.7 N., R. 18 E.) a well defined cuesta ridge is developed on the Holly Springs formation. The north or northeastern face, formed on the basal Holly Springs sand, is steep and ruggedly dissected while the back slope, developed on the clays of the upper part of the formation, slopes gently to the south and southwest and presents a smoothly rolling surface. The Holly Springs cuesta is cut through and modified by Ponta Creek north of Lockhart and by Toomsuba Creek near Toomsuba, and it seems also to have been modified by faulting between Lizelia and Lockhart and between Toomsuba and the old town of Alamucha. Thus in these two areas the cuesta is bifurcate, each prong showing the typical cuesta development and each presenting an almost complete section of the Holly Springs formation. On the back slopes of the two southernmost prongs the basal Bashi sands extend almost to the crest.

A third cuesta, developed on the Bashi-Hatchitigbee sands and clays, extends from near Martin school (Sec. 2, T. 8 N., R. 14 E.), where it is poorly developed and obscured by the headwaters tributaries of Okatibbee Creek, to the southeastern corner of the county near Whynot (Sec. 22, T. 5 N., R. 18 E.). The crest of this ridge is formed by the basal sands of the Hatchitigbee formation, and almost the entire Bashi is exposed in the northeast slopes. On the whole, the scarp face is steep, and from Meridian to the state line it is not badly eroded. Where the Bashi begins to lose its identity, northwest of Meridian, however, the cuesta is more complex, and erosion has partly obscured the front slope. The back slope is more hilly than that of the Holly Springs cuesta, and in many places the major streams have cut through the sands and clays of the Hatchitigbee to expose the upper clay and marl of the Bashi.

The Tallahatta cuesta is the most prominent topographic feature of the county, extending from the Newton County line northwest of Suqualena (Sec. 6, T. 7 N., R. 14 E.) to the Clarke County line south of Causeyville (Sec. 32, T. 5 N., R. 17 E). Its northeastern face forms a precipitous bluff-like line of hills in which the entire thicknesses of the Tallahatta claystone, the Meridian sand, and in some places (south of Meridian) the Hatchitigbee formations are exposed. Furthermore, outliers of the Tallahatta claystone form the cap rock of several high steep-sided hills. The back slope of the cuesta is underlain by marls of the Winona and by loose red sands of the Kosciusko, both members of the Lisbon formation. Since these marls and sands erode easily, the streams of the back slope have cut deeply into them, producing a rugged terrain in which the gentle southwestward slope of the hill tops is all that remains of the original back slope.

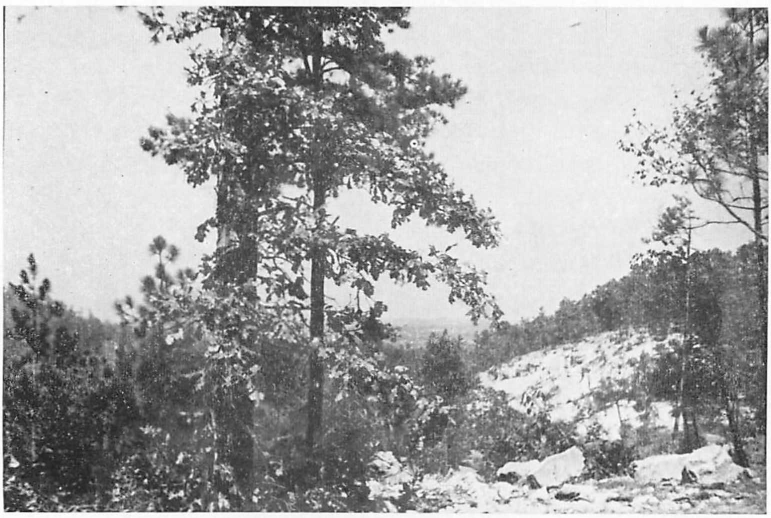


Figure 3.—Dissected escarpment of the Tallahatta cuesta from "The Mountains," looking north toward Meridian. October 14, 1938.

STRATIGRAPHIC AND AREAL GEOLOGY

INTRODUCTORY SUMMARY

Except for recent alluvium and several doubtful terrace deposits, the outcropping formations of Lauderdale County, extending from upper Midway to middle Claiborne, are all Eocene in age. For the most part, these formations consist of unconsolidated or poorly consolidated sands, sandy clays and shales, and individual beds vary greatly from place to place. Where exposed in hillsides, they erode and slump rather easily, and it is often impossible to determine whether or not a given exposure represents material in place, slumped, reworked by running water in a former erosion cycle, or material accumulated through colluvial action. Under these circumstances, therefore, it is very difficult, and often impossible, to correlate individual beds over long distances. However, the major stratigraphic features, especially the general succession of beds in which sands, clays, or shales predominate and the relation of these beds to such key beds, as lignite and glauconite, are rather constant and characteristic.

In the report, stratigraphic descriptions are generalized and detailed sections selected to illustrate major relationships rather than detailed stratigraphy of any particular locality. In the following generalized section, all thicknesses are approximate, being based on surface outcrops.

GENERALIZED STRATIGRAPHIC SECTION

LAUDERDALE COUNTY

Eocene system	Feet	Feet
Claiborne series, from 270 to		322
Lisbon formation		140
Upper marl member (not exposed in Lauderdale County)		
Disconformity		
Kosciusko member (100 feet)		
48. Sand, white to red, cross-bedded, medium to coarse grained; slumps and washes easily	100	
Disconformity (?), poorly exposed,		
Winona member (40 feet)		
47. Clay, brown to gray-brown, sandy, shaly, glauconitic, fossiliferous (Zilpha of Moore). Feather edge to	8	
46. Sand; glauconitic marl in unweathered state, weathers to highly limonitic indian-red sand; contains some interbedded clay-shale; highly fossiliferous; "Scutella bed" near base	32	
Disconformity, marked by sharp contact between lithologically different beds, by thickening and thinning of underlying bed, and by evidence of erosion at top of underlying bed.		
Tallahatta formation		90
45. Claystone and siltstone in alternating hard and soft layers that tend to harden on exposure; some beds have very low specific gravity when dry; some beds are dense, almost ivory-like, some are earthy; and some contain considerable sand; fucoid-like markings are common. The beds are light yellow to buff, have a block-like fracture, and at upper contact are locally quartzitic	80	
44. Sandstone, coarse grained, grit-bearing, glauconitic; lenticular and locally absent. From 1 to	2	
43. Claystone, glauconitic, sandy, contains thin lenses and rounded masses of coarse grit-bearing sand and local concentrations of such lenses as much as 1/2 foot thick near base of bed. From 1 to	2	

42. Sand, greenish gray, glauconitic; contains many thin beds and lenticular layers of soft claystone and irregular nodular masses of sandy claystone; grades downward into fairly pure glauconitic grit-bearing sand	6	
Disconformity, marked by sharp change in lithology, by borings and by a zone of leaching at the top of underlying formation; and by a basal grit in overlying formation		
Meridian formation, from 40 to		92
41. Sand, fine to medium grained micaceous massive white, containing irregular fucoidal markings, which in places, are definitely borings filled with a mixture of the surrounding sand and glauconitic sand from above. From 2 to	7	
40. Sand, medium to coarse grit-bearing cross-bedded; light buff stained with reddish brown along planes of bedding and cross-lamination; lower part locally contains lenses of sandy clay; locally developed sand-clay conglomerate in lower 15 to 20 feet the clay pebbles being rounded and showing evidence of some transportation. From 35 to	85	
Disconformity, erosional, marked by irregular contact and overlap		
Wilcox series, from 675 to		900
Hatchitigbee formation, from 75 to		150
Upper member (From feather edge to 90 feet)		
39. Clay-shale, silty and sandy, lignitic leaf-bearing; interbedded with silt and fine grained argillaceous sand; cross-bedded in part; grades laterally into fine grained argillaceous sand interbedded with silt and clay. From 25 to	70	
38. Lignite, argillaceous, persistant. From 1 to	2	
37. Silt and clay interbedded, grading laterally into sandy shale and into fine grained argillaceous sand interbedded with clay. From 12 to	15	
36. Lignite; discontinuous; in places represented by lignitic clay	1	
35. Clay lignitic leaf-bearing; grades downward into sandy silt. From 3 to	10	
Lower member (From 30 to 100 feet)		
34. Sand, very fine grained argillaceous cross-bedded, contains some silt and clay interbedded and interlaminated; locally carbonaceous and leaf-bearing; grades upward into overlying silty clay member and downward into Bashi fossiliferous clay; in extreme northwest corner of county it overlies the Holly Springs disconformably. From 30 to	100	
Conformity, marked by gradational transition into overlying sand		
Bashi formation from 90 to		125

Upper member (From 30 to 50 feet)

33. Silt, argillaceous and arenaceous, interbedded with clay; grades laterally into fine grained sand which may or may not be glauconitic or lignitic; locally developed as a silty clay, which in one locality is indurated to a claystone closely resembling that of the Claiborne; sparingly fossiliferous; the sandy facies is best developed in southeastern part of the county. Weathers to red argillaceous indistinguishable from weathered Hatchitigbee. From 30 to 50

Greensand marl member (From 20 to 30 feet)

32. Sand, medium grained highly glauconitic; has peculiar pepper and salt appearance due to mixture of white quartz sand and glauconite; unindurated; weathers to brown limonitic sand; grades upward to silt; locally absent. From 1 to 5

31. Sand, gray to green glauconitic; coarse grained and grit-bearing in most places; highly fossiliferous or locally sparingly fossiliferous; commonly indurated to an irregular, nodular, or discontinuous ledge of marl, but may consist of unconsolidated material; locally contains large amount of reworked lignite, commonly as large rounded masses; grades downward into underlying bed and locally indistinguishable from it. 4

30. Sand, medium to fine grained silty carbonaceous, glauconitic sparingly fossiliferous; commonly contains large nodular calcareous concretions ranging up to 4 or 5 feet in diameter and many are highly fossiliferous; becomes more silty in lower part, grading downward into underlying bed. From 6 to 15

Lower member (From 40 to 55 feet)

29. Silt interbedded with fine grained sand and sandy clay; carbonaceous, locally contains two or three lenticular beds of reworked lignite mixed with sand and silt; sparingly glauconitic throughout, a few beds approaching glauconitic marl; grades downward into underlying sands and laterally into sand indistinguishable from the basal sands; some beds sparingly fossiliferous. From 15 to 25

28. Sand, fine grained, grading downward to coarse grained; locally glauconitic throughout or consisting of interbedded glauconitic and non-glauconitic beds; silty and carbonaceous in places, the silt being intermixed or interbedded or as thin partings along cross-lamination; sparingly fossiliferous; in some localities small fragments and logs of silicified wood are fairly abundant. From 15 to 40

Disconformity, erosional, marked by irregular contact, by cutting out of underlying beds and by overlap

Holly Springs formation, from 175 to 275

Upper member (From 60 to 160 feet)

27. Clay and silt, interbedded and interlensed with sand; the fine grained material is dominant throughout; very irregular and channeled upper surface; in some localities entirely cut out or overlapped by overlying sand. From feather edge to 60
26. Lignite; contains two clay partings which locally thicken to as much as 8 feet giving appearance of two lignite beds or, rarely, three, separated by underclays; pyritiferous. From 0.5 to 4
25. Clay, silt, and very fine grained sand, interbedded and interlensed; grading vertically and laterally from one to the other; carbonaceous and in part lignitic. From 20 to 40
24. Lignite; contains clay parting which locally thickens to as much as 7 or 8 feet, giving appearance of two lignites separated by underclay. From 0.5 to 3
23. Silt, clay, and fine grained argillaceous sand interbedded and interlensed, grading laterally and vertically from one to the other; pyritiferous, carbonaceous underclay 0.5 to 2.5 feet thick at top. From 20 to 30
22. Lignite, impure pyritiferous. From 0.3 to 2
21. Sand, silt, and clay interbedded and interlensed; grading laterally and vertically from one to the other; pyritiferous, carbonaceous, and slightly micaceous; locally lignitic and leaf-bearing. Underclay from 0.5 to 2.3 feet thick at top. From 15 to 30

Lower member (From 40 to 140 feet)

20. Sand, fine grained silty at top, grading downward to medium grained and containing scattered coarse sand or fine grit particles; cross-bedded micaceous; thin and discontinuous clay partings along planes of cross-lamination; thin layers of interbedded clay and sand common, especially toward top; clay and silt lenses interbedded with the sand, locally reaching thicknesses of several feet; clay pebbles scattered throughout but not common, locally concentrated to form sand-clay conglomerate. From 40 to 140

Disconformity, erosional, represented by irregular surface, by absence of upper beds, or entire upper member of Ackerman, and by limonite concentration at contact

Ackerman formation, from 175 to 200

Upper member (From feather edge to 75 feet)

19. Sandy clay and argillaceous sand, interlaminated and interbedded; lignitic gray to greenish gray 14
18. Lignite, argillaceous, not sharply separated from adjacent beds. From feather edge to 1
17. Clay, arenaceous and silty, grading laterally to fine grained argillaceous sand, pyritiferous, micaceous plastic; under clay locally developed at top 5

16. Lignite, argillaceous, from 0.5 to 2
15. Clay, arenaceous, grading laterally to fine grained silty sand; laminated pyritiferous, micaceous, lignitic. From 12 to 20
14. Lignite, argillaceous and silty; contains a clay parting near center which locally thickens to 5.0 feet or more, forming a pyritiferous underclay between two impure lignites. From 0.5 to 1
13. Clay intermixed and interbedded with silt and sand; the upper 2 or 3 feet forms an underclay; grades downward through silty cross-bedded sand interbedded with sandy silt and clay into lower Ackerman member 30

Lower member (100 feet)

12. Sand, medium grained at top grading downward to coarse grit-bearing sand in lower part, in which are to be found scattered pebbles and boulders ranging up to 3 or 4 inches in diameter. Upper part contains a few clay lenses and partings along planes of cross-lamination; lower part contains clay pebbles up to 2 inches in diameter, so concentrated locally as to form a basal conglomerate 100

Disconformity, erosional, represented by irregular surface, by absence of upper part, or all of Fearn Springs formation, and by overlap of Ackerman sands onto beds as low as Porters Creek

Fearn Springs formation, from feather edge to 125

Upper member (From 15 to 95 feet)

11. Sand and sandy shale, interbedded, grading laterally from one to the other; highly micaceous, cross-bedded in more sandy portions. Locally composed almost entirely of sand having a few clay partings along planes of cross-lamination; in other localities the shale beds reach thicknesses of 10 or 15 feet, separated by thin beds of sand. Varies in color from white or yellow brown to black and lignitic 75
10. Clay, highly plastic (pottery clay zone); varies from dark gray lignitic to light gray and from pure clay to sandy clay or argillaceous sand; grades upward into overlying bed. Locally absent. From 3 to 17

Lower member (From 30 to 50 feet)

9. Lignite; locally absent or present as highly argillaceous and sandy lignite composed of reworked material. From 0.3 to 4
8. Underclay, dark lignitic, grading laterally into and interlensed with fine grained argillaceous sand similar to uppermost part of underlying bed; highly carbonaceous and slightly pyritiferous. Locally very plastic and may be suitable for pottery or brick clay. From 0.5 to 15

7. Sand, fine grained silty and argillaceous at top, grading downward to coarse grained, grit-bearing sand; locally contains much reworked bauxite and kaolinite intermixed and interlensed with the sand; grades laterally into dark gray or black sandy shale; highly micaceous throughout. From feather edge to 35

Disconformity, erosional, represented by concentration of limonite in some places and by cutting out of bed No. 6 entirely in some places

Midway series (Well exposed along highway U. S. 45 in Kemper County) From 550 to 600

Naheola formation, from 50 to 84

6. Sand and sandy clay-shale, variable in lithology. As usually developed it consists dominantly of sand, fine grained but locally containing small scattered quartz grit; highly cross-bedded, with clay and limonite partings; locally the cross-bedding is not well developed in some beds; highly micaceous in most places; some parts locally glauconitic. Grades both laterally and vertically into black or gray, sandy and evenly laminated clay-shale or fissil shale. In some localities grades downward into bed No. 5, in others the contact is fairly sharp; slumps easily. From 20 to 70

5. Clay similar to Porters Creek in lithology, but it is glauconitic in most places and some what more shaly. Interbedded with discontinuous layers, lenses and flattened nodules of limonite which is sandy, glauconitic and sparingly fossiliferous. From 11 to 14

4. Marl, glauconitic, calcareous, and very sandy; irregularly interbedded with glauconitic clay resembling the Porters Creek; contains abundant large irregular and flattened limonite nodules; highly fossiliferous. Not everywhere well developed; seems to be a discontinuous bed or lenticular zone 6

Porters Creek formation, from 500 to 567

3. Clay, dark gray to black, weathering to light gray; indistinctly laminated, some parts shaly and containing very fine sand. As developed in most places it is remarkably even textured and shows typical conchoidal fracture. Siderate concretions and limonite partings common in upper 50 or 60 feet. From 500 567

Clayton formation, from feather edge to 80

2. Shale and lime or chalk interbedded (Reported from Craig well No. 1, NW.1/4, Sec. 28, T.7 N., R.14 E., Lauderdale County.) 80

1. Chalk and marl, sandy, indistinctly cross-bedded fossiliferous (*Ostrea pulaskensis*, Harris.); grades laterally to coarse cross-bedded sand and to argillaceous marl; lower few inches grit bearing in some places. From 9 to 12

Disconformity, erosional, marked by irregular contact

Cretaceous system

Prairie Bluff formation .... ?

EOCENE

MIDWAY SERIES

The name Midway was originally applied to a relatively thin section of limestone and marl at the base of the Eocene, which crops out at Midway Landing on the Alabama River, Wilcox County, Alabama. [1]Later the name was redefined by Harris[2] to include all of the marls, clays, shales and sands lying between the Wilcox and Cretaceous, which his work showed to be a "stratigraphic and paleontological unit."

In east-central Mississippi the Midway may be divided into three distinct lithologic units: the Clayton, Porters Creek, and Naheola. These units correspond to the Clayton, Sucarnoochee, and Naheola formations of Alabama. The name Porters Creek is used rather than Sucarnoochee since it is the older and therefore takes precedence. As generally defined in the geologic literature on Mississippi, the Porters Creek is practically the equivalent of the Sucarnoochee in Alabama, although in some localities the upper Porters Creek, as formerly described, also included the Naheola. The Naheola formation has not previously been recognized as a mappable unit in Mississippi, but has been variously described as basal Ackerman, upper Porters Creek, or as transition beds between the Midway and Wilcox.

CLAYTON FORMATION

The Clayton formation derives its name from outcrops of calcareous sand and sandy limestone near Clayton, Barbour County, Alabama. The term as originally defined by Langdon[3] includes the entire thickness of calcareous sand, marl, and limestone which make up the basal beds of the Midway and directly overlie the Cretaceous of Georgia, Alabama and Mississippi.

Although this formation does not crop out in Lauderdale County, it is desirable that it be considered in this report in order that the stratigraphic relations of the Midway may be understood. Natural gas from this zone has been reported in several wells drilled in Lauderdale, and it is from the sandy marls of the Clayton formation that gas is produced in the Jackson Field.

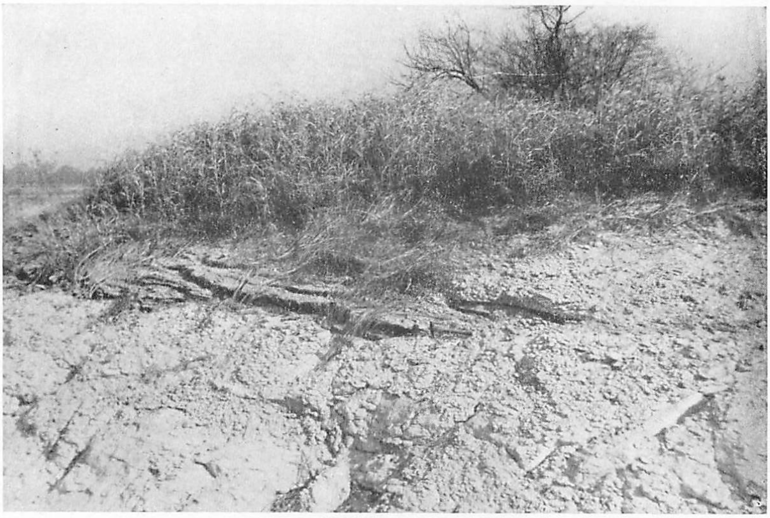


Figure 4.—Cretaceous-Eocene contact of the Prairie Bluff formation and the overlying crossbedded calcareous Clayton sandstone; in highway cut on U. S. 45, 3.7 miles north of Scooba, Kemper county. January 10, 1940.

The stratigraphic relations of the Midway are easily seen along U. S. Highway 45 in Kemper County where the full thickness is exposed. The Cretaceous-Midway contact is well exposed in the vicinity of Scooba. The Clayton formation attains a maximum thickness of about 20 feet in this area, and seems to consist of reworked Cretaceous chalk, deposited in irregularities on the bottom of the Midway sea. Thus it is similar lithologically to the underlying Cretaceous and varies considerably in thickness over relatively short distances, being entirely absent in many places. It is characterized, however, by a small capulate pelecypod (*Ostrea pulaskensis,* Harris) and is separated from the underlying Prairie Bluff chalk by a distinct disconformity. In a cut on U. S. Highway 45, 3.7 miles north of Scooba, Kemper County, the Cretaceous-Eocene contact is typically exposed.

Section of Cretaceous-Eocene contact, 3.7 miles north of Scooba—Sec. 19, T.12 N., R.18 E.

	Feet	Feet
Recent		
3. Soil, dark brownish gray to black; very sticky; somewhat granular or conchoidal fracture. Sharp lower contact.	1.0	
Eocene		
Midway		
Clayton		15.0
2. Chalk, dark blue-gray to light yellowish gray indistinctly cross-bedded highly arenaceous fossiliferous (*Ostrea pulaskensis*, Harris), contains abundant small irregular concretions of fairly pure lime, and larger spherical concretions of limonite; grades laterally into a coarse cross-bedded brownish gray sandy marl; lower contact sharp and irregular; basal 2.0 feet of bed is conglomeratic, containing small phenoclasts of chalk similar to that below. From 12.0 to	15.0	
Cretaceous		
Prairie Bluff		12.0
1. Chalk, blue-gray, weathering to light yellowish gray; dense massive fairly hard fossiliferous. From 9.0 to	12.0	

The Clayton-Porters Creek contact was described by Lowe* as disconformable in north Mississippi and as gradational in Kemper County. Other authors have described a gradational contact at other places in central and east-central Mississippi and in Alabama; the lower Porters Creek clay becoming progressively more calcareous toward the base and grading into argillaceous and sandy marl both vertically and laterally. A gradational contact in east-central Mississippi is indicated by several deep wells in Lauderdale County which show limey shale interbedded with shaly chalk at this horizon. As exposed in the vicinity of Scooba, the contact appears rather sharp and no interbedding of shale and chalk was noted. Furthermore, the clay overlying the chalky marl of undoubted Clayton age is non-calcareous. The contact, however, is poorly exposed, and in no case was more than 5 or 10 feet of outcrop observed. It is possible, therefore, that the non-calcareous character of the clay and the few minor irregularities noted in the contact are due to leaching. In no case was evidence of an erosional unconformity noted. It is probable, therefore, that the Clayton-Porters Creek contact in Kemper and Lauderdale Counties is gradational.

PORTERS CREEK FORMATION

The oldest rocks exposed at the surface in Lauderdale County constitute a part of the clay formation which underlies the Flatwoods physiographic unit of Tennessee, Mississippi, and Alabama. This formation was first described by Hilgard[5] as the Flatwoods clay phase of the Northern Lignitic formation. Since this was a descriptive rather than a geographic term, it was later replaced by the name Porters Creek formation, the name applied by Safford[6] to clays of similar lithology and age which crop out along Porters Creek, near Middleton, Tennessee.

In Lauderdale County, Mississippi, the Porters Creek clay attains a thickness of more than 500 feet, as shown in deep well records, ranging from 505 feet 2.5 miles west of Toomsuba (Knox Fee Well No. 1, Meridian Oil and Gas Company, Sec. 27, T.7 N., R.17 E.) to 567 feet 2 miles northwest of Topton (Lackey Well No. 1, Lauderdale Oil and Gas Company, Sec. 2, T.7 N., R.16 E.). Surface outcrops, however, are confined to the extreme northeastern corner of the county (Sec's.1,2,3,4,11, and 12, T.8 N., R.18 E. and Sec. 6, T.8 N., R. 19 E.), where the major streams have cut through the overlying sands and shales and into the Porters Creek to a depth of 75 or 100 feet.

In the less weathered exposures typical of stream channels and deep road cuts, it consists of a rather stiff massive or indistinctly laminated joint clay, dark gray to black in color. It has a remarkably even texture, free from sand or silt and is characterized by a subconchoidal fracture. In the completely unweathered condition the laminated character of the clay is much more marked and the subconchoidal fracture is less well developed; in fact, some parts of the member are distinctly shaly in the unweathered state, whereas other beds consist of dark gumbo-like clay. In the more weathered exposures, on the contrary, the color is light gray to light yellow or white, and the most striking characteristics are a non-bedded or massive structure and a well developed conchodial fracture.

In many places minutely comminuted fragments of carbonized organic matter are present, but rarely are any well preserved fossils found. Within Lauderdale County, the only recognizable fossil found in the Porters Creek by the present survey was an insect wing (SE1/4 SE1/4, Sec.2, T.8 N., R.18 E.). Mellen,[7] however, reports that samples from Winston County were examined by M. L. Thompson and showed the entire thickness of Porters Creek to contain foraminifera. While samples from Lauderdale and Kemper counties have not yet been studied, the similarity of lithology would indicate deposition under similar conditions. Morse[8] and Lowe[9] report that in the eastern part of the State, the Porters Creek clays become lignitic and contain indistinct leaf impressions. No lignite and no leaf impressions were found in the Porters Creek of Lauderdale County, however, and none were observed in the clays exposed in the road cuts of Kemper County to the north. It is probable that the lignite to which they made reference was in the upper "transition beds" which are now referred to the basal Wilcox.

Throughout that part of the formation exposed in Lauderdale, there are thin partings and flattened nodules of limonite. The nodules range in size up to 3 or 4 feet long and 1/4 foot thick and appear to have been originally present in the clay as siderite ($FeCO_3$) nodules. In the less weathered exposures some of the nodules consist of a shell of limonite surrounding a siderite core, showing a complete gradation from siderite to fairly pure limonite. Several nodular masses of partially consolidated silty clay, similar in size, shape, and general appearance to the limonite nodules were also noted. Both limonite partings and nodules are increasingly abundant toward the top of the formation and seem to be especially associated with the development of a more shaly character and a slight increase in fine grained sand and silt along the planes of lamination.

The typical Porters Creek clay grades upward into the Naheola without a sharp break, although within the upper 2 or 3 feet the change is rather abrupt in most places.

NAHEOLA FORMATION

The name Naheola was applied in 1887 by Smith and Johnson[10] to 150 feet or more of sands and sandy shales overlying the "Black Bluff" or Sucarnoochee (Porters Creek of Mississippi) and unconformably underlying the Wilcox along the Tombigbee River near Naheola Landing, Choctaw County, Alabama. The following section was described from the type locality by Smith, Johnson and Langdon in 1894, and included by Cooke[11] in his description of the Cenozoic formations of Alabama:

SECTION AT NAHEOLA LANDING, TOMBIGBEE RIVER, ALABAMA

	Feet	Feet
Naheola formation		27.0
6. Laminated gray sandy clays, with two or three indurated ledges 8 to 10 inches thick of lighter colored, sandier materials. From 18.0 to	20.0	
5. Ledge of greensand, oxidized into a brown iron ore of irregular thickness. From 0.25 to	0.5	

4. Black shaly sandy clay	3.0	
3. Ledge like bed 5, of irregular thickness	0.5	
2. Greensand marl, the upper part indurated forming a kind of limestone; fossiliferous	3.0	
Sucarnoochee clay:		15.0
1. Black slaty clay like that on the river between Naheola and Black Bluff. From 10.0 to	15.0	

The Naheola has not heretofore been recognized as a mappable unit in Mississippi and, therefore, was not given formational rank in former publications. As early as 1927, however, Morse[12] suggested that the bauxite and associated sands and clays, which had formerly been described as lower Ackerman, were probably the "Naheola equivalent." In 1933, Lowe[13] described a series of sands, glauconitic sands, and sandy clays, including the bauxite deposits that follow the Midway-Wilcox contact almost across the State. He placed these beds in the basal part of the Ackerman formation, but stated they were probably the "Naheola equivalent." It was pointed out by Grim[14] that the Naheola formation of Alabama can be traced into Kemper County, Mississippi, where "it seems to merge with beds previously placed in the base of the Wilcox." He also described a series of "transition beds from the Porters Creek clay to the basal Wilcox material" in the central and northern parts of the State which he tentatively correlated with the Naheola, but included in the Ackerman formation of Mississippi on the basis of lithologic similarity and apparently conformable relations.

The investigations of Mellen[15] in Winston County and the work of the present survey in Lauderdale County have shown conclusively that the "Naheola equivalent" of Lowe and the "transition beds" of Grim included parts of three separate and distinct stratigraphic units separated by two profound and wide-spread unconformities, and that only the lowermost of these beds, those below and including the bauxite-kaolin zone, are the true Naheola equivalent. It is in that sense that the term Naheola is used in this report. For stratigraphic reasons which will be discussed later, the beds above the bauxite-kaolin zone are considered to be Wilcox. Because of the weak development of the Naheola beds in Winston County and their gradational contact with the Porters Creek, and because of the uncertainty of their lateral extent over the State, Mellen did not consider them of formational rank, but described them as the upper part of the Porters Creek. Further study has revealed beds of similar lithology and stratigraphic relations in widely scattered parts of the State, and the writer has traced them from Kemper and Lauderdale Counties. Mississippi, into Sumter and Choctaw Counties, Alabama, where they are mapped by the Alabama survey as Naheola[16]. Since the Naheola of east-central Mississippi is a mappable unit ranging up to 75 or 100 feet thick in some places, although varying greatly in thickness and locally absent due to the unconformable contact between the Midway and Wilcox, and since it has a lithology different from other parts of the Midway, it is proposed that the Naheola of central and eastcentral Mississippi be given formational rank.

In Lauderdale and adjacent parts of Kemper Counties, the Naheola formation consists of sands and sandy clay-shales with a concretionary clay and a glauconitic marl bed at the base. The lithology varies greatly over short distances, but in all exposures of the contact the Naheola sands or sandy shales grade downward into the Porters Creek clay through a basal clay very similar to the Porters Creek in general appearance, but separable from it by the presence of glauconite and the abundance of marly limonite lenses and nodules or discontinuous beds which are typically glauconitic, sandy, and fossiliferous. The marly limonite makes up about a fourth of the basal beds in some localities and is believed to be derived mainly from the weathering of glauconite rather than of siderite, as is the case in the upper Porters Creek. In a few exposures the actual contact is marked by an especially heavy concentration of marl and can be drawn within a zone only a few inches thick. In other places the transition is more gradual and includes 4 or 5 feet of indeterminate age.

The major part of the formation is normally represented in outcrop by yellow and red sand, highly cross-bedded and containing thin clay and silt partings along the lines of lamination. In other exposures, however, the beds are seen to be much more highly argillaceous than is apparent from the normal hillside outcrop. In many places they present a definite shaly appearance, and the color ranges from light greenish gray to almost black. Locally, also, some beds are slightly glauconitic.

The entire formation is well exposed in fresh road cuts along U. S. 45 Highway in southern Kemper County.

SECTION ON SOUTH WALL OF BLACKWATER CREEK VALLEY, CUT ON U. S. 45 HIGHWAY, 4 MILES NORTH OF LAUDERDALE-KEMPER COUNTY LINE—SEC. 7, T.9 N., R.18 E.

	Feet	Feet
Midway series		168.0
Naheola formation		80.0
8. Sand, reddish brown, indistinctly cross-bedded to massive; contains a few small scattered quartz grit (The weathered phase of bed 7)	11.3	
7. Sand, light yellow-brown to light gray fine grained highly cross-bedded; thin partings of clay along planes of cross-lamination; lower contact gradational where well exposed, but slumping has completely covered bed 6 in most of the outcrop.	51.7	
6. Clay, light greenish gray, slightly sandy or silty, resembling Porters Creek; interbedded with limonite or ironstone concretions which are sparingly fossiliferous	11.0	
5. Marl, glauconitic, calcareous, highly limonitic; arranged in irregular beds and masses and interbedded with greenish gray, glauconitic clay, similar to bed 6, entire mass highly glauconitic	6.0	
Porters Creek formation		88.0
4. Clay, dark gray, weathering to light gray; subconchoidal fracture; indistinct bedding and lamination best seen in weathered portions where small mica flakes and a little silt weather to form planes of separation, giving somewhat shaly appearance; contains irregular scattered limonite separations; upper 2 or 3 feet leached to light greenish gray sticky clay which appears to be slightly glauconitic in upper part	55.0	
3. Covered interval	16.0	
2. Clay, light gray; typical Porters Creek	6.0	
1. Covered interval to water level of creek	11.0	

The above section presents the thickest exposure of Naheola measured in Lauderdale and southeastern Kemper Counties and seems to represent the entire formation as developed in that part of the State. Although bed No. 8 seems to be the weathered phase of the underlying sand, and is therefore described as Naheola, it is probable that it is in part reworked and that the scattered grit particles are derived from the basal Ackerman grit.

The Naheola-Porters Creek contact is also well exposed 2 miles east of the above section in the west valley wall of a tributary to Blackwater Creek, and in the east wall of Ponta Creek in the extreme northeastern corner of Lauderdale County. A comparison of these two sections with that described above illustrates the gradational although variable character of the contact and of the lower Naheola.

SECTION OF CUT ON WEST VALLEY WALL OF TRIBUTARY TO BLACKWATER CREEK, ALONG EAST-WEST ROAD, 1.3 MILES EAST OF OLD U. S. 45 HIGHWAY—SEC. 5, T.9 N., R.18 E. — KEMPER COUNTY

Midway series		129.0
Naheola formation		41.0
3. Sand, red to reddish yellow cross-bedded; contains thin layers of light gray silt and clay along planes of cross-lamination. Badly slumped, giving appearance of brecciation in places where clay partings are broken	37.0	
2. Marl, brown to green sandy, glauconitic fossiliferous; irregularly cemented with limonite; seems to be somewhat cross-bedded. Seems to be thicker than exposed, upper part being covered by washing and slumping of overlying sand	4.0	
Porters Creek formation		88.0
1. Clay, dark brownish gray or black, weathers to light gray; indistinctly shaly to massive; conchoidal fracture. Contains a few concretionary clay masses and a few lenses and discontinuous layers of limonite	88.0	

SECTION ALONG EAST-WEST ROAD, EAST VALLEY WALL OF PONTA CREEK—SW.1/4, NE.1/4, SEC. 2, T.8 N., R.18 E.—LAUDERDALE COUNTY

	Feet	Feet
Wilcox series		18.0
Fearn Springs formation		18.0
8. Sand, red highly argillaceous badly weathered	3.0	
7. Lignite, argillaceous badly weathered	0.5	
6. Underclay, light gray arenaceous	4.5	
5. Covered interval	10.0	
Midway series		116.0
Naheola formation		55.0
4. Sand and silt, light brownish gray, argillaceous, slightly micaceous; thinly bedded	20.0	
3. Sand, red fine grained cross-bedded; thin partings of light gray silty clay; upper and lower contacts poorly exposed	21.0	
2. Clay similar to Porters Creek below, but light greenish gray in color; interbedded with discontinuous layers lenses and flattened nodules and concretionary masses of limonite which are sparingly fossiliferous; lower contact is indefinite within about 3 feet.	14.0	
Porters Creek formation		61.0
1. Clay, light to dark gray; massive to indistinctly laminated; conchoidal fracture; scattered limonite partings and concretions; poorly exposed to valley flat	61.0	

A road cut in U. S. 45 Highway, 3 miles north of the Lauderdale County line and 1 mile south of Blackwater Creek shows the contact of the Naheola with the overlying Wilcox and illustrates the variable character of the upper Naheola.

SECTION OF HIGHWAY CUT 1 MILE SOUTH OF BLACKWATER CREEK—
SEC. 19, T.9 N., R.18 E.

Wilcox series		23.3
Ackerman formation (?), from 3.0 to		5.0
7. Sand, red grit-bearing; badly weathered. From 3.0 to	5.0	
Disconformity, erosional, marked by heavy concentration of ironstone and by irregular contact		
Fearn Springs formation		18.3
6. Lignite or highly lignitic black clay; follows irregularities of contact and seems to have been reworked	0.3	
5. Underclay, silty light gray indistinctly bedded. From 3.0 to	4.0	
4. Silt and sand, light brownish gray thinly bedded to laminated, rather fissil; interbedded with fine grained brownish gray sand; grades laterally into gray or yellow cross-bedded sand	14.0	
Disconformity, marked by poorly exposed irregular contact		
Midway series		69.0
Naheola formation		69.0
3. Clay, silt, and sand, black evenly laminated; contains unidentifiable lignitized plant fragments, fine grained sand, and large mica flakes along planes of lamination; grades laterally into red or brown cross-bedded sand	24.0	
2. Sand, red to brownish yellow cross-bedded with partings of light gray silt and clay increasing in prominence toward top. Grades into overlying bed	42.0	
1. Clay and marl, highly limonitic, containing abundant concretions, lenses and discontinuous beds of limonite; sparingly fossiliferous	3.0	

Exposures in the valley walls of a small creek, along the east-west road bordering the J. E. Toney farm, illustrate the variation in lithologic character of the Naheola over relatively short distances, as well as the erosional unconformity at the top of the Midway.

SECTION OF EAST WALL OF TONEY CREEK ALONG EAST-WEST ROAD—
SW.1/4, NE.1/4, SEC.11, T.8 N., R.18 E.

Midway series		78.0
Naheola formation		73.0
6. Covered interval to top of hill	10.0	
5. Clay-shale, brownish gray silty, sandy, micaceous; contains considerable limonite, both as nodules and as thin partings along planes of lamination	34.0	
4. Silt and sand grading downward from gray-brown through dark gray to black; fine grained sand increasing in prominence toward base; highly micaceous, abundant limonite partings; somewhat lignitic in lower part.	8.0	

3. Sand, dark gray to black fine grained carbonaceous, micaceous; weathers to brown color and in weathered parts the laminated character is obscured	5.0	
2. Covered interval, including contact with Porters Creek	16.0	
Porters Creek formation		5.0
1. Clay, dark gray to black slightly sandy, resembles typical Porters Creek. Contains abundant concretions and discontinuous lenticular beds of siderite-limonite; sparingly fossiliferous. Exposed in stream channel. Test hole 50 shows a little interlaminated gray sand	5.0	

SECTION OF WEST WALL OF TONEY CREEK ALONG EAST-WEST ROAD—N.1/2, NW.1/4, SW.1/4, SEC.11, T.8 N., R.18 E.

Recent		7.0
10. Sand, red coarse grained, contains fragments of ironstone to top of hill	7.0	
Disconformity marked by irregular concentration of ironstone fragments		
Wilcox series		113.0
Ackerman formation		38.0
9. Sand, red to yellow coarse grained heavily grit bearing; considerable cementation by limonite in upper half along a few beds 1 or 2 inches thick. Contains several zones in which pebbles and blebs of white plastic clay and kaolinitic clay are concentrated; conglomeratic character especially prominent in lower half	38.0	
Disconformity, covered		
Fearn Springs formation		75.0
8. Sand, light yellow, almost white, to yellow-brown and red fine grained crossbedded micaceous; very poorly exposed and badly slumped	54.0	
7. Lignite	1.0	
6. Underclay, dark brown to black, weathers gray; lignitic, highly plastic; grades downward into bed below	2.0	
5. Clay, blue, with yellow streaks; semi-plastic; covered in section but encountered in Test hole 51	5.0	
4. Clay, slate gray highly silty and sandy, somewhat lignitic; contains small scattered pyrite nodules; covered in section but encountered in Test hole 51	12.0	
3. Sand, dark green micaceous, contains fragments of clay similar to that below	1.0	
Disconformity, covered		
Midway series		49.0
Naheola formation		38.0
2. Sand and silt interlaminated highly argillaceous black carbonaceous, and slightly lignitic, micaceous; limonite partings abundant. Test hole 51 shows the interlaminated sand of the upper part to be glauconitic. Grades downward into underlying bed	38.0	

Porters Creek formation 11.0

1. Clay, dark gray to black indistinctly bedded. The same as bed 1 of preceding section. Test hole 50 shows this clay to be interlaminated with gray silty sand........ 11.0

MIDWAY-WILCOX CONTACT

Prior to 1939 the Midway-Wilcox contact in Mississippi was described as transitional and was arbitrarily drawn at the top of the typical gumbo-like clay of the Porters Creek formation. The directly overlying sands and sandy shales, including the bauxite-kaolin zone, were considered to be basal Ackerman on the basis of lithologic similarity to the lignitic Ackerman clays and shales. As pointed out above, the work of Mellen[17] showed conclusively that the so-called "transition beds" of Lowe and Grim included parts of three distinct sedimentary series, separated by two wide-spread disconformities.

In the completely developed section, the gumbo-like clays of the typical Porters Creek are overlain conformably by fine grained cross-bedded micaceous sands and sandy shales grading upward into the bauxite-kaolin zone. Mellen tentatively correlated these sands and shales with the Naheola of Alabama, a correlation verified by the present survey which traced them into an area of known Naheola in that state.

The Naheola is disconformably overlain by the lithologically similar Fearn Springs formation which appears to consist largely of reworked Naheola materials. The Fearn Springs, in turn, is overlain disconformably by more than 75 feet of red and white cross-bedded grit and boulder-bearing sand which passes upward conformably into the typical lignitic clays and sands of the Ackerman formation.

The erosional disconformities which mark the Naheola-Fearn Springs and Fearn Springs-Ackerman contacts are both well developed, and both the Naheola and Fearn Springs formations vary greatly in thickness as a result. As pointed out by Mellen[18], however, the lower unconformity appears to mark the greater time break of the two, inasmuch as the laterization of the old soil, resulting in the development of the bauxite-kaolin zone, reached a depth of as much as 25 feet in some localities, whereas no such profound weathering is evident at the top of the Fearn Springs. The bauxite-kaolin zone is absent in places in north Mississippi, only locally present in central Mississippi, and completely eroded prior to deposition of the Fearn Springs in Lauderdale and Kemper Counties. The presence of bauxitic and kaolinitic lenses and fragments in many exposures of basal Fearn Springs, however, indicates its former extent throughout the State, and both bauxite and kaolin have been reported at the top of the Naheola in eastern Alabama. It is evident, therefore that the weathering condition and the time interval necessary for its formation were widespread rather than local. The Fearn Springs deposition, therefore, is considered the initiation of a new sedimentary cycle and is referred to the Wilcox, rather than to the Midway, which it so closely resembles lithologically.

WILCOX SERIES

The rocks now included in the Wilcox series were formerly grouped with the "Flatwoods Clay" (Porters Creek) to constitute the northern Lignitic group of Hilgard[19]. Later, with the establishment of the term Midway by Smith and Harris, the name "Lignitic" was restricted to those beds now designated as Wilcox. In 1905 the committee on nomenclature of the U. S. Geological Survey adopted the geographic term Wilcox from an unpublished report by Dr. E. A. Smith of the Alabama State Geological Survey. The type locality is in Wilcox County, Alabama, where the complete section is well exposed. The name was first used in the literature in 1906[20], and was defined to include all beds lying between the Porters Creek clays below and the "Tallahatta Buhrstone" above.

The Wilcox extends from northwest to southeast across Lauderdale County, and the sands and lignitic clays of which it is composed form the surface materials of more than three-fourths of the county. It overlies the Midway and underlies the Claiborne series, from each of which it is separated by an erosional disconformity, and from both of which it differs genetically in that it is composed largely of continental sediments, whereas they are mostly of marine origin.

This area is critically situated with reference to a study of the Wilcox formations inasmuch as it lay close to the strand line during much of Wilcox time. In adjacent counties of Alabama, the Wilcox consists of interbedded marine and continental sediments, showing alternating encroachment and withdrawal of the sea. In Mississippi, on the other hand, no marine Wilcox has been found north of Lauderdale County. As would be expected from its intermediate location, the Wilcox of Lauderdale differs somewhat from sediments of the same age on either side. Overlapping on the older beds by the younger is more pronounced than has been reported elsewhere in the State, and sand appears to be a more prominent constituent than farther north. Only one marine encroachment extended into the county, although deep wells in Clarke County, at Barnett and Quitman, less than 20 miles south of the belt of outcrop, encountered several marine beds both in the upper and lower parts of the series.

On the basis of lithology and stratigraphic relations, a five fold division of the Wilcox in Lauderdale County is recognized. In ascending order these are (1) Fearn Springs, (2) Ackerman, (3) Holly Springs, (4) Bashi, and (5) Hatchitigbee. Each, in the complete section, is characterized by a basal zone in which sand is predominant. The sand becomes finer grained upward and grades into an upper zone in which silt and clay are the dominant constituents. Well developed and continuous erosional disconformities mark the Fearn Springs-Ackerman, Ackerman-Holly Springs, and Holly Springs-Bashi contacts. The Bashi-Hatchitigbee contact, however, is conformable, the sandy marine clay grading upward into highly carbonaceous sand. For the purpose of this survey the contact is arbitrarily drawn where sand replaces clay as the dominant constituent, a gradation zone which also seems to mark the transition from a marine to a continental environment. In view of the limited extent of the marine beds in Mississippi, it is questionable whether it should be given formational rank or grouped with the Hatchitigbee as the locally developed marine facies of a single formation. It remains for further detailed work in other parts of the State to disclose whether or not the Bashi is to be considered a mappable unit in Mississippi.

FEARN SPRINGS FORMATION

In 1939 Mellen[47] described a section of sand, shale, and lignitic clay, including a lignite bed and several workable deposits of high grade ball-clay, lying disconformably above the bauxite-kaolin zone and disconformably overlain by the basal Ackerman sands. Because of these stratigraphic relations, "persistent throughout the State," he considered this section a distinct formation and named it from the characteristic development near Fearn Springs, Winston County, Mississippi. Concerning the correlation of these beds, Mellen says "the Fearn Springs is possibly equivalent to the Ackerman formation as limited in Alabama by Cook, or to the old 'Coal Bluff series' of Langdon. At the time of Cook's correlation, the Ackerman was defined as all the Wilcox below the Holly Springs formation. The Coal Bluff beds may possibly, therefore, be Fearn Springs in age." According to Cooke[48], G. I. Adams of the Alabama Geological Survey reported that "the 'Coal Bluff beds' are not completely overlapped near the Mississippi border, as I had supposed after a brief reconnaissance, but they can be traced westward across the state line into the Ackerman formation." In the course of the present survey, the Fearn Springs formation was traced from Winston County through Kemper and Lauderdale counties and for a distance of about 10 miles into Sumter County, Alabama. Although no specific localities were mentioned by Cook, it appears from the description of materials and the stratigraphic relations that the exposures of "Coal Bluff beds" near the State line, to which he referred, are identical with the Fearn Springs of that area and that the equivalency of the Coal Bluff and Fearn Springs is thereby established.

In Lauderdale County, Mississippi, the Fearn Springs formation is limited to a relatively narrow belt in the extreme northeast corner. The formation is characteristically composed of fine grained cross-bedded sand and sandy shale, but it varies considerably over short distances. It closely resembles the underlying Naheola formation from which it may be distinguished by the more fissil character of the shales, the more complete assortment of materials according to grain size, and the somewhat smaller size of the mica flakes. The Fearn Springs appears to have been derived mainly from weathering and erosion of the Naheola and redeposition of the derived sediments in a continental environment after transportation for only a short distance. Thus the lithologic character of the basal Fearn Springs varies with the local gradations of the underlying Naheola, and since the sediments were deposited on an uneven surface, the lowermost beds of the formation are locally absent.

In the complete section the Naheola is overlain by a medium to coarse grained sand, locally intermixed and interlensed with sandy bauxite or kaolin. Where typically exposed this bed is highly cross-bedded and consists of alternating beds of fine to coarse grained grit-bearing sand interbedded with a few thin beds or lenses of clay or sandy clay-shale. Locally, however, the argillaceous material is dominant, especially in the upper part, and the entire bed grades laterally and vertically into highly argillaceous shaly sand or sandy shale similar to that found in the Naheola. This basal grity sand is best exposed in the gulleys and road cuts five or six miles east of the town of Lauderdale (SW.1/4, SW.1/4, Sec. 23, and SW.1/4, Sec. 24, T.8 N., R.18 E.) and in the road cut at Elizabeth Church (NW.1/4, SW.1/4, Sec. 35, T.8 N., R.18 E.) where it reaches a thickness of 35 feet or more as shown in test holes throughout that area. The following section illustrates the lithologic character where typically developed (See also test holes 30, 31, 32, 34, 35, 36, 40, 43, and 48).

Figure 5.—Sandy shale in Lower member of Fearn Springs formation revealing a small fault that fails to reach the lignite bed at the top of highway cut on U.S. 45, 2.8 miles north of the Lauderdale-Kemper County line. October 10, 1938.

Section of Basal Fearn Springs, road cut 5.5 miles east of Lauderdale—SW1/4, Sec. 23, T.8 N., R.18 E.

	Feet	Feet
Fearn Springs formation		14.8
4. Sand, light reddish brown mixed with silt and clay; fine grained massive and structureless; badly weathered, grading downward to bed 3	6.8	
3. Sand similar to that in bed 4 but less weathered; thinly bedded and shows indistinct cross-lamination; light gray kaolinitic clay is interlaminated and interbedded in layers up to 0.1 foot thick	2.4	
2. Sand, brown fine grained grit-bearing; contains small fragments and lenses of bauxitic clay	1.6	
1. Clay, pisolitic or bauxitic, carbonaceous; contains much coarse sand and grit; grades laterally into non-pisolitic clay; apparently reworked bauxite	4.0	

Overlying this typical grit bearing zone and grading downward into it by increase in the shaly and sandy character of the materials, there is found in most localities a bed of dark gray to black gumbo-like clay, grading upward into a typical underclay having lignitized root marking and overlain by a thin bed of lignite. The sand associated with this part of the member is very fine grained and highly argillaceous, so that all parts are quite plastic. In its purer phases this bed consists of 7 to 9 feet of structureless clay which may be of value in the manufacture of pottery or brick. However, it contains appreciable amounts of soluable iron salts (enough to taste in some parts) which may affect its commercial value. This entire bed may be properly considered an underclay developed on the upper, more argillaceous, part of the underlying bed, since it is best developed where the lignite is thickest and varies lithologically with the lateral gradations of the underlying material. For instance, in the area five or six miles east and southeast of Lauderdale where the lignite is two or three feet thick the underclay reaches a thickness of 7 to 9 feet of pure clay and as much as 15 feet in thickness where the clay is interbedded and interlensed with fine grained argillaceous sand. In the same area, on the other hand, where the lignite is thinner the underclay is correspondingly thinner (See test hole records 1A, 2, 3, 7, 8, 13, 14, 15, 16, 27, 28, 34, and 60).

The lignite is the most easily recognizable and most constant single bed in the Fearn Springs formation. It varies in thickness from 1/4 foot to about 4 feet, the thicker parts being rather argillaceous. It probably has no potential economic value as fuel, but because of its persistency and the ease with which it is recognized not only in outcrop but also in test holes and wells, it should make an excellent key bed in the search for potential oil and gas structures.

Immediately overlying the lignite is the zone in which the pottery and ball-clay are found. It consists of highly plastic clay interlensed and interbedded with fine grained highly argillaceous and plastic sand. Lithologically it bears a close resemblance to the underclay except that it is less lignitic and fairly free of soluble iron salts, and it may have been derived from erosion of the underclay in other areas, following the cessation of swamp conditions and resumption of the sedimentary cycle. Locally it consists of a bed of massive clay which is very pure in the lower 7 or 8 feet (Test holes 1 and 34), grading upward through sandy clay and alternating beds and lenses of fine argillaceous sand and clay into the overlying beds. Elsewhere the pottery clay is relatively thin, and in some places highly plastic argillaceous sand is the dominant constituent. Locally the sandy facies reaches a thickness of about 17 feet. This zone is especially well developed five or six miles east and southeast of Lauderdale (SW.1/4, Sec. 23 and Sec. 34, T.8 N., R.18 E.), but farther north and northwest, in the valley walls of Toney and Ponta Creeks and in the highway and railroad cuts north of Lauderdale it is absent.

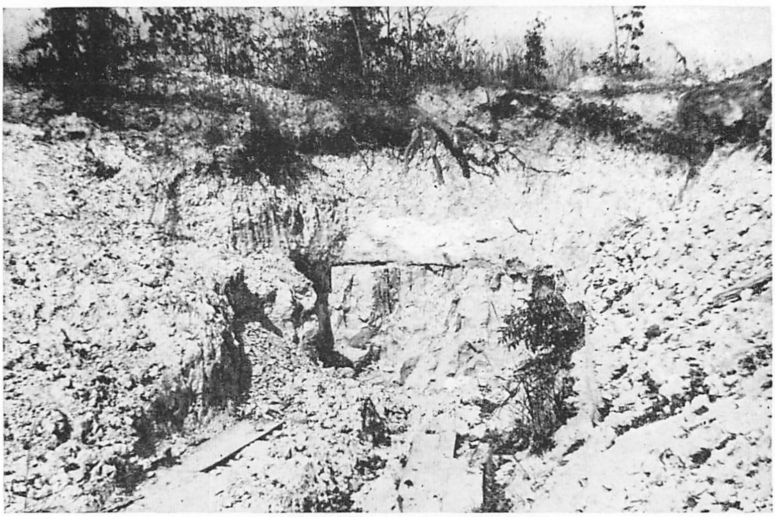


Figure 6.—Clay-pit on S. N. Shelby Farm (SW.1/4, SW.1/4, Sec. 23, T.8 N., R.18 E.) which supplies the Lauderdale Pottery. October 17, 1938.

The upper part of the Fearn Springs consists of 75 feet or more of alternating beds of blue to gray clay-shale and micaceous cross-bedded sand. In some localities the shale constitutes the major portion of the bed while in others it consists almost entirely of light yellow brown highly micaceous cross-bedded sand with a few thin lenticular clay beds and with clay partings along the planes of cross-lamination. Elsewhere the sand and clay are interbedded and interlaminated in almost equal proportions. Throughout the area of exposure, moreover, the upper Fearn Springs grades downward into the pottery clay zone, where that bed is present, and together they seem to represent a period of gradually changing but uninterrupted sedimentation. In no exposure is the entire bed exposed and estimates of thickness are based purely on calculations of observed dip and statements of local residents regarding depth to the lignite in the vicinity of Lauderdale.

Over much of its outcrop area, the Fearn Springs is poorly exposed, being obscured by slumping and washing of the abundant sands. Furthermore the formation is disconformably overlain by 100 feet or more of the coarse unconsolidated sand of lower Ackerman age which caps most of the hills and collects as colluvium on the hill slopes and in the valleys. The upper part of the Fearn Springs in most localities, therefore, is either cut out by the unconformity or obscured by colluvium. The following sections and reference to the test hole records, however, will serve to illustrate the variations in lithology referred to above (Test hole records 1A, 2, 3, 6, 8, 10, 11, 12, 13, 14 15, 16, 20, 27, 28, 30, 56, 60, 61, 64, 73, 77, 80, and 185).

SECTION ALONG LAUDERDALE-CUBA ROAD, 1.4 MILES EAST OF THE L. E. COBB STORE—SW.1/4, SW.1/4, SEC. 36, T.8 N., R.18 E.

	Feet	Feet
Fearn Springs formation		21.5
6. Clay and sand weathered to a soil	3.0	
5. Lignite weathered	0.7	
4. Clay, gray lignitic massive plastic, grades downward into bed 3	2.5	
3. Clay, gray, streaked with brownish yellow; laminated and grading downward into "varve type" near base	4.0	
2. Clay and sand, brown, dark brown, and light gray interbedded; sand concentrated along planes of lamination	6.0	
1. Sand, gray interlaminated with brownish gray; argillaceous, the clay being concentrated near the center of the laminae	5.3	

SECTION IN CLAY PIT OF LAUDERDALE POTTERY, LAUDERDALE-CUBA ROAD 1.1MILES NORTHWEST OF THE L. E. COBB STORE — SE.1/4, NW.1/4, SEC. 34, T.8 N., R.18 E.

	Feet	Feet
Colluvium (?)		1.3
4. Sand, red argillaceous structureless	1.3	
Fearn Springs formation		8.9
3. Sand, light gray and reddish brown in alternating bands; mixed with silt and clay; fine grained, rather plastic; lower part irregular in character and containing elongated fragments or lenses of clay similar to that of bed 1. From 1.5 to	3.0	
2. Clay, light gray slightly silty highly plastic massive; used by Lauderdale pottery. From 2.6 to	4.3	
1. Clay similar to bed 2 but less silty	0.3	

In the above section, which is situated on the lower slope of a small valley, there has apparently been some movement down hill of the beds overlying the pottery clay. In test hole 1-A, which was drilled some 16 feet higher on the slope, the total thickness of the clay was found to be 8.6 feet. It was underlain by 2.0 feet of lignite. The lignite in turn was underlain by 8.0 feet of underclay grading downward into sand and silt. In test hole 13, about 0.1 mile to the east, 19 feet of clay and sandy clay interbedded with thin beds of sand was encountered above the lignite and 15 feet of clay grading downward into argillaceous sand below the lignite. Thus, over relatively short distances the thickness and character of both the pottery clay and the underclay may change considerably.

SECTION IN ROAD-SIDE DITCH 5.0 MILES EAST OF LAUDERDALE, SOUTHWEST SIDE OF RUTHERFORD BRANCH — SW.1/4, SW.1/4, SEC. 23, T.8 N., R.18 E.

	Feet	Feet
Alluvium, from a feather edge to		3.7
5. Sand and clay, light yellow to orange brown weathered to a soil in upper part; lower contact irregular, cutting out underlying beds near the creek. From a feather edge to	3.7	
Fearn Springs formation		11.0
4. Clay, light bluish gray massive highly plastic; upper part somewhat weathered and limonitic in some places	8.0	
3. Lignite, argillaceous; several clay partings in upper half	1.0	
2. Underclay, dark brownish gray; contains lignitized root markings; highly plastic; grades downward into bed 1	0.5	
1. Clay, light gray massive highly plastic	1.5	

In test hole 34, located about 100 feet north of the outcrop, the underclay was 2.6 feet thick grading downward through 5.5 feet of highly argillaceous and plastic sand to coarse grained sand containing bauxitic and kaolinitic clay fragments and lenses.

SECTION ALONG EAST-WEST ROAD 4.0 MILES NORTHEAST OF LAUDERDALE, EAST VALLEY WALL OF TRIBUTARY TO PONTA CREEK — SW.1/4, NE.1/4, SEC. 5, T.8 N., R.18 E.

	Feet	Feet
Ackerman formation		21.0
5. Sand, red coarse grained, grit-bearing strongly cross-bedded; lower contact is irregular and shows concentration of limonite	21.0	
Disconformity, erosional		
Fearn Springs formation		13.5
4. Clay shale, very sandy dark brown to black in color; fine sand and silt and small mica flakes concentrated along planes of lamination; lignitized plant markings sparingly present. Lower contact distinct but regular	13.5	
Disconformity, erosional		
Naheola formation		25.0
3. Sand, dark brownish gray to black; abundant lignitized plant fragments and large mica flakes along laminae; highly argillaceous and silty	6.0	

2. Sand, light greenish gray fine grained thinly but indistinctly bedded; highly argillaceous in places; abundant large mica flakes	7.0
1. Covered interval to Mobile & Ohio Railroad tracks	12.0

In test hole 73, about 0.4 mile northwest of the above section, the lignite is found at an elevation slightly above that of the Ackerman-Fearn Springs contact as drawn in the foregoing section, and, since there is a regional dip of at least 15 feet a mile toward the west-southwest in this part of the county, it is reasonable to assume that bed 4 lies beneath the lignite and is to be correlated with the argillaceous facies of the lower Fearn Springs.

SECTION IN KEMPER COUNTY ALONG EAST-WEST ROAD, 0.3 MILE NORTH OF COUNTY LINE AND 1.2 MILES EAST OF U. S. 45 HIGHWAY — NE.1/4, SE.1/4, SEC. 31, T.9 N., R.18 E.

	Feet	Feet
Ackerman ? or Colluvium		6.0
8. Sand, red grit-bearing; lower contact shows channel filling	6.0	
Fearn Springs		12.0
7. Clay, silty shaly gray; flattened lense-like concretions of limonite, showing gradation to siderite near center, fairly abundant	6.0	
6. Lignite, black and firm in some places, red impure and ashy in other places. From 1.0 to	1.5	
5. Underclay, light gray plastic	1.0	
4. Clay, highly lignitic	0.5	
3. Clay, laminated shaly silty and somewhat sandy	3.0	
Naheola formation		15.0
2. Sand, greenish gray glauconitic (?), micaceous; contains thin streaks of gray sand; very fine grained; iron stained in lower 4.0 feet	10.0	
1. Sand, interlaminated light and dark gray highly micaceous, carbonaceous, lignitic very fine grained	5.0	

The irregular thickness of the lower Fearn Springs, as well as the local variation in lithology, is illustrated by a comparison of the foregoing sections. This thickening and thinning may be explained by deposition on a moderately irregular topography, and, hence in many places, the lowermost beds are missing. The local differences in lithology are due to the heterogeneous conditions of sedimentation in a continental environment.

The upper member of the Fearn Springs—those beds above the lignite—is poorly exposed in Lauderdale and adjacent parts of Kemper Counties. This is due in part to slumping and washing of the overlying Ackerman sand, and in part to their removal during the Fearn Springs-Ackerman erosion cycle. The pottery clay zone has been well illustrated in the foregoing sections. The best exposures of the higher beds are to be found in the highway cuts just north of the Lauderdale-Kemper County line and along the road east of the town of Lauderdale.

SECTION OF HIGHWAY CUT ON U. S. 45 1.5 MILES SOUTH OF BLACKWATER CREEK AND 2.5 MILES NORTH OF LAUDERDALE-KEMPER COUNTY LINE

	Feet	Feet
Ackerman formation, from 1.0 to		12.0
11. Sand, red cross-bedded grit-bearing; basal contact marked by concentration of limonite. From 1.0 to	12.0	
Disconformity, erosional		
Fearn Springs formation		48.6
10. Clay, light gray; little or no sand or silt; massive to indistinctly bedded, laminations becoming more distinct in lower part; plastic in upper 3 feet	12.0	
9. Sand, light gray, streaked with brownish yellow; laminated very fine grained silty, argillaceous; limonite partings prominent	3.5	
8. Silt, highly argillaceous light brown	1.4	
7. Sand, light gray to white, stained with light yellowish brown; indistinctly cross-bedded; lower part contains thin partings of clay	4.0	
6. Clay and sand interbedded; the clay is light brown; the sand is light yellow and cross-bedded; abundant limonite partings	2.0	
5. Sand, light gray, streaked with light yellowish brown; fine grained cross-bedded micaceous; thin limonite partings abundant	4.5	
4. Covered interval on north side of hill; part of this interval seems to be represented on the south slope by outcrops of sand similar to bed 5	16.5	
3. Clay, light gray plastic (pottery clay)	2.0	
2. Lignite	1.0	
1. Underclay, light gray plastic	1.7	

SECTION OF HIGHWAY CUT ON U. S. 45 AT LAUDERDALE-KEMPER COUNTY LINE, EXTENDING 0.5 MILE NORTH AND 0.3 MILE SOUTH OF THE LINE

	Feet	Feet
Recent		2.0
13. Top soil; light reddish yellow sand	2.0	
Ackerman formation		73.0
12. Sand, red grit-bearing highly cross-bedded micaceous; contains blebs and fragments of white clay similar to underlying bed; the clay fragments, mica, and grit are especially abundant in the lower 25 or 30 feet	73.0	
Disconformity, erosional, marked by irregular contact and by concentration of limonite		

Fearn Springs formation		39.3
11. Clay, silty and sandy light gray to light reddish brown structureless; grades downward into bed 10. From 3.0 to	13.0	
10. Shale, composed of silt and clay with very fine sand and mica along planes of lamination; light gray, upper part considerably stained with brown and yellow; many limonite partings and a few irregular limonite nodules	4.0	
9. Sand and clay interlaminated; light gray to light brownish gray slightly micaceous and carbonaceous	4.5	
8. Clay, black silty carbonaceous; interlaminated with very fine gray sand; small mica flakes abundant along planes of lamination	1.8	
7. Silt, lignitic; interbedded with very fine grained sand	3.4	
6. Sand and silt, very fine grained indistinctly laminated dark gray to black highly carbonaceous; grades downward into bed 5	0.8	
5. Clay, indistinctly laminated dark gray to black limonitic plastic; subconchoidal fracture	5.5	
4. Sand and clay intermixed, black highly micaceous lignitic. From 0.2 to	0.7	
3. Lignite	2.0	
2. Underclay, light grayish brown silty lignitic indistinctly laminated; considerable iron staining	1.6	
1. Silt and very fine grained sand intermixed; gray brown limonite stained micaceous, lignitic	2.0	

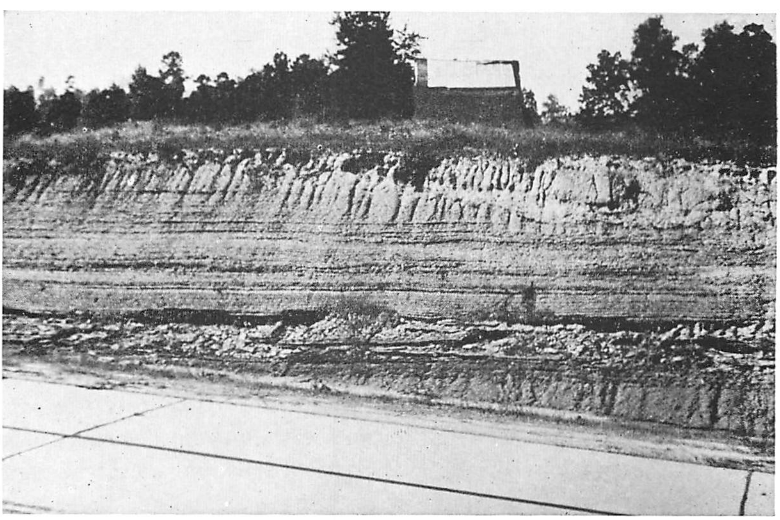


Figure 7.—Interbedded sand and shale in Upper member of Fearn Springs formation. Highway cut on U.S. 45, 0.5 mile north of the Lauderdale-Kemper County line. October 10, 1938.

SECTION OF ROAD CUT IN THE SOUTH WALL OF A SMALL VALLEY 1.3 MILES EAST OF LAUDERDALE — SE.1/4, SW.1/4, SEC. 19, T.8 N., R.18 E.

	Feet	Feet
Ackerman formation		20.6
7. Sand, red to light brown, with scattered streaks of gray clay shale along planes of cross-lamination	19.0	
6. Sand, brown coarse grained grit-bearing; cemented to ironstone in places. From 0.3 to	1.6	
Fearn Springs formation		30.5
5. Sand, bright yellow mottled with light gray; contains numerous thin and irregular layers of limonite which seem to cut across the bedding	3.5	
4. Sand, yellow, gray, and red; irregularly interbedded with gray clay grading downward to gray sand	9.7	
3. Clay, dark gray to black; considerable gray sand and limonite stains along planes of lamination	3.0	
2. Sand, dark gray massive very fine grained lignitic; contains considerable silt and clay in lower part	6.2	
1. Sand, white, light gray, yellow and brown highly micaceous; rather pure, but parts of bed contain thin laminae of gray clay	8.1	

SECTION AT LAUDERDALE POTTERY, LAUDERDALE—SW.1/4, SW.1/4, SEC. 24, T.8 N., R.17 W.

	Feet	Feet
Ackerman formation		26.5
5. Sand, white to light yellow	2.0	
4. Sand, reddish brown coarse to fine grained cross-bedded; contains irregular patches and lenses of moderately fine grit and scattered clay pebbles; lower contact irregular	10.0	
3. Clay, dark gray shaly sandy, lignitic; apparently lenticular. From 0.3 to	3.5	
2. Sand, reddish brown cross-bedded; contains lenses and irregular patches of rather coarse grit; clay pebbles scattered throughout	11.0	
Disconformity, erosional, marked by irregular contact		
Fearn Springs formation		14.7
1. Sand, gray to brown fine grained highly argillaceous, micaceous; discontinuous streaks of clay along planes of cross-lamination; grades downward to black lignitic sand	14.7	

The last two sections seem to represent approximately the same part of the Fearn Springs formation and, although no definite correlation could be made with the beds exposed at the county line, it seems probable from the field evidence that they lie above those beds. The last three sections, therefore, probably represent an almost complete upper Fearn Springs section as developed on the surface outcrop.

Further confirmation of this assumption is supplied by the drillers log of Mattie Hauser No. 1 (SW.1/4, NW.1/4, Sec. 33, T.8 N., R.18 E.) in which the total thickness of sediments which can be referred to the Fearn Springs is about 130 feet. The thickness down dip, however, probably increases rapidly since the entire outcrop area gives evidence of overlap by the basal Ackerman across the beveled edges of the Fearn Springs and Naheola formations.

ACKERMAN FORMATION

In 1913 Lowe[21] suggested the name Ackerman for the basal formation of the Wilcox as recognized in Mississippi at that time. The name was selected because of the excellent exposure of the formation along the Illinois Central Railroad at Blantons Gap near Ackerman, Choctaw County, Mississippi. As pointed out above, Lowe's definition and later usage included in the Ackerman formation lower beds, which are now considered to be equivalent to the Naheola of Alabama, and intermediate sands and shales which are not exposed in the type section and which are separated from the Ackerman of the type locality by a distinct and wide-spread erosional unconformity.

As now restricted by the Mississippi Geological Survey[22], the Ackerman formation includes those beds lying disconformably above the "basal clays" or "transition beds" of the older publications (here included in the Naheola and Fearn Springs) and disconformably below the basal sands of the Holly Springs formation.

In Lauderdale county the maximum thickness of the Ackerman exposed at the surface does not exceed 200 feet, and reaches that maximum only in a small area east and north east of Lockhart. Elsewhere in the county the upper beds are overlapped by the basal sands of the Holly Springs formation which, in many places, lie directly on the basal Ackerman sands. In Winston county Mellen reports a maximum thickness of 400 feet, and comparable thicknesses have been reported from other parts of the State. It is probable, therefore, that more complete and, therefore, thicker sections of the Ackerman will be encountered in deep wells in the southwestern two-thirds of the county, an assumption which seems to be borne out by the drillers logs of a few such wells drilled in the past.

In Lauderdale county, and throughout the State of Mississippi, the Ackerman seems to be composed entirely of continental deposits, and the major part of the formation, all but the basal sand, was deposited in a poorly drained, swampy environment, as shown by the abundance of lignite and lignitic clay. Although marine beds are found in the equivalent formation, the Nanafalia of Alabama, within a few miles of the State line, a thorough search of the Ackerman beds in Lauderdale county has failed to reveal any marine sediments. It is probable, in view of the presence of marine Nanafalia in western Alabama, that similar sediments will be encountered in wells drilled down dip.

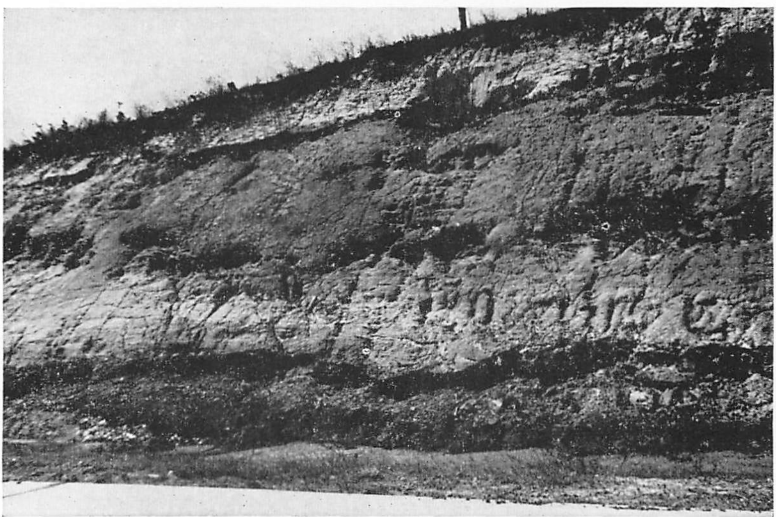


Figure 8.—Fearn Springs—Ackerman unconformity, the basal Ackerman sand directly overlying and truncating the Fearn Springs lignite. Highway cut on U.S. 45, 2.0 miles north of the Lauderdale-Kemper County line. October 10, 1938.

The lower member of the formation consists of 100 feet or more of coarse-grained, grit-bearing cross-bedded sand grading upward through finer micaceous sand interbedded with silt, into the silty lignite-bearing clays, silts and fine grained sands of the upper member. The lower 25 or 30 feet contains clay fragments as large as 2 inches in diameter, locally so abundant as to form a basal sand-clay conglomerate, and the entire member contains irregular lenses of clay some of which attain a thickness of several feet. The grit particles average less than 1/16 inch in longest diameter, but pea-gravels and scattered pebbles as large as 1 or 2 inches in diameter are not uncommon, and two boulders 4.5 and 6 inches in diameter respectively, were found near Elizabeth Church (SW.1/4, Sec. 32, T.8 N., R.18 E.)

The preceding sections have shown the local characteristics of the member, as well as its stratigraphic relations to the older formations. The thickest single exposure of basal Ackerman sands was found in a road cut 4 miles east of Lauderdale (See also test hole records 25 and 89).

SECTION OF ROAD CUT IN SOUTH WALL OF VALLEY, 4 MILES EAST OF LAUDERDALE—NW.1/4, NE.1/4, SEC. 28, T.8 N., R.18 E.

	Feet	Feet
Ackerman formation: Lower member		85.0
3. Sand, red coarse grained cross-bedded micaceous; grading downward into underlying bed	40.0	
2. Sand, red coarse grained, grit-bearing cross-bedded; lower part contains scattered clay fragments and subangular quartz pebbles as much as 0.5 inch long; very irregular lower contact marked by heavy concentration of limonite	45.0	
Disconformity, erosional		
Fearn Springs formation		4.5
1. Clay, gray silty semi-plastic	4.5	

Outcrops along the roads and in the gulleys southwest of Lauderdale present the best exposures of the gradation zone between the lower and upper members.

SECTION OF ROAD CUT ON GRAVEL ROAD 0.4 MILE SOUTHWEST OF LAUDERDALE—NE.1/4, NE.1/4, SEC. 26, T.8 N., R.17 E.

Recent: Colluvium		4.8
6. Top soil; fine grained white sand	0.8	
5. Sand, brown argillaceous structureless grit-bearing; limonite nodules and fragments throughout, the flat fragments resting at all angles; lower contact irregular and marked by concentration of limonite	4.0	
Disconformity, erosional, marked by concentration of limonite		
Ackerman formation: Lower member		25.3
4. Sand, light reddish brown argillaceous; contains many irregular limonite concretions and thin irregular wavy discontinuous partings of clay	2.0	
3. Sand, similar to bed 4 except for absence of limonite and clay partings; small grit particles scattered throughout, becoming more abundant near base	2.3	
2. Sand and clay; brown argillaceous sand interbedded with gray shaly clay; individual layers of both sand and clay are lenticular; the clay is present both as thin wavy layers separated by sand and as discontinuous partings within the sand beds; grades laterally from predominantly sand to predominantly clay; locally grit-bearing, abundant limonite in thin partings parallel to bedding planes	6.0	

1. Sand, fine grained variegated red, yellow, and brown slightly micaceous; small grit particles scattered throughout and locally concentrated along planes of cross-lamination; contains fragments and discontinuous partings of clay 15.0

SECTION OF HILL SLOPE ALONG U. S. 45 HIGHWAY, 1.0 MILE SOUTHWEST OF LAUDERDALE — SE.1/4, SW.1/4, SEC. 23. T.8 N., R.17 E.

Holly Springs formation (?) Lower member		16.0
6. Covered interval	4.0	
5. Sand, reddish brown very fine grained argillaceous, slightly micaceous; grades downward to light yellow, stained with brown; scattered particles of small grit	12.0	
Ackerman: Lower member (?)		38.1
4. Silt, light gray shaly arenaceous, micaceous	1.5	
3. Clay, light gray shaly silty	1.3	
2. Sand, dark red to brown slightly micaceous fine grained; contains scattered small grit particles and a few thin lenses of coarse sand near the top	28.0	
1. Silt, highly argillaceous, slightly arenaceous and micaceous dark gray to black; interlaminated with lighter gray along U. S. 45	7.3	

SECTION OF HIGHWAY CUT ALONG U. S. 45 0.3 MILE NORTHEAST OF RAILROAD CROSSING AT LOCKHART — SW.1/4, NW.1/4, SEC. 27, T.8 N., R.17 E.

Holly Springs formation: Lower member		39.0
4. Sand, light yellow to reddish brown; weathered to deep red in upper few feet; fine grained highly cross-bedded highly micaceous; contains clay and silt blebs and fragments throughout, lower 10 feet being a sand-clay conglomerate	39.0	
Disconformity, erosional, marked by irregular contact		
Ackerman formation: Upper member (?)		62.0
3. Silt, light gray to light brownish gray; very fine sandy, argillaceous laminated and locally shaly; contains a few thin layers of black lignitic material and numerous thin limonite partings; upper part sharply truncated toward south by overlying bed	28.5	
2. Sand, red to brown, grading downward to light brownish yellow mottled with gray; fine grained grading toward medium grained near center. Several thin beds partly indurated to ferruginous sandstone	21.0	
1. Covered interval to base of hill	13.0	

The upper member of the Ackerman formation consists of interbedded fine grained sands, silts, and sandy clays or clay-shales and three or four thin beds of lignite. The member is poorly exposed throughout the county, being overlapped by the Holly Springs in most places. Scattered outcrops of lignitic shales and silts, however, are to be found along the base of the steep northward facing hill slopes of Ponta and Reed Creeks, west and southwest of Lauderdale, and of Possum creek east of Topton. Lignitic silt and fine grained sand are found in a borrow pit at Toomsuba and in the highway and railroad cuts 1.5 miles west of Toomsuba, and a bed of lignite, 2.3 feet thick and associated dark silty clays crop out beneath the lower Holly Springs sand in a small creek 1 mile south of Toomsuba. Both the following sections were taken from the area between Lauderdale and Lockhart, where the overlap is least (See test holes 85, 86, and 90).

SECTION OF ROAD CUT IN GRAVEL ROAD 2.0 MILES SOUTHWEST OF LAUDERDALE — NE.1/4, SE.1/4, SEC. 27, T.8 N., R.18 E.

Recent		2.0
12. Top soil: red sandy clay	2.0	
Ackerman formation: Upper member		54.3
11. Silt, sandy light gray indistinctly laminated; contains much limonite as irregular nodules, concretionary shells, and irregular discontinuous partings along planes of lamination	8.8	
10. Clay, gray to dark gray, lignitic, slightly micaceous; irregularly intermixed with light gray silt and very fine sand; has distinct odor of H_2S	6.0	
9. Lignite, dark brown to black; contains streaks and irregular masses of light gray silt and very fine sand	1.0	
8. Underclay, gray to black massive slickensided; lignitized root markings; strongly marked sulphurous odor and bitter salty metallic taste	2.5	
7. Silt, dark steel gray slightly micaceous; contains very fine sand disseminated throughout	4.0	
6. Covered interval	5.0	
5. Underclay grading downward to light gray silty clay; slickensided	5.0	
4. Clay, very silty and shaly light gray; streaked with brown limonite stain, grades downward to dark gray	6.0	
3. Sand, light gray to black very fine grained silty; strong iron sulphate taste	0.5	
2. Clay, black; indistinctly inter-laminated with gray silt and very fine sand	0.5	
1. Covered to base of hill	15.0	

SECTION OF MOBILE & OHIO RAILROAD CUT 1.7 MILES NORTHEAST OF LOCKHART — NW.1/4, NW.1/4, SEC. 28, T.8 N., R.17 E.

Holly Springs formation: Lower member		30.0
3. Sand, light gray to brownish yellow highly cross-bedded; lower part contains clay blebs and fragments; irregular lower contact	30.0	
Disconformity, erosional, marked by concentration of limonite		

Ackerman formation: Upper member		8.0
2. Clay-shale, light brownish gray to black laminated lignitic leaf-bearing; thin lignite bed locally developed at base	2.0	
1. Clay, dark gray to black; contains stem, root, and leaf fragments, all lignitized; very sandy in some parts	6.0	

HOLLY SPRINGS FORMATION

The term Holly Springs sand was first applied by Lowe[23] to "the middle division of the Wilcox formation" as typically developed at and for several miles east of Holly Springs, Benton County, Mississippi. He defined the Holly Springs as including all of the beds lying between the Ackerman below and the thick series of lignitic clays above, for which he suggested the name Grenada and which he tentatively correlated with the Hatchtigbee of Alabama.

In Lauderdale County the Holly Springs formation includes 175 to 275 feet of sediments having characteristics and sequence similar to those of the Ackerman. It is separated from the Ackerman formation by a distinct disconformity, overlapping the upper beds of that formation; and is, in turn, disconformably overlain and partly overlapped by the Bashi, or, farther north where the Bashi is absent, by the Hatchitigbee.

The basal sand of the Holly Springs, is much finer grained than that of the Ackerman and no concentrations of coarse grit are to be found. It is highly micaceous and cross-bedded and in many localities the cross-laminae are marked by thin clay partings. Lenticular beds of clay or silt ranging from an inch or less to two feet thick may be encountered throughout the basal sand, but increase in prominence toward the top. Such discontinuous clay beds, interbedded with sand, form a prominent feature of the lower Holly Springs along the short steep valleys 3 miles northwest of Topton. Locally, also, clay fragments are so abundant as to form a sand-clay conglomerate. Toward the top of the member the sand becomes finer grained and argillaceous, and passes into the overlying lignitic silts and clays by gradual transition.

The upper member consists of interbedded and interlensed clay, silt, and very fine grained argillaceous sand, the finer materials becoming increasingly prominent as the top of the formation is approached. The entire member is carbonaceous and the prevailing color of the unweathered material is dark gray to black. Where exposed at the surface, however, much of the carbonaceous matter has been oxidized and outcrops present an apparently uniform light gray silty clay, the variations in texture becoming apparent only after close examination. The member contains three persistent beds of lignite ranging from 0.2 to 2.0 or 3.0 feet thick and separated by 20 to 40 feet of silty clays and sands. The two upper lignites have clay partings which range from a paper thin streak to a maximum of 7 or 8

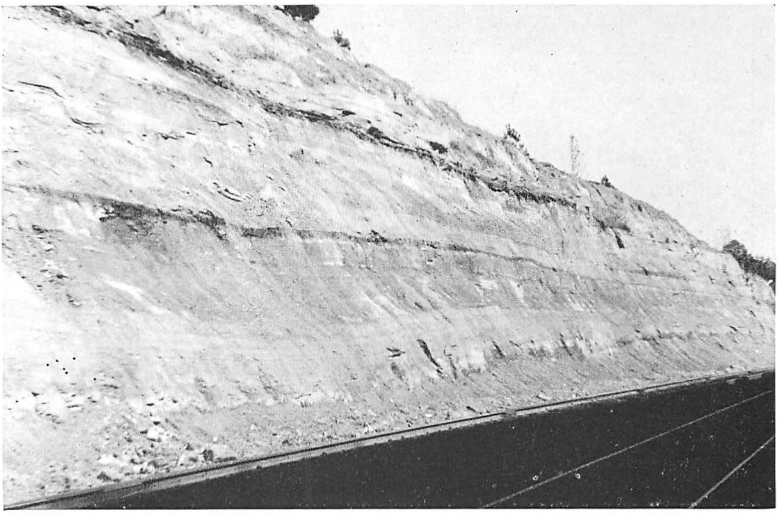


Figure 9.—Upper member of the Holly Springs formation containing three beds of lignite, total 100 feet. Six feet of overlying Bashi sand scarcely shows in photograph. Cut on the Southern Railroad 1.3 miles northeast of Russell (SE.1/4, SE.1/4, Sec. 29, T.7 N., R.17 E.). December 9, 1938.

feet in thickness. Locally, therefore, a complete section of the member may present four or five beds of lignite, and in one locality, half a mile southwest of Lockhart on U. S. 45 Highway, no less than six lignites were encountered. Careful tracing of these beds in the test hole records, however, showed that within three miles in either direction the upper three lignites and the next two lower lignites respectively converged into two beds.

The entire Holly Springs formation is well exposed in the northward facing cuesta slope which follows the belt of outcrop. The following sections, selected from widely scattered localities, illustrate the remarkable uniformity in lithology throughout the county (See also test holes 93, 95, 97, 98, 100, 101, 102, 112, 112A, 116, 118, 120, 259, and 260).

Section of Holly Springs cuesta along Mississippi 39 Highway, 4.0 miles southwest of Lizelia; beginning at Andrews Chapel and extending north 1.0 mile — E.1/2, Sec. 29, T.8 N., R.16 E.

	Feet	Feet
Holly Springs formation		219.0
Upper member		79.0
19. Silt, light gray sandy; interbedded with fine sand	2.5	
18. Sand, light greenish gray very fine grained silty, argillaceous	2.5	
17. Clay, light gray silty thinly bedded; comminuted lignite fragments scattered throughout	1.0	
16. Sand, light gray very fine grained silty, argillaceous	1.3	
15. Lignite, impure highly argillaceous	0.5	
14. Clay, gray to light gray thinly bedded, indistinctly laminated, silty; weathers to shale; limonite partings along bedding planes and joints; about 1 foot of underclay at top	19.0	
13. Lignite, impure highly argillaceous	0.9	
12. Covered interval	9.0	
11. Clay, gray to dark gray sandy, silty thinly bedded	14.0	
10. Lignite, highly argillaceous	1.8	
9. Clay, sandy shaly; thin underclay at top	16.0	
8. Covered interval	6.0	
7. Silt and very fine sand interbedded, light gray indistinctly laminated highly argillaceous	4.5	
Lower member		140.0
6. Sand, light brownish gray cross-bedded unconsolidated; limonitic near base	17.0	
5. Silt, argillaceous buff gray massive leaf-bearing; irregularly interbedded and cross-bedded with stiff gray clay	9.0	
4. Sand, light brownish gray indistinctly laminated and cross-bedded; contains lenses of well-cemented cross-bedded sandstone	19.0	
3. Silt, highly arenaceous and argillaceous light gray; interlaminated with blue gray; minor lensing and cross-bedding; contains several beds of silty cross-bedded sand	18.0	
2. Sand, fine grained light grayish brown unconsolidated highly cross-bedded; contains a few thin layers of silt parallel to planes of cross-lamination and also scattered clay fragments, so abundant in places as to give appearance of basal conglomerate	27.0	
1. Poorly exposed and partly covered, but apparently consists entirely of a sand-clay conglomerate in which pebbles and fragments of light gray shaly and silty clay form the major constituent and are embedded in a matrix of brownish gray fine grained sand; may be slumped but appears to be in place	50.0	

A mile south of the above section, test holes show that approximately 60 feet of silt and clay overlie the upper lignite (Test hole 116, SE.1/4, SW.1/4, Sec. 32 and 112A, SW.1/4, SE.1/4, Sec. 32, T.8 N., R.16 E.) giving the Holly Springs a total thickness in excess of 270 feet—the greatest thickness found in the outcrop area.

SECTION OF HOLLY SPRINGS CUESTA 2.0 MILES SOUTHEAST OF TOPTON, EXPOSED ALONG ROAD EXTENDING FROM NW.1/4, NW.1/4, SEC. 16, TO SE.1/4, NW.1/4, SEC. 9, T.8 N., R.18 E. (THICKNESS CORRECTED FOR DIP)

	Feet	Feet
Bashi formation		37.0
Lower member		37.0
12. Sand, red fairly coarse; may be reworked	37.0	
Disconformity, erosional, marked by irregular contact and by truncation of underlying beds.		
Holly Springs formation		126.0
Upper member		87.0
11. Clay, silt, and very fine grained argillaceous sand, interbedded and intermixed	8.0	
10. Lignite	0.7	
9. Clay, silt, and very fine grained argillaceous sand, interbedded and intermixed	39.0	
8. Lignite	0.9	
7. Clay, silt and, very fine argillaceous sand, interbedded and intermixed	20.0	
6. Lignite	0.4	
5. Silt and very fine argillaceous sand, interbedded and intermixed	18.0	
Lower member		39.0
4. Sand, fine grained argillaceous, silty, and highly lignitic; grades downward into medium grained fairly pure cross-bedded sand containing scattered grains of coarser sand	39.0	
Disconformity (?), contact poorly exposed and indistinct but appears to be irregular		
Ackerman formation (?)		34.0
Upper member		34.0
3. Sand fine grained, with clay partings	25.5	
2. Clay, dark blue shaly and sandy	4.5	
1. Sand, fine grained cross-bedded argillaceous	4.0	

Since the greatest development of upper Ackerman encountered in Lauderdale County is to be found two miles north of this locality, this area was probably relatively high land at the beginning of Holly Springs deposition, and it is believed that this explains the thinness of the lower Holly Springs in the foregoing section.

COMPOSITE SECTION EXTENDING 2.5 MILES ALONG ROAD FROM MT. GILLEAD CHURCH TO TOOMSUBA CREEK—NW.1/4, SE.1/4, SEC. 11, T.6 N., R.17 E. TO SW.1/4, SW.1/4, SEC. 31, T.7 N., R.18 E. (THICKNESSES CORRECTED FOR DIP)

	Feet	Feet
Bashi formation		20.0
Lower member		20.0
10. Sand, red coarse grained, grit-bearing; contains a few small quartz pebbles up to 0.7 inch in diameter	20.0	
Disconformity, erosional, marked by irregular contact and by truncation of underlying beds toward east		
Holly Springs formation		197.0
Upper member		110.0
9. Clay, light gray silty, sandy. From feather edge to	25.0	
8. Lignite; locally splitting into two beds separated by as much as 0.3 to 0.5 foot of plastic lignitic clay. From 1.5 to	2.0	
7. Clay, gray silty, sandy	23.0	
6. Lignite	1.4	
5. Clay and silt, sandy light gray to gray	28.0	
4. Lignite. From 0.3 to	1.0	
3. Silt and sand interbedded with clay near the top; grades downward into sand	30.0	
Lower member		87.0
2. Sand, red, yellow, and brown medium grained cross-bedded; thin layers of clay and silt along some of bedding planes and clay partings along planes of cross-lamination, especially prominent in upper half; clay pebbles scattered throughout and concentrated locally to form clay-sand conglomerate; lower half contains layers and lenses of gray silt and fine sand ranging from thin partings to several feet in thickness	87.0	
Disconformity (?), contact poorly exposed but appears to be irregular		
Ackerman formation, from 10.0 to		15.0
Upper member, from 10.0 to		15.0
1. Clay, dark blue to black lignitic, silty, sandy, and locally somewhat shaly; exposed along roadside to valley flat; also poorly exposed in bed of creek on west side of road where it overlies a bed of lignite 1.5 to 2.0 feet thick. From 10.0 to	15.0	

In two exposures, 2 miles south and 6 miles southeast of Mt. Gillead Church (Sec. 24, T.6 N., R.17 E. and Sec. 4, T.5 N., R.18 E.) respectively, the clay above the upper lignite, 35 and 50 feet in thickness, suggests a thickening toward the south. Such a thickening may be evidence of an overlap, successively higher beds appearing down dip beneath the overlying Bashi formation. Thus it is to be expected that considerably greater thicknesses of the formation will be encountered in wells drilled down dip from the outcrop area.

No marine sediments were found in the Holly Springs of Lauderdale County, although within a few miles of the state line, the equivalent beds of Alabama (Tuscahoma) included glauconitic marls having a varied marine fauna. At a point east of Kewanee, where Highway U. S. 80 enters Alabama, are to be found alternating beds of fine grained sand and silt, some beds of which contain leaf impressions and others of which contain poorly preserved casts of a small pelecypod. About 150 yds. east of the state line, and about 40 feet lower in the section, there is a bed of glauconitic sand containing poorly preserved fossil casts. It is probable that these beds are to be correlated with the Tuscahoma formation of Alabama (Holly Springs of Mississippi) and, if so, represent the most northwesterly advance of the Tuscahoma sea in this area. It is to be expected, therefore that marine beds of Holly Springs age will be encountered in wells within a relatively short distance down-dip.

BASHI FORMATION

The name Bashi was first used by Smith and Johnson[24] to designate a section of marine sands and marls and associated lignitic clays and silts lying between the Hatchitigbee and Tuscahoma (Holly Springs) and typically exposed along Bashi Creek and its tributaries, Clarke County, Alabama. As described by these authors, the base of the formation in Alabama is marked by 2 feet of lignite and lignitic clay overlain by 35 to 40 feet of yellowish cross-bedded sand which grades upward into 25 feet or more of gray lignitic sandy clays and associated beds of lignite. The top of the formation is marked by 15 to 30 feet of glauconitic marl, which is fossiliferous and contains large concretionary masses of limestone in the upper part. This member passes upward without apparent break into the overlying lignitic sands and clays of the Hatchitigbee formation.

Essentially the same section, with the exception of the basal lignite, is found in Mississippi, extending from the southeastern corner of Lauderdale County (Sec. 35, T.5 N., R.18 E.) to Meridian, near the center of the County. In this area, the typical Bashi marl is overlain by a bed of sandy clay and silt which reaches a thickness of 50 feet in some localities, and grades upward into lignitic sand and silt. Inasmuch as this clay contains small marine fossils in many places, it is here placed in the Bashi formation, although Lowe[25] and Cooke[26] considered it to be the basal bed of the Hatchitigbee. Since there is no apparent unconformity between the Bashi and the overlying Hatchitigbee in Mississippi, the contact is arbitrarily drawn at the top of the marine deposits which, in Lauderdale County, is at the top of the silty clay and the base of a rather thick section of continental sands.

Northwest of Meridian the distinctive marine facies of the Bashi-Hatchitigbee sedimentary cycle becomes thinner, the upper Bashi apparently passing by lateral gradation into continental deposits which are here assigned to the Hatchitigbee formation. Two miles northeast of Collinsville (SW.1/4, SE.1/4, Sec. 25, T.8 N., R.14 E.) a road cut exposes a badly weathered highly ferruginous sand

Figure 10.—Holly Springs-Bashi unconformity: Highway cut on State 19, 3.2 miles southeast of Whynot (SW.1/4, NE.1/4, Sec. 22, T.5 N., R.18 E.). June 4, 1939.

which contains a few partly altered grains of glauconite and a few poorly preserved fossil casts. This bed seems to be equivalent to a glauconitic, slightly marly bed found near the base of the Bashi in the vicinity of Meridian, and it is the northernmost outcrop of marine sediment yet found at this stratigraphic horizon. North and northwest of this locality, the Bashi equivalent seems to be represented by continental deposits included in the Hatchitigbee formation.

The Bashi disconformably overlies the Holly Springs formation, and the basal sands cap the higher hills along the cuesta-like back slope of the Holly Springs belt of outcrop. For the most part, these outliers are badly weathered and on first glance present little evidence of their marine origin. In many places, indeed, they appear to have been reworked. They may be traced into less weathered sands of undoubted Bashi age, however; and, in a few outcrops, highly ferruginous sands containing scattered particles of only partly altered glauconite and occasional poorly preserved casts of small pelecypods, may be found. In the less weathered outcrops, the basal sand is light yellow in color and sparingly glauconitic throughout. In many localities interbedded sandy silt and clay partings are common along planes of cross-lamination, and locally the characteristic medium grained sands are interbedded with coarser sands.

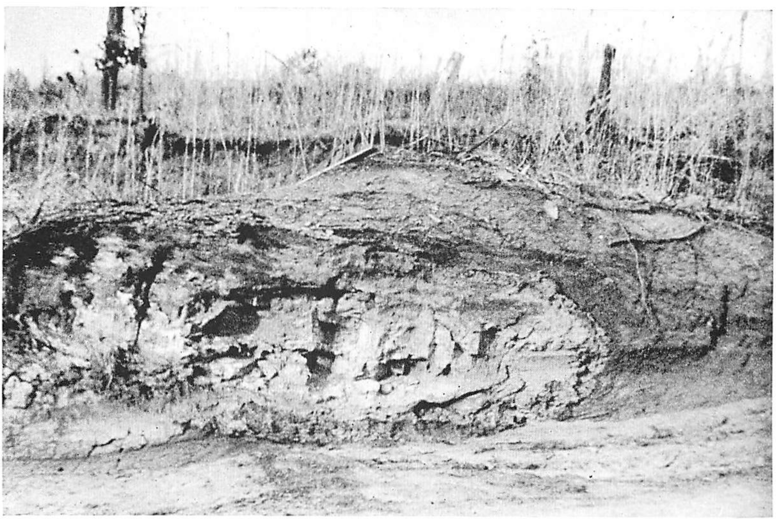


Figure 11.—Large shell-like concretion of limonite in Basal member of the Bashi formation, 2.0 miles north of Meridian. March 17, 1939.

The basal sands normally grade upward into 15 feet or more of interbedded carbonaceous sand, silt, and clay, some parts of which are lignitic and may or may not be sparingly glauconitic. In the lower part of this zone two or more lenticular beds of lignite are present in some localities. However, the lignitic material is mixed with sand and silt, and in one exposure glauconite and a few small marine fossils were found intimately intermixed with the lignite (NE.1/4, SE.1/4, Sec. 5, T.6 N., R.16 E.). A bed of highly glauconitic sand, four or five feet thick and locally fossiliferous and marly, is rather persistent over the county near the base of the lignitic zone. This bed may be distinguished from the marl member of the formation by its thinner development and the presence of large shell-like limonite, rather than calcareous, concretions. It is probable that it is the weathered remnants of this bed which are sometimes found in the outliers as described above. The entire lignitic zone grades laterally into sands which, in many outcrops, are indistinguishable from those of the underlying bed.

The greensand marl member, persistent throughout the belt of outcrop from the southeastern corner of the county to the vicinity of Popular Springs (Sec. 31, T.7 N., R.16 E.), is typically separable into

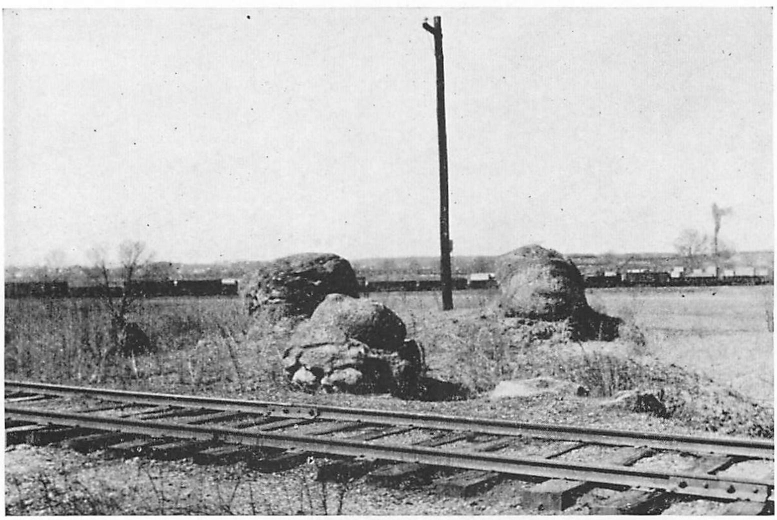


Figure 12.—Large calcareous concretions in the Greensand marl member of the Bashi formation. Purdues Cut on the Gulf Mobile and Northern Railroad. May 2, 1940.

three distinctive beds, the lower of which, in most localities, constitutes the major thickness of the member. It is composed of fine grained silty laminated carbonaceous, glauconitic sand which is sparingly fossiliferous and contains large nodular calcareous concretions which may be highly fossiliferous. Toward the top of the bed the sand is coarser grained and the nodular concretions more abundant. The overlying bed is a coarse grit-bearing sand, highly glauconitic and highly fossiliferous. In many localities it is indurated to a nodular or lenticular ledge and in some places it includes large nodule-like masses of highly lignitic material in which the shells of the fossils are almost perfectly preserved. The upper bed consists of loose white or gray non-fossiliferous sand containing abundant glauconite which gives the bed a pepper and salt appearance. Either one or both of the upper beds of this member may be locally absent, and where present they seem to be continuous with or locally developed phases of the basal bed of the member.

The uppermost member of the formation comprises 30 feet or more of silty and sandy marine shales and interbedded clays which grade upward into the overlying sands of the Hatchitigbee formation. Some parts of this member are slightly glauconitic, especially in the lower part, and poorly preserved casts of small pelecypods have been noted in widely separated outcrops extending from Mt. Barton (Seymours Hill), near Meridian to the southeastern corner of the county. In some areas in the southeastern part of its outcrop, notably southeast of Vimville (Sec. 33, T.6 N., R.17 E.) and Whynot (Sec. 7, T.5 N., R.18 E.) this member is a fine grained highly argillaceous sand which is indistinguishable in the weathered outcrop from the weathered sands of the Hatchitigbee. In the road cuts and gullys southeast of Russell (Secs. 3, 4, and 5, T.6 N., R.17 E.) the silty clays of this member are indurated to a claystone closely resembling the Tallahatta claystone. These beds were described by Hilgard in 1860[27] who considered them to be Claiborne in age.

One of the classic exposures of the Bashi in Mississippi is that at Purdue's cut on the Mobile and Ohio Railroad south of Meridian (NW.1/4, SE.1/4, Sec. 24, T.6 N., R.15 E.), where the following section is exposed.

SECTION AT PURDUES CUT, MOBILE AND OHIO RAILROAD 1.5 MILES SOUTHWEST OF MERIDIAN POST OFFICE—NW.1/4, SE.1/4, SEC. 24, T.6 N., R.15 E.

	Feet	Feet
Recent: Colluvium (Reworked Meridian sand)		23.2
11. Topsoil: dark gray sand	1.2	
10. Sand, reddish brown to red coarse grained to medium grained argillaceous cross-bedded	22.0	
Disconformity, erosional, marked by irregular contact		
Hatchitigbee formation (?)		3.9
9. Clay, gray sandy laminated	0.5	
8. Sand, yellow micaceous, argillaceous laminated	3.4	
Bashi formation (?)		30.6
Upper member		11.9
7. Clay, grayish yellow to brown laminated sandy, slightly micaceous	6.0	
6. Clay, black to brown highly lignitic sandy, slightly micaceous	1.5	

5. Clay, gray carbonaceous, micaceous, slightly sandy fossiliferous (one poorly preserved pelecypod cast); lower few inches sandy and glauconitic	4.4	
Greensand Marl member		7.7
4. Sand, yellow speckled with green glauconitic unconsolidated non-fossiliferous; grades upward into overlying clay within 3 or 4 inches	5.7	
3. Sand, highly glauconitic coarse grained, grit-bearing fossiliferous	2.0	
Lower member		11.0
2. Sand, silty thinly bedded to laminated fossiliferous; medium grained, grading downward to fine grained; contains numerous large lime nodules of indurated greensand which are highly fossiliferous (reaching diameter in excess of 5 feet)	7.0	
1. Covered to track level	4.0	

That part of the above section below bed 4 is now covered by talus from the bluff above, and it was necessary to trench to the foot of the bluff in making the section. The lower beds, therefore, are descriptions of a face about 4 feet wide that gave no chance of observing possible lateral gradations. However, the section is practically identical with that made by Lowe, when the cut was fresh[28]; and comparison with test hole records 173 and 174 show little or no variation over a distance of some 150 feet. In these holes the greensand is seen to grade downward into lignitic silts and sands similar to those of the Holly Springs, and Lowe[29] reports that "a few rods north of this cut wells sunk to a depth of 62 feet strike water in the sands of the Bashi." Excellent exposures of these basal silts, sands, and lignitic clays may be seen in the cuts along a secondary road near Martin School, 2 miles northeast of the Meridian Post Office. (NW.1/4, SE.1/4, Sec. 5 to NE.1/4, NW.1/4, Sec. 4, T.6 N., R.16 E.). At the top of the hill by the old school the highly weathered greensand marl crops out, and in the road cuts to the east at least 60 feet of interbedded sand, silt, and lignitic clay grading downward into the basal sand are exposed. Near the base of the silty zone are two or more lenticular beds of impure lignite and one bed of fossiliferous glauconitic marl. The basal cross-bedded sands capping the hills above the Holly Springs clay can be traced northward for six miles or more (See also test hole records 145, 150, 152, 153, 154, 168, 169, 170, 172, 173, 174, 203, 204, 210, 211, 212, 213, 214, 235, 237, and 238, for descriptions of various parts of the formation).

The two sections which follow illustrate the basal sands in areas where the lignitic silt is not well developed. In each case the glauconitic marl bed is believed to be the equivalent of that found in the lignitic silty phase north of Martin School. The other two sections show the major variations in lithology of the greensand marl and upper members.

SECTION ALONG RUSSELL-KNOX MILL ROAD, 1.8 MILES NORTH OF RUSSELL—SW.1/4, SEC. 20, T.7 N., R.17 E.

	Feet	Feet
Bashi formation: Basal member		57.2
8. Silt, shaly; thinly interbedded with glauconitic sand	8.0	
7. Sand, highly glauconitic and limonitic fossiliferous; marly in some parts of outcrop	2.3	
6. Sand and silt, slightly glauconitic, sparingly fossiliferous, interbedded and interlaminated; both the glauconite and fossils being least abundant in lower part	5.7	
5. Sand, yellow fairly fine grained cross-bedded unconsolidated; weathers to a deep red; fresh material contains scattered grains of glauconite and a few poorly preserved casts of a small pelecypod	20.0	
4. Silt, apparently non-glauconitic shaly; inter-laminated with very fine grained sand; contains a few fossil leaves	14.0	
3. Sand, fine grained; grading upward into bed 3 and downward into coarse grained sand	7.2	
Disconformity, erosional, marked by irregular lower contact		
Holly Springs formation: upper member		15.3
2. Lignite, weathered; cut out to east by overlying sand	0.3	
1. Clay, silty light gray; about 2 feet of underclay at top is cut out to east by overlying sand	15.0	

Successively lower beds of the Holly Springs clay are seen in the road cuts to the east. In several places the clay is overlain unconformably by reddish-brown cross-bedded grit-bearing sand similar to the basal Bashi. In most instances these may be reworked material but in a few localities they seem to be in place and may indicate an overlap of the Bashi onto the beveled edge of the Holly Springs in this area.

SECTION OF HIGHWAY CUT ON U. S. 80 AT PINE HILL CLUB, 1.6 MILES NORTHEAST OF RUSSELL — NW.1/4, NW.1/4, SEC. 33, T.7 N., R.17 E.

	Feet	Feet
Bashi formation: lower member, from 66.7 to		71.0
9. Sand, light to dark reddish brown micaceous, limonitic coarse grained; interbedded with light gray clay and silt. From 18.0 to	20.0	

8. Sand, light to dark reddish brown medium-grained; with scattered grains of coarser sand or fine grit	12.3	
7. Sand, light gray to white highly argillaceous, silty, micaceous	6.5	
6. Sand, light brownish gray highly glauconitic; marly in places	5.2	
5. Sand, reddish brown, micaceous, limonitic; interbedded with light gray clay and silt	10.0	
4. Sand, light gray to brown fine grained micaceous	8.7	
3. Sand, light to dark slate gray, very argillaceous, micaceous, glauconitic, limonitic. From 6.0 to	8.3	
2. Sand, white to light gray and brown medium grained micaceous; concentration of limonite near base	3.0	
Disconformity, erosional, marked by irregular contact		
Holly Springs formation: upper member		20.0
1. Silt, sand, and clay very fine grained micaceous, limonitic interbedded	20.0	

SECTION OF SOUTH VALLEY WALL OF ASYLUM CREEK, MISSISSIPPI HIGHWAY 19 0.7 MILES NORTHWEST OF JUNCTION WITH U. S. 80 — SW.1/4, SW.1/4, SEC. 11 T.6 N., R.15 E.

	Feet	Feet
Meridian (?) formation		50.0
5. Sand, red coarse grained, grit-bearing cross-bedded	50.0	
Hatchitigbee formation (?)		21.0
4. Sand, silt, and clay interbedded, gray and light yellowish brown; the sand is fine grained, silty cross-laminated and irregularly bedded; the clay is silty and weathers to a clay-shale	21.0	
Bashi formation		32.0
Upper member		23.0
3. Clay, gray silty, arenaceous, locally glauconitic; grades downward into bed 2	23.0	
Greensand marl member		9.0
2. Sand, fine to medium grained gray to white, speckled highly glauconitic unconsolidated	4.0	
1. Sand, fine grained highly silty dark gray glauconitic fossiliferous; contains large limy concretions composed largely of cemented greensand marl and fossil shells	5.0	

SECTION OF SOUTH VALLEY WALL OF CLEAR BRANCH CREEK, ALONG SECONDARY ROAD, 1.7 MILES NORTHEAST OF BONITA — SW.1/4, NE.1/4, SEC. 10, T.6 N., R.16 E.

	Feet	Feet
Hatchitigbee formation (?)		11.0
8. Sand, white to light reddish brown very micaceous; contains thin partings and layers of light gray clay	11.0	
Bashi formation		76.8
Upper member		49.8
7. Sand and clay interlaminated	15.0	

6. Sand, light to dark reddish brown very fine grained micaceous, highly limonitic	6.5	
5. Sand, gray to brown argillaceous, micaceous, limonitic; numerous clay partings	16.3	
4. Sand, steel gray argillaceous, micaceous, sparingly glauconitic	12.0	
Greensand marl member		12.0
3. Sand, coarse grained highly glauconitic highly fossiliferous; cemented in places to form an irregular ledge	4.0	
2. Sand, dark reddish brown glauconitic, micaceous slightly fossiliferous	8.0	
Lower member		15.0
1. Clay and fine grained sand interbedded, micaceous, carbonaceous, lignitic	15.0	

HATCHITIGBEE FORMATION

In 1886 Smith and Aldrich[30] used the name: Hatchitigbee for the upper division of the "Lignitic" (Wilcox) in Alabama. The name derives from typical exposures at Hatchitigbee Bluff on the Tombigbee River, northeastern Washington County, Alabama. The following year the formation was defined to include all of the beds lying between the "base of the Buhrstone (Tallahatta) and the uppermost of the Woods Bluff (Bashi) fossiliferous beds."[31] Lowe described an unconformity between the lignitic sands and clay-shales of the typical Hatchitigbee and the thick red sand which immediately underlies the claystone in Mississippi, and limited the formation to that section lying between the "basal Claiborne sands" and the Bashi.[32] It is in the latter sense that the term has since been used in Mississippi.

In Lauderdale County the formation is composed of lignitic sands, sandy silts, and silty or sandy clays interbedded one with the other. In general, the basal part of the formation is more sandy than the upper part, and northwest of Meridian, extending to the county line north of Post (Sec. 18, T.8 N., R.14 W.), it is easily separable into two members, an upper member composed of clay-shale, including one well developed lignite bed 1.0 to 2.5 feet thick, and a lower member composed of relatively fine or medium grained sand locally grading down into coarse grit-bearing sand. Southeast of Meridian, however, the upper member either grades laterally into a more sandy facies or the formation is partly overlapped by the Meridian sand. Both factors may be involved since the basal member increases considerably in thickness in that direction, while the total thickness of the formation is much less than in the vicinity of Meridian. An overlap is also suggested by the fact that southwest of Fairview Church

(See test hole 140, NW.1/4, NE.1/4, Sec. 19, T.6 N., R.17 E.) the upper member is absent in outcrop except along the southwestern flank of a structural high (Alamucha Structure east of Causeyville).

In Mississippi the Bashi-Hatchitigbee contact marks the conformable transition from marine to continental types of sediment and seems to represent a progressive withdrawal of the sea. Thus the contact is diagonal in nature—marine sediments recognized as Bashi in the southeastern part of the county being represented by continental sediments considered as Hatchitigbee toward the northwest. Although there is no recognizable unconformity between the two formations, the basal sands of the Hatchitigbee throughout the county contains local concentrations of large angular and, in many places, distorted blocks and fragments of Bashi material. Since the unconsolidated sediments of the Bashi could not withstand transportation over long distances, and since the fragments show no sign of rounding or corrosion, they probably represent local undercutting and consequent caving along an old shore line.

In Alabama, according to Cooke[33] and others, the Hatchitigbee contains both marine and non-marine beds, the marine deposits being both glauconitic and fossiliferous. A careful search of the Hatchitigbee in Lauderdale County has failed to discover any glauconite in the Mississippi section, and in only one outcrop was any evidence of marine fossils found. In the highway cut along State 19 on the east valley wall of Bucatunna Creek, 1.1 miles east of the Vimville Post Office, (NE.1/4, NE.1/4, Sec. 33, T.6 N., R.17 E.) there is an outcrop of fine gray silt underlain by gray clay in which a very poorly preserved cast of a small pelecypod was found. A short distance up the hill the silt is overlain by red sand similar to the Meridian sand. On this basis the fossiliferous clay is interpreted as Hatchitigbee. However, about a mile to the north (SE.1/4, SW.1/4, Sec. 21, T.6 N., R.18 E.) a somewhat similar clay was proved to be Bashi by drilling a test hole to the Greensand marl member. The two outcrops are at about the same elevation, and it may be that the Hatchitigbee correlation of the Vimville exposure is erroneous.

The most complete exposed section of Hatchitigbee to be found in the county is that on the north slope of Mt. Barton (Seymores Hill) just south of Meridian. Along the secondary road at that locality the section begins in the upper member of the Bashi and includes about 57 feet of the Tallahatta claystone. Thus the complete sections of the Hatchitigbee and Meridian formations are exposed.

SECTION OF NORTH FACE OF MT. BARTON (SEYMORES HILL), ALONG ROAD 1.1 MILES SOUTH OF THE CORNER OF 31ST AND 5TH ST., MERIDIAN—NE.1/4, SE.1/4, SEC. 24, T.6 N., R.15 E.

	Feet	Feet
Claiborne series		128.5
Tallahatta formation		58.5
40. Claystone, light yellow or buff to almost white; stained yellow-brown with limonite in some places; beds massive from 0.5 to 1.5 feet; some beds dense, almost ivory-like; others chalky or earthy and softer; some beds contain grains of clear quartz and in places grade to a hard sandstone intermixed with claystone; fucoid-like markings common in some beds	44.0	
39. Sandstone, coarse, grit-bearing; contains irregular patches and fragments of claystone of ivory-like density, especially in upper 0.2 feet where the layer grades upward into overlying claystone and in lower 0.8 feet where it grades into the soft shaly claystone below	1.5	
38. Claystone, light buff gray shaly soft	2.3	
37. Claystone, light gray very sandy rather hard	0.3	
36. Claystone, shaly; intermixed with unindurated clayey sand, which is glauconitic	4.0	
35. Sand, light greenish and brownish yellow grit-bearing glauconitic; contains considerable irregularly laminated shale similar to that above; grit especially abundant in upper 1.5 feet; irregular upper and lower contact; lower contact very sharp and marked by concentration of thin irregular and wavy limonite layers	5.4	
Disconformity, marked by sharp contact, by borings in the lower bed which appears to have been filled with sand from overlying bed		
Meridian formation		70.0
34. Sand, white to light buff medium grained; upper 6 feet more prominently marked by irregular yellow brown limonite stains which seem to be borings or fucoidal markings; contact of brown and white colors usually very sharp; cross-bedded; beds rather irregular and indistinct, from 0.3 to 1.0 foot thick	38.5	
33. Sand, reddish brown grit-bearing cross-bedded; contains fragments of white clay-shale	11.5	
32. Covered interval	13.0	
31. Sand, light gray to brown to light yellow-brown fine grained argillaceous; contains thin layers of light gray clay	2.3	
30. Sand, light gray, iron stained very fine grained argillaceous, silty indistinctly bedded; the lower 2.0 feet contains blebs and fragments of light gray clay which is underlain by a bed 2.0 feet thick of light brown cross-bedded grit-bearing sand with irregular lower contact		

showing heavy concentration of limonite. This lower sand seems to be lenticular in character and discontinuous toward the south. In the southern part of the exposure the entire member is represented by clay shale, light gray in color and slightly iron stained along laminae. The sand and clay meet along a sharp line of contact sloping diagonally across the member from north to south at an angle of about 30°. There is no distortion of bedding and no concentration of limonite along the contact	7.0	
Disconformity, erosional, marked by irregular contact cutting across some of lower beds		
Wilcox series		142.7
Hatchitigbee formation		121.4
Upper member		90.3
29. Clay, light gray shaly aplastic slightly silty; contains a thin black lignitic zone at upper contact which seems not to be present at southern end of exposure	5.0	
28. Silt and sand, light gray; irregularly streaked with iron stains along what appear to be laminae and cross-laminae; a thin discontinuous concentration of limonite at basal contact	0.8	
27. Sand, light gray to almost white; streaked and mottled with light brown iron stains; lower contact shows heavy concentration of limonite, lower 2 or 3 feet is light brown in color	5.0	
26. Clay, light gray silty thinly bedded; about 0.5 foot of dark gray lignitic clay 2.0 feet from top; several thin partings of limonite near center	8.8	
25. Sand, very fine grained silty, argillaceous, micaceous; light gray stained with yellow-brown; indistinctly bedded to massive	1.5	
24. Covered interval	22.0	
23. Clay, light gray thinly bedded, somewhat shaly semiplastic silty; poorly exposed; lower 2 or 3 feet streaked and stained with light brown along joint planes; seems to grade into underlying bed without sharp contact	9.5	
22. Silt, light gray indistinctly bedded; contains a few flattened nodules and discontinuous separations of impure limonite with rather heavy concentration of limonite in lower 0.3 foot; this bed seems to be somewhat lenticular, thinning toward north. From 2.5 to	5.0	
21. Sand and silt intermixed, light gray; irregularly streaked with limonite stains; thin concentrations of limonite along base	3.0	
20. Silt, light gray argillaceous thinly bedded; streaked with limonite stains along bedding planes and indistinct lamination planes; contains two rather heavy concentrations of limonite as much as one inch thick near center		

of bed; lower 0.4 foot more argillaceous, contains lignitized leaf prints	2.5	
19. Sand, light gray very fine grained, silty; heavily streaked with limonite stains; near center of bed contains 0.3 foot brown sand separated on top and bottom by thin concentrations of limonite	3.3	
18. Clay, dark bluish gray laminated arenaceous; very fine grained light gray sand being concentrated along planes of lamination; lower 1.5 feet almost black in color, contains lignitized plant fragments	4.7	
17. Lignite; lower 0.6 foot shows several distinct clay partings; irregular lower contact	2.4	
16. Silt, dark gray to light brownish gray laminated lignitic; thin partings of lignitized material and limonite; a few concretions of siderite	5.6	
15. Clay, silty dark gray to black; sub-conchoidal fracture; indistinct bedding	1.8	
14. Silt, clay, and very fine grained sand interlaminated; the sand is light gray, the silt is dark gray, and the clay is black; more highly argillaceous toward base	5.0	
13. Lignite; lower part highly argillaceous, appears to grade into underlying bed	1.3	
12. Clay, black hard leaf-bearing, highly lignitic	2.3	
11. Silt, light brownish gray laminated; streaked with limonite; contains numerous thin concentrations of limonite	0.8	
Lower member		31.1
10. Sand, light gray to light brownish gray thinly bedded, silty	1.4	
9. Sand, light gray thinly bedded or laminated; streaked with light brown; contains several laminae of light gray clay; limonite nodules throughout	4.5	
8. Sand, light gray fine-grained slightly argillaceous; similar to overlying bed except it contains no clay layers, and is somewhat less consolidated	5.0	
7. Sand, white pure unconsolidated indistinctly cross-bedded; irregularly streaked in places with limonite; contains numerous irregular cemented pipes, nodules, and thin limonite partings	5.7	
6. Sand, fine grained brown to light gray; interbedded with thin streaks of light brown clay; cross-bedded badly weathered; clay beds become increasingly prominent toward the base; grades upward into overlying pure sand	8.0	
5. Sand, very fine grained light orange brown cross-bedded; cross-laminations stained to limonite brown	3.5	
4. Sand, very fine grained light gray cross-bedded; streaked with limonite stains; apparently unweathered phase of overlying bed	2.0	

3. Sand and clay interlaminated, cross-bedded light gray	1.0	
Bashi formation		21.3
Upper member		21.3
2. Sand and silt, very fine grained light gray to greenish gray thinly bedded and apparently cross-bedded; interbedded with gray to black silt and clay, especially prominent in upper few feet where it contains abundant lignitized, but unrecognizable plant remains; grades downward into clay; several poorly preserved marine fossils in lower half of bed	15.0	
1. Clay, light gray indistinctly laminated silty sub-conchoidal fracture	6.3	

In the foregoing section, it will be noted, the upper member of the Hatchitigbee formation has a thickness of 90 feet. Both northwest and southeast of Meridian the member is thinner. As pointed out above, the thinning toward the southeast is interpreted as overlay of the upper beds by the Meridian sand and lateral gradation of the lower beds into a more sandy facies. Toward the northwest, the thinning is believed to be due to removal of the uppermost beds of the formation during the erosion period following Hatchitigbee deposition. In this connection it is significant that throughout the northwestern part of the county, a persistent lignite bed, believed to be equivalent to bed 17 of the foregoing section, lies less than 25 feet below the unconformity.

The lower or sandy member of the formation, on the other hand, has a thickness of 65 to 70 feet where the upper member is most poorly developed, near Whynot, in the southwestern part of the county, and of more than 100 feet north of Collinsville in the northwestern part, where the formation includes the continental equivalent of the Bashi. Thus, in the outcrop area, the Hatchitigbee formation ranges in thickness from 70 feet more or less to 150 feet or more.

WILCOX-CLAIBORNE CONTACT

The proper position of the Wilcox-Claiborne contact is now in dispute. As originally defined, the Wilcox included all of the sediments between the base of the "Buhrstone" (Tallahatta) and the top of the Midway and the contact was believed to be conformable. The Hatchitigbee formation included all beds between the top of the Woods Bluff (Bashi) and the base of the "Buhrstone." In Mississippi the typical lignitic sands and clays of the Hatchitigbee are separated from the claystone (Buhrstone) of the typical Tallahatta by a considerable thickness of coarse cross-bedded red and white sand, which was formerly included in the Hatchitigbee formation. In 1919, however, Lowe[34], pointing out a wide-spread unconformity between the lignitic sands and clays and the overlying red sand, limited the Hatchitigbee formation in Mississippi to the beds below the unconformity. He considered the red sands to be of Claiborne age on the basis of supposed conformable relations with the claystone, and included both in the Tallahatta formation.

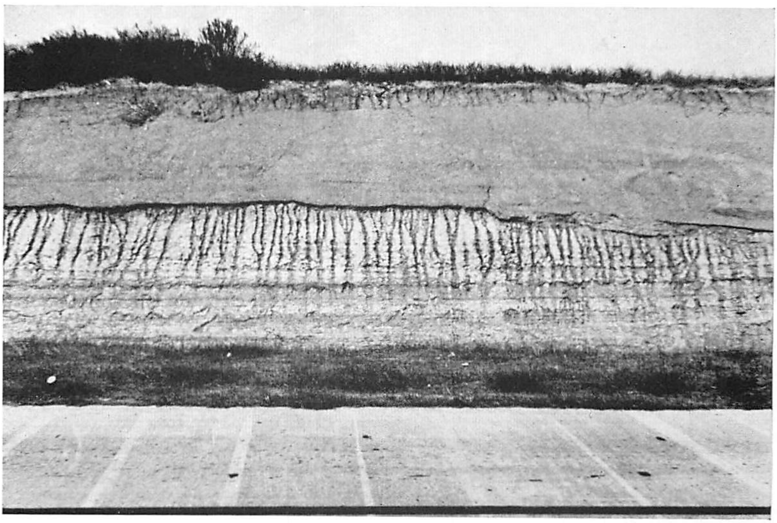


Figure 13.—Hatchitigbee-Meridian unconformity: Highway cut on U.S. 80 at city limits, Meridian (Sec. 14, T.6 N., R.15 E.). October 21, 1938.

Grim[35], in 1936, questioned the continuous and widespread character of the unconformity at the top of the Hatchitigbee and described "breaks within the basal Claiborne sands—(which) seem to be as large as the break between the Claiborne and the Wilcox series." He included the sand in the Claiborne series on the basis of its supposed glauconitic content, marking the change from dominantly continental sedimentation in Wilcox time to dominantly marine conditions in the Claiborne. Later detailed field work by the writer and others has tended to prove the continuity and widespread character of the unconformity at the top of the Hatchitigbee formation. Furthermore, the "breaks within the basal Claiborne sand" described by Grim have proved to be a continuous and widespread disconformity between the sand and a sandy bed at the base of the claystone. Also it has been established that the glauconite, on the presence of which Grim based the correlation of the sand as Claiborne, lies entirely above the disconformity (except in borings within a few feet of the top). There is a strong tendency at present, therefore, especially among commercial geologists, to place this sand at the top of the Wilcox rather than at the base of the Claiborne. Although additional field data may necessitate a revision of classification, the current usage of the Mississippi State Geological Survey is here followed in placing the sand in the Claiborne.

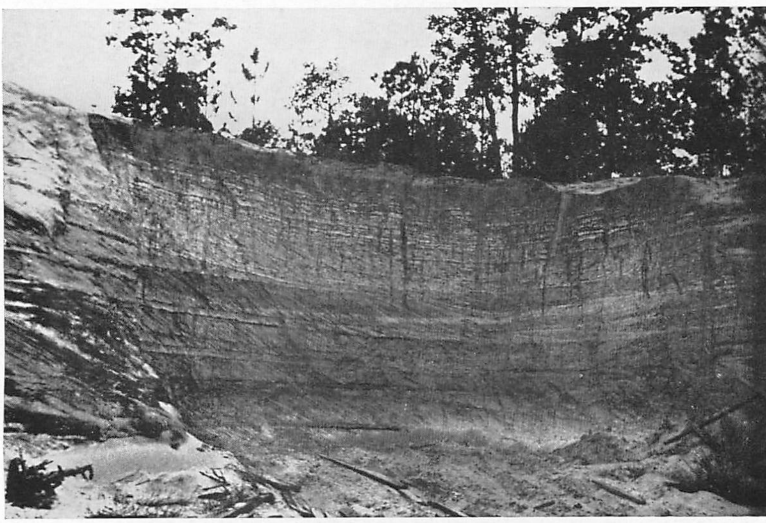


Figure 14.—Meridian sand, showing deltaic crossbedding. Sand pit on U. S. 80 Highway, 3.5 miles west of Meridian (NW.1/4, SE.1/4, Sec. 20, T.6 N., R.15 E.). October 14, 1938.

CLAIBORNE SERIES

MERIDIAN FORMATION

In 1933 Lowe[36] proposed that the basal Claiborne sand be considered a member of the Tallahatta formation and named it the Meridian sand from typical exposures at and near Meridian, Lauderdale County. He later recognized the probability of an unconformity at the top and, in an uncompleted manuscript, separated the basal Claiborne sands as a distinct formation[37]. Since it is now established that the stratigraphic relations are disconformable both above and below, and since the sands constitute a stratigraphic unit which is different lithologically from the overlying and underlying beds, the Meridian sand is now generally considered to be of formational rank.

As pointed out above, the unconformity at the base is clear in all outcrops of the contact except in those localities where the Meridian sand lies directly on a sand of the underlying formation. In those localities, both formations consisting of loose unconsolidated sand, it is rarely possible to accurately locate the contact. In all exposures in which it can be distinguished, however, it is irregular and commonly marked by a heavy concentration of limonite. Locally, also, the lower few feet of the Meridian formation contains abundant small fragments of clay which are rounded and show evidence of transportation.

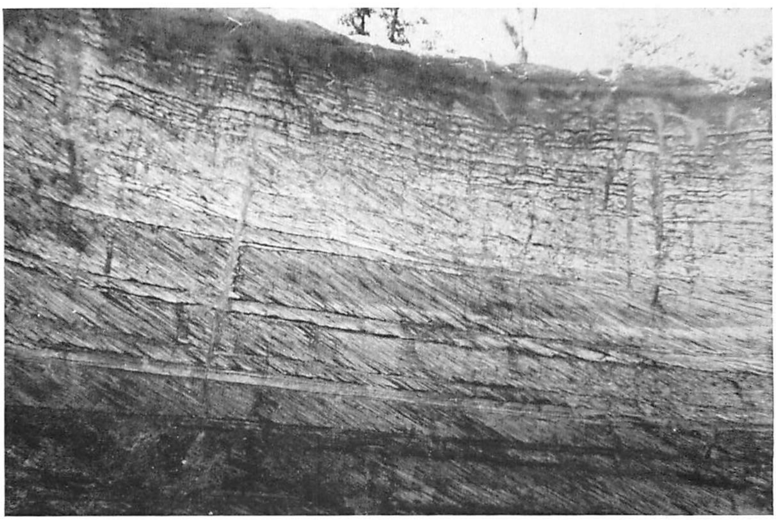


Figure 15.—Meridian sand—closer view of pit October 14, 1938.

The unconformity at the top is not as striking as that at the base. Nevertheless, it seems to be persistent over a wide area and it is uniform in character; in fact it is characteristic throughout the area in which it has been studied.

The basal few feet of the Tallahatta consists of glauconitic sand interbedded with soft claystone and contains discontinuous beds and lenses of grit-bearing sand. The claystone decreases in prominence toward the base and is not found below the contact. The upper four or five feet of the Meridian consists of fine to medium grained sand, which is white in color and grades downward to a light brown or red cross-bedded sand. It appears to be a zone in which the iron has been leached out (soil zone?). Normally this bed is from 4 to 6 feet in thickness and is prominently marked by fucoid-like limonite stains.

Locally these markings are less weathered and seem to be borings filled with slightly glauconitic sand. The contact shows only minor irregularities, but it is quite sharp and locally marked by a thin concentration of limonite.

Whether or not there are major erosional irregularities at the top of the formation the writer is unable to say, since the formation is so uniform in lithology that no key beds within the formation could be found. However, it is probably significant that the thickness varies from almost 90 feet to 40 feet or less within distances of 10 or 12 miles.

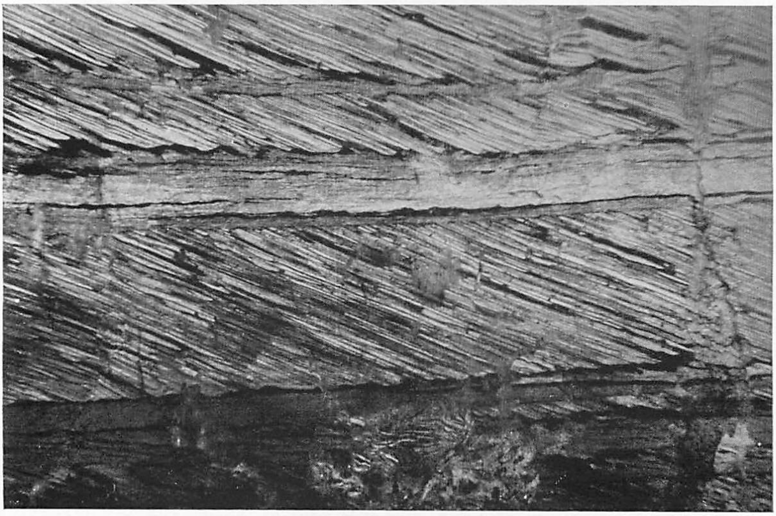


Figure 16.—Meridian sand—still closer view of pit October 14, 1938.

The formation consists almost entirely of rather pure cross-bedded medium to coarse grained sand. In relatively fresh outcrop, it is light yellow-brown streaked with darker reddish brown along the planes of bedding and cross-lamination, but in some test holes, parts of the formation were light gray. In the lower half of the formation are a few lenses of argillaceous sand or sandy clay, and locally the lower 15 or 20 feet contains small rounded clay pebbles, in some places so concentrated as to form a sandy-clay conglomerate. The following section, in which the entire thickness is exposed, is characteristic (See also section at Mt. Barton).

SECTION ALONG U.S. 80 HIGHWAY 3.5 MILES WEST OF JUNCTION WITH MISSISSIPPI 19 HIGHWAY, MERIDIAN — SW.1/4, SEC. 20, T.6 N., R.15 E.

	Feet	Feet
Claiborne series		115.2
Tallahatta formation		15.2
14. Claystone, badly broken and weathered light gray; stained with limonite along bedding and joint planes; well indurated	3.5	
13. Claystone in alternating soft and hard beds; thinly bedded greenish gray, stained with limonite along bedding and joint planes	3.5	
12. Sandstone, coarse grained, grit-bearing friable, reddish brown; mottled with gray	2.0	
11. Claystone, glauconitic light greenish gray soft; contains thin lenses and rounded masses of coarse brown grit-bearing sand, concentration of such lenses up to 0.6 foot in thickness along the base; rather irregular lower contact	1.2	
10. Sand, greenish gray glauconitic; grades downward into fairly pure white sand; contains numerous thin beds of light gray siltstone; limonite stains, concretions, and nodules are abundant throughout the bed; lower part contains thin partings of glauconitic siltstone	5.0	
Disconformity, marked by sharp change in lithology, by thin limonite concentration, and by borings in lower bed		
Meridian formation		100.0
9. Sand, white unconsolidated fine grained cross-bedded; marked with leopard-like mottlings of limonite stains, partly cemented areas, nodules and pipes of limonite (fucoidal markings); grades downward without distinct contact into underlying bed. From 2.0 to	7.0	
8. Sand, medium grained, grit-bearing light brownish yellow; interlaminated with brown; beds 0.6 foot to 3.6 feet thick; highly cross-bedded; brown limonite stains concentrated along planes of cross-lamination and bedding. From 23.0 to	28.0	
7. Covered interval	14.0	
6. Sand similar to bed 8, but non-grit-bearing and more iron stained; near the center is a zone 1.0 foot to 3.0 feet in thickness containing considerable light gray clayey material interlaminated with light gray and brown sand; apparently lenticular; lower part contains a few rounded clay fragments. In a highway cut about 100 yards away, what appears to be the lower 18 or 20 feet of this bed is grit-bearing, and has many small clay pebbles concentrated along planes of cross-lamination, giving the appearance of a basal conglomerate	28.0	

5. Covered or slumped (?). This interval is represented in roadside cuts by fine reddish brown sand which is slightly grit-bearing and cross-bedded. Some of this material seems to be in place. The lower contact is very irregular and distinctly unconformable. At some places (the highest outcrop of the underlying bed) the lower 2.0 feet of sand contains large irregular fragments of light gray clay. At or near the contact the sand has been well cemented by concentration of limonite. This sand apparently truncates the underlying bed. From 15.0 to	23.0	
Wilcox series		8.0
Hatchitigbee formation		8.0
4. Clay, light gray to white slightly silty plastic; the upper contact forms a spring horizon	0.5	
3. Lignite, highly argillaceous; grading down to clay	0.5	
2. Clay-shale, black highly lignitic; becoming less lignitic near the base	3.0	
1. Clay, dark blue-gray lignitic laminated; weathers to light gray	4.0	

TALLAHATTA FORMATION

The Tallahatta formation derives its name from typical exposures in the hills bordering Tallahatta Creek (locally known as the Tallahatta Hills) in Choctaw County, Alabama. The name was suggested by Dr. E. A. Smith to Dr. W. H. Dall in 1897 to replace the older descriptive terms, "Buhrstone" and "Siliceous Claiborne."[38]

The unconformable contact with the Meridian formation, described above, has been traced by the writer from the Alabama line in northeastern Clarke County to a point about 3 miles west of Philadelphia in Neshoba County, and the contact, showing similar characteristics, has been described by Mellen in southwestern Winston County.[39] Throughout this extent it retains an almost identical character. Northwest of Winston County the contact has not yet been studied in detail. The writer and Mellen, working independently in widely separated parts of the State, have concluded that the Tallahatta is also separated from the overlying Winona by a wide-spread unconformity.

Although the upper contact is covered or poorly exposed in most places, due to the unconsolidated character of the Kosciusko (?) sand which caps the hills on the back slope of the Tallahatta cuesta, excellent exposures are to be found in the new cuts along Highways U. S. 80, U. S. 11, and U. S. 45 in southwestern Lauderdale County and along several local roads which have recently been repaired and widened. Similar road cuts have been studied in a few scattered localities of Neshoba County. Wherever the upper contact has been seen in fresh exposures the transition from claystone to glauconitic or highly ferruginous clay and marl is sharp; the claystone at the contact shows many smooth minor irregularities as though it had been subjected to weathering and erosion, and over distances of a hundred feet or more some of the upper layers of the claystone are truncated by the overlying ferruginous or glauconitic sands and clays. In many places an apparent rounding and widening of the joints in the claystone was noted, permitting the overlying materials to fill in the upper

Figure 17.—Tallahatta claystone in cut along Southern Railroad, 1.0 mile north of Basic Station. October 17, 1938.

two or three inches of the joint; and in one locality, near the Lauderdale-Clarke County line on U. S. 11 Highway (W.1/2, Sec. 33, T.5 N., R.15 E.), the upper bed of the Tallahatta appears as flat nodule-like masses, a foot or more thick and 5 to 10 feet long, separated by Winona sediments.

There seems to be some variation in thickness of the formation, possibly due to a pre-Winona erosion epoch, but the magnitude could not be determined with any degree of accuracy, due to the large amount of slumping and colluvial deposits from the overlying loose sand. In several places where the exposed contact seemed to show no slumping, however, test holes drilled within 200 feet of the outcrop encountered the claystone at elevations 10 or 15 feet higher or lower than in the road cut, and the total thickness of the formation, measured in scattered parts of the county, varied as much as 25 or 30 feet.

The formation is typically composed of a soft silicious siltstone of low specific gravity. It is rather evenly bedded in layers from an inch or less to 2 feet or more thick, the more thickly bedded material being more uniformly fine grained and more abundant in the upper half of the formation. It is commonly exposed in bluffs and very steep hill

Figure 18.—Tallahatta claystone, a closer view of the Southern Railroad cut. October 17, 1938.

slopes along the belt of outcrop, and where so exposed the individual beds are jointed and block-like, the subconchoidal fracture being one of the striking features. In fresh cuts, however, the material is more earthy or chalk-like and the subconchoidal fracture is not so well developed.

Throughout the formation there are branching and interlacing root-like markings as much as an inch or more in diameter, which may be algal markings, or borings of worms or molluscs. Near the upper and lower contacts these fucoid-like markings are especially striking, since they are composed of sandy material, commonly glauconitic, and in many localities are cemented to a quartzitic sandstone.

They are in part responsible for the Buhrstone character of some beds. In the upper few feet, the formation is locally composed of sharp irregular fragments of dense claystone imbedded in a matrix of hard quartzitic sandstone. In some localities, also, the upper beds show an irregular cementation to a dense, hard quartzite. Such is true in the railroad cut at Basic (NE.1/4, NW.1/4, Sec. 4, T.4 N., R.15 E.), Clarke County, Mississippi, where a local zone about 20 feet thick has been cemented to a hard glassy quartzite.

The following sections illustrate the character of the formation (See also section at Mt. Barton).

SECTION ALONG U. S. 11 HIGHWAY, 1.3 MILES EAST OF GRAHAM — NE.1/4, SE.1/4, SEC. 23, T.6 N., R.14 E.

	Feet	Feet
Tallahatta formation		94.8
7. Claystone, light gray; alternating beds of evenly bedded block-like hard claystone of low density, and softer shaly greenish gray glauconitic claystone, containing irregular beds and nodule-like masses of more highly indurated claystone. Some parts of this member are sandy and some parts are highly cemented to a fine-grained quartzitic sandstone. The shaly, less consolidated material becomes more prominent near the base	78.0	
6. Claystone, hard, dense; containing scattered sand grains and irregular patches of sand, which have been cemented into a hard quartzite; lower contact is very irregular and nodular in appearance. From 1.0	2.0	
5. Sand, light greenish gray glauconitic, highly argillaceous; somewhat shaly in appearance; contains numerous nodular and lens-like masses of more highly cemented claystone and quartzite	8.5	
4. Sandstone, light gray speckled coarse grained well-cemented; in some places having a quartzitic appearance; contains irregular masses of dense hard claystone	1.0	
3. Sand, argillaceous; containing nodular masses of coarse well-cemented sandstone. From 1.0	1.3	
2. Silt, light greenish gray glauconitic; contains considerable fine sand, appears to be poorly consolidated claystone	4.0	
Disconformity		
Meridian formation		28.0
1. Sand, white, unconsolidated fine grained cross-bedded; irregularly mottled with limonite stains and with partly cemented nodules and pipes of limonite (fucoidal markings); grades downward within a few feet into highly cross-bedded brown and yellow sand	28.0	

SECTION ALONG U. S. 11 HIGHWAY, 0.8 MILE NORTH OF LAUDERDALE-CLARKE COUNTY LINE — SW.1/4, SEC. 33, T.5 N., R.15 E.

	Feet	Feet
Winona formation		9.0
9. Sand, indian-red. From 4.0 to	5.0	
8. Clay, light greenish gray; weathered shaly appearance; less weathered portion similar to soft unindurated claystone	4.0	
Disconformity		
Tallahatta formation		74.1
7. Sandstone, highly argillaceous well cemented; contains abundant fragments of dense claystone and irregular nodular branching masses similar to those found in the claystone	2.0	
6. Claystone, light gray; alternating beds of evenly bedded block-like hard claystone of low density and softer shaly gray glauconitic claystone containing irregular beds and nodular masses of more highly indurated claystone. Some parts of this member are sandy and some parts are highly cemented to a fine-grained quartzitic sandstone. Contains several 1.0 to 2.0-foot ledges of hard glauconitic, quartzitic sandstone including angular fragments of dense claystone. Some parts of these ledges are more highly cemented than others, and in places the matrix of sand seems to grade into the claystone	60.5	
5. Sandstone, quartzitic coarse glauconitic; contains patches of dense gray claystone. In places the sand matrix appears to penetrate and grade into the claystone	0.8	
4. Sand and claystone intermixed, greenish gray glauconitic; contains irregular nodular lenses of more highly cemented sand and claystone	4.5	
3. Sandstone, light gray speckled coarse grained; well cemented in some places giving a quartzitic character and an irregular nodular appearance	0.8	
2. Claystone, sandy soft, unindurated glauconitic gray speckled	5.5	
Disconformity		
Meridian formation		
1. Sand, reddish brown cross-bedded	3.0	

Although the Tallahatta formation is sparingly fossiliferous throughout, no extensive collections have been made, due to the difficulty of getting the casts of the small pelecypods and gastropods from the claystone without destroying them. Lowe lists the following species from two localities in Lauderdale County.[40]

Station 6489. Tallahatta formation, Dunns Mill—SE.1/4, SW.1/4, Sec. 36, T.5 R., R.14 E.

Leda cf. L. tysoni Clark and Martin

Leda n. sp.?

Venericardia sp.

(C. Wythe Cooke, collector)

Station 6491. Tallahatta formation, a tunnel on Alabama and Vicksburg Railroad 1.5 miles west of Lost Gap Station and 8.5 miles west of Meridian, Mississippi—NE.1/4, SW.1/4, Sec. 24, T.6 N., R.14 E.

Leda cf. L. potamacensis Clark and Martin

Corbula sp.

Venericardia planacosta (Lamarck)

LISBON FORMATION—GENERAL

In 1886 Aldrich[41] used the term "Lisbon horizon" rather loosely to designate the marly beds immediately overlying the "Buhrstone" (Tallahatta) at Lisbon Bluff on the Alabama River, Clarke County. Alabama. The term was also used to designate similar beds in other localities which he correlated with the Lisbon Bluff section. In succeeding years "Lisbon beds" was used by a number of authors to designate the basal part of the Claiborne (including the "Buhrstone"), and it was not until 1907 that Smith applied the name Lisbon to the entire formation overlying the Tallahatta, the usage now generally accepted[42].

In Mississippi the Lisbon formation is composed of sand, sandstone, greensand marl, and silty or clayey marl. It overlies the Tallahatta unconformably and underlies the Yegua lignitic clays and sands without perceptible break.

The accepted classification of the Lisbon formation is:

	Feet
Unnamed silty marl (Wautubbee of some reports), from 100 to	120
Kosciusko sand, locally cemented to sandstone and quartzite, from 25 to	400
Winona greensand marl, from 45 to	350

There has recently been some question about this classification, however, and additional field work throughout the belt of outcrop will probably lead to revision. In an unpublished manuscript in course of preparation at the time of his death, Lowe describes an unconformity at the top of the Winona, for which he proposes formational rank, and another at the top of the Kosciusko member in Clarke County. Recently Mellen[43] has reported a wide-spread unconformity within what has been called the Kosciusko. The writer has examined two fresh road cuts in Clarke County (Highway U. S. 11, 3 miles south of Enterprise, and Highway U. S. 45, about 6 miles north of Quitman), in each there appears to be an erosional disconformity between the loose reddish and white sands below and the silty marls above. Furthermore, wherever the contact between the loose red or white sand and the greensand marl was observed, there was a sharp irregular contact. Due to the large amount of slumping and colluvial action on the loose sands, however, it has been impossible to determine definitely whether or not the undisturbed contact was seen. It is probably significant, however, that in all but a few localities the Kosciusko sand lies directly on the Tallahatta, the Winona being either covered by colluvium from the overlying sand, or absent.

Since the upper member of the Lisbon is not present in Lauderdale County and hence was not studied in detail, and since the generally poor exposures of the Winona in Lauderdale and adjacent counties render a description of the contact doubtful, it remains for additional work in other parts of the State to determine the true relationship of these beds. For the purpose of this report, therefore, the current usage of the Mississippi Geological Survey and the U. S. Geological Survey is being followed in the classification of the Lisbon.

LISBON FORMATION—WINONA MEMBER

The basal member of the Lisbon formation consists of coarse to fine grained glauconitic sand and sandy marl interbedded with some clay and clayey marl. In adjacent counties, exposures may be found showing a gradation upward to brown or brownish gray clay and clay-shale which is glauconitic and contains thin interbedded lenses of glauconitic sand. From exposures along the Zilpha River in Attala County, this part of the member has been callel the Zilpha by Raymond Moore[44], formerly of the Arkansas Fuel Oil Company. Sections showing the Zilpha are to be seen along the old Meridian-Enterprise highway, 1.5 miles south of Basic, and along U. S. 11 Highway, about 1.3 miles south of the Lauderdale County line, both cuts being in northern Clarke County. The clay was cut by U. S. 80 Highway, about 3.5 miles west of Chunky, Newton County, but not the underlying greensand. In only one outcrop in Lauderdale County has the Zilpha part of the member been observed (U. S. 80 Highway, 2.5 miles southwest of Graham), and its absence in the road cuts and gullies may be indicative of an unconformity.

The greensand marl weathers to a highly ferruginous indian-red color, and concentrations of limonite, which form a major constituent of the bed, are characteristic of the weathered outcrops.

The following section is descriptive of its typical outcrop and shows the greatest thickness observed in the county (See test hole 261).

SECTION ALONG U. S. 80 HIGHWAY, 2.5 MILES SOUTHWEST OF GRAHAM STATION—NW.1/4, SE.1/4, SEC. 29, T.6 N., R.14 E.

	Feet	Feet
Lisbon formation		36.5
Winona member		36.5
5. Clay-shale, light gray; contains a little fine sand along joint and bedding planes; lower 3.0 feet contains a considerable concentration of limonite and appears to be somewhat glauconitic	7.5	
4. Marl, indian red highly fossiliferous grit-bearing; in places highly glauconitic, weathering to limonite, as nodular concretions, irregular partings and replacement material. Several thin irregular beds are cemented to a shell marl. Fossils, although poorly preserved, closely resemble those found in the marl bed at Enterprise (Only pelecypods recognizable)	24.5	
3. Clay, silty light gray glauconitic fossiliferous; weathers to a shaly appearance	4.5	
Tallahatta formation		88.0
2. Sandstone, highly argillaceous well-cemented; contains abundant fragments of dense claystone and many irregular nodular branching masses similar to those found in the claystone below	2.0	
1. Claystone, light gray alternating beds of evenly bedded block-like hard claystone of low density, and softer shaly greenish gray glauconitic claystone that contains irregular beds and nodular masses of more highly indurated claystone. Some parts of this member are sandy, and some parts are cemented to a fine grained quartzitic sandstone which includes angular fragments of dense claystone. Some parts of these ledges are more highly cemented than others, and in places the matrix of sand seems to grade into the claystone	86.0	

At Dunns Fall in the southwest corner of the county (SE.1/4, SW.1/4, Sec. 36, T.5 N., R.14 E.) a less weathered part of the Winona is exposed in contact with the Tallahatta.

Figure 19.—Waterfall over the Tallahatta claystone at Dunns Mill—a small artificially diverted tributary of Chunky Creek—4 miles northwest of Enterprise (SE.1/4, SW.1/4, Sec. 36, T.5 N., R.14 E.). March 11, 1939.

SECTION OF BLUFF AND ROAD CUT AT DUNNS FALL, ON CHUNKY CREEK, 4.0 MILES NORTHWEST OF ENTERPRISE—SE.1/4, SW.1/4, SEC. 36, T.5 N., R.14 E.

	Feet	Feet
Lisbon formation		77.0
Kosciusko member		50.0
7. Sand, loose red cross-bedded. From 40.0 to	50.0	
Disconformity, (?) marked by irregular contact		
Winona member		22.0
6. Sand and clay, interbedded red glauconitic (?). From feather edge to	4.0	
5. Sand, highly ferruginous, glauconitic, marly highly fossiliferous; grades downward into less weathered material below. From 4.0 to	6.0	
4. Greensand marl, highly fossiliferous; locally indurated to sandstone. From 3.0 to	4.0	

Figure 20.—Another view of Dunns Fall. March 11, 1939.

3. Sandstone, marly, glauconitic highly fossiliferous (Scutella bed)	5.0	
2. Clay, glauconitic, somewhat sandy, sparingly fossiliferous poorly exposed. From 2.0 to	3.0	
Disconformity, poorly exposed and partly covered by slump		
Tallahatta formation		67.0
1. Claystone, sparingly fossiliferous; slightly glauconitic in upper part.	67.0	

The member is highly fossiliferous throughout, but in most localities it is so highly weathered that only unidentifiable fragments can be secured. At Dunns Fall in Southwestern Lauderdale County, however, and at several localities near Enterprise, Clarke County, Mississippi, relatively unweathered material is exposed. Lowe and Cooke made extensive collections from these localities and Lowe lists the following species, identified by Cooke[45].

Station 346. In contact with "Tubba Buhrstone" of Hilgard, Enterprise, Mississippi

Crab
Ostrea sellaeformis var. divaricata Lea
Pecten sp.
Protocardia sp.
Venericardia rotunda Lea
(Frank Burns, collector)

Station 2138. Moores Iron Mine, Chickasawhay River, near Enterprise, Mississippi

Turris sp.
Olivella cf. mediavia Harris
Pseudoliva vetusta (Conrad)
Papillina dumosa var. trapaquara Harris?
Cypraea smithi Aldrich?
Leda? sp.
Ostrea sellaeformis var. divaricata Lea
Pecten clarkeanus Aldrich?
Teredo sp.
Crassatellites trapaquara (Harris?)
Venericardia rotunda Lea
(L. C. Johnson, collector, 1888)

Station 2629. In the banks of the Chickasawhay River at Enterprise, Mississippi. Heavy bed of "greensand," hard at the top, containing great numbers of Scutella

Crab
Scutella mississippiensis Twitchell
Calyptraphorus? sp.
Ostrea sellaeformis var. divaricata Lea
Pecten sp.
Protocardia sp.
Venericardia rotunda Lea?
V. planicosta Lamarck?
(Frank Burns, collector, 1894)

Station 130. Spillmans clam bed at the Cemetery Creek bridge on the New Orleans and Northeastern Railroad, Enterprise, Mississippi

Scutella mississippiensis Twitchell
Calyptraphorus? sp.
Ficus? sp.
Glycymeris staminea (Conrad)
Ostrea sellaeformis var. divaricata Lea
Anomia ephippoides Gabb
Pecten sp.
P. (Pseudamusium) scintillatus Conrad
Protocardia sp.
Tellina? sp.
Venericardia rotunda Lea
Crassatellites trapaquara (Harris)?
(L. C. Johnson, collector)

Station 116. "Radiate banks," Cemetery Branch, Enterprise, Clarke County, Mississippi

Scutella mississippiensis Twitchell
Ostrea sellaeformis var. divaricata Lea
Pecten (Pseudamusium) scintillatus Conrad
Protocardia sp.
(L. C. Johnson, collector)

Station 129. Cemetery Creek, west of Enterprise, Clarke County, Mississippi

Scutella mississippiensis Twitchell	V. rotunda Lea
Ostrea sellaeformis var. divaricata Lea	Crassatellites sp.
Protocardia sp.	(L. C. Johnson, collector)
Venericardia planicosta Lamarck	

Station (C-37-12) 6487. (Lower Claiborne) Eocene: "Scutella bed," East bank of the Chickasawhay River, about one-half mile below Enterprise, Clarke County, Mississippi

Scutella mississippiensis Twitchell	O. johnsoni (Aldrich)
Crab	Pecten scintillatus Conrad
Shark tooth	P. johnsoni Clark
Pseudoliva vetusta (Conrad)?	P. dalli Clark?
Calyptraphorus velatus (Conrad)?	P. sp.
Turritella sp.	Modiolus sp.
Ostrea sellaeformis var. divaricata Lea	Protocardia sp.
Venericardia planicosta Lamarck	Crassatellites trapaquara (Harris)?
V. rotunda Lea	(E. N. Lowe and C. Wythe Cooke, collectors, Oct. 23, 1912)

Station 6488. Eocene (Claiborne) above "Scutella-bearing bed," Dunns Mill, on Chunky Creek, just north of the Clarke-Lauderdale County line and 3 or 4 miles north of Enterprise, Mississippi

Natica sp.	Ostrea sellaeformis var. divaricata Lea
Calyptraea sp.	Tellina sp.
Glycymeris sp.	Venericardia sp.
Pecten clarkeanus Aldrich?	Crassatellites sp.
Pecten sp.	(E. N. Lowe and C. Wythe Cooke, collectors, Oct. 25, 1912)

Station 6486. Pebbly glauconitic marl, just above "scutella-bearing bed," Enterprise, Mississippi; on Cemetery Branch, 200 yards below the New Orleans and Northeastern Railroad bridge.

Olivula? sp.	Protocardia sp.
Ficus (Fusoficula) penitus (Conrad)	Diplodonta? sp.
Cassis (Phalium) globosum Dall?	Venericardia rotunda Lea
Natica sp.	Crassatellites trapaquara (Harris)
Limopsis aviculoides (Conrad)	Astarte 2 sp.
Ostrea sellaeformis var. divaricata Lea	(C. Wythe Cooke, collector)
Pecten (Pseudamusium) scintillatus Conrad	

Station 6485. Above "scutella-bearing bed," from creek bank at "Graveyard Bridge" near cemetery at Enterprise, Clarke County, Mississippi

Crab
Plejona? sp.
Cassis sp.
Ficus (Fusoficula) penitus (Conrad)
Teredo sp.
Protocardia sp.
Phacoides? sp.
Venericardia rotunda Lea
Solariella cancellata (Lea)
Ostrea sellaeformis var. divaricata Lea
Pecten cf. wilcoxii Dall
Pecten (Pseudamusium) scintillatus Conrad
Crassatellites trapaquara (Harris)
Astarte sp.
(E. N. Lowe and C. Wythe Cooke, collectors, Oct. 23, 1912)

LISBON FORMATION—KOSCIUSKO (?) MEMBER

A thick bed of red or light yellow-brown sand overlies the Winona member in Lauderdale and adjacent counties. In the southwestern part of the county it is badly gullied and stands in vertical bluffs 50 feet or more high. In the east bluff of Chunky Creek, 2 miles northeast of Wanita Lake, 123 feet of this sand was measured between its lower contact and the top of the hill at the road forks (NE.1/4, SE.1/4, Sec. 22, T.5 N., R.14 E.). However, at this locality the exposed thickness of the Winona is only about 15 feet and there has obviously been some slumping of the overlying sand. It is probable, therefore, that the thickness of the sand at this point is not more than 90 or 100 feet.

Lowe and others have considered this sand to be Pliocene (?). However, the present survey has shown that it can be traced into outcrops which are overlain by typical Lisbon marl (4 miles south of Enterprise on U. S. 11 Highway and about 6 miles north of Quitman on U. S. 45 Highway), and should, therefore, be correlated with the "Decatur sand" of early Mississippi reports. Since the name Decatur was preoccupied, Cooke, in 1925, suggested it be known as the Kosciusko sand member[46], from typical exposures in the vicinity of Kosciusko, Attala County. At the type locality, however, Cooke described the member as consisting of ledges of saccharoidal to quartzitic sandstone, which he correlated with the unconsolidated red sand in the same position elsewhere in the State. As pointed out above, the recent work of Mellen seems to show that an unconformity exists at the top of the typical Kosciusko as described in the type locality, and that the loose red and white fairly coarse grained sands, so common at this stratigraphic position throughout the State, lie above that unconformity. This could not be confirmed in Lauderdale and adjacent counties, since the typical Kosciusko is not present, the entire section between the Winona sand member and the upper marls being occupied by loose red cross-bedded sand. It remains, therefore, for future field work to prove the stratigraphic relations of the various members of the Lisbon in Mississippi.

STRUCTURAL GEOLOGY

GENERAL

The formations of the county crop out in slightly concentric belts, the general trend of which is from northwest to southeast. The regional dip is between 25 and 30 feet a mile toward the southwest, but is more south-southwest in the eastern part of the county. This dip appears to have been original with the deposition of the beds and the slight arc, or swing toward the south, is probably due to the position of the area at the mouth of the Mississippi embayment; that is, to the original configuration of the coast line, rather than to later diastrophism.

The regional dip, however, is interrupted in many places by minor flexures and faults; many of which, no doubt, were produced by the normal settling and compaction of the sediments subsequent to their deposition; and others of which are due to recent slumping of the strata along steep hillsides. Excellent examples of minor structures, which may be due to one of these processes, are to be seen in the fresh highway cuts along U. S. 45 between the Lauderdale-Kemper line and Blackwater Creek, 4 miles north of the county line (Figure 5). Similar types are to be found throughout the area underlain by the unconsolidated Wilcox sediments. Such structures are probably important only in demonstrating the highly incompetent character of the beds, but it should be borne in mind that such minor features may be associated with larger, more important structures; they may be one of the surface expressions of such structures. In areas where they are especially abundant, therefore, they deserve special study with a view of determining whether or nor there are other evidences of a major structure. Three such structural areas were studied in detail in the present survey.

ALAMUCHA STRUCTURE

Because of its apparent magnitude and because of the current wide-spread interest in the search for possible oil producing structures within the state, one of these areas, lying between Toomsuba and Kewanee on the north and the southeastern corner of the county on the south, was described in a preliminary press release.

MISSISSIPPI STATE GEOLOGICAL SURVEY
University, Mississippi

MEMORANDUM FOR THE PRESS

FOR RELEASE ON
DECEMBER 4, 1939

The Alamucha Structure

A structural area of a type favorable for the accumulation of oil and gas has been discovered in southeastern Lauderdale County, Mississippi, and adjacent parts of Alabama by Vellora Meek Foster, supervising geologist of the WPA-Mississippi State Geological Survey, while making a Mineral Survey of Lauderdale County—that part of a project in which the Meridian Chamber of Commerce and the Mississippi State Planning Commission acted as co-sponsors.

Along the southeast strike from a highway cut 1.7 miles east of Russell to a point 2.5 miles east of Whynot, the Bashi glauconitic sand lies at elevations of approximately 480 to 500 feet above sea level (No. 1 on map, lower member, 480 feet NW.1/4, NW.1/4, Sec. 33, T.7 N., R.17 E.; No. 2, upper member, 480 feet, NE.1/4, NW.1/4, Sec. 3; No. 3, upper member, 478 feet, SW.1/4, SE.1/4, Sec. 3; No. 4, greensand marl member, 473 feet, NE.1/4, SE.1/4, Sec. 22, T.6 N., R.17 E.; No. 5, lower member, 480 feet, SW.1/4, SW.1/4, Sec. 33, T.6 N., R.18 E.; No. 6, greensand marl member, 480 feet, SE.1/4, SW.1/4, Sec. 10, T.5 N., R.18 E.). The outcrops in this belt are among the highest exposures of the Bashi to be found in Lauderdale County, where the regional dip is toward the southwest. In the northern third of this belt, the beds appear to have the normal regional southwest dip of 20 feet per mile. In the remainder of the belt, however, the dip becomes progressively steeper. Two miles northeast of Vimville (No. 4), the marl member crops out at 473 feet, whereas in a test hole (No. 222) 0.8 mile due east, it was encountered at an elevation of 512 feet, showing an apparent dip of 48 feet per mile toward the west (actual dip probably greater toward the southwest). As stated above, the greensand marl 2.5 miles east of Whynot (No. 6) has an elevation of 480 feet. In road cut on State Highway No. 19, 1.5 miles to the south, however, its elevation is 454 feet (No. 7, NW.1/4, NW.1/4, Sec. 22, T.5 N., R.18 E.), and 1.7 miles still farther south it is only 367 feet (No. 8, NE. 1/4, NW.1/4, Sec. 34, T.5 N., R.18 E.). Thus, over a distance of approximately 3.2 miles the apparent dip toward the south increases from about 20 feet per mile to more than 45 feet per mile. The actual dip appears to be even greater toward the south southwest.

In the hills to the north and east of this line of outcrops, the full thickness of the upper Holly Springs is exposed, and the major valleys cut into the lower Holly Springs member. Further east, in Alabama, the Bashi greensand marl is again encountered in outcrops at Yantley Station (No. 9), a mile north of the station (No. 10), near the Alamucha Creek-State line intersection (No. 12), two miles southwest of Cuba (No. 13), and at U. S. Highway 80—State line intersection (No. 14), where it lies at elevations ranging from 300 feet at No. 9 to 234 feet at No. 13—much lower than those in Lauderdale County. These elevations range from 200 feet to 450 feet lower than would be expected on the basis of the regional dip. Furthermore, on this easternmost side of the area, the upper Holly Springs is not exposed, suggesting a faulted structure with the downthrow on the east (A and B).

In the south wall of Salem Creek Valley (NE.1/4, Sec. 7, T.6 N., R.18 E.), 2.5 miles south of Toomsuba, the lower 60 or 70 feet of the upper Holly Springs beds are well exposed. The dip of these beds seems to follow the south slope of the hill to a point (SE.1/4, SW.1/4, Sec. 17, T.6 N., R.17 E.), 4.5 miles southeast of Toomsuba. In the hills to the west and south of the last named point

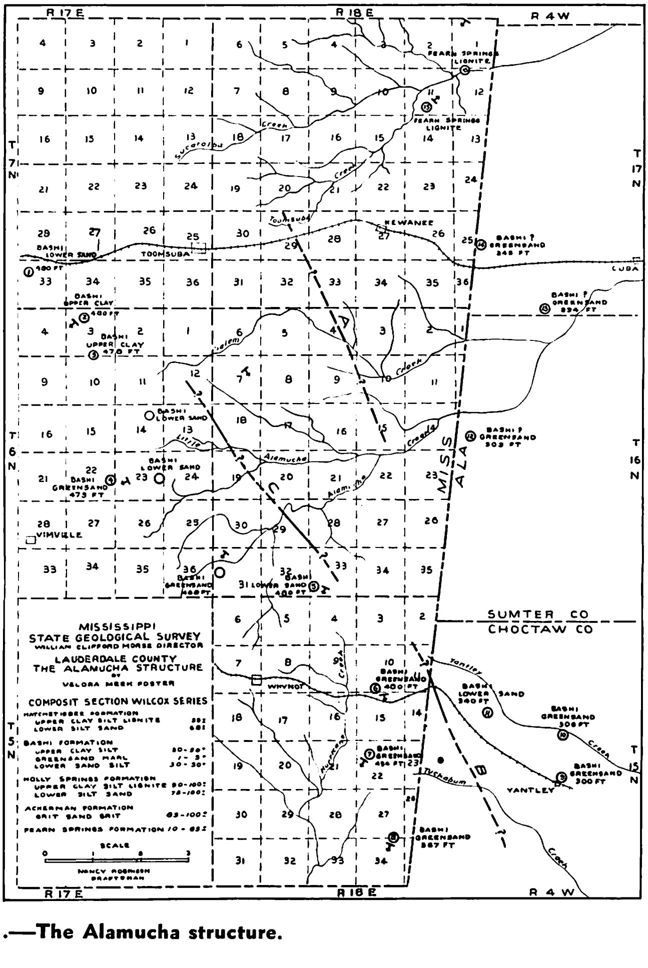


Figure 21.—The Alamucha structure.

(Sec. 17), however, there is a repetition of beds, the entire thickness of the upper part of the Holly Springs and some of the lower being well exposed. This repetition of beds also suggests a fault with the downthrow on the east (C).

A bed of lignite, associated with typical Fearn Springs sand and clay, crops out in the valley wall of Toomsuba Creek (No. 15, Sec. 11, T.7 N., R.18 E.), 2.5 miles north-northeast of Kewanee. The same lignite, 1.3 miles still farther to the northeast (No. 16, Sec. 12), lies in the bed of the creek at an elevation at least 25 feet lower, thus showing a reverse dip toward the northeast. Along the northern edge of the area under consideration the beds apparently retain the normal regional dip toward the south-southwest.

Between the outcrops of Fearn Springs northeast of Kewanee (No. 15 and No. 16) and of the Bashi greensand at the State line (No. 14), two miles east of Kewanee, the Holly Springs is missing, only the red grit-bearing sand of probable lower Ackerman age being exposed in the hillslopes. This condition may be explained either by a fault striking west northwest—east southeast with the downthrow toward the south, or by an overlap of the Holly Springs by the Bashi.

It is believed, therefore, that the area between Russell and Kewanee on the north and the Lauderdale-Clarke County line on the south, and particularly that part of it constituting the belt of high lying Bashi beds (No. 1 to No. 8) should be further explored, by more detailed surface surveys and by geophysical methods, to determine whether or not the subsurface structure is such as to warrant the drilling of one or more commercial test wells.

This Alamucha Structure was checked by Assistant State Geologist Frederic Francis Mellen, who discovered the Tinsley Dome, and Assistant Geologist Harlan Richard Bergquist, an especially well-trained man in both macro- and micro-paleontology, in sedimentary petrography, and in oil geology, both of whom agree with the conclusion of Mr. Foster. All elevations were determined with the barometer, and should be more accurately established by an instrumental survey.

Because of the great expense involved in oil and gas exploration and especially in deep drilling tests, this press notice is being released by William Clifford Morse, State Geologist, only on the condition that the article be accepted in its entirety.

Since one of the bases for describing a structure in this area is the proposed correlation of marly glauconitic beds in Sumter and Choctaw Counties, Alabama, with similar beds in Mississippi, the latter known to be of Bashi age, it is well to bear in mind certain alternate considerations. Although no marine beds below the Bashi were found in outcrop in Lauderdale County, at least two glauconitic marls have been described in the Tuscahoma (Holly Springs) and one or more in the Nanafalia (Ackerman) of Sumter and Choctaw Counties; and these beds are said closely to resemble the marly glauconite of the Bashi. Similar marine beds in the Holly Springs and Ackerman formations are also reported from deep wells in Clarke County, within 20 or 30 miles of the area under consideration. It is entirely possible, therefore, that the beds studied in Alabama are incorrectly correlated with the Bashi of Mississippi. However, it should also be noted that if the normal regional dip and the known thicknesses of the formations are taken into consideration the beds in question crop out at elevations lower than would be expected even though they be considered Tuscahoma or Nanafalia in age. Therefore, regardless of the correlation, a structure is indicated by the position of beds as well as by the other evidences cited in the press release (abnormally high dips, reversal of dip, repetition of beds, etc.). From the evidence in hand it would seem that the dominant structure is anticlinal, modified by cross-faulting.

LAUDERDALE STRUCTURAL AREA

In the area east of the town of Lauderdale (T.8 N. and the northeastern part of T.7 N., R.18 E.), there are many minor evidences of structural disturbance (Figure 22). One of these, the reverse dip of the Fearn Springs lignite in the valley of Toomsuba Creek, 2.5 miles northeast of Kewanee, is mentioned in the description of the Alamucha Structure, and the various minor folds and faults described below may be local indications related to that major structure.

At least three small faults are exposed in this area, in two of which the basal bauxitic grit of the Fearn Springs on the upthrow side is slightly higher than the lignite on the downthrow, showing a vertical displacement of 50 feet or more. In the road cut at Elizabeth Church (NE.1/4, SW.1/4, Sec. 35, T.8 N., R.18 E.), there is a fault zone in which both the lignite and the basal grit are exposed at an elevation of 254 feet (Figure 23). About 500 yards west of the church (Test hole 16) and 600 yards southwest (Test hole 15), the lignite was encountered at elevations of 246 and 220 feet respectively, showing an abnormally steep dip toward the southwest. In several test holes 0.7 mile northwest of the church (NW.1/4, Sec. 34, T.8 N., R.18 E.), the elevations of the lignite, as determined by barometric traverse, indicate a small anticline trending in a general east-west direction (Test holes 1, 2, 6, 8, 10, and 13).

Toward the east, also, there are evidences of minor folding. A half mile east of the crossroads at the L. E. Cobb Store, the elevation of the lignite is 244 feet (Test hole 33), while about 0.4 mile farther east (SE.1/4, SW.1/4, Sec. 36, T.8 N., R.18 E.), the lignite crops out in the road cut, and was encountered in test hole 27 at an elevation of 200 feet, and at the state line (Test hole 28) at 210 feet. Thus for a distance of about a mile west of the L. E. Cobb Store, the lignite has a reverse (eastward) dip of 60 feet or more a mile, but, in the vicinity of the state line, it resumes the normal regional dip of 20 or 30 feet a mile toward the southwest.

A similar fault is exposed in the valley wall of Rutherford Branch (SW.1/4, SW.1/4, Sec. 23, T.8 N., R.18 E.), where the Fearn

Springs crops out in the road cuts 1.6 miles east of the observation tower. Near the residence of Mrs. Helen Wood the lignite was encountered at an elevation of 295 feet (Test hole 30) and 0.7 mile to the east the basal bauxitic grit crops out in the road side at an elevation of about 300 feet (Test hole 32). The average dip of this area seems

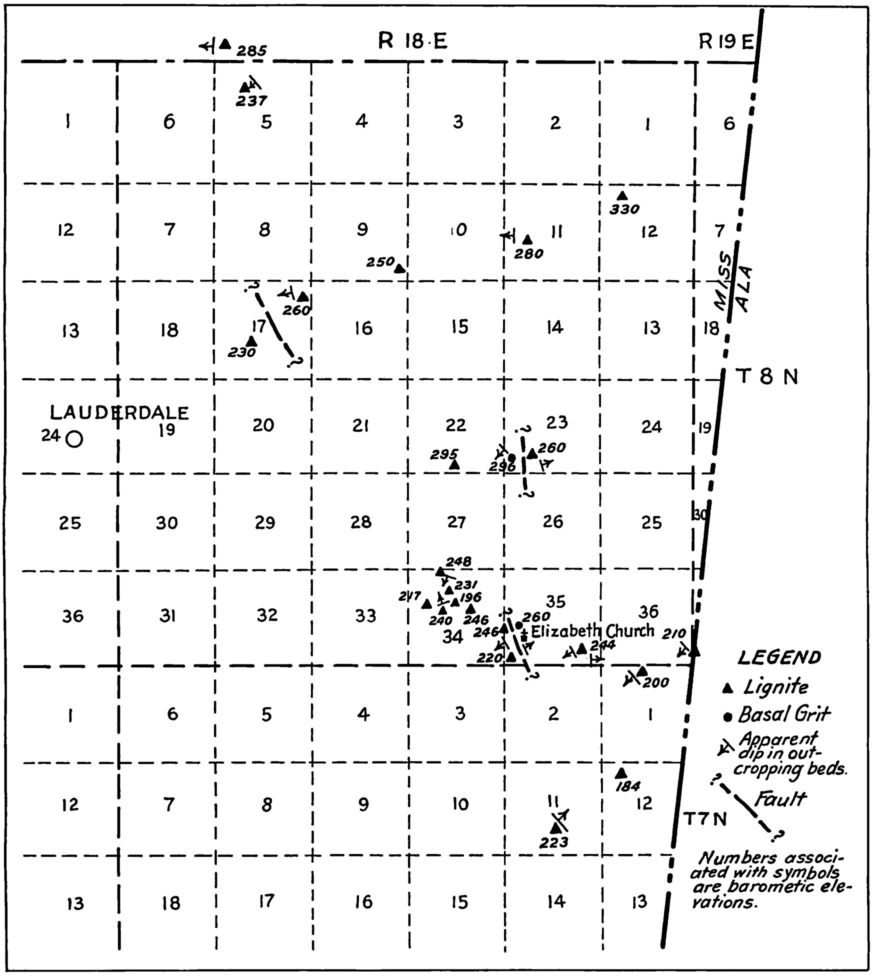


Figure 22.—The Lauderdale structural area.

to approximate the regional dip. In the last mentioned outcrop (SW. 1/4, SW.1/4, Sec. 23, T.8 N., R.18 E.), however, the beds have a slight reverse dip, and about 100 yards farther east the lignite crops out in the valley flat at an elevation of 269 feet (Test hole 34). There is little or no evidence of folding west of this fault. Toward the east, however, within 300 yards of the exposed lignite, the basal grit was encountered at 300 feet elevation (Test hole 35), and about 1.3 miles still father east (SW.1/4, SE.1/4, Sec. 24, T.8 N., R.18 E.) at an elevation of 372 feet (Test hole 42). The lignite is also exposed at about 300 feet in the road cuts near the Alabama line (SW.1/4, SW.1/4, Sec. 19, T.8 N., R.19 E.). Thus, between Rutherford Branch and the state line there is a small anticline with a closure of 50 feet or more.

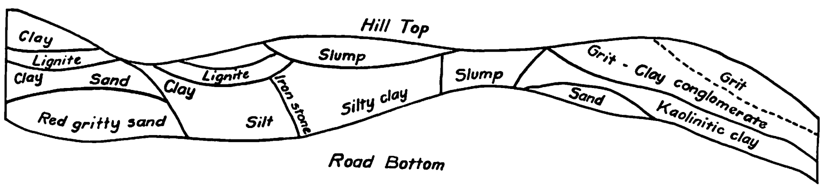


Figure 23.—Diagram of fault zone in road cut at Elizabeth church, 4.5 miles southeast of Lauderdale.

The third small fault is exposed in a road cut 2.5 miles northeast of Lauderdale (SW.1/4, NW.1/4, Sec. 17, T.8 N., R.18 E.). In the north valley wall of a tributary to Ponta Creek, the Fearn Springs clay which overlies the lignite is in contact with the basal Ackerman sand, and at one point is thrust over a part of that sand. The fault surface is sharp and distinct, but there is no means of determining the magnitude of displacement, since no key beds are exposed. As illustrated in the accompanying diagram (Figure 22), elevations of the lignite in this area show some evidence of minor folding.

LIZELIA STRUCTURAL AREA

The south wall of Ponta Creek valley between Lauderdale and Lizelia rises abruptly to the crest of the Holly Springs cuesta, forming an escarpment-like slope (extending across the southern part of T.8 N., R.16 W.). Almost the entire thickness of the Holly Springs formation is exposed in the road cuts and gulleys which descend the face of this escarpment. The typical lignite-bearing clays of the upper member form the crest at elevations of 500 feet or more, and dip regularly toward the southwest at a rate of about 30 feet a mile. The sands of the lower member are exposed in the lower slopes. Only a short distance to the north, in some localities less than 1.5 miles, similar lignitic clays are exposed in the bottom of the valley of Ponta Creek and in the lower slopes of both the north and south valley walls at elevations of 100 to 175 feet lower than in the cuesta proper. Furthermore, in several such exposures in the lower slope of the south valley wall considerable brecciation and distortion of the clay beds are striking features, which suggest faulting and repetition of beds (SE.1/4, Sec. 21, NE.1/4, Sec. 26, T.8 N., R.16 E.; and SW.1/4, Sec. 30, T.8 N., R.17 E.).

Further evidence of disturbance is the steep dip toward the northeast of the beds exposed in the highway cut 1.0 mile northwest of Lockhart (SW.1/4, SW.1/4, Sec. 29, T.8 N., R.17 E.).

In the vicinity of Lizelia and Ponta, the upper Holly Springs is exposed at an elevation of approximately 400 feet; and in the north valley wall, which rises gently toward the north, the lignite and clay of the upper Holly Springs formation are exposed throughout (SW. 1/4, NW.1/4, Sec. 7, T.8 N., R.17 W.; NE.1/4, NW.1/4, Sec. 12; NW. 1/4, NE.1/4, Sec. 17; SW.1/4, SW.1/4, Sec. 5; NW.1/4, NE.1/4, Sec. 6, T.8 N., R.16 E.). Thus the evidence at hand would seem to indicate a major fault, trending in a general east-west direction and extending from the vicinity of Lockhart (Sec. 29, T.8 N., R.17 E.) to a point several miles southwest of Lizelia (Sec. 20, T.8 N., R.16 E.). In the area northwest of Daleville, just north of the county line, faulting is also indicated by the steep scarp-like hills and by the repetition of beds.

Minor indications of structural disturbance are seen in the road cuts along the Lauderdale-Lizelia road where minor flexures alternately expose the upper clays and the lower Holly Springs sands.

STRUCTURAL INDICATIONS IN THE TALLAHATTA CLAYSTONE

The average regional dip of the strata which underlie the county is between 20 and 30 feet a mile toward the southwest. Due to the prevalence of crossbedding and the highly incompetent character of the beds which permits wide-spread slumping, it is often difficult to recognize local interruptions in the normal dip. In the outcrop area of the Tallahatta claystone, however, it is apparent that the regional dip it not as regular as would be supposed at first glance. In many exposures local steepening of the dip is evident; and a thorough study of the area would unquestionably reveal local reversals of dip.

About 2.8 miles southwest of Post, the Tallahatta is exposed in the road cuts of northeastern Newton County near Duffee, and dip southwest at a rate of 60 to 70 feet a mile. Just south of Post, however, (NW.1/4, NW.1/4, Sec. 20, T.8 N., R.14 E.) an outlier of Tallahatta caps a low hill at an elevation much lower than would be expected on the bases of such a dip. Furthermore, the beds of this outlier show no perceptible dip.

Beds having abnormally high dip toward the west (about 60 feet a mile) are also exposed along U. S. 90 Highway just east of the Chunky Creek bridge (Secs. 30 and 29, T.6 N., R.14 W.) where, within a distance of about 1.3 miles, the contact between the Tallahatta and the overlying Winona descends from near the crest of the ridge to a point near the base of the slope, showing a difference in elevation of almost 100 feet.

A similar steepening of the dip of the beds toward the south is noted on U. S. 11 Highway and in the cuts along the Southern Railroad north of Basic (Sec. 33, T.5 N., R.15 E.). In this locality, according to Lowe[45], the average dip is 35 feet a mile toward the south. The dip, however, is far from regular; in the northward facing hillslope, dips as great as 264 feet a mile may be measured, but within a few hundred feet they flatten to more normal inclinations, and in some places the beds appear to be nearly horizontal.

ECONOMIC GEOLOGY

OIL AND GAS

The first attempt to find oil or gas in Lauderdale County was in the eastern part in 1915 when the Meridian Oil and Gas Co. drilled the Knox Fee No. 1 well 2.5 miles west of Toomsuba (NE.1/4, SW.1/4, Sec. 27, T.7 N., R.17 E.). The well was abandoned at 2,378 feet. Subsequently three offset wells were drilled within an area of about 10 acres.

In 1920 and 1921 two wells were drilled in the western part of the county—Craig No. 1 by Baird Hughes Drilling Co., 3.0 miles southwest of Suqualena (SW.1/4, NW1/4, Sec. 28, T.7 N., R.14 E.), to a depth of 3,000 feet, and Middlebrook No. 1, by the Citizens Oil and Trust Co., 4.8 miles northwest of Meridian (SE.1/4, NE.1/4, Sec. 29, T.7 N., R.15 E.), to a depth of 3,288 feet. The driller's log of Craig No. 1 reveals a show of gas from near the middle of the Selma chalk, between 2,338 and 2,383 feet, and a show of oil from the lower part of the Eutaw sand at 2,815 feet.

There was no further activity in the county till early in 1928, when the Lauderdale Oil and Gas Co. began drilling the Gunn No. 1, 1.0 mile south of Topton (NE.1/4, NE.1/4, Sec. 13, T.7 N., R.16 E.). The well was abandoned at 3,487 feet and the driller's log revealed shows of gas from the top of the Midway (639 feet), base of the Midway (1,190 feet), and from the upper Eutaw (2,180 feet). Oil and gas shows were also reported from two beds in the Tuscaloosa (2,814 and 3,300 feet). The following year the same company drilled Lackey No. 1, 2.0 miles northwest of Topton (NW.1/4, NE.1/4, Sec. 2, T.7 N., R.16 E.), and reported shows of oil from several beds in the Tuscaloosa at depths between 2,814 and 3,373 feet. The well was abandoned at 3,434 feet.

In 1929 the Meridian Natural Gas Co. drilled Mattie Hauser No. 1, 3.0 miles southeast of the town of Lauderdale (SW.1/4, SW.1/4, Sec. 33, T.8 N., R.18 E.) to a depth of 2,410 feet. Shows of gas were reported from the basal Midway (657 feet), from several horizons in the Selma chalk (823 feet, 1,104 feet, 1,259 feet, and 1,445 feet), and from the Tuscaloosa (2,341 feet).

Although many of the older logs are difficult to interpret, and although some of them are, no doubt, inaccurate, the repeated references in them to shows of oil and gas are encouraging; and it would seem that suitable structures are deserving of adequate drilling tests.

LIGNITE

Within Lauderdale County are found eight persistent beds of lignite, one in the Fearn Springs formation, three in the Ackerman formation, three in the Holly Springs formation, and one in the Hatchitigbee formation, all of which are described in the stratigraphic section of the report. All are relatively thin and impure, and are unlikely to be of use as commercial fuel in the predictable future. In those few localities where the overburden is sufficiently thin to make possible the mining of the lignite, the beds are so highly weathered and the area so limited as to preclude their use, even as domestic fuel.

SAND

Sand suitable for structural use is abundant but confined to two formations, the basal Ackerman and the Meridian. The sands of the Bashi and Hatchitigbee formations are so highly argillaceous, and the Fearn Springs and Holly Springs sands are so highly micaceous as to render them all unfit for commercial use in structural concrete. The basal Ackerman is slightly argillaceous and in most localities somewhat micaceous, but may be used successfully. The upper 50 feet or more of the Meridian sand is even grained and pure, and throughout its outcrop it is suitable for structural use.

In the Fearn Springs formation the argillaceous sand associated with the pottery clay and underclay is rather plastic and may be of value as molding sand. However, no localities were found in which the characteristics are uniform over an area large enough to warrant commercial exploitation.

No sand was found in which the iron content was sufficiently low to permit its use in the manufacture of glass.

ROAD MATERIALS

The Tallahatta claystone should be satisfactory for light traffic roads when crushed and properly rolled. It is fairly even grained, slightly silty, and, when fresh, soft. In its crushed form, it compacts readily, hardens on exposure, and roads built on the outcrop do not become muddy when wet. It is recommended, therefore, that it be thoroughly tested as a road building material. Similar materials are now being used successfully elsewhere. It would seem, therefore, that the almost unlimited quantities of the Tallahatta claystone of Lauderdale County may be of commercial value.

CLAYS

One of the most important mineral resources of Lauderdale County is the clay of the northeastern area. The distribution of the various clay deposits, their stratigraphic relations, their thickness and extent, their lateral and vertical gradations, and the amount and character of their overburden have all been discussed under the section on stratigraphic geology; and the samples collected are listed and described in the "test hole records" which follow. Inasmuch as practically all the laboratory tests of the minerals of Lauderdale County are of clays, perhaps it will best serve the purpose of the survey to leave a fuller discussion of characteristics and potential utility to Ceramist McCutcheon under that part of the report devoted to "Tests." It may be helpful here, however, to summarize the available field information on some of the deposits, especially of the Fearn Springs formation, which are believed to be of the greatest economic value.

The largest and most important deposit of the Fearn Springs pottery clay and bond clay lies on the property of S. N. Shelby and E. R. Shelby 4.5 miles southeast of Lauderdale (E.1/2, NW.1/4 and W.1/4, NE.1/4, Sec. 34, T.8 N., R.18 E.). It is estimated that within an area of about 120 acres, in which the overburden is 10 feet or less, there are available approximately 1,355,000 cubic yards of clay above the lignite and 1,742,000 cubic yards of underclay. Both are believed to be of potential commercial value, and the upper clay is now being used locally in the manufacture of stoneware pottery. The properties of these clays are illustrated in samples from test holes 1, 1-A, and 2. The lateral gradations are further described in the records of test holes 3, 6, 7, 8, 10, 11, and 13.

On the property of Lonnie Gibbs, 0.5 mile southeast of the Shelby property (W.1/2, SW.1/4, Sec. 35, T.8 N., R.18 E.), the two clay beds underlie approximately 50 acres, and have an overburden of 7 feet or less. It is estimated that there are 580,000 cubic yards of the pottery clay and 806,000 cubic yards of underclay available in this deposit. The quality of the clay is represented by samples from test holes 14, 16, and 17, and the lateral gradations are further described in the records of test holes 15 and 20.

On the May Pack property (SE.1/4, SE.1/4, Sec. 35, T.8 N., R.18 E.), about 450,000 cubic yards of a good grade clay, lying in the pottery clay zone, is available under an overburden of 15 feet or less. The deposit covers an area of about 20 acres and its characteristics are represented by the record of test hole 23.

The lignite and associated clay beds are exposed in a road-side ditch on the J. T. Rutherford property, 4.7 miles east of Lauderdale (SW.1/4, Sec. 23, T.8 N., R.18 E.), and samples from test holes 32, 34, and 38 show the clay to be of good quality. Sample B-34-FS, a face sample from the clay overlying the lignite, seems to be especially high grade. The beds show a considerable range in thickness over short distances, however, and the deposit is in an area of structural disturbance. The magnitude of the deposit, therefore, is doubtful, but it is believed that at least 23,000 cubic yards of the upper clay is available under little or practically no overburden (less than 5 feet) in an area of about 10 acres, and about 600,000 cubic yards of the underclay, having an overburden of 10 feet or less, in an area of about 50 acres. Samples taken from other beds of the Fearn Springs clay in the same area (Test holes 43 and 49) are of lower grade but may be suitable for the manufacture of brick and tile. The bed represented by Sample B-43-P-1 lies beneath the underclay and is relatively thin, the quantity available being uncertain. Sample B-49-P-1, on the other hand, was taken from a bed lying higher in the formation, and represents a clay body exposed in a relatively long, narrow, and easily accessible hill on the property of Mrs. B. F. Lancaster (NW.1/4, NE.1/4, Sec. 23) and the adjacent Watkins property (SW.1/4, SE.1/4, Sec. 14, T.8 N., R.18 E.). It is estimated that approximately 3,864,000 cubic yards of the clay is available in an area of about 80 acres where the overburden is 20 feet or less.

On the H. S. Hatcher property (NW.1/4, Sec. 5, T.8 N., R.18 E.) and on the adjacent property of Ed Cannady (SW.1/4, SW.1/4, Sec. 32, T.9 N., R.18 E.), the lignite and associated clays underlie an area of about 125 acres where the overburden is 20 feet or less. It is estimated that approximately 1,000,000 cubic yards of the upper clay and 726,000 cubic yards of the lower clay are available. Their properties are represented by samples from test holes 64, 73, 78, 80, and 82. From the tests on these samples, it will be seen that the quality of the clay in this deposit is rather variable, and it is probable that the average quality is such as to render it unsuitable for use as pottery clay. It may, however, be of a grade to warrant its use in the manufacture of a high grade brick.

Samples were also taken from two small deposits of fairly high grade clay in the upper Fearn Springs, both of which are limited in areal extent and may, therefore, be of only slight economic importance. On the property of J. E. Toney (NE.1/4, SE.1/4, Sec. 10, T.8 N., R.18 E.) a lens of clay underlies the crest of a knoll immediately beneath the Ackerman sand (Test hole 54). It is estimated that there is available approximately 40,000 cubic yards of clay, averaging 5.0 feet in thickness, and having an overburden of 15 feet or less.

On the property of E. R. Crooker, 0.5 mile east of Lauderdale (NW.1/4, SW.1/4, Sec. 19, T.8 N., R.18 E.), the uppermost beds of Fearn Springs to be found in the county are exposed in a road cut. Tests of a sample of a 17-foot clay bed (Test hole 63) show it to be a fairly good grade of bond clay. It is estimated that approximately 1,000,000 cubic feet of this clay is available within an area of about 40 acres and with an overburden of less than 30 feet.

The clays of the Porters Creek, which crop out in the extreme northeastern corner of the county, were sampled at several localities, but, in spite of the large quantity available, tests show them to be of doubtful economic value (Test holes 50 and 250).

The clays of the Naheola formation are somewhat variable in character, but on the whole are very sandy and highly micaceous. They seem to be of little or no economic value (Test holes 42, 51, 56, 59, 65, 66, 70, 71, and 87). In only one sample did the test suggest a possible utility. In test hole 42 a thin bed of clay, doubtfully referred to the Naheola formation, proved to be of fairly high quality. The thinness of the deposit and the large overburden, however, preclude its commercial use.

The upper and lower clays of the Fearn Springs formation, with the exception of those beds previously described as of possible economic value, are highly micaceous and sandy, and are believed to have no commercial possibilities.

In the one locality in which the upper Ackerman clays are sufficiently well exposed to permit sampling, the James Dickson property (Sec. 27, T.8 N., R.17 E.), their gradation in quality over short distances is such as to render impossible the estimation of tonnages for a specific quality. Samples taken from the same bed less than 0.2 mile apart have entirely different properties (Test holes 85, 86, and 90).

The upper clays of the Holly Springs formation crop out along a rather broad strip from the Kemper County line near Daleville to the State line in the southeastern corner of Lauderdale County. Throughout most of that extent the upper part is well exposed in the northeastward facing cuesta scarp and is at or near the surface on the back slope. It retains the same general physical character throughout its lateral extent. No attempt was made, therefore, to sample every exposure, and, since the economic value of the clay is doubtful, no extensive samples were collected in any special area. Scattered large samples were selected for burning tests and numerous small confirmation samples were taken for later experimental study. Since this part of the formation consists of relatively thin beds of clay and sandy silt, interlensed and intermixed, most of the samples taken included several individual beds. In a few instances, however, the intervals included were small, and it is believed that the samples tested fairly represent the character of the smaller intervals as well as the more generalized character of the larger intervals which it would be necessary to consider for any commercial development. Because of the broad extent of the clay bearing member and because of the contrasting quality of thin adjacent beds, no attempt was made to estimate tonnages.

The clays of the Bashi and Hatchitigbee formations are very sandy and are not believed to be of commercial value. The Tallahatta claystone is represented by samples from test hole 261; its value as a ceramic material is doubtful. No ceramic clays were found in the Lisbon formation.

TEST HOLE RECORDS

S. N. Shelby Property

Test Hole Record 1

Location: T.8 N., R.18 E., Sec. 34, SE.1/4, NW.1/4; 210 feet north, 75° east of bridge on east-west road Drilled: May 27, 1938

Elevation: 254 feet Water level: 14.3 feet

No.	Depth	Thick.	Description of Strata
			Recent
1	....	4.7	Sand, reddish brown fine grained, silty, argillaceous, limonitic; grades downward to yellowish brown micaceous sand, which contains scattered fragments of ironstone
			Fearn Springs formation
2	4.7	0.1	Clay, light yellow sandy
3	4.8	1.0	Sand, yellowish brown silty
4	5.8	1.3	Sand, light gray fine grained argillaceous plastic. Sample C-1
5	7.1	7.1	Clay, bluish gray slightly silty highly plastic; some parts are iron-stained. Sample P-1
6	14.2	0.1	Clay, highly limonitic. Sample C-3
7	14.3	1.5	Lignite. Sample C-3
	15.8	15.8	Total

S. N. SHELBY PROPERTY

TEST HOLE RECORD 1A

Location: T.8 N., R.18 E., Sec. 34, SW.1/4, NE.1/4; 820 feet N. 65° E. of bridge on east-west road Drilled: September 13, 1938

Elevation: 254 feet Water level: 15.0 feet

No.	Depth	Thick.	Description of Strata
			Recent
1	....	0.9	Topsoil; light yellow silty fine sand
2	0.9	1.4	Sand, reddish brown very argillaceous, grit-bearing; thin layer of limonite at base
			Fearn Springs formation
3	2.3	3.1	Clay, light gray silty plastic; sandy in lower half. Sample P-1
4	5.4	1.0	Sand, brown very coarse slightly micaceous; scattered siderite nodules encrusted with limonite
5	6.4	8.6	Clay, slate gray fine grained slightly micaceous, sandy; streaked with brown. Samples P-2 (2.8 feet), P-3 (3.0 feet), and P-4 (2.4 feet)
6	15.0	2.0	Lignite, pyritiferous. Sample P-5
7	17.0	8.0	Clay, dark brown to dark gray highly plastic lignitic, silty, slightly micaceous, slightly pyritiferous. Samples P-6 (1.2 feet), P-7 (2.0 feet), P-8 (2.4 feet), and P-9 (2.4 feet)
8	25.0	5.4	Sand and silt, dark to light gray slightly plastic micaceous, pyritiferous; contains scattered clay fragments
	30.4	30.4	Total

Remarks: Samples numbered in descending order.

S. N. Shelby Property

Test Hole Record 2

Location: T.8 N., R.18 E., Sec. 34, NE.1/4, NW.1/4; 600 feet N. 47° E. of bridge on east-west road Drilled: July 6, 1938

Elevation: 255 feet Water level: 16.9 feet

No.	Depth	Thick.	Description of Strata
			Recent
1	....	1.2	Topsoil: light gray to yellow sandy loam
			Fearn Springs formation
2	1.2	7.6	Clay, light gray and red sandy, micaceous, sparingly limonitic
3	8.8	4.4	Clay, dark gray highly plastic sandy, micaceous; streaked with red and yellow. Sample C-1
4	13.2	3.7	Clay, light gray and yellow sandy, micaceous, lignitic; contains scattered limonite nodules
5	16.9	6.9	Clay, dark slate gray highly plastic sandy, micaceous
6	23.8	2.4	Lignite, pyritiferous
7	26.2	9.2	Clay, dark gray highly plastic micaceous, limonitic, lignitic. Samples C-3 (3.8 feet) and P-1 (4.3 feet)
	35.4	35.4	Total

Remarks: Samples numbered in descending order.

E. R. Shelby Property

Test Hole Record 3

Location: T.8 N., R.18 E., Sec. 34, SE.1/4, SW.1/4; 640 feet N. 75° E. of bridge on east-west road Drilled: May 30, 1938

Elevation: 253 feet Water level: 14.3 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.1	Topsoil; brown sandy loam
2	1.1	1.5	Sand, yellowish brown slightly plastic. Sample C-1
3	2.6	3.4	Clay, gray and red plastic sandy, micaceous
4	6.0	2.7	Sand, yellowish red fine grained argillaceous plastic
5	8.7	0.6	Clay, brown micaceous
6	9.3	0.2	Clay, dark brown plastic silty, micaceous
7	9.5	0.1	Sand, yellow and brown fine grained, plastic argillaceous, micaceous
8	9.6	9.5	Clay, dark gray silty, micaceous; somewhat iron-stained near center
9	19.1	2.7	Lignite, argillaceous
10	21.9	12.4	Clay, dark gray plastic lignitic, sandy, micaceous
	34.2	34.2	Total

S. N. SHELBY PROPERTY

TEST HOLE RECORD 6

Location: T.8 N., R.18 E., Sec. 34, SE.1/4, NW.1/4; 810 feet N. 66° W. of section center Drilled: June 2, 1938

Elevation: 221 feet Water level: 13.2 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	0.6	Topsoil
2	0.6	8.5	Clay, red and white plastic sandy, micaceous. Sample C-1
3	9.1	0.8	Sand, fine grained plastic argillaceous, limonitic; red and white interlaminated
4	9.9	0.3	Clay, dark gray sandy, lignitic
5	10.2	0.3	Clay, highly lignitic, sandy
6	10.5	1.4	Clay, dark gray micaceous, sandy; grades downward to bed 7
7	11.9	2.0	Sand, gray; interlaminated with yellow sand; a few thin interbedded layers of clay. Sample C-2
8	13.9	0.1	Clay, bluish gray sandy, micaceous, lignitic
9	14.0	0.2	Sand, slate gray argillaceous, carbonaceous, highly micaceous
10	14.2	3.1	Clay, very plastic lignitic; streaked with sand toward the base
11	17.3	0.8	Sand, slate gray fine grained plastic argillaceous, carbonaceous, micaceous
12	18.1	1.3	Sand, highly lignitic, pyritiferous
13	19.4	1.5	Clay, gray plastic, micaceous; interlaminated with sand
14	20.9	1.8	Clay, dark slate gray sandy, silty, micaceous, carbonaceous; grades downward to bed 15
15	22.7	2.3	Sand, light slate gray fine grained micaceous, argillaceous; grades downward to bed 16
16	25.0	0.3	Clay, plastic lignitic, micaceous, pyritiferous, slightly sandy
17	25.3	1.5	Lignite, pyritiferous
	26.8	26.8	Total

E. R. SHELBY PROPERTY

TEST HOLE RECORD 7

Location: T.8 N., R.18 E., Sec. 34, NE.1/4, SW.1/4; 900 feet S. 9° E. of bridge on east-west road Drilled: June 6, 1938

Elevation: 242 feet Water level: 11.4 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	1.0	Topsoil; grayish yellow sand
2	1.0	1.6	Sand, light yellow fine grained silty; interlaminated with clay in lower half
3	2.6	1.4	Clay, yellow-gray plastic micaceous; slightly iron-stained
4	4.0	3.0	Clay, light gray very plastic silty, micaceous. Sample C-1
5	7.0	0.5	Lignite
6	7.5	3.0	Clay, dark brownish gray and yellow plastic micaceous; limonitic in lower 0.5 foot.
7	10.5	0.8	Clay, dark gray slightly plastic sandy highly micaceous
8	11.3	1.2	Sand, dark gray micaceous
9	12.4	10.5	Clay, iron gray lignitic, highly micaceous; contains interlaminated sand in some parts
			Naheola ? formation
10	23.0	13.0	Sand, iron-gray micaceous. Sample C-3
	36.0	36.0	Total

S. N. SHELBY PROPERTY

TEST HOLE RECORD 8

Location: T.8 N., R.18 E., Sec. 34, SW.1/4, NE.1/4; 1050 feet N. 78° E. of bridge on east-west road Drilled: June 6, 1938

Elevation: 253 feet Water level: 5.7 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	0.4	Topsoil
2	0.4	0.9	Sand, white coarse grained; grades downward into fine soft sand
3	1.3	0.3	Sand and clay, yellowish brown semi-plastic slightly micaceous
4	1.6	4.1	Clay, yellowish brown and red sandy, micaceous; grades downward into bed 5
5	5.7	2.4	Sand, yellow and white highly argillaceous fine grained plastic
6	8.1	2.0	Clay, dark brown, red, and yellow plastic silty, sandy, micaceous, lignitic
7	10.1	7.3	Clay, slate gray slightly sandy very plastic; limonitic in some parts
8	17.4	1.7	Lignite, argillaceous, plastic
9	19.1	6.9	Clay, dark brown to slate gray highly plastic micaceous, carbonaceous; interlaminated with dark gray-brown and ochre-yellow sand; grades downward to bed 10
10	26.0	3.4	Sand, slate gray fine grained micaceous, argillaceous. Sample C-1
11	29.4	2.4	Sand and silt, gray and grayish brown laminated plastic micaceous; sand increases in prominence toward base
	31.8	31.8	Total

S. N. SHELBY PROPERTY

TEST HOLE RECORD 10

Location: T.8 N., R.18 E., Sec. 34, NE.1/4, NW.1/4; 890 feet N. 30° W. from bridge on east-west road Drilled: June 7, 1938

Elevation: 260 feet Water level: 6.9 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	....	1.0	Topsoil: alluvial brown sand
2	1.0	6.0	Sand, light brown to reddish yellow coarse grained, grit bearing, limonitic; contains considerable red clay near base; lower contact marked by thin layer of ironstone
			Fearn Springs formation
3	7.0	0.2	Clay, grayish white very plastic micaceous, silty, slightly sandy
4	7.2	1.9	Sand, light yellow to reddish brown fine grained limonitic
5	9.1	0.7	Clay, light gray very plastic; interlaminated with sand; slightly ironstained
6	9.8	2.2	Sand, white, yellow, and red very plastic highly argillaceous; grades downward to slate gray. Sample C-1
7	12.0	1.0	Lignite, argillaceous
8	13.0	4.7	Sand, massive argillaceous, lignitic, micaceous
9	17.7	1.9	Clay, light gray very plastic silty, slightly sandy, pyritiferous
10	19.6	3.0	Sand, light gray very micaceous, limonitic, pyritiferous; contains a few laminae of clay
11	22.6	2.5	Sand, dark brown and white fine grained limonitic, lignitic; contains scattered grit particles
12	25.1	1.0	Sand, black to light gray and brown very fine grained lignitic, micaceous. Sample C-2
	26.1	26.1	Total

E. R. SHELBY PROPERTY
TEST HOLE RECORD 11

Location: T.8 N., R.18 E., Sec. 34, SE.1/4, NW.1/4; a roadside ditch Drilled: June 8, 1938
Elevation: 256 feet Water level: 8.7 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	2.9	Sand, brownish yellow semi-plastic micaceous
2	2.9	15.3	Sand, light gray to yellow micaceous; lignitic in lower part; contains limonite nodules scattered throughout. Sample C-1
3	18.2	4.2	Sand, brownish yellow highly micaceous, lignitic; concentration of limonite at lower contact. Sample C-2
4	22.4	1.8	Lignite, Sample C-3
5	24.4	0.8	Clay, dark gray plastic lignitic, micaceous, pyritiferous. Sample C-4
6	25.0	4.6	Clay, dark bluish gray, plastic lignitic; contains pyrite nodules as large as 3 inches in diameter; becomes sandy and micaceous in lower part. Sample C-5
	29.6	29.6	Total

Remarks: 7.6 feet of white micaceous sand overlain by 1.0 foot of clay in the road cut above the drill hole.

W. P. PAINE PROPERTY
TEST HOLE RECORD 12

Location: T.8 N., R.18 E., Sec. 34, NW.1/4, SE.1/4; 200 feet N. 70° E. of road junction Drilled: June 9, 1938
Elevation: 281 feet Water level: 12.9 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	2.6	Topsoil
2	2.6	10.4	Sand, argillaceous, limonitic; dark reddish brown interbedded with yellow. Sample C-1
3	13.0	0.4	Grit, coarse red
			Fearn Springs formation
4	13.4	1.5	Clay, brown plastic sandy, micaceous
5	14.9	1.1	Sand, yellow to reddish brown coarse grained plastic argillaceous, limonitic
6	16.0	1.7	Clay, light gray plastic silty, sandy, slightly micaceous, limonitic
7	17.7	6.1	Sand, white to yellowish brown coarse grained micaceous lignitic. Sample C-2
	23.8	23.8	Total

T. E. Suggs Property

Test Hole Record 13

Location: T.8 N., R.18 E., Sec. 34, SE.1/4, NW.1/4; 910 feet S. 80° E. of bridge on east-west road Drilled: June 13, 1938

Elevation: 278 feet Water level: 19.7 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	0.3	Topsoil
2	0.3	1.9	Clay, reddish brown plastic slightly sandy; grades downward to light gray. Sample C-1
3	2.2	5.0	Clay, gray plastic slightly sandy, slightly micaceous, limonitic. Samples C-2 (2 feet), C-3 (2 feet), and C-4 (1 foot)
4	7.2	1.0	Sand, dark reddish brown micaceous; interbedded with gray clay
5	8.2	8.2	Clay, slate gray sandy plastic; interlaminated with yellowish brown sand near center of bed. Samples C-5 (2 feet), C-6 (2.1 feet), C-7 (1 foot), C-8 (2.1 feet)
6	16.4	2.2	Sand, dark gray plastic; interlaminated with dark gray clay. Sample C-9
7	18.6	0.9	Clay, dark gray to black highly plastic carbonaceous, silty, slightly sandy. Sample C-10
8	19.5	1.6	Lignite. Sample C-11
9	21.1	5.3	Clay, dark gray to black highly plastic, pyritiferous, slightly silty. Samples C-12 (3.3 feet), C-13 (2 feet)
10	26.4	8.0	Clay, slate gray plastic sandy, micaceous. Samples C-14 (2 feet), C-15 (2.4 feet), C-16 (2.2 feet)
11	34.4	1.9	Clay, dark slate gray shaly plastic sandy, silty, micaceous, carbonaceous, limonitic, pyritiferous. Samples C-17 (1.4 feet), C-18 (1 foot)
12	36.3	2.1	Sand, dark gray fine grained silty, argillaceous, carbonaceous
	38.4	38.4	Total

Remarks: Samples numbered in descending order.

LONNIE GIBBS PROPERTY

TEST HOLE RECORD 14

Location: T.8 N., R.18 E., Sec. 35, NW.1/4, SW.1/4; 290 feet N. 74° E. intersection of road and section line 34-35 Drilled: June 13, 1938

Elevation: 256 feet Water level: 13.1 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	0.3	Topsoil, light gray sandy
2	0.3	2.0	Clay, grayish brown plastic micaceous, very sandy
3	2.3	10.8	Clay, light gray to white sandy, silty; interbedded with yellow and red clay; several concentrations of limonite nodules. Sample C-1
4	13.1	2.5	Sand, light gray to white; ironstained in places
5	15.6	7.0	Sand, dark gray fine grained semi-plastic lignitic, micaceous, argillaceous; grades downward to 0.3 feet of dark gray massive lignitic clay at base
6	22.6	2.5	Lignite. Sample C-2
7	25.1	4.0	Clay, light gray highly plastic micaceous; lignitic near upper and lower contacts. Sample C-3
8	29.1	4.3	Clay, dark brown highly plastic lignitic, micaceous, slightly pyritiferous; grades downward to slate gray clay. Sample P-1
9	33.4	18.8	Sand, dark gray to black laminated fine grained highly argillaceous, micaceous, lignitic. Samples C-4 (9.1 feet), C-5 (1.4 feet), C-6 (4.3 feet), C-7 (4.0 feet)
	52.2	52.2	Total

Remarks: Samples numbered in descending order.

LONNIE GIBBS PROPERTY

TEST HOLE RECORD 15

Location: T.8 N., R.18 E., Sec. 35, SW.1/4, SW.1/4; 780 feet N. 28° E. of intersection of road and section line 34-35 Drilled June 13, 1938

Elevation: 238 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	0.6	Topsoil: very dark sandy loam
2	0.6	5.4	Sand, dark reddish brown argillaceous
3	6.0	4.0	Sand, red limonitic
4	10.0	8.0	Clay, dark slate gray; grades downward to dark brown clay; contains several limonite partings. Sample C-1
5	18.0	1.4	Lignite. Sample C-2
6	19.4	11.4	Clay, black highly plastic lignitic, sandy, micaceous; concentration of limonite nodules near center of bed. Sample C-3
7	30.8	9.8	Sand, light steel gray fine grained slightly plastic argillaceous, micaceous, slightly lignitic. Sample C-4
8	40.6	5.3	Sand, dark gray lignitic, very micaceous, limonitic. Sample C-5
9	45.9	1.3	Sand, dark brown medium to coarse grained carbonaceous, slightly micaceous
	47.2	47.2	Total

LONNIE GIBBS PROPERTY
TEST HOLE RECORD 16

Location: T.8 N., R.18 E., Sec. 35, NW.1/4, SW.1/4; 910 feet N. 24° E. of intersection of road and section line 34-35 Drilled: June 21-24, 1938
Elevation: 267 feet Water level: 10.4 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.4	Topsoil
2	1.4	4.6	Clay, reddish brown, semi-plastic micaceous, sandy; scattered limonite nodules
3	6.0	1.6	Clay, light gray plastic sandy, silty, limonitic. Sample C-1
4	7.6	2.8	Sand, reddish brown medium grained semi-plastic argillaceous, micaceous
5	10.4	3.1	Sand, yellowish brown coarse grained, micaceous, argillaceous
6	13.5	3.8	Sand, light gray to dark slate gray fine grained semi-plastic argillaceous micaceous lignitic
7	17.3	0.6	Clay, dark brown to black plastic silty, lignitic
8	17.9	1.7	Lignite, argillaceous
9	19.6	11.2	Clay, dark brown to black plastic; interlaminated with greenish brown pyritiferous sand. Sample P-1
10	30.8	9.3	Sand, dark slate gray to black plastic argillaceous. Sample C-2
11	40.1	3.7	Sand, dark gray to black semi-plastic micaceous; interlaminated with clay. Sample C-3
	43.8	43.8	Total

LONNIE GIBBS PROPERTY
TEST HOLE RECORD 17

Location: T.8 N., R.18 E., Sec. 35, NW.1/4, SW.1/4; 60 feet S. 65° E. of the SE. corner of Elizabeth church Drilled: June 31, 1938
Elevation: 264 feet Water level: 19.4 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	....	1.2	Topsoil: coarse grained yellowish brown sand mixed with clay and silt
2	1.2	3.4	Sand, yellowish brown and red coarse grained, grit bearing, contains scattered clay pebbles and limonite nodules
			Fearn Springs formation
3	4.6	7.9	Clay, light gray; ironstained. Sample P-1
4	12.5	20.0	Sand, red and yellow fine to coarse grained micaceous
	32.5	32.5	Total

LONNIE GIBBS PROPERTY

TEST HOLE RECORD 20

Location: T.8 N., R.18 E., Sec. 35, NW.1/4, SW.1/4, Drilled: June 24, 1938

Elevation: 243 feet Water level: 9.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	2.2	Clay and sand, light brown
2	2.2	3.9	Clay, brown slightly plastic sandy limonitic
3	6.1	2.9	Clay, gray highly plastic; contains a few laminae of red and white sand
4	9.0	7.3	Clay, gray highly plastic silty micaceous, lignitic, slightly limonitic. Sample C-1
5	16.3	6.4	Clay, dark gray to black sandy, micaceous, lignitic. Sample C-2
6	22.7	6.1	Clay, dark slate gray silty, micaceous, pyritiferous; interlaminated with sand
7	28.8	12.2	Sand, dark brown silty, lignitic, highly micaceous, slightly pyritiferous. Sample C-3
8	41.0	1.0	Lignite
9	42.0	4.3	Sand, dark brown silty, lignitic, limonitic
10	46.3	1.7	Clay, dark brown to black, highly plastic; interlaminated with gray sand
	48.0	48.0	Total

MAY PACK PROPERTY

TEST HOLE RECORD 23

Location: T.8 N., R.18 E., Sec. 35, SE.1/4, SE.1/4 Drilled: July 5, 1938

Elevation: 284 feet Water level: 38.5 feet

No.	Depth	Thick.	Description of Strata
			Recent ?
1	--------	0.9	Topsoil: white sand
2	0.9	5.2	Sand, red, coarse grained
			Fearn Springs formation ?
3	6.1	14.8	Clay, gray, red, and yellowish brown plastic, highly ferruginous; concentration of ironstone in lower 0.3 of a foot. Samples P-1 (5.8 feet), C-1 (9 feet)
4	20.9	1.7	Sand, yellowish brown very plastic highly argillaceous, micaceous, limonitic. Sample C-2
5	22.6	3.9	Sand, coarse grained red to dark yellow; contains small fragments of clay. Sample C-3
6	26.5	7.5	Sand, yellow and white fine grained micaceous, silty, limonitic; contains partings of yellow-gray clay
7	34.0	5.8	Sand, gray fine grained micaceous; several partings of clay and lignite; grades into bed 8
8	39.8	1.2	Lignite; interbedded with dark gray clay
9	41.0	0.8	Sand, yellow medium grained micaceous, lignitic
10	41.8	--------	Clay, slate gray lignitic plastic
	41.8	41.8	Total

L. E. COBB PROPERTY

TEST HOLE RECORD 25

Location: T.8 N., R.18 E., Sec. 35, NE.1/4, SE.1/4; 1.2 miles west along road from intersection of state line Drilled: July 5, 1938

Elevation: 285 feet Water level: 27.0 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formations lower member
1	....	0.9	Topsoil, red sandy
2	0.9	0.4	Sand, gray-white fine grained
3	1.4	7.7	Sand, red and yellowish brown coarse grained; lower part contains gray gritty sand pebbles as much as 2 inches in diameter
4	9.1	7.7	Clay, light gray plastic sandy, micaceous, limonitic; interlaminated with yellow and dark red sand. Sample C-1
5	16.8	11.0	Sand, yellow, brown, and light gray fine grained semi-plastic argillaceous, micaceous; interbedded with grit-bearing sand
6	27.8	3.1	Clay, yellow and slate gray extremely plastic sandy, micaceous, slightly limonitic; interlaminated with sand. Sample C-2
7	31.5	0.3	Sand, grayish brown coarse grained, grit-bearing
8	31.8	0.2	Grit, grayish brown
	32.0	32.0	Total

CHARLIE GIBBS PROPERTY

TEST HOLE RECORD 26

Location: T.8 N., R.18 E., Sec. 36, SE.1/4, SW.1/4; 0.7 mile west of state line along east-west road and 60 feet north of the center line of the road
Drilled: July 6, 1938

Elevation: 284 feet Water level: 50 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	0.7	Topsoil: white sand
2	0.7	5.7	Sand, red fine grained slightly micaceous; contains a few partings of clay
3	6.4	8.6	Sand, red coarse grained, grit-bearing; contains local concentrations of clay pebbles
			Fearn Springs formation
4	15.0	4.0	Clay, slate gray plastic micaceous; ironstained. Sample C-1
5	19.0	17.2	Sand, yellow, red, and gray fine grained semi-plastic slightly argillaceous micaceous, limonitic. Sample C-2
6	36.2	8.6	Sand, gray and yellow brown to red fine grained semi-plastic argillaceous, micaceous, limonitic near base
7	24.8	10.8	Sand, light yellow fine grained micaceous, argillaceous, lignitic
8	55.6	3.6	Clay, dark slate gray very plastic lignitic; interlaminated with white micaceous sand and silt. Sample C-3
	59.2	59.2	Total

Remarks: Bed 8 is the approximate equivalent of bed 3, test hole 27.

MRS. W. H. SHEFFIELD PROPERTY

TEST HOLE RECORD 27

Location: T.7 N., R.18 E., Sec. 1, NE.1/4, NW.1/4; 0.5 mile west of state line and 130 feet south of road center Drilled: July 6, 1938

Elevation: 233 feet Water level: 9.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.0	Topsoil: brown fine sandy loam
2	1.0	2.4	Sand, yellowish red fine grained limonitic
3	3.4	3.0	Clay, yellowish red sandy
4	6.4	8.9	Clay, gray sandy, silty, micaceous, limonitic. Sample C-1
5	15.3	1.5	Clay, iron gray carbonaceous, pyritiferous; interlaminated with gray sand
6	16.8	10.8	Sand, dark gray argillaceous, slightly micaceous, pyritiferous. Sample C-2
7	27.6	5.7	Clay, steel gray plastic micaceous, pyritiferous; interlaminated with gray sand; grades into bed 8. Sample C-3
8	33.3	2.4	Lignite, pyritiferous. Sample C-4
9	35.7	10.9	Clay, steel gray very plastic silty micaceous, lignitic, slightly pyritiferous. Samples C-5 (1.6 feet), C-6 (2.3 feet), C-7 (3.9 feet)
	46.6	46.6	Total

Remarks: Samples numbered in descending order.

RANS HORNE PROPERTY

TEST HOLE RECORD 28

Location: T.8 N., R.18 E., Sec. 36, SE.1/4, SE.1/4; 20 feet south of the intersection of east-west road and state line Drilled: July 11, 1938

Elevation: 218 feet Water level: 10.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	5.9	Topsoil: dark red sand
2	5.9	1.7	Sand, slate gray semi-plastic, micaceous
3	7.6	2.1	Lignite
4	9.7	2.7	Clay, red and yellow very plastic silty. Sample C-1
5	12.4	2.7	Clay, slate gray highly plastic limonitic. Sample C-2
6	15.1	7.9	Clay, dark brown, highly plastic, micaceous, carbonaceous, pyritiferous. Sample C-3
7	23.0	17.8	Clay, dark brown to black highly plastic sandy, micaceous, lignitic
	40.8	40.8	Total

H. R. McDANIEL PROPERTY

TEST HOLE RECORD 29

Location: T.8 N., R.18 E., Sec. 22, SW.1/4, SW.1/4; 0.6 mile east along road from fire tower in Sec. 28 and 150 feet south of center of road Drilled: July 27, 1938

Elevation: 304 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	0.4	Topsoil: dark brown sandy loam
2	0.4	3.6	Clay, yellowish red slightly micaceous, limonitic; grades downward to bed 3. Sample C-1
3	4.0	7.0	Sand, yellowish red to steel gray fine grained slightly micaceous, limonitic; contains a few clay partings. Sample C-2
4	11.0	0.3	Clay, dark steel gray micaceous, sandy, lignitic
5	11.3	11.7	Sand, dark steel gray micaceous; contains scattered clay partings. Sample C-3
6	23.0	8.6	Clay, dark steel gray plastic micaceous, lignitic pyritiferous; interlaminated with gray lignitic sand. Samples P-1 (5.4 feet), C-4 (3.2 feet)
7	31.6	5.6	Sand, dark steel gray and red very coarse grained; contains fragments of kaolinitic clay
	37.2	37.2	Total

Remarks: Samples numbered in descending order.

H. R. McDANIEL PROPERTY

TEST HOLE RECORD 29A

Location: T.8 N., R.18 E., Sec. 22, SW.1/4, SW.1/4; 0.6 mile east along road from fire tower in Sec. 28 and 40 feet south of center of road Drilled: July 21, 1938

Elevation: 292 feet Water level: 8.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.6	Topsoil: brown sandy loam
2	1.6	2.2	Sand, yellow fine grained. Sample C-1
3	3.8	4.3	Sand, white very fine grained; grades downward to bed 4
4	8.1	2.8	Sand, dark gray lignitic, very micaceous; contains clay partings. Sample C-2
5	10.9	8.5	Clay, dark steel gray lignitic, micaceous, sandy; interlaminated with gray sand. Sample P-1
6	19.4	0.4	Sand, dark steel gray micaceous, lignitic
7	19.8	1.2	Clay, dark grayish brown lignitic, micaceous, pyritiferous; interlaminated with sand
8	21.0	1.3	Sand, dark yellowish brown argillaceous; contains limonite partings
9	22.3	3.7	Sand, dark steel gray micaceous. Sample C-3
	46.0	46.0	Total

Remarks: Bed 5 is the equivalent of bed 6, test hole 29.

MRS. HELEN WOOD PROPERTY

TEST HOLE RECORD 30

Location: T.8 N., R.18 E., Sec. 22, SW.1/4, SE.1/4; 0.8 mile S. 84° E. from fire tower to Sec. 28 Drilled: July 21-22, 1938

Elevation: 315 feet Water level: 16.8 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	2.0	Topsoil
2	2.0	3.4	Sand, brown and brownish gray slightly plastic argillaceous; grades downward to very sandy clay base
3	5.4	1.1	Sand, brown coarse grained
4	6.5	1.5	Sand, light gray fine grained; contains scattered clay fragments
5	8.0	9.1	Sand, yellow, red, brown. and gray coarse grained, grit-bearing; contains a few clay pebbles and small pieces of silicified wood. Sample C-1
			Fearn Springs formation
6	17.1	1.4	Clay, light slate gray plastic very sandy, micaceous
7	18.5	1.4	Sand, dark slate gray very fine grained argillaceous, lignitic; grades downward to sandy clay at base
8	19.5	0.4	Lignite, argillaceous
9	20.3	4.8	Clay, dark slate gray plastic lignitic, micaceous, slightly pyritiferous; interlaminated with brown sand. Sample C-2
10	25.1	1.9	Sand, yellow to brown coarse grained, grit-bearing, lignitic; contains pebbles of gray kaolinitic clay
	27.0	27.0	Total

MRS. HELEN WOOD PROPERTY

TEST HOLE RECORD 31

Location: T.8 N., R.18 E., Sec. 23, SW.1/4, SE.1/4; 1.2 miles east along road from fire tower in Sec. 28 and 40 feet south of road Drilled: July 25, 1938

Elevation: 314 feet Water level: 12.9 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	0.2	Topsoil: white sand
2	0.2	9.4	Sand, red fine to coarse highly argillaceous; grades downward to bed 3
3	9.6	10.0	Clay, dark to light gray very plastic; interlaminated with white sand; limonitic near base. Sample C-1
4	19.6	8.1	Sand, yellow and brown semi-plastic highly argillaceous, micaceous, limonitic; grades downward to gray sand
	27.7	27.7	Total

TOM RUTHERFORD PROPERTY

TEST HOLE RECORD 32

Location: T.8 N., R.18 E., Sec. 23, SW.1/4, SW.1/4; 440 feet S. 80° W. of the road crossing at the SW.1/4, SW.1/4, Sec. 23 Drilled: July 21, 1938

Elevation: 314 feet Water level: 20.4 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	2.5	Topsoil: light yellow sand and silt
2	2.5	10.5	Sand, reddish brown fine grained, grit-bearing, micaceous, limonitic; contains pebbles of light gray clay. Sample C-1
3	13.0	9.9	Clay, light to dark slate gray kaolinitic, sandy, micaceous, limonitic. Sample P-1
4	22.9	1.1	Clay, light brown and slate gray sandy, micaceous, limonitic. Sample C-2
5	24.0	1.5	Clay, very light gray highly plastic limonitic; interbedded with coarse grained, grit-bearing sand which contains pebbles of white bauxitic clay. Sample C-3
6	25.5	1.2	Sand, light yellow coarse grained limonitic; interlensed with white and gray kaolinitic and bauxitic clay. Sample C-4
7	26.7	11.9	Sand, fine grained yellow; grades downward to grit-bearing bauxitic clay-sand conglomerate. Sample C-5
	38.6	38.6	Total

TOM RUTHERFORD PROPERTY

TEST HOLE RECORD 34

Location: T.8 N., R.18 E., Sec. 23, NW.1/4, SW.1/4; 100 feet N. 10° W. from road crossing on quarter line Drilled: July 26, 1938

Elevation: 269 feet Water level: 18.1 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	2.3	Topsoil: red semi-plastic sand and clay
2	2.3	3.9	Clay, light gray very plastic; limonitic along joints and bedding planes. Sample C-1
3	6.2	2.8	Clay, light gray very plastic sandy, micaceous, limonitic. Samples C-2 (1.6 feet), C-3 (1.1 feet)
4	9.0	0.5	Clay, gray very plastic lignitic; slightly ironstained. Sample C-4
5	9.5	0.3	Lignite, argillaceous
6	9.8	2.6	Clay, gray very plastic lignitic. Sample P-1
7	12.4	5.5	Sand, gray plastic highly argillaceous, micaceous, limonitic; grades downward to bed 8
8	17.9	6.2	Sand, white, red, and yellow coarse grained highly micaceous; grades downward to sand which contains bauxitic lenses and pebbles
	24.1	24.1	Total

Remarks: Samples numbered in descending order.

J. T. RUTHERFORD PROPERTY

TEST HOLE RECORD 35

Location: T.8 N., R.18 E., Sec. 23. SW.1/4, SW.1/4; 805 feet N. 45° W. from road intersection to the SW.1/4, SW.1/4, Sec. 23 Drilled: August 4, 1938

Elevation: 305 feet Water level: 20.8 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	4.7	Topsoil: reddish brown sand
2	4.7	3.3	Clay, bauxitic; contains iron-stained pisolites as much as 1/4 inch in diameter. Sample C-1
3	8.0	3.1	Sand, yellow and brown slightly micaceous; bauxitic
4	11.1	1.8	Sand, dark brown argillaceous, slightly micaceous
5	12.9	14.2	Sand, light gray to brown grit-bearing, bauxitic; lower 2 feet is a sand-clay conglomerate
			Naheola formation ?
6	27.1	3.7	Clay, gray plastic pyritiferous. Sample C-2
	30.8	30.8	Total

LAUDERDALE COUNTY PROPERTY

TEST HOLE RECORD 36

Location: T.8 N., R.18 E., Sec. 23, SW.1/4, SW.1/4; 780 feet N. 10° E. from road crossing from the SW.1/4, SW.1/4, Sec. 23 Drilled: July 28, 1938

Elevation: 305 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.0	Topsoil: coarse grained very argillaceous sand
2	1.0	2.0	Clay, red; grades downward to bed 3
3	3.0	5.6	Sand, dark red and yellow silty, limonitic
4	8.6	2.2	Clay, light gray highly plastic sandy, micaceous, limonitic. Sample C-1
5	10.8	14.0	Sand, yellow, gray, and white argillaceous limonitic
6	24.8	2.4	Bauxite, very sandy, limonitic. Sample C-2
7	27.2	2.0	Sand, red to yellow very coarse grained limonitic
	29.2	29.2	Total

J. R. RUTHERFORD PROPERTY

TEST HOLE RECORD 40

Location: T.8 N., R.18 E., Sec. 23, NW. 1/4, SE. 1/4; 740 feet N. 20° E. from a point 1930 feet east along road from quarter line SW.1/4, SW.1/4, Sec. 23 Drilled: August 3, 1938

Elevation: 308 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	0.9	Topsoil: dark sandy loam
2	0.9	2.7	Clay, light gray semi-plastic very micaceous. Sample C-1
3	3.6	1.0	Sand, dark red limonitic
4	4.6	0.8	Clay, gray semi-plastic micaceous; ironstained
5	5.4	14.0	Sand, light yellow and red; contains scattered kaolinitic clay pebbles
6	19.4	0.6	Sand, white bauxitic, limonitic
7	20.0	1.0	Clay, light gray semi-plastic very sandy, micaceous. Sample C-2
8	21.0	1.0	Clay, light blue; interlaminated with yellow micaceous sand. Sample C-3
9	22.0	8.0	Sand, red bauxitic, limonitic, micaceous
	30.0	30.0	Total

W. R. JEMISON PROPERTY

TEST HOLE RECORD 41

Location: T.8 N., R.18 E., Sec. 24, SW.1/4, SW.1/4; 670 feet east along road from section line Drilled: August 4, 1938

Elevation: 333 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.8	Topsoil: yellow-brown sand
2	1.8	5.0	Sand and clay, light yellow bauxitic, limonitic
3	6.8	24.4	Sand, yellow and brown bauxitic, micaceous
	31.2	31.2	Total

E. KEY PROPERTY

TEST HOLE RECORD 42

Location: T.8 N., R.18 E., Sec. 24, SW.1/4, SE.1/4; 240 feet south from a point 0.4 of a mile east along road from road junction at section line Drilled: August 8, 1938

Elevation: 372 feet Water level: 60.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	4.0	Topsoil: gray sand
2	4.0	1.0	Sand, red and white micaceous, limonitic; interbedded fine and coarse grained sand grading downward to coarse grit-bearing sand which is a sand-clay conglomerate at the base
			Naheola formation
3	25.0	4.2	Clay, light yellow and red sandy. Sample P-1
4	29.2	0.8	Sand, variegated fine grained
5	30.0	2.8	Clay, gray semi-plastic sandy, micaceous, ironstained
6	32.8	27.2	Sand, yellow, brown, and gray fine grained micaceous, carbonaceous; upper half ironstained
	60.0	60.0	Total

J. R. RUTHERFORD PROPERTY

TEST HOLE RECORD 43

Location: T.8 N., R.18 E., Sec. 23, NW.1/4, SE.1/4; 800 feet N. 10° E. of a point 0.4 mile east along road from quarter line in SW.1/4, SW.1/4, Sec. 23 Drilled: August 9, 1938

Elevation: 267 feet Water level: 25.4 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	0.9	Topsoil
2	0.9	7.3	Clay, brown plastic limonitic, micaceous; grades downward to argillaceous sand
3	8.1	3.2	Clay, brown very plastic; interlaminated with light gray micaceous sand. Sample P-1
4	11.3	14.3	Sand, variegated bauxitic, grit-bearing; interbedded fine and coarse grained sand becoming coarser grained toward base; grades downward to bauxitic and kaolinitic clay-sand conglomerate
	25.6	25.6	Total

W. R. JEMISON PROPERTY

TEST HOLE RECORD 44

Location: T.8 N., R.18 E., Sec. 24, SW.1/4, SW.1/4; 340 feet north of a point 0.2 of a mile east from section line along road Drilled: August 8, 1938

Elevation: 343 feet Water level: 30.1 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.6	Topsoil
2	1.6	18.9	Sand, reddish brown and white argillaceous, micaceous, grit-bearing; contains fragments of bauxitic clay in lower half. Sample P-1
3	20.5	1.6	Clay, light gray; interlaminated with fine grained sand. Sample C-1
4	22.1	9.9	Sand, white and brown fine grained micaceous; contains small fragments of bauxitic clay
	32.0	32.0	Total

THE ESTATE OF PEG CHAMBERS PROPERTY

TEST HOLE RECORD 46

Location: T.8 N., R.18 E., Sec. 25, SW.1/4, SW.1/4; 150 feet east of a point 0.8 of a mile south from road junction at section line along road Drilled: August 9-10, 1938

Elevation: 314 feet Water level: 40.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	2.7	Topsoil
2	2.7	1.3	Sand, dark reddish brown coarse grained, grit-bearing, argillaceous
3	4.0	4.0	Clay, light gray plastic sandy; grades downward to bed 4. Sample C-1
4	8.0	32.8	Sand, light gray, yellow, and brown fine grained argillaceous, micaceous; interbedded with and containing fragments of gray kaolinitic clay. Samples P-1 (14.0 feet), P-2 (18.3 feet)
	40.8	40.8	Total

Remarks: Samples numbered in descending order.

J. R. RUTHERFORD PROPERTY

TEST HOLE RECORD 48

Location: T.8 N., R.18 E., Sec. 23, NW.1/4, SE.1/4; 50 feet west of a point on the road 0.2 of a mile north of a road junction near the center of Sec. 23
Drilled: August 11, 1938

Elevation: 375 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	1.0	Topsoil: gray sand
2	1.0	4.4	Clay, red and gray semi-plastic micaceous; interlaminated with sand
3	5.4	3.4	Clay, dark gray very plastic slightly silty, slightly micaceous. Sample C-1
4	8.8	0.8	Sand, light brown coarse grained micaceous, limonitic
5	9.6	4.1	Clay, light gray very plastic silty, micaceous, limonitic. Sample C-2
6	13.7	17.4	Sand, yellow, red, and white fine grained semi-plastic, micaceous, limonitic; contains fragments of red and gray clay
7	31.1	9.5	Clay, yellow to dark gray very plastic sandy, limonitic, slightly micaceous. Sample P-1
8	40.6	16.4	Sand, red to yellow medium grained argillaceous, limonitic; grades downward to coarse grained grit-bearing sand which is intermixed with kaolinitic clay
			Naheola formation
9	57.0	0.7	Clay, pink semi-plastic, sandy limonitic
10	57.7	2.3	Sand, pink medium grained, micaceous
	60.0	60.0	Total

MRS. B. F. LANCASTER PROPERTY

TEST HOLE RECORD 49

Location: T.8 N., R.18 E., Sec. 23, NW.1/4, NE.1/4; 0.7 of a mile north along road from road junction near center of Sec. 23 Drilled: August 22, 1938

Elevation: 358 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	3.0	Topsoil
2	3.0	4.3	Sand, brown very fine grained argillaceous, micaceous, limonitic. Sample C-1
3	7.3	36.4	Clay, dark gray slightly plastic sandy, micaceous, slightly limonitic. Sample P-1
	43.7	43.7	Total

J. E. Toney Property

Test Hole Record 50

Location: T.8 N., R.18 E., Sec. 11, NE.1/4, SW.1/4; 75 feet N. 35° W. of bridge on east-west road Drilled: August 15, 1938

Elevation: 234 feet Water level: 17.0 feet

No.	Depth	Thick.	Description of Strata
			Naheola formation
1	--------	1.0	Topsoil: grayish brown sand
2	1.0	4.1	Clay, red limonitic; interlaminated with silt. Sample C-1
3	5.1	8.0	Clay, brown to dark gray sandy, micaceous, pyritiferous
4	13.1	10.9	Clay, dark gray slightly plastic micaceous; interlaminated with gray sand. Sample P-1
	24.0	24.0	Total

J. E. Toney Property

Test Hole Record 51

Location: T.8 N., R.18 E., Sec. 11, NW.1/4, SW.1/4; 50 feet north of road and 0.2 mile west of bridge Drilled: August 17, 1938

Elevation: 286 feet Water level: 7.6 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	8.0	Topsoil
2	8.0	2.0	Underclay, dark brown to black highly plastic lignitic, silty, micaceous. Sample C-1
3	10.0	4.8	Clay, blue and yellow semi-plastic micaceous. Sample C-2
			Naheola formation ? (indicated by ceramic tests)
4	14.8	12.2	Clay, slate gray semi-plastic lignitic, pyritiferous; interlaminated with sand and silt. Sample P-1
5	27.0	1.2	Sand, dark green micaceous, glauconitic ?, argillaceous
6	28.2	7.8	Clay, dark brown to black slightly plastic lignitic, micaceous, pyritiferous; interlaminated with glauconitic ? sand
	36.0	36.0	Total

J. E. TONEY PROPERTY

TEST HOLE RECORD 54

Location: T.8 N., R.18 E., Sec. 10, NE.1/4, NE.1/4; 25 feet south of road and 0.5 mile west of bridge in Sec. 11 Drilled: August 22-23, 1938

Elevation: 298 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	2.9	Topsoil: grayish white sandy loam
2	2.9	8.9	Sand, reddish brown grit-bearing, slightly argillaceous; lower contact marked by concentration of limonite
			Fearn Springs formation
3	11.8	5.7	Clay, light gray fine grained plastic sandy, micaceous; grades downward to bed 4. Sample P-1
4	17.5	2.6	Silt, brown to gray semi-plastic sandy, slightly micaceous
5	20.1	12.3	Sand, yellow and gray fine grained silty, micaceous; contains clay partings
6	32.4	4.6	Sand, white and yellow fine grained micaceous
	37.0	37.0	Total

H. S. WEDGEWORTH PROPERTY

TEST HOLE RECORD 56

Location: T.8 N., R.18 E., Sec. 9, SE.1/4, SW.1/4; 50 feet south of the road 0.3 mile east of bridge in Sec. 9 Drilled: August 24, 1938

Elevation: 258 feet Water level: 14.4 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	1.3	Topsoil: gray sand
2	1.3	6.7	Sand, red fine grained semi-plastic argillaceous, limonitic
3	8.0	1.0	Lignite, Sample C-1
4	9.0	2.0	Underclay, slate gray plastic sandy; grades downward to bed 5
5	11.0	6.0	Sand, gray fine grained semi-plastic argillaceous, limonitic; contains clay pebbles; lower contact marked by concentration of limonite
			Naheola formation
6	17.0	18.5	Clay, black to dark gray plastic lignitic, highly micaceous; upper part interbedded with dark green glauconitic sand. Sample P-1 (7.8 feet)
	35.5	35.5	Total

H. S. WEDGEWORTH PROPERTY

TEST HOLE RECORD 59

Location: T.8 N., R.18 E., Sec. 9, SE.1/4, SE.1/4; 15 feet south of road and 0.5 mile east of bridge in Sec. 9 Drilled August 24, 1938

Elevation: 257 feet Water level: 23.5 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation ?
1	--------	1.3	Topsoil
2	1.3	4.7	Clay, light brown and gray micaceous; interbedded with sand
3	6.0	1.8	Sand, light yellow to red very fine grained micaceous, limonitic
			Naheola formation
4	7.8	3.7	Clay, lignitic, limonitic, very micaceous; interbedded with yellow sand and silt. Sample C-1
5	11.5	26.0	Clay, dark brown to black lignitic, pyritiferous; interbedded with fine grained dark green glauconitic? sand. Sample P-1
	37.5	37.5	Total

FIRST NATIONAL BANK OF MERIDIAN PROPERTY

TEST HOLE RECORD 60

Location: T.8 N., R.18 E., Sec .17, NE.1/4, SW.1/4; top of first road cut north of bridge in Sec. 17 Drilled: September 6, 1938

Elevation: 244 feet Water level: 14.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	0.6	Topsoil: grayish brown sand
2	0.6	1.0	Sand, grayish brown medium to fine grained micaceous
3	10.6	3.8	Clay, gray silty, micaceous. Sample C-1
4	14.4	1.5	Lignite. Sample C-2
5	15.9	17.5	Clay, dark grayish brown plastic sandy, micaceous, limonitic
	33.4	33.4	Total

E. E. SKINNER PROPERTY

TEST HOLE RECORD 61

Location: T.8 N., R.18 E., Sec. 17, SE.1/4, NW.1/4; 0.3 mile northeast of bridge in Sec. 17 and 50 feet north of road Drilled: August 29, 1938

Elevation: 297 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	3.7	Topsoil: red limonitic micaceous sand.
2	3.7	3.6	Clay, dark red slightly plastic sandy, micaceous, limonitic. Sample C-1
3	7.3	1.7	Sand, red and yellow highly plastic argillaceous, micaceous
4	9.0	3.4	Clay, gray and yellow semi-plastic sandy, limonitic, micaceous
5	12.4	4.6	Clay, dark brown to black slightly plastic silty, micaceous, lignitic. Sample C-3
	17.0	17.0	Total

E. R. CROOKER PROPERTY

TEST HOLE RECORD 63

Location: T.8 N., R.18 E., Sec. 19, NW.1/4, SW.1/4; 20 feet north of the road and 410 feet east of the first road junction east of Lauderdale Drilled: August 30, 1938

Elevation: 265 feet Water level: 20.9 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	....	1.6	Topsoil: yellow sand
2	1.6	6.4	Clay, yellow sandy, micaceous, limonitic
3	8.0	6.5	Sand, yellow fine grained argillaceous, very micaceous
4	14.5	2.0	Clay, yellow and gray very micaceous. Sample C-1
5	16.5	4.2	Sand, yellow and gray fine grained slightly argillaceous, very micaceous
6	20.7	17.0	Clay, dark gray very plastic silty, limonitic, lignitic. Sample P-1
7	37.7	4.4	Grit, dark brown slightly micaceous, limonitic
	42.1	42.1	Total

Ed Cannady Property

Test Hole Record 64

Location: T.9 N., R.18 E., Sec. 32, SW.1/4, SW.1/4; 1200 feet north of Lauderdale-Kemper County line on north side of road Drilled: August 31, 1938

Elevation: 296 feet Water level: 39.6 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	....	2.2	Topsoil: yellowish gray grit-bearing sand
2	2.2	4.0	Sand, red coarse-grained, grit-bearing argillaceous, micaceous
			Fearn Springs formation
3	6.2	5.2	Clay, light gray to red. Sample P-1
4	11.4	0.7	Lignite
5	12.1	10.2	Clay, gray highly plastic lignitic, micaceous; grades downward into sandy clay. Sample P-2
6	22.3	18.9	Silt and sand, brownish yellow to red argillaceous, micaceous; interbedded with fine and coarse grained sand becoming coarser grained toward the base. Lower half of bed is a grit-bearing sand containing clay pebbles as much as 1 inch in diameter
	41.2	41.2	Total

MRS. WHITE PROPERTY

TEST HOLE RECORD 65

Location: T.9 N., R.18 E., Sec. 31, SW.1/4, SE.1/4; 20 feet north of east-west road and 0.6 mile east of U. S. 45 in Kemper County Drilled: August 30, 1938

Elevation: 256 feet Water level: 6.5 feet

No.	Depth	Thick.	Description of Strata
			Naheola formation
1	--------	0.8	Topsoil
2	0.8	3.2	Clay, brownish yellow plastic micaceous, limonitic; interbedded with fine grained sand. Sample C-1
3	4.0	3.5	Clay, lignitic, highly micaceous, pyritiferous; interlaminated with dark greenish gray sand. Sample P-1
4	7.5	6.5	Sand, dark gray to green argillaceous, very micaceous, slightly lignitic, glauconitic ?, pyritiferous
5	14.0	2.5	Clay, dark gray sandy, micaceous; interlaminated with sand. Sample C-2
6	16.5	4.5	Sand, dark gray argillaceous, very micaceous, lignitic. Sample C-3
7	21.0	4.0	Clay, dark gray micaceous, lignitic; interlaminated with gray sand
8	25.0	2.0	Sand, dark gray
9	27.0	3.0	Clay, dark gray
10	30.0	3.0	Sand, dark gray
	23.0	23.0	Total

EARNEST BROWN PROPERTY

TEST HOLE RECORD 66

Location: T.8 N., R.18 E., Sec. 5, NW.1/4, NE.1/4, Lot 2; 25 feet north of east-west road and 850 feet east of the Mobile & Ohio Railroad Drilled: September 1, 1938

Elevation: 217 feet Water level: 16.2 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	1.0	Topsoil
2	1.0	4.5	Clay, brownish red plastic sandy, micaceous, limonitic. Sample C-1
3	5.5	5.5	Clay, light gray plastic very sandy, slightly micaceous. Sample C-2
			Naheola formation
4	11.0	4.0	Clay, dark steel gray very silty and sandy, micaceous, pyritiferous. Sample C-3
5	15.0	1.2	Silt, steel gray argillaceous, micaceous. Sample C-4
6	16.2	16.0	Clay, dark steel gray plastic sandy, micaceous. Sample P-1
	32.2	32.2	Total

E. R. CROOKER PROPERTY

TEST HOLE RECORD 68

Location: T.8 N., R.18 E., Sec. 19, NW.1/4, SW.1/4; 20 feet north of road and 410 feet east of first road junction east of Lauderdale Drilled: September 1, 1938

Elevation: 275 feet Water level: 18.0 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	9.0	Clay, gray and yellow semi-plastic silty, limonitic. Sample P-1
2	9.0	16.0	Sand, light gray coarse grained, grit bearing, micaceous; includes pebbles of clay
	25.0	25.0	Total

SAM MEYER PROPERTY

TEST HOLE RECORD 70

Location: T.8 N., R.18 E., Sec. 4, NE.1/4, NW.1/4, Lot 6; 60 feet north of road and 1.0 mile east of Mobile & Ohio Railroad Drilled: September 6, 1938

Elevation: 223 feet Water level: 5.7 feet

No.	Depth	Thick.	Description of Strata
			Naheola formation
1	--------	0.1	Topsoil
2	0.1	5.6	Sand, red to brown very argillaceous, highly micaceous, limonitic
3	5.7	3.6	Clay, dark slate gray plastic sandy, very micaceous, lignitic. Sample C-1
4	9.3	5.9	Sand, brown to gray fine grained very micaceous, lignitic, limonitic. Sample C-2
5	15.2	20.8	Clay, gray sandy, very micaceous, pyritiferous. Sample P-1
	36.0	36.0	Total

H. C. HATCHER PROPERTY

TEST HOLE RECORD 71

Location: T.8 N., R.18 E., Sec. 5, SE.1/4, NW.1/4, Lot 11; 185 feet N. 55° E. of Mobile & Ohio Railroad crossing Drilled: September 1, 1938

Elevation: 288 feet Water level: 22.5 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	0.2	Topsoil
2	0.2	5.3	Sand, light reddish brown coarse grained, grit-bearing; contains a few pebbles of light brown clay
			Fearn Springs formation
3	5.5	9.3	Clay, reddish brown to yellow plastic sandy; grades downward into bed 4. Sample C-1
4	14.8	8.8	Sand, dark slate gray very fine grained semi-plastic argillaceous, highly micaceous. Sample P-1
			Naheola formation
5	23.6	9.3	Clay, dark brown to black fine grained plastic sandy, micaceous, pyritiferous; contains scattered laminae of sand. Sample P-2
	32.9	32.9	Total

H. C. HATCHER PROPERTY

TEST HOLE RECORD 73

Location: T.8 N., R.18 E., Sec. 5, NE.1/4, NW.1/4; 0.7 mile north of bridge in the SW.1/4 of Sec. 5 Drilled: September 8, 1938

Elevation: 254 feet Water level: 26.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	0.3	Topsoil
2	0.3	2.7	Sand, brownish yellow argillaceous, slightly micaceous
3	3.0	4.0	Clay, reddish yellow micaceous, sandy
4	7.0	4.0	Clay, gray plastic. Sample P-1
5	11.0	0.6	Clay, light brown to red; interbedded with lignitic clay
6	11.6	3.0	Clay, similar to bed 4
7	14.6	1.4	Clay, dark gray to brown sandy, very micaceous, lignitic
8	16.0	10.8	Sand, gray slightly plastic carbonaceous, micaceous, sandy, limonitic
9	26.8	1.2	Lignite; interbedded with sand and silt
10	28.0	1.4	Sand, dark gray lignitic, micaceous
	29.4	29.4	Total

W. H. SHEFFIELD PROPERTY

TEST HOLE RECORD 77

Location: T.7 N., R.18 E., Sec. 12, NW.1/4, NW.1/4; in channel of Toomsuba creek Drilled: September 12, 1938

Water level: 0.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	2.8	Lignite. Sample P-1
2	2.8	12.5	Clay, gray highly plastic lignitic, pyritiferous; lower foot interlaminated with greenish gray sand. Samples P-2 (6.0 feet), P-3 (6.5 feet)
	15.3	15.3	Total

Remarks: Samples numbered in descending order.

H. S. HATCHER PROPERTY

TEST HOLE RECORD 78

Location: T.8 N., R.18 E., Sec. 5, NE.1/4, NW.1/4, Lot 3; 50 feet N. 5° E. of a point on the road 0.7 mile north of bridge in SW.1/4, Sec. 5 Drilled: September 13, 1938

Elevation: 257 feet Water level: 26.0 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	--------	6.0	Topsoil
2	6.1	3.2	Clay, red to brown silty, limonitic; interbedded with micaceous sand
3	9.3	2.2	Clay, red to brown highly plastic micaceous, limonitic. Sample P-1
4	11.5	6.8	Sand, light yellow micaceous, limonitic; interbedded with gray and red clay
5	18.3	4.6	Clay, gray and yellow highly plastic; interbedded with silt. Sample P-2
			Naheola formation ?
6	22.9	7.3	Sand and silt, dark gray to black plastic lignitic, micaceous
	30.2	30.2	Total

H. S. HATCHER PROPERTY

TEST HOLE RECORD 80

Location: T.8 N., R.18 E., Sec. 5, NW.1/4, NW.1/4, Lot 4; 1000 feet N. 85° W. of bridge in southwest quarter of Sec. 5 Drilled: September 14, 1938

Elevation: 227 feet Water level: 18.6 feet

No.	Depth	Thick.	Description of Strata
			Fearn Springs formation
1	-- -- -	1.0	Topsoil
2	1.0	8.7	Clay, yellow and gray slightly sandy, micaceous, limonitic. Sample P-1
3	9.7	4.4	Lignite. Sample C-1
4	14.1	6.8	Sand, gray very fine grained plastic argillaceous, micaceous
	20.9	20.9	Total

W. H. SHEFFIELD PROPERTY

TEST HOLE RECORD 81

Location: T.7 N., R.18 E., Sec. 1, NW.1/4, SW. 1/4; 0.8 mile south along farm road from public highway in Sec. 36 Drilled: September 13, 1938

Water level: 7.2 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation ?
1	--------	0.8	Topsoil
2	0.8	6.4	Sand, reddish brown to light gray very argillaceous, micaceous; grades downward to coarse grained sand
3	7.2	1.7	Grit, reddish brown micaceous; contains fragments of clay
			Fearn Springs formation
4	8.9	6.4	Sand, light gray very fine grained micaceous
5	15.3	15.2	Clay, light gray plastic micaceous; interlaminated with fine grained sand in upper part. Sample C-1
	30.5	30.5	Total

H. S. HATCHER PROPERTY

TEST HOLE RECORD 82

Location: T.8 N., R.18 E., Sec. 5, NW.1/4, NW.1/4, Lot 4; 0.5 mile north of bridge in SW.1/4 Sec. 5 and 50 feet east of road Drilled: September 14, 1938

Elevation: 248 feet

Water level: 8.4 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	4.7	Sand, light yellow medium grained, grit-bearing
2	4.7	0.4	Clay, sandy, silty limonitic
3	5.1	2.1	Sand, coarse grained
4	7.2	4.8	Sand, yellow medium grained; contains many fragments of gray clay
			Fearn Springs formation
5	12.0	4.8	Clay, very dark gray; interlaminated with micaceous sand. Sample P-1
6	16.8	3.8	Clay, dark slate gray plastic sandy micaceous; grades downward to fine grained sand
	20.6	20.6	Total

H. C. HATCHER PROPERTY

TEST HOLE RECORD 83

Location: T.8 N., R.18 E., Sec. 5, SE.1/4, SW.1/4, Lot 6; 700 feet N. 70° E. of a point on the road 0.5 mile north of bridge in the SW.1/4 of Sec. 5 Drilled: September 20, 1938

Elevation: 257 feet Water level: 20.0 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation
1	--------	4.5	Sand, red very coarse grained
2	4.5	3.5	Sand, yellow fine grained; grades downward to coarse grit-bearing sand
3	8.0	4.0	Grit, white to yellow; contains small quartz pebbles. Sample C-1
			Fearn Springs formation
4	12.0	4.0	Clay, yellowish gray plastic areanaceous, micaceous. Sample C-2
5	16.0	9.0	Clay, dark steel gray areanaceous, micaceous. Sample P-1
	25.0	25.0	Total

JOHN DICKSON PROPERTY

TEST HOLE RECORD 85

Location: T.8 N., R.17 E., Sec. 27, NW.1/4, SE.1/4; 0.7 mile east along road from junction with U. S. 45 in Sec. 27 and 60 feet north of road Drilled: September 25, 1938

Elevation: 324 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Ackerman formation: Upper member
1	--------	0.4	Sand, grayish white silty
2	0.4	6.6	Clay, red plastic sandy micaceous lignitic. Sample P-1
3	7.0	0.1	Lignite
4	7.1	2.3	Clay, brown to gray slightly sandy lignitic; 0.2 of a foot of impure lignite at base. Sample P-2
5	9.4	7.7	Sand, yellow to gray slightly micaceous; grades downward to bed 6
6	17.1	5.8	Silt and clay brownish gray plastic micaceous
7	22.9	5.6	Clay, steel gray plastic sandy, micaceous, lignitic. Sample P-3
			Ackerman formation: Lower member
8	28.5	9.5	Sand, light gray to yellow fine grained micaceous; contains partings and scattered fragments of clay
9	38.0	15.5	Sand and silt, brownish gray to yellow fine grained argillaceous, slightly lignitic; grades downward to coarse grained sand which includes fragments of gray clay
	53.5	53.5	Total

JAMES DICKSON PROPERTY
TEST HOLE RECORD 86

Location: T.8 N., R.17 E., Sec. 27, NE.1/4, NE.1/4; 90 feet northwest of road and 0.8 mile east of junction with U. S. 45 in Sec. 27 Drilled: October 12, 1938

Elevation: 342 feet Water level: 27.8 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation: Upper member
1	--------	0.9	Topsoil
2	0.9	3.2	Sand, light brown to gray slightly plastic limonitic, lignitic; contains partings of gray clay. Sample C-1
3	4.1	10.8	Clay, light gray shaly areanaceous, lignitic, micaceous. Sample P-1
4	14.9	0.7	Lignite. Sample C-2
5	15.6	12.2	Clay, similar to bed 3. Sample P-2
6	27.8	0.7	Lignite. Equivalent to bed 9, test hole 90 and to bed 3, test hole 85. Sample C-3
7	28.5	4.5	Clay, gray slightly plastic micaceous highly lignitic. Sample P-3
8	33.0	0.8	Lignite. Sample C-4
9	33.8	30.5	Silt, gray to black sandy micaceous, lignitic. Sample C-5
	64.3	64.3	Total

H. C. HATCHER PROPERTY
TEST HOLE RECORD 87

Location: T.8 N., R.18 E., Sec. 5, SW.1/4, NW.1/4, Lot 12; 200 feet west of road and 0.4 mile north of bridge in SW.1/4 of Sec. 5 Drilled: September 21, 1938

Elevation: 237 feet Water level: 25.0 feet

No.	Depth	Thick.	Description of Strata
			Naheola formation
1	--------	0.3	Topsoil
2	0.3	6.1	Sand, brown argillaceous, slightly micaceous
3	6.4	1.0	Clay, light gray sandy slightly micaceous
4	7.4	7.0	Sand, light brown to gray very argillaceous, slightly micaceous; interbedded with clay
5	14.4	2.0	Sand, dark steel gray very argillaceous slightly micaceous
6	16.4	1.2	Clay, dark gray sandy, slightly micaceous
7	17.6	3.2	Sand, dark gray argillaceous very micaceous
8	20.8	3.6	Clay, similar to bed 6
9	24.4	1.0	Sand, argillaceous very micaceous, carbonaceous
10	25.4	10.6	Clay, similar to bed 6. Sample P-1
	36.0	36.0	Total

James Dickson Property

Test Hole Record 89

Location: T.8 N., R.17 E., Sec. 27, 1200 feet S. 10° E. of a point on road 0.8 mile east of junction with U. S. 45 in Sec. 27 Drilled: September 23, 1938

Elevation: 293 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Ackerman formation: Lower member
1	--------	0.6	Topsoil
2	0.6	35.0	Sand, variegated shades of yellow, red, and brown fine grained silty slightly argillaceous, micaceous
	35.6	35.6	Total

James Dickson Property

Test Hole Record 90

Location: T.8 N., R.17 E., Sec. 27, NW.1/4, NE.1/4; 625 feet north of the road 0.7 mile east of junction U. S. 45 in Sec. 27 Drilled: September 26, 1938

Elevation: 331 feet Water level: 21.5 feet

No.	Depth	Thick.	Description of Strata
			Ackerman formation: Upper member
1	--------	0.6	Topsoil
2	0.6	4.2	Clay, reddish brown and yellow semi-plastic silty, slightly micaceous, limonitic. Sample C-1
3	4.8	10.2	Clay, light gray and yellow slightly plastic very sandy, micaceous, limonitic. Sample P-1
4	15.0	6.0	Clay and silt, light gray very plastic. Sample P-2
5	21.0	2.0	Lignite. Sample C-2
6	23.0	5.4	Clay, dark brown and gray highly plastic lignitic. Sample P-3
7	28.4	0.6	Lignite. Equivalent to bed 4, test hole 86. Sample C-3
8	29.0	18.0	Sand and silt, slate gray lignitic, slighty micaceous, pyritiferous; interlaminated with greenish gray sand
9	47.2	1.2	Lignite, equivalent to bed 6, test hole 86, and bed 3, test hole 85. Sample C-4
	48.4	48.4	Total

L. D. GUNN PROPERTY
TEST HOLE RECORD 93

Location: T.7 N., R.16 E., Sec. 1, SE.1/4, SE.1/4; 1900 feet N. 30° E. of a point along road 580 feet east of southwest section corner Drilled: October 5, 1938

Elevation: 458 feet Water level: 13.0 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	1.5	Topsoil
2	1.5	11.4	Clay, light gray to red plastic sandy, very micaceous, limonitic. Equivalent to beds 1 and 2, test hole 93A. Sample C-1
3	12.9	3.8	Silt and clay, dark gray to black. Sample P-1
4	16.7	3.4	Clay, dark brown to black, pyritiferous. Sample C-2
5	20.1	1.9	Silt, bluish gray, micaceous. Sample C-3
6	22.0	8.0	Clay and silt, brownish gray. Samples C-4 (4 feet), C-5 (3.6 feet)
7	30.4	2.6	Lignite. Equivalent to bed 6, test hole 93A, bed 7, test hole 94, bed 5, test hole 95, beds 8, 9, and 10, test hole 92
8	33.0	3.0	Clay, grayish brown to black, lignitic, micaceous; thin lignite at base
9	36.0	9.5	Silt and clay, gray lignitic, micaceous. Sample P-2
	45.5	45.5	Total

J. B. GUNN PROPERTY
TEST HOLE RECORD 93A

Location: T.7 N., R.16 E., Sec. 1, SE.1/4, SW.1/4; 60 feet east of test hole 93 Drilled: September 20, 1939

Elevation: 452 feet Water level: 17.0 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	11.0	Clay, reddish brown and gray very plastic sandy, slightly micaceous. Sample P-2
2	11.0	1.0	Lignite. Equivalent to bed 2, test hole 93 and bed 4, test hole 260
3	12.0	1.8	Clay, dark steel gray plastic slightly areanaceous
4	13.8	3.0	Sand, dark gray argillaceous
5	16.8	6.8	Clay, steel gray plastic slightly areanaceous
6	23.6	6.1	Lignite, grading downward to gray underclay. Equivalent to bed 8, test hole 120 and beds 7 and 8, test hole 93
7	29.7	2.8	Sand, steel gray argillaceous, micaceous
	32.5	32.5	Total

Barney Green Property

Test Hole Record 95

Location: T.7 N., R.16 E., Sec. 1, NE.1/4, SE.1/4; Drilled: October 11, 1938

Elevation: 465 feet Water level: 54.0 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	--------	1.6	Topsoil
2	1.6	7.4	Clay, gray to light brown. Sample C-1
3	9.0	5.9	Sand, light yellow silty, micaceous. Sample C-2
4	14.9	7.9	Clay, dark gray semi-plastic. Samples C-3 (5.5 feet), C-4 (1.6 feet)
5	22.8	5.3	Lignite, argillaceous. Equivalent to bed 7 and 8, test hole 94. Samples C-5 (2.0 feet), C-6 (1.4 feet), C-7 (1.6 feet)
6	28.1	17.3	Silt and sand, gray plastic argillaceous, pyritiferous; grades downward into clay. Samples C-8 (4.7 feet), C-9 (2.4 feet), C-10 (2.6 feet), C11 (6.3 feet)
7	45.4	0.6	Lignite, argillaceous
8	46.0	7.7	Clay, gray plastic, slightly micaceous. Samples C-12 (3.7 feet), C-13 (1.9 feet)
9	53.7	5.8	Clay, dark gray plastic slightly micaceous, pyritiferous. Samples C-14 (1.6 feet), C-15 (1.5 feet)
10	59.5	6.1	Silt, dark gray plastic sandy, slightly micaceous, sideritic. Samples C-16 (3.0 feet), C-17 (4.6 feet)
11	65.6	6.9	Clay, dark gray plastic, micaceous. Samples C-18 (1.8 feet), C-19 (2.5 feet), C-20 (2.5 feet)
	72.5	72.5	Total

Remarks: Samples numbered in descending order.

W. C. PARKER PROPERTY

TEST HOLE RECORD 97

Location: T.7 N., R.17 E., Sec. 7, NW.1/4, NW.1/4; 50 feet east of road and 0.4 of a mile S. SE. of intersection with U. S. 45 in Sec. 6 Drilled: October 17, 1938

Elevation: 432 feet Water level: 24.0 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.2	Topsoil
2	0.2	2.3	Clay, brown and gray plastic. Equivalent to lower part of bed 8, test hole 98. Sample C-1
3	2.5	7.1	Clay, gray plastic slightly micaceous, limonitic. Sample C-2
4	9.6	0.8	Clay, dark gray plastic silty. Sample C-3
5	10.4	2.0	Clay, steel gray plastic, limonitic. Sample C-4
6	12.4	3.1	Clay, light gray plastic sandy, slightly micaceous. Sample C-5
7	15.5	9.0	Clay, steel gray plastic sandy, micaceous. Samples C-6 (1.5 feet), P-1 (7.5 feet)
8	24.5	3.5	Lignite. Sample C-7
9	28.0	4.0	Clay, dark gray areanaceous; grades downward to bed 10. Sample C-8
10	32.0	9.8	Sand, steel gray very fine grained argillaceous, micaceous, pyritiferous. Sample C-9
	41.8	41.8	Total

Remarks: Samples numbered in descending order.

J. B. GUNN PROPERTY

TEST HOLE RECORD 98

Location: T.7 N., R.17 E., Sec. 6, SW.1/4, SW. 1/4; 0.15 mile S. 15° E. of intersection of U. S. 45 in Sec. 6 Drilled: October 12, 1938

Elevation: 448 feet Water level: 17.1 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.1	Topsoil
2	0.1	8.2	Clay, brown, red, and gray limonitic; interlaminated with sand. Sample C-1
3	8.3	2.7	Clay, light gray to dark brown plastic sandy. Sample C-2
4	11.0	6.1	Clay, light brown to dark gray highly limonitic, sideritic. Sample C-3
5	17.1	0.9	Lignite. Sample C-4
6	18.0	1.3	Clay, dark slate gray lignitic, pyritiferous. Sample C-5
7	19.3	3.0	Lignite. Sample P-1
8	22.3	8.6	Clay, plastic highly lignitic; grades downward to non-lignitic pyritiferous clay. Lower half equivalent to bed 2, test hole 97. Sample P-2
	30.9	30.9	Total

J. B. GUNN PROPERTY

TEST HOLE RECORD 100

Location: T.7 N., R.16 E.,, Sec. 11, SW.1/4, NE.1/4; 0.9 mile N. 60° W. along road from junction with U. S. 45 in NE.1/4 of Sec. 12 Drilled: October 14, 1938

Elevation: 420 feet Water level: 15.7 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.7	Topsoil
2	0.7	2.2	Sand, reddish brown argillaceous, limonitic. Sample C-1
3	2.9	4.5	Clay, brown, red, and gray areanaceous, micaceous. Sample C-2
4	7.4	4.7	Clay, light gray plastic sandy, lignitic, micaceous. Sample C-3
5	12.1	3.6	Clay and silt, light gray streaked with yellow sandy. Sample C-4
6	15.7	0.4	Lignite, highly argillaceous. Equivalent to bed 3, test hole 258 and bed 10, test hole 259
7	16.1	9.4	Clay and silt, light blue, micaceous, limonitic, pyritiferous. Sample C-5
8	25.5	2.7	Silt, light gray to brown, pyritiferous; highly limonitic. Sample C-6
9	28.2	8.8	Clay and silt, light gray micaceous. Sample C-7
10	37.0	1.1	Clay, red and gray sandy micaceous, limonitic
11	38.1	6.6	Clay, gray and red plastic micaceous; grades downward to gray sand
	44.7	44.7	Total

EARNEST BROWN PROPERTY

TEST HOLE RECORD 101

Location: T.7 N., R.17 E., Sec. 9, NW.1/4, SW.1/4; 1.4 miles N. 30° E. of road intersection in Sec. 17 Drilled: October 20, 1938

Elevation: 490 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	--------	5.4	Topsoil
2	5.4	1.7	Sand and clay, yellow; grades downward to bed 3
3	7.1	4.9	Clay, light gray slightly plastic. Sample C-1
4	12.0	1.4	Clay, light brown lignitic. Sample C-2
5	13.4	0.6	Lignite. Equivalent to bed 3, test hole 263
6	14.0	14.9	Clay, gray plastic sandy, slightly micaceous. Samples C-3 (5.4 feet), C-4 (2.8 feet), C-5 (2.3 feet), C-6 (3.4 feet)
7	28.9	13.2	Sand, gray semi-plastic argillaceous, micaceous; grades downward to lignitic clay. Samples C-7 (2.6 feet), C-8 (2.0 feet), C-9 (6.1 feet)
8	42.1	0.7	Lignite. Equivalent to bed 4, test hole 102
	42.8	42.8	Total

Remarks: Samples numbered in descending order.

HERMAN BROWN PROPERTY

TEST HOLE RECORD 102

Location: T.7 N., R.17 E., Sec. 9, NW.1/4, SW.1/4; 800 feet N. 15° E. along road from test hole 101 Drilled: October 21, 1938

Elevation: 446 feet Water level: 28.8 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	--------	7.4	Clay and sand, brown to yellow. Sample C-1
2	7.4	2.1	Sand, yellow and brown laminated. Sample C-2
3	9.5	18.2	Silt and sand, gray. Sample C-3
4	27.7	2.3	Lignite. Equivalent to bed 8, test hole 101. Sample C-4
5	30.0	6.9	Clay and silt, brown and dark gray lignitic, micaceous. Sample C-5
	36.9	36.9	Total

Remarks: Drilling was begun immediately beneath the outcrop of lignite, the equivalent of bed 5, test hole 101.

MRS. LILLA TINNAN PROPERTY

TEST HOLE RECORD 108

Location: T.7 N., R.16 E., Sec. 3, SE.1/4, SE.1/4; 0.35 mile west along road from intersection in SE.1/4, SW.1/4, Sec. 2 Drilled: November 7, 1938

Elevation: 431 feet Water level: 27.6 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	1.2	Topsoil
2	1.2	5.0	Clay, reddish brown fine grained plastic sandy, limonitic, sideritic. Samples C-1 (2.3 feet), C-2 (2.7 feet)
3	6.2	16.1	Clay and sand, variegated semi-plastic. Samples C-3 (1.5 feet), P-1 (14.0 feet)
4	22.3	5.6	Silt and clay, variegated very plastic, very fine grained slightly sandy, slightly micaceous. Sample P-2
5	27.9	20.7	Clay, variegated very plastic; somewhat sandy in parts. Samples P-3 (4.1 feet), C-4 (8.9 feet
	48.6	48.6	Total

Remarks: Samples numbered according to descending order.

MRS. WILLIE HOBGOOD PROPERTY

TEST HOLE RECORD 109

Location: T.7 N., R.16 E., Sec. 11, SE.1/4, NE.1/4; 0.2 mile south 15° W. along road from intersection of NE.1/4, NE.1/4 of Sec. 11 Drilled: October 31, 1938

Elevation: 436 feet Water level: 19.0 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.5	Topsoil
2	0.5	3.6	Sand, yellow medium grained argillaceous
3	4.1	4.8	Clay, yellow and gray plastic sandy, limonitic. Sample P-1
4	8.9	2.4	Clay, light gray slightly plastic. Sample C-1
5	11.3	4.2	Clay, yellow and gray plastic sandy. Sample C-2
6	15.6	2.5	Clay, dark gray plastic sandy. Sample C-3
7	18.1	1.3	Silt, dark gray and brown sandy, slightly micaceous
8	19.4	10.3	Clay, dark gray sandy, slightly micaceous, pyritiferous. Samples C-4 (4.7 feet), C-5 (4.2 feet)
9	29.7	0.3	Silt and sand, dark gray slightly argillaceous, lignitic, pyritiferous
	30.0	30.0	Total

G. B. Harvey Property

Test Hole Record 110

Location: T.7 N., R.16 E., Sec. 4, SE.1/4, SE.1/4; 40 feet north of the road and 0.5 mile east of the intersection in the SE.1/4, SE.1/4, Sec. 5 Drilled: November 8, 1938

Elevation: 453 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Colluvium
1	———	8.7	Sand, reddish yellow and light gray argillaceous. Sample C-1
			Holly Springs formation
2	8.7	19.4	Clay, gray slightly plastic, micaceous, pyritiferous. Samples C-2 (4.0 feet), C-3 (3.5 feet), C-4 (2.7 feet), C-5 (5.0 feet)
3	28.1	0.6	Sand, brown silty
4	28.7	5.8	Clay and silt, gray slightly plastic limonitic; interlaminated with yellow sand. Sample C-6
5	34.5	0.8	Clay and silt, gray semi-plastic. Sample C-7
6	35.3	3.0	Sand and silt, gray to yellow, pyritiferous. Sample C-8
	38.3	38.3	Total

Remarks: Sample P-1 (26.3 feet) including beds 2, 3, 4, and 5. Samples numbered in descending order.

W. E. McCarty Property

Test Hole Record 112

Location: T.8 N., R.16 E., Sec. 32, SW.1/4, SE.1/4; 308 feet east along road from intersection on section line Drilled: November 7, 1938

Elevation: 480 feet Water level: 23.6 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	--------	0.8	Topsoil
2	0.8	9.6	Clay, light brown and gray. Samples C-1 (7.8 feet), C-2 (1.8 feet)
3	10.4	0.8	Silt and clay, very dark brown. Sample C-3
4	11.2	2.4	Silt, light brown plastic sandy, limonitic, sideritic. Sample C-4
5	13.6	3.8	Silt and clay, light to dark gray plastic, micaceous. Sample C-5
6	17.4	0.6	Lignite. Equivalent to bed 4, test hole 112A. Sample C-6
7	18.0	5.9	Sand, steel gray fine grained argillaceous, micaceous, pyritiferous. Sample C-7
8	23.9	8.4	Clay, steel gray plastic sandy, micaceous, lignitic, equivalent to the upper part of bed 4, test hole 118. Sample C-8
	32.3	32.3	Total

Remarks: Bed 1 lies immediately below bed 4 of test hole 116.

W. E. McCarty Property

Test Hole Record 112A

Location: T.8 N., R.16 E., Sec. 32, SW.1/4, SE.1/4; 308 feet east along road from intersection on section line Drilled: September 20, 1939

Elevation: 480 feet Water level: 23.6 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	--------	5.0	Sand, reddish brown slightly argillaceous. Equivalent to lower part of bed 4, test hole 116
2	5.0	7.0	Clay, light grayish brown very sandy. Sample P-1
3	12.0	6.0	Silt and sand, steel gray slightly argillaceous
4	18.0	0.6	Lignite. Equivalent to bed 2, test hole 93A and bed 4, test hole 260 and bed 6, test hole 112
	18.0	18.0	Total

George Brown Property

Test Hole Record 114

Location: T.7 N., R.16 E., Sec. 9, SW.1/4, NW.1/4; 0.63 mile south along road from intersection to SE.1/4, SE.1/4 of Sec. 5 Drilled: November 14, 1938

Elevation: 444 feet Water level: 17.4 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation ?
1	....	0.9	Topsoil: fine grained gray sand
2	0.9	4.3	Sand, fine grained, micaceous
3	5.2	0.5	Sand, yellow, limonitic
			Holly Springs formation
4	5.7	7.8	Clay, yellow plastic limonitic, micaceous; interbedded with sand. Sample C-1
5	13.5	3.9	Clay, light gray to yellow, very plastic silty, micaceous, limonitic. Sample C-2
6	17.4	4.1	Clay, dark gray semi-plastic, micaceous, limonitic; interbedded with sand
7	21.5	8.8	Clay, dark slate gray very plastic sandy, pyritiferous
8	30.3	5.3	Clay, brown very plastic, micaceous, limonitic
	35.6	35.6	Total

Remarks: Sample P-1 (29.9 feet) taken between depths of 5.7 and 35.6 feet.

W. E. McCarty Property

Test Hole Record 116

Location: T.8 N., R.16 E., Sec. 32, SE.1/4, SW.1/4; Drilled: November 9, 1938

Elevation: 514 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	1.5	Topsoil
2	1.5	7.5	Clay, red slightly plastic very sandy, micaceous. Sample C-1
3	9.0	3.0	Clay, light gray sandy, highly micaceous. Sample C-2
4	12.0	23.5	Sand, red and gray micaceous, limonitic. Equivalent to bed 1 of test hole 112
	35.5	35.5	Total

LYLE ESTATE PROPERTY

TEST HOLE RECORD 118

Location: T.8 N., R.16 E., Sec. 32, SW.1/4, SW.1/4; Drilled: November 10, 1938

Elevation: 430 feet Water level: 29.2 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	2.4	Topsoil: light gray sand and silt
2	2.4	2.5	Sand, light brown; interbedded with red and gray clay. Sample C-1
3	4.9	14.4	Clay, light gray sandy, micaceous, limonitic. Sample C-2
4	19.3	0.9	Lignite; interbedded in lower part with yellow clay. Sample C-3
5	20.2	15.0	Silt, gray plastic argillaceous, pyritiferous, sideritic; interbedded and intermixed with fine micaceous sand. Sample C-4
6	35.2	5.0	Lignite, pyritiferous; interbedded with clay. Samples C-5 (3.0 feet), and C-6 (2.0 feet)
7	40.2	4.9	Silt, gray lignitic, micaceous, pyritiferous, sandy. Sample C-7
	45.1	45.1	Total

Remarks: Samples listed in descending order. Upper part of bed 3 is equivalent to bed 8, Test Hole 112.

BEN TINNIN PROPERTY

TEST HOLE RECORD 120

Location: T.7 N., R.16 E., Sec. 3, NW.1/4, NW.1/4; 0.65 mile east of road intersection in the SE.1/4, Sec. 33, T.8 N., R.16 E., and 30 feet south of road Drilled: November 14, 1938

Elevation: 472 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.9	Topsoil: very fine gray sand
2	0.9	3.9	Sand, red and gray fine grained; interbedded with gray clay. Sample C-1
3	4.8	6.6	Clay, gray; interbedded with silt. Sample C-2
4	11.4	5.8	Clay, gray sandy ironstained. Sample C-3
5	17.2	0.7	Sand, dark brown lignitic
6	17.9	16.1	Sand, silt, and clay, blue to gray highly plastic micaceous. Sample C-4
7	34.0	1.4	Clay, brown and gray. Sample C-5
8	35.4	3.8	Lignite. Sample C-6
9	39.2	3.1	Clay, dark brown lignitic, pyritiferous. Sample C-7
10	42.3	2.7	Sand, fine gray argillaceous, micaceous
	45.0	45.0	Total

Remarks: Bed 5 equivalent to bed 4, test hole 260. Bed 8 equivalent to bed 6, Test hole 93-A.

C. B. TINNIN PROPERTY

TEST HOLE RECORD 121

Location: T.7 N., R.16 E., Sec. 4, NE.1/4, SE.1/4; 0.38 mile north of road intersection at Ponta School and 30 feet east of road Drilled: November 15, 1938

Elevation: 432 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.2	Topsoil
2	0.2	1.0	Sand, yellow argillaceous
3	1.2	2.7	Clay, red and gray plastic sandy. Samples C-1 (1.3 feet), and C-2 (1.4 feet)
4	3.9	3.0	Sand, red; grades downward to bed 5
5	6.9	7.3	Clay, gray plastic; interbedded with highly lignitic clay and lignite in lower 2.3 feet. Samples P-1 (4.0 feet), C-3 (2.0 feet), C-4 (1.3 feet)
6	14.2	7.7	Sand, gray argillaceous, micaceous; grades downward to clay at base. Samples C-5 (5.2 feet), and C-6 (2.1 feet)
	21.9	21.9	Total

Remarks: Samples listed in descending order

Ed Ollhoft Property

Test Hole Record 129

Location: T.8 N., R.16 E., Sec. 29, NE.1/4, NW.1/4; 0.45 mile northwest of Brooks' store along state 39 Highway. Drilled: November 22, 1938

Elevation: 428 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	--------	0.1	Topsoil
2	0.1	7.3	Clay, dark brown to gray very plastic lignitic; interlaminated with lignite in lower 0.4 feet. Samples C-1 (1.6 feet), P-1 (5.3 feet)
3	7.4	1.0	Silt, gray limonitic; interbedded with clay and fine sand
4	8.4	9.6	Sand, light gray fine grained argillaceous, micaceous. Sample C-2
5	18.0	16.0	Silt, steel gray very argillaceous, pyritiferous. Sample C-3
	34.0	34.0	Total

Remarks: Samples listed in descending order.

E. G. Mosley Property

Test Hole Record 136

Location: T.8 N., R.16 E., Sec. 5, NE.1/4, SW.1/4; 1.4 miles north of road intersection in NE.1/4, NW.1/4, Sec. 17. Drilled: November 30, 1938

Elevation: 405 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	--------	4.7	Clay, red and gray plastic sandy. Sample C-1
2	4.7	1.7	Lignite; interbedded with clay. Sample C-2
3	6.4	5.0	Clay, gray sandy, micaceous. Sample P-1
4	11.4	9.7	Sand, dark gray micaceous, lignitic, highly silty
5	21.1	0.5	Silt, dark gray to black argillaceous. Sample C-3
	21.6	21.6	Total

T. Blackwell Property

Test Hole Record 140

Location: T. 6 N., R.17 E., Sec. 19, NW.1/4, NE.1/4 Drilled: December 1, 1938
Elevation: 503 feet Water level: 24.9 feet

No.	Depth	Thick.	Description of Strata
			Hatchitigbee formation: Upper member
1	....	4.0	Clay, light gray. Sample C-1
2	4.0	7.9	Sand, brown micaceous. Sample C-2
3	11.9	2.5	Clay, blue-gray to brown plastic highly silty, pyritiferous. Sample C-3
4	14.4	2.5	Lignite. Sample C-4
5	16.9	14.1	Clay, gray to brown sandy; grades downward to fine sand and lignitic silt. Samples C-5 (3.0 feet), and C-6 (6.1 feet)
6	31.0	3.5	Lignite. Sample C-7
7	34.5	2.4	Clay, gray micaceous, sandy. Sample C-8
			Hatchitigbee formation: Lower member
8	36.9	3.1	Sand, fine grained micaceous
	40.0	40.0	Total

Remarks: Samples listed in descending order.

Miss Nettie Coker Property

Test Hole Record 145

Location: T.6 N., R.17 E., Sec. 21, SW.1/4, NW.1/4; 0.6 mile north of road intersection in SE.1/4, SW.1/4, Sec. 21; Drilled: December 6, 1938
Elevation: 491 feet Water level: 21.6 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member
1	....	8.0	Clay, red, yellow, and gray plastic micaceous, slightly sandy. Samples C-1 (5.9 feet), and C-2 (2.1 feet)
2	8.0	1.6	Sand and silt, dark brown argillaceous, lignitic. Sample C-3
3	9.6	15.7	Clay, gray to steel gray plastic slightly sandy, micaceous. Samples C-4 (4.7 feet), C-5 (3.0 feet), C-6 (1.1 feet), C-7 (1.7 feet), C-8 (2.0 feet), and C-9 (3.2 feet)
4	25.3	4.0	Sand and silt, steel gray argillaceous, pyritiferous. Sample C-10
5	29.3	3.4	Clay, steel gray plastic slightly sandy, micaceous, pyritiferous. Sample C-11
	32.7	32.7	Total

Remarks: Samples listed in descending order. Lower part of bed 3 equivalent to beds 2 and 3 of Test hole 150.

MISS NETTIE COKER PROPERTY

TEST HOLE RECORD 150

Location: T.6 N., R.17 E., Sec. 21, SE.1/4, NW.1/4; 0.4 mile northeast of Test hole 195. Drilled: December 16, 1938

Elevation: 476 feet Water level: 44.6 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member
1	....	0.4	Topsoil
2	0.4	5.6	Clay, gray sandy; ironstained. Sample C-1
3	6.0	2.3	Sand and silt, gray to brown. Sample C-2
4	8.3	22.5	Silt and clay, gray semi-plastic sandy, micaceous, pyritiferous. Sample C-3
			Bashi formation: Greensand Marl member
5	30.8	15.2	Sand yellow to light brown glauconitic, silty, fossiliferous
	46.0	46.0	Total

Remarks: Bed 2 equivalent to lower part of bed 3, Test hole 145

L. E. COKER PROPERTY

TEST HOLE RECORD 152

Location: T.6 N., R.17 E., Sec. 20, SW.1/4, SE.1/4; 0.55 mile west of road intersection in SE.1/4, SW.1/4, Sec. 21 Drilled: December 15, 1938

Elevation: 493 feet Water level: 16.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member ?
1	....	0.3	Topsoil
2	0.3	7.7	Clay, gray and red plastic limonitic, micaceous
			Bashi formation: Greensand marl member
3	8.0	8.0	Sand, coarse grained greenish gray glauconitic
4	16.0	11.5	Sand, fine grained gray to green glauconitic, micaceous
	27.5	27.5	Total

Mr. Chambers Property

Test Hole Record 153

Location: T.6 N., R.17 E., Sec. 20, NE.1/4, SW.1/4; 0.35 mile west of Test hole 152 Drilled: December 15, 1938

Elevation: 510 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member
1	--------	0.2	Topsoil
2	0.2	1.4	Sand, yellow fine grained argillaceous
3	1.6	9.4	Clay, gray, yellow, and red sandy. Samples C-1 (6.4 feet), and C-2 (3.0 feet)
4	11.0	4.5	Clay, lignitic; interbedded with silt; grades downward into sand
5	15.5	7.9	Clay, dark greenish gray sandy. Sample C-3
			Bashi formation: Greensand marl member
6	23.4	0.9	Sand, medium grained reddish yellow glauconitic, micaceous, argillaceous
7	24.3	12.5	Sand, silt, and clay, gray to yellow fine grained glauconitic
	36.8	36.8	Total

H. McMullan Property

Test Hole Record 154

Location: T.6 N., R.17 E., Sec. 20, SE.1/4, NW.1/4; 0.38 mile west of Test hole 153 Drilled: December 15, 1938

Elevation: 532 feet Water level: 28.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member ?
1	--------	0.4	Topsoil
2	0.4	3.0	Sand, fine grained light yellow micaceous
3	3.4	7.1	Clay, light gray plastic sandy, micaceous. Sample C-1
4	10.5	0.4	Lignite, argillaceous, sandy. Sample C-2
5	10.9	11.7	Clay, light gray plastic sandy, micaceous, pyritiferous, interlaminated with highly lignitic clay
			Bashi formation: Greensand marl member
6	22.6	6.4	Sand, coarse grained yellow glauconitic, highly micaceous
	29.0	29.0	Total

C. VINSON PROPERTY

TEST HOLE RECORD 168

Location: T.6 N., R.16 E., Sec. 4, NE.1/4, NW.1/4; 600 feet west of road intersection and 100 feet south of road.

Elevation: 370 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Bashi formation: Lower member
1	--------	0.6	Topsoil
2	0.6	3.8	Clay and sand, yellow. Sample C-1
3	4.4	4.5	Sand and silt, yellow to gray. Sample C-2
4	8.9	3.0	Silt, dark gray sandy, pyritiferous, micaceous. Sample C-3
5	11.9	45.2	Sand, gray silty, limonitic; grades to pure sand near base. Samples C-4 (16.5 feet), and C-5 (28.7 feet)
	57.1	57.1	Total

E. B. THOMPSON PROPERTY

TEST HOLE RECORD 169

Location: T.6 N., R.16 E., Sec. 4, NE.1/4, NW.1/4; 800 feet southwest of Test hole 168 Drilled: January 16, 1939

Elevation: 364 feet Water level: 20.2 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Lower member
1	--------	0.9	Topsoil
2	0.9	2.7	Clay, reddish brown very sandy, micaceous. Sample C-1
3	2.6	3.7	Clay and sand, yellow, brown, and white micaceous. Sample C-2
4	7.3	15.3	Silt, gray plastic sandy, pyritiferous; becomes lignitic and highly argillaceous toward base. Samples C-3 (1.6 feet), and C-4 (11.3 feet)
5	22.6	1.0	Lignite, highly argillaceous. Sample C-5
6	23.6	13.6	Clay, dark brown to black plastic highly lignitic. Samples C-6 (6.6 feet), and C-7 (6.7 feet)
7	36.9	2.6	Lignite, highly argillaceous, pyritiferous. Sample C-8
8	39.5	4.0	Clay, brown to black plastic lignitic, slightly sandy. Sample C-9
9	43.5	2.3	Sand and silt, dark grayish green plastic lignitic, micaceous
	44.8	44.8	Total

Remarks: Bed 3 approximately equivalent to bed 2, test hole 168.

H. W. MARKLINE PROPERTY

TEST HOLE RECORD 170

Location: T.6 N., R.16 E., Sec. 5, NW.1/4, SE.1/4; 2950 feet southwest of test hole 169 and 20 feet west of road. Drilled: January 18, 1939

Elevation: 383 feet Water level: 52.7 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation
1	....	0.5	Topsoil
2	0.5	5.8	Clay, red to gray plastic sandy, micaceous; interbedded with silt and sand in lower part. Samples C-1 (3.3 feet), and C-2 (2.5 feet)
3	6.3	8.9	Sand, gray fine grained argillaceous, micaceous, lignitic
4	15.2	5.7	Clay, gray plastic slightly sandy, micaceous. Sample C-3 (1.7 feet)
5	20.9	46.0	Sand, coarse grained light greenish gray glauconitic, argillaceous, micaceous, lignitic; contains scattered clay fragments. Sample C-5
	66.9	66.9	Total

Remarks: Bed 4 approximately equivalent to bed 3, test hole 169

C. VINSON PROPERTY

TEST HOLE RECORD 172

Location: T.6 N., R.16 E., Sec. 5, NW.1/4, NW.1/4; 0.4 mile north of road intersection and 40 feet west of road Drilled: January 23, 1939

Elevation: 383 feet Water level: 56.2 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member
1	....	0.9	Topsoil
2	0.9	2.8	Clay, reddish brown semi-plastic. Sample C-1
3	3.7	6.6	Sand, light gray fine grained argillaceous. Sample C-2
4	10.3	6.6	Silt, dark gray sandy. Sample C-3
			Bashi formation: Greensand marl member
5	16.9	31.3	Sand, light yellow and brown fine grained highly glauconitic
			Bashi formation: Lower member
6	48.2	1.2	Sand and silt, dark brown and gray micaceous. Sample C-4
	75.5	75.5	Total

Remarks: Bed 2 equivalent to bed 7, test hole 170; bed 2, test hole 171; and to bed 4, test hole 179.

MRS. DEGRAFFENREID PROPERTY

TEST HOLE RECORD 173

Location: T.6 N., R.15 E., Sec. 24, NW.1/4, SE.1/4; Top of bluff at Purdues cut, 1550 feet west of 31st Ave. and 220 feet south of Gulf Mobile and Northern Railroad Drilled: January 24, 1939

Elevation: 370 feet Water level: 59.6 feet

No.	Depth	Thick.	Description of Strata
			Colluvium
1	....	0.4	Topsoil
2	0.4	22.9	Sand, reddish gray to white, coarse grained; grades downward to red. Seems to be reworked Meridian sand. Sample C-1
			Hatchitigbee formation: Lower member ?
3	23.3	0.6	Clay, gray plastic sandy, micaceous. Sample C-2
4	23.9	3.3	Sand, gray coarse grained argillaceous, lignitic
			Bashi formation: Upper member
5	27.2	5.7	Clay, red and gray plastic lignitic. Sample C-3
6	32.9	1.4	Clay, brown sandy, highly lignitic, pyritiferous. Sample C-4
7	34.3	4.6	Clay, gray plastic micaceous. Sample C-5
			Bashi formation: Greensand marl member
8	38.9	15.3	Sand, gray glauconitic, silty fossiliferous; upper part coarse grained. Sample C-6
9	54.2	6.9	Sand, gray coarse grained glauconitic, fossiliferous
	61.1	61.1	Total

GULF MOBILE AND NORTHERN RAILROAD PROPERTY

TEST HOLE RECORD 174

Location: T.6 N., R.15 E., Sec. 24, NW.1/4, SE.1/4; base of bluff at Purdues Cut, 1520 feet west of 31st Ave. and 50 feet south of the Gulf Mobile and Northern Railroad Drilled: January 25, 1939

Elevation: 317 feet Water level: 15.4 feet

No.	Depth	Thick.	Description of Strata
			Colluvium
1	....	2.6	Topsoil
2	2.6	2.9	Clay, yellow and gray sandy, limonitic. Sample C-1
			Bashi formation: Lower member
3	5.5	8.0	Silt and sand, yellow micaceous. Sample C-2
4	13.5	2.9	Sand, yellow micaceous
5	16.4	20.6	Sand, fine grained bluish gray micaceous, silty; several thin lignitic streaks in lower part. Samples C-3 (7.6 feet), and C-4 (2.4 feet)
	37.0	37.0	Total

U. S. 45 Right of way Property

Test Hole Record 185

Location: T.9 N., R.18 E., Sec. 19, SW.1/4, NE.1/4; 2.6 miles north northeast of Lauderdale-Kemper county line at U. S. 45 Highway. Drilled: March 13, 1939

Water level: dry

No.	Depth	Thick.	Description of Strata
			Ackerman formation: Basal member
1	--------	0.4	Topsoil
2	0.4	5.5	Sand, deep red medium grained, grit-bearing
3	5.9	8.0	Sand, gray and red coarse grained, grit-bearing
4	13.9	4.5	Sand-clay conglomerate; light gray silty clay pebbles embedded in coarse red grit-bearing sand
			Fearn Springs formation: Upper member
5	18.4	5.5	Clay, dark slate gray sandy, micaceous, highly lignitic; contains numerous limonite partings
6	23.9	4.5	Sand, brown highly micaceous, highly limonitic; heavily interlaminated with gray silt and clay
7	28.4	1.6	Clay, slate gray plastic sandy, micaceous, heavily interlaminated with limonite
8	30.0	4.5	Lignite
	34.5	34.5	Total

County Road Property

Test Hole Record 186

Location: T.8 N., R.18 E., Sec. 2, SE.1/4, NW.1/4; 1.2 miles east of road intersection in NE.1/4, Sec. 3 Drilled: March 15, 1939

No.	Depth	Thick.	Description of Strata
			Porters Creek formation
1	--------	0.4	Topsoil
2	0.4	1.7	Clay, reddish brown very plastic sandy, very limonitic
3	2.1	10.9	Clay, dark gray to black highly plastic. Sample P-1
	13.0	13.0	Total

J. W. SNOWDEN PROPERTY

TEST HOLE RECORD 203

Location: T.8 N., R.15 E., Sec. 20, SE.1/4, NW.1/4; 0.2 mile west of road intersection Drilled: May 23, 1939

Water level: 22.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Basal member
1	....	9.1	Sand, light brown to red fine grained slightly micaceous, argillaceous; limonite partings prominent in lower 2.0 feet
2	9.1	20.4	Sand, gray fine grained argillaceous, micaceous, pyritiferous; contains scattered small fragments and partings of plastic clay
	29.5	29.5	Total

MRS. L. KING PROPERTY

TEST HOLE RECORD 204

Location: T.7 N., R.15 E., Sec. 26, SW.1/4, SE.1/4; 0.7 mile north of road intersection. Drilled: May 24, 1939

Elevation: 443 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Bashi formation: Lower member
1	....	3.2	Sand, reddish brown argillaceous, micaceous, limonitic
2	3.2	12.6	Sand, gray fine grained argillaceous, micaceous; contains scattered fragments and partings of clay
3	15.8	1.8	Sand, gray-brown argillaceous, micaceous, limonitic
4	17.6	10.9	Sand, very light gray to greenish gray fine grained highly glauconitic
5	28.5	1.0	Sand, brown argillaceous, micaceous, limonitic
	29.5	29.5	Total

Remarks: Bed 4 equivalent to bed 2, Test hole 205

MRS. L. KING PROPERTY

TEST HOLE RECORD 205

Location: T.7 N., R.15 E., Sec. 26, SW.1/4, SE.1/4; 150 feet southwest of Test hole 204. Drilled: June 2, 1939

Elevation: 428 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Bashi formation: Lower member
1	--------	2.6	Sand, reddish brown argillaceous, highly limonitic
2	2.6	5.5	Sand, light greenish gray fine grained highly glauconitic. Sample C-1
3	8.1	27.9	Sand, yellow to gray micaceous, limonitic; contains scattered fragments and partings of clay
	36.0	36.0	Total

Remarks: Bed 2 equivalent in part to bed 5, Test hole 104

MRS. BESSIE RAE PROPERTY

TEST HOLE RECORD 210

Location: T.6 N., R.16 E., Sec. 16, NE.1/4, NE.1/4; 0.15 mile east of road intersection

Water level: 25.0 feet

No.	Depth	Thick.	Description of Strata
			Hatchitigbee formation ?
1	--------	0.9	Topsoil
2	0.9	9.3	Sand, reddish brown argillaceous, micaceous, limonitic; lower part contains small clay pebbles
			Bashi formation: Upper member
3	10.2	11.6	Sand, fine grained argillaceous, micaceous, limonitic; alternating beds of brown and gray
4	21.8	15.3	Sand, steel gray argillaceous, micaceous
	37.1	37.1	Total

MRS. BESSIE RAE PROPERTY

TEST HOLE RECORD 211

Location: T.6 N., R.16 E., Sec. 15, SW.1/4, NW.1/4; 600 feet east of Test hole 210 on State 19 Highway Drilled: June 20, 1939

Elevation: 433 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member
1	....	0.3	Topsoil
2	0.3	12.0	Sand, brown to gray fine grained argillaceous, micaceous, limonitic
			Bashi formation: Greensand marl member
3	12.3	6.7	Sand, light gray highly glauconitic, micaceous, limonitic
	19.0	19.0	Total

MRS. D. R. BROCK PROPERTY

TEST HOLE RECORD 212

Location: T.6 N., R.16 E., Sec. 15, SW.1/4, NW.1/4; 450 feet east of Test hole 211 on State 19 Highway and 50 feet south of center of the highway Drilled: June 21, 1939

Water level: 25.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Greensand marl member
1	....	0.8	Sand, brown highly argillaceous highly limonitic
2	0.8	19.2	Sand, yellow to gray glauconitic, micaceous
3	20.0	10.0	Sand, steel gray silty, micaceous, pyritiferous
	30.0	30.0	Total

Remarks: Bed 2 equivalent to bed 4, Test hole 211

M. R. ADAMS PROPERTY

TEST HOLE RECORD 213

Location: T.6 N., R.16 E., Sec. 10, SW.1/4, NE.1/4; 1.5 miles northeast of road intersection in NE.1/4, Sec. 16

Water level: 25.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member
1	....	22.8	Sand, brown to gray-brown fine grained argillaceous, micaceous, limonitic
			Bashi formation: Greensand marl member
2	22.8	8.7	Sand, steel gray argillaceous, glauconitic, micaceous, pyritiferous
	31.5	31.5	Total

Remarks: Bed 2 equivalent to bed 3, test hole 214

M. R. ADAMS PROPERTY

TEST HOLE RECORD 214

Location: T.6 N., R.16 E., Sec. 10, SW.1/4, NE.1/4; 900 feet northeast of Test hole 213 Drilled: June 29, 1939

Water level: 26.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Upper member
1	....	0.2	Topsoil
2	0.2	21.5	Sand, fine grained argillaceous, micaceous, highly limonitic; alternating beds of brown and gray
			Bashi formation: Greensand marl member
3	21.7	9.3	Sand, gray-brown glauconitic, micaceous, limonitic. Sample C-1
4	31.0	1.4	Sand, dark steel gray argillaceous, micaceous, lignitic
	32.4	32.4	Total

Remarks: Bed 3 equivalent to bed 2, Test hole 213

MELBORNE RAWSON PROPERTY

TEST HOLE RECORD 222

Location: T.6 N., R.17 E., Sec. 23; NE.1/4, SW.1/4; 0.1 mile west of road intersection in Sec. 23. Drilled: July 13, 1939

Elevation: 518 feet Water level: 10.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation
1	....	2.3	Sand, gray-brown argillaceous, micaceous, limonitic
2	2.3	3.2	Sand, light gray argillaceous, micaceous, limonitic
3	5.5	6.5	Sand, gray-brown glauconitic, marly
4	12.0	5.5	Sand, steel gray argillaceous, micaceous, slightly lignitic
	17.5	17.5	Total

COUNTY ROAD RIGHT OF WAY PROPERTY

TEST HOLE RECORD 235

Location: T.7 N., R.17 E., Sec. 33, NW.1/4, NW.1/4; 0.6 miles east of road intersection Drilled: August 7, 1939

Elevation: 481 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Bashi formation: Lower member
1	....	9.2	Sand, reddish brown to gray micaceous, limonitic
2	9.2	5.0	Sand, light gray extremely glauconitic, argillaceous, micaceous
3	14.2	3.8	Sand and silt, steel gray micaceous
	18.0	18.0	Total

D. R. VENABLE PROPERTY

TEST HOLE RECORD 237

Location: T.6 N., R.16 E., Sec. 8, NE.1/4, NW.1/4; 150 feet east of intersection with U. S. 45 Highway Drilled: August 10, 1939

Elevation: 381 feet Water level: 15.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Greensand marl member
1	....	1.3	Topsoil: fine grained micaceous sand
2	1.3	13.2	Sand, reddish brown and gray argillaceous, micaceous, glauconitic, limonitic
			Bashi formation: Lower member
3	14.5	1.5	Sand, brown highly argillaceous; many limonite partings
4	16.0	6.0	Silt, steel gray very argillaceous, micaceous
	22.0	22.0	Total

CLITE WALKER PROPERTY

TEST HOLE RECORD 238

Location: T.6 N., R.16 E., Sec. 8, SE.1/4, NW.1/4; 0.3 mile north of road intersection Drilled: August 11, 1939

Elevation: 371 feet Water level: 24.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation: Lower member
1	....	0.8	Topsoil: sand
2	0.8	8.2	Sand, brown and gray argillaceous, micaceous, limonitic
3	9.0	5.0	Sand, brown glauconitic, limonitic, micaceous
4	14.0	11.0	Sand, brown and gray micaceous, limonitic
	25.0	25.0	Total

J. B. GUNN PROPERTY

TEST HOLE RECORD 250

Location: T.7 N., R.17 E., Sec. 6, SW.1/4, SW.1/4 Drilled: September 8, 1939

Elevation: 453 feet Water level: 17.2 feet

No.	Depth	Thick.	Description of Strata
			Bashi formation
1	....	0.3	Topsoil
2	0.3	16.7	Sand, brown argillaceous, limonitic, micaceous; glauconitic (?) in part; grades downward to steel gray sand
			Holly Springs formation
3	17.0	7.5	Clay, steel gray slightly sandy, plastic. Sample P-1
4	24.5	0.7	Lignite
5	25.2	1.8	Underclay, lignitic
6	27.0	2.5	Lignite
	29.5	29.5	Total

J. B. GUNN PROPERTY

TEST HOLE RECORD 258

Location: T.7 N., R.16 E., Sec. 11, SW.1/4, NE.1/4; 600 feet east of Test hole 100 Drilled: October 2, 1939

Elevation: 430 feet Water level: 28.0 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.3	Topsoil
2	0.3	22.9	Sand, variegated brown and gray highly argillaceous. Sample P-1
3	23.2	2.1	Lignite
4	25.3	2.7	Clay, gray very plastic lignitic. Sample C-1
5	28.0	17.0	Sand, steel gray argillaceous, lignitic, pyritiferous
	45.0	45.0	Total

Remarks: Bed 3 equivalent to bed 6, Test hole 100

J. B. GUNN PROPERTY

TEST HOLE RECORD 259

Location: T.7 N., R.16 E., Sec. 11, NE.1/4, NE.1/4; 0.2 mile north of Test hole 258 Drilled: October 6, 1939

Elevation: 440 feet Water level: 23.0 feet

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	0.8	Topsoil
2	0.8	3.6	Sand, brown very fine grained argillaceous, limonitic. Sample C-1
3	4.4	1.4	Clay, light gray plastic sandy, limonitic. Sample C-2
4	5.8	0.9	Sand, brown argillaceous, very limonitic
5	6.7	2.1	Clay, light gray plastic sandy. Sample C-3
6	8.8	1.8	Sand, gray-brown argillaceous, limonitic, slightly lignitic
7	10.6	3.0	Clay, light gray very plastic sandy, limonitic. Sample C-4
8	13.6	10.7	Sand, gray-brown argillaceous, very limonitic. Sample C-5
9	24.3	1.4	Clay, steel gray plastic sandy, lignitic. Sample C-6
10	25.7	0.9	Lignite
11	26.6	2.9	Underclay, steel gray plastic; grades downward to argillaceous sand. Sample C-7
12	29.5	7.1	Sand, steel gray argillaceous
	36.6	36.6	Total

Remarks: Bed 10 equivalent to bed 3, Test hole 258, and to bed 6, Test hole 100

BEN TINNIN PROPERTY

TEST HOLE RECORD 260

Location: T.8 N., R.16 E., Sec. 33, SE.1/4, SE.1/4; 500 feet northwest of Test hole 120; Drilled: October 13, 1939

Elevation: 492 feet Water level: 22.0 feet

No.	Depth	Thick.	Description of Strata
			Bashi (?) formation
1	....	11.0	Sand, brown argillaceous, slightly micaceous; very limonitic. Sample C-1
			Holly Springs formation
2	11.0	17.5	Sand, gray very fine grained argillaceous. Sample C-2
3	28.5	10.6	Clay, steel gray plastic sandy. Sample P-1
4	39.1	0.9	Lignite
5	40.0	0.7	Sand, gray slightly argillaceous
	40.7	40.7	Total

Remarks: Bed 4 equivalent to bed 8, Test hole 120, bed 2, Test hole 93-A, and bed 4, Test hole 112-A

H. W. JONES PROPERTY

TEST HOLE RECORD 261

Location: T.6 N., R.14 E., Sec. 29, SW.1/4, SE.1/4; 0.2 mile east of road intersection Drilled: October 21, 1939

Elevation: 400 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Lisbon formation: Winona member
1	....	23.0	Sand, reddish brown argillaceous very limonitic. Sample P-1
			Tallahatta formation
2	23.0	88.0	Siltstone, gray; alternating beds of hard and soft. Sample P-2
3	111.0	11.0	Sand, gray very silty, micaceous, glauconitic
	122.0	122.0	Total

Jessie Cook Property

Test Hole Record 262

Location: T.7 N., R.16 E., Sec. 16, NE.1/4, SW.1/4; 1.0 mile north of Test hole 114 Drilled: October 23, 1939

Elevation: 429 feet Water level: 17.5 feet

No.	Depth	Thick.	Description of Strata
			Bashi (?) formation
1	....	3.7	Sand, brown argillaceous, very limonitic. Sample C-1
			Holly Springs formation
2	3.7	12.0	Clay, gray sandy plastic. Sample P-1
3	15.7	4.3	Sand, gray-brown micaceous. Sample C-2
4	20.0	11.0	Clay, steel gray plastic very sandy, grades downward into sand and silt. Sample P-2
	31.0	31.0	Total

Earnest Brown Property

Test Hole Record 263

Location: T.7 N., R.17 E., Sec. 9, NW.1/4, SW.1/4; 150 feet north of Test hole 101. Drilled: October 25, 1939

Elevation: 488 feet Water level: dry

No.	Depth	Thick.	Description of Strata
			Holly Springs formation
1	....	5.4	Sand, gray brown argillaceous, limonitic. Sample C-1
2	5.4	9.2	Clay gray brown to dark gray very plastic. Sample P-1
3	14.6	1.1	Lignite
4	15.7	12.5	Sand, gray semiplastic highly argillaceous. Sample P-2
	28.2	28.2	Total

Remarks: Bed 3 equivalent to bed 5, Test hole 101

REFERENCES

1. Smith, Eugene A., and Aldrich, T. H., Alabama Geol. Survey Bull. 1, pp. 14, 60, 1886.
2. Harris, G. D., On the geological position of the Eocene deposits of Maryland and Virginia: American Jour. Sci., 3d ser., vol. 47, pp. 303, 304, 1894. Also The Midway stage: Bull. Am. Pal. vol. 1, no. 4, pp. 10-38, 1896.
3. Langdon, D. W., Variation in the Cretaceous and Tertiary strata of Alabama: Geol. Soc. Am. Bull. vol. 2, pp. 589-605, 1891.
4. Lowe, E. N., Midway and Wilcox groups: Mississippi State Geol. Survey Bull. 25, pp. 5-7, 1933.
5. Hilgard, E. W., Report on the Geology and Agriculture of the State of Mississippi: pp. 110, 111, 275, 1860.
6. Safford, J. M., On the Cretaceous and superior formations of west Tennessee: Am. Jour. Sci., 2d ser., vol. 37, pp. 361, 368, 1864.
7. Mellen, Frederic F., Winston County Mineral Resources: Mississippi State Geol. Survey Bull. 38, pp. 23-26, 1939
8. Morse, Paul Franklin, The Bauxite Deposits of Mississippi: Mississippi State Geol. Survey Bull. 19, pp. 86-89, 1923.
9. Lowe, E. N., Geology and Mineral Resources of Mississippi: Mississippi State Geol. Survey Bull. 20, p. 56, 1925.
10. Smith, Eugene A., and Johnson, L. C., Geology of the Coastal Plains of Alabama: U. S. Geol. Survey Bull. 43, pp. 57-60, 1887.
11. Cooke, C. Wythe, and others, Geology of Alabama: Alabama Geol. Survey Special Report 14, p. 256, 1926.
12. Morse, W. C., Personal Communication: 1927.
13. Lowe, E. N., Midway and Wilcox groups: Mississippi State Geol. Survey Bull. 25, pp. 2, 3, 14, 21, 35, 49, 63, 1923.
14. Grim, Ralph Early, Eocene Sediments of Mississippi: Mississippi State Geol. Survey Bull. 30, pp. 33, 34, 52, 1936.
15. Mellen, Frederic F., Winston County Mineral Resources: Mississippi State Geol. Survey Bull. 38, 1939.
16. Adams, George I., Butts, Charles, Stephnson, L. W., and Cooke, C. Wythe, Geology of Alabama: Alabama Geol. Survey Special Report 14, 1926.
17. Loc. cit.
18. Op. cit. pp. 27, 28.
19. Hilgard, Eugene W., Geology and Agriculture of Mississippi: pp. 110-123, 1860.
20. Crider, A. F., and Johnson, L. C., Underground Water Resources of Mississippi: U. S. Geol. Survey W. S. P. 159, pp. 5, 9, 1906.
    Crider, A. F., Geology and Mineral Resources of Mississippi: U. S. Geol. Survey Bull. 283, pp. 7, 25, 28, 1906.
21. Lowe, E. N., Preliminary Report on Iron Ores of Mississippi: Mississippi State Geol. Survey Bull. 10, pp. 23-35, 1913.
22. Mellen, Frederic F., Winston County Mineral Resources: Mississippi State Geol. Survey Bull. 38, pp. 37, 38, 1939.

23. Lowe, E. N., Preliminary Report on Iron Ores in Mississippi: Mississippi State Geol. Survey Bull. 10, pp. 23-25, 1913.
24. Smith, Eugene A., and Johnson, L. C., Geology of the Coastal Plains of Alabama: U. S. Geol. Survey Bull. 43, pp. 43-47, 1887.
25. Lowe, E. N., Midway and Wilcox groups: Mississippi State Geol. Survey Bull. 25, p. 105, 1933.
26. Cooke, C. Wythe, Correlation of the Eocene formation in Mississippi and Alabama: U. S. Geol. Survey Prof. Paper 108-E, p. 61, 1917.
27. Hilgard, E. W., Report on the Geology and Agriculture of the State of Mississippi: p. 124, 1860.
28. Loc. cit.
29. Op. cit. p. 106.
30. Smith, Eugene A., and Aldrich, T. H., Alabama Geol. Survey Bull. 1, pp. 7-14, 1886.
31. Smith, Eugene A., and Johnson, L. C., Geology of the Coastal Plains of Alabama: U. S. Geol. Survey Bull. 43, pp. 39-43, 1897.
32. Lowe, E. N., Midway and Wilcox groups: Mississippi State Geol. Survey Bull. 25, pp. 106-108, 1933.
33. Cooke, C. Wythe, The Cenozoic formations; Geology of Alabama: Alabama Geol. Survey Special Report 14, pp. 267-268, 1926.
34. Lowe, E. N., Geology and Mineral Resources of Mississippi: Mississippi State Geol. Survey Bull. 14, pp. 73-76, 1919.
35. Grim, Ralph Early, The Eocene Sediments of Mississippi: Mississippi State Geol. Survey Bull. 30, 1936.
36. Lowe, E. N., Midway and Wilcox groups: Mississippi State Geol. Survey Bull. 25, pp. 1, 106-108, 1933.
37. Lowe, E. N., Claiborne group of Mississippi; Unpublished manuscript, in process of final revision at time of Dr. Lowe's death in 1934.
38. Dall, W. H., 18th Annual Report: U. S. Geol. Survey pt. 2, 1898.
39. Op. cit. pp. 46-48.
40. Lowe, E. N., The Claiborne group of Mississippi, Unpublished manuscript in process of final revision at time of Dr. Lowe's death.
41. Aldrich, T. H., Alabama Geol. Survey Bull. 1, pp. 44-60, 1886.
42. Smith, Eugene A., The Underground Water Resources of Alabama: Alabama Geol. Survey, p. 18, 1907.
43. Mellen, Frederic F., Personal Communication: February-March 1940.
44. Mississippi Geological Society: Manual for Claiborne Wilcox Field Trip, March 9-10, p. 3, 1940.
45. Lowe, E. N., The Claiborne group of Mississippi, unpublished Manuscript.
46. Cooke, C. Wythe, U. S. Geol. Survey Prof. Paper 140, pp. 133-135, 1925.
47. Op. cit. pp. 33-37.
48. Cooke, C. Wythe, Ackerman Formation in Alabama; Bull. Am. Assoc. Petroleum Geol. vol. 17, no. 2, pp. 192-195, Feb. 1933.

LAUDERDALE COUNTY MINERAL RESOURCES

TESTS

THOMAS EDWIN McCUTCHEON, B.S., CER. ENGR.

CLAYS

INTRODUCTION

In the geologic part of this report, Foster has pointed out the many variations that exist within a formation such as the gradation of one type of material into another and the inclusion of lignitic beds, silty beds, and sand. He has also shown that in many cases there is a gradational contact between one formation and another. In general, the geologic variations are reflected in the test data, for, when all the clay samples are subjected to the same tests, variations in their properties are directly related to their composition and geologic age. These properties are expressed in mathematical terms which serve as a means of comparing different clays and evaluating them. Clays from different formations exhibit distinctive properties that are characteristic of the formation. Tests of different beds within a formation exhibit the same general characteristics but vary in degree rather than kind. A classification of clays based on physical and pyrometric properties is closely related to geologic observations, but where the samples under consideration are very impure and where they represent more than one bed or are graditional, the correlation between field observations and laboratory tests may not be in accord and is consequently less applicable. Such is the case for many of the samples from Lauderdale County; however, they have been classified according to their economic utilization which is a more general way of expressing the field and laboratory correlation and which allows for variations that exist within and between earthy materials.

CLASSIFICATION OF CLAYS

INTRODUCTORY STATEMENT

In the following classification, clays that have comparable properties have been placed in one group. It follows that clays possessing a certain set of properties are more suitable for use in specific products than clays of different properties; however, the mere classification of a clay into one group does not necessarily preclude its use for products other than those specified. Possible uses for a clay besides those specified in the classification are given in the part of this report entitled, "Possibilities for Utilization."

In the classification, a quality rating is given each clay. Clays within a group having the same quality rating are of equal quality. The rating of 1 indicates the best clay or clays in the group for the use indicated. A rating of 2 and 3 indicates that the clays are suitable but less desirable, and a rating of 4 indicates that the clay is of doubtful economic value. Quality ratings are relative to the clays within a single group and are not comparable to ratings in other groups.

The test data of the clays for each formation are presented in the succeeding parts of this report. In the tables of "Physical Properties in the Unburned State," each clay is identified as to type which serves as a cross reference to "Classification of Clays" and to "Possibilities for Utilization."

1

KAOLINITIC CLAY

A. CREAM TO BUFF BURNING, CONTAINING AN APPRECIABLE AMOUNT OF QUARTZ SAND

Sample number	Thickness in feet	Relative quality	Formation by Foster
B41P1	5.0	1	Fearn Springs

2

POTTERY CLAYS

A. CREAM TO BUFF BURNING, CONTAINING AN APPRECIABLE AMOUNT OF SILT

Sample number	Thickness in feet	Relative quality	Formation by Foster
B38P1	5.7	2	Fearn Springs
B42P1	4.2	2	Naheola
B34P1	2.6	1	Fearn Springs
B54P1	5.7	1	Fearn Springs

B. CREAM TO BUFF BURNING, CONTAINING APPROXIMATELY 10 PERCENT MICACEOUS SILT

Sample number	Thickness in feet	Relative quality	Formation by Foster
B1P1	10.1	1	Fearn Springs
B1AP1	3.1	1	Fearn Springs
B1AP2	8.6	1	Fearn Springs
B1AP3	3.0	1	Fearn Springs
B1AP4	2.4	1	Fearn Springs
B17P1	7.9	1	Fearn Springs
B34FS	?	1	Fearn Springs
B64P2	10.2	1	Fearn Springs

3

BOND CLAYS

A. CREAM TO GRAY BURNING

Sample number	Thickness in feet	Relative quality	Formation by Foster
B2P1	9.2	2	Fearn Springs
B23P1	14.8	1	Fearn Springs (?)
B64P1	5.2	1	Fearn Springs
B86P2	12.2	3	Ackerman (upper)
B90P2	6.0	2	Ackerman (upper)
B129P1	5.3	3	Holly Springs

B. BUFF TO GRAY BURNING, IRON STAINED, CONTAINING AN APPRECIABLE AMOUNT OF SOLUBLE IRON SULFATE

Sample number	Thickness in feet	Relative quality	Formation by Foster
B1AP6	1.2	1	Fearn Springs
B1AP7	2.0	1	Fearn Springs
B1AP8	2.4	3	Fearn Springs
B1AP9	2.4	1	Fearn Springs
B14P4 (1)	4.3	3	Fearn Springs
B16P1	11.2	1	Fearn Springs
B32P1	9.9	1	Fearn Springs
B48P1	9.5	2	Fearn Springs
B63P1	17.0	3	Ackerman
B90P3	5.4	3	Ackerman (upper)

C. RED TO GRAY BURNING

Sample number	Thickness in feet	Relative quality	Formation by Foster
B85P2	2.2	1	Ackerman (upper)
B109P1	4.8	1	Holly Springs
B121P1	4.0	1	Holly Springs

4

BRICK AND TILE CLAYS

A. BUFF TO RED AND BROWN BURNING

Sample number	Thickness in feet	Relative quality	Formation by Foster
B43P1	3.2	2	Fearn Springs
B49P1	36.4	1	Fearn Springs
B68P1	9.0	1	Ackerman
B78P1	2.2	2	Fearn Springs
B78P2	4.6	2	Fearn Springs
B80P1	5.7	3	Fearn Springs
B85P1	6.6	2	Ackerman (upper)
B90P1	10.2	2	Ackerman (upper)
B108P1	15.1	1	Holly Springs
B108P3	20.7	1	Holly Springs

5

RED BURNING CLAYS OF DOUBTFUL ECONOMIC VALUE

A. OPEN-BODIED, OVERBURNS BEFORE REACHING MATURITY

Sample number	Thickness in feet	Relative quality	Formation by Foster
B29P1	8.6	2	Fearn Springs
B29AP1	8.5	2	Fearn Springs
B51P1	12.2	2	Naheola
B56P1	18.5	1	Naheola
B59P1	26.1	2	Naheola
B70P1	20.8	1	Naheola
B71P1	6.8	3	Naheola
B86P1	10.8	1	Ackerman (upper)

B. SILTY, SHORT MATURING RANGE

Sample number	Thickness in feet	Relative quality	Formation by Foster
B71P2	9.3	3	Naheola
B77P2 } B77P3 }	12.5	1	Fearn Springs
		1	Fearn Springs
B81P1	15.2	2	Fearn Springs
B83P1	9.0	2	Fearn Springs
B85P3	5.6	2	Ackerman (upper)
B87P1	10.6	2	Naheola
B86P3	4.5	4	Ackerman (upper)

C. TIGHT-BODIED, OVERBURNS AT MATURITY

Sample number	Thickness in feet	Relative quality	Formation by Foster
B50P1	10.9	3	Porters Creek
B50SP1	8.0	3	Porters Creek
B66P1	16.1	2	Naheola
B93P1	3.8	3	Holly Springs
B93P2	9.5	3	Holly Springs
B97P1	7.5	1	Holly Springs
B98P2	8.6	3	Holly Springs

6

BROWN BURNING CLAYS OF DOUBTFUL ECONOMIC VALUE

A. OVERBURNS BEFORE REACHING MATURITY

Sample number	Thickness in feet	Relative quality	Formation by Foster
B110P1	27.0	4	Holly Springs
B250P1	?	4	?
B260P1	10.6	4	Holly Springs

B. NOT OVERBURNED AT MATURITY

Sample number	Thickness in feet	Relative quality	Formation by Foster
B112P1	7.0	1	Holly Springs
B262P1	12.0	1	Holly Springs
B262P2	11.0	2	Holly Springs
B263P1	9.2	1	Holly Springs
B263P2	12.5	2	Holly Springs

7

TALLAHATTA CLAY

Sample number	Thickness in feet	Relative quality	Formation by Foster
B261P2	88.0	1	Tallahatta

LABORATORY TESTS OF THE PORTERS CREEK CLAY

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample No.	Type of Clay	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in lbs./sq.in.	Texture	Color
			Volume in percent	Linear in percent			
B50P1	5C	41.15	37.44	14.50	1119	Dense	Dk. gray
B50SP1	5C	41.83	37.96	14.73	1141	Dense	Dk. gray

SCREEN ANALYSES

SAMPLE B50P1

Retained on screen	Percent	Character of Residue
30	0.97	Abundance of micaceous lignitic clay nodules; traces of pyrite and lignite.
60	13.03	Abundance of micaceous lignitic clay nodules; small amount of pyrite; trace of lignite.
100	9.93	Abundance of micaceous lignitic clay nodules; traces of muscovite and lignite.
150	7.50	Abundance of gray clay nodules; considerable quantity of muscovite; trace of lignite.
200	5.65	Abundance of gray clay nodules; considerable quantity of muscovite; trace of lignite.
250	6.28	Abundance of gray clay nodules; considerable quantity of muscovite; small amount of quartz; trace of lignite.
Cloth	56.64	Clay substance including residue from above.

SAMPLE B50SP1

Retained on screen	Percent	Character of Residue
30	3.51	Abundance of micaceous lignitic clay nodules.
60	22.83	Abundance of micaceous lignitic clay nodules. Trace of pyrite.
100	11.41	Abundance of micaceous lignitic clay nodules; traces of muscovite and quartz.
150	5.65	Abundance of micaceous lignitic clay nodules; small amount of muscovite.
200	5.10	Abundance of clay nodules; traces of quartz and muscovite.
250	4.89	Abundance of clay nodules; small amounts of quartz and muscovite.
Cloth	52.26	Clay substance including residue from above.

PYRO-PHYSICAL PROPERTIES

TEST HOLE B50

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	
B50P1	01	14.41	7.87	1.83	2.14	14.32	5.05	1118	Dull red	Bl., St. H.
	2	11.21	5.33	2.11	2.37	24.91	9.14	N.D.	Dull red	
B50SP1	01	11.05	6.43	1.72	1.93	9.80	3.38	745	Lt. red	Bl., St. H.
	2	5.11	2.30	2.23	2.35	30.18	11.29	N.D.	Dull red	

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

LABORATORY TESTS OF THE NAHEOLA CLAYS

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample No.	Type of Clay	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in lbs./sq. in.	Texture	Color
			Volume in percent	Linear in percent			
B42P1	2A	20.08	8.49	2.92	83	Open	Cream
B51P1	5A	27.23	17.23	6.14	562	Open	Dk. gray
B56P1	5A	25.14	14.03	4.94	354	Open	Dk. gray
B59P1	5A	22.59	6.54	2.25	324	Open	Dk. gray
B66P1	5C	39.84	37.51	14.55	1028	Dense	Dk. gray
B70P1	5A	29.15	19.65	7.05	469	Silty	Dk. gray
B71P1	5A	19.92	3.06	1.04	189	Open	Dk. gray
B71P2	5B	32.37	25.34	9.31	606	Silty	Dk. gray
B87P1	5B	33.23	22.45	8.15	622	Dense	Dk. gray

SCREEN ANALYSES

SAMPLE B42P1

Retained on screen	Percent	Character of Residue
30	1.20	Abundance of quartz; traces of lignite and muscovite.
60	4.54	Abundance of quartz; traces of clay and lignite.
100	7.77	Abundance of quartz; traces of muscovite and kaolin.
150	5.45	Abundance of muscovite and quartz; small amount of clay; traces of rutile and tourmaline.
200	10.40	Abundance of quartz; considerable quantity of muscovite; traces of rutile and tourmaline.
250	3.50	Abundance of quartz; considerable quantity of muscovite; traces of rutile and tourmaline.
Cloth	67.14	Clay substance including residue from above.

SAMPLE B51P1

Retained on screen	Percent	Character of Residue
30	1.07	Abundance of lignitic clay nodules; considerable quantity of pyrite; small amounts of quartz and limonite.
60	11.83	Abundance of lignitic clay nodules; small amounts of pyrite and quartz; trace of glauconite.
100	15.28	Abundance of lignitic clay nodules; small amounts of muscovite and pyrite; trace of kaolin.
150	18.63	Abundance of lignitic clay nodules; considerable quantities of quartz and muscovite; small amount of lignite; trace of glauconite.
200	15.17	Abundance of quartz; considerable quantity of lignitic clay nodules; small amounts of glauconite and pyrite.
250	6.69	Abundance of quartz; considerable quantities of lignitic clay and muscovite; small amount of glauconite.
Cloth	31.33	Clay substance including residue from above.

SAMPLE B56P1

Retained on screen	Percent	Character of Residue
30	1.15	Abundance of arenaceous gray clay nodules; traces of lignite and quartz.
60	8.35	Abundance of micaceous arenaceous clay nodules; small amounts of lignite and muscovite.
100	13.52	Abundance of quartz; considerable quantity of muscovite; small amounts of lignite and gray clay; trace of pyrite.
150	28.42	Abundance of quartz; traces of lignite, clay and muscovite.
200	22.55	Abundance of quartz; traces of muscovite, magnetite and pyrite.
250	3.56	Abundance of quartz; considerable quantity of muscovite; trace of quartz.
Cloth	22.45	Silt including residue from above.

SAMPLE B59P1

Retained on screen	Percent	Character of Residue
30	2.02	Abundance of micaceous lignitic clay nodules; trace of plant fragments.
60	11.70	Abundance of micaceous lignitic clay nodules; traces of lignite and marcasite.
100	11.23	Abundance of micaceous lignitic clay nodules; traces of lignite and marcasite.
150	16.05	Abundance of micaceous lignitic clay; considerable quantities of quartz and muscovite; trace of glauconite.
200	16.28	Abundance of micaceous lignitic clay nodules; considerable quantity of quartz; small amount of muscovite; traces of lignite and glauconite.
250	9.65	Abundance of micaceous lignitic clay nodules; considerable quantity of quartz; small amounts of muscovite and glauconite; trace of lignite.
Cloth	32.07	Clay substance including residue from above.

SAMPLE B66P1

Retained on screen	Percent	Character of Residue
30	0.67	Abundance of micaceous lignitic clay nodules; small amounts of limonitic material and pyrite; trace of plant fragments.
60	10.00	Abundance of micaceous lignitic clay nodules; trace of pyrite.
100	8.06	Abundance of micaceous lignitic clay nodules; small amount of muscovite; trace of quartz.
150	5.99	Abundance of micaceous lignitic clay nodules; small amount of muscovite; trace of lignite.
200	5.85	Abundance of micaceous lignitic clay nodules; considerable quantity of muscovite; trace of lignite.
250	7.55	Abundance of clay nodules; considerable quantity of muscovite; trace of lignite.
Cloth	61.88	Clay substance including residue from above.

SAMPLE B70P1

Retained on screen	Percent	Character of Residue
30	0.81	Abundance of micaceous lignitic clay nodules; small amounts of lignite and muscovite; trace of pyrite.
60	7.43	Abundance of micaceous lignitic clay nodules; small amount of muscovite; traces of pyrite, lignite and limonite.
100	19.88	Abundance of clay nodules; considerable quantity of muscovite; small amounts of quartz and lignite; trace of limonite.
150	15.55	Abundance of quartz; small amount of muscovite; trace of lignite.
200	16.90	Abundance of quartz; small amounts of clay nodules and muscovite; traces of magnetite and lignite.
250	3.52	Abundance of clay nodules; small amounts of muscovite and quartz; traces of magnetite and lignite.
Cloth	35.91	Clay substance including residue from above.

SAMPLE B71P1

Retained on screen	Percent	Character of Residue
30	1.27	Abundance of micaceous arenaceous lignitic clay nodules; small amounts of quartz and limonitic arenaceous nodules; trace of pyrite.
60	7.81	Abundance of micaceous arenaceous nodules; small amount of muscovite; traces of limonitic and lignitic material.
100	16.50	Abundance of arenaceous material and muscovite; small amount of lignitic material; traces of limonite and biotite.
150	26.44	Abundance of quartz; small amounts of carbonaceous material, glauconite and muscovite; trace of magnetite.
200	23.88	Abundance of quartz; small amounts of muscovite and glauconite; traces of magnetite and lignite.
250	3.24	Abundance of quartz and clay nodules; small amount of muscovite; traces of limonite, magnetite and lignite.
Cloth	20.86	Silt including residue from above.

SAMPLE B71P2

Retained on screen	Percent	Character of Residue
30	0.58	Abundance of gray arenaceous nodules; considerable quantity of quartz; small amount of plant fragments.
60	11.32	Abundance of gray arenaceous nodules; considerable quantity of quartz; trace of plant fragments.
100	10.20	Abundance of gray clay nodules; considerable quantity of quartz; small amount of muscovite; trace of lignite.
150	5.85	Abundance of gray clay nodules; considerable quantity of muscovite; small amount of quartz; trace of lignite.
200	14.53	Abundance of gray clay nodules; considerable quantities of muscovite and quartz; traces of lignite and limonite.
250	3.20	Abundance of gray clay nodules; considerable quantity of quartz; shall amount of muscovite; traces of lignite and limonite.
Cloth	54.32	Clay substance including residue from above.

SAMPLE B87P1

Retained on screen	Percent	Character of Residue
30	0.27	Abundance of gray clay nodules; small amount of quartz; traces of pyrite and lignite.
60	3.67	Abundance of gray clay nodules; small amount of quartz; traces of limonite and muscovite.
100	5.03	Abundance of gray clay nodules; considerable quantity of quartz; small amount of muscovite; trace of lignite.
150	4.87	Abundance of gray clay nodules; considerable quantity of muscovite; trace of lignite.
200	8.91	Abundance of clay nodules; considerable quantities of muscovite and quartz; trace of lignite.
250	9.37	Abundance of clay nodules; considerable quantities of muscovite and quartz; trace of lignite.
Cloth	67.88	Clay substance including residue from above.

CHEMICAL ANALYSIS

SAMPLE B66P1

Whole sample ground to pass 100 mesh screen.

Moisture, air dried ..... 3.75 Sulphur, SO_3 ..... 1.53

Ignition loss	7.77	Iron oxide, Fe_2O_3	0.99	Magnesia, MgO	0.21
Silica, SiO_2	63.25	Titania, TiO_2	0.72	Potash, K_2O	0.27
Alumina, Al_2O_3	23.44	Lime, CaO	2.66	Soda, Na_2O	0.16

Water soluble SO_4 1.35

PYRO-PHYSICAL PROPERTIES

TEST HOLES B42, B51, B56, B59, B66, B70, B71, B87

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
B42P1	01	35.27	21.56	1.71	2.65	.54	.20	278	White
	2	35.45	20.38	1.74	2.69	.38	.13	284	White
	4	33.77	19.33	1.75	2.63	1.79	.60	404	White
	6	32.17	18.07	1.71	2.61	3.04	1.04	437	White
	8	30.90	17.47	1.78	2.62	3.95	1.35	529	White
	10	29.70	16.31	1.82	2.59	5.96	2.04	964	White
	12	30.76	16.91	1.84	2.62	5.81	2.01	1017	White
	14	29.31	15.69	1.85	2.60	7.54	2.60	1383	Cream, specked St. H.
B51P1	01	36.55	21.67	1.69	2.66	3.22	1.11	598	Red
	2	35.11	20.37	1.72	2.66	5.17	1.76	589	Red
	4	33.90	19.65	1.72	2.61	5.30	1.80	610	Red
	6	29.00	16.61	1.73	2.36	6.02	2.08	826	Red
	8	26.69	15.39	1.74	2.46	6.68	2.29	853	Red Not St. H.
B56P1	01	37.44	22.28	1.68	2.68	2.80	.94	421	Red
	2	37.36	22.33	1.67	2.66	2.38	.81	434	Red
	4	37.60	22.71	1.65	2.65	1.22	.44	516	Red
	6	31.95	18.31	1.70	2.44	3.33	1.15	546	Red
	8	30.59	18.04	1.77	2.56	5.90	2.01	580	Dk. red Not St. H.
B59P1	01	38.43	23.33	1.65	2.67	14.57	5.12	500	Red
	2	35.33	21.02	1.68	2.60	12.97	4.54	590	Red
	4	36.03	21.54	1.67	2.62	15.55	5.50	800	Red
	6	27.92	17.37	1.64	2.23	11.26	3.92	500	Red Not St. H.
B66P1	01	18.08	9.27	1.97	2.41	18.21	6.52	1968	Dull red St. H.
	2	14.74	6.94	2.12	2.49	24.02	8.78	Bl.	Dull red
B70P1	01	33.35	19.06	1.75	2.63	6.74	2.32	546	Red
	2	32.38	18.31	1.77	2.62	7.49	2.57	564	Red
	4	31.95	17.97	1.78	2.61	9.31	3.24	858	Red
	6	21.27	12.57	1.72	2.15	3.74	1.28	1253	Red Not St. H.
B71P1	01	39.73	24.43	1.62	2.69	3.13	1.08	241	Salmon
	2	38.19	23.39	1.63	2.61	4.17	1.42	161	Salmon
	4	36.10	21.62	1.67	2.61	5.65	1.94	337	Dull red
	6	32.32	19.26	1.68	2.48	4.80	1.63	326	Dull red
	8	34.14	21.47	1.59	2.42	1.78	.60	477	Dull red Not St. H.
B71P2	01	27.67	14.61	1.89	2.62	13.72	4.83	1097	Dull red St. H.
	2	20.06	10.16	2.00	2.52	18.49	6.59	1333	Dull red
	4	18.30	9.10	2.01	2.45	18.04	6.44	1773	Dull red
	6	22.63	16.44	1.38	1.78	–19.25	–6.90	1443	Dk. red Bl.
B87P1	01	25.15	13.18	1.90	2.54	16.52	5.72	1415	Dull red St. H.
	2	24.11	11.82	1.94	2.54	17.78	6.32	1519	Dull red
	4	20.03	10.07	1.99	2.49	20.10	7.21	2740	Dull red
	6	21.15	13.51	1.57	1.98	–1.06	–.37	1776	Dk. red Bl.

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

LABORATORY TESTS OF THE FEARN SPRINGS CLAYS

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample No.	Type of Clay	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in lbs./sq. in.	Texture	Color
			Volume in percent	Linear in percent			
B1P1	2B	34.43	22.03	7.99	245	Dense	Lt. gray
B1AP1	2B	34.36	23.37	8.50	209	Dense	Lt. gray
B1AP2	2B	34.37	23.44	8.54	220	Dense	Lt. gray
B1AP3	2B	33.69	22.57	8.18	182	Dense	Lt. gray
B1AP4	2B	30.88	20.83	7.52	230	Dense	Lt. gray
B1AP6	3B	39.63	26.75	9.88	441	Dense	Lt. gray
B1AP7	3B	40.05	33.55	12.76	531	Dense	Lt. gray
B1AP8	3B	37.01	31.47	11.85	545	Dense	Lt. gray
B1AP9	3B	29.82	18.52	6.63	383	Dense	Lt. gray
B2P1	3A	36.03	29.94	11.21	530	Dense	Dk. gray
B14P1	3B	36.44	37.82	14.68	1079	Dense	Dk. gray
B16P1	3B	29.11	22.30	8.07	468	Dense	Dk. gray
B17P1	2B	31.07	21.38	7.71	155	Dense	Lt. gray
B23P1	3A	42.20	42.97	17.09	815	Dense	Purple
B29P1	5A	30.60	32.81	12.45	766	Open	Dk. gray
B29AP1	5A	26.42	22.05	7.99	510	Open	Dk. gray
B32P1	3B	36.43	34.14	13.02	912	Dense	Gray
B34P1	2A	29.54	16.23	5.76	144	Dense	Lt. gray
B34FS	2B	42.85	33.57	12.76	259	Dense	Lt. gray
B38P1	2A	28.42	13.46	4.72	119	Open	Cream
B41P1	1A	17.52	6.49	2.22	40	Open	Cream
B43P1	4A	32.89	21.90	7.91	448	Silty	Yellow
B48P1	3B	31.44	29.35	10.96	615	Dense	Dk. gray
B49P1	4A	38.87	43.85	17.53	946	Silty	Dk. brown
B54P1	2A	27.99	17.76	6.32	240	Dense	Cream
B64P1	3A	39.77	25.98	9.55	232	Dense	Gray
B64P2	2B	33.89	24.66	9.02	406	Dense	Gray
B77P2	5B	37.71	28.15	10.45	688	Dense	Dk. gray
B77P3	5B	34.77	24.47	8.94	903	Dense	Dk. gray
B78P1	4A	40.09	45.08	18.12	932	Silty	Brown
B78P2	4A	38.18	40.17	15.75	894	Silty	Yellow
B80P1	4A	27.59	19.00	6.78	659	Silty	Brown
B81P1	5B	36.43	26.43	9.75	416	Silty	Dk. gray
B83P1	5B	36.62	21.04	7.60	489	Silty	Dk. gray

SCREEN ANALYSES

Sample B1P1

Retained on screen	Percent	Character of Residue
30	0.16	Abundance of micaceous limonitic clay nodules; small amounts of quartz and lignite.
60	1.03	Abundance of micaceous limonitic clay nodules; considerable quantities of gray clay and quartz; traces of hematite and lignite.
100	1.22	Abundance of muscovite; considerable quantity of quartz; small amounts of clay nodules and lignite
150	1.78	Abundance of muscovite; considerable quantity of quartz; small amounts of limonitic material, kaolinite, biotite and lignite.
200	2.42	Abundance of muscovite; considerable quantity of quartz; small amounts of limonitic material, kaolinite and biotite.
250	2.60	Abundance of muscovite; small amounts of quartz, clay nodules, limonite and biotite.
Cloth	90.79	Clay substance including residue from above.

Sample B1AP1

Retained on screen	Percent	Character of Residue
30	0.11	Abundance of limonitic arenaceous nodules; considerable quantity of quartz; trace of lignite.
60	0.77	Abundance of kaolinitic clay nodules; considerable quantities of limonitic nodules and quartz; small amount of muscovite; traces of magnetite and lignite.
100	1.38	Abundance of quartz, limonitic and kaolinitic clay nodules; small amount of muscovite; trace of biotite.
150	1.46	Abundance of limonitic and kaolinitic clay nodules; considerable quantity of quartz; traces of biotite and rutile.
200	2.05	Abundance of limonitic and kaolinitic clay nodules; considerable quantity of quartz and muscovite; traces of rutile, biotite and tourmaline.
250	1.11	Abundance of clay nodules; considerable quantity of quartz and muscovite; traces of biotite and tourmaline.
Cloth	93.12	Clay substance including residue from above.

SAMPLE B1AP2

Retained on screen	Percent	Character of Residue
30	0.32	Abundance of quartz; small amounts of limonite and gray clay; trace of plant fragments.
60	3.61	Abundance of quartz; small amounts of limonite and plant fragments.
100	1.03	Abundance of muscovite; considerable quantity of quartz; small amount of limonitic clay; trace of ferruginous rock.
150	1.48	Abundance of muscovite; considerable quantity of quartz and gray clay; trace of biotite.
200	2.99	Abundance of quartz; considerable quantity of muscovite and clay; trace of biotite.
250	1.19	Abundance of quartz; considerable quantity of muscovite, small amount of clay; trace of biotite.
Cloth	89.38	Clay substance including residue from above.

SAMPLE B1AP3

Retained on screen	Percent	Character of Residue
30	0.10	Abundance of quartz; considerable quantity of limonitic material; small amount of plant fragments.
60	0.81	Abundance of micaceous limonitic clay nodules; considerable quantity of quartz; small amount of ferruginous material; trace of plant fragments.
100	1.14	Abundance of micaceous gray clay; considerable quantity of limonitic clay nodules; small amount of quartz; trace of muscovite.
150	1.29	Abundance of micaceous gray clay nodules; considerable quantity of muscovite; small amount of limonitic clay.
200	2.02	Abundance of gray clay; considerable quantity of muscovite; small amount of limonite; trace of biotite.
250	1.56	Abundance of gray clay; considerable quantity of muscovite; small amount of limonitic clay.
Cloth	93.08	Clay substance including residue from above.

SAMPLE B1AP4

Retained on screen	Percent	Character of Residue
30	0.18	Abundance of micaceous limonitic nodules; small amount of plant fragments.
60	0.81	Abundance of micaceous limonitic nodules; considerable quantity of quartz; small amounts of muscovite and plant fragments; trace of ferruginous rock.
100	2.14	Abundance of kaolinitic nodules; considerable quantities of limonitic clay nodules and muscovite; small amount of quartz; trace of biotite.
150	2.20	Abundance of muscovite and kaolinitic nodules; small amounts of quartz and limonite; trace of biotite.
200	5.38	Abundance of muscovite; considerable quantity of kaolinitic nodules; small amount of limonite; trace of biotite.
250	2.08	Abundance of muscovite; considerable quantity of quartz; small amount of kaolinitic nodules; trace of limonite.
Cloth	87.21	Clay substance including residue from above.

SAMPLE B1AP6

Retained on screen	Percent	Character of Residue
30	1.02	Abundance of lignite; trace of clay.
60	6.56	Abundance of lignite; trace of clay.
100	7.32	Abundance of clay nodules; considerable quantity of lignite; small amount of quartz.
150	4.50	Abundance of clay nodules; considerable quantity of lignitic nodules; small amounts of quartz and muscovite.
200	3.78	Abundance of clay nodules; considerable quantity of lignitic nodules; small amounts of quartz and muscovite.
250	3.62	Abundance of clay and lignitic nodules; considerable quantity of muscovite; small amount of quartz.
Cloth	73.20	Clay substance including residue from above.

SAMPLE B1AP7

Retained on screen	Percent	Character of Residue
30	0.23	Abundance of pyrite; considerable quantity of lignite; small amount of quartz; trace of limonitic clay.
60	1.05	Abundance of lignitic clay nodules; considerable quantities of pyrite and lignite; small amount of quartz.
100	1.21	Abundance of gray clay nodules; considerable quantity of lignite; small amount of pyrite.
150	1.62	Abundance of gray clay nodules; considerable quantity of lignite; small amounts of pyrite, muscovite and quartz.
200	2.30	Abundance of gray clay; considerable quantity of lignite; traces of muscovite and pyrite.
250	2.60	Abundance of gray clay; considerable quantity of lignite; small amounts of muscovite, pyrite and quartz.
Cloth	90.99	Clay substance including residue from above.

SAMPLE B1AP8

Retained on screen	Percent	Character of Residue
30	1.53	Abundance of lignitic micaceous clay nodules; traces of pyrite, lignite and limonite.
60	7.23	Abundance of lignitic micaceous clay nodules; trace of pyrite.
100	7.42	Abundance of micaceous clay nodules; considerable quantity of lignite; small amount of quartz.
150	5.45	Abundance of micaceous clay nodules; considerable quantity of lignite; small amounts of quartz and muscovite; trace of pyrite.
200	8.74	Abundance of clay nodules; small amounts of lignite, quartz and muscovite.
250	2.17	Abundance of clay nodules; considerable quantity of muscovite; trace of lignite.
Cloth	67.46	Clay substance including residue from above.

SAMPLE B1AP9

Retained on screen	Percent	Character of Residue
30	0.29	Abundance of micaceous lignitic clay nodules; considerable quantity of pyrite; small amounts of lignite and quartz.
60	2.74	Abundance of micaceous lignitic clay nodules; considerable quantity of pyrite; trace of lignite.
100	6.34	Abundance of clay nodules; small amount of muscovite; traces of quartz and lignite.
150	4.35	Abundance of muscovite; considerable quantity of clay nodules; traces of quartz and lignite.
200	10.95	Abundance of muscovite; considerable quantity of clay; traces of quartz and lignite.
250	3.91	Abundance of muscovite; considerable quantity of clay; small amount of quartz; traces of lignite and pyrite.
Cloth	71.42	Clay substance including residue from above.

SAMPLE B2P1

Retained on screen	Percent	Character of Residue
30	0.67	Abundance of lignitic clay nodules; considerable quantities of lignite and pyrite; small amount of limonitic material.
60	3.50	Abundance of lignitic clay nodules; considerable quantities of lignite and pyrite; small amount of limonitic clay nodules.
100	4.52	Abundance of gray clay nodules; trace of lignite.
150	3.63	Abundance of gray clay nodules; small amount of quartz; traces of lignite and limonite.
200	4.32	Abundance of gray clay nodules; traces of lignite, muscovite, limonite and quartz.
250	4.52	Abundance of gray clay nodules; traces of lignite, muscovite and quartz.
Cloth	79.04	Clay substance including residue from above.

SAMPLE B14P1

Retained on screen	Percent	Character of Residue
30	3.64	Abundance of micaceous lignitic clay nodules; small amount of lignite.
60	16.99	Abundance of micaceous lignitic clay nodules; traces of pyrite and lignite.
100	14.88	Abundance of micaceous lignitic clay nodules; small amounts of muscovite and lignite.
150	8.66	Abundance of micaceous lignitic clay nodules; small amounts of lignite and muscovite.
200	11.84	Abundance of micaceous lignitic clay nodules; small amounts of lignite and muscovite; trace of quartz.
250	2.93	Abundance of gray clay nodules; small amounts of lignite and muscovite.
Cloth	41.06	Clay substance including residue from above.

SAMPLE B16P1

Retained on screen	Percent	Character of Residue
30	1.02	Abundance of gray lignitic clay nodules; considerable quantity of quartz; small amounts of pyrite and lignite.
60	14.57	Abundance of gray lignitic clay nodules; considerable quantity of quartz; small amounts of lignite and pyrite.
100	12.80	Abundance of gray clay nodules; considerable quantity of quartz; small amounts of muscovite and lignite.
150	4.99	Abundance of gray clay nodules; considerable quantity of quartz; small amounts of muscovite, pyrite and lignite.
200	6.10	Abundance of clay nodules; small amounts of muscovite, quartz and lignite; trace of pyrite.
250	1.96	Abundance of clay nodules; small amounts of muscovite, quartz and lignite; trace of pyrite.
Cloth	58.56	Clay substance including residue from above.

SAMPLE B17P1

Retained on screen	Percent	Character of Residue
30	0.23	Abundance of limonitic material; considerable quantity of quartz; trace of plant fragments.
60	1.52	Abundance of white and limonitic clay nodules; considerable quantity of quartz; trace of plant fragments.
100	1.89	Abundance of clay nodules; considerable quantity of quartz; small amount of muscovite; trace of ferruginous rock.
150	2.89	Abundance of white clay and limonitic stained clay nodules; considerable quantities of quartz and muscovite.
200	4.85	Abundance of clay nodules and muscovite; considerable quantity of quartz; traces of biotite and rutile.
250	2.01	Abundance of clay and muscovite; considerable quantity of quartz; traces of biotite and rutile.
Cloth	86.61	Clay substance including residue from above.

SAMPLE B23P1

Retained on screen	Percent	Character of Residue
30	0.33	Abundance of hematite; small amounts of gray clay and limonite; trace of lignite.
60	4.18	Abundance of gray clay nodules; considerable quantity of hematite; small amount of limonite; traces of quartz and plant fragments.
100	7.10	Abundance of gray clay nodules; considerable quantity of hematite; small amount of limonite; traces of quartz and muscovite.
150	8.77	Abundance of gray clay; considerable quantity of hematite; small amount of limonite; trace of quartz.
200	8.00	Abundance of gray clay; small amounts of muscovite, hematite and quartz.
250	5.50	Abundance of gray clay; small amounts of muscovite, hematite, limonite and quartz.
Cloth	66.12	Clay substance including residue from above.

SAMPLE B29P1

Retained on screen	Percent	Character of Residue
60	5.65	Abundance of micaceous lignitic gray clay.
60	24.25	Abundance of micaceous lignitic gray clay; small amount of quartz.
100	23.09	Abundance of micaceous lignitic gray clay; small amount of quartz; traces of pyrite and muscovite.
150	13.98	Abundance of gray clay nodules; considerable quantity of quartz; trace of muscovite.
200	8.37	Abundance of clay nodules; considerable quantity of quartz; traces of lignite and pyrite.
250	5.03	Abundance of clay nodules; considerable quantity of quartz; traces of lignite and pyrite.
Cloth	19.63	Silt including residue from above.

SAMPLE B29AP1

Retained on screen	Percent	Character of Residue
30	0.60	Abundance of micaceous lignitic clay nodules; considerable quantity of lignite; small amounts of muscovite, pyrite and quartz.
60	7.73	Abundance of micaceous lignitic clay nodules; considerable quantity of lignite and muscovite; small amount of pyrite.
100	25.74	Abundance of quartz; considerable quantity of clay nodules; small amounts of lignite and muscovite; trace of glauconite.
150	23.63	Abundance of quartz; small amounts of clay and lignite.
200	18.17	Abundance of quartz; small amounts of clay and lignite.
250	2.08	Abundance of clay and lignite; small amounts of quartz and muscovite.
Cloth	22.05	Silt including residue from above.

SAMPLE B32P1

Retained on screen	Percent	Character of Residue
30	9.40	Abundance of gray micaceous lignitic clay nodules.
60	26.24	Abundance of micaceous lignitic clay nodules; trace of quartz.
100	13.51	Abundance of micaceous lignitic clay nodules; small amounts of lignite and muscovite.
150	5.39	Abundance of micaceous lignitic clay nodules; considerable quantity of muscovite; small amount of lignite.
200	6.11	Abundance of micaceous lignitic clay nodules; considerable quantity of muscovite; small amount of lignite.
250	1.82	Abundance of clay nodules; considerable quantities of lignite and muscovite.
Cloth	37.53	Clay substance including residue from above.

SAMPLE B34P1

Retained on screen	Percent	Character of Residue
30	0.22	Abundance of micaceous limonitic nodules; small amount of quartz.
60	0.67	Abundance of micaceous limonitic nodules; considerable quantity of quartz; small amount of muscovite; trace of lignite.
100	0.74	Abundance of muscovite; considerable quantity of limonite; small amounts of quartz, gray clay and biotite.
200	5.05	Abundance of muscovite; considerable quantity of quartz; small amount of clay; trace of biotite.
250	9.22	Abundance of quartz; small amounts of muscovite and clay; trace of biotite.
Cloth	81.95	Clay substance including residue from above.

SAMPLE B34FS

Retained on screen	Percent	Character of Residue
30	0.01	Abundance of gray clay nodules; considerable quantity of lignitic nodules; small amount of quartz; trace of limonite.
60	2.15	Abundance of clay nodules; traces of limonite, lignite and muscovite.
100	4.62	Abundance of clay nodules; traces of limonite, lignite and muscovite.
150	5.96	Abundance of clay nodules; considerable quantity of muscovite; trace of quartz.
200	6.35	Abundance of clay nodules; considerable quantity of muscovite; traces of quartz, lignite and limonite.
250	5.64	Abundance of clay nodules; considerable quantity of muscovite; small amount of quartz; traces of biotite and lignite.
Cloth	74.27	Clay substance including residue from above.

SAMPLE B38P1

Retained on screen	Percent	Character of Residue
30	0.94	Abundance of quartz; considerable quantity of lignitic clay nodules; small amount of lignite.
60	7.29	Abundance of quartz; considerable quantities of gray and white clay nodules, muscovite and lignite; small amount of limonite.
100	7.18	Abundance of muscovite; considerable quantity of kaolinitic clay; small amount of gray clay; trace of biotite.
150	18.25	Abundance of quartz; considerable quantity of muscovite; small amounts of white clay and limonitic clay.
200	25.79	Abundance of quartz; small amounts of clay and muscovite; trace of biotite.
250	3.17	Abundance of quartz; small amounts of muscovite and clay nodules.
Cloth	37.08	Clay substance including residue from above.

SAMPLE B41P1

Retained on screen	Percent	Character of Residue
30	12.42	Abundance of quartz; small amount of limonitic clay.
60	33.80	Abundance of quartz; considerable quantity of clay nodules; small amounts of limonite and hematite.
100	7.07	Abundance of quartz; considerable quantity of clay nodules; small amounts of limonite and hematite; trace of kaolinite.
150	3.06	Abundance of white clay nodules; considerable quantities of quartz and limonitic clay nodules; small amounts of hematite, rutile and kaolinite.
200	1.77	Abundance of kaolinitic clay; considerable quantity of quartz; small amounts of limonite, kaolinite and muscovite; traces of hematite and rutile.
250	1.60	Abundance of kaolinitic clay; considerable quantities of quartz and kaolinite; small amounts of limonite and hematite; trace of rutile.
Cloth	40.28	Clay substance including residue from above.

SAMPLE B43P1

Retained on screen	Percent	Character of Residue
30	0.38	Abundance of quartz; considerable quantity of limonitic clay nodules; traces of muscovite and plant fragments.
60	4.78	Abundance of micaceous limonitic clay nodules; considerable quantity of muscovite; trace of ferruginous material.
100	0.50	Abundance of muscovite; considerable quantity of limonitic clay; traces of pyrite and biotite.
150	6.23	Abundance of muscovite; considerable quantity of limonitic clay; small amount of quartz; trace of biotite.
200	5.77	Abundance of muscovite; considerable quantity of quartz; small amount of clay nodules; traces of biotite and hematite.
250	5.68	Abundance of clay nodules; considerable quantities of muscovite and quartz; trace of biotite.
Cloth	76.66	Clay substance including residue from above.

SAMPLE B48P1

Retained on screen	Percent	Character of Residue
30	1.58	Abundance of micaceous lignitic clay nodules; considerable quantity of limonitic quartz aggregate; small amount of quartz.
60	14.45	Abundance of micaceous lignitic clay nodules; small amounts of quartz and limonite.
100	9.95	Abundance of micaceous lignitic clay nodules; considerable quantity of limonitic clay nodules; small amounts of muscovite and quartz.
150	8.63	Abundance of micaceous lignitic clay nodules; considerable quantity of limonitic clay nodules; small amounts of muscovite and quartz.
200	7.84	Abundance of clay nodules; considerable quantity of muscovite; small amount of quartz.
250	6.78	Abundance of clay nodules and quartz; traces of lignite and muscovite.
Cloth	50.77	Clay substance including residue from above.

SAMPLE B49P1

Retained on screen	Percent	Character of Residue
30	1.30	Abundance of limonitic micaceous clay nodules; considerable quantity of gray clay; traces of quartz and hematite.
60	12.12	Abundance of gray clay nodules; small amount of limonite; traces of quartz and lignite.
100	11.70	Abundance of gray clay nodules; small amounts of quartz, limonite and muscovite; trace of lignite.
150	8.47	Abundance of gray clay nodules and limonitic material; considerable quantity of quartz; small amount of muscovite.
200	11.37	Abundance of clay nodules; considerable quantity of quartz; small amount of muscovite.
250	1.57	Abundance of quartz; considerable quantity of clay; traces of biotite, tourmaline and limonite.
Cloth	54.47	Clay substance including residue from above.

SAMPLE B54P1

Retained on screen	Percent	Character of Residue
30	0.70	Abundance of quartz; considerable quantity of micaceous limonitic clay nodules; trace of plant fragments.
60	0.99	Abundance of quartz; considerable quantity of white clay nodules; small amounts of limonitic clay and hematite; trace of muscovite.
100	1.65	Abundance of white clay nodules and muscovite; considerable quantities of hematite and limonite; small amount of biotite.
150	2.33	Abundance of muscovite; considerable quantities of clay nodules and quartz; small amounts of hematite and limonite; trace of biotite.
200	4.17	Abundance of muscovite; considerable quantities of white clay nodules and quartz; small amounts of hematite and limonite; trace of biotite.
250	4.03	Abundance of muscovite; small amount of clay nodules; traces of biotite, limonite, hematite and rutile.
Cloth	85.13	Clay substance including residue from above.

SAMPLE B64P1

Retained on screen	Percent	Character of Residue
30	0.99	Abundance of quartz; considerable quantity of hematite; small amount of limonite.
60	4.62	Abundance of quartz; considerable quantities of hematite and limonite; small amount of gray clay; trace of lignite.
100	5.73	Abundance of hematite, limonitic stained and white clay nodules; small amounts of muscovite and quartz.
150	2.67	Abundance of clay nodules; small amount of quartz.
200	3.92	Abundance of clay nodules; small amounts of quartz and muscovite.
250	1.00	Abundance of clay nodules; trace of muscovite.
Cloth	81.07	Clay substance including residue from above.

SAMPLE B64P2

Retained on screen	Percent	Character of Residue
30	0.60	Abundance of quartz; considerable quantities of limonitic arenaceous nodules, gray clay nodules lignite; trace of plant fragments.
60	2.93	Abundance of quartz; considerable quantity of gray clay; small amount of lignite.
100	5.52	Abundance of gray clay; small amount of muscovite; trace of lignite.
150	4.44	Abundance of gray clay; considerable quantity of muscovite; traces of quartz and biotite.
200	9.86	Abundance of gray clay; considerable quantity of muscovite; small amount of quartz.
250	2.32	Abundance of gray clay; considerable quantity of muscovite; small amount of quartz.
Cloth	74.33	Clay substance including residue from above.

SAMPLE B77P2

Retained on screen	Percent	Character of Residue
30	4.92	Abundance of gray clay nodules; small amount of lignitic nodules.
60	22.11	Abundance of gray clay nodules; small amount of lignite; traces of pyrite and quartz.
100	14.51	Abundance of gray clay nodules; small amount of lignite; trace of muscovite.
150	5.78	Abundance of gray clay nodules; small amount of lignite; traces of quartz and muscovite.
200	7.00	Abundance of gray clay nodules; small amounts of lignite and muscovite; trace of quartz.
250	2.18	Abundance of gray clay nodules; small amount of lignite; traces of quartz and muscovite.
Cloth	43.50	Clay substance including residue from above.

SAMPLE B77P3

Retained on screen	Percent	Character of Residue
30	1.88	Abundance of micaceous lignitic arenaceous nodules; small amounts of lignite, quartz and pyrite.
60	17.19	Abundance of micaceous lignitic arenaceous nodules; trace of quartz.
100	12.60	Abundance of micaceous lignitic arenaceous nodules; small amount of muscovite.
150	6.68	Abundance of micaceous lignitic nodules; small amount of muscovite.
200	8.87	Abundance of micaceous lignitic nodules; small amounts of muscovite and quartz.
250	2.45	Abundance of micaceous lignitic nodules; considerable quantities of quartz and muscovite.
Cloth	60.33	Clay substance including residue from above.

SAMPLE B78P1

Retained on screen	Percent	Character of Residue
30	0.97	Abundance of limonitic quartz aggregates; small amount of gray clay nodules.
60	6.51	Abundance of gray clay nodules; small amounts of limonitic clay nodules and muscovite.
100	19.77	Abundance of gray clay nodules; considerable quantity of limonite; small amounts of quartz and muscovite.
150	11.62	Abundance of gray clay nodules; considerable quantities of limonitic clay nodules and muscovite; trace of hematite.
200	9.52	Abundance of gray clay nodules; considerable quantity of limonitic clay; small amounts of muscovite and quartz.
250	8.00	Abundance of gray clay nodules; considerable quantity of limonitic clay; small amount of quartz; trace of rutile.
Cloth	43.61	Clay substance including residue from above.

SAMPLE B78P2

Retained on screen	Percent	Character of Residue
30	1.10	Abundance of limonitic arenaceous nodules; small amount of micaceous gray clay; trace of quartz.
60	9.17	Abundance of gray clay nodules; considerable quantity of limonitic nodules; trace of muscovite.
100	9.63	Abundance of gray clay nodules; considerable quantity of limonitic nodules; small amounts of quartz and muscovite.
150	9.16	Abundance of gray clay and limonitic clay nodules; considerable quantities of quartz and muscovite.
200	12.25	Abundance of gray clay and limonitic clay nodules; considerable quantities of quartz and muscovite.
250	10.00	Abundance of gray clay and limonitic clay nodules; considerable quantities of quartz and muscovite.
Cloth	48.69	Silt including residue from above.

SAMPLE B80P1

Retained on screen	Percent	Character of Residue
30	2.88	Abundance of ferruginous micaceous nodules and gray micaceous clay nodules.
60	17.93	Abundance of gray micaceous clay nodules; considerable quantity of limonitic clay nodules; small amounts of quartz and muscovite.
100	19.35	Abundance of gray clay nodules; considerable quantity of limonitic clay; small amounts of quartz and muscovite.
150	8.75	Abundance of quartz; considerable quantities of muscovite and limonitic clay nodules; small amount of biotite; trace of hematite.
200	9.77	Abundance of quartz; considerable quantities of gray and limonitic clay nodules; small amount of muscovite; trace of rutile.
250	1.51	Abundance of clay nodules and quartz; small amounts of muscovite, rutile and hematite.
Cloth	60.19	Clay substance including residue from above.

SAMPLE B81P1

Retained on screen	Percent	Character of Residue
30	1.12	Abundance of micaceous lignitic clay nodules; small amounts of quartz and limonite.
60	12.43	Abundance of micaceous lignitic clay nodules; small amounts of limonite and muscovite.
100	23.58	Abundance of micaceous lignitic clay nodules; considerable quantity of quartz; trace of muscovite.
150	11.24	Abundance of clay nodules and quartz; considerable quantity of muscovite; small amount of lignite; traces of kaolin, limonite and glauconite.
200	7.84	Abundance of gray clay nodules; considerable quantity of muscovite; small amount of lignite; traces of limonite and kaolin.
250	6.50	Abundance of gray clay; considerable quantities of lignite and muscovite; trace of kaolin.
Cloth	37.29	Clay substance including residue from above.

SAMPLE B83P1

Retained on screen	Percent	Character of Residue
30	6.54	Abundance of micaceous lignitic clay nodules; trace of quartz.
60	20.02	Abundance of micaceous lignitic clay nodules; small amount of quartz.
100	12.82	Abundance of micaceous lignitic clay nodules; small amounts of quartz and muscovite; trace of biotite.
150	11.43	Abundance of clay nodules; considerable quantity of muscovite; small amount of quartz; trace of biotite.
200	8.40	Abundance of quartz; considerable quantities of clay nodules and lignite; small amount of muscovite.
250	4.49	Abundance of clay nodules; considerable quantity of quartz; small amount of lignite.
Cloth	36.30	Clay substance including residue from above.

CHEMICAL ANALYSES

Composite of Samples B1AP2-3-4

Analysis of residue washed through 250 mesh screen

Moisture, air dried 1.60 Sulphur, SO_3 0.30

Ignition loss	9.39	Iron oxide, Fe_2O_3	0.31	Magnesia, MgO	Trace
Silica, SiO_2	56.59	Titania, TiO_2	1.78	Potash, K_2O	1.04
Alumina, Al_2O_3	31.60	Lime, CaO	Trace	Soda, Na_2O	0.20

Composite of Samples B1AP6-7-8-9

Whole sample ground to pass 100 mesh screen

Moisture, air dried 2.40 Sulphur, SO_3 2.95

Ignition loss	14.01	Iron oxide, Fe_2O_3	0.78	Magnesia, MgO	0.11
Silica, SiO_2	50.98	Titania, TiO_2	1.66	Potash, K_2O	1.20
Alumina, Al_2O_3	30.73	Lime, CaO	Trace	Soda, Na_2O	0.80

Water soluble SO_4 1.02
Water soluble $FeSO_4$ 0.64

Composite of Samples B1AP6-7-8-9

Analysis of residue washed through 250 mesh screen

Moisture, air dried 2.90 Sulphur, SO_3 0.11

Ignition loss	12.35	Iron oxide, Fe_2O_3	0.96	Magnesia, MgO	Trace
Silica, SiO_2	51.29	Titania, TiO_2	1.86	Potash, K_2O	0.26
Alumina, Al_2O_3	32.85	Lime, CaO	Trace	Soda, Na_2O	0.16

Water soluble SO_4 0.46
Water soluble $FeSO_4$ 0.31

Sample B17P1

Analysis of residue washed through 250 mesh screen

Moisture, air dried 1.70 Sulphur, SO_3 0.27

Ignition loss	9.05	Iron oxide, Fe_2O_3	0.91	Magnesia, MgO	0.04
Silica, SiO_2	56.99	Titania, TiO_2	2.05	Potash, K_2O	0.74
Alumina, Al_2O_3	30.72	Lime, CaO	Trace	Soda, Na_2O	0.26

Sample B34FS

Analysis of residue washed through 250 mesh screen

Moisture, air dried 2.48 Sulphur, SO_3 2.16

Ignition loss	10.07	Iron oxide, Fe_2O_3	0.71	Magnesia, MgO	0.12
Silica, SiO_2	54.97	Titania, TiO_2	2.22	Potash, K_2O	0.20
Alumina, Al_2O_3	32.01	Lime, CaO	0.64	Soda, Na_2O	0.08

Sample B38P1

Whole sample ground to pass 100 mesh screen

Moisture, air dried 0.65 Sulphur, SO_3 2.60

Ignition loss	5.53	Iron oxide, Fe_2O_3	0.92	Magnesia, MgO	0.14
Silica, SiO_2	71.31	Titania, TiO_2	0.80	Potash, K_2O	1.01
Alumina, Al_2O_3	19.08	Lime, CaO	0.77	Soda, Na_2O	0.72

Sample B49P1

Whole sample ground to pass 100 mesh screen

Moisture, air dried 3.75 Sulphur, SO_3 0.85

Ignition loss	7.83	Iron oxide, Fe_2O_3	0.71	Magnesia, MgO	0.02
Silica, SiO_2	62.47	Titania, TiO_2	1.06	Potash, K_2O	0.80
Alumina, Al_2O_3	26.58	Lime, CaO	0.59	Soda, Na_2O	0.62

Sample B64P1

Analysis of residue washed through 250 mesh screen

Moisture, air dried 2.75 Sulphur, SO_3 0.09

Ignition loss	10.43	Iron oxide, Fe_2O_3	0.84	Magnesia, MgO	0.33
Silica, SiO_2	51.77	Titania, TiO_2	1.17	Potash, K_2O	0.12
Alumina, Al_2O_3	34.24	Lime, CaO	1.33	Soda, Na_2O	Trace

Sample B64P2

Analysis of residue washed through 250 mesh screen

Moisture, air dried 2.65 Sulphur, SO_3 0.18

Ignition loss	10.94	Iron oxide, Fe_2O_3	0.50	Magnesia, MgO	0.31
Silica, SiO_2	52.88	Titania, TiO_2	1.07	Potash, K_2O	0.21
Alumina, Al_2O_3	32.44	Lime, CaO	1.20	Soda, Na_2O	0.11

PYRO-PHYSICAL PROPERTIES

Test Holes B1, B1A

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	
B1P1	01	31.12	18.03	1.72	2.51	11.00	3.81	933	Cream	
	2	30.91	17.75	1.74	2.52	11.48	3.99	1188	Cream	
	4	26.78	14.59	1.84	2.51	15.94	5.65	1829	Cream	
	6	22.55	11.86	1.91	2.46	18.94	6.78	2001	Cream	
	8	21.36	10.95	1.93	2.48	20.85	7.52	2383	Cream	St. H.
	10	16.75	7.93	2.03	2.42	24.19	8.82	3609	Cream	
	12	12.26	5.79	2.12	2.42	27.41	10.16	3676	Cream	
	14	.89	.39	2.24	2.26	32.32	12.24	4351	Gray	
B1AP1	01	31.93	18.19	1.75	2.58	12.71	4.46	1400	Cream	
	2	27.78	14.96	1.86	2.58	16.95	6.02	1900	Cream	
	4	27.59	14.81	1.86	2.57	17.60	6.25	2314	Cream	
	6	27.13	14.66	1.86	2.54	17.96	6.40	2484	Cream	
	8	26.45	13.62	1.94	2.61	21.09	7.60	2945	Cream	St. H.
	10	15.12	7.16	2.11	2.49	27.47	10.16	2990	Cream	
	12	14.05	6.60	2.14	2.48	28.35	10.54	3305	Cream	
	14	2.36	1.04	2.28	2.33	32.73	12.41	3915	Gray	
B1AP2	01	31.87	18.55	1.72	2.53	10.84	3.77	1040	Cream	
	2	29.95	16.78	1.78	2.54	14.47	5.01	1617	Cream	
	4	29.18	16.25	1.79	2.53	14.55	5.12	1675	Cream	
	6	27.25	15.14	1.81	2.49	14.86	5.16	2143	Cream	
	8	26.00	13.49	1.88	2.52	20.35	7.32	2389	Cream	St. H.
	10	17.63	8.57	2.06	2.50	25.16	9.22	2847	Cream	
	12	13.41	6.40	2.10	2.42	26.82	9.92	3254	Cream	
	14	1.55	.69	2.26	2.29	32.10	12.11	4982	Gray	
B1AP3	01	31.20	18.16	1.72	2.50	11.34	3.95	1088	Cream	
	2	29.74	16.44	1.79	2.54	14.80	5.20	1235	Cream	
	4	27.42	14.81	1.85	2.55	18.08	6.44	2180	Cream	
	6	22.88	11.95	1.91	2.48	20.23	7.28	2490	Cream	
	8	19.00	9.62	1.98	2.44	22.83	8.30	3349	Cream	St. H.
	10	13.60	6.44	2.11	2.44	27.77	10.29	3436	Cream	
	12	11.65	5.37	2.17	2.47	29.91	11.21	3620	Cream	
	14	.42	.18	2.28	2.29	32.32	12.32	5165	Gray	
B1AP4	01	30.78	17.50	1.76	2.55	10.70	3.70	1691	Cream	
	2	27.46	14.88	1.85	2.54	14.75	5.20	1724	Cream	
	4	26.78	14.37	1.86	2.54	15.75	5.57	1759	Cream	
	6	23.96	12.88	1.89	2.50	16.90	5.98	2437	Cream	St. H.
	8	19.36	9.70	2.00	2.48	21.52	7.79	2501	Cream	
	10	17.29	8.48	2.04	2.47	23.17	8.42	2880	Cream	
	12	10.86	5.07	2.14	2.41	27.01	10.00	3164	Cream	
	14	1.54	.68	2.26	2.30	30.74	11.55	4510	Gray	
B1AP6	01	32.48	21.01	1.55	2.29	17.56	6.25	1274	Cream, stained	
	2	30.08	19.12	1.57	2.25	18.68	6.67	1491	Cream, stained	
	4	29.31	18.35	1.60	2.26	19.84	7.13	1610	Cream, stained	St. H.
	6	18.74	10.61	1.77	2.19	27.22	10.08	1853	Buff, stained	
	8	18.40	10.32	1.78	2.14	28.19	10.45	1999	Buff, stained	
	10	17.59	9.59	1.84	2.07	30.30	11.34	2042	Buff, stained	
	12	10.90	5.88	1.85	2.22	30.15	11.29	2109	Buff, stained	
	14	16.26	9.10	1.78	2.13	27.89	10.33	1168	Brownish gray, stained	

Abbreviations: St. H., steel hard.

TEST HOLES B1A, B2, B14, B16

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
B1AP7	01	27.35	15.85	1.76	2.44	20.42	7.36	2415	Cream, stained St. H.
	2	26.37	14.85	1.82	2.47	22.28	8.07	2677	Cream, stained
	4	24.43	13.30	1.84	2.43	23.89	8.70	2685	Cream, stained
	6	13.88	6.97	1.98	2.28	29.31	10.96	2939	Buff, stained
	8	10.95	5.25	2.08	2.34	32.59	12.32	941	Buff, stained
	10	3.57	1.68	2.12	2.20	33.35	12.67	689	Gray-buff, stained
	12	9.61	4.75	2.02	2.24	30.77	11.55	489	Gray-buff, stained Bl.
	14	7.50	3.83	1.96	2.13	28.49	10.58	2603	Brownish gray, S. Cr.
B1AP8	01	26.59	14.90	1.79	2.48	20.91	7.56	2550	Buff, stained St. H.
	2	21.61	11.69	1.84	2.35	22.30	8.07	2621	Buff, stained
	4	16.14	8.25	1.96	2.30	27.66	10.25	2621	Buff, stained
	6	10.65	5.31	2.00	2.25	29.65	11.08	2918	Buff, stained
	8	10.45	5.23	2.00	2.24	28.80	10.71	665	Buff, stained
	10	2.75	1.39	1.98	2.04	28.57	10.62	632	Gray-buff, stained Bl.
B1AP9	01	31.67	18.11	1.75	2.56	11.22	3.92	1367	Salmon-buff, stained
	2	30.38	17.05	1.78	2.56	13.02	4.57	1396	Salmon-buff, stained
	4	29.89	16.03	1.79	2.52	13.05	4.57	1475	Salmon-buff, stained
	6	22.40	11.78	1.87	2.39	15.76	5.57	1546	Salmon-buff, S., St. H.
	8	22.19	11.47	1.94	2.49	19.85	7.13	2248	Salmon-buff, stained
	10	10.90	5.19	2.10	2.36	26.84	9.92	2957	Reddish gray, stained
	12	10.64	4.96	2.14	2.40	27.67	10.25	3121	Gray, stained
	14	12.01	9.22	1.74	2.07	11.11	3.88	2031	Brown, stained Bl.
B2P1	01	24.16	13.22	1.83	2.41	17.51	6.25	2385	Buff St. H.
	2	22.18	11.74	1.89	2.43	22.23	8.07	2928	Buff
	4	22.18	11.73	1.89	2.42	22.20	8.03	3388	Buff
	6	12.35	5.99	2.05	2.35	28.33	10.54	3691	Buff
	8	11.49	4.67	2.11	2.37	30.17	11.29	4118	Dk. buff
	10	1.57	.73	2.17	2.20	32.59	12.32	3520	Gray-buff
	12	7.79	3.73	2.09	2.29	31.10	11.68	2835	Gray-buff Bl.
	14	12.44	6.60	1.87	2.13	21.75	7.87	2319	Grayish brown Bl.
B14P1	01	17.23	8.98	1.92	2.32	21.49	7.75	2384	Salmon-buff, S., St. H.
	2	15.97	8.22	1.94	2.32	20.39	7.32	3151	Salmon-buff, stained
	4	15.62	7.97	1.96	2.31	20.97	7.56	3229	Salmon-buff, stained
	6	13.72	7.22	1.90	2.20	19.78	7.01	3018	Salmon-buff, stained
	8	15.87	8.48	1.87	2.23	18.09	6.44	1867	Salmon-buff, S., Bl.
B16P1	01	30.62	16.81	1.82	2.62	12.39	4.32	1773	Buff, stained St. H.
	2	29.77	16.39	1.82	2.59	13.38	4.68	2057	Buff, stained
	4	29.20	15.79	1.85	2.61	14.34	5.05	2111	Buff, stained
	6	20.74	10.94	1.95	2.48	18.57	6.63	2680	Buff, stained
	8	19.50	9.78	1.95	2.47	18.78	6.71	2675	Buff, stained
	10	17.57	9.46	1.99	2.37	20.62	7.44	3227	Gray-buff, stained
	12	12.98	6.53	1.99	2.28	20.36	7.32	2775	Gray-buff, stained
	14	11.80	5.96	1.98	2.25	19.99	7.17	1923	Brown, stained

Abbreviations: Bl., bloated; Cr., cracked; St. H., steel hard; S., stained.

TEST HOLES B17, B23, B29, B29A, B32, B34

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
B17P1	01	31.94	18.45	1.73	2.55	8.89	3.06	920	Cream
	2	28.96	15.89	1.82	2.51	13.84	4.87	1219	Cream
	4	26.87	14.77	1.83	2.50	13.95	4.90	2100	Cream
	6	26.48	14.15	1.87	2.45	15.70	5.53	2108	Cream St. H.
	8	18.73	9.44	1.99	2.44	20.77	7.48	2973	Cream
	10	16.24	7.90	2.05	2.44	23.58	8.58	3108	Cream
	12	13.63	6.58	2.08	2.41	24.47	8.94	3300	Cream
	14	8.80	4.03	2.18	2.39	27.96	10.37	3876	Gray
B23P1	01	26.68	14.05	1.90	2.59	16.79	5.95	2687	Salmon-buff St. H.
	2	20.04	9.95	2.01	2.52	21.58	7.79	3021	Salmon-buff
	4	16.70	8.00	2.09	2.51	23.14	8.42	3154	Salmon-buff
	6	14.40	6.82	2.11	2.47	24.95	9.14	3590	Salmon-buff
	8	4.20	1.88	2.26	2.34	26.28	9.67	3907	Gray-buff
	10	1.66	.71	2.34	2.38	32.88	12.45	4978	Gray
	12	3.08	1.23	2.23	2.30	29.35	10.96	3933	Gray
	14	9.88	4.88	2.03	2.30	22.57	8.12	3343	Grayish brown
B29P1	01	31.63	18.00	1.76	2.58	2.72	.94	949	Salmon, stained
	2	31.57	17.67	1.79	2.61	4.42	1.52	1253	Lt. red, stained
	4	32.92	18.31	1.77	2.63	3.40	1.15	1255	Lt. red, stained
	6	27.77	16.84	1.65	2.29	–3.07	–1.04	1443	Red, stained
	8	30.63	19.23	1.59	2.30	–6.41	–2.22	1424	Red, stained
	10	26.15	18.15	1.46	1.98	–15.04	–5.31	1009	Dk. red, S., Bl., Not St. H.
B29AP1	01	37.00	22.16	1.67	2.65	–.59	–.20	566	Salmon, stained
	2	37.21	22.42	1.66	2.64	–.39	–.13	491	Salmon, stained
	4	35.80	21.37	1.68	2.62	–.41	–.17	562	Lt. red, stained
	6	33.68	18.15	1.67	2.40	–.20	–.07	564	Lt. red, stained
	8	34.12	20.74	1.64	2.40	–1.68	–.57	602	Lt. red, S., Not St. H.
B32P1	01	28.87	16.56	1.70	2.35	17.01	6.06	903	Cream, stained St. H.
	2	27.42	16.12	1.74	2.45	17.08	6.06	1784	Cream, stained
	4	27.09	15.99	1.69	2.33	19.02	6.82	1788	Cream, stained
	6	23.07	13.12	1.73	2.30	20.65	7.44	2206	Buff, stained
	8	18.05	9.68	1.86	2.28	24.21	8.86	567	Buff, stained
	10	14.50	7.44	1.95	2.28	27.51	10.21	496	Buff, stained
	12	15.44	8.07	1.91	2.27	24.37	8.90	420	Buff, stained
	14	16.17	8.72	1.85	2.21	24.17	8.82	782	Brown, stained
B34P1	01	38.52	23.33	1.65	2.68	4.46	1.52	503	Cream
	2	36.52	22.48	1.64	2.59	3.74	1.28	527	Cream
	4	36.27	21.85	1.67	2.62	4.50	1.52	696	Cream
	6	33.49	19.67	1.68	2.56	5.88	2.01	926	Cream
	8	31.59	18.77	1.70	2.46	7.10	2.42	1051	Cream
	10	27.57	15.38	1.79	2.47	11.90	3.77	1171	Cream
	12	27.27	14.92	1.83	2.52	13.84	4.87	1238	Cream St. H.
	14	14.28	6.98	2.04	2.38	24.42	8.94	2607	Gray-buff

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

TEST HOLES B34, B38, B41, B43, B48

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
B34FS	01	32.29	18.81	1.72	2.54	14.70	5.16	1831	Cream St. H.
	2	27.22	14.43	1.89	2.61	22.38	8.11	2270	Cream
	4	26.08	13.83	1.87	2.55	22.45	8.15	2679	Cream
	6	23.19	11.98	1.93	2.51	23.62	8.62	2782	Cream
	8	18.91	9.05	2.05	2.52	28.44	10.58	3443	Cream
	10	13.11	6.10	2.15	2.48	32.06	12.11	3745	Cream
	12	12.08	5.71	2.18	2.48	32.98	12.50	4430	Cream
	14	.11	.04	2.34	2.37	36.89	14.23	5090	Gray
B38P1	01	41.33	25.82	1.58	2.67	.74	.27	298	Cream
	2	41.18	25.70	1.60	2.72	2.09	.70	328	Cream
	4	39.19	24.05	1.63	2.68	1.98	.67	445	Cream
	6	36.84	22.36	1.63	2.61	3.39	1.15	471	Cream
	8	34.54	21.21	1.67	2.48	4.91	1.70	508	Cream
	10	34.88	20.76	1.68	2.58	6.28	2.15	661	Cream
	12	34.50	20.31	1.70	2.59	7.63	2.64	708	Cream
	14	27.17	15.49	1.82	2.53	13.69	4.79	971	Buff, specked St. H.
B41P1	01	34.72	19.53	1.78	2.72	.00	.00	46	Grayish white
	2	33.72	18.88	1.79	2.69	.00	.00	27	Grayish white
	4	34.87	19.67	1.77	2.72	.00	.00	79	Grayish white
	6	32.79	18.50	1.77	2.63	.00	.00	80	Grayish white
	8	33.36	18.58	1.80	2.70	1.02	.37	86	Grayish white
	10	30.02	16.61	1.81	2.58	1.76	.60	140	Grayish white
	12	31.85	17.56	1.81	2.66	2.17	.74	128	Grayish white
	14	32.55	17.82	1.81	2.67	2.49	.84	214	G. W., S. Not St. H.
B43P1	01	35.24	20.15	1.75	2.70	8.39	2.88	1296	Salmon
	2	31.97	17.50	1.82	2.68	12.52	4.39	1440	Salmon
	4	31.14	16.84	1.83	2.67	12.62	4.43	1483	Salmon
	6	23.08	12.00	1.92	2.50	16.78	5.95	2219	Dull red St. H.
	8	22.70	11.38	1.98	2.56	19.14	6.86	2453	Dull red
	10	18.55	9.19	2.02	2.48	21.23	7.67	2847	Dull red
	12	15.54	7.46	2.08	2.47	23.31	8.50	2860	Reddish brown
	14	8.95	4.21	2.13	2.33	25.10	9.18	2823	Brown
B48P1	01	29.59	16.36	1.81	2.57	10.24	3.56	1318	Salmon, stained
	2	28.04	15.32	1.83	2.54	11.33	3.95	2207	Salmon, stained
	4	25.01	13.02	1.91	2.54	14.70	5.16	2230	Salmon, stained St. H.
	6	18.50	9.59	1.96	2.40	16.36	5.80	2258	Dull red, stained
	8	18.50	9.56	1.98	2.44	17.68	6.29	2872	Dull red, stained
	10	12.04	5.68	2.12	2.41	23.33	8.50	3124	Reddish brown, stained
	12	13.06	6.33	2.07	2.37	21.66	7.83	3226	Reddish brown, stained
	14	16.78	9.45	1.78	2.10	8.73	3.07	1798	Brown, stained Bl.

Abbreviations: Bl., bloated; St. H., steel hard; G. W., grayish white; S., specked.

TEST HOLES B49, B54, B64, B77

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	
B49P1	01	32.66	18.23	1.80	2.65	6.58	2.25	1313	Salmon-buff	
	2	31.73	17.62	1.80	2.64	7.19	2.46	1465	Salmon-buff	
	4	27.06	14.52	1.87	2.57	8.50	2.92	1526	Salmon-buff	
	6	26.24	14.22	1.87	2.50	9.61	3.34	1885	Salmon-buff	
	8	26.23	13.90	1.89	2.56	11.25	3.92	N.D.	Buff	St. H.
	10	23.46	12.35	1.90	2.48	11.89	4.14	1996	Buff	
	12	21.82	11.39	1.91	2.45	12.64	4.43	2070	Buff	
	14	5.85	3.15	1.85	1.97	9.68	3.34	1700	Brown	
B54P1	01	32.95	18.65	1.77	2.64	7.56	2.60	875	Cream	
	2	32.54	18.35	1.77	2.63	7.66	2.64	884	Cream	
	4	30.15	16.33	1.83	2.62	10.49	3.63	984	Cream	St. H.
	6	26.73	14.46	1.85	2.52	11.36	3.95	2040	Buff	
	8	25.02	13.08	1.92	2.55	14.71	5.20	2080	Buff	
	10	20.40	10.31	1.98	2.49	18.26	6.52	2060	Buff	
	12	19.97	10.00	2.00	2.49	18.31	6.55	2267	Buff	
	14	10.93	5.14	2.12	2.39	23.43	8.54	3232	Gray-buff	
B64P1	01	32.44	18.70	1.74	2.57	17.49	6.21	968	Cream	
	2	29.40	16.01	1.84	2.61	22.17	8.03	1095	Cream	
	4	28.82	15.47	1.83	2.61	23.38	8.50	2331	Cream	St. H.
	6	23.49	11.96	1.96	2.57	25.89	9.51	2832	Cream	
	8	18.02	8.62	2.10	2.56	31.75	11.98	3381	Cream	
	10	11.37	5.12	2.22	2.51	35.75	13.73	4260	Buff	
	12	9.27	4.11	2.29	2.49	36.75	14.18	4811	Gray-buff	
	14	1.76	.74	2.37	2.41	39.82	15.61	4568	Brown	
B64P2	01	31.10	17.90	1.72	2.49	11.52	4.03	1197	Cream	
	2	30.26	17.29	1.76	2.51	13.45	4.72	1833	Cream	
	4	28.49	15.37	1.85	2.59	18.30	6.52	2441	Cream	St. H.
	6	23.20	12.27	1.89	2.46	19.36	6.94	2518	Cream	
	8	21.05	10.85	1.94	2.46	21.84	7.83	2670	Cream	
	10	16.48	8.16	2.03	2.42	25.53	9.39	3342	Buff	
	12	12.46	5.93	2.10	2.40	28.35	10.54	3304	Buff	
	14	6.17	2.82	2.20	2.35	31.53	11.89	3109	Gray	
B77P2	01	23.52	13.05	1.93	2.51	21.65	7.83	2530	Salmon	St. H.
	2	18.97	9.41	2.01	2.49	25.33	9.31	N.D.	Salmon	
	4	13.70	6.62	2.07	2.40	26.80	9.88	2144	Red	
	6	19.94	13.96	1.44	1.80	–5.42	–1.87	1904	Red	Bl.
B77P3	01	24.64	13.02	1.89	2.51	18.42	6.59	2395	Salmon	St. H.
	2	19.23	9.55	2.02	2.50	23.23	8.46	2930	Lt. red	
	4	18.97	9.61	1.98	2.41	21.97	7.95	2763	Red	Bl.
	6	14.14	8.54	1.65	1.93	6.29	2.15	3223	Red	Bl.

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

TEST HOLES B78, B80, B81, B83

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	
B78P1	01	31.99	17.44	1.83	2.69	5.32	1.83	1643	Salmon	
	2	28.62	15.12	1.89	2.63	8.06	2.78	1786	Salmon	St. H.
	4	27.37	14.29	1.92	2.63	9.05	3.13	1966	Lt. red	
	6	22.60	11.66	1.96	2.50	9.28	3.20	2016	Lt. red	
	8	22.32	11.19	1.99	2.58	12.84	4.50	2355	Red	
	10	18.71	9.15	2.04	2.52	15.15	5.35	2234	Grayish red	
	12	16.25	7.75	2.10	2.56	17.05	6.06	2235	Gray-buff	
	14	10.03	4.83	2.07	2.31	16.48	5.83	2456	Brown	
B78P2	01	31.01	16.78	1.85	2.68	7.11	2.46	1588	Salmon	St. H.
	2	30.65	16.55	1.85	2.68	7.26	2.50	1556	Salmon	
	4	27.74	14.45	1.91	2.66	10.30	3.56	1546	Salmon	
	6	23.66	12.30	1.92	2.52	11.23	3.92	2078	Lt. red	
	8	22.59	11.37	1.99	2.57	13.60	4.76	2298	Lt. red	
	10	17.92	8.63	2.08	2.53	17.88	6.36	2690	Red	
	12	14.19	6.60	2.15	2.51	20.16	7.25	N.D.	Grayish red	
	14	8.50	4.72	1.88	2.06	8.13	2.81	N.D.	Brown	Bl.
B80P1	01	32.85	18.28	1.80	2.68	8.23	2.85	1252	Salmon	
	2	32.13	17.77	1.81	2.67	8.73	3.02	1416	Salmon	
	4	31.73	17.31	1.84	2.67	8.80	3.02	1503	Salmon	
	6	27.87	14.61	1.86	2.56	10.13	3.52	1569	Salmon	
	8	24.29	12.69	1.91	2.53	12.70	4.43	1768	Red	
	10	20.36	10.22	1.99	2.50	16.39	5.80	1772	Grayish red	St. H.
	12	18.08	8.82	2.05	2.51	19.15	6.86	2102	Grayish red	
	14	3.86	2.01	1.91	1.99	12.00	4.17	1995	Brown	Bl.
B81P1	01	35.12	20.75	1.69	2.62	13.87	4.87	904	Salmon	
	2	34.98	20.38	1.72	2.63	14.38	5.05	1052	Salmon	
	4	30.80	17.22	1.79	2.59	17.93	6.40	1262	Dull red	
	6	18.00	9.90	1.82	2.22	19.02	6.82	1357	Dull red	St. H.
	8	22.92	12.73	1.80	2.34	18.71	6.71	1399	Dull red	
B83P1	01	33.83	19.93	1.70	2.57	18.29	6.52	1028	Salmon	
	2	33.39	19.57	1.72	2.59	19.47	6.98	1332	Salmon	
	4	31.60	17.90	1.77	2.57	21.68	7.83	1515	Dull red	St. H.
	6	19.61	10.65	1.84	2.29	24.69	9.02	1320	Dull red	
	8	24.91	15.15	1.65	2.19	16.12	5.72	N.D.	Dull red	Bl.

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

LABORATORY TESTS OF THE ACKERMAN CLAYS

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample No.	Type of Clay	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in lbs./sq. in.	Texture	Color
			Volume in percent	Linear in percent			
B63P1	3B	32.95	38.26	14.87	1010	Dense	Dk. gray
B68P1	4A	28.50	22.57	8.18	359	Silty	Yellow
B85P1	4A	36.45	34.33	13.11	454	Silty	Tan
B85P2	3C	47.28	50.65	21.00	803	Dense	Dk. brown
B85P3	5B	29.73	27.40	10.12	876	Silty	Dk. gray
B86P1	5A	34.75	25.67	9.43	687	Open	Dk. gray
B86P2	3A	33.89	33.87	12.89	1015	Dense	Gray
B86P3	5B	42.42	35.40	13.55	N.D.	Silty	Dk. gray
B90P1	4A	35.58	32.13	12.15	558	Silty	Brown
B90P2	3A	36.56	37.23	14.41	768	Dense	Gray
B90P3	3B	40.90	38.91	15.19	807	Dense	Dk. gray

SCREEN ANALYSES

SAMPLE B63P1

Retained on screen	Percent	Character of Residue
30	0.45	Abundance of micaceous lignitic clay and quartz; considerable quantity of pyrite; small amounts of lignite and limonite.
60	9.30	Abundance of micaceous lignitic clay nodules; traces of lignite, pyrite and limonite.
100	14.65	Abundance of micaceous lignitic clay nodules; small amounts of biotite, quartz and pyrite.
150	9.95	Abundance of micaceous lignitic clay nodules; small amounts of biotite, quartz and pyrite.
200	9.40	Abundance of micaceous lignitic clay nodules; small amounts of quartz and muscovite; trace of pyrite.
250	7.17	Abundance of micaceous lignitic clay nodules; considerable quantity of muscovite; trace of lignite.
Cloth	49.08	Clay substance including residue from above.

Sample B68P1

Retained on screen	Percent	Character of Residue
30	0.38	Abundance of micaceous lignitic arenaceous nodules; considerable quantity of quartz; small amount of gray clay.
60	1.49	Abundance of micaceous limonitic nodules; considerable quantity of kaolinitic clay nodules; small amount of muscovite.
100	2.82	Abundance of muscovite; considerable quantity of limonitic clay and kaolinitic clay nodules; small amounts of quartz and ferruginous rock.
150	3.50	Abundance of muscovite; small amounts of limonitic clay and kaolinitic clay nodules; traces of biotite and ferruginous rock.
200	4.14	Abundance of clay nodules; considerable quantity of muscovite; traces of biotite and quartz.
250	5.00	Abundance of muscovite; considerable quantity of clay nodules; small amounts of limonite and quartz.
Cloth	82.67	Clay substance including residue from above.

Sample B85P1

Retained on screen	Percent	Character of Residue
30	0.67	Abundance of limonitic arenaceous nodules; traces of lignite and plant fragments.
60	4.58	Abundance of gray clay nodules; considerable quantity of limonitic arenaceous nodules; trace of plant fragments.
100	6.15	Abundance of gray clay nodules; considerable quantity of limonitic clay nodules; small amount of muscovite.
150	8.77	Abundance of limonitic clay nodules; considerable quantity of gray clay nodules; small amounts of muscovite and quartz; trace of rutile.
200	27.20	Abundance of quartz; considerable quantity of limonitic and gray clay nodules; trace of rutile.
250	13.35	Abundance of quartz; considerable quantity of limonitic and gray clay nodules; trace of rutile.
Cloth	39.28	Silt including residue from above.

SAMPLE B85P2

Retained on screen	Percent	Character of Residue
30	6.90	Abundance of micaceous gray clay nodules; considerable quantity of limonitic clay; small amount of ferruginous rock.
60	27.32	Abundance of gray clay nodules and limonitic stained clay; small amount of ferruginous rock.
100	16.05	Abundance of gray and limonitic clay nodules; small amount of ferruginous rock.
150	6.49	Abundance of gray and limonitic clay nodules; small amount of ferruginous rock.
200	7.48	Abundance of limonitic clay nodules; small amount of gray clay; traces of ferruginous rock and quartz.
250	2.26	Abundance of limonitic clay nodules; small amount of gray clay; trace of ferruginous rock.
Cloth	33.50	Clay substance including residue from above.

SAMPLE B85P3

Retained on screen	Percent	Character of Residue
30	1.76	Abundance of micaceous lignitic gray clay nodules; trace of lignite.
60	10.47	Abundance of micaceous lignitic gray clay nodules; trace of lignite.
100	12.57	Abundance of micaceous lignitic clay nodules; small amount of quartz; trace of muscovite.
150	7.25	Abundance of lignitic arenaceous nodules; considerable quantity of muscovite.
200	19.49	Abundance of quartz; considerable quantity of arenaceous material; small amount of muscovite.
250	4.59	Abundance of arenaceous material; small amount of muscovite.
Cloth	43.87	Clay substance including residue from above.

SAMPLE B86P1

Retained on screen	Percent	Character of Residue
30	7.55	Abundance of micaceous arenaceous clay nodules.
60	22.32	Abundance of micaceous arenaceous clay nodules.
100	10.89	Abundance of micaceous arenaceous clay nodules; small amount of muscovite; traces of lignite and limonite.
150	6.72	Abundance of clay nodules; small amounts of muscovite and quartz; trace of limonite.
200	22.87	Abundance of quartz; small amount of muscovite; traces of pyrite and hematite.
250	5.42	Abundance of quartz; traces of muscovite and biotite.
Cloth	24.23	Silt including residue from above.

SAMPLE B86P2

Retained on screen	Percent	Character of Residue
30	1.39	Abundance of gray clay nodules; considerable quantity of micaceous lignitic arenaceous nodules; small amount of pyrite.
60	6.83	Abundance of gray clay; considerable quantity of micaceous lignitic arenaceous material.
100	13.21	Abundance of gray clay; considerable quantity of arenaceous material; small amounts of muscovite and lignite.
150	6.67	Abundance of gray and white clay nodules; trace of lignite.
200	16.84	Abundance of gray clay; considerable quantities of quartz and muscovite; trace of lignite.
250	3.87	Abundance of gray clay; considerable quantities of quartz and muscovite.
Cloth	51.19	Clay substance including residue from above.

SAMPLE B86P3

Retained on screen	Percent	Character of Residue
30	4.60	Abundance of lignite; considerable quantity of micaceous lignitic clay nodules; trace of plant fragments.
60	24.60	Abundance of gray clay nodules; considerable quantity of lignite; traces of pyrite and gypsum.
100	13.53	Abundance of gray clay; considerable quantity of lignite.
150	7.96	Abundance of gray clay; considerable quantity of lignite; trace of muscovite.
200	6.50	Abundance of gray clay; considerable quantity of lignite; small amount of muscovite.
250	4.77	Abundance of gray clay; considerable quantity of lignite; small amounts of quartz and muscovite.
Cloth	38.04	Clay substance including residue from above.

SAMPLE B90P1

Retained on screen	Percent	Character of Residue
30	1.20	Abundance of micaceous limonitic material; considerable quantity of gray clay; trace of lignite.
60	6.99	Abundance of gray clay; considerable quantity of limonitic material.
100	7.13	Abundance of gray clay; considerable quantity of limonite; small amount of muscovite; trace of hematite.
150	5.87	Abundance of gray clay; considerable quantities of limonite and muscovite; trace of hematite.
200	31.25	Abundance of quartz; considerable quantities of limonitic material and hematite.
250	4.85	Abundance of quartz; small amounts of clay and muscovite.
Cloth	42.71	Clay substance including residue from above.

SAMPLE B90P2

Retained on screen	Percent	Character of Residue
30	3.69	Abundance of micaceous gray clay nodules; small amount of limonite.
60	18.27	Abundance of micaceous gray clay nodules; small amount of limonite; trace of plant fragments.
100	13.33	Abundance of micaceous gray clay nodules; small amount of limonite; trace of lignite.
150	6.61	Abundance of micaceous gray clay nodules; small amounts of muscovite, quartz and limonite.
200	8.99	Abundance of gray clay nodules; small amount of limonite; traces of quartz and muscovite.
250	3.02	Abundance of gray clay nodules; small amounts of quartz, muscovite and limonite.
Cloth	46.09	Clay substance including residue from above.

SAMPLE B90P3

Retained on screen	Percent	Character of Residue
30	8.84	Abundance of micaceous gray clay nodules; considerable quantity of lignite; small amount of pyrite; trace of gypsum.
60	31.57	Abundance of gray clay nodules; considerable quantity of lignite.
100	13.18	Abundance of gray clay nodules; considerable quantity of lignite; trace of plant fragments.
150	6.25	Abundance of clay nodules; small amount of lignite; trace of muscovite.
200	4.81	Abundance of clay nodules; small amount of lignite; traces of quartz and muscovite.
250	4.00	Abundance of clay nodules; small amount of lignite; traces of quartz and muscovite.
Cloth	31.35	Clay substance including residue from above.

CHEMICAL ANALYSES

SAMPLE B68P1

Whole sample ground to pass 100 mesh screen

Moisture, air dried 2.00 Sulphur, SO_3 0.26

Ignition loss 6.14	Iron oxide, Fe_2O_3 0.60	Magnesia, MgO 0.40
Silica, SiO_2 65.82	Titania, TiO_2 1.13	Potash, K_2O 0.27
Alumina, Al_2O_3 25.14	Lime, CaO 0.89	Soda, Na_2O 0.19

SAMPLE B90P1

Whole sample ground to pass 100 mesh screen

Moisture, air dried 3.00 Sulphur, SO_3 0.34

Ignition loss 4.50	Iron oxide, Fe_2O_3 0.75	Magnesia, MgO 0.11
Silica, SiO_2 72.29	Titania, TiO_2 2.03	Potash, K_2O 0.37
Alumina, Al_2O_3 19.06	Lime, CaO 1.03	Soda, Na_2O 0.14

SAMPLE B90P1

Analysis of residue washed through 250 mesh screen

Moisture, air dried 5.00 Sulphur, SO_3 0.32

Ignition loss 5.62	Iron oxide, Fe_2O_3 0.97	Magnesia, MgO 0.14
Silica, SiO_2 66.31	Titania, TiO_2 1.45	Potash, K_2O 0.27
Alumina, Al_2O_3 23.78	Lime, Cao 0.85	Soda, Na_2O 0.18

SAMPLE B90P2

Whole sample ground to pass 100 mesh screen

Moisture, air dried 3.15 Sulphur, SO_3 0.77

Ignition loss 7.65	Iron oxide, Fe_2O_3 0.93	Magnesia, MgO 0.18
Silica, SiO_2 59.38	Titania, TiO_2 1.48	Potash, K_2O 0.19
Alumina, Al_2O_3 28.75	Lime, CaO 0.95	Soda, Na_2O 0.22

SAMPLE B90P2

Analysis of residue washed through 250 mesh screen

Moisture, air dried 4.00 Sulphur, SO_3 0.37

Ignition loss 7.50	Iron oxide, Fe_2O_3 0.80	Magnesia, MgO 0.35
Silica, SiO_2 59.98	Titania, TiO_2 1.61	Potash, K_2O 0.16
Alumina, Al_2O 27.28	Lime, CaO 1.48	Soda, Na_2O 0.19

SAMPLE B90P3

Whole sample ground to pass 100 mesh screen

Moisture, air dried 4.55 Sulphur, SO_3 7.07

Ignition loss 20.71	Iron oxide, Fe_2O_3 4.80	Magnesia, MgO 0.28
Silica, SiO_2 49.43	Titania, TiO_2 1.02	Potash, K_2O 0.12
Alumina, Al_2O_3 22.17	Lime, CaO 1.34	Soda, Na_2O 0.31

Water soluble $FeSO_4$ 1.65

SAMPLE B90P3

Analysis of residue washed through 250 mesh screen

Moisture, air dried 4.75 Sulphur, SO_3 3.74

Ignition loss 14.66	Iron oxide, Fe_2O_3 1.30	Magnesia, MgO 0.31
Silica, SiO_2 54.38	Titania, TiO_2 1.28	Potash, K_2O 0.07
Alumina, Al_2O_3 27.38	Lime, CaO 0.90	Soda, Na_20 Trace

PYRO-PHYSICAL PROPERTIES

TEST HOLES B63, B68, B85, B86

Sample No.	At cone	Porosity in percent	Absorption in percent	Bulk specific gravity	Apparent specific gravity	Volume shrinkage in percent	Linear sh. inkage in percent	Modulus of rupture in lbs./sq. in.	Color and remarks
B63P1	01	23.79	12.66	1.88	2.47	12.80	4.46	1318	Buff, stained St. H.
	2	21.87	11.60	1.90	2.44	14.52	5.12	1430	Buff, stained
	4	19.27	9.92	1.94	2.40	15.88	5.61	2367	Buff, stained
	6	13.62	6.80	2.01	2.32	18.29	6.52	797	Buff, stained
	8	14.20	7.35	1.93	2.26	15.82	5.61	2814	Dk. buff, stained
	10	13.97	7.46	1.87	2.18	13.32	4.68	2762	Gray, stained Bl.
	12	17.45	9.69	1.80	2.18	9.55	3.31	2267	Gray, stained Bl.
B68P1	01	32.64	18.42	1.77	2.64	4.92	1.70	1068	Salmon buff
	2	31.59	17.65	1.79	2.61	5.83	2.01	1246	Salmon buff
	4	30.04	16.46	1.82	2.61	7.65	2.64	1335	Salmon buff
	6	23.08	12.46	1.85	2.41	8.54	2.95	1390	Salmon buff
	8	22.82	11.86	1.92	2.51	11.48	3.99	1808	Salmon buff St. H.
	10	20.59	10.64	1.95	2.46	13.48	4.72	2022	Buff
	12	17.58	8.67	2.03	2.46	16.99	6.02	2332	Buff
	14	4.40	2.11	2.08	2.18	19.46	6.98	3365	Grayish brown
B85P1	01	33.83	19.46	1.74	2.63	1.54	.54	712	Salmon
	2	34.33	19.72	1.74	2.65	1.97	.67	646	Lt. red
	4	33.96	19.40	1.75	2.65	2.25	.77	734	Lt. red
	6	28.67	16.31	1.76	2.47	2.56	.87	878	Lt. red
	8	33.07	18.76	1.76	2.63	3.66	1.15	778	Red
	10	29.19	16.24	1.79	2.54	5.74	1.94	729	Red
	12	26.44	14.03	1.88	2.56	9.61	3.34	656	Brownish red
	14	3.94	2.06	1.91	1.98	11.78	4.10	1587	Brown Bl., St. H.
B85P2	01	29.66	13.76	1.92	2.61	13.29	4.65	2512	Salmon St. H.
	2	20.56	10.21	2.01	2.63	21.13	7.63	2078	Salmon
	4	21.25	10.59	2.02	2.56	21.33	7.71	2308	Salmon
	6	19.93	9.87	2.01	2.56	22.69	8.22	2420	Salmon
	8	12.68	5.82	2.18	2.50	27.80	10.29	2716	Red
	10	8.52	3.76	2.26	2.47	30.25	11.34	3135	Grayish brown
	12	8.17	3.63	2.25	2.45	29.58	11.04	3253	Grayish brown
B85P3	01	31.97	18.60	1.73	2.54	4.68	1.59	1679	Dull salmon, stained
	2	31.32	17.68	1.77	2.58	7.35	2.53	1130	Dull salmon, stained
	4	33.07	18.95	1.74	2.61	6.06	2.08	1482	Dull salmon, stained
	6	23.50	12.96	1.81	2.37	10.03	3.49	1593	Dull salmon, stained
	8	22.64	12.33	1.84	2.37	9.42	3.27	1793	Dull sal., S., Not St. H.
B86P1	01	34.46	20.52	1.68	2.56	5.05	1.73	811	Salmon
	2	34.00	20.02	1.70	2.52	6.30	2.15	1038	Salmon
	4	32.73	18.92	1.73	2.57	6.84	2.36	970	Salmon
	6	32.61	21.61	1.51	2.24	–8.78	–3.02	1203	Dull red Bl.
	8	33.37	24.07	1.35	2.03	–17.88	–6.36	998	Dull red, Bl., Not St. H.

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

TEST HOLES B86, B90

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
B86P2	01	22.17	11.83	1.88	2.41	12.70	4.43	1693	Buff St. H.
	2	20.01	10.35	1.94	2.41	15.12	5.35	2112	Buff
	4	18.63	9.62	1.94	2.38	15.59	5.50	2461	Buff
	6	12.18	6.10	2.02	2.27	18.96	6.78	3865	Buff
	8	12.12	5.99	2.04	2.31	19.49	6.98	3843	Gray
	10	17.22	9.63	1.79	2.16	8.39	2.88	2146	Gray Bl.
	12	15.18	8.34	1.82	2.14	8.22	2.85	2261	Gray Bl.
B86P3	01	39.48	26.92	1.47	2.45	23.12	8.42	N.D.	Dull salmon, stained
	2	37.52	24.51	1.53	2.43	25.35	9.31	N.D.	Dull salmon, stained
	4	37.03	24.68	1.53	2.33	23.13	8.42	N.D.	Dull salmon, stained
	6	25.41	16.26	1.58	2.02	27.59	10.21	N.D.	Dull salmon, stained
	8	21.64	13.71	1.57	2.09	27.70	10.25	N.D.	Dull salmon, S., St. H.
B90P1	01	35.05	20.59	1.70	2.62	.97	.33	749	Salmon
	2	35.28	20.78	1.70	2.62	1.30	.44	757	Salmon
	4	35.80	21.00	1.70	2.65	1.52	.54	778	Salmon
	6	33.95	19.45	1.72	2.52	1.60	.54	849	Salmon
	8	31.79	18.54	1.74	2.63	3.12	1.08	1003	Dull red
	10	29.33	16.21	1.79	2.54	6.04	2.02	1057	Dull red
	12	30.15	16.72	1.80	2.58	7.34	2.53	825	Dull red
	14	4.31	2.28	1.90	1.99	11.59	4.03	1367	Brown St. H.
B90P2	01	23.58	12.52	1.88	2.47	12.52	4.39	2615	Buff
	2	23.37	12.26	1.91	2.48	13.17	4.61	2708	Buff St. H.
	4	18.38	9.25	1.98	2.43	16.83	5.98	3160	Buff
	6	16.37	7.96	2.06	2.47	20.70	7.44	3352	Buff
	8	13.09	6.20	2.11	2.43	22.05	7.99	3875	Buff
	10	2.40	1.07	2.24	2.29	26.19	9.63	4210	Gray
	12	1.03	.46	2.23	2.25	26.03	9.59	4586	Gray
	14	8.12	4.26	1.93	2.10	14.51	5.12	3781	Brownish gray
B90P3	01	31.14	18.76	1.66	2.42	19.23	6.90	534	Salmon St. H.
	2	27.36	16.36	1.67	2.28	19.63	7.05	588	Salmon
	4	19.32	11.27	1.72	2.17	21.45	7.75	N.D.	Salmon
	6	17.27	9.75	1.77	2.14	24.08	8.78	483	Dull red
	8	20.55	12.33	1.67	2.10	20.33	7.32	556	Dull red
	10	20.55	13.24	1.55	1.95	13.35	4.68	592	Gray

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

LABORATORY TESTS OF THE HOLLY SPRINGS CLAYS

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample No.	Type of Clay	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in lbs./sq. in.	Texture	Color
			Volume in percent	Linear in percent			
B93P1	5C	36.73	40.49	15.89	1194	Dense	Dk. gray
B93P2	5C	39.38	39.61	15.52	1223	Dense	Dk. gray
B97P1	5C	37.85	28.50	10.58	651	Dense	Dk. gray
B98P2	5C	36.98	38.22	14.87	772	Dense	Dk. gray
B108P1	4A	32.35	27.72	10.29	414	Silty	Lt. red
B108P3	4A	32.39	29.47	11.00	404	Silty	Lt. red
B109P1	3C	39.72	46.50	18.82	733	Dense	Brown
B110P1	6A	35.75	39.92	15.66	301	Dense	Dk. gray
B112P1	6B	41.85	53.95	22.81	137	Dense	Gray
B121P1	3C	41.52	51.15	21.27	1094	Dense	Brown
B129P1	3A	33.20	45.38	18.27	970	Dense	Gray
B250P1	6A	39.70	41.68	16.46	231	Dense	Dk. gray
B260P1	6A	38.63	46.78	18.97	229	Dense	Dk. gray
B262P1	6B	41.46	57.64	24.93	133	Silty	Brown
B262P2	6B	35.80	44.37	17.77	430	Dense	Dk. gray
B263P1	6B	40.75	48.94	20.10	183	Dense	Gray
B263P2	6B	34.34	27.86	10.33	229	Dense	Gray

SCREEN ANALYSES

SAMPLE B93P1

Retained on screen	Percent	Character of Residue
30	1.45	Abundance of gray clay; considerable quantity of limonitic material; trace of pyrite.
60	7.59	Abundance of micaceous lignitic clay nodules; considerable quantity of limonitic nodules.
100	6.91	Abundance of micaceous lignitic clay nodules; considerable quantity of limonitic clay nodules.
150	4.29	Abundance of micaceous lignitic clay nodules; considerable quantity of limonitic clay nodules; trace of muscovite.
200	7.63	Abundance of gray and limonitic clay; trace of quartz.
250	1.69	Abundance of gray and limonitic clay; trace of quartz.
Cloth	70.44	Clay substance including residue from above.

SAMPLE B93P2

Retained on screen	Percent	Character of Residue
30	0.25	Abundance of micaceous lignitic clay nodules; considerable quantity of lignite; small amount of limonite; trace of quartz.
60	4.65	Abundance of micaceous lignitic clay nodules; small amount of lignite; trace of plant fragments.
100	6.60	Abundance of gray clay nodules; small amount of lignite; trace of muscovite.
150	4.64	Abundance of gray clay nodules; trace of lignite.
200	5.00	Abundance of clay nodules; traces of lignite, limonite, quartz and muscovite.
250	4.90	Abundance of clay nodules; considerable quantity of quartz; traces of lignite, limonite and muscovite.
Cloth	73.96	Clay substance including residue from above.

SAMPLE B97P1

Retained on screen	Percent	Character of Residue
30	2.36	Abundance of micaceous arenaceous nodules; small amount of ferruginous rock; trace of marcasite.
60	13.01	Abundance of micaceous arenaceous nodules; trace of ferruginous rock.
100	11.43	Abundance of micaceous arenaceous nodules; trace of ferruginous rock.
150	4.54	Abundance of arenaceous nodules; traces of limonite and muscovite.
200	6.21	Abundance of arenaceous nodules; traces of muscovite and limonite.
250	1.92	Abundance of clay nodules; traces of muscovite and limonite.
Cloth	60.53	Clay substance including residue from above.

SAMPLE B98P2

Retained on screen	Percent	Character of Residue
30	0.78	Abundance of micaceous arenaceous nodules; considerable quantity of pyrite; small amount of limonitic material.
60	7.37	Abundance of micaceous arenaceous nodules; traces of pyrite and limonite.
100	7.19	Abundance of micaceous arenaceous nodules; traces of lignite, pyrite and quartz.
150	6.43	Abundance of micaceous nodules; small amount of muscovite; traces of lignite and pyrite.
200	10.26	Abundance of arenaceous material; considerable quantity of quartz; small amounts of muscovite and lignite.
250	3.15	Abundance of arenaceous nodules; considerable quantity of quartz; trace of lignite.
Cloth	64.82	Clay substance including residue from above.

SAMPLE B108P1

Retained on screen	Percent	Character of Residue
30	0.63	Abundance of hematite stained clay; small amounts of limonitic stained clay and quartz; trace of muscovite.
60	9.06	Abundance of hematite stained clay; small amount of quartz; trace of muscovite.
100	21.16	Abundance of hematite stained clay; small amount of quartz.
150	12.66	Abundance of quartz; considerable quantity of hematite stained clay.
200	11.00	Abundance of hematite and limonite stained clay; small amount of quartz; trace of muscovite.
250	1.90	Abundance of clay nodules; considerable quantity of quartz.
Cloth	43.59	Clay substance including residue from above.

SAMPLE B108P3

Retained on screen	Percent	Character of Residue
30	0.33	Abundance of arenaceous ferruginous nodules; considerable quantity of limonitic nodules; small amounts of clay and quartz.
60	3.87	Abundance of pinkish clay nodules; considerable quantity of limonitic nodules; small amount of quartz; trace of pyrite.
100	7.91	Abundance of pink and white clay nodules; small amount of quartz; trace of muscovite.
150	7.84	Abundance of pink and white clay nodules; considerable quantity of quartz; small amount of muscovite; trace of kaolinite.
200	15.49	Abundance of clay nodules; considerable quantity of quartz; small amount of muscovite.
250	3.18	Abundance of clay nodules; considerable quantity of quartz; trace of muscovite.
Cloth	61.38	Clay substance including residue from above.

SAMPLE B109P1

Retained on screen	Percent	Character of Residue
30	3.54	Abundance of micaceous limonitic clay nodules; considerable quantity of micaceous clay nodules; trace of plant fragments.
60	21.29	Abundance of gray clay nodules; considerable quantity of limonitic clay nodules; small amount of hematite.
100	16.37	Abundance of limonitic clay nodules; considerable quantity of gray clay nodules; small amounts of quartz and hematite.
150	5.77	Abundance of limonitic clay nodules; considerable quantity of gray clay nodules; small amount of hematite; trace of quartz.
200	7.98	Abundance of white and limonitic clay nodules; considerable quantity of hematite.
250	2.57	Abundance of clay nodules; considerable quantity of quartz; small amount of hematite.
Cloth	42.48	Clay substance including residue from above.

SAMPLE B110P1

Retained on screen	Percent	Character of Residue
30	5.02	Abundance of micaceous lignitic clay nodules; traces of limonitic material and plant fragments.
60	9.58	Abundance of micaceous lignitic clay nodules; trace of limonitic material.
100	8.68	Abundance of gray clay nodules; small amount of limonitic material; trace of muscovite.
150	4.71	Abundance of gray clay nodules; small amounts of limonite, quartz and muscovite.
200	11.71	Abundance of quartz; considerable quantity of gray clay nodules; small amounts of limonite and muscovite.
250	2.89	Abundance of quartz; considerable quantity of gray clay nodules; small amounts of limonite and muscovite.
Cloth	57.39	Clay substance including residue from above.

SAMPLE B112P1

Retained on screen	Percent	Character of Residue
30	4.35	Abundance of white clay nodules; small amounts of gray clay nodules and limonitic nodules; trace of ferruginous material.
60	15.33	Abundance of white clay nodules; small amounts of gray clay and limonitic clay nodules; trace of hematite.
100	12.55	Abundance of white clay nodules; small amounts of gray clay and limonitic clay nodules.
150	5.28	Abundance of white clay nodules; small amounts of gray clay and limonitic clay nodules; trace of quartz.
200	6.52	Abundance of white clay nodules; small amounts of gray clay and limonitic clay nodules and quartz.
250	1.75	Abundance of white, gray and limonitic clay nodules; small amount of quartz; trace of muscovite.
Cloth	54.21	Clay substance including residue from above.

SAMPLE B121P1

Retained on screen	Percent	Character of Residue
30	0.50	Abundance of micaceous lignitic clay nodules; considerable quantity of gray clay nodules; trace of lignite.
60	9.47	Abundance of gray clay nodules; considerable quantity of limonitic clay nodules; traces of hematite and lignite.
100	13.15	Abundance of gray clay nodules; considerable quantity of limonitic clay nodules; small amount of hematite.
150	11.15	Abundance of gray clay nodules; considerable quantity of limonitic clay nodules; small amount of hematite; trace of muscovite.
200	7.32	Abundance of gray clay nodules and limonitic clay nodules; small amount of hematite; trace of muscovite.
250	6.51	Abundance of gray clay nodules; considerable quantity of limonitic clay nodules; small amounts of hematite and quartz.
Cloth	51.90	Clay substance including residue from above.

SAMPLE B129P1

Retained on screen	Percent	Character of Residue
30	0.18	Abundance of gypsum; small amount of limonitic material.
60	2.08	Abundance of gypsum; considerable quantity of clay nodules; small amount of limonitic clay.
100	2.26	Abundance of gray clay nodules; small amount of lignite; trace of plant fragments.
150	3.85	Abundance of gray clay nodules; trace of lignite.
200	5.29	Abundance of gray clay nodules; traces of limonite and lignite.
250	4.12	Abundance of gray clay nodules; traces of limonite and lignite.
Cloth	82.22	Clay substance including residue from above.

SAMPLE B250P1

Retained on screen	Percent	Character of Residue
30	2.21	Abundance of micaceous lignitic clay nodules; small amount of pyrite.
60	16.00	Abundance of micaceous lignitic clay nodules; trace of pyrite.
100	11.08	Abundance of micaceous lignitic clay nodules; traces of pyrite and quartz.
150	3.87	Abundance of micaceous lignitic clay nodules; small amount of quartz.
200	5.07	Abundance of micaceous lignitic clay nodules; small amount of quartz.
250	1.29	Abundance of micaceous lignitic clay nodules; small amount of quartz.
Cloth	61.52	Clay substance including residue from above.

SAMPLE B260P1

Retained on screen	Percent	Character of Residue
30	4.63	Abundance of micaceous lignitic clay nodules.
60	17.90	Abundance of micaceous lignitic clay nodules; trace of pyrite.
100	11.48	Abundance of micaceous lignitic clay nodules; trace of quartz.
150	3.88	Abundance of micaceous lignitic clay nodules; traces of quartz and lignite.
200	7.13	Abundance of micaceous lignitic clay nodules; small amounts of quartz, muscovite and lignite.
250	2.30	Abundance of micaceous lignitic clay nodules; traces of quartz, muscovite and lignite.
Cloth	52.98	Clay substance including residue from above.

SAMPLE B262P1

Retained on screen	Percent	Character of Residue
30	2.02	Abundance of ferruginous material; small amount of white clay nodules.
60	9.38	Abundance of white clay nodules; considerable quantity of limonitic clay nodules; small amount of gray clay nodules.
100	9.98	Abundance of white clay nodules; considerable quantity of limonitic clay nodules; small amount of gray clay nodules.
150	3.65	Abundance of white clay nodules; considerable quantity of limonitic clay nodules; traces of quartz and muscovite.
200	6.61	Abundance of white clay nodules; considerable quantity of limonitic clay nodules; small amount of quartz and muscovite.
250	1.52	Abundance of clay nodules; small amount of quartz and muscovite.
Cloth	66.84	Clay substance including residue from above.

SAMPLE B262P2

Retained on screen	Percent	Character of Residue
30	1.26	Abundance of gray clay nodules; small amount of limonitic material; traces of lignite and pyrite.
60	8.56	Abundance of micaceous lignitic clay nodules.
100	13.26	Abundance of micaceous lignitic clay nodules; trace of muscovite.
150	7.42	Abundance of micaceous lignitic clay nodules; small amount of quartz.
200	13.35	Abundance of micaceous lignitic clay nodules; considerable quantity of quartz.
250	2.81	Abundance of micaceous lignitic clay nodules; considerable quantity of quartz; small amount of muscovite.
Cloth	53.34	Clay substance including residue from above.

SAMPLE B263P1

Retained on screen	Percent	Character of Residue
30	1.65	Abundance of gray micaceous clay nodules; considerable quantity of limonitic clay nodules.
60	17.50	Abundance of gray micaceous clay nodules; small amount of limonitic clay nodules; trace of quartz.
100	15.71	Abundance of gray clay nodules; small amount of limonitic clay nodules; trace of quartz.
150	3.89	Abundance of gray clay nodules; small amount of limonitic clay nodules; trace of quartz.
200	4.97	Abundance of gray clay nodules; small amount of limonitic clay nodules; trace of quartz.
250	1.09	Abundance of gray clay nodules; small amount of limonitic clay nodules; trace of quartz.
Cloth	55.19	Clay substance including residue from above.

SAMPLE B263P2

Retained on screen	Percent	Character of Residue
30	6.90	Abundance of micaceous gray clay nodules; small amount of pyrite.
60	17.87	Abundance of micaceous gray clay nodules; small amount of limonitic stained clay nodules; trace of pyrite.
100	10.14	Abundance of micaceous gray clay nodules; small amounts of limonitic clay nodules and quartz.
150	4.39	Abundance of micaceous gray clay nodules; considerable quantity of muscovite; small amounts of quartz and ferruginous material; trace of glauconite.
200	10.93	Abundance of clay nodules; considerable quantities of muscovite and quartz; small amounts of ferruginous material and pyrite.
250	3.33	Abundance of clay nodules; considerable quantity of quartz; small amount of muscovite.
Cloth	46.44	Clay substance including residue from above.

CHEMICAL ANALYSES

SAMPLE B129P1

Whole sample ground to pass 100 mesh screen

Moisture, air dried .... 4.35 Sulphur, SO_3 .... 0.61

Ignition loss	8.01	Iron oxide, Fe_2O_3	1.25	Magnesia, MgO	0.25
Silica, SiO_2	61.65	Titania, TiO_2	1.18	Potash, K_2O	0.28
Alumina, Al_2O_3	26.65	Lime, CaO	0.76	Soda, Na_2O	0.19

Water soluble SO_4 .. 0.57

SAMPLE B129P1

Analysis of residue washed through 250 mesh screen

Moisture, air dried .... 4.35 Sulphur, SO_3 .... 0.53

Ignition loss	7.87	Iron oxide, Fe_2O_3	0.80	Magnesia, MgO	0.34
Silica, SiO_2	62.09	Titania, TiO_2	1.34	Potash, K_2O	0.31
Alumina, Al_2O_3	26.00	Lime, CaO	0.40	Soda, Na_2O	0.11

PYRO-PHYSICAL PROPERTIES

TEST HOLES B93, B97, B98, B108, B109, B110, B112

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	
B93P1	01	14.64	8.32	1.76	2.07	5.34	1.83	711	Salmon	Bl., St. H.
	2	12.55	5.84	2.16	2.46	21.55	7.79	N.D.	Salmon	
B93P2	01	16.39	8.82	1.86	2.22	13.27	4.65	1840	Salmon	Bl., St. H.
	2	14.44	7.14	2.04	2.39	19.90	7.13	N.D.	Salmon	
B97P1	01	13.84	6.66	2.09	2.42	23.92	8.74	2391	Dull red	St. H.
	2	10.35	4.72	2.20	2.45	27.66	10.25	2517	Dull red	
	4	4.82	2.14	2.25	2.42	28.95	10.79	3485	Dull red	
	6	8.06	3.80	2.13	2.32	25.09	9.18	3179	Dull red	
B98P2	01	13.64	7.30	1.86	2.16	12.29	4.28	2869	Dull red	Bl., St. H.
	2	12.44	5.93	2.10	2.40	21.97	7.95	N.D.	Dull red	
B108P1	01	35.09	20.04	1.76	2.72	2.71	.94	829	Salmon-gray	
	2	33.66	18.89	1.78	2.68	2.96	1.01	829	Salmon-gray	
	4	32.85	18.44	1.80	2.67	3.23	1.11	876	Salmon-gray	
	6	31.00	17.20	1.81	2.61	4.62	1.59	977	Salmon-gray	
	8	30.70	16.66	1.83	2.65	6.02	2.08	1022	Salmon-gray	
	10	27.87	15.03	1.86	2.58	7.16	2.46	1222	Salmon-gray	
	12	27.56	14.60	1.89	2.61	8.46	2.92	1224	Buff	
	14	21.71	11.04	1.97	2.51	12.60	4.31	1541	Dk. buff	St. H.
B108P3	01	32.91	18.34	1.79	2.68	3.34	1.15	995	Salmon-gray	
	2	32.42	18.00	1.80	2.67	4.05	1.39	1107	Salmon-gray	
	4	31.88	17.46	1.82	2.68	4.75	1.63	1125	Salmon-gray	
	6	30.84	16.97	1.82	2.62	5.08	1.73	1155	Salmon-gray	
	8	26.25	13.77	1.91	2.58	9.55	3.31	1402	Salmon-gray	
	10	24.16	12.59	1.93	2.53	10.94	3.81	1480	Salmon-gray	
	12	24.13	12.33	1.95	2.66	11.70	4.06	1550	Salmon-gray	
	14	14.23	6.81	2.09	2.44	17.59	6.25	2206	Brownish buff	St. H.
B109P1	01	21.25	10.56	2.01	2.56	14.04	4.94	2126	Salmon	St. H.
	2	21.06	10.31	2.04	2.58	15.36	5.42	2549	Salmon	
	4	18.39	8.88	2.07	2.56	16.18	5.72	2637	Salmon	
	6	13.17	6.15	2.14	2.47	19.23	6.90	2735	Red	
	8	12.72	5.85	2.18	2.49	20.43	7.36	4307	Red	
	10	10.58	4.66	2.27	2.47	23.80	8.66	4603	Dk. red	
	12	6.85	2.98	2.30	2.47	24.92	9.14	4290	Gray	
	14	17.96	10.23	1.80	2.20	3.87	1.32	1992	Brown	Bl.
B110P1	4	21.16	13.12	1.62	2.05	-3.04	-1.04	693	Dk. brown	Bl.
	7	*	*	*	*	*	*	N.D.	Dk. brown,	Bl., St. H.
B112P1	4	2.04	.90	2.26	2.31	26.03	9.59	1565	Dk. brown	St. H.
	7	.00	.00	2.28	2.28	26.25	9.67	232	Dk. brown	

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

* Data unreliable due to condition of test pieces.

TEST HOLES B121, B129, B250, B260, B262, B263

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
B121P1	01	19.85	9.71	2.04	2.55	13.68	4.79	3312	Salmon St. H.
	2	19.30	9.30	2.09	2.52	17.15	6.10	3555	Salmon
	4	13.05	5.97	2.18	2.51	18.96	6.78	3641	Salmon
	6	8.70	3.83	2.27	2.48	22.68	8.22	4589	Lt. red
	8	5.16	2.25	2.28	2.44	22.95	8.34	4637	Red
	10	3.83	1.68	2.30	2.39	23.89	8.70	6840	Gray
	12	8.40	3.97	2.13	2.32	17.19	6.10	6335	Gray
	14	20.82	12.67	1.64	2.08	-6.87	-2.36	2930	Grayish brown Bl.
B129P1	01	7.06	3.28	2.18	2.34	18.51	6.63	3363	Olive buff St. H.
	2	7.16	3.28	2.18	2.35	18.68	6.67	3615	Olive buff
	4	2.02	.91	2.21	2.26	19.80	7.01	3735	Olive buff Cr.
	6	1.16	.53	2.20	2.23	19.29	6.90	3948	Olive buff
	8	6.69	3.22	2.06	2.21	13.70	4.79	4633	Olive buff
	10	7.89	4.03	1.96	2.12	9.41	3.27	3464	Olive buff Cr.
B250P1	4	15.57	9.92	1.57	1.86	-2.21	-.77	457	Dk. brown Bl., St. H.
	7	*	*	*	*	*	*	N.D.	Dk. brown Bl.
B260P1	4	12.27	8.73	1.41	1.60	-16.42	-5.83	N.D.	D. B., Bl., Cr., St. H.
	7	*	*	*	*	*	*	N.D.	Dk. brown Bl., Cr.
B262P1	4	4.41	2.02	2.22	2.32	23.94	8.74	278	Dk. brown St. H.
	7	1.10	.49	2.26	2.28	25.22	9.27	871	Dk. brown
B262P2	4	2.89	2.44	2.00	2.06	16.46	5.83	2895	Dk. brown Bl., St. H.
	7	4.74	2.70	1.75	1.84	4.53	1.56	432	Dk. brown Bl.
B263P1	4	4.22	1.96	2.16	2.25	23.62	8.62	505	Dk. brown St. H.
	7	.11	.05	2.27	2.28	28.18	10.45	553	Dk. brown
B263P2	4	14.94	7.61	1.97	2.31	18.50	6.59	1841	Dk. brown Bl.. St. H.
	7	1.38	.76	1.81	1.84	12.41	4.35	2202	Dk. brown Bl.

Abbreviations: Bl., bloated; Cr., cracked; St. H., steel hard; D. B., dark brown.

* Data unreliable due to condition of test pieces.

LABORATORY TESTS OF THE TALLAHATTA CLAY

PHYSICAL PROPERTIES IN THE UNBURNED STATE

Sample No.	Type of Clay	Water of plasticity in percent	Drying shrinkage		Modulus of rupture in lbs./sq. in.	Texture	Color
			Volume in percent	Linear in percent			
B261P2	7	45.98	26.92	9.96	229	Silty	Gray

SCREEN ANALYSIS

SAMPLE B261P2

Retained on screen	Percent	Character of Residue
30	16.69	Abundance of white clay with quartz embedded; small amount of limonitic clay nodules.
60	11.74	Abundance of white clay with quartz embedded; small amount of limonitic clay nodules.
100	9.58	Abundance of white clay with quartz embedded; considerable quantity of quartz; small amounts of limonite and muscovite.
150	15.28	Abundance of quartz; small amount of clay nodules.
200	16.31	Abundance of quartz; small amount of clay nodules; traces of muscovite and kaolin.
250	2.33	Abundance of clay nodules; considerable quantity of quartz; small amount of muscovite; trace of kaolin.
Cloth	28.07	Clay substance including residue from above.

PYRO-PHYSICAL PROPERTIES

TEST HOLE B261

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
B261P2	4	38.91	26.04	1.50	2.45	9.12	3.17	580	Dk. buff
	7	33.75	21.10	1.60	2.41	15.62	5.53	593	Brownish buff Not St. H.

Abbreviations: St. H., steel hard.

MARL

SCREEN ANALYSIS OF WINONA LIMONITIC MARL

SAMPLE B261P1

Retained on screen	Percent	Character of Residue
30	11.68	Abundance of quartz; small amounts of glauconite and ferruginous material.
60	35.36	Abundance of quartz; considerable quantity of glauconite; small amount of ferruginous material.
100	19.20	Abundance of limonitic material; considerable quantities of glauconite and quartz.
150	5.75	Abundance of limonitic material; considerable quantity of quartz; small amount of glauconite.
200	7.48	Abundance of limonitic material; considerable quantity of quartz; small amount of glauconite.
250	1.69	Abundance of limonitic material; small amount of quartz; trace of glauconite.
Cloth	18.84	Clay substance including residue from above.

SAND

SCREEN ANALYSIS OF FEARN SPRINGS SAND

SAMPLE B44P1

Retained on screen	Percent	Character of Residue
30	5.20	Abundance of quartz; small amount of ferruginous material; trace of kaolinite.
60	62.80	Abundance of quartz; traces of kaolinite, limonite, hematite and microcline.
100	10.52	Abundance of quartz; traces of kaolinite, magnetite, limonite and microcline.
150	3.49	Abundance of quartz; considerable quantity of limonitic clay nodules; small amounts of magnetite, muscovite and kaolinite; trace of microcline.
200	2.00	Abundance of limonitic clay nodules; small amount of quartz and muscovite; trace of kaolinite.
250	1.30	Abundance of quartz; considerable quantity of limonitic clay nodules; traces of magnetite and muscovite.
Cloth	14.69	Clay substance including residue from above.

POSSIBILITIES FOR UTILIZATION

POSSIBILITIES FOR UTILIZATION—CLAYS

1

KAOLINITIC CLAY

A. CREAM TO BUFF BURNING, CONTAINING AN APPRECIABLE AMOUNT OF QUARTZ SAND

Sample B141P1 is the only one of its kind tested. It is a mixture of kaolin and sand in about equal amounts. Screen analysis shows that 40.28 percent of the mixture is fine enough to pass a 250 mesh screen. The water of plasticity of sample B41P1 is 17.52 percent, its linear drying shrinkage is 2.2 percent, and the green modulus of rupture is 40 pounds per square inch. During burning the clay is not appreciable altered between cones 01 and 14. Fired strength is slightly increased from 46 pounds per square inch at cone 01 to 214 pounds per square inch at cone 14. The clay is not free enough of iron impurities to make it worth while to beneficiate it by washing out the quartz. It is suitable for blending with bond clays for the manufacture of refractory brick and light colored face brick and for use as a plastic refractory patching material.

2

POTTERY CLAYS

A. CREAM TO BUFF BURNING, CONTAINING AN APPRECIABLE AMOUNT OF MICACEOUS SILT

Clays in this group are essentially of the pottery type but contain enough silt and sand to cause them to be open burning at high temperatures. Their average typical properties are: water of plasticity, 26.5 percent; linear drying shrinkage, 4.93 percent; green modulus of rupture, 146 pounds per square inch; porosity at cone 01, 37.0 percent, at cone 14, 20.4 per cent; linear burning shrinkage at cone 01, 1.5 percent, and at cone 14, 6.2 percent. There is a wide variation in the burned strengths of the several clays at different temperatures. At cone 01, the modulus of rupture ranges between 278-875 pounds per square inch, and at cone 14, between 971-4568 pounds per square inch. Clays B38P1 and B42P1 have weaker burned strengths than the other clays in the group and would be greatly improved by an addition of pottery clays of the type under classification 2B or bond clays under classification 3A. The clays burn to an even cream color up to cone 14 where the color is darker and slightly specked. Clays 34P1 and 54P1 are especially suitable for making a fine grade of glazed structural tile for interior use, plain or glazed wall tile, statuary, fire proofing, and flue lining. By blending dense burning pottery clays (2B) or bond clays (3A) with the clays in this group they would be suitable for making heavy clay products for exterior use which includes light colored face brick, enameled brick, terracotta, faience, garden pottery, and conduit.

B. Cream to buff burning, containing approximately 10 percent micaceous silt

The clays in this group are probably the most valuable in the county. They are all very similar in character and are of equal quality. Clay B34FS is an outcrop sample taken in the vicinity of test hole B34 and is the purest and burns to the lightest color of all. It is believed that some of the silt in the other clays could be eliminated by careful mining, however a small amount of silt is not necessarily detrimental to most products and is advantageous to some.

The typical average properties of the clays are: water of plasticity, 34.4 percent; linear drying shrinkage, 8.78 percent; green modulus of rupture, 238 pounds per square inch; porosity at cone 01, 31.5 percent, at cone 14, 2.7 percent; linear shrinkage at cone 01, 4.0 percent, and at cone 14, 12.1 percent. The fired modulus of rupture ranges between 933-1831 pounds per square inch at cone 01 and 3109-5090 pounds per square inch at cone 14. The clays have a clear even cream color up to cone 14 where they turn to a dark gray. They become steel hard at cones 6-8 and are not overburned at cone 14.

Though the clays have an excellent cream color for some products, they would not be improved enough by washing to allow their use in the best grades of whiteware; however, clay B34FS is equal in color to many commercial ball clays and would be suitable for use in semi-viterous whiteware, such as hotel china.

Chemical analyses indicate that the clays are very similar in composition to the anauxite clays of the Fearn Springs formation that were sampled from Winston County and which are referred to in Bulletin Number 38 of the Mississippi Geological Survey. Clay B34FS contains the smallest amount of silt, and its silica-alumina content is in the proportion of silica, 54.97 percent and alumina, 32.01 percent. The theoretical proportions for pure anauxite[1] are 54.3 percent silica and 32.91 percent alumina or a silica to alumina ratio of 280:100. The silica to alumina ratio of the clays in this group is approximately 3 to 1 and is a very desirable ratio for pottery clays. The clays contain

1. Ross, C. S., and Kerr, P. F., The kaolin minerals. U. S. Geological Survey Professional Paper No. 165, (1930).

a considerable amount of very finely divided muscovite-like mica which assists in making them resistent to thermal shock. They are consequently especially suited for use in making pottery dinner ware, hotel china, oven ware, kitchen ware, electrical insulators and other products that are subjected to thermal shock. They are refractory enough for use as a bond in fire brick, kiln furniture, crucibles, and saggers, and their resistance to thermal shock would likely lend to a high resistance to spalling in refractory products.

The clays seem to be free of iron bearing mineral aggregates that would cause specking, they are consequently suitable for products that are glazed such as sanitary ware, bathroom fixtures, enameled and glazed face brick, glazed facing tile, terracotta, faience, stoneware, and art pottery. Their fairly low drying and burning shrinkage (except B34F'S), uniform color over a wide firing range and high fired strengths, render the clays very desirable for light colored structural products, such as face brick, hollow facing tile and building block. The clays are also suitable for making fire proofing, flue lining, and drain tile but are more valuable for use in higher priced products. The clays in this group offer the best opportunity for industrial development.

3

BOND CLAYS

Clays that have the capacity of holding together large quantities of relatively non-plastic materials are called bond clays. To be of value they must function properly in the fired state as well as in the green state. It usually follows that clays possessing unusually high dry strengths are good bond clays provided they have desirable burning properties. The clays in group 3A, B, C are of about equal rank as to bonding strength in the green state but possess different firing characteristics and are accordingly divided into three types.

A. Cream to Gray Burning

The typical average properties of the clays in this group are: water of plasticity, 36.9 percent; linear drying shrinkage, 13.9 percent; green modulus of rupture, 722 pounds per square inch; porosity at cone 01, 22.68 percent, at cone 10, 5.42 per cent; linear shrinkage at cone 01, 5.6 percent and at cone 10, 9.36 percent. The clays reach steel hardness at cones 01-4. The fired modulus of rupture values show considerable variation between individual clays; at cone 01 the average is about 2,000 pounds per square inch although some clays are as low as 968 pounds per square inch and some are as high as 3,363 pounds per square inch. The maximum modulus of rupture values are obtained at cones 6, 8, 10, and 12, and the variation is between 3,865 pounds per square inch and 4,978 pounds per square inch. The individual strength-temperature relations of the clays make it difficult to draw general conclusions regarding their fired properties; however, it can be said that they develop steel hardness and strength at early temperatures and overburn above cone 10.

The clays are suitable as a semi-refractory bond for use in gas retorts and zinc retorts and abrasives. The fired colors of light buff to gray would not be undesirable for stone ware, art pottery, yellow ware, faience, and face brick, and, for these products, the clays could be used to increase strength and plasticity in other clays that are deficient in these properties but are otherwise suitable for use in the products above mentioned.

B. BUFF TO GRAY BURNING, IRON STAINED, CONTAINING AN APPRECIABLE AMOUNT OF IRON SULFATE AND QUARTZ SILT

The average typical properties of the clays in this group are: water of plasticity, 35.4 percent; linear drying shrinkage, 11.8 percent; green modulus of rupture, 679 pounds per square inch; porosity at cone 01, 27.9 percent, at cone 10, 12.6 percent; linear shrinkage at cone 01, 5.8 percent, and at cone 10, 8.9 percent. The clays are steel hard at cone 01, and though some begin to overburn at cone 6, others are resistant through cone 10. Strength-temperature relations are peculiar to the individual clays. In some instances, strength normally increases to a maximum at maturity and in others, strength increases normally for a few cones then decreases abruptly for one cone or more and at higher cones increases again to a new but lower maximum. Such fluxuations in strength are attributed to the expansion and contraction of quartz silt at critical temperatures during burning and cooling. At early temperatures the clay is porous enough to absorb the strain of expansion and contraction of quartz. At higher temperatures the bond of the clay is ruptured by the expansion but at still higher temperatures the quartz is taken into solution forming silicates of alumina, iron, etc., and thus looses its identity, and characteristic of expanding and contracting independently of other ingredients, but imparts to the clay a brittleness which renders it somewhat weaker than its optimum strength at lower temperatures.

The presence of appreciable amounts of iron sulfate in these clays limits their usefulness. During drying, iron sulfate is inconspicuously deposited on the surface of the ware, and during burning it is converted to red iron oxide which permanently stains the clay in an unsightly and uncontrollable manner. Iron sulfate can be rendered insoluble by adding barium sulfate to the clay; however, this procedure is expensive and is hardly worth while with clays that are of mediocre quality. The amount of iron sulfate present in several typical samples is given in the test data. Several of the clays were analyzed before and after washing (see chemical analyses) to determine the extent of beneficiation by washing. The results of this indicate that some improvements were made but not enough to justify the procedure on a commercial basis. The clays are thus limited to use in structural products where the esthetic value is unimportant, such as, hollow partition tile, fireproofing, drain tile, and common brick. Clays having normal fired strengths (B14P1, B16P1, B48P1) are suitable for making load bearing tile and flue lining.

C. Red to gray burning

The typical average properties of the clays in this group are: water of plasticity, 42.3 percent; linear drying shrinkage, 20.4 percent; green modulus of rupture, 877 pounds per square inch; porosity at cone 01, 23.6 percent, at cone 10, 7.6 percent; linear shrinkage at cone 01, 4.8 percent, and at cone 10, 9.6 percent. The fired modulus of rupture at cone 01 ranges between 2,126 pounds per square inch and 3,363 pounds per square inch. The modulus of rupture increases normally at higher temperatures and reaches maximum values ranging between 3,253 pounds per square inch and 4,633 pounds per square inch at cones 8, 10, and 12. The clays are steel hard at cone 01 and do not overburn below cones 10 and 12. The fired colors at different temperatures over a long firing range are several shades of red, but they turn to a green-red color at cones 8, 10 and 12.

The bond clays in this group are the strongest in the unburned state and possess the best burning properties of the three groups. They are not suited for use in refractory products but should find an excellent application in the manufacture of sewer pipe where they are especially suited for bonding semi-refractory clays and grogs. They would be desirable to improve strength, plasticity, and working properties of silty clays which are otherwise suitable for a wide variety of heavy clay products.

4

BRICK AND TILE CLAYS

A. Buff to red and brown burning

The average typical properties for the clays in this group are: water of plasticity, 34.3 percent; linear drying shrinkage, 12.1 percent; modulus of rupture, 707 pounds per square inch; porosity at cone 01, 33.3 percent, at cone 12, 21.2 percent; linear shrinkage at cone 01, 1.69 percent, and at cone 12, 5.2 percent. The fired modulus of rupture at cone 01 averages 1,044 pounds per square inch and reaches a maximum average value of 2,070 per square inch at cones 10, 12, and 14. Steel hardness is obtained at different temperatures with different clays but is not generally reached before cone 8.

These clays possess very attractive colors over a wide firing range and are not appreciably altered during burning intervals of several cones. They are suitable for making attractive face brick and building block as well as hollow partition tile, fire proofing, drain tile, and common brick. Clay 68P1 burns to warm tones of buff and will make very attractive face brick when burned above cone 6.

5

RED BURNING CLAYS OF DOUBTFUL ECONOMIC VALUE

A. Open-bodied, overburns before reaching maturity

The average typical properties of the clays in this group are: water of plasticity, 26.96 percent; linear drying shrinkage, 6.3 percent; green modulus of rupture, 482 pounds per square inch; porosity at cone 01, 36.1 percent, at cone 6, 29.5 percent. The linear shrinkage at cone 01 is 1.68 percent and slightly increases at higher cones until the clays begin to overburn; at cone 6 the linear shrinkage is actually less than at lower temperatures and in some instances the clay test pieces are larger than before burning. The fired modulus of rupture averages less than 1,000 pounds per square inch at all cones.

These clays are essentially mixtures of sand, silt, mica, and just enough clay substance to hold them together. They are not suited for ceramic products.

B. Silty, short maturing range

The clays in this group are similar in character to those in the preceding group except that they contain less silt and more clay. Their average typical properties are: water of plasticity 35.4 percent; linear drying shrinkage, 9.7 percent; green modulus of rupture

657 pounds per square inch; porosity at cone 01, 30.2 percent, at cone 4, 25.4 percent; linear shrinkage at cone 01, 5.8 percent, and at cone 4, 7.1 percent. With the exception of sample B71P2 the fired modulus of rupture for the several clays average approximately 1,500 pounds per square inch at maturity. Steel hardness is reached at cones 01-2, and overburning commences at cone 6. The clays have a short but satisfactory burning range and are suitable for making common brick, drain tile, partition tile, and fire proofing. Their burned color is dull red and this is marred by scum formed by soluble salts except for clays B77P2 and B77P3 which have the best fired colors.

C. TIGHT-BODIED, OVERBURNS AT MATURITY

These clays are typical of certain phases of the Porters Creek formation that have undesirable burning characteristics. The typical average properties of this group of clays are: water of plasticity, 39.1 percent; linear drying shrinkage, 14.4 percent; green modulus of rupture 1,118 pounds per square inch; porosity at cone 01, 14.6 percent; and linear shrinkage at cone 01, 4.9 percent. The properties of the clays when burned above cone 01 are unreliable due to the development of a vesicular structure. The clays are unsuited for ceramic purposes, however they do possess such high bonding strengths in the unburned state that they should be suitable for use as a bond in molding sand for foundry use.

It is interesting to note the graduation in properties of the clays in groups 5A, 5B, and 5C. Screen analyses indicate that the clays in group A contain the least amount of clay substance, and that those in group B contain a greater amount, and that those in group C, a still greater amount. All other properties of the clays are directly related to the amount of clay substance, for example, water of plasticity, linear drying shrinkage, and modulus of rupture increase with increasing amounts of clay substance, and during firing, porosity decreases and strength and shrinkage increase with increased clay substance at comparable temperatures.

6

BROWN BURNING CLAYS OF DOUBTFUL ECONOMIC VALUE

A. OVERBURNS BEFORE REACHING MATURITY

The clay samples in this group and those in group 6B arrived at the laboratory too late to be tested with the other clays of the county. Their properties in the unburned state are accurate and reliable, but it is believed that the results of burning are unreliable, due to the fact that they were burned at only two different temperatures and under conditions that were not conducive of best results.

The clays in group A were overburned at cone 4; however it is doubtful that they would be of economical value if burned at lower temperatures.

B. NOT OVERBURNED AT MATURITY

The clays in this group appeared to be similar in character to those in group 4A which are recommended for use in heavy clay products such as face brick and building tile. The dark brown color of these clays appears to be due to flashing, and it is believed that they will burn to buff and red colors under oxidizing conditions.

7

TALLAHATTA CLAY

Sample B61P2 is a light weight silty clay. Its properties in the unburned state are: water of plasticity, 45.9 percent; linear drying shrinkage, 9.9 percent; green modulus of rupture, 229 pounds per square inch; porosity at cone 4, 38.9 percent, at cone 7, 33.7 percent; linear shrinkage at cone 4, 3.2 percent and at cone 7, 5.5 percent. The bulk specific gravity increases from 1.5 at cone 4 to 1.6 at cone 7. The fired modulus of rupture is 580 pounds per square inch at cone 4 and 593 pounds per square inch at cone 7. This material is unsuited for the usual ceramic products; however it is believed that by blending with this clay a small amount of bond clay, structural building blocks could be made which would possess fair insulating properties. This product would necessarily be used as a backup unit and be covered with water-proof cement or stucco.

POSSIBILITIES FOR UTILIZATION—MARL

WINONA LIMONITIC MARL

Sample B261P1 does not appear to be high enough in lime or iron to be of economic value.

POSSIBILITIES FOR UTILIZATION—SAND

FEARN SPRINGS SAND

Sample B44P1 is a good grade of sand for use in making plaster wall coating and mortar. Screen analysis indicates that the size gradation is not coarse enough for concrete construction. The sand contains approximately 15 percent clay and silt which will probably add to the working consistency of cement mortar and plaster without appreciably decreasing strength. It is not free enough of iron bearing minerals to consider its use as glass sand.

LABORATORY PROCEDURE

PREPARATION

Samples of clay were dried between 110° and 120° C. 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; the residue coarser than 20-mesh was ground in a burr mill until it passed the 20-mesh screen. The final bit of residue remaining on the 20-mesh screen was collected for examination. The clay which had passed the 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, thermal analysis, chemical analysis, and for making pyrometric cones. Approximately 75 pounds of clay from the remainder were 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; 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 then pressing them 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 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 100 short bars were made from each primary clay sample. Certain C 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 were oven-dried by gradually increasing the temperature of 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 dessicators, and on cooling to room temperature they were reweighed and revolumed. The 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 test pieces. Clays having a suitable plasticity were formed into pottery shapes by throwing on a potters wheel. Where the quantity of clay permitted, standard size brick were made in a hand mold for the purpose of observing drying characteristics of thick bodies. The water of plasticity, modulus of rupture, and volume of shrinkage, were calculated by methods outlined by the American Ceramic Society. The linear shrinkage was calculated from the volume shrinkage and checked against the linear shrinkage measured from the long bars.

FIRED PROPERTIES

The long and short bars were burned in a downdraft surface combustion kiln especially designed for the purpose, using Butane gas 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 gasses. The kiln was fired at the rate of 200° F. per hour up to a temperature of 200° F. below the optimum 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 thermocouple up to 2,100° F., at which point the couple was withdrawn from the kiln, and pyrometric cones alone were used.

The fusion point of pyrometric cone equivalent of the several clays was determined in accordance with the standard procedure outlined by the American Ceramic Society, by using double tangent burners in a furnace especially designed for the purpose.

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

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.

CHEMICAL ANALYSES

Grinding: The samples which were completely analysed were ground to pass a 100-mesh sieve. Some of the samples were washed through a 250-mesh sieve; the portion that passed through was dried, ground, and analyzed.

Moisture: Moisture determinations were run on all samples as received: i. e., in an air dried condition. An oven temperature of 110° C. was maintained on each sample for one hour.

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

Silica: Ignited samples were fused with 8 to 10 times their weight of anhydrous sodium carbonate, and the fusion dissolved in dilute hydrochloric acid. Double dehydrations of the silica with hydrochloric acid were carried out in all cases. The resulting silica was filtered off, ignited, weighed, volatilized by hydrofluoric acid, and the crucible reweighed. SiO_2 was found by difference.

Alumina: Alumina, iron, and titania were precipitated together by ammonium hydroxide in the presence of ammonium chloride. Macerated filter paper was added to give a fine-grain precipitate. Double precipitations were found necessary to remove all manganese, calcium, and magnesium. The mixed hydroxides were filtered off, washed free of chlorides, ignited, and weighed. The weight represents the total of alumina, iron oxide, and titania. The mixed oxides were fused with sodium bisulfate to which a little sodium sulfate had been added to reduce sputtering. The fusion was dissolved in dilute sulfuric acid. In a few cases small amounts of silica were recovered here by filtration, ignition, and volatilization with hydrofluoric acid; accordingly, this was added to silica and deducted from alumina.

Iron Oxide: An aliquot of the solution of the bisulfate fusion was reduced with test lead, and titrated with potassium dichromate with diphenlyamine indicator. The dichromate was standardized so that the percentage of ferric oxide in the original sample was equal to the number of cc. of solution used.

Titania: Another aliquot of the bisulfate fusion solution was placed in a colorimeter tube, and hydrogen peroxide added. The colorimeter was of the Schreiner type: i. e., a tube within a tube. The standard titania solution was diluted so that the height of the standard column divided by the height of the unknown column gave the percentage of TiO_2 in the original sample. The total of titania and iron oxide was subtracted from the weight of the combined precipitate of alumina, iron oxide, and titania, leaving alumina.

Manganese: Manganese was determined in the filtrate from alumina determination. Unless the carbonate fusion in the silica determination was blue, no manganese determination was made. Manganese was precipitated as the dioxide from a buffered acetate solution by oxidation with bromine. The dioxide was filtered off, ignited, and weighed as Mn_3O_4.

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

Magnesia: Magnesia was determined in the lime filtrate by precipitation as the mixed ammonium phosphate. It was ignited and weighed as $Mg_2P_2O_7$.

Alkalies: Alkalies were determined by the J. Lawrence Smith method as outlined in Scott "Standard Methods of Chemical Analysis." The hydrofluoric acid method of decomposition was used because it was found to be more practicable with the apparatus at hand.

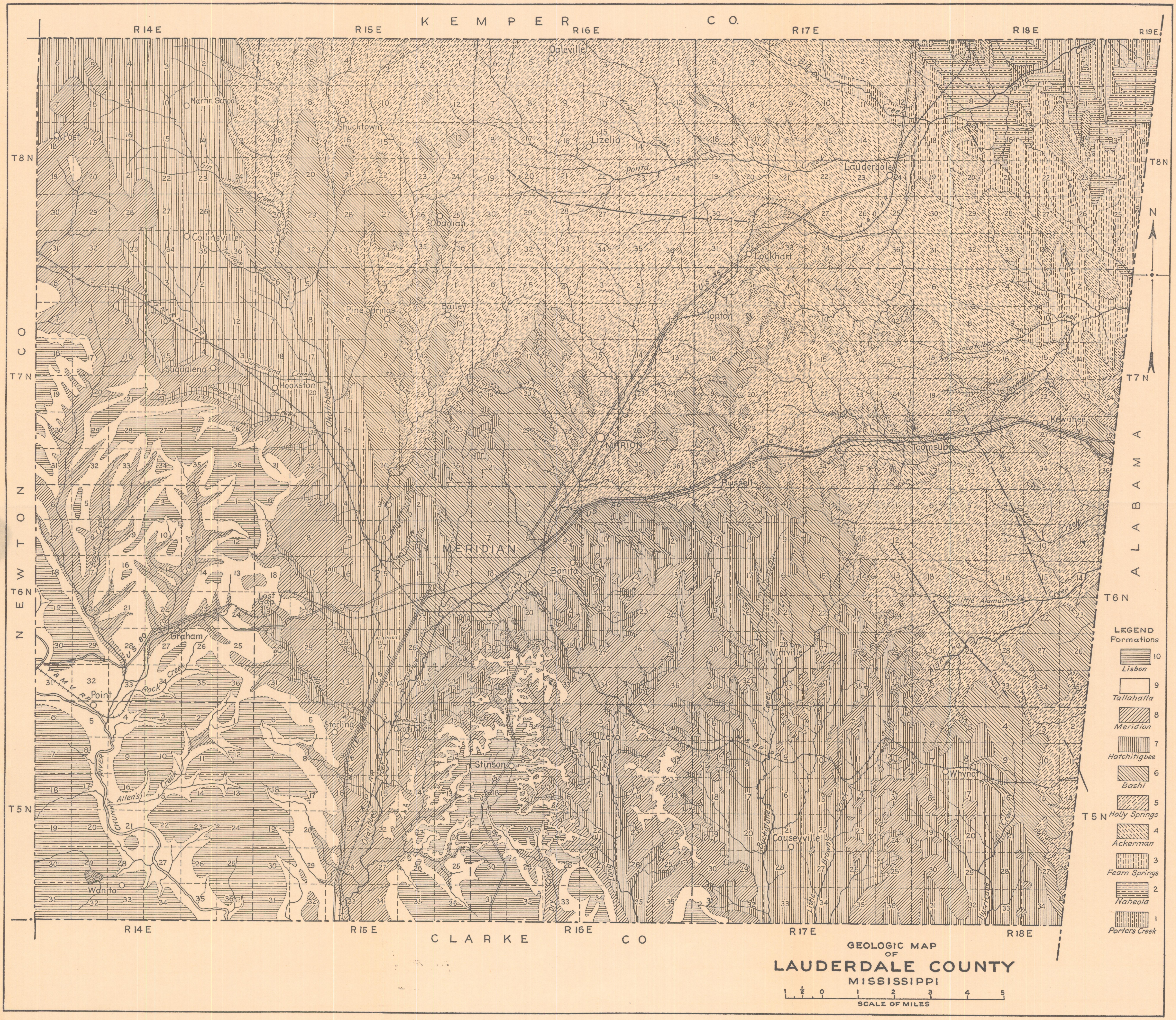
Sulphur: Sulphur was determined in a separate sample by a carbonate fusion, solution in dilute hydrochloric acid, oxidation to SO_4 with bromine and precipitation with 10 percent barium chloride solution. Precipitate was weighed as barium sulfate. Ignition losses were corrected for SO_3 before totaling the analyses. Duplicate analyses were made of each clay and the average reported.

Soluble salts: Ten grams of each clay were accurately weighed and boiled in 100 cc. of water to which 10 cc. of HCl were added. The precipitates were allowed to settle and 10 cc. portions of $BaCl_2$ solution (1 cc. equivalent to .001 gram SO_4) were run in. After each addition, the solutions were stirred, allowed to settle, and one drop added to a drop of dilute H_2SO_4 on a spot plate. As soon as a white precipitate formed in one spot the percent of soluble salts was taken as the number of cc. run in, divided by 100.

Soluble Iron Sulfate: A ten-gram sample of clay was digested for one hour, cooled, and filtered. An aliquot of the filtrate was reduced with test lead and titrated with dichromate solution for iron determination. Another aliquot was acidified, and the sulfates were precipitated with $BaCl_2$, ignited, and weighed. From these two determinations, the soluble iron sulfate was calculated, assuming all the iron was present as sulfate if a sufficient amount of SO_4 was present. In all cases, the total SO_4 was slightly greater than would be necessary to combine with the iron found.

MISSISSIPPI STATE GEOLOGICAL SURVEY
—WILLIAM CLIFFORD MORSE, DIRECTOR

BULLETIN 41
PLATE 1



GEOLOGIC MAP
OF
LAUDERDALE COUNTY
MISSISSIPPI

Prepared in cooperation with the Lauderdale citizens, the State Planning Commission, and the WPA as a report on O. P. 465-62-3-275.