# BAUXITE IN NORTHEASTERN MISSISSIPPI.

By Ernest F. Burchard.

## INTRODUCTION.

The occurrence of bauxite in 10 or more counties of northeastern Mississippi became known in an interesting manner. In the fall of 1921 J. W. Adams, of Tuscumbia, Ala., in prospecting for clays, discovered deposits of bauxite and bauxitic clay near Margerum, Colbert County, Ala. These deposits are in erosion channels and sink holes in Mississippian limestone that have been partly filled by Cretaceous (Tuscaloosa) gravel. Adams believed that there should be bauxite also in adjacent portions of Mississippi, but in Tishomingo County in areas of Mississippian limestone he was able to find only deposits of lean bauxitic clay. He thereupon undertook a study of the literature of the geology of Mississippi and in an early State report[1] found the following statement in a description of the features of the "Orange sand":

> A singular rock belonging to this formation and much resembling a true pudding stone is found in a few localities in western Tippah and eastern Lafayette counties on the territory of the Lignitic Tertiary (for example, sec. 1, T. 5, R. 2 E., Tippah County; sec. 33, T. 9, R. 1 W., Lafayette County). It consists of a ferruginous and somewhat sandy cement, in which are embedded numerous rounded concretions of a pisolitic structure, formed of concentric layers of a siliceous material more or less ferruginous and in some almost white, the largest being about three-quarters of an inch in diameter.

Hilgard evidently did not recognize the material as bauxite, and in fact bauxite was probably not known to occur in the United States at that time, as it is understood to have been first recognized in Georgia and in Arkansas in 1887. The earliest reference to the mineral recorded by Dana[2] cites a description of "alumine hydratée de Beaux" (France) in the Annales des mines by Berthier, its discoverer, in 1821. As Hilgard's description is a very good pen picture of bauxite, Adams felt that his search was leading him in the right direction, and accordingly he examined the deposit in Tippah County

[1] Hilgard, E. W., Report on the geology and agriculture of the State of Mississippi, p. 14, Jackson, Miss., 1860.

[2] Dana, E. S., Descriptive mineralogy, 6th ed., p. 251, 1909.

near Blue Mountain and took samples that on analysis showed a considerable percentage of aluminum hydroxide. Thus encouraged and guided by the geologic relations which he had observed, Adams continued his reconnaissance throughout northeastern Mississippi along the contact of the Porters Creek clay and the overlying lignitic sand and clay of the Ackerman formation, making traverses across each of these formations at sufficiently close intervals to avoid missing any prominent indications of bauxite throughout the area of outcrop from the Tennessee line on the border of Tippah County to the Alabama line on the border of Kemper County. This reconnaissance by Adams resulted in the discovery of deposits of bauxite and bauxitic clay in 10 counties of northeastern Mississippi as follows, beginning at the north: Tippah, Benton, Union, Pontotoc, Calhoun, Webster, Oktibbeha, Winston, Noxubee, and Kemper. The deposit in Lafayette County referred to by Hilgard in the description quoted above could not be found, and it is thought that possibly Hilgard saw some float material there that had been derived from the deposits in western Union and Pontotoc counties, or possibly that some boulders had been hauled there to supply rock for building chimneys or foundations. More than 60 years elapsed between the publication of Hilgard's description of the bauxite deposit and the utilization of the information. In that interval many geologists had been over the same ground in quest of underground water, clay, iron ore, and oil and presumably had read the report, but it fell to the lot of a nontechnical but keen and persevering prospector to interpret the facts and to bring to light this most interesting resource. Geologists may, however, console themselves in reflecting that the note as published by Hilgard was clear and accurate and that it eventually pointed the way to a valuable discovery.

The reconnaissance by Adams was followed by prospecting under his supervision in the areas that were regarded as promising; topographic maps and studies of the deposits were made during the summer of 1922 for a syndicate of Alabama and Mississippi business men, known as the Mississippi Bauxite Co., by W. C. and P. F. Morse, geologists, of Starkville, Miss.; and about 125 samples of ore and clay were analyzed by Dr. W. F. Hand at the Mississippi Agricultural and Mechanical College, Agricultural College, Miss. The prospecting consisted of digging test pits of varying depths and of sinking holes with an Empire drill. It was the writer's privilege to be accompanied by Mr. Adams on a brief visit of inspection to these deposits during the last week of June, 1923. It was a favorable time to visit the deposits, for the roads were nearly all passable, and many of the test pits, especially on the outcrops of the bauxite, were dry, but necessarily some of the deeper pits contained water.

At most of the openings the material excavated had been systematically piled on the surface and could readily be inspected.

A bulletin based on the field work for the Mississippi Bauxite Co. has recently been published by the Mississippi State Geological Survey.[3] This bulletin contains, in addition to a description of the Mississippi deposits, a general discussion of bauxite, its occurrence throughout the world, and the technology of its analysis, mining, preparation, and uses. The descriptions of the Mississippi deposits are accompanied by about 14 topographic maps.

## LOCATION AND TOPOGRAPHY OF ORE FIELD.

The bauxite is distributed in groups of small separate deposits in a belt 3 to 5 miles wide describing an arc from north to southeast about 150 miles long, corresponding to the outcrop of the associated formations throughout the northeast quarter of Mississippi, which crosses portions of Tippah, Benton, Union, Pontotoc, Calhoun, Webster, Oktibbeha, Winston, Noxubee, and Kemper counties. (See fig. 28.) In the first six of these counties this belt lies 2 to 10 miles west of the Gulf, Mobile & Northern Railroad, but in Oktibbeha County it crosses this railroad and the Illinois Central Railroad, and in Kemper County near the Alabama State line it crosses the Mobile & Ohio Railroad. A few of the deposits, all of little value except one, are near a railroad, but most of them are 5 to 10 miles or more distant and are separated from the railroad by "flatwoods" country, underlain by deep sticky clay, the roads over which are practically impassable for vehicles in wet weather and are hard and rutty in dry seasons.

The surface of northeastern Mississippi consists of a moderately dissected plateau that slopes very gently toward the southwest. The former plateau is represented by the interstream ridges and gently rolling or broken uplands. The crests of many of the ridges are narrow and very irregular in direction, and roads laid out along them are extremely tortuous. The higher land forms divides between the drainage systems of Tennessee River and other streams, such as Hatchie River and Yazoo River, that flow northwestward and westward into Mississippi River and those that flow eastward into Tombigbee River. Portions of the upland are broad and gently sloping and afford excellent cotton land. The valleys of the principal streams have been cut down nearly to base-level, the bottoms are flat, and the streams meander. To prevent overflow at times of heavy rains and to drain swampy tracts drainage canals have been dug in certain localities; these have diverted the waters into courses that are straighter and have more even grades than the

[3] Morse, P. F., The bauxite deposits of Mississippi: Mississippi Geol. Survey Bull. 19, 208 pp., 1923 (issued in April, 1924).

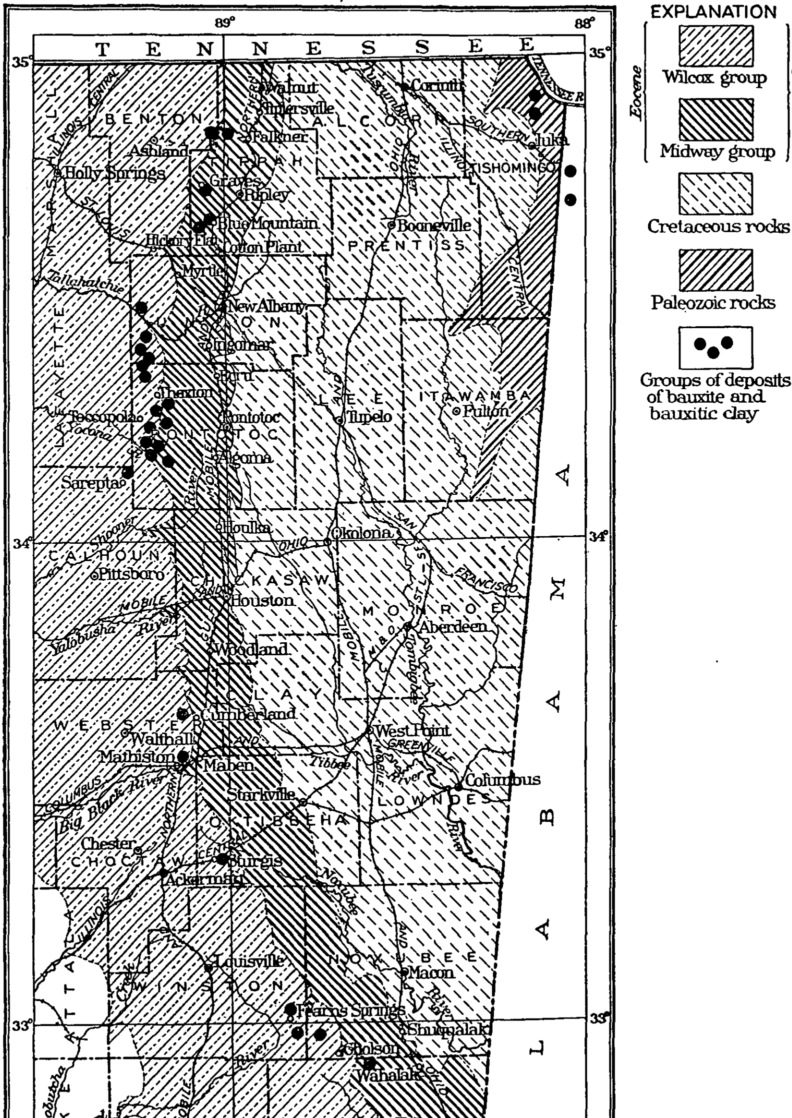


FIGURE 28.—Map showing distribution and geologic relations of bauxite deposits of northeastern Mississippi.

original streams. Many deep, narrow ravines open from the uplands into the valleys, and in these localities the hill slopes are steep. The streams are fed by springs and by surface run-off, which is gathered by innumerable small branches that flow only in wet weather.

The altitude ranges from about 175 feet above sea level near Macon, Noxubee County, to nearly 700 feet above sea level on the highest points in the northeastern part of the State, but in general the higher ridges are at altitudes of 450 to 600 feet and the larger streams 200 to 250 feet lower, giving considerable relief for a region developed on poorly consolidated rocks.

If the surface features of northeastern Mississippi are studied systematically, they may be divided into five topographic divisions, all of them related to the distribution of the geologic formations, as recognized by geologists who have studied this area in detail [4]—the Tennessee River hills, in the extreme northeast corner of the State; the Black Prairie belt, lying along the valley of Tombigbee River; Pontotoc Ridge, a strip of high land forming a divide on the west border of the Black Prairies between the Tombigbee and Mississippi river drainage systems; the Flatwoods, lying west of Pontotoc Ridge; and the north-central plateau, lying west of the Flatwoods. The correspondence of these topographic divisions to the underlying rock formations is evident, for the Tennessee River hills, except on the immediate border of Tennessee River, are developed on gravel and sand of the Tuscaloosa and Eutaw formations, the Black Prairies on the soft, massive Selma chalk, Pontotoc Ridge on harder sand and marl of the Ripley formation, the Flatwoods on the Porters Creek clay, and the north-central plateau on sand, sandstone, and clay of the Wilcox group. The bauxite deposits are found in only two of these divisions, occurring on the crests of hills along the boundary between the north-central plateau and the Flatwoods. Some of these hills are detached from the main area of the plateau and form outliers within the Flatwoods area.

The character of the Flatwoods area has an important bearing on the problem of transportation of the bauxite, for throughout most of the ore field this area lies between the bauxite deposits and Pontotoc Ridge, along which the nearest railroad is built. The Flatwoods forms a band 2 to 8 or 10 miles wide of low flat land, distinct from bordering areas, which is underlain by a gray joint clay that is very sticky and inclined to hold water for long periods but when it dries shows cracks and becomes extremely hard on the surface. In wet weather unsurfaced roads across soil of this sort are practically impassable for motor trucks, and during the dry season they are

[4] Crider, A. F., and Johnson, L. C., Underground water resources of Mississippi: U. S. Geol. Survey Water-Supply Paper 159, pp. 2-3, 1906. Lowe, E. N., Mississippi, its geology, geography, soil, and mineral resources: Mississippi Geol. Survey Bull. 14, pp. 29-32, 1919.

so hard and rutty that a truck going over them would soon be ruined. Fortunately the building of roads is being undertaken in this portion of the State, and though making slow progress at first, it will undoubtedly grow in popularity as the benefits are realized. Except for relieving swampy conditions the digging of drainage canals does not directly benefit the roads of the Flatwoods area because of the tendency of the clay to retain water.

## THE BAUXITE.

### TOPOGRAPHIC RELATIONS.

The bauxite deposits are found generally on the crests of hills and ridges or high on the slopes and on high terraces, but in a few localities bauxitic material is exposed by small streams at levels perhaps 50 feet lower than those of other bauxite deposits in the vicinity. The altitude of the bauxite deposits ranges from 400 to 500 feet above sea level, and they lie generally 50 to 100 feet above the neighboring stream. Their topographic position has been determined by the superior hardness of the rock bauxite, which has resisted erosion longer than the sand and clay of which the associated formations are largely composed. The hills that contain the bauxite lie just west of the Flatwoods area, the topographic features of which are due to the character of the underlying formation, the Porters Creek clay.

### STRATIGRAPHIC RELATIONS.

#### GENERAL SECTION.

Stratigraphically the bauxite is in the lower part of the Ackerman formation, the lowest formation of the Wilcox group of the Eocene. Underlying the Ackerman is the Porters Creek clay of the Midway group, also of Eocene age. It is believed that the Midway-Wilcox contact is unconformable.

An outline of the surface formations in northeastern Mississippi will serve to indicate the stratigraphic position of the bauxite beds and the sequence of the local formations.

*Outline of geologic formations in northeastern Mississippi.*

| System. | Series. | Group. | Formation and member. | Thickness (feet). | Lithology and topographic expression. |
|---|---|---|---|---|---|
| Tertiary. | Eocene. | Wilcox. | Holly Springs sand. | 160–600 | Highly cross-bedded, more or less micaceous sand with lenses of clay. Forms hilly and broken portion of north-central plateau. Steep-sided gullies produced by erosion. |
| | | | -Unconformity. | | |
| Tertiary. | Eocene. | Wilcox. | Ackerman formation. | 500–600 | Gray, more or less lignitic clay, lignite, and sand. Contains thin lenses of iron carbonate and bauxite in lower part. Forms gently rolling to hilly surface. |
| | | | -Unconformity. | | |
| Tertiary. | Eocene. | Midway. | Porters Creek clay. Tippah sandstone member. | 0–100 | Glauconitic sandstone and sand with glauconitic and lignitic clay in lower part. Forms hills and escarpments in Tippah County. |
| Tertiary. | Eocene. | Midway. | Porters Creek clay. | 150–200 | Gray joint clay, slightly lignitic in places. Forms low, flat region forested with inferior grades of oak and pine. |
| | | | -Unconformity. | | |
| Tertiary. | Eocene. | Midway. | Clayton formation. | 0–70 | Greenish-gray glauconitic sandy marl, 25 to 40 feet thick. Limestone, 0 to 25 feet thick ("*Turritella*" limestone). Forms crest and west slopes of Pontotoc Ridge and supports fine hardwood forests. |
| Unconformity. | | | | | |
| Cretaceous. | Upper Cretaceous. | | Ripley formation (Owl Creek tongue at top and McNairy sand member below). | 0–400 | Sandstone, limestone, glauconitic sand, and marl. Forms hills and broken surface known as Pontotoc Ridge. |
| Cretaceous. | Upper Cretaceous. | | Selma chalk. | 250–1,000 | Semi-indurated limestone, sandy in lower part and clayey near middle. Forms broad belt having slight topographic relief known as Black Prairies, with productive soil of black calcareous clay loam. |
| Cretaceous. | Upper Cretaceous. | | Eutaw formation. | 250–550+ | Prevailingly sand, micaceous and cross-bedded near base, glauconitic and calcareous toward top. Small lenses of clay are present in places. Forms rough and hilly surface. |
| Cretaceous. | Upper Cretaceous. | | Tuscaloosa formation. | 200± | Gravel and sand with clay lenses. |
| Unconformity. | | | | | |
| Carboniferous. | Mississippian.[a] | | Hartselle sandstone. | 100+ | Coarse-grained light-gray sandstone. |
| Carboniferous. | Mississippian.[a] | | Tuscumbia limestone. | 100+ | Blue to gray cherty limestone. |
| Carboniferous. | Mississippian.[a] | | Fort Payne chert. | 20–250 | Stratified jointed light-colored chert. |
| Unconformity. | | | | | |
| Devonian. | Lower Devonian. | | "Yellow Creek beds" of Lowe. | 100 exposed. | Dark-gray and blue shaly limestone. Crop out in bluffs and steep slopes along Tennessee River and tributary creeks in extreme northeast corner of Mississippi. |

[a] The Mississippian beds crop out only in steep hills and cliffs in the vicinity of Tennessee River.

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The distribution of the geologic formations and of the bauxite deposits is indicated in Figure 28, in which the formations are mapped in accordance with the work of E. N. Lowe, State geologist of Mississippi, and L. W. Stephenson and C. W. Cooke, of the United States Geological Survey. It has not been possible for these geologists to map the geologic boundaries with absolute accuracy, owing to the lack of topographic and other detailed maps. Certain of the bauxite deposits appear to fall within the area of the Porters Creek clay, and this may be accounted for by assuming that the geologic boundaries should be shifted in places or should be so drawn as to inclose small areas of the Ackerman formation on high points. It is doubtful if any of the bauxite is actually within the Porters Creek clay except as masses may have been gradually lowered by the erosion and disintegration of inclosing clay and sand of the Ackerman until the residual bauxite rested directly on the Porters Creek. Such an occurrence has been observed 1 mile northwest of Blue Mountain, Tippah County. As may be inferred from the distribution of the formations indicated on the map the beds have a low dip toward the southwest, which in the northern part of this area ranges from 15 to 25 feet to the mile.

The formations most closely associated with the bauxite, the Porters Creek clay and the Ackerman formation, will be described briefly.

## PORTERS CREEK CLAY.

The Porters Creek or "Flatwoods" clay of the Midway group, which lies below the beds containing the bauxite, consists of 150 to 200 feet of very fine grained, slightly lignitic gray joint clay. Lowe [5] considered that it was laid down in fresh water, but in the opinion of L. W. Stephenson the clay is of marine origin. Petrographic examination by C. S. Ross, of the United States Geological Survey, shows that this clay contains a considerable proportion of bentonitic material, possibly related to leverrierite (?). When immersed in water the clay slacks slowly, and on drying it breaks into rounded nodular lumps and conchoidal spalls.

The only available analysis of the Porters Creek clay is given in the following table. The specimen was taken from a ravine about 25 feet lower than a deposit of gravel bauxite 1 mile northwest of Blue Mountain, Tippah County, Miss. Its resemblance in composition to bentonite, analyses of which are also given in the table, is of interest.

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[5] Lowe, E. N., Mississippi, its geology, geography, soil, and mineral resources: Mississippi Geol. Survey Bull. 14, p. 64, 1919.

*Analyses of Porters Creek clay from Mississippi and of bentonite from Tennessee and Wyoming.*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Silica ($SiO_2$) | 60.68 | 56.80 | 63.25 | 59.78 |
| Alumina ($Al_2O_3$) | 15.66 | 17.01 | 12.63 | 15.10 |
| Ferric oxide ($Fe_2O_3$) | 6.40 | 2.87 | 3.70 | 2.40 |
| Ferrous oxide (FeO) | None. | | | |
| Titanium dioxide ($TiO_2$) | 1.00 | .12 | | |
| Manganous oxide (MnO) | Trace? | | | |
| Magnesium oxide (MgO) | 1.75 | 4.26 | 3.97 | 4.14 |
| Calcium oxide (CaO) | .29 | 4.40 | 4.12 | .73 |
| Sodium oxide ($Na_2O$) | | 14.54? | 3.55 | |
| Potassium oxide ($K_2O$) | | | | |
| Sulphur trioxide ($SO_3$) | | | 1.58 | |
| Moisture ($H_2O-$) | 5.56 | | | |
| Water ($H_2O+$) | 6.18 | | 6.91 | 16.26 |
| Carbon dioxide ($CO_2$) | None. | | | |
| | 97.52 | 100.00 | 99.71 | 98.41 |

1. Porters Creek clay, Blue Mountain, Miss. J. G. Fairchild, U. S. Geol. Survey, analyst.
2. Bentonite from Bragg's quarry, near Chattanooga, Tenn. Nelson, W. A., Appalachian bauxite deposits: Geol. Soc. America Bull., vol. 34, p. 537, 1923.
3. Bentonite from Newcastle, Wyo. U. S. Geol. Survey Bull. 285, p. 446, 1906.
4. Bentonite from Peach Creek, Wyo U. S. Geol. Survey Bull. 260, p. 560, 1905.

In northern Mississippi beds of sand, sandstone, and clay, reaching a maximum thickness of 100 feet in Tippah County, lie at the top of the Porters Creek clay and have been termed the Tippah sandstone member. The sandstone is gray to greenish gray, becoming yellowish on weathering; it is fossiliferous and is speckled with grains of glauconite. Its superior resistance to erosion has produced a series of hills along the west border of the Flatwoods area, such as the eminence known as Blue Mountain, an eastward-facing escarpment in Porters Creek clay capped by beds of the Tippah sandstone member. These beds have been recognized in Hardeman County, Tenn., but probably thin and disappear toward the south, as they have not attracted attention south of Tippah County, Miss.

### ACKERMAN FORMATION.

The Ackerman formation, which contains the bauxite deposits, consists of 500 to 600 feet of gray, more or less lignitic clay, lignite, and variegated sand. In the basal portion of the formation are irregular-shaped bodies of interbedded bauxite and light-colored clay. The clay contains too much fine-grained silica sand to be regarded as kaolin but is mixed with varying proportions of bauxite. Associated with the bauxite and elsewhere at two or three horizons in the lower part of the formation are lenticular masses of siderite, 6 to 20 inches thick. This iron carbonate is light gray where fresh but alters to limonite in concentric shells on the surface. It is of dense, fine-grained, and homogeneous texture and is tough and extremely resistant to the blows of a hammer. At Winborn, Benton County, a deposit of iron ore, mainly limonite altered from siderite, was mined from an open cut, and pig iron was made from it in a small charcoal blast furnace in 1914.

The Ackerman beds are regarded by Lowe [6] as having been laid down in fresh water, largely in peat swamps, as indicated by the character of the fossil leaves and tree trunks associated with the lignite, and Berry [7] regards the beds of iron carbonate as furnishing "striking evidence of the palustrine character of the early Wilcox, the low surface of the Wilcox mainland, the absence of terrigenous materials in the Wilcox lagoons at this time, and the highly ferruginous character of the run-off." There is physical evidence in Mississippi of an unconformity between the Ackerman and the underlying Porters Creek clay in the abrupt change and widely different character of the sediments, and C. W. Cooke [8] finds faunal indications of an unconformity. Berry [9] notes an erosional unconformity between the Midway and Wilcox near Fort Gaines, Ga., where numerous pothole-like depressions in the Midway, as much as 20 feet deep, are filled with Wilcox deposits, and he cites other evidence of erosional unconformities along the Rio Grande in Texas, but he considers that the most convincing evidence has been brought to light through a study of the fossil floras. It is of importance to interpret the geologic history of the early Wilcox correctly in order to account for the origin of the bauxite and siderite.

The topography of the area occupied by the Ackerman formation is more or less rolling and hilly and becomes rougher toward the west, where the Ackerman is overlain by the Holly Springs sand.

## CHARACTER.

### PHYSICAL AND CHEMICAL PROPERTIES.

As is shown in the descriptions of the deposits (pp. 116–142), the Mississippi bauxite is not at all uniform in physical or chemical character, and in this respect it is similar to most other American bauxite. The two most diverse types of material found in Mississippi are the hard or rock bauxite and the soft, claylike form. The specific gravity of four specimens from this field in lump form ranges from 1.585 in claylike material to 2.730 in rocklike, pisolitic material cemented by siderite. A large pisolite of fairly pure bauxite, containing 59.58 per cent of alumina, 2.78 per cent of silica, 1.72 per cent of ferric oxide, 3.60 per cent of titanium dioxide, and 31.98 per cent of water of constitution, showed a specific gravity of 2.050.

The rock bauxite consists of rounded, concretion-like bodies, termed pisolites, set in a finer-grained matrix or cementing medium.

[6] Lowe, E. N., op. cit., p. 67.
[7] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, pp. 43–44, 1916.
[8] Personal communication.
[9] Berry, E. W., Erosion intervals in the Eocene of the Mississippi embayment: U. S Geol. Survey Prof Paper 95, p. 76, 1916.

The pisolites range in size from those smaller than the head of a pin to some 1½ inches in diameter. They range in color from nearly white to yellow, brown, and reddish tints and are composed of fine-grained noncrystalline but strongly compacted earthy material. Polished sections show the larger pisolites to be made up of smaller granular and concretionary bodies. The hardness of typical pisolites is between 3 and 4 in the Mohs scale, or a little greater than that of calcite, but the pisolites that contain considerable iron oxide are a little harder. The matrix where ferruginous may be as hard as the pisolites, but where free from iron it is softer. In the Mississippi field the pisolites usually contain a greater percentage of alumina than the cementing matrix, and therefore a deposit that contains a large proportion of pisolitic rock bauxite may be expected to have a relatively high content of alumina. On the other hand, the harder material is likely to carry a high percentage of iron oxide, which will offset to some extent the value of the bauxite for certain purposes. The pisolitic material is similar in most respects to the bauxite of that type found in other American fields, but the softer material appears to contain more silica and impure clay and less kaolin than in the deposits of the Georgia Coastal Plain. The softer, claylike material is less pisolitic than the rock bauxite, and some that is high in bauxite may show no pisolites at all. Pseudo-pisolites occur locally in some clays and sands that do not contain bauxite, and so the presence of these small concretionary bodies in the softer material is not always a certain evidence of the presence of bauxite.

The rock bauxite crops out on the crests or upper slopes of hills and in places extends for a short distance into the hills under a cover of a few feet of soil. It is also found as boulders broken from the rock ledges or scattered about on wooded hills and in hillside fields, and in places it has disintegrated so much as to leave only loose gravel and coarse sand, or "buckshot" ore. The soft bauxite and bauxitic clay are found below a capping of rock bauxite or of soil, sand, and other unconsolidated material and as layers alternating with material that contains but little bauxite.

Notwithstanding the easily recognized characteristics of the pisolitic bauxite, other forms of rock such as ferruginous pebbly conglomerate and coarse sandstone that occur in this portion of Mississippi are likely to be mistaken for it by persons not familiar with bauxite. As the pisolitic character is less marked in the softer, more claylike material, it is difficult even for the trained prospector to appraise its quality, and so it is safest for a landowner who suspects that he has a deposit of bauxitic material to submit samples of it for identification to persons who are known to be familiar with the substance or to the State or Federal Geological Survey.

Considerable iron is present in the rock bauxite. In much of the material the iron occurs in the mineral siderite, which in fresh specimens forms a brilliantly crystalline matrix, but in most of the material the siderite has altered to limonite. Small cavities were noted lined with rhombohedral crystals of siderite 2 or 3 millimeters in length exhibiting curved faces. Dense, fine-grained siderite is found in lenticular masses below and interbedded with the bauxite, and its occurrence in this association as well as in the matrix of the bauxite is unusual for bauxite deposits of the Coastal Plain, so far as the writer has been able to ascertain, but Mead [10] has noted secondary siderite in the bauxite near Little Rock, Ark.

Bauxite is of commercial value because it consists of a mixture of hydrated oxides of aluminum from which the metal aluminum or its salts are obtained. Two other substances closely related to bauxite, both of them hydrated oxides of aluminum, have been identified in crystalline form and found to contain definite proportions of alumina and water—namely, diaspore ($Al_2O_3.H_2O$), which contains 85.01 per cent of alumina and 14.99 per cent of water, and gibbsite ($Al_2O_3.3H_2O$), which contains 65.41 per cent of alumina and 34.59 per cent of water—and it was formerly considered that bauxite could be represented by the formula $Al_2O_3.2H_2O$, with 73.93 per cent of alumina and 26.07 per cent of water, thus being intermediate between the two other hydrates.[11] However, the definite mineral corresponding to the formula of aluminum dihydrate seems not to have been identified, and its existence is doubtful. In view of these conditions it seems that the term "bauxite" may properly be applied to an amorphous mixture of hydrates of alumina containing percentages of water intermediate between those of diaspore and gibbsite. Clarke [12] states that it is sometimes near one and sometimes near the other of these minerals.

The composition of the Mississippi bauxite seems to corroborate these conclusions, for if the loss on ignition is considered entirely water and applied to the requirements of the ferric oxide as limonite ($2Fe_2O_3.3H_2O$) and of the alumina as diaspore ($Al_2O_3.H_2O$) or as gibbsite ($Al_2O_3.3H_2O$), it is found that the quantity is higher than would be required for diaspore and also generally higher than would be required by a dihydrate, if there were such a compound, and slightly lower than would be required by gibbsite. Petrographic examination by C. S. Ross shows that the substance of both pisolites and matrix is mainly amorphous, but he noted a few traces of crystalline material that included very small quantities of diaspore and gibbsite. The indices of refraction of the amorphous material varied

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[10] Mead, W. J., Occurrence and origin of the bauxite deposits of Arkansas: Econ. Geology, vol. 10, p. 43, 1915.

[11] Percentages according to Shearer, H. K., Bauxite and fuller's earth of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 31, p. 103, 1917.

[12] Clarke, F. W., The data of geochemistry, 4th ed.: U. S. Geol. Survey Bull. 695, p. 493, 1920.

between that of diaspore and that of gibbsite. The natural inference is that this variation indicates an amorphous mixture of these two hydrates of alumina.

Inspection of many analyses shows that hydrates of alumina are seldom found in a pure enough state to yield the maximum percentages of alumina. In the Mississippi deposits the commonly associated minerals are clay, sand, siderite, limonite, and various silicates and oxides, among which the oxide of titanium is almost invariably present. In commercial chemical analyses the determinations commonly made are those of alumina ($Al_2O_3$), ferric oxide ($Fe_2O_3$), silica ($SiO_2$), titanium dioxide ($TiO_2$), combined water ($H_2O+$), and moisture ($H_2O-$). One hundred or more analyses made by Dr. W. F. Hand, State chemist of Mississippi, and a few by J. G. Fairchild, of the United States Geological Survey, indicate that a large proportion of the Mississippi bauxite in its natural state contains so much ferric oxide and silica that it is of low to medium grade, as compared with deposits that are now being mined in Arkansas, Alabama, Georgia, and foreign countries. The following tabular summary of ranges in composition brings out these relations:

*Range in composition of bauxite, in per cent.*

| Locality. | $Al_2O_3$. | | $Fe_2O_3$. | | $SiO_2$. | | $TiO_2$. | | $H_2O$. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range. | Bulk | Range. | Bulk | Range. | Bulk. | Range. | Bulk. | Range. | Bulk. |
| Northeastern Mississippi [a] | 25-60 | 35-45 | 0-40 | 5-35 | 3-40 | 10-30 | 0. 5-3. 6 | 1. 5-2. 5 | 11-32 | 15-25 |
| Georgia (Coastal Plain) [b] | 34-62 | 46-58 | 0. 5-34 | 1-5 | 1. 2-32 | 10-20 | 0. 23-3. 08 | 1. 6-2. 4 | 14-33 | 23-30 |
| Georgia (Paleozoic) [c] | 51-67. 5 | 53-59 | 0-14 | 1-3 | 0. 6-12 | 2. 7-4. 8 | 0-8. 8 | 2. 4-4. 2 | 24-33 | 28.4-31.5 |
| Alabama (Paleozoic) [c] | 41-62 | ----- | 1. 20-23 | ----- | 0. 4-9 | ------- | 3. 12-3. 40 | ------- | 20-32 | ------- |
| Tennessee, Missionary Ridge [d] | 55-58 | ----- | 1. 10-1. 38 | ----- | 11-13 | ------- | --------- | ------- | 29-30. 3 | ------- |
| Arkansas [c] | 52-62 | 52-53 | 1. 7-22 | 4-10 | 2-17 | 4-10 | 3. 5-4 | 3. 5 | 17-30 | 29-30 |
| Arkansas [e] | 46-60 | ----- | 1. 6-4. 8 | ----- | 5. 5-24. 8 | ------- | 1. 3-2. 8 | ------- | 22. 9-30. 7 | ------- |
| France [c] | 60-82 | ----- | 0. 10-25 | ----- | 2-3 | ------- | --------- | ------- | 12-14 | ------- |
| France (red variety) [f] | 30-33 | ----- | 35-49 | ----- | 0-2 | ------- | 0-1. 6 | ------- | 8. 6-22 | ------- |
| France (white variety) [f] | 55-77 | ----- | 0. 10-25 | ----- | 0. 30-4. 8 | ------- | 3. 1-4 | ------- | 11-16 | ------- |
| Germany [c] | 46-76 | ----- | 6-19 | ----- | 4-11 | ------- | --------- | ------- | 26-32 | ------- |

[a] W. F. Hand, Mississippi Agricultural and Mechanical College, and J. G. Fairchild, U. S. Geological Survey, analysts.
[b] Shearer, H. K., Report on the bauxite and fuller's earth of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 31, 1917.
[c] Watson, T. L., Preliminary report on the bauxite deposits of Georgia: Georgia Geol. Survey Bull. 11, 1904.
[d] Phalen, W. C., Bauxite and aluminum in 1914: U. S. Geol. Survey Mineral Resources, 1914, pt. 1, p. 187, 1915.
[e] Mead, W. J., op. cit., p. 50. Analyses of a series of 14 samples from 3 feet to 31 feet below the surface in the same test pit.
[f] Phalen, W. C., U. S. Geol. Survey Mineral Resources, 1910, pt. 1, p. 716, 1911.

## FORM OF DEPOSITS.

About 60 deposits, most of them bauxite, the rest bauxitic clay or bauxitic limonite, in northeastern Mississippi were examined by the writer in June, 1923, and there are reported to be many deposits that were not visited. The deposits examined range in size from roadside outcrops a few inches in thickness and a few feet in length to bodies proved by prospecting to be 10 to 15 feet thick and to occupy an area of several acres. Many of the deposits are in groups so situated topographically as to suggest that they were originally parts of a single larger body that later was dissected and greatly reduced in size by erosion. None of the deposits have been mined, and until they are mined out their exact form will not be certainly known, but prospecting by digging pits and drilling holes has outlined fairly well the general form of a large number of them. A few of them consist of a fairly even ledge of rock bauxite capping the flat top of a hill, as at East Smoky Top and Big Hill, Pontotoc County. Others consist of more or less disintegrated rock bauxite in a similar position, as at Blue Mountain and east of Mount Hope Church, Tippah County. Many deposits appear to occupy terraces slightly below the highest topographic level and to have been exposed by erosion on the escarpments or steep upper slopes of the hills. Testing indicates that these deposits on terraces have irregular outlines, vertically as well as laterally, and that they do not extend far into the hills. The deposits south of the creek west of Smoky Top School, in Pontotoc County, illustrate this type. Where hard bauxite occupies knobs or ridges, its presence has influenced the local topographic forms.

In a general way the original form of the bauxite deposits may have been lenticular, such as would have been assumed by deposits of chemical sedimentary origin in swampy depressions. In places there is a suggestion that the material has been subjected to the action of spring waters, but this action is believed to have been subsequent to the formation of the main mass of bauxitic material. In vertical section the deposits consist of alternate layers of bauxite and of clay that ranges from a more or less bauxitic material to clay practically free from bauxite and admixed with sand. Many detailed sections will be found in the descriptions by counties (pp. 116–142). These sections vary greatly in details, even for test pits that are not far apart. The hard bauxite is found usually at the surface, either at the top of the deposit or on the outcrop at the brow and on the slope of the hills. The induration may have been caused by a secondary process of "casehardening," due in part to the deposition of iron carbonate by percolating waters and the subsequent alteration of the iron carbonate to limonite, for the harder bauxite is generally more ferruginous than the softer material. In the prospect pits and drill holes, which ranged in depth from 4.3 feet to 46 feet, the total thickness of the layers of bauxite and bauxitic clay encountered ranged from about 2 feet to 15.7 feet. The areal extent of the principal deposits, as indicated by prospecting, ranges from about 0.6 acre to more than 9 acres, but it is not certain that bauxite is present below the whole of the large areas, because prospecting has not been sufficiently intensive. The structure of the deposits seems to be that of many overlapping lenses of bauxite and clay, and some of these exhibit more or less gradation from one into the other.

## SUGGESTIONS AS TO GENESIS.

The geologic relations of the bauxite that are of possible significance consist in its occurrence in a formation that was evidently laid down in fresh water, largely in peat swamps, and that overlaps a thick clay which petrographic examination and chemical analysis have shown to contain a considerable proportion of bentonitic material. Below the clay and cropping out to the east of it are formations containing a great deal of glauconite. These relations offer suggestions as to the deposition of both the siderite and the bauxite. The glauconite is a possible and adequate source of the iron. Waters containing organic acids acting on glauconite would produce solutions of iron salts from which the iron might be precipitated as iron carbonate through the influence of carbonic acid and, possibly, bacterial organisms. Iron carbonate ore, apparently derived from glauconite, occurs in rocks of Eocene age in northeastern Texas.[13] Laboratory studies by Nelson[14] lead to the conclusion that bentonitic clay will readily yield alumina to ground waters containing small quantities of sulphuric acid and that swamp or surface waters containing tannic acid will precipitate the alumina. Thus it is possible that streams flowing from the Cretaceous and early Eocene land areas on the east bore glauconitic and bentonitic material in a finely divided state as well as iron and aluminum salts in solution into the waters of the Ackerman swamps, which, being charged with organic acids, produced favorable conditions for the precipitation of iron carbonate and aluminum hydroxide. Nelson indicates that similar principles may have controlled the deposition of bauxite near Chattanooga, Tenn., where alumina derived from bentonite is believed to have been precipitated through the influence of organic acids in or near peat swamps. He considers that the formation of the bauxite in eastern Tennessee took place in early Pleistocene time, but Watson[15] considered the age of the bauxite deposits of the Paleozoic area of Alabama-Georgia, which may perhaps be correlated with those near Chattanooga, to be late Eocene, which is nearly contemporaneous with those of northeastern Mississippi. The bentonitic source of the alumina in eastern Tennessee, however, is probably of Ordovician (Lowville) age, although the rocks on

[13] Burchard, E. F., Iron ore in Cass, Marion, Morris, and Cherokee counties, Tex.: U. S. Geol. Survey Bull. 620, pp. 69–109, 1915.

[14] Nelson, W. A., Appalachian bauxite deposits: Geol. Soc. America Bull., vol. 34, pp. 525–539, 1923.

[15] Watson, T. L., Preliminary report on the bauxite deposits of Georgia: Georgia Geol. Survey Bull. 11, p. 130, 1904.

which the bauxite rests are even older, and Nelson's explanation of the origin of the eastern Tennessee bauxite requires faulted structure and upward-moving ground water. The bauxite in northeastern Mississippi seems to have been formed under much less complex conditions of deposition—similar, perhaps, to those under which deposits of bog iron ore are believed to have originated. There appears to be no good evidence that these bauxite deposits originated through subaerial weathering and residual accumulation, although the possibility that some of the material was formed through the alteration of water-laid clays should be considered.

## THE DEPOSITS.

### TIPPAH AND BENTON COUNTIES.

Bauxite has been found in four localities in Tippah County and in one locality in Benton County. The localities in Tippah County are 3½ and 6 miles west of Falkner, 5½ miles west of Ripley, and 1 to 2 miles west of Blue Mountain. The locality in Benton County is a continuation of the Tippah County area 6 miles west of Falkner and extends only about half a mile into Benton County. Since the writer visited the field correspondents have reported bauxite and bauxitic clay in the southeastern part of Benton County not far from Myrtle, Union County. The towns of Falkner, Ripley, and Blue Mountain are on the Gulf, Mobile & Northern Railroad, which is the nearest rail line on which the bauxite may be carried to markets. The wagon roads to the railroad are mostly over the Porters Creek clay or Flatwoods country and are consequently poor. When the writer inspected the deposits in June, 1923, it was possible to travel to all the localities in a Ford car, but the roads were rough in places and unless improved more uniformly would be difficult for heavy hauling.

The locality 3 to 4 miles west-northwest of Falkner is in the vicinity of Mount Hope Church. East of the church, in sec. 4, T. 3 S., R. 3 E., several pits have been dug, ranging in depth from 3 or 4 feet to 16 feet. The pits are on the tops and slopes of the hills, ranging in altitude [16] from 500 to 570 feet, mostly in wooded land, and the reported thickness of the ore ranges from 1 foot to 10 or 12 feet. Near the surface and in outcrops the ore is generally hard and rocklike, but it becomes softer and more like clay below. The hard ore is generally iron stained, and fragments of limonite are associated with it. Concretionary lumps with varying proportions of limonite and bauxite were noted, and one had a central cavity partly filled with pisolites of bauxite and yellow sand. The claylike ore usually contains fewer pisolites than the hard ore.

[16] Altitudes are taken from maps of Mississippi Bauxite Co., based on assumed bench marks.

A test pit north of the main highway from Falkner showed the following section:

*Section of test pit near middle of sec. 4, T. 3 S., R. 3 E.*

| | Ft. | in. |
|---|---|---|
| Soil | | 2–6 |
| Bauxitic clay | 1 | 6 |
| Limonite, of "curly" porous texture | | 6 |
| Clay | | 8 |
| Bauxite | 2 | 6 |
| Clay | 1 | |

In the eastern part of sec. 4 the pisolites of bauxite are so large that the hard masses of bauxitic rock resemble a pebbly conglomerate. Through disintegration of the pebbly rock large quantities of loose pisolites or "pebbles" of bauxite have been spread over the east and west slopes of a low ridge that was formerly capped with the rock at an altitude of about 565 feet. These pebbles range from half an inch to 1½ inches in diameter. They are generally ellipsoidal, and many of them when broken open are found to be composed of smaller pisolitic bodies. The composition of the bauxite pebbles is that of high-grade bauxite, as shown by the analysis given below, but the matrix carries a higher percentage of impurities, such as silica. Large boulders of hard bauxite, 1 foot 6 inches to 2 feet thick, are scattered about in many places and have been much used locally for foundations of houses, as hard rocks other than bauxite and limonite are scarce. The presence of these boulders around houses proved a valuable guide to the prospectors in discovering several deposits in place. More than 100 acres of land in sec. 4 is reported to have been purchased by the Mississippi Bauxite Co. as of possible value for bauxite.

The commercial yield of the deposit in this locality is expected to range between 40 and 48 per cent of alumina, with silica between 25 and 30 per cent and iron oxide between 2 and 5 per cent, according to Morse,[17] who has estimated a total of 44,250 tons of bauxite in two tracts in the N. ½ sec. 4, T. 3 S., R. 3 E.

*Analysis of large bauxite pisolite from deposit 4 miles west-northwest of Falkner, Tippah County, Miss.*

[J. G. Fairchild, analyst.]

| | |
|---|---|
| Alumina ($Al_2O_3$) | 59. 58 |
| Ferric oxide ($Fe_2O_3$) | 1. 72 |
| Ferrous oxide (FeO) | None. |
| Silica ($SiO_2$) | 2. 78 |
| Titanium dioxide ($TiO_2$) | 3. 60 |
| Magnesium oxide (MgO) | . 07 |
| Calcium oxide (CaO) | None. |
| Moisture ($H_2O-$) | . 36 |
| Loss on ignition ($H_2O+$) | 31. 98 |
| Manganous oxide (MnO) | Trace? |
| Carbon dioxide ($CO_2$) | None. |
| | 100. 09 |

[17] Morse, P. F., op. cit., pp. 158–159.

In the NE. ¼ sec. 5, T. 3 S., R. 3 E., west of and part way down the ridge below Mount Hope Church, are boulders and lumps of float bauxite coming from a hillside outcrop at an altitude of about 455 feet. This rock bauxite is more or less ferruginous as well as siliceous and is regarded as carrying between 30 and 38 per cent of alumina.

Another locality in which bauxite occurs is 1½ to 2½ miles west of Mount Hope Church, on the headwaters of Shelby Creek, southwest of the village of Finger, Tippah County, and extending half a mile into Benton County. By wagon road this locality is about 7 miles west of the Gulf, Mobile & Northern Railroad at Falkner, although only about 6 miles in an air line. Here the bauxite is found principally on and near the banks of small creeks or branches, which have cut into the deposits. Associated with the bauxite is much limonite in various stages of alteration from lumps of impure siderite or "clay ironstone." In a small branch of Shelby Creek about a quarter of a mile south of Finger the following section occurs:

*Section in southern part of sec. 6, T. 3 S., R. 2 E.*

| | Ft. | in. |
|---|---|---|
| Soil and loose bauxite boulders | 5 | |
| Bauxite (massive) | 2 | 10 |
| Iron carbonate incrusted by limonite | 1 | 4 |
| Clay. | | |

Analyses of an unweathered specimen of the iron carbonate and of its incrustation were made with the following results:

*Analyses of fresh and altered iron carbonate from deposit near Finger, Tippah County, Miss.*

[J. G. Fairchild, analyst.]

| | Unweathered specimens. | Altered incrustation. |
|---|---|---|
| Silica ($SiO_2$): | | |
| Soluble | 0.51 | Not det. |
| Insoluble | 11.88 | 16.18 |
| Ferrous oxide (FeO) | 50.20 | 0.43 |
| Ferric oxide ($Fe_2O_3$) | 1.05 | 69.83 |
| Alumina ($Al_2O_3$) | .00 | Not det. |
| Titanium dioxide ($TiO_2$) | .22 | Not det. |
| Ferrous carbonate ($FeCO_3$) | 80.84 | 0.693 |

Down this creek as far as the Benton County line beds of softer bauxitic clay, abundantly pisolitic, are exposed in several places, and on the slopes above the creek débris of hard bauxite is exposed by the uprooting of a tall pine tree and numerous boulders of similar material were noted. Several prospect pits have been made north of the main wagon road near the Tippah-Benton County line and in the SE. ¼ sec. 1, T. 3 S., R. 2 E., in Benton County. Much of the bauxite seen in Benton County is soft and claylike. Some of the deposits are fairly thick, one of them showing nearly 15 feet vertically in the bank of a stream. The bauxite in this locality is abundant but is regarded as of mediocre grade, the larger part of it carrying between 30 and 35 per cent of alumina and the remainder between 35 and 40 per cent; the iron oxide and silica are high. Morse[18] has estimated a total of 735,333 tons of bauxite in two tracts partly in sec. 5 and partly in sec. 12, T. 3 S., R. 3 E., Benton County, consisting of 405,333 tons carrying about 31 per cent of alumina and 330,000 tons carrying 34 to 42 per cent.

The bauxite deposits in Benton and Tippah counties west of Falkner appear to be near the base of the Ackerman formation. A short distance above the bauxite are beds of pure-white sandy clay, and a little higher are exposures of lignitic clay. The altitude of these bauxite deposits ranges between 425 and 460 feet above sea level.

About 5½ miles directly west of Ripley, in the vicinity of Shady Grove, bauxitic clay and float fragments of bauxite along the roadsides led to the prospecting of some ridge land near the west edge of sec. 12 and in the NE. ¼ sec. 14, T. 4 S., R. 2 E. One of these prospects near the top of the ridge about an eighth of a mile north of Shady Grove shows yellowish bauxitic clay, reported to contain between 40 and 50 per cent of alumina, and on the west slope of the hill below this pit are masses of rock bauxite generally of fair grade but inclined to show iron oxide stains in places. In the most ferruginous material the iron oxide seems to be segregated chiefly in the pisolites, and the purest bauxite occurs as the matrix.

A specimen of slightly pisolitic smooth white clay, thought to be bauxitic, from a roadside outcrop about 5½ miles west of Ripley was analyzed in the laboratory of the United States Geological Survey with the following results:

*Analysis of slightly pisolitic white clay from deposit 5½ miles west of Ripley, Tippah County, Miss.*

[J. G. Fairchild, analyst.]

| | |
|---|---|
| Silica ($SiO_2$) | 47.32 |
| Alumina ($Al_2O_3$) | 36.18 |
| Ferric oxide ($Fe_2O_3$) | 1.08 |
| Ferrous oxide (FeO) | None. |
| Titanium dioxide ($TiO_2$) | 1.60 |
| Manganous oxide (MnO) | Trace? |
| Magnesium oxide (MgO) | .07 |
| Calcium oxide (CaO) | None. |
| Carbon dioxide ($CO_2$) | None. |
| Moisture ($H_2O-$) | .49 |
| Water ($H_2O+$) | 13.19 |
| | 99.93 |

[18] Morse, P. F., op. cit., p. 165.

The fourth area containing bauxite in Tippah County is northwest and west of the town of Blue Mountain, deposits having been found at distances of 1 to 2½ miles from the Gulf, Mobile & Northern Railroad. These deposits are the nearest to the railroad of all that have been discovered in northeastern Mississippi. The deposit in the NE. ¼ sec. 1, T. 5 S., R. 2 E., is the one of which Hilgard wrote, as quoted on page 101. This deposit is about 1 mile northwest of Blue Mountain station, on a hill occupied in part by an old graveyard. Float bauxite in the form of small, loose pebbles is scattered over the northeast slope of the hill, and residual masses of "shot ore" several feet thick occur in a small area on the crest of the hill. Just northwest of the graveyard, in a steep gully, fine-grained gray clay, typical of the Porters Creek (see analysis, p. 109), is well exposed not more than 25 feet lower than the bauxite, and large boulders of rock bauxite lie in the gully. The whole deposit of bauxite may be residual, having been let down from its original position by disintegration, erosion, and solution of underlying beds until it rested practically upon the Porters Creek clay. This bauxite appears to be of good grade: a sample of the loose ore is reported to have contained 57 per cent of alumina. The quantity in sight is small, and its topographic position is such as to preclude the probability of much more being found by prospecting, but in view of its nearness to the railroad, it may perhaps be shipped profitably when a market is created for bauxite in this region.

Bauxitic clay crops out in gullies at the side of the road west of Blue Mountain in secs. 11 and 12, T. 5 S., R. 2 E. This clay in the SW. ¼ sec. 11 is white to cream-colored, is finely laminated in places, and shows faint elliptical spots that suggest pisolites, but the material in the spots is as soft as the matrix. In the NW. ¼ sec. 12 boulders and float fragments of rock bauxite were found in a field on the top and on the east slope of a hill south of the main wagon road. A few pits sunk on top of the hill showed deposits 3 to 4 feet thick of hard light-colored bauxite and bauxitic clay. The whole of the bauxite-bearing area near Blue Mountain falls within the area of Porters Creek clay as mapped by Lowe, but it appears probable that the bauxite is above this clay, as it lies on high points that are probably remnants of the Ackerman formation.

The following sections of test pits and chemical analyses of bauxite from the pits are available through the courtesy of the Mississippi Bauxite Co:

*Sections of test pits and analyses of bauxite, Tippah and Benton counties, Miss.*[a]

**Tippah County.**

| Location. | Pit No. | Altitude (feet). | Section. | | Analyses. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| NE. ¼ NE. ¼ sec. 4, T. 3 S., R. 3 E. | 1 | 572 | Overburden | 0.0 | | | | | | |
| | | | Bauxite | 12.0 | 47.75 | 2.15 | 27.24 | 2.40 | 19.76 | 0.78 |
| | | | Clay | 1.0 | | | | | | |
| Do | 2 | 559 | Overburden | 1.0 | | | | | | |
| | | | Bauxite | 2.5 | | | | | | |
| | | | Clay | 8.0 | | | | | | |
| S. ½ NW. ¼ sec. 4, T. 3 S., R. 3 E. | 1 | 501 | Float | 3.5 | | | | | | |
| | | | Bauxite | 3.5 | | | | | | |
| | | | Clay | 1.5 | | | | | | |
| Do | 2 | 501 | Overburden | 0.0 | | | | | | |
| | | | Bauxite | 2.5 | | | | | | |
| | | | Iron | 0.8 | | | | | | |
| | | | Bauxite | 1.0 | | | | | | |
| Do | 3 | 506 | Overburden | 4.0 | | | | | | |
| | | | Bauxite | 10.3 | 40.58 | 4.72 | 26.96 | 2.20 | 16.33 | 9.25 |
| | | | Clay, bauxitic | 0.7 | | | | | | |
| NW. (?) ¼ sec. 5, T. 3 S., R. 3 E. | 1 | 457 | Overburden | 2.0 | | | | | | |
| | | | Bauxite | 3.0 | 32.44 | 8.06 | 38.86 | 0.50 | 11.92 | 7.45 |
| | | | Do | 2.5 | 30.62 | 25.88 | 22.26 | 0.90 | 15.30 | 3.12 |
| | | | Do | 2.5 | 37.90 | 5.90 | 29.86 | 1.20 | 15.00 | 8.89 |
| **Benton County.** | | | | | | | | | | |
| SW. ¼ NE. ¼ sec. 12, T. 3 S., R. 2 E. | 1 | 440 | Overburden | 2.5 | | | | | | |
| | | | Clay, bauxitic | 2.0 | 29.64 | 9.06 | 39.30 | 0.60 | 11.00 | 2.54 |
| | | | Sandstone | 1.5 | | | | | | |
| | | | Bauxite | 3.0 | 32.45 | 10.05 | 33.88 | 0.70 | 12.66 | 6.84 |
| | | | Do | 3.0 | 29.60 | 32.00 | 14.80 | 0.80 | 15.90 | 5.33 |
| | | | Clay | 1.5 | | | | | | |
| Do | 1 | 426 | Overburden | 1.5 | | | | | | |
| | | | Bauxite | 4.0 | 34.57 | 7.33 | 41.80 | 1.60 | 12.32 | 0.65 |
| | | | Do | 4.0 | 34.18 | 16.62 | 31.28 | 1.60 | 14.70 | 1.65 |
| | | | Do | 4.2 | 38.00 | 10.60 | 28.88 | 1.60 | 15.22 | 6.77 |
| | | | Do | 2.7 | 41.61 | 1.49 | 38.56 | 1.60 | 15.55 | 0.52 |
| | | | Clay | 0.3 | | | | | | |

[a] Sections by W. C. and P. F. Morse; analyses by W. F. Hand.

## UNION COUNTY.

The deposits of bauxite that have been found in Union County are in the western and southwestern parts of the county, in Tps. 7 and 8 S., R. 1 E., and are adjacent to some valuable deposits in the Smoky Top area, in northwestern Pontotoc County. These deposits are west of the area of the Porters Creek clay as mapped by Lowe.

Specimens of hard, coarsely pisolitic bauxite with an appreciable proportion of silica sand but not much iron oxide in the matrix were sent to the United States Geological Survey in March, 1924, by John H. Carnal, who reported the occurrence of this material on his place in sec. 8, T. 7 S., R. 1 E., at a distance of 8½ miles from the railroad at Myrtle. He reports a thickness of 20 feet, more or less, of bauxite and associated clay and states that there are indications of an extensive deposit, but there has been no opportunity for the writer to make a field inspection of this deposit. The specimens consist of a fair grade of bauxite. This deposit is the farthest north of all thus far noted in Union County. J. C. Harris has submitted specimens of ferruginous pisolitic hard bauxite obtained near Etta.

In the S. ½ NW. ¼ and the N. ½ SW. ¼ sec. 33, T. 7 S., R. 1 E., several occurrences of bauxite are known. On a wooded hill northeast of the abandoned Pontotoc and Memphis wagon road ferruginous bauxite boulders 2 feet or more in thickness crop out, and 20 feet higher, on top of the hill, a prospect shows the following section:

*Section of prospect pit on hill in western part of sec. 33, T. 7 S., R. 1 E.*

| | Ft. | in. |
|---|---|---|
| Soil and clay | 1 | 6 |
| Bauxite, slightly ferruginous in places | 7–8 | |
| Bauxitic clay, white | 4 | |
| Clay, white, free from grit | 3 | |

Several other outcrops were noted around the periphery of this hill, which is several acres in extent.

In the W. ½ SW. ¼ sec. 4 and the E. ½ SE. ¼ sec. 5, T. 8 S., R. 1 E., there is float bauxite, and two prospect pits sunk to depths of 6 and 8 feet are reported to have shown 3 to 4 feet of ore. Near the middle of sec. 5, principally in the SE. ¼ NW. ¼, there are outcrops of ferruginous bauxite about an eighth of a mile apart in ravines on the east and west sides of a ridge. Seven prospects sunk on and near the top of the ridge did not yield very encouraging indications, and it will probably be essential to drive trenches in on the outcropping ledges in order to demonstrate whether they are continuous through the hill. The indications suggest either an irregular deposition of bauxite or else a partly eroded mass upon which sand and clay have subsequently been laid. Limonite was found in all the test pits, whether bauxite was present or not, and there was more or less siderite in very hard lumps.

In the western part of the NE. ¼ sec. 8, T. 8 S., R. 1 E., bauxite in hard ferruginous ledges crops out around the margin of a low hill covered by a pine thicket. One test pit in clay that was caving down at the time of visit showed hard, ferruginous bauxite on the dump, and the ledge from which it had been derived was said to be 4 or 5 feet thick. Another hole a few rods distant showed only clay and sand.

Two localities affording indications of bauxite have been noted in sec. 10, T. 8 S., R. 1 E. In the W. ½ SW. ¼, half a mile south of the settlement known as Pinedale, a roadside outcrop shows bauxite and bauxitic clay accompanied by a little siderite in small concretions surrounded by crusts of limonite. The following prospect pit was noted:

*Section in prospect pit on hill in SW. ¼ sec. 10, T. 8 S., R. 1 E.*

| | Ft. | in. |
|---|---|---|
| Soil and clay | 4 | |
| Limonite | | 1½ |
| Bauxite and bauxitic clay containing pieces of siderite and streaks of lignite | 8–10 | |
| Water. | | |

A specimen of the siderite containing pisolites was analyzed in the laboratory of the United States Geological Survey. The specimen was divided into two portions—the fine-grained body of the rock (1) and the pisolites separated from the matrix (2). The analyses indicate that No. 1 is largely a mixture of aluminum hydrate and iron carbonate and that No. 2 is similar but contains more aluminum hydrate and less iron carbonate. Possibly this is suggestive of replacement of the iron carbonate by aluminous minerals.

*Analyses of aluminous iron carbonate and associated pisolites from southwestern Union County, Miss.*

[J. G. Fairchild, analyst.]

| | 1 | 2 |
|---|---|---|
| Silica ($SiO_2$) | 2.88 | 8.10 |
| Alumina ($Al_2O_3$) | 27.83 | 38.55 |
| Ferric oxide ($Fe_2O_3$) | 1.78 | 3.35 |
| Ferrous oxide ($FeO$) | 27.58 | 15.29 |
| Titanium dioxide ($TiO_2$) | 2.00 | 2.80 |
| Manganous oxide ($MnO$) | 1.53 | .75 |
| Magnesium oxide ($MgO$) | .77 | .51 |
| Calcium oxide ($CaO$) | 1.10 | .51 |
| Carbon dioxide ($CO_2$) | 19.13 | 10.84 |
| Moisture ($H_2O-$) | Not det. | .73 |
| Water ($H_2O+$) | 15.55 | 19.63 |
| | 100.15 | 101.06 |
| Iron carbonate ($FeCO_3$) | 44.46 | 24.64 |

Near the southern border of Union County, in the N. ½ SW. ¼ and S. ½ NW. ¼ sec. 16, T. 8 S., R. 1 E., about a quarter of a mile south-southeast of the Pinedale and Lafayette Springs road, bauxite ledges crop out at the sides of small gullies. The rock is hard, dark brownish red, and rather ferruginous. Prospects a short distance from the outcrop on higher ground show only a little bauxite, mainly in the form of clay.

The bauxite-bearing portions of the above-mentioned lands on the farms of L. B. Busby, O. D. Gray, J. V. Wallace, T. D. Messer, L. W. Robbins, and Tom Hudson are reported to have been leased by the Mississippi Bauxite Co. This company has kindly furnished the following sections and analyses:

*Sections of test pits and analyses of bauxite, Union County, Miss.*[a]

| Location. | Pit No. | Altitude (feet). | Section. | | Analysis. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| N. ½ SW. ¼ sec. 33, T. 7 S., R. 1 E. | 1 | 454 | Overburden | 1.4 | | | | | | |
| | | | Clay, bauxitic | 2.0 | | | | | | |
| | | | Bauxite | 5.0 | 34.52 | 15.88 | 29.08 | 1.60 | 14.30 | 2.38 |
| | | | Clay, bauxitic | 1.0 | | | | | | |
| | | | Clay, gray | 6.7 | | | | | | |
| SE. ¼ NW. ¼ (?) sec. 5, T. 8. S., R. 1 E. | 1 | 543 | Overburden | 13.2 | | | | | | |
| | | | Clay, bauxitic | 5.8 | 30.12 | 16.86 | 30.58 | 1.36 | 15.82 | 4.77 |
| | | | Clay | 4.5 | | | | | | |
| Do | 3 | 550 | Overburden | 18.8 | | | | | | |
| | | | Bauxite, hard | 4.5 | 41.07 | 25.49 | 10.06 | 1.84 | 18.80 | 3.43 |
| | | | Bauxite | 3.5 | 43.67 | 15.13 | 15.66 | 2.00 | 21.40 | 1.60 |
| | | | Clay | 1.1 | | | | | | |
| Do | 5 | 539 | Overburden | 9.7 | | | | | | |
| | | | Clay, bauxitic | 1.4 | | | | | | |
| | | | Clay | [b]2.8 | 34.43 | 8.81 | 29.86 | 1.76 | 14.53 | 9.80 |
| | | | Clay, bauxitic | 4.0 | | | | | | |
| | | | Clay and sand | 2.4 | | | | | | |
| Do | 7 | 543 | Overburden | 9.1 | | | | | | |
| | | | Bauxite, soft | 1.2 | 25.23 | 17.79 | 32.54 | 1.52 | 12.44 | 4.01 |
| | | | Bauxite, hard | 2.4 | 26.86 | 38.56 | 11.58 | 1.52 | 15.45 | 3.84 |
| | | | Bauxite, soft | 2.5 | 35.98 | 14.46 | 26.92 | 1.76 | 15.55 | 5.12 |
| | | | Clay, bauxitic | .9 | | | | | | |
| | | | Clay | 1.2 | | | | | | |
| Do | 8 | 541 | Overburden | 3.6 | | | | | | |
| | | | Bauxite (?), soft | 1.0 | 9.37 | 41.19 | 31.18 | 1.44 | 12.95 | 1.97 |
| | | | Bauxite | 3.6 | 30.35 | 32.65 | 15.02 | 1.60 | 16.10 | 2.95 |
| | | | Clay, bauxitic | 1.2 | | | | | | |
| | | | Clay | 1.7 | | | | | | |
| NE. ¼ sec. 8, T. 8 S., R. 1 E. | 1 | 401 | Overburden | 8.9 | | | | | | |
| | | | Bauxite, reddish yellow, lower part hard. | 3.9 | 28.76 | 39.94 | 7.16 | 1.60 | 18.37 | 2.85 |
| | | | Bauxite, soft, reddish yellow. | 2.9 | 36.00 | 14.44 | 27.26 | 1.76 | 15.80 | 2.35 |
| | | | Clay, bauxitic | 1.0 | | | | | | |
| | | | Clay | .6 | | | | | | |

[a] Sections by W. C. and P. F. Morse; analyses by W. F. Hand.
[b] Not included in sample analyzed.

Morse[19] has estimated a total of 66,071 tons of bauxite in southwestern Union County, comprising 43,405 tons of bauxite carrying 30 to 34 per cent of alumina, 2,666 tons carrying 35 per cent, and 20,000 tons carrying 41 to 44 per cent. The area underlain by this bauxite measured on the property maps appears to cover about 5.72 acres in secs. 5 and 8, T. 8 S., R. 1 E., and sec. 33, T. 7 S., R. 1 E.

## PONTOTOC COUNTY.

The bauxite deposits of Pontotoc County are in the western part of the county, in Tps. 8, 9, and 10 S., R. 1 E., at distances of 9 to 15 miles from the railroad at Pontotoc, the county seat, but those in the extreme northwest corner of the county can be reached best from the railroad station at Ecru. The Pontotoc County deposits include some of the most valuable that have been studied. Most of them lie in the area of the Ackerman formation, but some of those in T. 10 S. are within the Porters Creek clay area as delineated by Lowe.

[19] Morse, P. F., op. cit., pp. 145-148.

In the northwestern part of the county, in the S. ½ sec. 20 and the N. ½ sec. 29, T. 9 S., R. 1 E., in what is known as the Smoky Top locality, are some of the best prospected deposits of bauxite in Mississippi. Smoky Top is an east-west wooded ridge more than half a mile in length, having a few northward-projecting spurs and an outlying oval hill at the east end. (See fig. 29.) At the north base of this hill is the Smoky Top School, also known as the Bond Spring School. On the hillside south of the schoolhouse is a prominent outcrop of rock bauxite, and several large boulders have broken from it and lie on the hill slope. The thickness of these blocks reaches more than 4 feet. The main area of bauxite lies along the ridge west of the schoolhouse, and prospects extend along the north slope and on top of the ridge for more than a mile and indicate a width of several hundred feet. The altitude of these deposits, based on an assumed bench mark, ranges from 490 to 515 feet, and their height above local drainage level is 50 to 75 feet. Where trenches dug on the outcrop indicated good showings pits were sunk higher on the hill, and most of them disclosed bauxite, but generally the material under cover is softer and apparently carries less true bauxite and more clay than on the weathered outcrops. The overburden consists of soil and clay to depths of a few inches to 20 feet, and the thickness of the bauxite or bauxitic material is reported to have been from 10 to 18 feet. (See fig. 30.) At the time of visit the test pits were not in condition for verification of details, as many of them were caved and contained water, but the material dumped from the pits indicated that in most places the section was composed largely of bauxite and highly bauxitic clay. The soft, claylike bauxite is white to yellowish, contains some sand, and generally shows pisolites of bauxite of various sizes.

The following analysis of white, partly pisolitic bauxitic clay from one of the test pits was made in the laboratory of the United States Geological Survey:

*Analysis of bauxitic clay from test pit in the SE. ¼ SW. ¼ sec. 20, T. 9 S., R. 1 E., Pontotoc County, Miss.*

[J. G. Fairchild, analyst.]

| | |
|---|---|
| Silica ($SiO_2$) | 28. 61 |
| Alumina ($Al_2O_3$) | 46. 27 |
| Ferric oxide ($Fe_2O_3$) | 1. 46 |
| Ferrous oxide (FeO) | None. |
| Titanium dioxide ($TiO_2$) | 2. 50 |
| Manganous oxide (MnO) | Trace? |
| Magnesium oxide (MgO) | Trace |
| Calcium oxide (CaO) | None. |
| Carbon dioxide ($CO_2$) | None. |
| Moisture ($H_2O-$) | . 62 |
| Water ($H_2O+$) | 20. 56 |

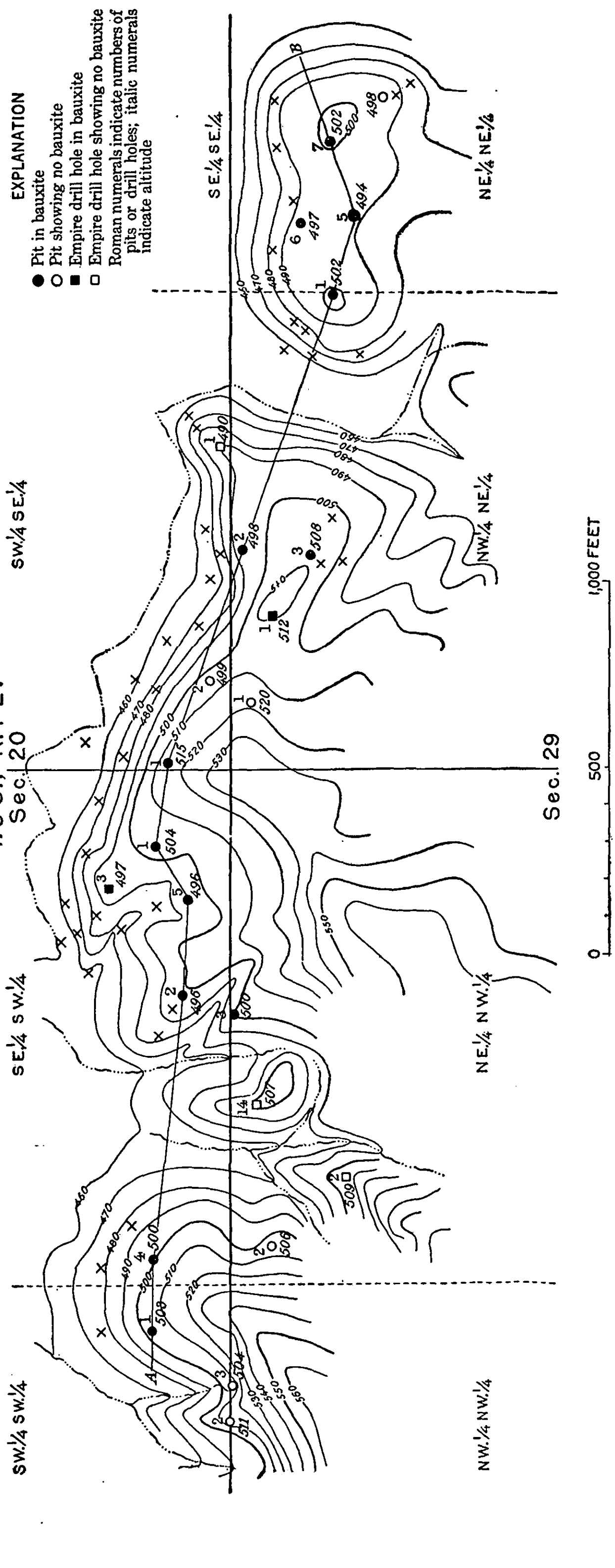


FIGURE 29.—Topographic map of Smoky Top bauxite area, Pontotoc County, Miss. *A–B*, Line of section in Figure 30. ×, Outcrop of bauxite.

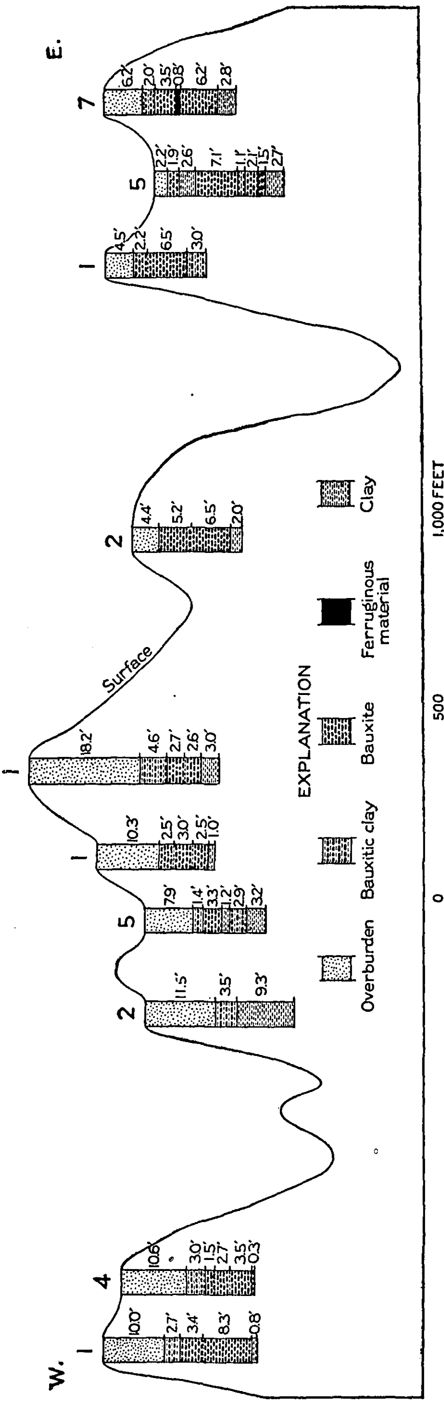


FIGURE 30.—Cross section of bauxite prospect pits, Smoky Top area, Pontotoc County, Miss., along line *A–B*, Figure 29. Vertical scale exaggerated.

In places, particularly on a tract south of the schoolhouse, the material cementing the hard ore consists of tabular yellowish to pink and brown crystalline siderite, or iron carbonate. The sparkling appearance of this mineral has earned for it the local term "mica." More or less siderite is associated with these deposits, and in prospect pits that have been sunk below water level very hard lumps of fine-grained siderite, mostly free from bauxite, are found. Where oxidation has occurred the iron carbonate passes into one of the hydrous oxides of iron, principally limonite, forming crusts or shells around the hard nucleus of siderite. The great quantity of limonite in the lower part of the Wilcox group in the Gulf States undoubtedly had its origin in siderite. The crystalline siderite that cements the rock bauxite is apparently readily altered to limonite, as may be noted in specimens showing various stages of the process. The close association of bauxite and siderite is shown by lumps of siderite that contain pisolites of bauxite. The pisolites of bauxite in the hard ore range in diameter from 0.02 inch to 1½ inches, gradations from 0.04 to 0.3 inch in diameter having been observed within a single piece of ore 2 or 3 inches thick.

The bauxite in the Smoky Top area carries from 25 to 58 per cent of alumina, 2 to 37 per cent of ferric oxide, 7 to 43 per cent of silica, and 1.3 to 3 per cent of titanium dioxide. The bulk of the available bauxite is considered to fall within the 30 to 35 per cent and 40 to 45 per cent grades, although an appreciable quantity is indicated as falling below, between, and above these grades. A summary of estimated tonnage is given on page 135. About 260 acres of land in the bauxite area, on the farms of J. R. Warren, A. B. Sneed, Oscar Sneed, and J. W. and D. M. Lowe, is reported to be controlled by the Mississippi Bauxite Co.

Bauxite crops out in ravines at the edge of a pine-covered hill east of the Smoky Top wagon road in the NE. ¼ sec. 20, T. 8 S., R. 1 E., on land of O. D. Gray, and in the NW. ¼ sec. 33, T. 8 S., R. 1 E., on land of T. A. Montgomery. On the Montgomery place several prospect holes have been dug which are reported to have disclosed about 4 feet of ore at the point of a low hill west of the wagon road. Some of this land has been leased by the Mississippi Bauxite Co.

The Smoky Top locality can be reached in dry weather by automobile by a rather roundabout road from the railroad at Ecru, a distance of nearly 15 miles, but much work would have to be done on this road before heavy loads could be hauled over it economically.

The following test-pit sections and analyses of bauxite from the Smoky Top locality were furnished by the Mississippi Bauxite Co.:

*Sections of test pits and analyses of bauxite, Smoky Top locality, Pontotoc County, Miss.* [a]

**East Smoky Top.**

| Location. | Pit No. | Altitude (feet). | Section. | | Analysis. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| NE. ¼ NE. ¼ sec. 29, T. 8 S., R. 1 E. | 1 | 502 | Overburden | 4.5 | | | | | | |
| | | | Bauxite | 2.2 | 35.94 | 15.26 | 23.30 | 2.24 | 17.10 | 6.48 |
| | | | Do | 6.5 | 38.49 | 23.81 | 12.62 | 1.70 | 20.00 | 1.45 |
| | | | Clay, bauxitic | 3.0 | | | | | | |
| Do | 5 | 494 | Overburden | 2.2 | | | | | | |
| | | | Bauxite | 1.9 | | | | | | |
| | | | Clay | 2.6 | | | | | | |
| | | | Bauxite | 7.1 | 52.10 | 3.42 | 19.51 | 1.68 | 22.05 | 1.08 |
| | | | Clay | 1.1 | | | | | | |
| | | | Bauxite | 2.1 | 57.68 | 0.14 | 15.36 | 1.68 | 25.22 | 0.60 |
| | | | Clay, bauxitic | 1.5 | 52.08 | 0.06 | 25.82 | 1.76 | 20.28 | 0.43 |
| | | | Clay and sand | 2.7 | | | | | | |
| Do | 6 | 497 | Overburden | 4.7 | | | | | | |
| | | | Bauxite | 7.3 | 33.25 | 29.65 | 13.03 | 2.24 | 17.12 | 3.92 |
| | | | Do | 4.0 | 42.59 | 8.67 | 17.78 | 2.24 | 20.40 | 8.30 |
| | | | Clay | .3 | | | | | | |
| | | | Bauxite | 1.7 | 55.40 | 2.40 | 12.40 | 1.60 | 19.60 | 8.24 |
| | | | Clay | 3.5 | | | | | | |
| Do | 7 | 502 | Overburden | 6.2 | | | | | | |
| | | | Bauxitic clay | 2.0 | | | | | | |
| | | | Bauxite | 3.5 | 33.76 | 36.48 | 8.20 | 1.60 | 18.08 | 2.00 |
| | | | Iron | .8 | | | | | | |
| | | | Bauxite | 6.2 | 49.11 | 8.53 | 16.12 | 2.40 | 22.73 | 1.45 |
| | | | Clay | 2.8 | | | | | | |

**West Smoky Top.**

| Location. | Pit No. | Altitude (feet). | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
|---|---|---|---|---|---|---|---|---|---|---|
| NW. ¼ NE. ¼ sec. 29, T. 8 S., R. 1 E. | 2 | 498 | Overburden | 4.4 | | | | | | |
| | | | Bauxite | 5.2 | 34.00 | 32.88 | 11.85 | 1.92 | 17.23 | 2.75 |
| | | | Do | 6.5 | 36.58 | 26.42 | 9.84 | 2.00 | 21.60 | 1.72 |
| | | | Clay | 2.0 | | | | | | |
| Do | 3 | 509 | Overburden | .8 | | | | | | |
| | | | Bauxite | 7.0 | 40.86 | 30.08 | 6.84 | 1.80 | 19.30 | 2.36 |
| | | | Do | 2.7 | 48.48 | 1.54 | 20.98 | 2.64 | 21.32 | 4.50 |
| | | | Clay | 1.4 | | | | | | |
| | | | Bauxite | 3.1 | 54.14 | 0.00 | 15.48 | 2.96 | 25.60 | 1.24 |
| | | | Clay | 3.0 | | | | | | |
| Do | 1 | 512 | Overburden | 12 | | | | | | |
| | | | Bauxite, red | 4.0 | 26.72 | 21.02 | 24.48 | 1.76 | 13.75 | 2.50 |
| | | | Bauxite | 4.0 | 41.79 | 9.51 | 15.76 | 2.70 | 20.20 | 7.77 |
| | | | Clay, blue | 20 | | | | | | |
| | | | Clay, lignitic | 6.0 | | | | | | |
| SW. ¼ SE. ¼ sec. 20, T. 8 S., R. 1 E. | 1 | 490 | Overburden | 1.3 | | | | | | |
| | | | Bauxite | 15.7 | 41.92 | 14.24 | 16.50 | 2.88 | 21.12 | 3.40 |
| | | | Clay | 13.0 | | | | | | |
| Do | 1 | 515 | Overburden | 18.2 | | | | | | |
| | | | Clay, bauxitic | 4.6 | | | | | | |
| | | | Bauxite | 2.7 | 32.94 | 31.78 | 10.67 | 1.92 | 18.97 | 3.13 |
| | | | Do | 2.6 | 40.34 | 19.38 | 11.63 | 2.48 | 23.50 | 2.18 |
| | | | Clay | 3.0 | | | | | | |
| SE. ¼ SW. ¼ sec. 20, T. 8 S., R. 1 E. | 1 | 504 | Overburden | 10.3 | | | | | | |
| | | | Bauxite | 2.5 | 25.54 | 28.70 | 30.16 | 1.36 | 13.44 | .63 |
| | | | Do | 3.0 | 30.43 | 34.29 | 9.28 | 1.68 | 22.06 | 1.87 |
| | | | Do | 2.5 | 33.83 | 34.38 | 7.37 | 2.24 | 22.35 | 1.20 |
| | | | Clay | 1.0 | | | | | | |
| Do | 2 | 496 | Overburden | 11.5 | | | | | | |
| | | | Clay, bauxitic | 3.5 | 39.94 | ........ | 42.50 | 1.92 | 13.59 | 2.42 |
| | | | Clay | 9.3 | | | | | | |

[a] Sections by W. C. and P. F. Morse; analyses by W. F. Hand.

*Sections of test pits and analyses of bauxite, Smoky Top locality, Pontotoc County, Miss.*—Continued.

**West Smoky Top**—Continued.

| Location. | Pit No. | Altitude (feet). | Section. | | Analysis. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| SE. ¼ SW. ¼ sec. 20, T. 8 S., R. 1 E. | 3 | 497 | Overburden | 8.3 | | | | | | |
| | | | Clay, bauxitic | 1.3 | | | | | | |
| | | | Clay | 6.5 | | | | | | |
| | | | Clay, bauxitic | 2.5 | | | | | | |
| | | | Clay | 6.0 | | | | | | |
| Do | 4 | 500 | Overburden | 10.6 | | | | | | |
| | | | Clay, bauxitic | 3.0 | 30.14 | ---- | 31.10 | 2.40 | 13.36 | 4.11 |
| | | | Bauxite, hard | 1.5 | 35.76 | 28.46 | 5.87 | 2.32 | 26.56 | 1.55 |
| | | | Bauxite, soft | 2.7 | 49.92 | 4.12 | 14.83 | 2.80 | 23.75 | 4.22 |
| | | | Do | 3.5 | 50.90 | 1.36 | 17.16 | 2.64 | 23.76 | 4.04 |
| | | | Clay | .3 | | | | | | |
| Do | 5 | 496 | Overburden | 7.9 | | | | | | |
| | | | Clay, bauxitic | 1.4 | | | | | | |
| | | | Bauxite, soft | 3.3 | 46.75 | .00 | 32.15 | 2.00 | 18.67 | 1.40 |
| | | | Clay | 1.2 | | | | | | |
| | | | Clay, bauxitic | 2.9 | 51.15 | .15 | 18.54 | 2.40 | 23.80 | .95 |
| | | | Clay | 3.2 | | | | | | |
| Do | 3 | 497 | Overburden | 11.0 | | | | | | |
| | | | Clay, bauxitic | 3.0 | 30.59 | 11.76 | 43.70 | 1.90 | 12.76 | .40 |
| | | | Bauxite, hard | 6.0 | 29.11 | 32.59 | 16.57 | 1.80 | 19.00 | .50 |
| | | | Do | 3.0 | 38.82 | 20.80 | 18.60 | 2.20 | 19.28 | .55 |
| | | | Clay | 2.0 | | | | | | |
| | | | Bauxite | 4.0 | 44.34 | 10.86 | 22.03 | 2.80 | 20.00 | .35 |
| | | | Clay, blue | 7.0 | | | | | | |
| SW. ¼ SW. ¼ sec. 20, T. 8 S., R. 1 E. | 1 | 503 | Overburden | 10.0 | | | | | | |
| | | | Clay, bauxitic | 2.7 | 31.48 | 17.64 | 29.12 | 1.68 | 12.50 | 3.05 |
| | | | Bauxite, soft | 3.4 | 39.01 | 1.79 | 38.36 | 2.40 | 12.42 | 4.53 |
| | | | Bauxite | 8.3 | 43.07 | 6.93 | 18.90 | 2.00 | 20.15 | 3.80 |
| | | | Clay | .8 | | | | | | |

One of the largest of the natural exposures of bauxite was noted on land of Jesse Russell in the NE. ¼ sec. 22, T. 9 S., R. 1 E., where a ledge about 3 feet thick crops out on the edge of a ravine for a distance of about 60 feet and shows a bare flat top extending back from the ravine for an equal distance. No pits have been dug here, but samples taken from the outcrop indicate that the material carries considerable silica in the form of gray sand and not much iron. Analyses are reported to show about 36 per cent of alumina and about 40 per cent of silica. Another similar outcrop is reported a short distance to the southeast. In the NW. ¼ and SE. ¼ sec. 27, T. 9. S., R. 1 E., on land of B. F. Anderson, outcrops of low-grade ore were noted.

Typical deposits of bauxite occur in what is known as the Big Hill locality, in T. 9 S., R. 1 E., about 9 miles west of Pontotoc and 5½ miles northeast of Tocopola. There are three hills in this locality that show more or less bauxite either in place or as débris. Hill No. 1 is in the N. ½ sec. 36. It has a flat top about 450 feet long and 185 feet wide, although it is much larger at the base. The altitude of the hill is about 500 feet, and it rises 75 to 80 feet above the adjacent drainage level. This hill is underlain close to the surface by a ledge of rock bauxite, in places as much as 10 feet thick, as shown by test pits on top and at the ends and by intermediate outcrops that show thicknesses of ore as great as 6 feet. The bauxite is of medium grain, abundantly pisolitic, and generally light in color but in places contains considerable iron. Analyses show 46 to 53 per cent of alumina, 5 to 11 per cent of ferric oxide, 16 to 19 per cent of silica, and about 1.65 per cent of titanium dioxide.

Hill No. 2, in the NW. ¼ sec. 36, shows residual bauxite around its margin, together with many crusts of limonite and cores of siderite, but three test pits on the hill are reported to have shown no ore. Apparently the ore bed, which has disintegrated and been largely removed by erosion, lay originally just above the present top of the hill, which is about 20 feet lower than the top of hill No. 1.

Hill No. 3 is mostly in the NW. ¼ SW. ¼ sec. 36. The top ranges in altitude from 482 to 491 feet, is about 765 feet long, and has an average width of 225 feet. Bauxite ledges or boulders show nearly all around the margin, and four or five test pits show 4 to 7 feet of somewhat ferruginous bauxite. Analyses show a range in alumina from 32 to 48 per cent, ferric oxide 10 to 35 per cent, silica 10 to 23 per cent, and titanium dioxide 1.76 to 2.4 per cent.

These three hills are on the farms of H. B. Owen and D. F. Gregory, and 320 acres of land including the promising bauxite deposits is reported to have been purchased by the Mississippi Bauxite Co. This company has kindly furnished the following sections and analyses:

*Sections of test pits and analyses of bauxite, Big Hill locality, Pontotoc County, Miss.*[a]

| Location. | Pit No. | Altitude (feet). | Section. | | Analysis. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| NW. ¼ NE. ¼ sec. 36, T. 9 S., R. 1 E. (hill No. 1). | 1 | 504 | Overburden | 2.0 | | | | | | |
| | | | Bauxite, hard | 6.8 | 46.10 | 11.16 | 15.72 | 1.60 | 21.15 | 1.97 |
| | | | do | 3.7 | 52.86 | 5.06 | 18.52 | 1.68 | 20.74 | 1.60 |
| | | | Clay, bauxitic | 2.5 | | | | | | |
| | | | Lignite | .8 | | | | | | |
| NW. ¼ SW. ¼ sec. 36, T. 9 S., R. 1 E. (hill No. 3). | 2 | 491 | Overburden | 5.5 | | | | | | |
| | | | Bauxite, soft | 1.0 | 33.30 | 21.74 | 23.16 | 1.76 | 17.18 | 2.10 |
| | | | Bauxite, hard | 6.8 | 32.16 | 34.60 | 9.52 | 1.84 | 19.36 | 2.08 |
| | | | Clay | 1.0 | | | | | | |
| Do | 3 | 489 | Overburden | 4.2 | | | | | | |
| | | | Bauxite | 4.0 | 35.16 | 20.04 | 23.31 | 2.00 | 16.74 | 2.36 |
| | | | Clay | 3.5 | | | | | | |
| | | | Clay, bauxitic | 1.0 | | | | | | |
| | | | Clay | 4.5 | | | | | | |
| NE. ¼ SW. ¼ sec. 36, T. 9 S., R. 1 E. | 4 | 475 | Overburden | 2.0 | | | | | | |
| | | | Bauxite, hard | 2.7 | 41.32 | 21.64 | 11.09 | 2.40 | 20.76 | 2.49 |
| | | | Bauxite | 1.3 | 48.26 | 9.80 | 15.47 | 2.40 | 22.60 | 1.98 |
| | | | Clay, bauxitic | 1.0 | | | | | | |
| | | | Clay | 5.0 | | | | | | |

[a] Sections by W. C. and P. F. Morse; analyses by W. F. Hand.

Southwest of the Big Hill locality, on the place of E. D. McGregor, there is an outcrop of boulders of light-colored bauxite of apparently good quality around the edge of a low hill, the altitude of which ranges from 405 to 415 feet. These boulders are 2 to 2½ feet thick, and several test pits showed bauxite ranging from 3 to 5 feet thick interbedded with clay and sand. Analyses indicate that the bauxite on this place carries 40 to 50 per cent of alumina, 7 to 11 per cent of ferric oxide, 12 to 32 per cent of silica, and 1.5 to 2.56 per cent of titanium dioxide. The greater part of the ore is considered to contain between 45 and 50 per cent of alumina. The following sections and analyses bring out these relations:

*Sections of test pits and analyses of bauxite, McGregor locality, Pontotoc County, Miss.*[a]

| Location. | Pit No. | Altitude (feet). | Section. | | Analysis. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| NE. ¼ NE. ¼ sec. 2, T. 10 S., R. 1 E. | 1 | 410 | Overburden | 1.0 | | | | | | |
| | | | Bauxite | 5.0 | 42.33 | 9.25 | 21.68 | 1.50 | 19.45 | 5.24 |
| | | | Clay, bauxitic | 6.2 | | | | | | |
| Do | 2 | 415 | Overburden | 1.0 | | | | | | |
| | | | Bauxite | 3.4 | 47.33 | 6.87 | 21.94 | 2.24 | 20.33 | 2.08 |
| | | | Bauxite, clayey | .8 | 34.64 | 10.40 | 31.86 | 2.56 | 19.12 | 1.79 |
| | | | Clay | 5.4 | | | | | | |
| NW. ¼ NW. ¼ sec. 1, T. 10 S., R. 1 E. | 3 | 405 | Overburden | .5 | | | | | | |
| | | | Bauxite | 4.7 | 49.65 | 9.47 | 11.86 | 2.56 | 24.92 | 1.62 |
| | | | Clay | 4.6 | | | | | | |

[a] Sections by W. C. and P. F. Morse; analyses by W. F. Hand.

In secs. 34 and 35, T. 9 S., R. 1 E., on the farms of W. W. Inmon and E. M. Tallant, seven or eight test pits and several outcropping ledges of bauxite were noted. The bauxite ledges showed thicknesses of 2 to 3 feet, and the pits showed thicknesses of light-colored bauxite from 3 to 5 feet, generally below an overburden of soil, clay, or sand from 6 to 15 feet deep and underlain by clay which in places is bauxitic. As shown in the next table of analyses the quality of the ore in this locality ranks high as compared with that of the Mississippi bauxite in general, its content of alumina being from 39 to 50 per cent; ferric oxide, 2.3 to 6 per cent; silica, 15 to 25 per cent; and titanium dioxide, 2.4 to 3.36 per cent. The altitude of these deposits, 500 feet or more, is about the same as that of Big Hill. The bauxite land on the E. D. McGregor, W. W. Inmon, and E. M. Tallant places is reported to have been bought by the Mississippi Bauxite Co.

*Sections of test pits and analyses of bauxite, Inmon and Tallant locality, Pontotoc County, Miss.*[a]

| Location. | Pit No. | Altitude (feet). | Section. | | Analysis. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| SW. ¼ NW. ¼ sec. 34, T. 9 S., R. 1 E. | 1 | 516 | Overburden | 15.4 | | | | | | |
| | | | Bauxite, soft | 3.8 | 48.24 | 2.72 | 19.31 | 3.20 | 24.70 | 1.44 |
| | | | Clay | 3.8 | | | | | | |
| Do | 2 | 505 | Overburden | 6.0 | | | | | | |
| | | | Bauxite | 4.6 | 47.50 | 5.12 | 20.16 | 2.88 | 22.00 | 2.31 |
| | | | Clay | 4.5 | | | | | | |
| Do | 3 | 515 | Overburden | 6.1 | | | | | | |
| | | | Clay, bauxitic | 1.5 | | | | | | |
| | | | Bauxite | 4.8 | 49.32 | 3.92 | 15.53 | 3.36 | 23.54 | 3.39 |
| | | | Clay, bauxitic | 1.5 | | | | | | |
| | | | Clay, blue | 5.0 | | | | | | |
| NW. ¼ SW. ¼ sec. 34, T. 9 S., R. 1 E. | 1 | 498 | Overburden | 7.1 | | | | | | |
| | | | Bauxite | 5.0 | 46.88 | 5.96 | 20.94 | 2.96 | 22.27 | 1.32 |
| | | | Clay, bauxitic | 2.0 | | | | | | |
| | | | Clay, white | 3.7 | | | | | | |
| Do | 2 | 507 | Overburden | 13.0 | | | | | | |
| | | | Clay, bauxitic | 6.0 | | | | | | |
| | | | Bauxite | 3.4 | 50.30 | 2.30 | 18.26 | 2.80 | 23.34 | 3.30 |
| | | | Clay | 1.8 | | | | | | |
| Do | 6 | 506 | Overburden | 6.2 | | | | | | |
| | | | Clay, bauxitic | 1.2 | 38.79 | 3.61 | 24.88 | 2.40 | 16.65 | 6.07 |
| | | | Bauxite, hard | 1.6 | 51.46 | 3.80 | 15.71 | 2.40 | 22.85 | 3.00 |
| | | | Bauxite, soft | 1.4 | 50.56 | 4.34 | 14.92 | 2.40 | 22.80 | 4.90 |
| | | | Clay | 4.2 | | | | | | |

[a] Sections by W. C. and P. F. Morse; analyses by W. F. Hand.

On both sides of the Pontotoc-Tocopola wagon road in the N. ½ sec. 2, T. 10 S., R. 1 E., on the J. E. Harmon place, bauxitic clay has been found in test pits, the search having been guided by the finding of pieces of float bauxite on the surface. In the ditch on the north side of the road pisolitic clay, probably bauxitic, has been exposed by erosion. In the NW. ¼ sec. 1, on land of Matt Collum, heavy boulders of rock bauxite appear on the hillside. Bauxite is also reported to occur in the NE. ¼ sec. 11, about a mile south of the wagon road.

The Big Hill, Owen, McGregor, Inmon-Tallant, and other bauxite localities are near the Pontotoc-Tocopola road, a direct route to the railroad, which is 9 to 11 miles distant. For several miles this road is paved with concrete 10 feet wide, and some of it is surfaced with gravel. It is planned to extend the concrete and gravel, and 2 or 3 miles more of such work will be necessary before hauling over it will be feasible.

On land of J. W. Tutor in the NW. ¼ sec. 16, T. 10 S., R. 1 E., leased by the Mississippi Bauxite Co., there is an extensive showing of bauxite boulders and outcropping masses on the slopes of a wooded hillside, about 440 feet in altitude, west of the wagon road that leads to Sarepta, Calhoun County. Several pits that have been sunk on this property disclose bauxite beds ranging from 2 to 9 feet in thickness. Analyses showed a range in constituents as follows: Alumina, 30 to 42 per cent; ferric oxide, 9 to 26 per cent; silica, 18 to 26 per cent; titanium dioxide, 1.52 to 1.76 per cent. The top of the hill that may be underlain by bauxite is more than 175 feet wide by 430 feet long. In the SE. ¼ sec. 17 boulders of bauxite occur on top of a hill on land of S. L. Tutor, but no ore was found in a test pit. The occurrence of these boulders is probably an illustration of the settling down of fragments of a bed of ore that formerly occupied a higher horizon. The following sections and analyses, furnished by the Mississippi Bauxite Co., indicate the character of the deposits in this locality:

*Sections of test pits and analyses of bauxite, Montgomery and Tutor locality, Pontotoc County, Miss.*[a]

| Location. | Pit No. | Altitude (feet). | Section. | | Analysis. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Material. | Thickness (feet). | $Al_2O_3$. | $Fe_2O_3$. | $SiO_2$. | $TiO_2$. | Loss on ignition. | Moisture. |
| NW. ¼ sec. 33, T. 9 S., R 1 E. | 3 | 401 | Overburden | 3.0 | | | | | | |
| | | | Bauxite | 3.3 | 29.75 | 33.39 | 14.70 | 1.40 | 15.80 | 3.12 |
| | | | Clay | 5.8 | | | | | | |
| SE. ¼ sec. 15, T. 10 S., R. 1 E. | 1 | 444 | Overburden | 8.7 | | | | | | |
| | | | Bauxite | 2.5 | 28.54 | 31.56 | 15.20 | 1.60 | 15.55 | 5.95 |
| | | | Clay | 9.2 | | | | | | |
| W. ½ sec. 16, T. 10 S., R. 1 E. | 2 | 445 | Overburden | 4.1 | | | | | | |
| | | | Bauxite, red | 4.7 | 36.63 | 26.27 | 14.18 | 1.60 | 14.83 | 3.25 |
| | | | Clay | .3 | | | | | | |
| | | | Bauxite | 2.9 | 41.46 | 13.42 | 21.92 | 1.52 | 16.30 | 4.20 |
| | | | Clay and sand | 3.9 | | | | | | |
| Do | 3 | 447 | Overburden | 3.1 | | | | | | |
| | | | Clay, bauxitic | 3.7 | 35.65 | 9.07 | 31.00 | 1.68 | 14.05 | 7.18 |
| | | | Bauxite, soft | 3.3 | 30.29 | 23.91 | 18.28 | 1.60 | 16.45 | 4.10 |
| | | | Do | 5.8 | 37.04 | 13.00 | 25.94 | 1.76 | 16.30 | 5.50 |
| | | | Clay | 1.7 | | | | | | |
| Do | 5 | 432 | Overburden | 2.5 | | | | | | |
| | | | Bauxite | 1.9 | 32.96 | 21.38 | 21.24 | 1.76 | 16.15 | 3.77 |
| | | | Clay, bauxitic | 1.0 | | | | | | |
| | | | Clay | ------- | | | | | | |

[a] Sections by W. C. and P. F. Morse; analyses by W. F. Hand.

Several other deposits of bauxite are reported within a few miles southeast and south of the J. W. Tutor place, but they were not visited by the writer, as only a small amount of prospecting was said to have been done on them. In the SE. ¼ sec. 15 and the NE. ¼ sec. 22, T. 10 S., R. 1 E., on lands of E. E. Anderson and J. J. Westmoreland, large boulders of bauxite are reported to be similar in character to those on the J. W. Tutor place but not so abundant. In the NE. ¼ sec. 27, T. 10 S., R. 1 E., on land of Dr. McGregor, numerous small boulders of bauxite have been observed, but they are not considered as indicating ore in place. In the NE. ¼ sec. 28, on land of L. C. Tutor, a pit is reported to have shown good bauxite about 2 feet thick on top of a small hill, but the topographic relations were such as to preclude the existence of more than a few hundred tons of ore. On land of A. N. H. Tutor in the NW. ¼ sec. 28 a few scattered boulders of bauxite are reported to have been found. In the NW. ¼ sec. 36 an outcrop of bauxitic clay, accompanied by a small quantity of good bauxite, is reported to have been observed in the side of a ravine.

The total quantity of bauxite ore of all grades in the above-mentioned properties in Pontotoc County is estimated at more than 570,000 long tons, as shown in a summary according to grades which was kindly furnished by the Mississippi Bauxite Co. A slightly larger total, amounting to about 616,000 tons for Pontotoc County, is indicated for all the properties described in the State Geological Survey bulletin,[20] as follows:

*Quantity of bauxite ore in Pontotoc County, Miss., by grades, in long tons.*[a]

| Percentage of alumina ($Al_2O_3$). | East Smoky Top. | West Smoky Top. | Big Hill. | All others. | Total. |
|---|---|---|---|---|---|
| 25–30 | | 11,186 | | | 11,186 |
| 30–35 | 26,245 | 71,674 | 52,133 | 9,710 | 159,762 |
| 35–40 | | 41,314 | 4,000 | 34,000 | 79,314 |
| 40–45 | 23,400 | 100,402 | 14,667 | 15,500 | 153,969 |
| 45–50 | | 24,763 | 11,900 | 18,240 | 54,903 |
| 50–55 | 29,700 | 21,490 | 12,333 | 81,317 | 144,840 |
| 55–60 | 12,150 | | | | 12,150 |
| | 91,495 | 270,829 | 95,033 | 158,767 | 616,124 |

[a] Estimates by W. C. and P. F. Morse.

## CALHOUN COUNTY.

In Calhoun County the only occurrence of bauxite observed by the writer was in sec. 12, T. 11 S., R. 1 W., just southeast of the wagon road to Sarepta and about 1½ miles east-northeast of that village. Here in an open field are outcrops of partly buried masses and boulders of bauxite. This ore is highly pisolitic and appears to be of relatively good quality. The outcrop is probably too low topographically to represent more than a residual deposit, but it indicates that considerable ore formerly occurred at or near this locality at a slightly higher horizon.

Other outcrops of bauxite are reported to occur a quarter of a mile south of this locality and surface boulders about 1 mile west of Sarepta.

## WEBSTER COUNTY.

Two deposits of bauxite in the eastern part of Webster County were examined—one about 2½ miles northwest of Cumberland and

[20] Morse, P. F., op. cit., pp. 89–138.

the other about 1¼ miles north of Mathiston—besides two or three outcrops of sandy bauxitic clay. These deposits are stratigraphically above the Porters Creek clay as mapped by Lowe.

The deposit near Cumberland is on land of H. E. Chandler, in the NW. ¼ SE. ¼ sec. 27, T. 21 N., R. 11 E., on a low hill on both sides of a wagon road and a short distance north of a logging railroad. Débris of bauxite in small boulders and small fragments is scattered over an acre or more. The material is light colored, not very hard, abundantly filled with pisolites, and apparently of good quality. Associated with the bauxite is more or less débris of limonite in concretions and crusts, evidently derived from siderite. If the siderite formerly underlay the bauxite, as is common in this field, the limonite débris may indicate that the base of the deposit has been reached by erosion in the greater part of the area of the deposit. One test pit, reported to have been made by the owner of the land, was noted. Traces of light-colored bauxite remained, but most of the material excavated had been filled back into the hole. All indications suggest that the bauxite deposit is thin, but in view of its good quality and its proximity to the logging railroad, which connects with the Gulf, Mobile & Northern Railroad about 4 miles to the east, this locality might warrant further prospecting.

About 2 miles north of Mathiston, in sec. 27, T. 20 N., R. 11 E., on the bank and in the bed of a small stream, pisolitic sandy clay, possibly slightly bauxitic, is exposed. The appearance of the material suggests that pisolitic structures may at present be in process of development. Some of the material is strongly ferruginous and contains partly indurated pebbles of sand cemented by iron oxide. On the highway between Maben and Mathiston a bed of sandy pisolitic white clay is exposed in a recent cut. This is near the top of a hill over which much débris of sandy limonite is scattered and is just above the contact of the Porters Creek clay with the overlying Wilcox group, as sketched by Lowe. Analysis shows the pisolitic clay to contain 32.20 per cent of alumina and 34.76 per cent of silica.[21]

About 1¼ miles north of Mathiston, a short distance northwest of the Bennett Academy, on the old road known as the Natchez Trace, is an outcrop of concretionary limonite grading into pisolitic material that closely resembles bauxite. Float boulders of true bauxite were also found here. These occurrences near Mathiston are not of commercial importance, but they are of interest in their bearing on the distribution and relations of bauxitic material.

[21] Morse, P. F., op. cit., p. 167.

## OKTIBBEHA COUNTY.

In a house near Sturgis blocks of bauxite are in use in a fireplace that is reported to have been built more than 75 years ago, thus attesting to the refractory nature of the rock.

One deposit containing bauxite was seen in Oktibbeha County, about 1½ miles east of Sturgis. In the SE. ¼ SE. ¼ sec. 10, T. 17 N., R. 12 E., a bed of sandy pisolitic bauxitic clay about 3 feet thick crops out in two places on a low ridge at the north side of a new cut in the highway. In an old road that branches toward the north there is an outcrop of harder and more bauxitic material than that on the main road. A few float boulders and fragments of hard pisolitic bauxite, with a bluish siliceous matrix, were found at several places in a field on top of the hill to a distance of about 1,200 feet north of the highway. Some sandy limonite accompanies the bauxite débris and occurs as residual fragments elsewhere in the vicinity. The bauxite débris in the field is only a short distance south of the Illinois Central Railroad, and if a large deposit were present it would be in an excellent situation for mining and shipment. The indications, however, suggest that the original deposit was at a higher level and that most of it has been removed by erosion; consequently no money has been spent in prospecting here. The locality is stratigraphically above Lowe's boundary between the Porters Creek clay and the Ackerman formation. Beds of Porters Creek clay are exposed in the cut of the Illinois Central Railroad 25 to 30 feet lower than the bauxite débris.

Morse[22] gives the following analysis of the hard pisolitic material from the outcrop on the hill:

*Analysis of bauxitic material from hill 1½ miles east of Sturgis.*

| | |
|---|---|
| Alumina ($Al_2O_3$) | 34.91 |
| Ferric oxide ($Fe_2O_3$) | 1.19 |
| Silica ($SiO_2$) | 32.70 |
| Titanium dioxide ($TiO_2$) | 1.19 |
| Loss on ignition | 12.35 |
| Nonvolatile with hydrofluoric acid (HF) | 15.98 |
| Moisture | 1.75 |

## WINSTON COUNTY.

Three places in northeastern Winston County near Betheden and several places in the southeastern part of the county near Fearns Springs where material suspected to be of bauxitic nature was reported to occur were examined. The beds in these places are apparently in the Ackerman formation, as there is more or less

[22] Morse, P. F., op. cit., p. 171.

sand and lignitic material present, but they lie within the area of the Porters Creek clay as mapped by Lowe.

About 1 mile north of Betheden, in the southeast corner of sec. 15, T. 16 N., R. 13 E., sandy ferruginous clayey material with a faintly pisolitic texture crops out on both sides of the wagon road near the top and on the southwest slope of the spur of a hill. The percentage of alumina in this material is probably very low. On the hill in the pine woods north of the road are scattered fragments of ferruginous sandstone a few pieces of which show pisolitic spots, but these spots consist of siliceous clay, possibly slightly bauxitic, and no true bauxite was found here. Half a mile east of Betheden, in the southern part of sec. 23, T. 16 N., R. 13 E., there is a conspicuous outcrop of white fine sandy clay several feet thick along the road both west and east of Dry Creek. A few feet of clay suspected as being bauxitic overlies the white sandy clay. It is of a light cream-color, is not very gritty, and contains pisolitic structure and impressions, but the analysis given below does not indicate a high percentage of aluminum hydroxide. Beneath the white sandy clay lies a bed of lignitic clay showing pisolitic texture in places. About 3¼ miles southwest of Betheden, in the NW. ¼ sec. 32, T. 16 N., R. 13 E., a thin streak of light-colored sandy clay having a pisolitic texture crops out in a gully on the north side of the highway just west of Mill Creek. The material in none of these three places can be regarded as of promise as a source of bauxite.

*Analysis of clay from deposit half a mile east of Betheden, Winston County, Miss.*

[J. G. Fairchild, analyst.]

| | |
|---|---|
| Silica ($SiO_2$) | 52. 57 |
| Alumina ($Al_2O_3$) | 31. 35 |
| Ferric oxide ($Fe_2O_3$) | 2. 27 |
| Ferrous oxide ($FeO$) | None. |
| Titanium dioxide ($TiO_2$) | 1. 60 |
| Manganous oxide ($MnO$) | Trace? |
| Magnesium oxide ($MgO$) | Trace. |
| Calcium oxide ($CaO$) | None. |
| Carbon dioxide ($CO_2$) | None. |
| Moisture ($H_2O-$) | . 48 |
| Water ($H_2O+$) | 11. 80 |
| | 100. 07 |

In the southeastern part of Winston County true bauxite was seen on the place of John Sullivan in the NW. ¼ sec. 27, T. 14 N., R. 14 E. The material occurs in the form of boulders of various sizes, the largest 3 or 4 feet in thickness and of greater length. These boulders lie on a terrace or spur of the hill 35 to 40 feet above and to the northeast of a small branch, and similar material is reported to have been found on the opposite side of the branch. The level at which the boulders lie is 75 to 100 feet lower than the main upland level, and several small lumps of bauxite were noted at higher points in the field and woods toward the north. It is reported that the Republic Mining & Manufacturing Co., of Philadelphia, Pa., leased the Sullivan property for a time and put down five test holes of a diameter of about 2 inches with an Empire drill on the spur extending southeastward from the knoll on which the bauxite boulders lie. These holes start at levels slightly lower than the bauxite boulders and appear not to have shown any ore, although possibly the one nearest the boulders may have shown some bauxitic clay. Several other holes are reported to have been drilled in the NE. ¼ sec. 27, and a few scattered boulders of bauxite are said to have been found in sec. 28. All the circumstances connected with this ore suggest that it is residual from a former heavy deposit of rock bauxite that originally lay at a higher level. The material appears to be of good quality. It is light yellow to light brown, the rock is well filled with pisolites of bauxite, and the cementing matrix is evidently bauxitic. According to Mr. Sullivan analyses showed 49 to 55 per cent of alumina, and an analysis (No. 1) is given below.[23] Some hard, nearly white, sparingly pisolitic material occurs as float fragments here, the analysis of which is also given (No. 2):

*Analyses of bauxite and clay from locality near Fearns Springs.*

| | 1 | 2 |
|---|---|---|
| Alumina ($Al_2O_3$) | 55.84 | 37.59 |
| Silica ($SiO_2$) | 15.04 | 44.19 |
| Ferric oxide ($Fe_2O_3$) | 4.56 | .77 |
| Titanium dioxide ($TiO_2$) | 1.80 | 3.20 |
| Nonvolatile with hydrofluoric acid (HF) | 1.62 | ---------- |
| Moisture ($H_2O-$) | .30 | .54 |
| Loss on ignition ($H_2O+$) | 21.92 | 13.64 |

1. Bauxite from surface, NW. ¼ sec. 27, T. 14 N., R. 14 E. W. F. Hand, analyst.
2. Hard white clay from surface, NW. ¼ sec. 27, T. 14 N., R. 14 E. J. G. Fairchild, analyst.

In the northern part of sec. 3, T. 13 N., R. 14 E., about half a mile west of Fearns Springs, at the south side of the road and west of a small creek that empties into a mill pond, there is a deposit of white clay containing a small percentage of fine white sand. Gullies expose a thickness of about 10 feet of this clay and show places where the material is slightly pisolitic. The pisolites are of soft clay similar to the main mass of the material and probably do not contain much bauxite, although the question has been raised as to whether such forms may not represent an incipient stage in the alteration of the clay to bauxite. Clay of this type is reported to

[23] Morse, P. F., op. cit., p. 172.

occur also near Haines Mill, in the NW. ¼ sec. 11, T. 13 N., R. 14 E., and bauxitic clay is reported in sec. 22, north of the Sullivan place.

## NOXUBEE COUNTY.

Indications of bauxite have been found in the southwestern part of Noxubee County, not far from the road between Fearns Springs and Gholson. They are chiefly in secs. 6, 7, and 8, T. 13 N., R. 15 E., and in most places consist of pisolitic clay, ferruginous sandstone, and limonite but comprise at least one occurrence of true bauxite. The material inspected on the land of T. H. Hurst in the SE. ¼ sec. 6 proved to be reddish, slightly pisolitic ferruginous sandstone. One locality reported to show indications of bauxite is in the NW. ¼ SE. ¼ sec. 7, on land of F. J. Hubbard, where deposits of slightly pisolitic sandy clay are exposed by deep gullies in the abandoned wagon road southwest of Factory Church. This clay is ferruginous in spots. Another locality is in the NW. ¼ sec. 8, on land of Matt Liddell, where pisolitic clay is exposed in a small wet-weather gully and pieces of pisolitic sandy ferruginous rock a little harder than clay are scattered about the neighboring field. Three or four prospect pits have been dug on this land, exposing pisolitic sandy clay and loose pisolites of clay that may be bauxitic but has not been analyzed. In the field a little higher than the prospects were found a few scattered fragments of sandy ferruginous, partly pisolitic rock, not very hard and of uncertain alumina content but probably containing a little bauxite. The test pits have been started too low to encounter any of the rock from which these lumps have been derived, but there is no evidence of the existence of a large deposit of good bauxite on this place.

In the NW. ¼ SE. ¼ sec. 8, T. 13 N., R. 15 E., a short distance southeast of the forks of the road as shown on the United States soil survey map of Noxubee County, on land reported to belong to W. J. Hubbard, Sr., of Shuqualak, Miss., was found the best bauxite noted in the county. The material was in the form of boulders of medium grain, somewhat ferruginous and containing a large proportion of pisolites. It was reported by Mr. T. H. Hurst, who lives in sec. 6 and who acted as guide to this property, that a piece broken from one of these boulders had been shown by analysis to contain about 53 per cent of alumina, and two analyses published by Morse [24] are given below. A prospect pit at the north side of the road disclosed softer material, mainly bauxitic clay, exposed to a depth of about 3 feet. Débris of hard bauxite of good grade is reported to occur a quarter to half a mile south of this locality. These localities are within the area of the Ackerman formation.

[24] Morse, P. F., op. cit., p. 173.

*Analyses of bauxite from southwestern Noxubee County, Miss.*

[W. F. Hand, analyst.]

| | 1 | 2 |
|---|---|---|
| Alumina ($Al_2O_3$) | 53.32 | 39.30 |
| Silica ($SiO_2$) | 16.18 | 29.64 |
| Ferric oxide ($Fe_2O_3$) | 4.68 | 12.40 |
| Titanium dioxide ($TiO_2$) | 2.00 | 1.60 |
| Nonvolatile with hydrofluoric acid (HF) | | 1.08 |
| Moisture | .65 | 1.37 |
| Loss on ignition | 23.17 | 15.32 |

1. From center of sec. 8, T. 13 N., R. 15 E. 2. From W. ½ sec. 8.

East of Gholson on the wagon road near the county line, in both Noxubee and Kemper counties, are exposures of light-colored clay with a suggestion of pisolitic texture, but no true bauxite was noted.

## KEMPER COUNTY.

One deposit of bauxite was observed near the middle of the north line of Kemper County and is of interest because it is the southeasternmost deposit that had been found in the belt of bauxite-bearing formations in Mississippi at the time of the writer's visit. This deposit, which as nearly as could be ascertained is near the southwest corner of sec. 3, T. 12 N., R. 16 E., appears to be within the area of Porters Creek clay as mapped by Lowe and 18 or 20 miles from the locality where that formation passes southeastward into Alabama. The topographic and geologic relations indicate that the high land on which the deposit is situated is an outlier of the Wilcox group (Ackerman formation?) resting upon the Porters Creek clay. The outcrop is on land owned by J. C. Flora, who lives about 2 miles west of Shuqualak, and is northeast of the ruins of the old White place, east of an old orchard, on a low eastward-facing escarpment within the edge of a wood lot. The deposit forms a ledge of rock, exposed westward from the escarpment, in places for 75 feet, to points where the overburden becomes thick enough to conceal it, and exposed from north to south for 200 feet or more, with scattered lumps of bauxite beyond in both directions. Where the bed breaks down at the brow of the hill the boulders are 1 to 3 feet in diameter, but whether the total thickness is greater than this has not been determined by prospecting, so far as could be learned. The quality of this bauxite appears good. The matrix is of a light-bluish or drab color, more or less granular, and a little harder than the pisolites. Some of the matrix appears to contain quartz grains. Brush fires that have passed over this outcrop have discolored and hardened the surface of some of the boulders. Analyses of this bauxite showed 50 to 58 per cent of alumina, 17 to 21 per cent of silica, and little ferric oxide, and the material is therefore of good quality for certain uses. Further prospecting might be warranted here, but if the deposit should prove to contain any great quantity of ore, the problem of transportation would be difficult, for it is 8 or 9 miles from the Mobile & Ohio Railroad at Shuqualak, and on the most direct route there is a very high, steep, rocky hill to be descended and a stretch of very boggy road on the Porters Creek clay to be crossed in order to reach the highway 4 or 5 miles north of the deposit; otherwise a long detour to the west must be made.

*Analyses of bauxite from north-central Kemper County, Miss.*

[Analysts: 1, J. G. Fairchild, U. S. Geol. Survey; 2, A. M. Garrison, chemist Sloss-Sheffield Steel & Iron Co., Sheffield, Ala.; 3, W. F. Hand, Mississippi Agricultural College, published by Morse, P. F., op. cit., p. 174.]

| | 1 | 2 | 3 |
|---|---|---|---|
| Silica ($SiO_2$) | 20. 86 | 16. 96 | 16. 94 |
| Alumina ($Al_2O_3$) | 49. 93 | 57. 80 | 54. 95 |
| Ferric oxide ($Fe_2O_3$) | 1. 37 | 1. 00 | . 15 |
| Ferrous oxide (FeO) | None. | | |
| Titanium dioxide ($TiO_2$) | 3. 00 | | 1. 60 |
| Nonvolatile with hydrofluoric acid (HF) | | | 3. 70 |
| Moisture ($H_2O-$) | 1. 16 | | . 60 |
| Water ($H_2O+$) | 23. 38 | | 23. 45 |

## COMMERCIAL CONSIDERATIONS.

### USES AND REQUIREMENTS OF BAUXITE.

Bauxite is used principally as a source of metallic aluminum, in the manufacture of aluminum salts and for other chemical purposes, in the manufacture of abrasives, and in the manufacture of refractories. The quantities of domestic bauxite consumed yearly by the four industries from 1919 to 1923 and the value of the total production for each year are of interest in this connection.[25]

*Domestic bauxite consumed in the United States by principal industries, 1919–1923, in long tons.*

| Industry. | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| Aluminum | 272, 270 | 383, 154 | 91, 700 | 211, 560 | 380, 520 |
| Chemical | 67, 842 | 85, 878 | 41, 000 | 78, 540 | 68, 870 |
| Abrasive | 35, 395 | 52, 276 | 6, 850 | 19, 270 | 72, 830 |
| Refractory | 1, 059 | | | 230 | 470 |
| Total quantity | 376, 566 | 521, 308 | 139, 550 | 309, 600 | 522, 690 |
| Total value | $2, 201, 747 | $3, 247, 345 | $889, 800 | $2, 012, 330 | $3, 156, 610 |
| Average value per ton | $5. 85 | $6. 23 | $6. 38 | $6. 50 | $6. 04 |

The above figures show that bauxite is a low-priced commodity, and it must be borne in mind that the domestic bauxite now produced is of a better quality than the greater part of the bauxite at present disclosed in Mississippi. A low-grade bauxite costs as much to mine and transport as the higher-grade material.

[25] Hill, J. M., U. S. Geol. Survey Mineral Resources, 1922, pt. 1, pp. 87–88, 1923.

In regard to the valuation of bauxite ore Hill[26] has said:

There is only one way to determine the value of bauxite, and that is by chemical analysis, which should show total silica, alumina, titanium oxide, iron oxide, and water. Bauxites of commercial grade should carry at least 52 per cent alumina, though much of that shipped contains from 58 to 65 per cent $Al_2O_3$, and some material as low as 42 per cent $Al_2O_3$ is mixed with higher-grade ore to bring the average up. Silica and iron should not run above 15 per cent, and the better grades of bauxite contain as low as 1 per cent iron and 3 to 5 per cent silica. Titanium is objectionable, and the content should be below 2 per cent, though much of the central Georgia bauxite carries nearly 3 per cent $TiO_2$. The combined water of American bauxites ranges from 15 to 33 per cent. Some of the Arkansas and central Georgia bauxites are particularly low in iron, titanium, and silica and are used in the preparation of alumina from which aluminum is made. * * * Apparently low content of silica and titanium is essential to the aluminum industry, but the content of iron may be fairly high, though bauxites low in iron and titanium are preferred by the makers of alum and aluminum sulphate. Makers of abrasives appear to be able to use bauxites of lower grade and containing larger proportions of silica and iron than are permissible in bauxite for other uses, but most abrasives are made from bauxites low in silica and iron. The bauxite used for refractories must apparently be fairly low in iron. * * *

A few characteristics, which indicate in a general way the quality of bauxite, may be mentioned, though it is recognized that none of them is dependable. In general, bauxite of fair grade will not show the marks of a hammer when it is hit a glancing blow, though some bauxite has been shipped which can be cut with the hammer. Good bauxite, which has been dried either in the open or in kilns, when thrown on a hard floor has a distinct rattle which bauxitic clay does not have. The pisolites of the lighter-colored bauxites of the central Georgia field have a peculiar brownish-buff color and look something like horn or flint; they ordinarily can not be broken or marked with the finger nail in bauxites of good grade.

Some measure of the relative quality of dried bauxite can be had by grinding a sample in an agate mortar for half a minute. A bauxite of good grade will be found hard to grind and will stick to the mortar with such tenacity that it will have to be scoured out; a poor bauxite or bauxite clay will grind much more easily and will stick very little, if at all; and clay or kaolin grinds with ease and does not stick to the mortar. Similar results are found if the sample is rubbed on glass, and the glass will not be scratched by even high-grade bauxite.

Morse[27] gives in his chapter on the technology of bauxite considerable information on mining, preparation of the ore, uses of bauxite, processes involved in its utilization, and grades of bauxite required for specific uses. Were it not for the hope he holds out on a later page that through drying the ore and washing some of it the grade can be improved, it would appear as if a comparatively small proportion of the material here described would fulfill the specifications for the principal commercial uses.

[26] Hill, J. M., U. S. Geol. Survey Mineral Resources, 1916, pt. 1, pp. 162-163, 1919; idem, 1917, pt. 1, p. 2, 1921.

[27] Morse, P. F., op. cit., pp. 182-183.

The following list of all users of bauxite in 1923 has been furnished by J. M. Hill, of the United States Geological Survey:

Aluminum Co. of America, Pittsburgh, Pa.
Calumet Chemical Co., Joliet, Ill.
Carborundum Co., Niagara Falls, N. Y.
Charles Lennig & Co. (Inc.), 112 South Front Street, Philadelphia, Pa.
Columbus Waterworks, R. D. 5, Columbus, Ohio.
Como Chemical Co., Kokomo, Ind.
E. I. du Pont de Nemours & Co., Wilmington, Del.
Exolon Co., 156 Sixth Street, Cambridge, Mass.
General Abrasives Co., Niagara Falls, N. Y.
General Chemical Co., 25 Broad Street, New York, N. Y.
General Refractories Co., Trinity Building, New York, N. Y.
Gulf Refining Co., Pittsburgh, Pa.
K. I. Herman Chemical Co., Matteson, Ill.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Jarecki Chemical Co., St. Bernard Station, Cincinnati, Ohio.
Kalbfleisch Corporation, Chattanooga, Tenn.
Kansas City Water Department, Kansas City, Mo.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Merrimac Chemical Co., 33 Broad Street, Boston, Mass.
Metropolitan Water District of Omaha, Nebr.
North Hudson Chemical Co. (Inc.), Albany, N. Y.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
Passaic Consolidated Water Co., Little Falls, N. J.
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Springfield Waterworks, Springfield, Mass.
Stauffer Chemical Co., Stege, Calif.
Superior Chemical Co., Joliet, Ill.
Trenton Waterworks, Trenton, N. J.
Welch Chemical Co., 8 East Long Street, Columbus, Ohio.

In 1923 bauxite was produced by the companies listed below:

American Bauxite Co., 1111 Harrison Building, Philadelphia, Pa.
Globe Bauxite Co., Joliet, Ill.
Ideal Bauxite Mining Co., Ideal, Ga.
Kalbfleisch Corporation, 31 Union Square West, New York, N. Y.
Norton & Co., Worcester, Mass.
Republic Mining & Manufacturing Co., 1111 Harrison Building, Philadelphia, Pa.
Southern Bauxite Co., Benton, Ark.
Warner Mining Co., Adairsville, Ga.

## UTILIZATION OF MISSISSIPPI ORE.

Estimates of the quantity of bauxite on the lands owned in fee and leased by the Mississippi Bauxite Co. in Benton, Tippah, Union, and Pontotoc counties, made by W. C. and P. F. Morse, show a grand total of nearly 1,500,000 long tons, of which about 608,000 tons carries 30 to 35 per cent of alumina, 604,000 tons between 35 and 45 per cent, 226,000 tons between 45 and 55 per cent alumina, and less than 25,000 tons is distributed between grades carrying less than 30 per cent and those containing between 55 and 60 per cent. There are other deposits of bauxite in northeastern Mississippi that have not been included in these estimates, and further studies are likely to add to the known reserves, as there are considerable areas adjacent to known deposits that have not yet been prospected, particularly in Pontotoc County. Although the bulk of this bauxite is of low grade, there are many uses for which such ore is of value. It is of course possible that some of it may be concentrated to a higher grade, and drying, which is commonly resorted to, will raise the alumina content by decreasing the mechanically held moisture. In addition to the current metallurgical, chemical, refractory, and abrasive uses for bauxite, a new use in the manufacture of alumina cement,[28] a quick-setting hydraulic cement now used to a large extent in France and soon to be manufactured in the United States, seems an interesting possibility. Experiments by the United States Department of Agriculture are in progress with a view to utilizing bauxite in the fixation of nitrogen for the manufacture of fertilizer.

Most of these deposits of bauxite are from 5 to 10 miles or more from the Gulf, Mobile & Northern and Mobile & Ohio railroads, and much of the intervening country is underlain by the Porters Creek clay, over which unsurfaced roads are impassable in wet weather and hard and rutty in dry weather. A beginning has been made in the use of gravel and concrete for road building in this part of the State, and a portion of the road from Pontotoc to Tocopola, which will tap one of the principal groups of bauxite deposits, has been paved. Other essential conditions for exploiting the bauxite deposits in northeastern Mississippi are more favorable. As has been shown in the prospect sections, the overburden is not excessive, and open-cut mining will not be difficult. Timber suitable for crossties and the simple needs of open-cut mining is abundant in the vicinity of the deposits, and water supplies may be provided for by impounding the run-off from the small streams. Some of the area is also well supplied with underground water.

Mining of the deposits will necessarily have to await the preparation of roads suitable for motor-truck haulage, but even though production is temporarily retarded here the rapid depletion of bauxite ore in other domestic fields and the proximity of large water power at Muscle Shoals, in the adjacent portion of Alabama, encourage the belief that the bauxite of northeastern Mississippi must be considered one of the natural resources that will contribute to the utilization of the Tennessee River power.

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[28] Eckel, E. C., Alumina cement in France: Eng. News-Record, Aug. 30, 1923, pp. 347-349.

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