Bauxite and Kaolin Deposits of Mississippi Exclusive of the Tippah-Benton District

GEOLOGICAL SURVEY BULLETIN 1199-B

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By LOUIS C. CONANT

BAUXITE DEPOSITS OF THE SOUTHEASTERN UNITED STATES

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Distribution and occurrence of low-grade bauxite

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[Plates are in pocket]

BAUXITE DEPOSITS OF THE SOUTHEASTERN UNITED STATES

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By Louis C. Conant

ABSTRACT

Investigations of the high-alumina clays and bauxite in Mississippi were carried out as a cooperative project by the U.S. Geological Survey and the U.S. Bureau of Mines from 1941 through 1943. Two promising kaolin areas were drilled, one in Benton and one in Union County, but the search for extensions and additional deposits of bauxite in Union, Pontotoc, Winston, Noxubee, and Kemper Counties was unsuccessful.

The kaolin and bauxite lie at the top of the Midway Group of Paleocene age and in the lower part of the Wilcox Formation of Eocene age, though the exact position of the contact between the two units is arbitrary. The kaolin is associated with the enclosing clays and sands in two ways:

1. In some places it grades downward through a sideritic zone into the typical black Porters Creek Clay of the Midway Group and seems to be a part of that formation.
2. Elsewhere it is interbedded with lignite and kaolin conglomerate in slightly younger long narrow channel deposits assigned to the Wilcox; these cut through the earlier kaolin and rest abruptly on the black Porters Creek Clay.

The first is referred to as the gradational or normal type, the second as the channel type of deposit. Even younger channels cut the lignite-kaolin channels, so the present extent of any kaolin body is unpredictable. In some places the channel kaolin is massive, but in others it is conglomeratic and consists of kaolin pebbles in a matrix of kaolin or sand. Most of the bauxite seems to have formed from the kaolin conglomerate, and the present bauxite pisolites are probably altered clayballs.

In Benton County, the kaolin deposit in the Fowler area is a somewhat elongated body of the normal type that grades downward through sideritic white clay into the black Porters Creek Clay. The kaolin contains 35 to 40 percent percent alumina and about 1.1 percent iron oxide in a bed 5 to 15 feet thick beneath 50 feet of overburden.

In Union County, the Pinedale kaolin area seems to consist of high-grade kaolin of the gradational type and a closely associated channel deposit. Bentonite younger than the kaolin was found in two of the holes, but it is of doubtful economic importance. A large deposit of kaolin contains 35 to 50 percent

alumina and about 1 percent iron oxide and fully half of it lies under an overburden ranging from only 1 to 25 feet in thickness.

In Pontotoc County, which has the largest and most abundant bauxite outcrops of the State, 95 power-drill holes and many hand-auger holes failed to reveal any new bauxite deposits, though some kaolin bodies were discovered. The known bauxite outcrops have been found not to extend underground to any appreciable extent. New tonnage estimates made from both old and new data and in the light of present geologic concepts indicate that only about half as much bauxite of all grades is present as was formerly estimated. In Winston, Noxubee, and Kemper Counties, drilling revealed no additional bauxite or kaolin.

Except for the Tippah-Benton district, all known bauxite and kaolin deposits of Mississippi that lie along the Midway-Wilcox contact are here described at least briefly. In the districts and areas studied, reserves of bauxitic material containing 30 to 55 percent alumina total approximately 400,000 long tons. About 4,000,000 long tons of kaolin containing at least 30 percent alumina is also estimated to be present.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATIONS

Late in 1941 Congress authorized the U.S. Geological Survey and the U.S. Bureau of Mines to search jointly for new sources of bauxite, alunite, and kaolin. This search was necessitated primarily by the rapidly accelerating need for aluminum, which threatened to exhaust our known domestic bauxite reserves in a very few years (Thoenen and Burchard, 1941, p. 40–41). A part of that program consisted in carefully exploring the Midway-Wilcox contact area in Mississippi where low-grade bauxite had long been known and high-grade kaolin had been found more recently.

The U.S. Geological Survey had the responsibility of studying the prospective areas and the known deposits in sufficient detail to provide a sound basis for interpretation of the origin and distribution of the materials so that recommendations could be made for further prospecting and drilling. The U.S. Bureau of Mines had the responsibility for the drilling or such other exploration as seemed warranted. Members of both organizations cooperated closely in the work. Fieldwork by both organizations began late in 1941 and lasted for nearly 2 years, after which time there seemed to be no justification for continuing the work. The generally good recovery and excellent quality of many of the cores aided greatly in evaluating the materials and in interpreting the geologic relations. At the conclusion of the work, cuts of the cores and a set of maps and logs were turned over to the Mississippi Geological Survey at the University of Mississippi.

F. S. MacNeil studied and mapped the Midway-Wilcox contact and the lower beds of the Wilcox throughout their outcrop area in Mississippi and correlated them with the better known Alabama section.

This study was done to determine the stratigraphic position of the bauxite and kaolin, to delimit possible bauxite-bearing areas, and possibly to discover additional deposits. H. A. Tourtelot and L. C. Conant mapped smaller areas in greater detail and made drilling recommendations to the U.S. Bureau of Mines. These recommendations aimed at (1) acquiring new data on known bodies of kaolin and bauxite, (2) finding extensions of known bodies, and (3) discovering new bodies.

In the spring of 1942, the U.S. Bureau of Mines drilled in two kaolin areas that had been inadequately explored (Conant, 1942, p. 57–60). These areas were on and near the L. V. Fowler property in southern Benton County (fig. 1) and near Pinedale in southwestern Union County (fig. 1) and are herein referred to as the Fowler and Pinedale areas.

In the spring and summer of 1943 drilling for bauxite was conducted in three widely separated parts of Mississippi: the Tippah-Benton district, the Pontotoc district, and the Winston-Noxubee-Kemper district. Figure 1 shows the locations of these bauxite and kaolin districts.

ACKNOWLEDGMENTS

The basic planning for the investigations was by Ernest L. Burchard and Watson H. Monroe. Mr. Monroe followed all phases of the work closely for its duration and made many invaluable suggestions. F. S. MacNeil and H. A. Tourtelot, in addition to their work already mentioned, helped several times with various parts of the work, especially during the drilling. Other geologists who were on the project for various lengths of time and rendered much service were Daniel Arden, Harlan R. Bergquist, William E. Benson, Brewster Baldwin, Samuel S. Goldich, Robert Heller, James H. Morris, Parke D. Snavely, and Karl Waagé. The writer is grateful to all these men for their help.

The U.S. Bureau of Mines engineers, Donald F. Reed and Don M. Coulter, worked closely with the Geological Survey party. The cooperation between members of the two Bureaus aided greatly in expediting the work and in obtaining geological information. The Works Progress Administration supplied laborers for a few months to drill exploratory hand-auger holes, which provided samples and other useful information. Members of the Mississippi Geological Survey were helpful, especially Thomas E. McCutcheon, Ceramic Engineer, who made several preliminary analyses of samples. Dr. Guy H. Woollett, Chairman of the Chemistry Department of the University of Mississippi, made office and storage space available for the staff of the U.S. Geological Survey. To these organizations and individuals thanks are expressed. J. W. Adams, who discovered the Mississippi

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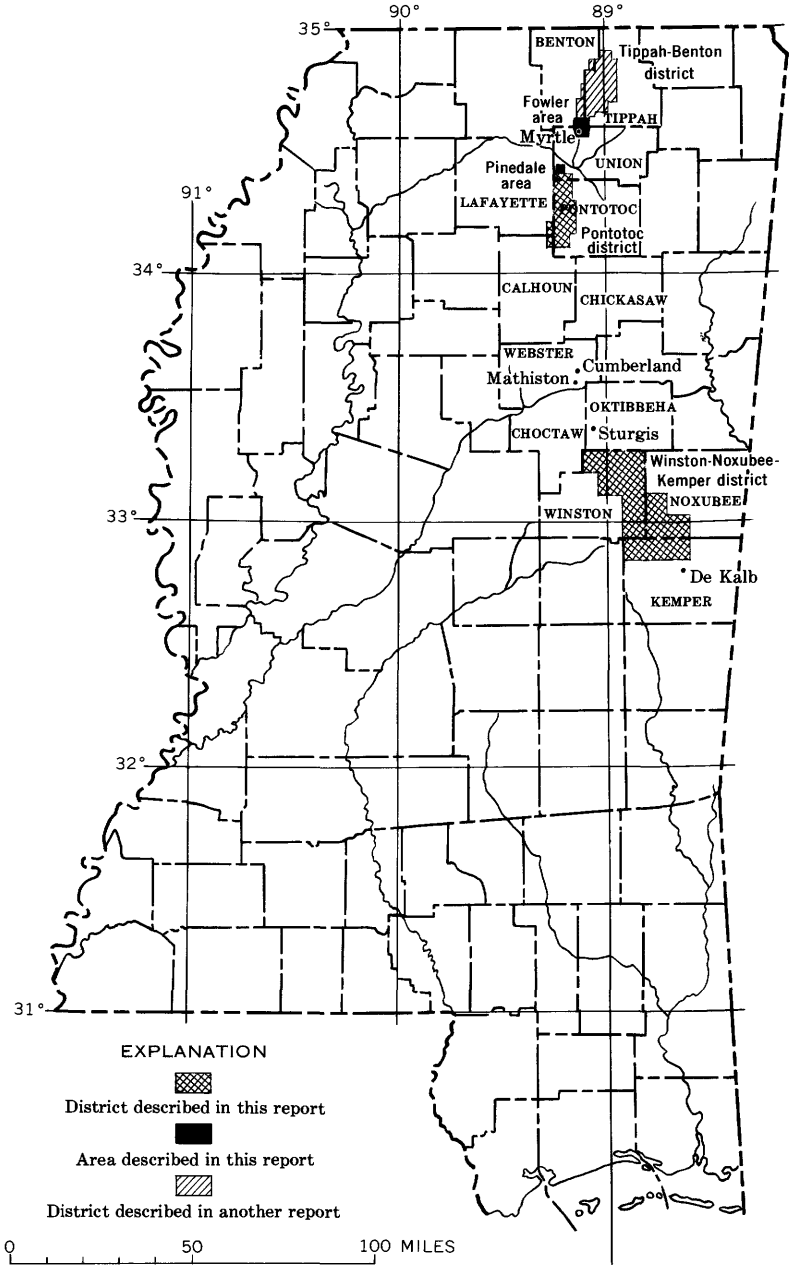

FIGURE 1.—Locations of the bauxite and kaolin districts and areas in Mississippi.

bauxite, helped appreciably at the start of the project by guiding Bureau of Mines and Geological Survey personnel to old outcrops and pits and to some previously unreported prospects.

HISTORICAL SUMMARY

The first published reference to bauxitic material in Mississippi was probably by Wailes (1854, p. 221–222), who stated: "A mile or two west of the residence of Mr. Frederick Braugher, in Tippah County, a conglomerate or puddingstone occurs, composed wholly of pisoform iron. The nodules, formed of concentric layers, are of more than the ordinary size."

Frederick Braugher at that time lived on the present site of Blue Mountain College in the village now known as Blue Mountain, and though Wailes' compass direction does not accurately locate the deposit, the place to which Wailes referred is probably about 1 mile northwest of Blue Mountain cemetery and is the source of specimens later attributed to him by Hilgard.

Hilgard (1860, p. 14) described bauxite in Mississippi, though he did not recognize the material as such. Bauxite was at that time not a widely known mineral and was not even reported from this country until 1887—more than a quarter of a century later. Hilgard's short description of it is as follows:

> A singular rock * * * much resembling a true puddingstone, is found in a few localities in W. Tippah and E. Lafayette counties, on the territory of the Lignitic Tertiary. (*e.g.*, S. 1, T. 5, R. 2, E., Tippah county; S. 33, T. 9, R. 1, W., Lafayette county.) It consists of a ferruginous and somewhat sandy cement, in which are imbedded numerous rounded concretions of a pisolithic structure, formed of concentric layers of a siliceous material, more or less ferruginous, and in some almost white; the largest being about ¾ inch in diameter.

An unfortunate error in Hilgard's description (1860, p. 14) of the "Lafayette" County locality should be corrected. He mentioned the presence of the material in "* * * S. 33, T. 9, R. 1, W., Lafayette County." Various people have searched in vain for bauxite in that sec. 33, which is occupied almost entirely by the flood plain of the Yocona River. Fortunately, the library of the University of Mississippi has Hilgard's field notes for 1859, and in those he stated that on April 6 he traveled from Oxford, in Lafayette County, to Toccopola, which is in Pontotoc County, and that on April 7 he traveled from Toccopola toward Pontotoc, on which day he recorded: "On S 33 T 9 R 1 W, I found on a slight elevation above the flatwoody hills, a deposit of singular pisolitic rock, specimens of which, collected by Wailes at Macedonia Church, Tippah, are in the collection * * *."

As the Lafayette-Pontotoc County line is the division between East and West ranges, there can be no doubt that Hilgard erroneously

recorded "R 1 W" instead of "R 1 E" and that later in writing his report he added "Lafayette County," as R. 1 W. is in that county. Along the present road in sec. 33, east of Toccopola (pl. 3), no bauxite is obvious, but just to the north there is a short abandoned stretch of road along which are many bauxite boulders from a nearby outcrop that would hardly have been overlooked by the observant Hilgard as he rode along in his second-hand mule-drawn ambulance (Hilgard, 1901).

The preceding notebook entry also makes it clear that Wailes had previously collected bauxite from Tippah County. The Macedonia Church has long since disappeared, but the nearby cemetery, now overgrown, is in an area containing bauxite float from a nearby outcrop.

In the autumn of 1921 J. W. Adams, who had discovered bauxite in northwestern Alabama, near Margerum, began searching the literature on Mississippi geology and found Hilgard's excellent description (Burchard, 1924, p. 437–438; 1925, p. 101). Upon reading that description, Adams (oral commun., 1942) stated, "I knew Hilgard was describing bauxite." In two days' time Adams traveled the 100 miles between Tuscumbia, Ala., and Blue Mountains, Miss., where he found the Tippah County locality described by Hilgard. Samples collected from there are said by Adams (oral commun., 1942) to have contained 57 percent alumina; so, Adams returned to Mississippi and spent several months diligently searching near the top of the Porters Creek Clay, interviewing farmers, and especially looking for bauxite boulders that had been used as foundation blocks under farm buildings. Much credit is due Adams both for observing that the bauxite lay close to the Midway-Wilcox contact and for finding at that time nearly all the bauxite known to this day in Mississippi. In 1942 Adams shipped 400 tons of Kemper County bauxite, the only known commercial shipment of Mississippi bauxite to the present time (1964).

As a result of Adams' discoveries of bauxite deposits scattered over 10 Mississippi counties, a small group of Sheffield, Ala., businessmen formed the Mississippi Bauxite Co. W. C. Morse and P. F. Morse, both of Starkville, Miss., were engaged as consulting geologists during the summer of 1922 to investigate the quantity and quality of bauxite on the company's holdings. These men supervised the digging of many test pits and bore holes, collected samples, determined thicknesses, prepared 14 topographic maps of the areas of the deposits, and estimated tonnages. As a result of that work the Mississippi Bauxite Co. bought many of the more promising properties, including the Green-Wattes and I. V. James properties in Tippah County and the Smoky Top, Big Hill, Eddie McGregor, and Inmon and Tal-

lant areas in Pontotoc County. The results of these investigations were later published by the Mississippi Geological Survey in a bulletin (Morse, 1923) that is the most detailed work on the subject. In the summer of 1923, E. F. Burchard visited the areas in company with Adams, and reports by Burchard (1924, p. 437–448; 1925, p. 101–146) summarize the findings of the Morse investigations, call attention to several showings of bauxite not mentioned in that report, and present some additional analyses and other information.

In 1925 W. D. Shelton found on the property of W. T. Meadows, in Tippah County, a large deposit of very low grade bauxite material that has been leased at various times but was not reported in the literature until 1941 (Conant, 1941, p. 63–64, 102; McCutcheon, 1941, p. 187, 202). This is the last large deposit of bauxitic material known to have been found in Mississippi.

From the late 1930's to the early 1940's the Mississippi Geological Survey, aided largely by funds and labor provided by the Works Progress Administration, (after July 1, 1939, Work Projects Administration), conducted investigations in several counties in the bauxite belt. Published reports of those surveys call attention to several previously unreported bauxite and kaolin deposits, chiefly kaolin, and give geological, chemical, and ceramic data concerning them.

In 1941 the Reynolds Metals Co. retested the Meadows property in Tippah County and the East Smoky Top deposit in Pontotoc County. In 1942 three Ripley, Miss., businessmen organized the Mississippi Ore Co. with the intention of procuring interests in some of the Mississippi bauxite and other deposits not already under lease, but the company appears to have obtained relatively small holdings. Also in 1942 the Bureau of Mines tested a carload of the Meadows material (Reed, 1948, p. 1) and in 1943 tested similar large samples from the Meadows property and from West Smoky Top (Coulter, 1948, p. 7).

BAUXITE NOMENCLATURE

A great diversity of material in Mississippi has been called bauxite, but recent investigations have showed that much of it is kaolinitic clay that has a structure superficially resembling the pistolitic structure commonly exhibited by bauxites. The nomenclature used in discussing the Mississippi deposits is as follows.

Bauxite is a rock consisting of a mixture of aluminous hydroxides and silicates, predominantly the minerals gibbsite ($Al_2O_3 \cdot 3H_2O$, containing 65.4 percent alumina and 34.6 percent water) and kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$, containing 39.5 percent alumina, 46.5 percent silica, and 14 percent water. In high-grade bauxites the alumina far exceeds the silica, whereas in kaolin the silica exceeds the alumina.

Only arbitrary distinctions can be made, but in this report material is considered bauxitic if the alumina-silica ratio exceeds that of kaolinite. In many analyses much iron is shown, even exceeding the alumina; the material in these rocks is called ferruginous bauxite or ferruginous bauxitic clay. As chemical analyses are necessary to determine what some of the material should best be called, the terms bauxite and bauxitic are necessarily used somewhat loosely.

The terms oolitic and pisolitic are used to describe the usual structure of bauxite and bauxitic clay. Oolites are loosely defined as spherical or subspherical grains about the size of fish eggs, whereas pisolites are commonly as large as peas. Both terms are indefinite, though about 2 mm ($\frac{1}{12}$ in.) is commonly considered a suitable maximum diameter for oolites. By this rule, most Mississippi bauxite is pisolitic. In addition, oolites and pisolites are grains showing concentric or radial growth structure.

In Mississippi, much of the kaolin found in drill cores contains abundant kaolin-type clay balls, some 5 to 10 mm in diameter, a fact suggesting that they have been dried, hardened, and reworked as angular or rounded fragments that were later deposited in either a sandy or kaolinitic matrix. If the fragments are white and mainly clean kaolin, the material is termed a kaolin conglomerate; if the fragments are dark or contain appreciable sand, silt, or mica impurities, the material is called a clay-ball conglomerate.

STRATIGRAPHY

GENERAL RELATIONS OF THE BAUXITE AND KAOLIN

The Mississippi bauxite and kaolin deposits are at or close to the Paleocene-Eocene contact, more often referred to as the Midway-Wilcox contact. In some places, they overlie and are part of a weathered zone at the top of the Porters Creek Clay of the Paleocene Series; at other places they are a part of channel fillings that have been variously assigned either to the top of the Porters Creek Clay or to the basal part of the overlying Wilcox Formation of the Eocene Series.

Previous reports on the bauxite of Mississippi have expressed various opinions on the age and stratigraphic relations of the bauxite and associated kaolin. Morse (1923, p. 89) and Burchard (1924, p. 439; 1925, p. 106) considered the bauxite to be in the lower part of the Ackerman Formation (basal Wilcox). Later Mellen (1939, p. 26–28, 30) believed the bauxite and kaolin to be residual materials formed by weathering of the Porters Creek Clay, and he considered them to be of Midway age. During the wartime investigations here reported, various tentative opinions were held at different times by the several workers. As a result, some of their preliminary reports have been

quoted by the U.S. Bureau of Mines to the effect that the bauxite and kaolin are in nonmarine beds grading downward into the Porters Creek Clay (Coulter, 1948, p. 4; Reed, 1948, p. 6; 1952, p. 5). In this report some of the bauxite and kaolin deposits are considered to be weathered products that grade into the Porters Creek Clay, and some to be channel deposits in the lower part of the Wilcox Formation.

The marine environment of the Midway may have been followed by shoaling conditions that produced a diversity of clayey and silty sediments. During early Wilcox time the exposed surface of the Porters Creek Clay was eroded extensively and, at least locally, was deeply weathered; widespread swamps caused the accumulation of lignitic clay and peat; unknown conditions permitted the local accumulation of sedimentary kaolin; locally, kaolin was partially altered to bauxite; and during much of the time shifting streams not only channeled and redeposited the newly accumulating sediments but brought in large quantities of sand from an outside source. The resulting Wilcox strata are so different from place to place and are so inadequately exposed that they have thus far generally defied attempts to interpret and classify them with certainty. Outcrops do not show many of the characteristics, and though drill cores obtained during these investigations revealed many new facts, much remains to be learned.

Several workers have described these sediments in local areas. At the start of a series of county studies by the Mississippi Geological Survey, Mellen (1939, p. 26–36) stated that some of these sediments—especially the kaolin and bauxite—were formed on the Midway land surface during a long interval of subaerial weathering. To these residual materials and some overlying lignite he applied the name Betheden Formation. At the start of a cycle of deposition in sediments of the Wilcox, he believed, much of the residual material was reworked, and new material was added to form a succession of dominantly clayey and silty beds to which he applied the term Fearn Springs Formation.

Subsequent county reports of the Mississippi Geological Survey on areas along the Midway-Wilcox contact followed Mellen's terminology and concepts except for minor modifications (Foster, 1940, p. 30; Conant, 1941, 1942; Priddy, 1943; Vestal, 1943, 1952; Attaya, 1951; and Lusk, 1956). Some of these reports give local details concerning these beds.

By far the most extensive study of the Paleocene-Eocene stratigraphy in Mississippi and the best general description of its complexity is by MacNeil (1946, p. 14–19), who spent about 2 years studying outcrops throughout Alabama and Mississippi. During this work he also drilled many hand-auger holes and had access to the many cores taken by the U.S. Bureau of Mines in its search for kaolin and bauxite.

He adopted Mellen's terms of Betheden Formation and Fearn Springs Formation but redefined them.

Later, after Mellen (1950) attempted to restore his original definitions and concepts to the terms, MacNeil (1951) wrote another article wherein he described the same confusing succession of beds and gave his ideas on their ages and correlations. In this later work MacNeil proposed that the term Betheden Formation be abandoned and that the entire succession of these beds be treated as the Fearn Springs member of the Wilcox Formation. That usage is followed in this report except that the clay and bauxitic material that seem to grade downward into the Porters Creek Clay are considered part of the Porters Creek.

As the bauxite and associated kaolin are restricted to an interval close to the Paleocene-Eocene contact, the areas explored and mapped in the present study were limited to the vicinity of that contact. Figure 3 and plates 3 and 5 show the outcrop of the contact in the areas of more intensive study. Because of the gentle dip and the consequent wide outcrop belts, only those formations are shown that bound the contact.

PALEOCENE SERIES

The Paleocene Series in Mississippi is represented by three formations. From oldest to youngest these are the Clayton Formation, the Porters Creek Clay, and the Naheola Formation. The Clayton and Porters Creek are universally assigned to the Midway Group, but the Naheola has been variously assigned to the Midway or to the overlying Wilcox Group (MacNeil, 1946, 1951, and Murray, 1955). In these investigations the Naheola was treated as a part of the Midway Group, and that usage is continued in this report. Within the areas mapped in this study, only the Porters Creek and Naheola are present.

PORTERS CREEK CLAY

The exposed Porters Creek Clay ranges in thickness from about 200 feet at the north end of Mississippi to about 500 feet where the outcrop belt passes into Alabama. It is a nearly black clay that, except for the upper part, is chiefly massive and has only indistinct lamination. Locally, parts of the formation, especially the massive ones, may be bentonitic (Burchard, 1925, p. 108; Bay, 1935, p. 32; Grim, 1936, p. 45), but the formation as a whole does not have the characteristics of a sediment derived primarily from volcanic ash.

A three-fold division of the formation has been widely noted in Mississippi (Mellen, 1939, p. 20–22; Conant, 1941, p. 34–37; 1942, p. 39–43; Priddy, 1943, p. 33–36; Vestal, 1943, p. 16–17; 1952, p. 15–25). The lower unit, about 50 feet thick, has been described in the southern

part of the State as a black massive clay containing foraminiferal shells and small lenses of sandy glauconitic, calcareous material in which are small molluscan and foraminiferal fossils. Many of the fossils have been described and illustrated by Kline (1943). In the northern part of the State the lower unit is very similar to the middle unit but differs from it in being somewhat glauconitic, harder, more noticeably bentonitic, and in having a green cast and a somewhat waxy appearance.

The middle unit is the typical near-black massive clay in which are inconspicuous thin and irregular laminae of very fine silt. The unit commonly ranges in thickness from about 100 feet in the north to 400 feet or more in the southern part of the State.

The upper unit, where present, is much more variable but consists chiefly of alternate layers of the more typical massive black clay of the formation and dark finely sandy micaceous clay. Unlike the two lower units, this one has a distinctly laminated or stratified appearance. Concretions of siderite, usually weathered to limonite, are common along some layers. Crossbedded micaceous fine-grained sand that is present locally ranges in thickness from a few inches to as much as 50 feet and increases in abundance upward. Exposures of this crossbedded sand can be seen in roadcuts just north and northwest of Thaxton and below the Hilgard bauxite locality, both in Pontotoc County (pl. 3). This sand may be a local facies that resulted from a shoaling of the Midway sea.

From Winston County northward these laminated and stratified beds of the upper unit have been assigned either provisionally or specifically to the Naheola Formation by several writers (Mellen, 1939, p. 22; Grim, 1936, p. 34; Conant, 1941, p. 37; 1942, p. 43; Priddy, 1943, p. 36; Attaya, 1951, p. 7; Vestal, 1952, p. 17–25; 1954, p. 22–26; Lusk, 1956, p. 11). In Kemper County, however, Hughes (1958, p. 101) more recently described similar beds in the upper part of the Porters Creek Clay just below the fossiliferous Mathews Landing Marl that is present in that area and in Alabama and is now considered the uppermost member of the Porters Creek (MacNeil, 1946, p. 11–12). It would seem that the practice of identifying these northern beds as the Naheola Formation is questionable until intensive efforts have been made to trace the several associated units over the considerable distances involved.

At many places the laminated micaceous and silty black clay, characteristic of the upper part of the formation, grades upward into a light-gray to white material referred to informally as the white Porters Creek Clay. The lowermost part of this unit is a light-gray laminated clay of identical texture and apparently similar mineral

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composition to the underlying black laminated clay and is typically 3 to 5 feet thick. Commonly, this unit grades upward, by decrease in mica and the coarser silt, into a white silty clay that nearly everywhere has abundant sand-size siderite pellets. In the more complete sections the sideritic clay, in turn, grades imperceptibly into clean kaolin, typically about 5 feet thick. In places, the kaolin contains pisolites about a quarter of an inch in diameter, many of which are thought to be altered clay pebbles. Locally, the mica and siderite pellets are present throughout the upper part, and at those places the white Porters Creek Clay may be nearly 20 feet thick, and no clean kaolin is present.

Deposits of kaolin that thus grade downward into the white Porters Creek Clay are herein referred to as the gradational or normal sequence. In this report, the Porters Creek Clay is taken to include the gradational sequence up to and including the associated kaolin or bauxitic kaolin. The beds are thus classified in full realization that the time of their alteration may have been closer to the time of deposition of the overlying sediments of the Wilcox than of the parent beds of the Midway. Workers of the Mississippi Geological Survey have previously considered all the gradational type of kaolin and any associated bauxite to belong to Mellen's Betheden Formation (Mellen 1939, p. 26–28; Conant, 1941, p. 39–41; 1942, p. 43–44; Priddy, 1943, p. 38–41; Vestal, 1943, p. 19; 1952, p. 25–27; 1954, p. 23; Lusk, 1956, p. 15). An especially good example of this gradational sequence is the high-alumina clay in the Fowler area in Benton County (p. B19–26).

NAHEOLA FORMATION

In and near Kemper County (fig. 1) the Porters Creek Clay is overlain by the Naheola Formation (MacNeil, 1946, p. 12; Hughes, 1958, p. 123–131). In Alabama, where the Naheola is well represented in outcrop, the formation consists of interlaminated fine sand and silty clay of marine origin. It can be traced from Butler County, Ala., as far west as Winston County, Miss., where it thins updip and in most places is overlapped by the Wilcox Formation and thus does not appear in outcrop. In Kemper County the Naheola is largely a fine-grained micaceous sand that contains *Halymenites* burrows and is interbedded with silt and clay shale.

In Mississippi, MacNeil (1946, p. 13, 17; 1951, p. 1067–1068) did not identify the Naheola Formation north of Winston County, though he considered that local lenses of the laminated and sandy upper beds assigned to the Porters Creek Clay and certain nonmarine beds immediately above them might be northern equivalents. As noted on page B11, several authors working in the northern counties have

assigned beds to the Naheola Formation, but those assignments seem questionable.

PALEOCENE-EOCENE CONTACT

LITHOLOGIC FEATURES

At most good exposures of the Midway-Wilcox contact, the marine beds of the Midway Group are overlain abruptly by the nonmarine beds of the Wilcox Formation, a fact which suggests that the contact is unconformable. Erosion just before or early in Eocene time beveled the Porters Creek Clay so that the overlying Wilcox strata at many places overlap the upper unit and to the east lie directly on the middle unit of the Porters Creek—further evidence of an unconformity. Where the Wilcox Formation overlies the massive clay of the middle unit, the contact is easily mapped, but farther west, where it lies on the laminated or sandy upper unit, the contact is much less distinct and locally is difficult to identify. At many places a channel contact separates the laminated, the sandy, or the kaolinitic beds of the upper unit of the Porters Creek from the overlying beds of the Wilcox. In a few places, however, especially as noted in drill cores, the kaolinitic clays are overlain by the Wilcox, and there is no apparent erosional break. This situation is notably true in some of the cores from the Fowler clay area in Benton County. In other places, lignitic clays of the Wilcox Formation are separated from the Porters Creek by a definite disconformity.

DURATION OF MIDWAY-WILCOX TIME INTERVAL

The magnitude of the time break between the Paleocene and Eocene Series, commonly referred to in the literature as the Midway-Wilcox interval, has been variously interpreted. Grim (1936, p. 28, 49) took exception to some earlier opinions that an unconformity was present and stated that no evidence had been found for a Midway-Wilcox unconformity, that the transition is gradational, and that the transitional beds are considered basal Wilcox.

Bramlette (1936, p. 6, 29), on the other hand, in describing the conditions in the Arkansas bauxite district, believed the Midway-Wilcox interval to be a long period of subaerial weathering that was responsible for a weathered zone at the top of the Midway as well as for the formation of the bauxite. He suggested that this interval of weathering might have lasted for a million years or more. Mellen (1939, p. 27–28), following Bramlette, believed that the kaolin and bauxite in Mississippi had been formed during a similar long period of weathering. His views have been accepted by other workers of the Mississippi Geological Survey.

Gordon, Tracey, and Ellis (1958, p. 100–101) in reporting on an extensive study of the Arkansas bauxite district discussed more fully the profound weathering of the clays of the Midway. The large amount of mining and core drilling in the Arkansas area, combined with chemical and petrographic studies of the materials, have afforded a vastly greater amount of information than has been available elsewhere. Gordon, Tracey, and Ellis agreed with Bramlette that the Midway-Wilcox time interval was appreciable, but they suspected (1958, p. 145) that it may have been considerably less than a million years.

The amount of time represented by the unconformity in Mississippi is not clear. The weathering phenomena, the formation of extensive kaolin deposits and meager bauxite deposits, and erosion of the Midway surface seemingly must have required considerable time.

An apparent downward gradation from the lignitic clays and shales, however, observed only in a few cores, suggests that there was very little, if any, time break between the Midway and Wilcox. Probably the limitations of information obtained from drill cores, in spite of their local excellence, have prevented accurate conclusions—obscure contacts, for example, may have been overlooked that would be unmistakable in a good roadcut or mine face. In conclusion, an erosional interval must have separated the two units, and it was long enough to permit the formation of kaolin deposits and bauxite. Probably, the onset of Wilcox deposition was extremely slow and irregular, characterized by low swampy conditions that covered some places long before the entire area was buried by sediments of the Wilcox Formation. Where the earliest sediments of Wilcox age were deposited on the kaolinitic residuum at the top of the Midway, there may have been sufficient mixing of the materials so that no decided break is apparent.

EOCENE SERIES

WILCOX FORMATION

The well-recognized formations of Wilcox age in Alabama—the Nanafalia, Tuscahoma, and Hatchetigbee—and their subdivisions can be identified at the surface for only short distances into Mississippi, beyond which they pass into a poorly defined succession of nonmarine beds. In Mississippi these beds have not been mapped in sufficient detail to permit definite correlations with the Alabama units or even to correlate from place to place within the State.

For many years the Wilcox strata in Mississippi were considered to be divisible into three nonmarine formations—the Ackerman Formation, Holly Springs Sand, and Grenada Formation. Near the Alabama State line certain marine beds were also recognized. Later, how-

ever, systematic mapping and subsurface work by geologists of oil companies and of State and Federal Surveys have shown the need for changes in this classification. McGlothlin (1944, p. 53) stated that the Grenada was of Claiborne age (middle Eocene) and suggested that all the surface Wilcox beds in Mississippi be treated as "Undifferentiated Wilcox." Mellen (1939, p. 33–37) assigned a sequence of beds at the base of the Ackerman to his Fearn Springs Formation, and this unit has since been recognized rather generally along the outcrop in the State. MacNeil (1946, p. 17–22) found that much of the Holly Springs Sand is also of Claiborne age and that the beds which for many years were assigned to the Ackerman Formation, at least in the Winston County area, are equivalent to most of the Wilcox group of Alabama. MacNeil redefined the Fearn Springs Formation of Mellen and also applied the name to a sequence of beds in the better known section of Alabama. A new geologic map of Mississippi (Mississippi Geological Soc., 1945) followed the recommendation of McGlothlin and other workers and treated all the beds of the Wilcox Group as the Wilcox Formation.

In this report, the Wilcox Formation and the Fearn Springs Sand Member at the base are taken to be equivalent to the whole Wilcox Group of Alabama and to represent an undifferentiated group in Mississippi. Future revisions of the Wilcox nomenclature are, however, almost inevitable as the beds are studied in more detail. For example, Mellen (1950) maintained that the strata of Wilcox age in Mississippi are the result of four cycles of deposition that can be recognized in the southern part of the outcrop area and in some well sections. Earlier Foster (1940, p. 32) recognized five cycles in Lauderdale County. Brown (1947, p. 34–36) pointed out two or three recognizable cycles in the subsurface but states that the upper beds do not reach the surface because they are overlapped by sand of Claiborne age. In Benton County, Lusk (1956) recognized the Fearn Springs and Ackerman Formations. In Kemper County, Hughes (1958, p. 140) recognized correlatives of the three formations in Alabama and two members. It is possible that future careful tracing of the beds, both along the outcrop and in the subsurface, will show that the Wilcox can be divided into units of formation rank. From south to north, the upper units of the Wilcox are progressively overlapped by strata of the Claiborne Group of middle Eocene age. In the southern part of the outcrop belt in Mississippi, the beds of Wilcox age have been variously reported to be about 600 to 900 feet thick (Foster, 1940, p. 14; MacNeil, 1946, p. 18), but at the north end of the State less than 100 feet of these beds is exposed (MacNeil, 1946, p. 18).

That part of the Wilcox of primary interest in a study of bauxite deposits is the lower unit, which consists of red sand, locally coarse

grained, and which is overlain by a succession of gray and lignitic silty clays. In many places, part or all of the underlying Fearn Springs was cut out before deposition of the basal sand. All these beds have been considered part of the Ackerman Formation by many previous writers.

FEARN SPRINGS SAND MEMBER

Some of the history of the term Fearn Springs Sand Member, which was proposed by Mellen (1939, p. 30–37), has already been reviewed. The name has been generally used by workers on the Mississippi Geological Survey for the lowermost unit of the Wilcox group and seems to be applicable over much of the 200-mile-long belt of outcrop in Mississippi. At many places the member is apparently absent at the outcrop, probably because of erosion shortly after its deposition. The formation has not yet been mapped through its entire extent in the State, though MacNeil (1946, p. 19; 1951, p. 1065) traced it into western Alabama and found it to be equivalent to the lowest part of the Nanafalia Formation.

Unpredictable variety is one of the outstanding characteristics of the Fearn Springs Sand Member. At the type locality in Winston County, MacNeil (1951, p. 1064) described the member as being 87 feet thick. At this locality, as described by MacNeil, the lower 47 feet is mostly sand and gravelly sand having scattered clay balls and lignitic logs; the upper 40 feet is chiefly a silty micaceous clay and fine sand. Hughes (1958, p. 151–157) described several sections farther southeast in and near Kemper County, and these show marked differences in thickness and composition. He mentioned thicknesses ranging from 25 to 85 feet, and his descriptions show that in general the lower part is chiefly sand, locally gravelly, and the upper part is a silty laminated clay, which is not everywhere present.

In the northern part of the State, beds actually assigned, or perhaps assignable, to the Fearn Springs have been described by several writers (Conant, 1941, p. 20, 43–44; 1942, p. 18, 46–48; Priddy, 1943, p. 13, 42–44; Vestal, 1943, p. 23; 1952, p. 28–32; 1954, p. 26–34; Attaya, 1951, p. 7–10; Lusk, 1956, p. 18–25). Insofar as one can generalize, the Fearn Springs Member may be absent or as much as 100 feet thick. In general, it consists of basal sand that is locally conglomeratic, overlain by assorted gray or brown clays that are laminated, micaceous, silty, and in some places strongly lignitic. In the kaolin areas the basal sand is commonly absent, and the lowest beds are chiefly kaolin conglomerate, lignite, and massive kaolin, some or all of which occupy channels that were cut into the underlying Porters Creek Clay. These are overlain, either abruptly or gradationally, by the assorted gray or

brown clays and lignitic beds. In some places, the basal kaolinitic clays are absent, and the gray or brown clays may directly overlie the gradational sequence at the top of the Porters Creek Clay. Figure 2 illustrates some of these many variations. The basal sand, or the lignite and clay that take its place, is of highly variable thickness, but the overlying brown or gray clays and lignite are as much as 50 feet thick.

In the Pinedale area, Union County, data from drill cores indicated that in places the main channel deposit is cut by a second clay-filled channel and that a still younger sand-filled channel cuts one, perhaps both, of the clay-filled channels. Only the main and sand-filled channels are present in the area of figure 2. Clay from some cores is composed in part of transported kaolin pebbles, elsewhere it may include a small amount of interstitial sand. The kaolin in channel deposits is as much as 15 feet thick and is some of the highest grade kaolin found in this investigation.

At a few places impure bauxite or kaolin is present in the Fearn Springs Member a few feet above the kaolin at the top of the Porters Creek Clay, but the relationships between the two kaolins are uncertain because of poor exposures.

The gray or brown clays in the upper part of the member contain many leaf fragments, but well-preserved leaves are rare. Poorly preserved shells of fresh-water mussels belonging to the family Unionidae have been found in Tippah County (Tourtelot, 1965) and in Pontotoc County (SE¼SE¼ sec. 10, T. 10 S., R. 1 E.).

ORIGIN OF THE BAUXITE

For many years bauxite has been considered to be a product of intense weathering, presumably under humid and tropical conditions. A summary of various earlier theories and a detailed discussion of current ideas have been presented in a recent report on the Arkansas bauxite (Gordon, Tracey, and Ellis, 1958). All the bauxite known in the southeastern part of the United States is either associated with the Midway-Wilcox contact or is so related to older rocks that it could well have formed at the same time. Special and unusual humid, tropical conditions may therefore have existed in all those areas at that time.

Most of the Arkansas bauxite has been formed from syenite, but in one area a few small bodies of high-silica bauxite may have been formed by weathering of the Porters Creek Clay (Gordon, Tracey, and Ellis, 1958, p. 100–101), referred to in Arkansas as the Wills Point Formation. This origin is indicated by a downward gradation of bauxite through kaolinitic clay which merges into weathered clay of the Wills Point Formation. This material in turn grades down-

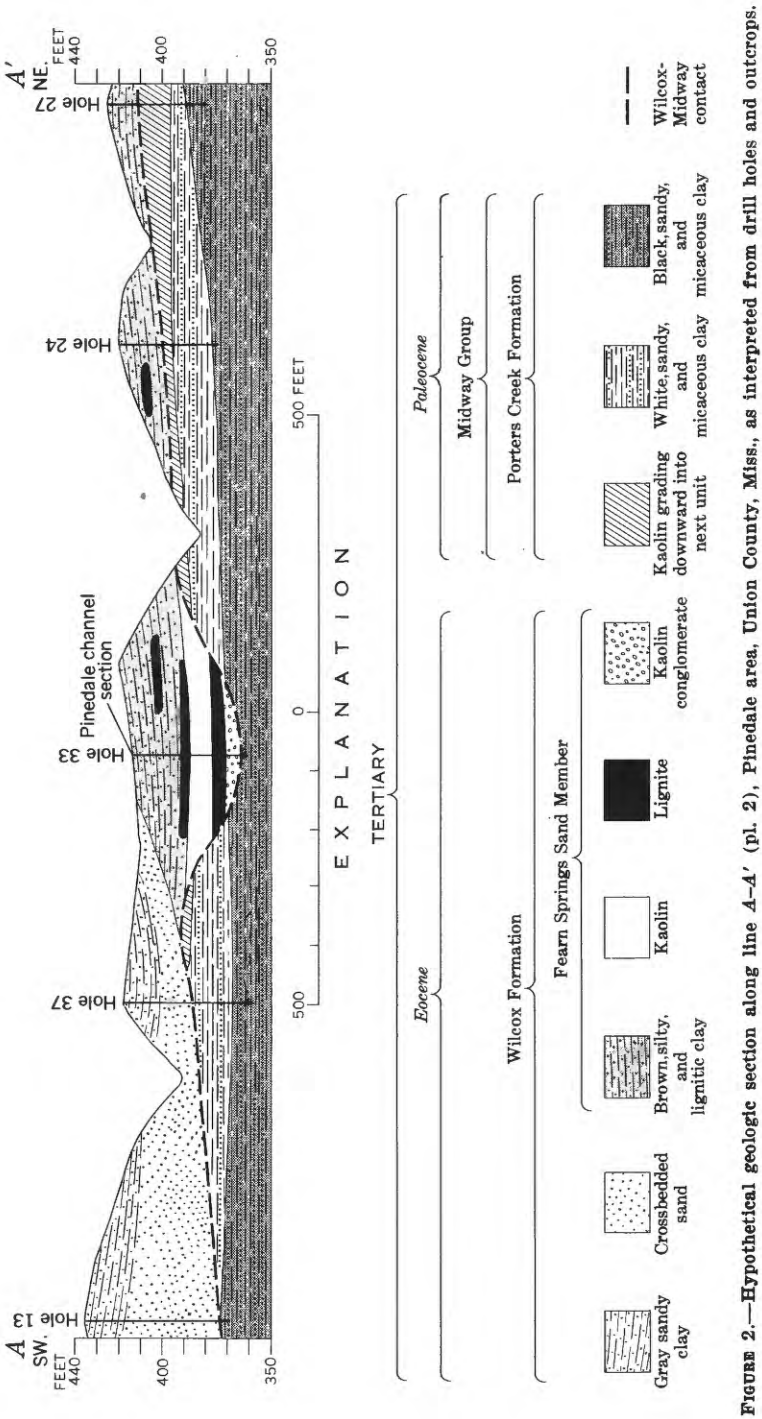

FIGURE 2.—Hypothetical geologic section along line *A–A'* (pl. 2), Pinedale area, Union County, Miss., as interpreted from drill holes and outcrops.

ward into unweathered black silty clay of the Wills Point. The published descriptions seem to be applicable to some of the Mississippi high-silica bauxite and kaolin. As in Mississippi, the clay of the Midway in Arkansas is relatively impermeable and commonly forms gentle slopes, conditions not conducive to leaching by ground water and the probable reason why so few bauxite deposits have been formed from the Porters Creek. If these explanations are correct, the outlook is not good for the future discovery of significant amounts of bauxite in Mississippi.

The Arkansas investigators (Gordon, Tracey, and Ellis, 1958, p. 31–33) believe that the carbonaceous matter was removed from the black clay of the Midway by organic agents or aeration. Pyrite, which is present in the fresh clay, is assumed to have been leached from the upper part on some sloping surfaces, carried downward and outward, and the iron reprecipitated as oxide in the zone of fluctuating water table. Red stains were presumably formed in the upper part of this zone, where there was intermittent aeration, and a khaki-colored stain, where there was little or no aeration. In Mississippi much the same relations exist at the places where the bauxite and kaolinitic material grade downward into the Porters Creek Clay. In Mississippi the bauxitic materials have been observed at some places to be on high areas of the Porters Creek surface, as is also the case in Arkansas. Seemingly, the conditions and processes described in Arkansas for bauxite derived from the Porters Creek Clay apply equally well to the Mississippi materials.

STRUCTURE

All the exposed strata in the area of this study are along the great arc, where the chiefly west-trending beds of Alabama swing to the north up the Mississippi embayment. At the north end of Mississippi the strike of the beds is slightly east of north, and in the vicinity of Pontotoc County it is just about north. In Kemper County where the beds pass into Alabama, the strike is northwest.

The strata dip gently to the west and southwest, the older ones somewhat more steeply than the younger. In the northern part of the State, where most of the bauxite studies were conducted, the Paleocene beds probably dip west about 25 feet per mile, and the overlying Eocene beds at perhaps half that rate.

BAUXITE AND KAOLIN DEPOSITS

BENTON COUNTY

FOWLER AREA

The Fowler area (fig. 1) is in the southeastern part of Benton County. Other Benton County areas, close to the Tippah County

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line some miles farther north and northeast, are described by H. A. Tourtelot (1965).

The Fowler area extends from the Union County line northward about 1½ miles and is about three-quarters of a mile wide. It is 3 to 4 miles north of the Myrtle community, which is in Union County. For many years Mr. L. V. Fowler, owner of much of the land underlain by the kaolinitic clay, was aware of the presence of the clay and called it to the attention of several potentially interested parties, but the first printed reference to it was in 1942 (Conant, 1942, p. 59–60).

Kaolinitic clay is exposed in two places in the property. One is in a small tributary of a west-flowing branch of Ocklimeta Creek[1] (NW¼SE¼ sec. 30, T. 5 S., R. 2 E.) and along the south side of the branch valley for about a quarter of a mile to the east (fig. 3). The second exposure is about a mile to the southeast along the creek in the eastern part of sec. 31. There the clay is impure and discontinuous. Data from the joint Federal drilling program indicated that the north outcrop is part of a body which extends southward under the divide as an irregularly shaped blanketlike deposit but that the south outcrop does not extend as much as 200 feet to the west and that the two exposed kaolin beds are not connected underground. Another exposure in sec. 29 is discussed on page B26.

In 1938–39, during a mineral survey by the Mississippi Geological Survey and Works Progress Administration, several hand-auger holes were drilled in the Fowler area (Conant, 1942), and samples were tested in the laboratory of the State Survey (McCutcheon, 1942). Although the overburden was too great in much of the area to permit satisfactory hand-auger exploration, considerable high-alumina clay was apparently present.

In 1942, as part of a Federal exploration program, the U.S. Geological Survey mapped about 22 square miles in the Fowler area and adjacent parts of Benton, Tippah, and Union Counties (fig. 3). The U.S. Bureau of Mines drilled several hand-auger holes and 45 power-drill holes in the most favorable parts of the mapped area. Results of drilling, brief logs, and chemical analyses have been published (Reed, 1952). The power-drill holes, which for the most part were on 470-foot centers over an area of about 270 acres, afforded good cores, and these, combined with the hand-auger holes, were sufficient to explore an area of about 320 acres in parts of secs. 29, 30, 31, and 32.

[1] Some modern maps show the name as Oaklimeter, but locally it is pronounced Ocklimeta, and older geologic reports use this spelling or a variant of it. Hilgard (1860, p. 112–113) referred to Ocklimita Creek, and Stephenson, Logan, and Waring (1928, p. 87) referred to Ocklimetah Creek. The field notes of the 1833 public land survey of the area called it Ocotimatah, Ocota-ma-tah, and similar variants. Obviously, whichever of the names is used today is a corruption of some Indian name, and attempts to give the name a spelling suggestive of English words are not warranted.

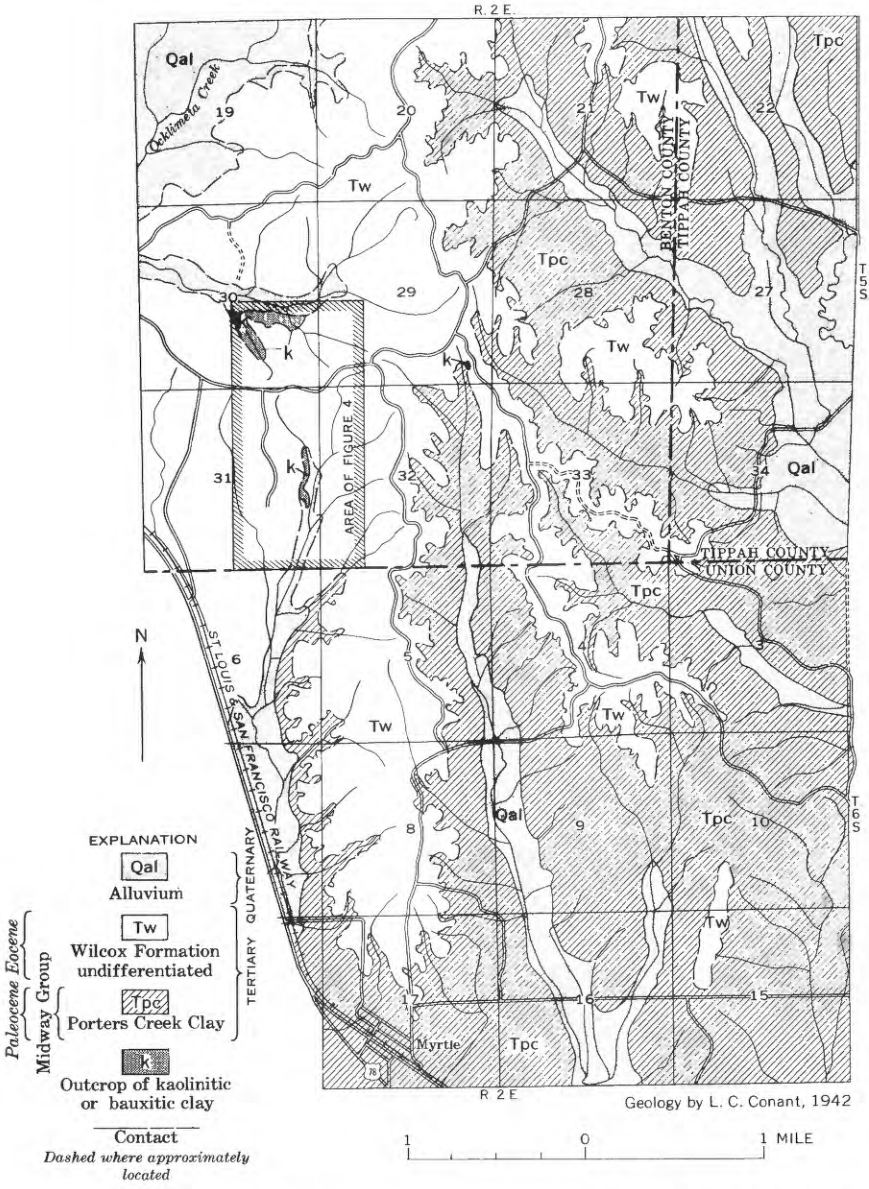

FIGURE 3.—Geology of the Fowler area and adjacent parts of Benton, Tippah, and Union Counties, Miss.

Locations of all the power-drill holes and some of the hand-auger holes and the extent of the clay body are shown in figure 4.

GEOLOGY AND DEPOSITS

In the cores from the Fowler area, massive white clay grades downward through several feet of sideritic white clay and micaceous silty clay (white Porters Creek Clay) into the black Porters Creek Clay. The clay body is typical of the gradational sequence and, accordingly, is more regular and extensive than bodies of the channel type.

In general, the white clay in the cores is overlain by carbonaceous and lignitic clay, here assigned to the Fearn Springs Sand Member, and in some places this member is in turn overlain by red sand and silty clay. Some of this uppermost material may be assignable to the Wilcox Formation, undifferentiated. The characteristic downward gradation from the white clay to the black Porters Creek Clay

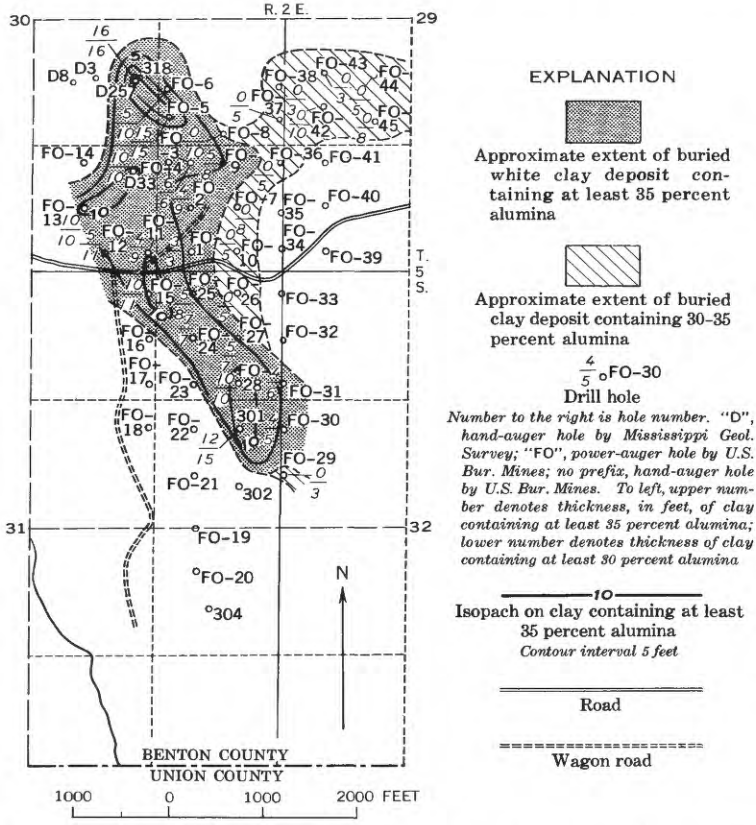

FIGURE 4.—Locations of drill holes and extent of the clay deposit, Fowler area, Benton County, Miss.

and an apparent upward gradation into the lignitic and silty clays of the Fearn Springs Sand Member are especially clear in core of hole Fo–5, which penetrated the thickest section of high-alumina clay (15 feet) in the Fowler area. Presumably a well-exposed section would reveal an unconformity within or at the top of the white clay sequence. No thick lignite is present in any of the cores that is similar to the lignite characteristically associated with the kaolin in the channels at Pinedale, but one or two of the cores might be interpreted as indicating a nonlignitic channel deposit overlying the kaolin.

The descriptive log of hole Fo–5 shows a characteristic variation of lithologic units of the Fearn Springs Sand Member and undifferentiated Wilcox above and the Porters Creek Clay below the white kaolinitic clay. Chemical analyses (Reed, 1952, p. 40) of the high-grade part of the core indicate a very pure kaolin underlain by a high-iron sideritic zone between the kaolin and the silty clays which grade downward into the black Porters Creek Clay. The descriptive log and chemical analyses follow:

Chemical analyses, hole Fo–5

[Reed, 1952, p. 40]

Depth (feet)		Analyses (percent)				
From	To	Al_2O_3	Insoluble	Fe_2O_3	TiO_2	Ignition loss
59.8	64.8	34.8	34.8	3.4	2.1	14.6
64.8	69.8	37.2	44.9	.7	2.5	13.9
69.8	74.8	35.8	42.7	2.6	2.7	14.2
74.8	79.8	26.2	43.5	11.0	1.7	14.6
79.8	81.7	16.9	67.2	4.2	.2	7.7

Log of drill hole Fo–5

Depth (feet)		Description
From	To	
0.0	7.0	Clay, brick-red, sandy; thin plates of ferruginous claystone or sandstone.
7.0	42.0	Sand, olive-gray and orange, fine-grained; some cream-colored silty clay. Scattered fragments of ferruginous claystone or sandstone.
42.0	45.0	Clay, dark-gray, silty, lignitic.
45.0	49.4	Clay, gray and white, silty.
49.4	59.0	Clay, dark-gray to black, silty, lignitic.
59.0	65.0	Clay, gray, nonsilty, grading downward into very light-gray clay.
65.0	73.0	Kaolinitic clay, white, indistinctly pisolitic.
73.0	76.0	Kaolinitic clay, white, pisolitic; fine-grained mica flakes increase in abundance downward.
76.0	81.0	Clay, very light gray; local concentrations of siderite pellets; some sand grains.
81.0	83.0	Clay, gray, slightly sandy; grades downward into next lower unit.
83.0	85.7	Clay, gray-black, silty micaceous; some fine white sand; some pale-green grains. Probably Porters Creek Clay.

The only material discovered in the Fowler area which contains more alumina than silica, and hence some gibbsite, is from holes Fo–4 and Fo–27 in the northern and southern parts, respectively, of the large body. In each hole this material is a bauxitic clay, generally light-gray and pisolitic, in which the pisolites have a poor to fair concentric structure and in which many are somewhat elongate vertically. The pisolites are about 1/8 to 1/4 inch in diameter. Some lignite streaks are present in the core. Chemical analyses (Reed, 1952, p. 40 and 42) of the bauxitic clay and the immediately adjacent clay from these two holes are as follows:

Depth (feet)		Analyses (percent)				
From	To	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Ignition loss
			Hole Fo–4			
53.7	56	37.9	40.6	1.0	2.2	15.5
56	60	41.4	39.3	.8	2.0	16.0
60	65	29.0	35.6	14.6	1.5	16.5
			Hole Fo–27			
43.5	45	41.8	35.0	0.9	2.2	19.5
45	48.7	40.5	39.0	.9	2.1	16.6
48.7	50.3	30.6	34.2	14.4	1.8	17.8

Petrographic study by C. S. Ross and V. T. Allen (unpub. data) indicated that in places the pisolites are siltier than the matrix and may be pebbles of a slightly different composition. Where the alumina content of the clay is more than 40 percent and the clay is pisolitic, probably gibbsite is largely present in shells that surround the supposed pebbles.

A body of white clay containing 35 to 42 percent alumina seems to underlie about 120 acres (fig. 4). In more than half of this area, the clay apparently ranges in thickness from 5 to 15 feet (fig. 4), averaging 7.5 feet. The U.S. Bureau of Mines analyses indicate that this part of the clay body contains an average of about 37 percent Al_2O_3 and 1.65 percent Fe_2O_3. The most probable extension of the deposit is to the west near the section line between secs. 30 and 31 and possibly extending from there to the southwest for about half a mile. Lusk (1956, p. 17) reported 5 feet of micaceous white clay in a drill hole beside the north-south wagon road in the NW1/4 sec. 31, about half a mile west of holes Fo–16 and Fo–17.

Kaolin containing 30 to 35 percent alumina is estimated to underlie an additional area about half as large as that underlain by the 35 to 42

percent material. The lower grade clay is generally thinner than the higher grade clay.

Subsurface contours drawn on the top of the black Porters Creek Clay in the Fowler area indicate a general westerly dip of the surface of about 100 feet per mile (fig. 5), much in excess of the regional dip of about 20 feet per mile. The top of the black Porters Creek was chosen because it is a break easily recognized in drilling and because the top of the Paleocene sequence in the area is not more than 10, or at most 20, feet above this break. Outside the area underlain by the white clay, the black Porters Creek is directly overlain by undifferentiated sands of the Wilcox. Inasmuch as the clay deposit is also largely a part of the Midway, the actual relief of the surface was somewhat greater than, not less than, that shown on the map, especially over the clay. The top of the black Porters Creek Clay presumably marks a horizon in a gradational weathering zone below

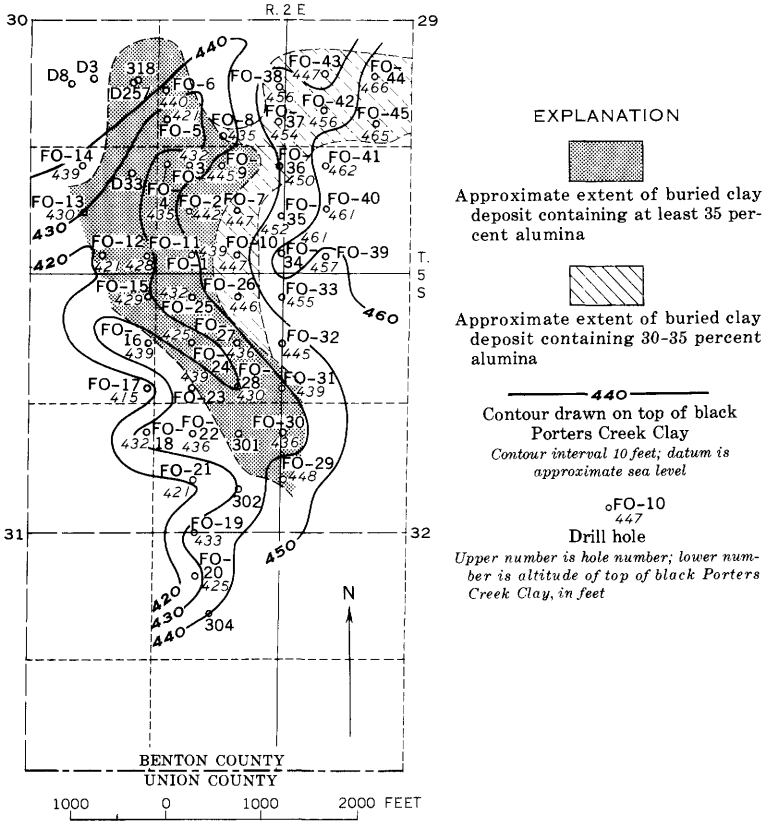

FIGURE 5.—Subsurface contours showing the approximate configuration of the pre-Eocene land surface and associated clay deposits, Fowler area, Benton County, Miss.

the pre-Wilcox land surface, and on the basis of that assumption the data seem to indicate that the clay deposit is largely along the sides of a pre-Eocene valley and subsidiary valleys whose sides slope at about 75 to 150 feet per mile. Thus the clay seems to have a geologic setting and origin similar to that of the bauxite and high-alumina clay in Arkansas that have been described as having been formed by weathering on the sides of valleys and in the same kind of clay (Gordon, Tracey, and Ellis, 1958, p. 119–130). A study of figures 4 and 5, coupled with this interpretation, suggests that any extension of the clay body should be to the west.

About 1½ miles east of the Fowler clay outcrops is a small outcrop of high-alumina clay (fig. 3). Just west of the road (SE¼SE¼ sec. 29, T. 5 S., R. 2 E.) on the slope across the road from an old house site, high-alumina clay was exposed in a small outcrop, and a pit penetrated about 9 feet of it (Conant, 1942, p. 60, 95; McCutcheon, 1942, p. 122). Several nearby auger holes north, east, and south of the pit penetrated no white clay, but U.S. Bureau of Mines hand-auger holes 319 and 321 on the same ridge slope, and about 400 to 1,200 feet to the south, penetrated about 6 feet of white clay that contains slightly more than 35 percent alumina (Reed, 1952, p. 18–19, 21). Apparently there are small pockets or channels of the clay in the area, but it is unlikely that there is a large deposit.

The presence of these high-alumina clays suggests the possibility of others between the outcrop and the major deposit in the Fowler area. Nearly all the intervening area (W⅔ sec. 32, and S⅓ sec. 29) is high enough in elevation to be underlain by the clay and has never been explored by drilling.

UNION COUNTY

PINEDALE AREA

The Pinedale area covers about 5 square miles in the southwest corner of Union County (fig. 1) where the bauxitic and kaolinitic clays in the area are genetically related to those in the Pontotoc district to the south. The area is about 2½ miles long in a north-south direction and about 2 miles wide. The village of Pinedale is in the southeastern part of the area (pl. 1).

Low-grade bauxite and some white clay have been known in Union County near Pinedale at least since 1922, but the possibility that a large body of high-alumina and kaolinitic clay might be present was not realized for several years. Morse (1923, p. 138–153) reported white clay and clay resembling fuller's earth, and Burchard (1925, p. 121–124) reported clay and low-grade bauxite. About 1937 C. H. Simmons, in digging a well (SW¼ sec. 10, T. 8 S., R. 1 E.), found

about 15 feet of nonsandy white clay, which was shown to Alta Ray Gault, a teacher who had been trained in geology. She recognized this material as a kaolinlike clay and later made the information available to the writer during his study of the mineral resources of the county for a project of the Mississippi Geological Survey and the Works Progress Administration. O. D. Gray called the author's attention to previously unreported outcrops of white kaolinlike clay on his property (pl. 1, W½ sec. 4, T. 8 S., R. 1 E.). During 1938 and 1939 several dozen hand-auger holes were drilled in the Pinedale area, and tests showed some of the material to be bauxitic clay but most of it to be kaolin (Conant, 1942, p. 57–59; McCutcheon, 1942, p. 122–134, 144–147). Data were too few and outcrops too scattered to give an idea of the potential tonnage or of the limits of the clay body.

In March and April 1942, 42 power holes were drilled in the Pinedale area by Ainsworth Brothers of Wichita, Kans., under the supervision of Donald F. Reed, U.S. Bureau of Mines. The excellent cores recovered revealed unsuspected geologic conditions and made possible a much better understanding of the area. A few hand-auger holes were also put down in 1941 during the program. Plate 1 shows the locations of most of these hand-auger and power-drill holes and the probable extent and thickness of the kaolin bodies that contain a minimum of 30 percent alumina.

GEOLOGY AND DEPOSITS

Prior to drilling, the kaolin had been assumed to occur as a more or less regular layer between the Porters Creek Clay and the overlying sands of the Wilcox Formation, as in the Fowler area, but drilling revealed a most confusing yet interesting set of conditions. Without any apparent order, successive cores showed: (1) a thick section of high-grade kaolin grading downward into Porters Creek Clay, (2) massive kaolin and kaolin conglomerate interbedded with lignite, (3) neither kaolin nor lignite, and (4) bentonite at the expected kaolin level. The drilling information suggested that channeling was the cause of nearly all the irregularities.

The author believes that a channel extended from half a mile west of Pinedale northward for at least 1½ miles, and in places cut out the kaolin at the top of the Porters Creek. He further believes that this channel was filled with kaolin conglomerate, lignite, and massive kaolin, of the Fearn Springs Sand Member, as represented in figure 2. The apparent course of the main kaolin-filled channel is shown by subsurface contours on plate 2. A short distance east of the channel deposits, kaolin of the gradational type has been removed by present-day erosion. To the west, it has been removed and replaced by sand

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of the Wilcox Formation that occupies a deep valley cut into the residual kaolin and the kaolin-filled channel (fig. 2).

After deposition of the Porters Creek Clay and prior to deposition of the Fearn Springs Sand Member, as here interpreted, the main part of a channel of the type shown on figure 2 cut through the kaolin beds into the black Porters Creek Clay. The channel was subsequently filled with kaolin conglomerate, lignite, and massive kaolin of the lower part of the Fearn Springs. In most places, the bottom few feet of the channel filling, which rests directly on black Porters Creek Clay, is mainly a kaolin conglomerate which includes fragments of lignite. This material is overlain by a bed of purer lignite locally containing kaolin pebbles. In some places the basal conglomerate consists principally of fragmental lignite containing kaolin balls or stringers. The kaolin pebbles were probably derived from the residual kaolin at the top of the Porters Creek, and the lignite fragments were probably peat or charcoal that were washed in from nearby swamp or land areas. Relatively massive kaolin overlies the conglomerate and lignite and is commonly 10 to 20 feet thick. At the top, the massive kaolin of the channel sequence grades abruptly into silty and carbonaceous clay similar to that overlying the gradational sequence.

Where the top of the Porters Creek has not been eroded, the same downward succession is present as in the Fowler area, the kaolin grading into a sideritic and silty white clay and that clay into the white Porters Creek. The kaolin in some of the cores appears to grade upward into the overlying carbonaceous and lignitic silty clay that is assigned to the top of the Fearn Springs Sand Member of the Wilcox sequence. Whether this is a true gradation or an obscure unconformity that separates the residual kaolin from the overlying beds is uncertain.

Various modifications of the sequences already described were found. Hole 17 in the channel penetrated only 7 inches of kaolin conglomerate and about 20 feet of lignite. In a few cores that seem to have come from the sides of the channel, notably core 34, clean kaolin typical of the channel material lies on sideritic kaolin and white Porters Creek Clay.

Two holes, Nos. 36 and 16 (pl. 2), penetrated 5 to 7 feet, respectively, of green bentonite. Petrographic examination by C. S. Ross (unpub. data, June 3, 1942) showed the material from hole 16 to be unusually pure bentonite, and tests by P. G. Nutting (in Ross, unpub. data, 1943) showed that after acid treatment this bentonite ranks high as an oil-bleaching material. In hole 36, the bentonite is in the middle of a thick lignitic kaolin section, but in hole 16 it occupies the full thickness of this kaolin bed except for a few inches of lignitic

kaolin above and below, into which it grades abruptly. As other nearby holes, including one between holes 16 and 36, did not penetrate bentonite, its distribution is clearly erratic and local. The circumstances of the accumulation of the bentonite are not understood, but bentonite probably occupies a small channel which cuts the upper part of the kaolin-filled channel but does not cut as deep as the conglomeratic or pisolitic material at the base of the channel. Because the overburden at hole 36 is only 10 to 12 feet thick, hand-auger holes could be used to determine the extent and relations of the bentonite.

Irregular and deep erosion prior to the deposition of the later sediments of the Wilcox Formation is indicated both by outcrops and by the drill cores. Subsequent to the deposition of the lignitic and silty channel clays of the Fearn Springs Sand Member, streams again cut channels through the sediments and into the Porters Creek Clay. One of these is at the west edge of the Pinedale area where a deep and wide sand-filled channel cuts off any westward extension of the kaolin (pl. 2). To the east, along the crest of the ridge underlain by the kaolin, the altitude of the base of the sand of the Wilcox Formation ranges from 380 to 425 feet, but in the valley to the west the base of the sand is exposed at one place in the creek bed at an altitude of only 350 feet. The section in figure 2 portrays the eastern and upper part of the channel where it lies on the beveled surface of the kaolin and the silty clay of the Fearn Springs. As the sand-filled channel has an apparent north-south trend and a similar channel appears to cut off the west end of the Smoky Top bauxite deposit about 3 miles to the south in Pontotoc County (pl. 3), the sand-filled channel at Pinedale probably continues to that place and presumably includes subsidiary channels not revealed in outcrop and drill holes. West of the apparent center line of the channel, three power-drill holes (40, 41, 42, pl. 2) and a hand-auger hole reached the top of the Porters Creek Clay at altitudes between 345 and 385 feet; this evidence indicates an irregular contact between the Midway and the Wilcox in that area also.

Bauxitic clay containing between 40 and 49 percent alumina has been found in hand-auger holes D–187, D–98, and D–186 and in power-drill holes 6, 28, 30, and 35. The distribution and thickness of the deposits, as interpreted from available data, are shown in plate 2. Available chemical analyses of the cored intervals in holes 6, 28, 30, and 35 are taken from Reed (1952, p. 65–67). Except for hole 30, the parts of the cores which contain some gibbsite appear to represent reworked but relatively massive kaolin of the channel sequence, overlying the thick lignite bed as shown in figure 2. Most of the samples are nearly white but contain some lignite particles or streaks. Core from hole 30 seems to represent material from the top of the white Porters Creek

Clay, but it contains some lignite fragments and, therefore, may have been slightly reworked. Samples from hole 30 also contained pisolites having a concentric structure. This was the highest grade bauxitic material found in the Pinedale area. The other samples were all largely nonpisolitic.

Chemical analyses of core from power-drill holes

[Reed, 1952, p. 65–67]

Depth (feet)		Analyses (percent)				
From	To	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Ignition loss
			Hole 6			
38.4	42.6	45.5	27.9	0.4	2.1	21.4
			Hole 28			
32.4	37.4	33.1	44.9	0.7	1.5	18.0
37.4	43.0	38.5	43.1	1.6	2.3	14.5
43.0	43.7	6.2	12.5	50.8	.7	26.3
43.7	48.7	40.0	41.6	.8	2.3	15.1
48.7	53.7	38.2	43.2	.8	2.2	14.5
53.7	55.9	36.0	45.5	1.1	2.4	14.0
55.9	57.5	29.1	53.6	1.3	2.1	12.8
			Hole 30			
55.7	60.7	48.9	26.8	1.0	2.8	20.2
60.7	62.7	38.0	38.4	4.4	2.5	16.3
62.7	67.7	28.9	35.9	14.2	2.4	17.7
67.7	72.7	18.1	45.4	18.8	1.3	14.8
			Hole 35			
6.2	11.4	27.8	53.6	2.8	1.9	10.8
11.4	14.8	34.5	44.0	2.0	1.8	16.5
14.8	19.8	46.1	31.5	.6	2.2	19.8
19.8	22.2	36.3	25.8	.9	1.7	31.8
22.2	27.2	34.5	50.0	.9	1.5	13.2

Kaolin is much more abundant in the Pinedale area than bauxite, as can be seen on plate 2. Where bauxitic clay is present, it is underlain by a much greater thickness of kaolin. Neither the kaolin in the channel nor in the gradational sequence, however, is continuous: instead, the kaolin grades laterally into lower grade material or has been eroded so that it occurs as a series of small deposits. No essential difference in the quality of kaolin in the two types of sequences has been found, except for the presence of lignite in the channel type. The following chemical analyses of the kaolinitic interval from holes

14 and 15 of the gradational sequence and from holes 3 and 33 of the channel sequence are very similar, although samples from the gradational sequence generally have a slightly higher iron and titanium content than samples from the channel sequence.

Chemical analyses of cores from holes 3, 14, 15, and 33

[Reed, 1952, p. 65–66]

Depth (feet)		Analyses (percent)				
From	To	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Ignition loss
			Hole 3			
43.8	46.9	34.7	45.6	1.1	1.5	15.7
46.9	50.3	33.2	46.2	1.2	1.6	15.4
50.3	53.0	30.8	53.5	.9	1.4	12.4
			Hole 14			
62.0	67.0	38.1	39.6	1.6	2.0	16.5
67.0	72.0	36.6	43.8	1.3	2.0	14.6
72.0	75.5	21.5	44.7	15.1	1.7	13.2
			Hole 15			
60.3	65.4	32.8	49.5	1.5	2.0	12.8
65.4	67.6	35.0	49.4	.8	2.2	12.6
67.6	72.6	21.8	63.1	3.8	1.6	9.6
72.6	76.6	21.4	68.2	.7	1.2	8.0
			Hole 33			
26.0	31.0	34.9	48.1	0.6	2.0	13.8
31.0	35.7	34.5	49.4	.9	1.9	13.3
35.7	37.7	27.4	57.6	.8	1.7	11.4
37.7	41.9	30.0	42.6	.3	1.6	25.7
41.9	45.0	31.1	46.7	.5	1.7	18.7
45.0	48.7	30.7	49.8	.6	1.4	15.5

Analyses of samples from holes 18, 28, 34, and 35 (Reed, 1952, p. 65–67) show the kaolin in the channel to average about 37 percent alumina and less than 1 percent iron oxide. An important feature in mining the uppermost kaolin is that much of this kaolin is under less than 25 feet of overburden and there is ample space for dumps at lower altitudes.

West of the center of the sand-filled channel low-grade kaolin crops out in two places (pl. 1): one is near the center of sec. 5, T. 8 S., R. 1 E. on the J. V. Wallace property; and the other is on the T. D. Messer property near the section line in the NW¼NE¼ sec. 8, T. 8 S., R. 1 E. These outcrops seem to be isolated and of low-grade material of no

appreciable extent (Morse, 1923, p. 135, 139, 141–145, 147, 170). Two samples reported by Morse from a test pit near the Wallace outcrop average about 42 percent alumina for an 8-foot interval, but material in several other pits was either much lower grade or not kaolinitic or bauxitic. Three power-drill holes by the U.S. Bureau of Mines (holes 40, 41, 42, pls. 1 and 2) near the Wallace outcrops and test pits did not penetrate either kaolin or bauxite, other than possibly about 3 feet of impure kaolinitic clay. The bauxitic material on the Wallace property crops out at an altitude of about 390 feet and that on the Messer property half a mile to the south, represented chiefly by a little float, is at about 420 feet.

This bauxitic material is interpreted as representing small remnants of impure kaolin that escaped pre-Wilcox erosion. As the deep sand-filled Wilcox channel passes a little to the east of the outcrops, any extension of the bauxitic material would have to be to the west or southwest.

OTHER BAUXITE DEPOSITS

About 1½ miles south of the south end of the Pinedale area, a little float of low-grade bauxite has been reported on the Tom Hudson property (pl. 3, sec. 16, T. 8 S., R. 1 E.), but two test pits nearby failed to penetrate any of it (Morse, 1923, p. 151–152). One and two miles farther south and southwest are several outcrops of bauxite, including the largest known deposit in Mississippi—that on Smoky Top, Pontotoc County; in adjacent parts of Union County the Bureau of Mines put down exploratory core-drill holes 1, 2, and 3 (pl. 3, secs. 16 and 17, T. 8 S., R. 1 E.), which revealed no trace of kaolin or bauxite. The best remaining prospect of finding a large body of kaolin or bauxite below the surface in Mississippi seems, however, to be in the 1 or 2 square miles of southwestern Union County between the Pinedale kaolin in Union County and the Smoky Top bauxite outcrops in Pontotoc County (pl. 3).

A small deposit of bauxite also has been reported (Burchard, 1925, p. 121–122; Conant 1942, p. 44, 61) on the property of Mr. John H. Carnal (NW¼ sec. 9, T. 7 S., R. 1 E.) a few miles to north of the Pinedale area. The material is very impure, only 4 feet thick, and hardly an acre in extent.

PONTOTOC COUNTY

EXPLORATION

Pontotoc County contains the greatest number and most of the well-known bauxite deposits of Mississippi. Like nearly all the Mississippi bauxite, the deposits are of too low grade to be of commercial value, though in places a small amount of medium-grade bauxite is associated with the low-grade deposits.

Most of the deposits were discovered by J. W. Adams in 1921–22, and the more promising locations as well as some others have been reported in earlier works (Morse, 1923; Burchard, 1925). In 1941 Priddy (1943), supervised a mineral survey of the county by the Mississippi Geological Survey and Work Projects Administration and explored the bauxite and kaolin deposits further by drilling many hand-auger holes in and near the outcrops. The report on that survey gives some additional facts on the bauxite and kaolin and suggests additional large areas believed to be underlain by bauxite and kaolin; however, investigations of the U.S. Geological Survey and Bureau of Mines have not, for the most part, borne out these suggestions. Many other small showings of bauxite, including some that were prospected with test pits in 1922, have escaped mention in previous works. Plate 3 shows all the known bauxite and kaolin localities in the county. As bauxite boulders are used for house foundations and road metal, the localities from which they may be obtained are well known, and any significant outcrops probably have not escaped attention.

The Midway-Wilcox contact was mapped in the greater part of the county (fig. 8) by members of the U.S. Geological Survey in order to delimit areas that contain possible bauxite-kaolin deposits and to find additional outcrops of these materials. All known bauxite and kaolin localities were visited to observe their extent and geologic relationships. J. W. Adams helped appreciably in the early part of this work by taking the writer to many of the outcrops that were difficult to find or that had not been reported in the literature. Mapping of the contact led to the discovery of a few unreported outcrops of bauxite and kaolin, but none of them appears to be of significant size.

In 1942 the U.S. Bureau of Mines drilled numerous hand-auger holes in two parts of the county to get preliminary information on the extent and character of the deposits in anticipation of a core-drill program. Chemical analyses of many of the samples were made by the Bureau of Mines. Reed (1952) presented a brief summary of this work, maps showing the hole locations, and analyses of the samples. For about 3 months in late 1942 and early 1943 the services of a hand-auger crew from the Work Projects Administration were made available to the Geological Survey. These men drilled 40 holes aggregating about 960 feet. The sites were chosen to explore for bauxite and kaolin in promising areas and for geologic information.

In the summer of 1943, the Bureau of Mines drilled 95 core-drill holes in Pontotoc County and 3 in a nearby part of Union County. All hole locations are shown on plate 3. The sites were selected by members of the Geological Survey, who also sampled and logged the

cores. The samples were analyzed by the Bureau of Mines. In October 1943 a 40-ton carload of the high-iron, high-silica bauxite from West Smoky Top was shipped to the Bureau of Mines Electrotechnical Station at Norris, Tenn., for experiments on the extraction of alumina. The sample was obtained from a trench about 110 feet west of the Morse test pit J. R. Warren 3, which is close to Bureau of Mines core hole Po–96.

RESULTS OF DRILLING

The drilling program was designed to locate buried deposits of bauxite or kaolin or to find extensions of known deposits. Many of these holes were on hills and ridges which had bauxite outcrops on two or more sides or toward which elongated deposits appeared to trend. Other holes were drilled in areas where no bauxite or kaolin outcrops were known but where buried deposits might possibly exist. A few holes were drilled close to old test pits in order to get specimens for comparative analyses and to test for the continuity of the beds. Most holes were continued until Porters Creek Clay was penetrated, except where geologic conditions made drilling unusually difficult; even then, the holes were abandoned only if their depths obviously exceeded the depth of any probable bauxite deposit or if the bauxite was likely to occur at depths from which it could not be economically mined.

The only bauxitic or kaolinitic materials considered worthy of analysis were in holes close to bauxite outcrops. No bauxite or bauxitic clay were discovered in holes designed to test areas or to locate extensions of known bodies. On the basis of these results the absence of bauxite or high-grade kaolin deposits at depth in Pontotoc County cannot be safely deduced, especially as the holes were commonly 600 to 800 feet apart; but inasmuch as 95 holes drilled in the most promising areas failed to locate any new deposits, the likelihood of the existence of more deposits in Pontotoc County is not good.

Aside from the negative results just mentioned, the information obtained from this drilling has aided in interpretation of the stratigraphic sequence and of the geologic conditions that produced the kaolin and bauxite. As in the Pinedale area of Union County, some of the kaolin and bauxite seemed to be formed by weathering of the Porters Creek Clay during the Midway-Wilcox interval. Some of the kaolin was apparently deposited in channels, perhaps as clay balls, and locally altered to bauxite. Most investigators apparently had believed, as did the writer, that the bauxite deposits formed as a blanket that continued for some distance at a more or less uniform level. Discovery of the channels at Pinedale, Union County, how-

ever, led to serious doubt that the bauxite and kaolin form a blanket, and this doubt has since been confirmed by drilling.

DESCRIPTIONS OF DEPOSITS

Most of the bauxite outcrops are marked by loose boulders on or near the crests of hills, a fact suggesting that the presence of the resistant material is in part responsible for those hills. Adams (oral commun., 1942) long ago noted a tendency for some of the smaller deposits to be alined, and careful mapping and study of the results of previous work not only bore out this impression of alinement but also indicated that most of the bauxite bodies are distinctly elongated and markedly narrow.

The kaolinitic or bauxitic material of the outcrop commonly is highly ferruginous, yet several considerations suggest that much of the iron represents a surficial accumulation and that deposits under a cover of about 50 feet would contain less iron and enough alumina to yield bauxite of acceptable quality. Evidence of iron enrichment is seen in a pisolitic bauxite boulder (fig. 6) from near the surface. Suggestions of surficial iron enrichment were also made by Morse (1923, p. 99) and Burchard (1924, p. 442; 1925, p. 114). In places, the analyses show less iron in samples from the lower parts of the holes than is present in samples from the upper parts, but that condition is by no means general. Samples from test pits, hand-auger holes, and power-drill holes all indicate that the bauxite is generally much softer underground, even where only a few feet below the surface, and this condition seems to result, at least in part, from a lower iron content.

Many of the deep vertical-walled test pits in bauxite dug by Adams and the Morses in the 1920's had a pronounced iron staining on the walls by 1942. The iron stains may completely cover the bauxite, exhibiting a uniform dark-red color, or they may occur as vertical streaks of varying widths and lengths extending down from the surface. A fresh exposure in the pit walls shows the iron stain to be restricted to the surface of the walls and to be a millimeter or two in thickness. The appearance of the iron coating, particularly on a light-colored bauxite, indicates deposition from surficial water high in dissolved iron. The magnitude of the coating deposited in two decades implies considerable secondary enrichment of iron in favorable localities.

In Union County, many cores of the kaolin associated with the bauxite show that it is in part a kaolin-ball conglomerate: locally, the balls consist partly of gibbsite, possess a concentric structure, and may be termed pisolites. In Pontotoc County, similar structures in

FIGURE 6.—Bauxite boulder showing an enrichment of iron in the outer part.

many of the kaolin beds suggest that some of the bauxite deposits are altered kaolin conglomerates.

In many places, the highly ferruginous bauxite has been dug, crushed, and spread on nearby country roads as a substitute for gravel. In general, the material is too friable to make good gravel, though it does improve roads that otherwise are virtually impassable in wet weather. Such use of the bauxite has sometimes been decried as a waste of mineral resources, but most of the material thus used is so low grade that it might as well be put to any use for which it is suited. As foundation stones under farm dwellings, the bauxite is reported

to be much better than other available rocks (chiefly ferruginous claystones and siltstones) because it does not disintegrate from frost action.

As no complete list of the bauxite deposits of Pontotoc County has been published, an attempt is made herein to describe all such localities together with the known kaolin deposits. The localities are described from north to south. Where they have been known by various names, the best-known name, commonly that used in the report by Morse (1923), is given first. The locations of all the deposits and all drill holes are shown on plate 3. Additional larger scale maps show some individual deposits or groups of deposits.

MRS. O. D. GRAY PROPERTY

The Mrs. O. D. Gray property is in the NE¼ sec. 20, T. 8 S., R. 1 E. (pl. 3). A few bauxite boulders as much as 1 foot in diameter are scattered for about 50 feet along the west side of a small south-draining tributary. Neither bauxite nor bauxitic kaolin was found in the two test pits (Morse, 1923, p. 126) dug near here. J. W. Adams (oral commun., 1942) reported abundant float about 150 feet to the east, on the other side of the stream, but the only boulders found there during this investigation had been used for machine foundations. About 300 feet southwest of the first-mentioned outcrop is a small outcrop of soft bauxite or clay-ball conglomerate in a streambed.

MRS. C. J. BUSBY PROPERTY

The Mrs. C. J. Busby property is in the SW¼ sec. 21, T. 8 S., R. 1 E. (pl. 3). A ledge of ferruginous bauxite some 3 feet thick and 50 feet long is exposed about 400 feet southeast of the Busby house and 300 feet south of the east-west road, in the edge of the woods. About 400 feet farther southeast, across a low drainage, is another similar ledge which has been quarried on a small scale, apparently for road metal. To the southeast the land is lower, so a further extension in that direction is unlikely. Northwest of the first-mentioned ledge is a narrow area of impure bauxite float extending for about 400 feet past the back of the house, approximately in the direction of an outcrop of impure pisolitic kaolin in the road ditch some 600 feet west of the Busby house. The northwesterly trend of these outcrops and float is directly toward the Mrs. O. D. Gray bauxite area, two-thirds of a mile away. To test for a continuation of the ore body, three holes were drilled, all without encountering material worth sampling. On the land of Mr. M. T. Hearns on the south side of the public road and about 300 feet east of the Busby house, one hole (Po-8) commenced 17 feet higher than the outcrop but penetrated only 21 feet of impure clays, below which were the white and black Porters

Creek clays. Hole Po–7, midway between the road outcrops and the Gray bauxite, went through a succession similar to that in hole Po–8. The third hole (Po–3), a quarter of a mile northwest of the Gray outcrop and just north of the Union County line on the east side of a public road, penetrated only impure sand to a depth of 41 feet, where it entered Porters Creek Clay.

As all the drill holes failed to penetrate bauxite and as the topography is such that any extensive bauxite bed would crop out at several places, the Busby and Gray exposures are, concluded to be sporadic outcrops representing one or more kaolin channels that have no significant present extent.

SMOKY TOP DEPOSIT

The Smoky Top deposit (Mississippi Bauxite Co. property), which lies astride the line between secs. 20 and 29, T. 8 S., R. 1 E. (pl. 3), is the largest and best known bauxite deposit in Mississippi. Several of the analyses given in the report by Morse (1923) indicate chemical-grade bauxite, though the high-grade material seems to be present either as thin beds or as local variations within low-grade material. Except for minor interruptions, bauxite ledges and float extend for two-thirds of a mile in an east-west direction, mostly on the north edge of a rugged hill area known locally as Smoky Top (pl. 4). The possibility of an important extension to the south under the hill was inferred by Morse (1923, p. 103) and Priddy (1943, p. 51), and the 1943 drilling program aimed to test that possibility, though on the basis of the then-suspected channel condition the likelihood of such an extension seemed slight. Data from seven power-drill holes, combined with limited hand-auger data, indicate that much of this hilly area contains no important bauxite or clay deposits. Plate 4 shows the locations of all the known drill holes and test pits on Smoky Top. In accordance with the channel theory, a westward downdip extension of the body was tested, but the two holes drilled for that purpose (Po–5 and –6, pl. 3) seem to have penetrated a deep channel filled with Wilcox sediments. This channel is probably an extension of the sand-filled channel west of the Pinedale kaolin area, about 3 miles to the north.

The east end of this bauxite deposit is at the top of a small hill, referred to as East Smoky Top; it is separated from the main mass by a small valley and apparently held up by the bauxite. Ferruginous bauxite boulders are strewn abundantly on the west slope, which faces the public road. Four test pits that were dug on East Smoky Top during the Morse investigation reveal extreme variation in the material. Pits 1 and 6 (pl. 4), about 200 feet apart on the west and north sides, penetrated a thick ledge of hard ferruginous bauxite, but pits

5 and 7 penetrated chiefly soft bauxite. Pit 5 showed 10.7 feet of bauxite containing more than 50 percent alumina and about 2½ percent iron oxide. A hand-auger hole drilled on the south side of the hill during the present survey—about 11 feet below pit 5, 125 feet S. 65° W. of it, and just above a kaolin outcrop—penetrated 5 feet of nonsandy kaolin underlain by 9 feet of slightly ocherous silty clay that grades downward through 4½ feet of white Porters Creek into black Porters Creek Clay. Apparently, some chemical-grade bauxite lies in the central part of the hill, but closely spaced drilling would be necessary to determine its extent.

An unusual mineralogical feature of the high-iron bauxite from pit 6 was discovered during petrographic examination by C. S. Ross (unpub. data, 1943), who found well crystallized grains of chamosite, probably some of the best specimens of that material ever reported.

West Smoky Top, which contains most of the bauxite, is a rugged and heavily wooded area as much as 175 feet above its surroundings. The bauxite crops out only along the north edge of the area on the spur tops, steep slopes, and in the small stream valleys. Fourteen test pits have been dug, and a similar number of holes have been drilled in the West Smoky Top area at various times to obtain samples and to trace the deposit. The 40-ton sample previously mentioned (p. B34) was from the eastern part of this area. All the data indicate that the bauxite-kaolin body is a narrow east-west-trending deposit having a width of about 500 to 700 feet, and the bauxite is restricted to the north edge. Bauxitic material generally extends back from the north edge only about 200 to 300 feet.

As new data are now available and as the assumptions used in previous calculations are unknown, the tonnages of the various grades were re-estimated, though sufficient information is not available to permit exact estimates. Inasmuch as there is no appreciable southward extension from the outcrop and test-hole locations, present estimates are appreciably lower than the older ones, in which extensions to the south were assumed.

In making the present estimates, the following assumptions have been made: (1) Thicknesses penetrated are the maximum thicknesses of material having the indicated alumina content; and (2) average thickness of a grade, as represented in the cuttings from test holes, persists over the entire area assumed to be underlain by that material (in a more rigid treatment, the material would be assumed to thin to a feather edge, thereby cutting the estimates by more than half).

Plate 4 shows the areas that were used in these estimates, and the following table compares the totals of these estimates with those given by Morse.

Comparative tonnage estimates, Smoky Top deposits

[According to Morse (1923, p. 95–109), except present report total]

Area	Al_2O_3		
	40–49 percent	50–55 percent	55+ percent
West Smoky Top:			
J. R. Warren area	69,788	[1] 19,544	----------
O. Sneed-Lowe area	22,480	[2] 7,500	----------
O. Sneed-Gaines area	[3] 23,439	11,718	----------
Total	115,707	38,762	----------
East Smoky Top	23,400	29,700	12,150
Total East and West Smoky Top	139,107	68,462	12,150
Present report total	82,000	41,000	5,000

[1] A little of this may exceed 55 percent.
[2] Includes half of "45-percent" material of Morse; other half in 40–49-percent group.
[3] Includes material listed as 38 percent.

At the J. R. Warren pit 3, on the east end of West Smoky Top, some discrepancies between analyses suggest that the older ones by Morse (1923) were too high. In 1943 the U.S. Bureau of Mines hole Po–96, about 6 feet from the pit, yielded cores which, though imperfect, gave analyses much lower in alumina than the analyses by Morse. If these newer figures are representative, most of the bauxite in that area is too low grade to be shown in the tonnage estimates. The large discrepancy between analyses may be due to an actual difference in content in the deposit over a distance of 6 feet, or it may be due to differences in sampling and analytical techniques. The following table compares the two sets of analyses from the area of the Warren pit 3.

Comparative analyses of samples from and near J. R. Warren test pit 3, West Smoky Top

[Samples 29, 30, and 31 from Warren test pit 3 (Morse, 1923, p. 100), recalculated to moisture-free basis and a total of 100 percent. Samples Po–38 and Po–39 from U.S. Bur. Mines core hole Po–96 (Coulter, 1948, p. 7), depths adjusted to levels in the test pit]

Sample	Depth (feet)		Analyses (percent)				
	From	To	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Ignition loss
29	1	8	41.3	6.9	30.5	1.8	19.5
30	8	10.5	51.0	22.0	1.7	2.8	22.5
Po–38	2	11.5	30.9	8.4	40.5	1.8	17.3
31	12	15	55.2	15.7	.0	3.0	26.1
Po–39	14	17	44.4	30.1	3.4	2.7	19.4

About half a mile southwest of the westernmost exposure of the bauxite, a little kaolin is exposed in a creek bed (pl. 3, NE¼ sec. 30, T. 8 S., R. 1 E.), but nearby power-drill hole Po–13, just to the west, penetrated only 13 feet of an impure sideritic clay resting on Porters Creek Clay. East of the outcrop, the rugged Smoky Top hills deeply cover any possible extension of the clay in that direction; to the north a deep valley rules out any extension in that direction; and only to the south and southwest, under lower hills, are there any kaolin deposits of possible economic value. This kaolin is possibly connected with the Waldrop kaolin body a mile to the southeast, but even if it is, most of the overburden in the intervening region is so thick that mining of the clay is not economically feasible.

WALDROP DEPOSIT

A small kaolin body, in places slightly bauxitic, was discovered on the J. E. and J. W. Waldrop properties along the line between secs. 29 and 32, T. 8 S., R. 1 E. (pl. 3 and fig. 7). The kaolin is exposed in a creek ditch at or near the section line about 800 feet east of the public road and was found by D. F. Reed of the U.S. Bureau of Mines in December 1941 during some preliminary investigations of Mississippi kaolin. The upper 5 or 6 feet of the exposure is a crossbedded kaolin-ball conglomerate having a sandy matrix and overlies a lignite bed about 6 inches to a foot thick, which lies on massive kaolin. For several hundred feet downstream, the kaolin and underlying beds are exposed. In places, the massive kaolin has a slightly pisolitic or clay-ball appearance and is commonly somewhat contaminated by silt. The kaolin grades downward into weathered sideritic clay, and this clay grades through white Porters Creek into black Porters Creek Clay.

The U.S. Bureau of Mines drilled 26 hand-auger holes (Reed, 1952, p. 9–10, 67–75) in an attempt to trace the kaolin or find the source of the kaolin balls (fig. 7). Four of these holes, within a few hundred feet north or south of the ditch, penetrated 3.5 to 12 feet of kaolin containing 35 to 40 percent alumina, and samples from two of the holes contained more alumina than silica. Later, the Bureau of Mines drilled five core holes in the area (Coulter, 1948, p. 6–7, pl. 1). One of these holes (Po–94), close to the ditch outcrop, penetrated 18.5 feet of kaolin, interrupted by 2.5 feet of lignite. Two others went through 4 and 5 feet of kaolin having between 35 and 39 percent alumina. Samples representing a thickness of 3 to 5 feet in each of these holes contained some gibbsite, for the alumina content ranged from 4 to 10 percent higher than the silica content. In early 1943, the Geological Survey with the aid of labor furnished by the Work Projects Ad-

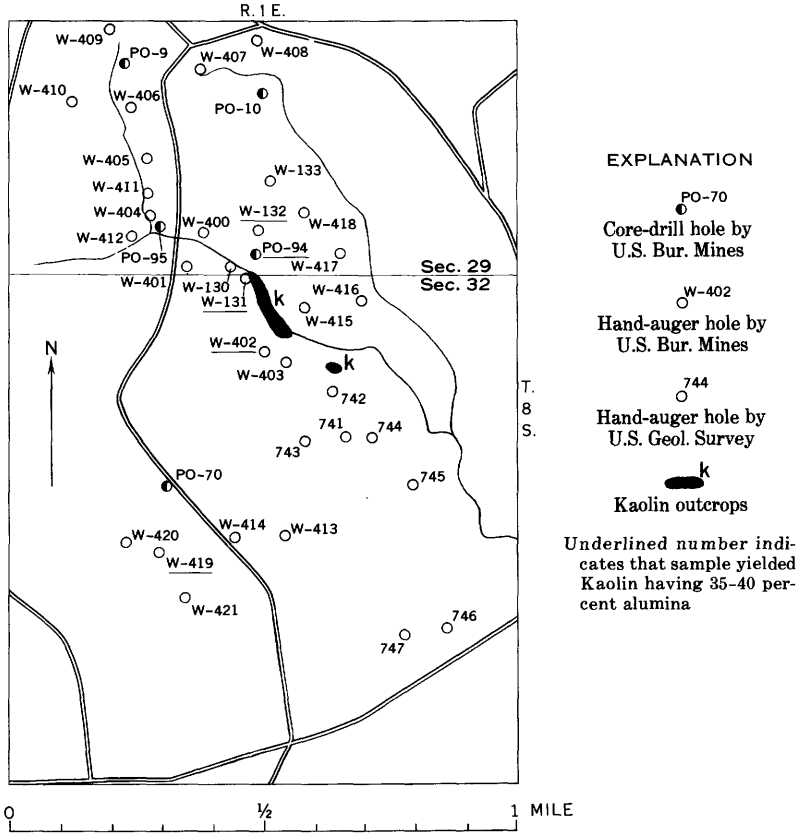


FIGURE 7.—Locations of drill holes, Waldrop deposit, Pontotoc County, Miss.

ministration drilled several hand-auger holes for nearly a mile south of the ditch outcrop (fig. 7) in an area of moderately thick overburden, but no good kaolin was found. Locations of all these holes are shown on figure 7, and analyses of the samples are given in the following table.

On the basis of these scanty data the Waldrop deposit does not seem large, though the Smoky Top deposit only a mile to the north and the small L. S. Russell (Montgomery) deposit nearly a mile to the southeast suggest that an appreciable body of kaolin might lie between them. Parts of the same kaolin body are probably represented by two small outcrops of impure kaolin about a quarter and a half mile south of the Waldrop ditch outcrop, but the clay is of no apparent economic value.

Analyses of Bureau of Mines samples from drill holes in the Waldrop deposit, Pontotoc County, Miss.

[Analyses of hand-auger samples (W-series) from Reed (1952, p. 74–75), and of core samples (Po-series) from Coulter (1948, p. 7)]

Hole	Depth (feet)	Al_2O_3	Insoluble	Fe_2O_3	TiO_2	Ignition loss
W-131	6.0–12.0	35.4	58.0	2.1	--------	--------
	12.0–16.0	35.6	52.0	2.0	--------	--------
	16.0–18.2	37.5	32.6	.8	--------	--------
W-132	18.5–25.5	36.8	43.4	5.2	--------	--------
W-402	5.0–9.0	39.6	37.4	3.1	2.4	16.1
W-419	18.6–22.0	39.1	43.4	1.5	2.8	14.1
Po-70	24.0–29.0	36.6	30.2	11.6	2.8	19.2
Po-94	11.0–18.0	35.1	47.8	2.8	1.4	13.1
	18.0–21.5	37.9	33.7	10.3	1.8	16.8
	24.0–32.0	38.8	43.5	.9	2.7	14.1
Po-95	23.0–27.0	39.4	29.9	9.6	2.8	19.6

T. A. MONTGOMERY PROPERTY

The T. A. Montgomery property is in the SW¼ sec. 27, T. 8 S., R. 1 E. (pl. 3). It is not the property of the same name described in the report by Morse (1923, p. 127–130) but is an unimportant and previously unreported locality 1½ miles southeast of the Smoky Top deposits. A little float of high-iron bauxite is scattered over an acre or less on top of a dissected area 300 yards north of the public road, on the east edge of the tract, at the top of the south valley wall of Keil Creek. About 100 yards west of the bauxite float locality, impure kaolin is exposed in a streambed and is poorly exposed on a hill slope 150 yards beyond. Fourteen feet above the last-mentioned outcrop an auger hole at a depth of 10 feet penetrated a 4-foot bed of slightly silty kaolin apparently containing some kaolin balls. This bed is underlain by 2 feet of ocherous silty kaolin which rests on interbedded blue-gray clay and sand of undetermined thickness. Had the hole been continued a few more feet, it probably would have reached Porters Creek Clay. Though this area is commonly cut by small streams, few outcrops of kaolin or bauxite are found, and therefore the area probably contains neither bauxite nor kaolin deposits of any appreciable extent.

L. S. RUSSELL PROPERTY

The L. S. Russell property (formerly T. A. Montgomery property, in part) is in the NW¼ sec. 33, T. 8 S., R. 1 E. (pl. 3). This property also contains a small outcrop of high-iron bauxite, now used locally as a low-grade road gravel. Morse's (1923, p. 127–129) test pit 3 penetrated 3.5 feet of the rock, and Priddy's test hole N82 (1943, p. 51, 66), which started at the base of the quarried bauxite ledge, penetrated 26 feet of high-iron silty clay. The U.S. Bureau of Mines

and Geological Survey did not test the area, but in the absence of additional outcrops and in view of the earlier test-hole showings, the author concludes that the bauxite is of no economic value as a source of alumina.

E. D. GRAHAM PROPERTY

The E. D. Graham property (formerly T. A. Montgomery property, in part) is in the SW¼ sec. 33, T. 8 S., R. 1 E. (pl. 3). Thinly scattered float of high-iron bauxite, about 400 yards southeast of the previously described Russell outcrop, has not been mentioned in reports heretofore published, though, according to local accounts the Montgomery pits 1 and 2 of Morse (1923, p. 127, 129) were near this place. Topographic considerations and the absence of good-quality material in the test pits indicate that this deposit is of no economic importance. This deposit may well have been once a part of the Russell deposit, these deposits having been separated from each other by present-day erosion. About a quarter of a mile farther southeast, a small area of float of very low grade sideritic nodular kaolin further suggests that formerly a northwest-southeast clay body existed, which may have been part of a larger body, as discussed in the description of the Mrs. N. S. Short bauxite deposit.

MRS. N. S. SHORT PROPERTY

The Mrs. N. S. Short property is in the SE¼ sec. 32, T. 8 S., R. 1 E. (pl. 3). Numerous boulders and a thin ledge of bauxite are present on half an acre or less, about 100 feet west of the section line, near the crest of a low ridge. One test pit (Morse, 1923, p. 131) exposed about 2 to 3 feet of ferruginous pisolitic material, underlain by 9 feet of yellow and somewhat pisolitic clay that was not analyzed. About 300 feet to the northwest, 10 to 15 feet of kaolin is exposed in an abandoned road just south of the present road, and 100 feet northwest of the road outcrop, impure kaolin is exposed in a streambed. About 450 feet southeast of the test pit, along the crest of the ridge in sec. 33, is a scraped area where clayey limonitic concretionary masses have been gathered for low-grade road gravel. Beneath this "gravel," fairly clean kaolin is exposed. There is no evidence of a westward extension of this bauxite or kaolin. As the trend of these four outcrops so nearly parallels the northwest-southeast row of outcrops a quarter of a mile to the northeast just across the valley, on the Russell and Graham properties, all these outcrops on both sides of the valley may well be edge remnants of a once large kaolin bed that extended northwest to the Waldrop locality, three-quarters of a mile away. If so, the main mass of kaolin and any associated bauxite have been removed by the creek that now flows between the parallel rows of outcrops. The broad valley of Duncan Creek to the south

rules out any possible continuation of this mass in that direction. A 50-foot section exposed along an abandoned and washed-out road on the east side of the valley suggests that the kaolin is associated with some 50 feet of fine sand and silty clay.

H. R. BEVILL PROPERTY

An unusual outcrop of kaolin is exposed in a small gully about 50 feet east of a wooded road and 500 feet north of the section line on the H. R. Bevill property (pl. 3, SE¼ sec. 3, T. 9 S., R. 1 E.). Several feet of white pisolitic or kaolin-ball clay is exposed in the gully and is underlain by fine sand; the surface is locally strewn with white pisolites. A hand-auger hole at the head of the gully penetrated 9½ feet of massive clean kaolin underlain by 7 feet of fine sand. Another hole about 85 feet to the north went through 2 feet of kaolin at a depth of 11 feet. A third hole, 135 feet to the southwest, penetrated 4 feet of kaolin at a depth of 32 feet. Unlike the other holes, the last one showed the kaolin lying abruptly on the Porters Creek Clay. No kaolin was found in three other auger holes within 175 feet north, west, and southeast of the first hole. Clearly, no large deposit of kaolin is present here, but some kind of channel sequence appears to be represented, and kaolin beds or pockets are present at several places.

THAXTON AREA

A ridge underlain by sediments of the Wilcox Formation extends eastward to the village of Thaxton (pl. 3) and interrupts a north-south sequence of bauxite and kaolin exposures that extends for about 12 miles south from Smoky Top. As it seemed likely that relatively iron-free deposits of bauxite or kaolin might be concealed beneath this ridge, 12 power-drill holes were put down in search of such deposits, but none were found. A long and narrow deposit of the channel type, like the one at Pinedale in Union County, has possibly escaped detection, but a broad deposit of the gradational type, like the Fowler deposit in Benton County, is not likely present in the area tested.

WORTHINGTON DEPOSIT

A small deposit of bauxitic material was first mentioned by Burchard (1925, p. 130) as occurring on a property owned by Jesse Russell, and later the deposit was noted by Priddy (1943, p. 53, 85), at which time the property was owned by Mrs. R. S. Worthington (pl. 3, NW¼ sec. 22, T. 9 S., R. 1 E.). Priddy sampled the rock, which was analyzed by B. F. Mandlebaum in a report by McCutcheon (1943, p. 117) as having the following composition: 44.05 percent SiO_2, 35.65 percent Al_2O_3, 3.96 percent Fe_2O_3, 1.35 percent TiO_2, 0.89 percent MgO, 0.18 percent MnO_2, 0.57 percent K_2O and Na_2O, 12.81 percent

ignition loss. In spite of its strikingly bauxitic appearance, the alumina content is reportedly only about 35 percent and is less than the silica content. The iron oxide content of about 4 percent is unusually low for the Mississippi bauxitic material.

The well-formed pisolites are embedded in a matrix that resembles chalcedony in appearance but is much softer. C. S. Ross (written commun., 1943) found by petrographic examination that the matrix is the clay mineral halloysite. The deposit probably was originally a kaolin-ball conglomerate in which the pebbles have been partially altered to gibbsite and the matrix has in some manner been altered to halloysite.

Priddy (1943, p. 85) found the bauxitic material to be underlain by about 22 feet of silt and fine sand that in turn is underlain by greenish-black micaceous clayey silt of the Porters Creek Clay. Similar thicknesses of silt and sand were found in six power-drill holes dug by the U.S. Bureau of Mines (pl. 3) in the immediate vicinity of the outcrop, but there was no underground extension of the pisolitic rock. The silt sand beds are probably part of the Porters Creek Clay. Thinly scattered float of the pisolitic material lies on the ridges for about 300 feet to the south and suggests that the deposit may originally have been connected with the small showing on the Gooch property.

The highest grade material penetrated during the joint Federal drilling program was in holes Po–87 and Po–93 at the edges of the deposit. Samples from hole Po–87 contained slightly more alumina than silica, a fact that indicates the presence of some gibbsite. Chemical analyses (Coulter, 1948, p. 8) are as follows:

Hole	Depth (feet)		Analyses (percent)				
	From	To	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Ignition loss
Po–87	5	10	41.4	38.4	4.1	1.8	14.8
Po–93	0	2	36.1	47.1	2.4	1.7	13.6
	2	75	30.0	54.8	3.2	1.4	11.3

The bauxite has been blasted and crushed for local use as road gravel, and for this purpose it is superior to the commonly used high-iron bauxite.

SHIRLEY GOOCH PROPERTY

Morse (1923, p. 126–127) mentioned boulders of hard red pisolitic bauxite near the top of the hill on the Shirley Gooch property (formerly J. L. Luther property) in the SW¼ sec. 22, T. 9 S., R. 1 E. (pl. 3). No bauxite is present in two nearby test pits, but two

bauxitic clay layers 2.5 and 3.2 feet thick are exposed interbedded with sand in Morse's pit 1 on the hill just above the boulders. The deposit appears to be closely related to the Worthington deposit just across the valley to the north.

BARNEY POYNER AND B. F. ANDERSON PROPERTIES

The Barney Poyner and B. F. Anderson properties (formerly all B. F. Anderson) in the NW¼ and SE¼, respectively, sec. 27, T. 9 S., R. 1 E. (pl. 3) were examined by Morse (1923, p. 131–133) and found to be of no commercial importance.[2] A small outcrop of ferruginous kaolin-ball conglomerate is exposed near the base of the northwest end of a low ridge on the Poyner property, but the nearby Morse test pit 3 revealed only 1.3 feet of high-iron bauxite, not analyzed, underlain by 1.3 feet of material that analyzed about 32 percent alumina (recalculated to moisture-free basis). At the Anderson locality high-iron float is sparsely scattered at two places about 500 feet east of the public road. Morse test pits 1 and 2 at these two places revealed only 3 to 4 feet of "bauxitic" material of no economic value. Because the region is well dissected, any extensive bauxite deposit would probably be exposed. In the absence of outcrops other than those mentioned, appreciable deposits are not likely to be present in this vicinity.

INMON-TALLANT DEPOSIT

A deposit on the former Inmon and Tallant farms, in 1942 the property of the Mississippi Bauxite Co. (pl. 3, sec. 34, T. 9 S., R. 1 E.), is probably the most attractive bauxite prospect in Mississippi from the standpoint of quality, size, and accessibility. Analyses (Morse, 1923, p. 116–122) show the bauxite to have relatively low iron content, ranging from about 2.3 to about 6 percent, alumina content from 47 to 53 percent, and silica content from 16 to 21 percent (recalculated to moisture-free basis).

The bauxite crops out on the northwest-facing slope of a hill (fig. 8) for a distance of about 500 feet. Data from test pits, holes drilled by Morse, and holes drilled during the joint Federal project indicated that the deposit has a total length of about 900 feet and a width ranging from 100 to 400 feet. The underlying kaolin body seems to have somewhat greater dimensions. The overburden on the bauxite generally is only about 10 to 15 feet thick, the maximum being 30 feet. Test-hole data and distribution of outcrops indicate that the bauxite-

[2] The report by Morse (1923) erroneously places the outcrops and three test pits in sec. 11, T. 10 S., R. 1 E., about 3 miles to the south. The error apparently resulted from the fact that B. F. Anderson owned property at both locations. The section 11 location contains no bauxite or kaolin, and no test pits were dug there.

kaolin body was originally long and narrow, trending southwest. Present topographic features cut it off at both ends, but directly in line with its southwest trend, some 1,500 feet away, is the Hilgard discovery deposit (pl. 3).

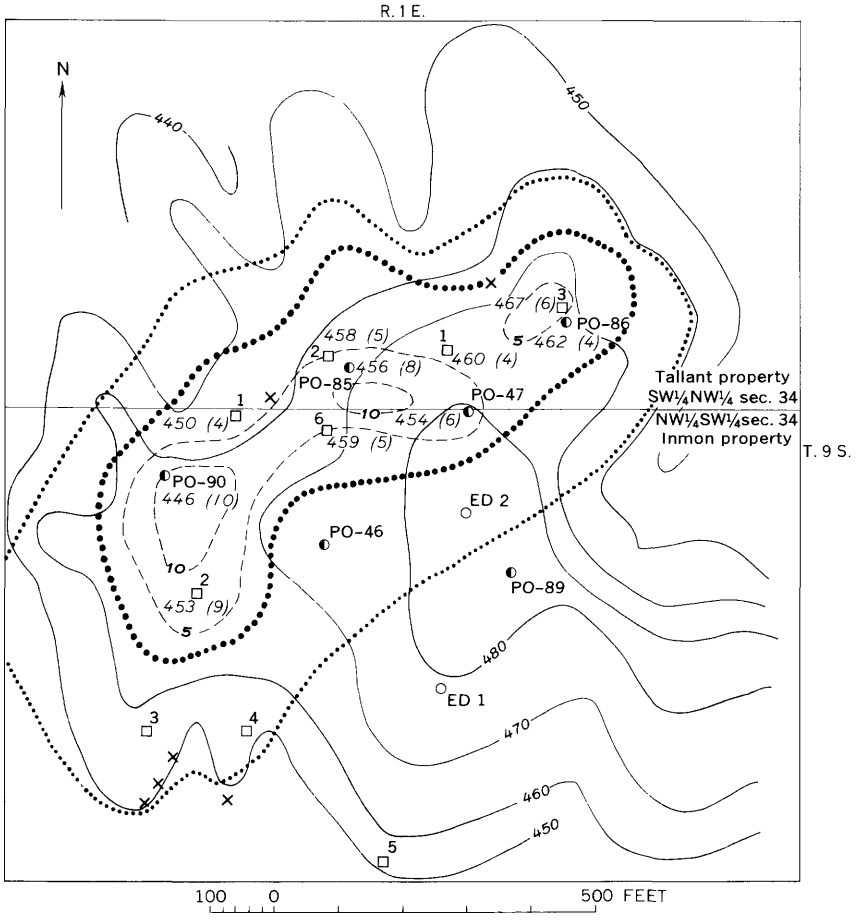
As shown on figure 8, a bauxite body, apparently continuous for about 900 feet and underlain by kaolin, was delimited by drill holes and test pits. Two holes—Po–46 and E.D. 2, both beyond the limits of the bauxite—penetrated only kaolin. Two U.S. Bureau of Mines holes (Po–85 and Po–86) were drilled within a few yards of the Morse test pits 2 and 3 on the Tallant farm and penetrated bauxite of similar thickness and appearance; this fact indicates that the deposit is reasonably uniform in thickness and composition over those short distances. Hole Po–90 verifies a westerly extension of the bauxite. The following table shows the thicknesses and chemical analyses of the bauxite in this deposit. Morse estimated that the deposit contained 81,317 tons of bauxite containing from 47 to 51 percent alumina, but in his calculation he apparently assumed an extension to the southeast under the hill, an assumption known from later drilling to be unwarranted. No attempt was made to re-estimate the reserves of this deposit.

Analyses of bauxite and kaolin samples, Inmon-Tallant deposit

[Prefix Po indicates U.S. Bur. Mines drill holes and analyses (Coulter, 1948, p. 8). Prefixes T and I indicate test pits and samples on the Tallant and Inmon farms, respectively; analyses taken from Morse (1923, p. 121) but recalculated to a moisture-free basis]

Hole	Elevation	Depth	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Ignition loss
Po–86	474	12–16	45.6	26.8	4.7	3.3	20.6
T 3	474	7.6–12.4	51.0	16.1	4.0	3.5	24.4
T 1	475	15.4–19.2	49.0	19.6	2.8	3.2	25.0
Po–47	480	21–27	35.5	47.8	2.1	1.8	13.9
		28–32	47.0	26.7	2.4	3.1	21.2
		32–37	40.3	38.4	2.5	3.1	15.9
Po–85 [1]	466	10–16	47.5	20.6	7.1	2.9	21.7
		16–18	42.0	35.5	3.4	3.1	16.1
		20–22	35.8	42.2	5.9	2.3	14.3
T 2	464	6–10	48.6	20.6	5.3	3.0	22.5
I 6	465	6.2–7.4	41.3	26.6	3.8	2.5	17.7
		7.4–9.0	53.0	16.2	3.9	2.5	23.6
		9.0–10.4	53.2	15.7	4.6	2.5	24.0
I 1	457	7.1–12.1	47.5	21.2	6.0	3.0	22.6
Po–90	461	15–19	40.6	33.2	5.9	2.7	17.6
		19–25	41.4	34.0	5.7	2.6	16.6
Po–46	470	19–27	37.2	38.6	8.1	1.8	14.8
		27–36	36.2	39.4	7.5	2.4	15.4
I 2	466	19.0–22.4	52.0	18.9	2.4	2.9	24.1

[1] Po–85 replaced nearby Po–62 which was lost.



EXPLANATION

Inferred limits of subsurface bauxite deposit

Inferred limits of subsurface kaolin deposit

Isopach lines on bauxite
Contour interval 5 feet

Bauxite outcrop or float

462 (4)
Altitude of bauxite if present in test pits or drill holes
Thickness in parentheses

460
Topographic contour
From Morse (1923, p. 149) but with datum reduced by 40 feet

PO-47
Drill hole by U.S. Bur. Mines

ED 2
Empire drill hole by Morse

4
Test pit by Morse

FIGURE 8.—Inmon-Tallant deposit, Pontotoc County, Miss.

An unusual geologic feature of the deposit is the presence of a thick bed of fine light-colored sand between the kaolin and the black Porters Creek Clay. Drill hole Po–86, at the northeast end of the deposit, penetrated about 55 feet of the sand beneath bauxite and kaolin, and hole Po–89, about 400 feet to the south, penetrated 48 feet. Drill holes to the west show the sand to become successively thinner and to be absent at hole Po–90, near the west limit of the bauxite deposit. This sand is probably a depositional unit of the Porters Creek Clay.

HILGARD DISCOVERY DEPOSIT

About 1,500 feet southwest of the Inmon-Tallant deposit and in line with it is the bauxite discovered by Hilgard in 1859 (1860, p. 14). The main outcrop is at the crest of a small knoll just north of the highway in sec. 33, T. 9 S., R. 1 E. (pl. 3 and fig. 9), but considerable bauxite float can be seen along an abandoned part of the road, just north of the present one. The white Porters Creek Clay, overlain by about 20 feet of fine light-colored sand below the bauxite, crops out in a washed-out ditch just north of the abandoned road and extends to a few hundred feet west of the bauxite.

This bauxite outcrop has not been mentioned heretofore in any publication on Mississippi geology except that by Hilgard. No known analyses have been made of the bauxite, which appears to be low in grade, and the quantity present must be very small, perhaps less than 1,000 tons. The deposit is primarily of historical interest as the Hilgard discovery locality. Apparently, the deposit was once connected with the larger Inmon-Tallant deposit, from which it is now separated by a valley.

A few hundred feet to the east a little pisolitic clay crops out on both sides of the old highway, and Priddy's auger hole N199 (Priddy, 1943, p. 52, 71; McCutcheon, 1943, p. 96, 115) went through 10.5 feet of kaolinitic, slightly gibbsitic clay. A thickness of 4.4 feet of this clay was found to have an alumina content of 40.7 percent. Originally, this deposit was also probably connected with the Inmon-Tallant and Hilgard discovery bodies, but now it is too small to be of economic importance. Below 19.5 feet of kaolinitic and bauxitic clay, auger hole N199 penetrated 23 feet of white and light-yellow fine micaceous sand that is underlain by Porters Creek Clay. The writer believes that this sand unit is the same one present at the Inmon-Tallant locality and that it is part of the Porters Creek. Kaolin 6 feet thick, cored in a nearby hole, Po–61, was analyzed as follows (Coulter, 1948, p. 8):

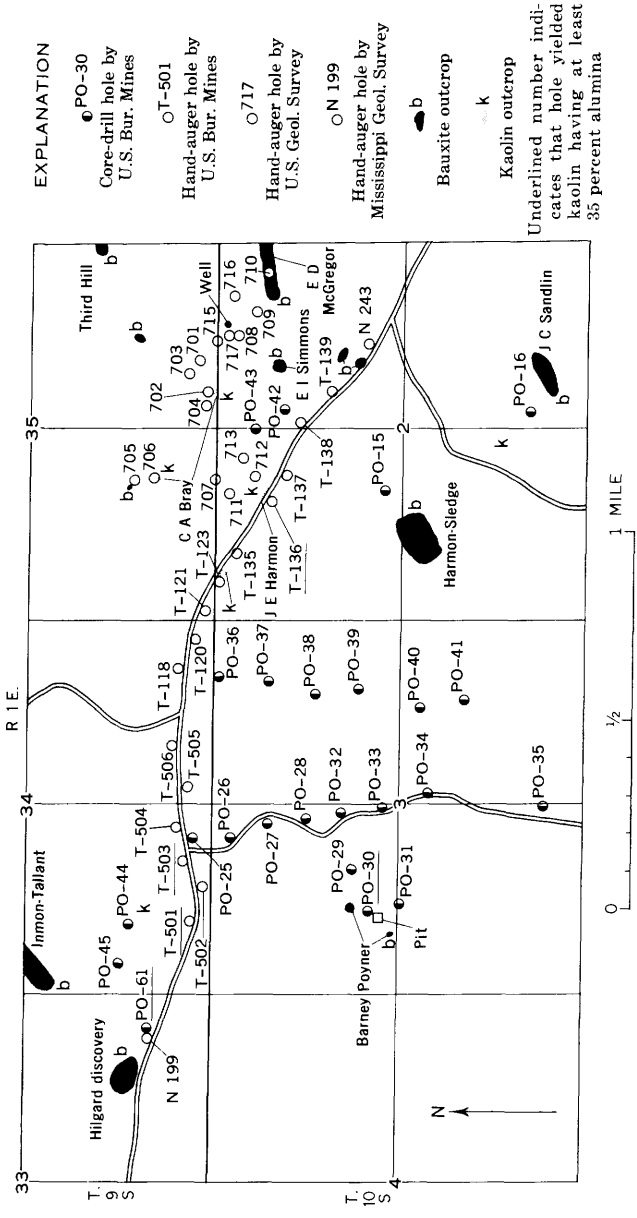


FIGURE 9.—Locations of drill holes in the area east of Toccopola, Pontotoc County, Miss.

Depth (feet)	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Ignition loss
18.0–20.0	35.8	35.9	11.5	2.2	15.4
20.0–24.0	40.6	39.6	2.3	3.0	15.4

McDANIEL PROPERTY

About two-thirds of a mile west of the Hilgard discovery deposit, a small amount of bauxite float was found at the south edge of a small valley on the McDaniel property (pl. 3, sec. 33, T. 9 S., R. 1 E.). Partly on the basis of this float, the U.S. Bureau of Mines drilled holes Po–17 to Po–23 (pl. 3) at intervals of 600 feet along the north-south ridge just west of here, but neither bauxite nor kaolin was found in any of them. The few float boulders appear to be the remnants of an originally very small deposit.

MRS. PEARLIE McGREGOR PROPERTY

"Bauxite" float is found in the woods and fields in three small patches close to a saw mill site on the Mrs. Pearlie McGregor property (pl. 3, NW¼ sec. 35, T. 9 S., R. 1 E.). The boulders, as much as a foot in diameter, are high in iron and quartz. As the boulder patches are approximately alined and the boulders seem to rest on Porters Creek Clay, they probably represent the last remnants of a small north-south trending bauxite deposit. As most of the nearby land is below the Midway-Wilcox contact, there is no likelihood of larger deposits being found here.

About a third of a mile to the west are two very small areas of less than an acre in extent at the foot of the west-facing valley wall of Cane Creek, where pea-sized float of light-colored pisolitic material is scattered just above the level of the Porters Creek Clay. The areas are so limited and the pieces of float so small that these probably represent only sporadic accumulations of a kaolin conglomerate.

BIG HILL DEPOSIT

Big Hill, a topographic high consisting of a resistant capping of hard bauxite, is the easternmost outlier of bauxite in Pontotoc County (pl. 3, sec. 36, T. 9 S., R. 1 E.). It was the former H. B. Owen property, and in 1942 was owned by the Mississippi Bauxite Co. The only test pit in the deposit penetrated 10.5 feet of bauxite averaging about 48 percent alumina, 9 percent iron oxide, and 16 percent silica (Morse, 1923, p. 109–111). Priddy (1943, p. 73) put down a hand-auger hole in the bottom of the pit to sample the underlying clays. About 13.5 feet of slightly pisolitic clay was penetrated and contained (McCutcheon, 1943, p. 115) about 38 percent alumina, 7 percent iron

oxide, and 37 percent silica. Analyses by the Reynolds Metals Co. of outcrop and float samples collected about 1941 near the old pit showed from 54 to 59 percent alumina and from 4.5 to 7 percent iron oxide (W. G. Waldo, unpub. data). Morse estimated a reserve of 24,233 tons of bauxite containing 46 to 53 percent alumina, and these estimates seem reasonable.

The log of the auger hole drilled by Priddy (1943, p. 73, test-hole N210) is interpreted as showing the bauxite to be underlain by 13.5 feet of kaolin-ball conglomerate which includes some lignite fragments and siderite concretions. The Big Hill deposit thus seems to be a remnant of a channel deposit much like that at Pinedale in Union County. The channel probably continued to the southwest and originally included the deposits commonly known as Second Hill and Third Hill (pl. 3); thus it had an original length of at least two-thirds of a mile.

SECOND HILL DEPOSIT

As pointed out by Morse (1923, p. 111–113), Second Hill (pl. 3, sec. 36, T. 9 S., R. 1 E.), about a quarter of a mile southwest of Big Hill, is just low enough that the original capping of bauxite has been largely removed. The hill is now covered by scattered float of pisolitic bauxite, which is apparently a remnant of a channel that once extended from Big Hill to Third Hill. Examination of the pits dug by Morse shows that white Porters Creek Clay is exposed at the top of some of them, a fact that bears out Morse's suggestion that only residual bauxite float is present.

THIRD HILL DEPOSIT

Third Hill (pl. 3) is about a third of a mile southwest of Second Hill and contains considerable low-grade high-iron bauxite. It extends from the SW¼ sec. 36, T. 9 S., R. 1 E., just across the line into sec. 35, including the former J. Wiley Moor property. On the basis of a deposit 6 feet thick, Morse (1923, p. 113–116) estimated a reserve for the entire deposit of 70,800 tons of bauxite containing 30 to 40 percent alumina. In the light of later studies this figure seems to be somewhat high. Priddy (1943, p. 52, 74) put down hand-auger hole N216, which went through 20 feet of kaolinitic clay below the bauxite; analyses of his samples (McCutcheon, 1943, p. 116, sample 216) show that the upper 14 feet contains about 35 percent alumina, 36 percent silica, and 13 percent iron oxide and that the lower 6 feet contains about 28 percent alumina, 55 percent silica, and 7 percent iron oxide. About a quarter of a mile to the southwest, a little scattered float of high-iron bauxitic clay suggests that the deposit once extended at least that far (pl. 3).

J. J. GREGORY PROPERTY

The J. J. Gregory property (pl. 3, SW¼ sec. 36, T. 9 S., R. 1 E.) in 1942 also included the former J. Wiley Moor property near the NW. cor. NE¼NE¼ sec. 2, T. 10 S. Scattered float of small pieces of very impure bauxite and exposures of impure kaolin are widely scattered over the property in sec. 36, but as these pieces are present only on the hilltops, one may conclude that they represent only remnants of a former deposit. Near the southeast corner of this piece of land, an unreported test pit was discovered at the crest of a small rise in the midst of bauxite float, but apparently neither bauxite nor kaolin was found.

The former John Wiley Moor homesite in sec. 2 is another property owned by Mr. Gregory and is a small tract about 1,000 feet northwest of the E. D. McGregor deposit (fig. 9). Kaolin was discovered in a dug well on the property (pl. 3 and fig. 9). Hand-auger holes drilled by the Geological Survey 50 feet south of the abandoned house and 75 feet northeast of the house (holes 708 and 717, respectively, fig. 7) each went through about 12 feet of fairly pure kaolin; but hole 715, which is 250 feet north-northwest of hole 708, along the fence line 75 feet north of the township line, penetrated only carbonaceous clay, lignite, and thin streaks of light-colored clay at depths corresponding to the white clay in the other holes. Hand-auger hole 709, in the low point of the saddle between the old Wiley Moor home and pit 1 dug by Morse on the McGregor property, penetrated only 3½ feet of kaolin, underlain by ocherous and silty clays resting on Porters Creek Clay.

The kaolin body near the old Moor house has a probable northeast-southwest elongation and is associated in some way with a channel deposit containing lignitic clays, as at Pinedale. An ignition loss determination, by McCutcheon of the Mississippi Geological Survey (oral commun., 1942), of the kaolin from a depth of 22 to 32 feet in hole 708 indicated an alumina content of about 40 percent.

MALT COLLUMS PROPERTY

The Malt Collums property is in two areas in the west half of sec. 1, T. 10 S., R. 1 E. (pl. 3). The more northerly of these two areas was mentioned by Morse (1923, p. 125–126) as the E. D. McGregor property 2. At that place Morse's three test pits (Nos. 4 to 6), spaced 200 and 250 feet apart in an east-west line along a small ridge, exposed only micaceous sand and clay, although some float of bauxite was present on the ridge. Like the bauxite on the nearby J. J. Gregory property to the north, the float is doubtless residual from a now-eroded deposit.

The more southern of the two areas owned by Mr. Collums is just north of old State Highway 6 from Pontotoc to Toccopola. Very impure bauxite is present as abundant float on the crest and south side of a small hill, but an auger hole dug by Priddy (1943, p. 79, hole N242, erroneously described as being in sec. 2) at the crest of the hill revealed only micaceous and silty weathered clay of the upper part of the Porters Creek.

E. D. McGREGOR PROPERTY

The E. D. McGregor property, owned in 1942 by the Mississippi Bauxite Co., is in the NE¼ sec. 2, T. 10 S., R. 1 E. (pl. 3, fig. 9). It was first prospected by the Morses (1923, p. 122–125), who dug three test pits along the east-west crest of the small ridge near the top of which the bauxite crops out. As a result of this early work, Morse thought that two beds of bauxite might be present here, but a 17-foot hand-auger hole (710) drilled by the Geological Survey beside pit 2 went directly into typical light-gray micaceous silty clay of the Porters Creek below about 5 feet of bauxite and 4 feet of underlying kaolin. Scattered small pieces of float of bauxite are also found on a northeast-southwest ridge about 525 feet northwest of pit 2. Auger hole 716 drilled on the ridge penetrated 14 feet of light-gray and yellow-stained kaolin that is locally pisolitic. The top of this clay is about 20 feet below the top of pit 2 and indicates irregularity of the post-Midway surface rather than two beds of bauxite and kaolin.

The previously described east-west deposit in the north part of the Malt Collums property, a quarter of a mile to the east across a valley, is exactly alined with this McGregor deposit (see pl. 3) as are also the Simmons bauxite, a quarter of a mile to the west, and the kaolin that crops out in the road ditch on the J. E. Harmon property another 0.3 mile to the west. The northern Collums deposit and the E. D. McGregor deposit are probably remnants of a mile-long channel that extended westward as far as the Harmon kaolin. The east-west trend of the McGregor ridge probably results from the resistance of the low-grade bauxite to erosion.

C. A. BRAY, E. I. SIMMONS, AND J. E. HARMON PROPERTIES

Very impure bauxite and some kaolin are found on three adjoining properties—the C. A. Bray, E. I. Simmons, and J. E. Harmon properties in the southern part of sec. 35, T. 9 S., and the northern part of sec. 2, T. 10 S. (pl. 3, fig. 9). Several scattered hand-auger holes and U.S. Bureau of Mines core holes Po–42 and Po–43 afford insufficient evidence to reveal the relationships of the several localities but

do suggest that they are not underlain by a continuous blanket of bauxite or kaolin.

A little bauxite float was found on the Bray property. Nearby, hand-auger hole 705 (fig. 9) penetrated about 6 feet of clay that appeared to be pisolitic and fairly high in alumina, and hole 706 to the south near a kaolin outcrop went through 12 feet of impure kaolin. Near the south edge of the Bray property (sec. 35) several more hand-auger holes (701–704 and 707) penetrated 4 to 6 feet of kaolin.

On the Simmons property a small deposit of very impure bauxitic clay about 1,000 feet north of the house has been used for low-grade road gravel. As already mentioned, this deposit is in line with the McGregor deposit, of which it probably was once a part. A few hundred feet east and southeast of the Simmons house (about 1,000 feet south of the bauxitic clay) impure bauxitic kaolin crops out in the field and road ditches, but information is not available as to the shape of the deposit. However, the material appears to be very low grade. Hand-auger hole N243 (fig. 9) by Priddy (1943, p. 80; McCutcheon, 1943, p. 116) penetrated 17 feet of silty ferruginous clay.

On the J. E. Harmon property kaolin is well exposed in the ditch on the north side of the road, about 800 feet west of the residence at the crest of a hill and 500 feet east of the valley bottom. Hand-auger holes 712 and 713 northeast of the outcrop went through about 12 feet of kaolin that appears to be of good quality and similar to the clay in the ditch. The clay appears to grade downward into Porters Creek Clay. Two power-drill holes (Po–42 and Po–43, fig. 9) near the southeast and northwest corners of a small cemetery at the top of the hill did not penetrate any high-grade kaolin.

HARMON-SLEDGE PROPERTIES

Boulders of high-iron bauxite as much as a foot or more in size are present on both sides of the fence line between the J. E. Harmon and R. W. Sledge properties (sec. 2, T. 10 S., R. 1 E., pl. 3, fig. 9). Power-drill hole Po–15, by the U.S. Bureau of Mines on the Sledge property close to the fence line, did not penetrate bauxite but went through impure white and yellow sandy clay that grades into Porters Creek Clay at a depth of about 18 feet. As at many other localities, the boulders appear to be remnants of an eroded small body of low-grade bauxite.

J. C. SANDLIN (BUDDY SMITH) PROPERTY

On the J. C. Sandlin (commonly known as "Buddy Smith") property (sec. 2, T. 10 S., R. 1 E., pl. 3, fig. 9), scattered bauxite boulders a foot or more in diameter are strewn on a small east spur of a high hill, and kaolin crops out in a small exposure in a gully about 1,000

feet west-northwest of the bauxite. Although the bauxite is not mentioned in previous reports, a test pit was once dug at the top of the hill presumably without finding any bauxite. In the present investigation, the Bureau of Mines drilled hole Po–16 near the crest of the ridge about midway between the bauxite float and the kaolin outcrop. The log of the hole showed only sand, sandy clay, 1 foot of silty white clay, and Porters Creek Clay at a depth of about 30 feet. No bauxite or kaolin of value is likely to be present at this locality.

BARNEY POYNER PROPERTY

About a quarter of a mile west of a north-south public road, showings of bauxite were found by Mr. Adams (oral commun., 1942) in the wooded and rough tract of the Barney Poyner property (in 1942, owned by the Fair Lumber Co.) in sec. 3, T. 10 S., R. 1 E. (pl. 3, fig. 9). Several test pits were dug during the early investigations, yet the locality has not heretofore been mentioned in any geological report. Beside the northernmost outcrop, an old trench 25 feet long and 2 to 3 feet deep was dug along the contour near the bottom of a small stream valley. The trench exposed considerable light-gray soft bauxite, as did three nearby shallow test pits. The trench is about 200 yards north of drill hole Po–30 but is not shown on the maps. To further test the extent of this deposit, a 15-foot hand-auger hole was drilled by the U.S. Geological Survey just below the trench, and three core holes were drilled by the U.S. Bureau of Mines in the general area (holes Po–29 to 31, pl. 3). The hand-auger hole, starting 1 foot below the bottom of the trench, penetrated 7½ feet of sand mixed with fragments of pisolitic clay, underlain by 4½ feet of pure kaolin that graded downward into sandy and micaceous clay. Core hole Po–30 penetrated 17 feet of overburden and 21 feet of more or less pure clay-ball conglomerate which had an average analysis of about 39 percent alumina, 1.2 percent iron oxide, 42 percent silica, and 15 percent ignition loss. Below the kaolin was 35 feet of clayey sand and silt of unknown age overlying the Porters Creek Clay. Only an impure clay-ball conglomerate, a little lignite, and silts and sands were found in the other two power holes (Po–29 and Po–31). Topographic conditions preclude any possibility of the occurrence of large quantities of bauxite or clay that have been overlooked in the exploration; so, it is concluded that only a small body of kaolin of unknown shape is present in this locality.

Two north-south rows of power-drill holes by the Bureau of Mines tested the ridge underlain by sediments of the Wilcox Formation between the Poyner and the Harmon-Sledge properties (pl. 3). No bauxite or kaolin was found in these holes except in Po–40 where about

4 feet of sandy pisolitic material was found below 48 feet of sandy and silty clay.

G. E. LINDSEY PROPERTY

On the G. E. Lindsey (formerly Barney Forshee) property (sec. 11, T. 10 S., R. 1 E., pl. 3), high-iron bauxite float is present on the upper part of a gently sloping round hill. The larger pieces have been removed for foundation blocks. The float appears to rest on weathered Porters Creek Clay, and no bauxite is in place.

MRS. MAGGIE NORWOOD PROPERTY

Small pieces of light-colored pisolitic material or clay-ball conglomerate abound over 2 or 3 acres on the crest of a low ridge on both sides of the line between sec. 8 and 9, T. 10 S., R. 1 E. (pl. 3), but two nearby drill holes (Po–52 and Po–53) found no bauxite or kaolin in the places that are topographically favorable for its occurrence. This float probably represents the weathered residuum of a small patch of kaolin conglomerate.

Thirteen additional core holes (pl. 3) were drilled by the Bureau of Mines in secs. 9, 10, 15, and 16 south and east of the areas of float to test for the presence of any large body of kaolin or bauxite beneath the ridges underlain by sediments of the Wilcox group. One hole, Po–56, at a depth of 55 feet, went through 5.5 feet of light-gray clay that contains numerous pisolites or clay balls. An analysis by the Bureau of Mines (Coulter, 1948, p. 8) gave 37.4 percent alumina, 43.9 percent silica, 1.8 percent iron oxide, 2.3 percent titania, and 15.2 percent loss on ignition. Kaolin or bauxite in other holes was in beds a foot or less thick. The cores showed, in unpredictable sequences, sand, silty and carbonaceous clay, scattered lignite fragments, and thin clay-ball conglomerate. The area was not sufficiently tested to be sure that no fairly large bodies of kaolin or bauxite are present, but the poor results from this sampling do not encourage further exploration.

PAT CREECH PROPERTY

On the Pat Creech property in sec. 15, T. 10 S., R. 1 E. (pl. 3) a little kaolinitic clay is exposed in a gullied field, and another outcrop was found about a quarter of a mile to the north. Though the outcrops were poor, they might indicate a body of kaolin under the ridge to the west. That ridge area was tested by core-drill holes Po–56, 57, and 58, but neither bauxite nor kaolin was found, except in hole Po–56 as mentioned above.

J. W. TUTOR PROPERTY

High-iron bauxite on the John Wiley Tutor property (sec. 16, T. 10 S., R. 1 E., (pl. 3) was examined in 1922 by the Morses (Morse

1923, p. 134, 136–138, 146). Several analyses of material from their test pits showed most of the bauxite to contain less than 40 percent alumina and between 13 and 27 percent iron oxide. The Morses estimated 8,500 tons of low-grade bauxite containing 43 percent alumina (recalculated to a moisture-free basis).

The results reported by Morse suggest, in the light of later ideas, that the body terminates rather abruptly on its east edge, where it might have been assumed to extend under higher ground. Five drill holes already mentioned (Po–56 to Po–60, pl. 3) in the region to the east and northeast failed to find bauxite or kaolin other than the thin bed of clay-ball conglomerate in Po–56.

S. L. TUTOR PROPERTY

Very low grade bauxitic clay crops out behind a residence on the S. L. Tutor property (sec. 17, T. 10 S., R. 1 E., pl. 3) (Morse, 1923, p. 138) and has been dug for road gravel. Surface evidence suggests that it underlies an area of about an acre along the section line. As exposed in the quarry face, the 2- to 3-foot ledge dips about 10° SW. and is underlain by sideritic and concretion-bearing white clay, which probably grades at a shallow depth into typical Porters Creek Clay.

E. E. ANDERSON, P. G. COATES, AND J. J. WESTMORLAND PROPERTIES

A small hill on the line between secs. 15 and 22, T. 10 S., R. 1 E. (pl. 3), is capped with bauxite and was prospected by the Morses (Morse, 1923, p. 130, 140) in 1922. More recently samples of a 20-foot bed of clay beneath the bauxitic material were obtained by Priddy (1943, p. 40, 52–53, 78–79) from hand-auger hole N238. Chemical analyses of clay indicated about 26 percent alumina (McCutcheon, 1943, p. 116). As the bauxite analysis given by Morse (1923, p. 130) shows about 30 percent alumina (recalculated to moisture-free basis), apparently neither the "bauxite" nor the kaolin are of value by present standards.

S. W. DORSETT PROPERTY

Considerable float of pisolitic bauxite is present in and near a cleared field just above and south of a small stream on the S. W. Dorsett property (sec. 19, T. 10 S., R. 1 E., pl. 3). No other signs of bauxite were found in nearby gullies or valleys except for a sandy clay-ball conglomerate exposed in the creek bed about a quarter of a mile upstream (southwest) in sec. 30. Much bauxite is not likely to be present in this area, though most of the land is high, and a fair-sized body might exist underground on either side of the Pontotoc-Lafayette County line.

WALTER TUTOR PROPERTY

Along the south edge of sec. 21, T. 10 S., R. 1 E. (pl. 3), a little indurated ferruginous clay-ball conglomerate, resembling bauxite, crops out near the farm buildings. It is probably an extension of the L. C. Tutor body.

L. C. TUTOR PROPERTY

Burchard (1925, p. 134–135) mentioned the L. C. Tutor locality (sec. 28, T. 10 S., R. 1 E., pl. 3) and noted that only a few hundred tons of material could be present. He stated that a test pit dug on the top of the hill in 1922 showed bauxite about 2 feet thick. Recent study of the distribution of the float suggests that the body probably has a general north-northwest elongation.

J. M. TUTOR PROPERTY

Low-grade high-iron bauxite has been scraped from the surface of a small wooded knoll about 150 feet east of a public road and about 800 feet south of a road intersection on the John M. Tutor (formerly Noah Tutor) property (sec. 28, T. 10 S., R. 1 E., pl. 3). Priddy (1943, p. 81) drilled auger hole N254 at this place but found only about 8 feet of high-iron kaolin beneath about 3 feet of impure bauxite (McCutcheon, 1943, p. 117).

W. C. PURDON PROPERTY

A little bauxite float is present about 75 yards east of the Purdon residence, in sec. 29, T. 10 S., R. 1 E. (pl. 3), but seems to represent no large bauxite deposit. In 1941 Priddy (1943, p. 80) drilled auger hole N253 near the crest of the hill just west of the public road about half a mile east of the Purdon bauxite and half a mile south of the previously mentioned John Tutor bauxite locality (the hole erroneously ascribed to sec. 28 instead of sec. 29). At a depth of 13 feet the hole penetrated a 13-foot bed of very slightly bauxitic kaolin that contains about 36 percent alumina and 40 percent silica (McCutcheon, 1943, p. 116, 123). Careful search of the vicinity revealed no outcrop of this clay which, on the basis of topography, could underlie 3 or 4 acres.

OTHER OUTCROPS

Burchard (1925, p. 135) cited, without having seen, a reported "outcrop of bauxitic clay, accompanied by a small quantity of good bauxite" in the side of a ravine, NW¼ sec. 36, T. 10 S., R. 1 E., which is about a mile southeast of Randolph. A search for this material revealed no one in the vicinity who knew of any buaxite, but a 6- to 8-foot exposure of clay-ball conglomerate in which white kaolin balls are in a red sand matrix may well have given rise to the report. This

outcrop is in a gully near the SW. cor. NW¼ sec. 36, about 100 yards east of a dwelling that stands on or close to the section line.

Burchard (1925, p. 134) also stated that on the Dr. McGregor property (NE¼ sec. 27, T. 10 S., R. 1 E.) "numerous small boulders of bauxite have been observed, but they are not considered as indicating ore in place." The present writer was unable to find these boulders, nor did Dr. McGregor know their exact location; so, Burchard's conclusion that there is no ore in place seems reasonable.

At many other places in Pontotoc County, white clay balls embedded in a sandy matrix are found a short distance above the Porters Creek Clay, and these may lead the optimistic observer to believe he is looking at bauxite. Such material, though it superficially resembles bauxite, is of no use as either bauxite or clay, nor does it indicate that an economically valuable body of bauxite or clay occurs nearby.

LAFAYETTE COUNTY

The outcrop said by Hilgard (1860) to be in Lafayette County is clearly the result of a field error in describing a locality in Pontotoc County (p. B5). As far as is known to Adams (oral commun., 1942) or the author, no bauxite has been found in Lafayette County, though the S. W. Dorsett deposit in sec. 19, T. 10 S., R. 1 E. (pl. 3), in Pontotoc County, is only about 1,000 feet east of the county line.

CALHOUN COUNTY

Considerable float of strongly pisolitic ferruginous bauxite has been reported from near Serepta in the northeastern part of the county by both Morse (1923, p. 165) and Burchard (1925, p. 135). The best exposure is about 2 miles northeast of Serepta along State Highway 9, where the bauxite is exposed beside the highway and in an open field (NW¼SW¼ sec. 12, T. 11 S., R. 1 W., pl. 3). The material was believed by both writers to be of good quality, though it apparently has never been tested. As pointed out by Burchard, the boulders seem to be the last remnants of an eroded body of bauxite.

Another bauxite area, reported by Adams in conversation but not listed by previous authors, is about two-thirds of a mile southeast of the previously mentioned locality. Here bauxite float and a possible poor outcrop are on the crest of a wooded north-south ridge, probably just north of the line between secs. 12 and 13, T. 11 S., R. 1 W. (pl. 3). Two or three test pits have been dug in the bauxitic material, which appears to be underlain by light-gray clay.

Morse (1923, p. 165) and Burchard (1925, p. 135) both mentioned bauxite 1 mile west of Serepta, but local inquiry failed to reveal the location, and Adams (oral commun., 1942) did not recall any west of the village.

WEBSTER COUNTY

Bauxitic clay has been reported (Morse, 1923, p. 167; Burchard, 1925, p. 135–136) from this county, but there seems to be no such material of value in the county. One deposit of high-iron bauxitic clay about 3 miles northwest of Cumberland has been almost completely removed for local use as road gravel.

Th best exposure seen by the writer is about half a mile north of the highway junction in Mathiston, in the road ditch on the Wood Junior College property (near NW. cor. sec. 2, T. 19 N., R. 11 E.). It seems to be a somewhat indurated ferruginous sandy clay-ball conglomerate.

Several recently excavated sand pits between Cumberland and Mathiston show a clay-ball conglomerate which has a sandy matrix, and where such material has been unusually rich in clay balls or has been partially indurated, it has likely been erroneously termed bauxite. From time to time local publicity suggests that bauxite deposits having commercial possibilities abound in the county, but such optimism seems unwarranted.

OKTIBBEHA COUNTY

Low-grade bauxite float has been reported by Morse (1923, p. 169–171) and Burchard (1925, p. 137) from the top of a hill about 1 mile east of Sturgis (SE¼ sec. 10, T. 17 N., R. 12 E.). Bauxitic material is exposed in a railroad cut north of the float locality and about 25 feet above Porters Creek Clay. In 1942 and 1952 the hard float was observed to be sparsely scattered on the upper hill slopes, and colluvial boulders were found in a 5- or 6-foot sand pit beside the road near the top of the hill. An analysis of the pisolitic material given by Morse shows about 35 percent alumina, 1.2 percent iron oxide, 33 percent silica, and 13 percent ignition loss. Although the material is of no value as bauxite, it is geologically interesting as an isolated deposit along the Midway-Wilcox contact.

WINSTON COUNTY

One exposure of hard low-grade bauxite and several outcrops of pisolitic kaolin have been reported from Winston County (Morse, 1923, p. 171–172; Burchard, 1925, p. 137–140; Mellen, 1939, p. 51, 58–67; McCutcheon, 1939, p. 91–97). Some drilling was done in 1922 near the bauxite locality by the Republic Mining and Manufacturing Co. (now Alcoa Mining Co.), apparently without penetrating any additional bauxite. In 1937–38 Mellen drilled hand-auger holes in several localities without finding more bauxite, though he did locate some kaolin deposits. During the present Federal investigation most of the previously reported localities were revisited, and the U.S. Bureau

of Mines (Reed, 1952, p. 10–12) drilled 9 holes in two parts of the county without encountering any bauxite (pl. 5).

The one known bauxite deposit in the county is about 2 miles north-northwest of Fearn Springs on the John W. Sullivan property, SE¼, sec. 28, T. 14 N., R. 14 E., where boulders as much as 3 or 4 feet in diameter abound on a small knoll less than an acre in extent on the side of a ridge. The only reported analysis (Morse, 1923, p. 172; Mellen, 1939, p. 51) of the boulders shows about 56 percent alumina, 4½ percent iron oxide, 15 percent silica, and 22 percent ignition loss. Mr. Adams (oral commun., 1942) reported finding a small quantity of scattered bauxite float across the valley from the main outcrop, but it is so sparse that it can hardly be economically valuable. U.S. Bureau of Mines holes 19 through 21 (pl. 5) were near the Sullivan bauxite but failed to reveal any extension of the material.

Holes 14 through 17 (pl. 5) were drilled about a mile and a quarter to the north on and near the J. H. Hurt property (in 1943 the Fair Lumber Co.), where Mellen (1939, p. 61) reported several outcrops of bauxitic and kaolinitic clay. The holes were drilled on a flat upland, about 50 feet above the outcrops, in the hope that some of the holes would locate an extension of the pisolitic kaolin which crops out in a ravine and which Mellen sampled by trenching (his sample 88); however, only somewhat silty clay was found in these holes.

Near Betheden, about 12 miles north-northwest of the Sullivan bauxite locality, kaolinitic clay was reported by both Morse and Burchard. Later, Mellen investigated the region and drilled some hand-auger holes, but only high-silica kaolins were discovered. U.S. Bureau of Mines holes 22 and 23 in this region also revealed nothing better than sandy kaolinitic clay. The analysis reported by McCutcheon (1939, p. 101) shows the clay to contain about 16.5 percent alumina, 73.2 percent silica, 1.2 percent iron oxide, and 5.4 percent ignition loss. Similar clays were found by Mellen in several holes on the R. G. Brown, Jr., property (sec. 21, T. 14 N., R. 14 E.) near the Sullivan bauxite area.

On the E. P. Rainey property (NE¼NW¼ sec. 26, T. 16 N., R. 12 E.) about 5 miles west of Betheden, Mellen (1939, p. 58–59) found beneath valley alluvium a kaolin deposit which had an average thickness of about 9 feet. The one analysis given by McCutcheon (1939, p. 91, 93, sample 13P1) shows 38.51 percent alumina, 41.76 percent silica, 1.61 percent iron oxide, and 14.34 percent ignition loss. No further prospecting was done in this area during the present Federal investigation.

Inasmuch as the one known bauxite deposit in the county, the Sullivan deposit, is small and no other bauxite has been found in the most

favorable localities during three independent drilling investigations, bauxite in commercial quantities will not likely be found in Winston County.

NOXUBEE COUNTY

Morse (1923, p. 172–174) and Burchard (1925, p. 140–141) both reported showings of bauxitic and pisolitic ferruginous material resembling bauxite in the southwestern part of Noxubee County. During the present investigation, a careful search for outcrops of bauxite and kaolin was made by walking the Midway-Wilcox contact along the greater part of its length in the county (pl. 5). No additional showings of bauxite were discovered, but several outcrops of kaolinitic clay were found in the creeks in and near the NE¼ sec. 16, T. 13 N., R. 15 E., and in the bottom of a ravine about 800 feet northwest of a road junction near the middle of section 15, where a 9-foot layer of slightly silty kaolin crops out along the creek bed for about 200 feet. A fairly large body of kaolin may underlie a considerable area near these outcrops and to the south, but if such a deposit is present, most of it must be under an overburden of about 50 feet of loose sand.

The only known material in Noxubee County that can be considered good quality bauxite crops out in a small roadcut near the center of sec. 8, T. 13 N., R. 15 E., on the Hubbard property, about 750 feet southeast of a road junction (pl. 5). Morse (1923, p. 173) gave the following analysis of it: 53.5 percent alumina, 4.7 percent iron oxide, 16.3 percent silica, 2.0 percent titania, and 23.3 percent ignition loss (analysis recalculated to moisture-free basis). A small prospect pit was reported by Burchard at this locality.

The U.S. Bureau of Mines drilled three holes, Nos. 11–13 (see pl. 5 of this report and Reed, 1952, p. 12) in the vicinity of the Hubbard bauxite outcrop. Hole 11 was at the north end of a field about half a mile south of the road intersection that is near the middle of sec. 8 and 500 feet north of an east-west road in the southern part of the section (near center, SE¼SW¼ sec. 8, T. 13 N., R. 15 E.). This hole was designed to test for an underground extension of a bauxite body that is suggested by obscure float about 500 feet to the north and about 60 to 70 feet below the hole site; however, owing to a misunderstanding, the hole was abandoned at a depth of 71 feet after it had penetrated about 3 feet of kaolin containing small pellets of siderite. Any kaolin that might have been found if the hole had been continued would not likely have been of commercial value, owing to the amount of overburden. Through most of its range the hole penetrated light-gray silty clay. Hole 12 was on the crest of the small hill about 300 feet north-northeast of the Hubbard bauxite test pit and 33 feet above the pit. The hole was 61 feet deep and penetrated

fine-grained silty sand, having layers of silty clay and coarse-grained sand. No bauxite or kaolin was found. Hole 13 was about 1,000 feet northwest of the road intersection near the center of sec. 8 and is at the east edge of a clearing some 400 feet north-northeast of a road. It penetrated only micaceous sand and silty clay. This last hole was on the Liddell property referred to by Morse (1923, p. 174). On the basis of outcrop and drill-hole evidence, there is little likelihood of finding commercial bauxite in Noxubee County.

KEMPER COUNTY

The bauxite deposit having the highest average grade so far known in Mississippi is at the land surface in the north edge of Kemper County on the property of the J. C. Flora estate (pl. 5, near the NW. cor. sec. 10, T. 12 N., R. 16 E.). Morse (1923, p. 174) reported samples from this deposit to contain 55.3 percent alumina, 0.15 percent iron oxide, 17.0 percent silica, 1.6 percent titania, and 23.6 percent ignition loss (recalculated to moisture-free basis). In 1942 J. W. Adams shipped 400 tons of the Flora bauxite to the Monsanto Chemical Co., Boston, Mass., and so far as known it is still (1964) the only commercial mining of bauxite in Mississippi. Adams (oral commun., 1942) stated that before shipping he guaranteed the bauxite would contain 50 percent alumina, less than 20 percent silica, and less than 1 percent iron oxide, and as far as known to the writer it met this guarantee.

Because of this outcrop of chemical-grade bauxite, a careful search of the vicinity was made for more, and several hand-auger (fig. 10) and power-drill holes (pl. 5) were put down. Evidence from the hand-auger holes indicates that the bauxite extends west from the main exposure somewhat beyond the nearby road but does not extend that far in any other direction. On the west side of the road about 250 feet west of the pit, two hand-auger holes penetrated, at depths of 3½ and 11½ feet, material that could not be cut and was believed to be bauxite. On the assumption that the bauxite extends to the road, the deposit can have an areal extent of somewhat less than an acre. The presence of a small amount of float about 200 feet west of the road (fig. 10) suggests that the main body may continue that far; if so, its areal extent would be somewhat less than 2 acres. The presence of a valley to the west rules out any further extension in that direction. The two U.S. Bureau of Mines power-drill holes, Nos. 1 and 2, closest to the Flora deposit, penetrated about 50 feet of fine and coarse sand but no bauxite or kaolin (Reed, 1948, p. 12, 78). Similar sand doubtless lies between the bauxite and kaolin and the underlying Porters Creek Clay in the Flora mine. Some or all of this underlying sand is probably part of the Naheola Formation.

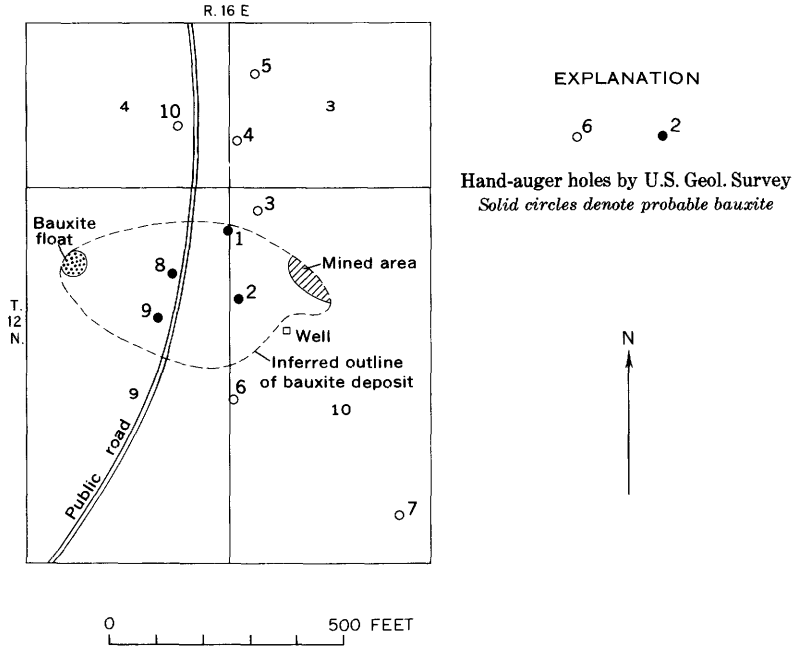


FIGURE 10.—Flora bauxite deposit, Kemper County, Miss.

The Flora deposit is the southernmost bauxite known in Mississippi. Occasional reports are heard of bauxite even farther south in Kemper County and in Lauderdale County, but such reports likely originate from small outcrops of sandy clay-ball conglomerate, such as are known to be present in those areas.

In the pit where Adams mined his shipment the hard bauxite ranges in thickness from 1 to 4 feet. A hand-auger hole drilled by members of the U.S. Geological Survey in the floor where the rock had been removed went through 4.7 feet of kaolin averaging 40 percent alumina, 1 percent iron oxide, 2 percent titania, 43 percent insoluble (silica), and 14 percent ignition loss (analysis by U.S. Bur. of Mines).

Scattered small pieces of pisolitic float are present 1,000 feet east of the main bauxite outcrop on the north slope of a ridge that extends eastward from just south of the outcrop, but several nearby hand-auger holes and power-drill hole 3 on the ridge encountered only sand.

Another showing of bauxite was found about two-thirds of a mile to the north of the Flora deposit. It is in the woods about 50 yards west of the road, about a quarter of a mile north of a road intersection, and about 400 feet north of a tenant house (west edge sec. 3, pl. 5). Here abundant float of buff to white slightly sandy bauxite abounds

along the hillside for about 125 feet in a north-south direction. Two nearby hand-auger holes indicate that the bauxite does not extend east to the road, and power-drill hole 9 just south of the tenant house showed only 33 feet of sand.

A little bauxite float has long been known in a field about half a mile southwest of the Flora outcrop. The boulders are mostly 6 to 10 inches in diameter and strongly resemble the Flora material. In the absence of any smaller pieces of float in the field or nearby woods, the writer believes these boulders were hauled there long ago from the Flora locality, perhaps to be used for harrow weights or for blocks under a small building.

A little bauxite float was found about 1 mile west of the Flora outcrop in and near the south end of a cleared ridge (SE¼SE¼ sec. 5), but there seems no likelihood that the bauxite has any appreciable extension.

Kaolin-ball conglomerate which has a sandy matrix crops out in several places in gullies in the central and northern parts of sec. 4, T. 12 N., R. 16 E. One of the largest of these outcrops is on the Kemper-Noxubee County line about 500 feet east of the northwest corner of the section, where a 4- to 5-foot bed of sandy kaolin overlies a 2-foot bed of sandy clay-ball conglomerate. Another good exposure of clay-ball conglomerate having a sand matrix is about 400 feet east of the center of sec. 4 in the head of a gully. Here clay balls as much as a foot or more in diameter are present.

Because of these exposures of kaolinitic clay, five power-drill holes (Nos. 5–8, 10, pl. 5) were drilled in the south half of sec. 4 in an attempt to find a body of bauxite under the undissected upland between these outcrops and the Flora bauxite; however, only sand and insignificant traces of clay balls were found.

The last outcrop of kaolinitic clay that merits mention is in a deep cut for the Shuqualak-De Kalb road, about 5 airline miles south of the Flora bauxite and about 5 miles north of De Kalb. A deep roadcut on the south side of a valley (near west edge NE¼ sec. 4, T. 11 N., R. 16 E.) exposes a great sand-filled channel that cuts into a finer micaceous sand. Near the base of the channel are boulders of sandy kaolinitic clay as much as 6 feet in diameter, and near the lowest part of the channel are a few boulders as much as 1 foot in diameter that are slightly pisolitic and nearly free from quartz. This assemblage suggests a nearby source for the pisolitic kaolin, but a careful search of the immediate vicinity failed to reveal such a source. Much of the region from the vicinity of this channel exposure northward to the Noxubee County line was explored carefully without finding any further trace of bauxite or kaolin.

RESERVES

The following table shows the estimated reserves of bauxite and kaolin in Mississippi exclusive of the Tippah-Benton district. Some of the estimates are based on several test pits, drill holes, and chemical analyses, but others are based solely on outcrops or on only one test pit or drill hole. On the basis of available evidence it must be concluded that there is in Mississippi little bauxite of potential commercial grade as a source of alumina for either the metal or chemical industry. Several million tons of high-alumina kaolin, however, are present in deposits large enough to be of potential commercial value. In the absence of new technological developments or of new processes demanding high-iron, high-silica bauxite, most of the Mississippi bauxite deposits seem destined to remain unused except for such purposes as foundation blocks and low-grade road metal. Results of the joint Federal mapping and drilling program offer little promise for the future discovery of large bauxite deposits in the State. Some of the kaolin deposits, however, may be developed for industrial uses such as refractories, ceramics, fillers, catalysts, and insecticides, in competition with kaolins of Georgia, South Carolina, Tennessee, and Kentucky. The largest kaolin deposits in the region studied are in the Pinedale and Fowler areas.

Estimated reserves of bauxite and kaolin in Mississippi, exclusive of the Tippah-Benton district

	Bauxite (long tons) containing indicated percentages of Al_2O_3				Kaolin	
	55	50–55	40–50	30–40	Long tons	Percent of Al_2O_3
Benton and Union Counties					3,500,000	30–49
Pontotoc County	5,000	65,000	140,000	175,000	380,000	35–42
Winston, Noxubee, and Kemper Counties		5,000	10,000		120,000	38–40
Total	5,000	70,000	150,000	175,000	4,000,000	

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