Bauxite Deposits of the Anniston, Fort Payne and Ashville Areas Northeast Alabama

GEOLOGICAL SURVEY BULLETIN 1199-O

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By PRESTON E. CLOUD, JR.

BAUXITE DEPOSITS OF THE SOUTHEASTERN UNITED STATES

GEOLOGICAL SURVEY BULLETIN 1199-O

Distribution, occurrence, and resources of bauxite

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BAUXITE DEPOSITS OF THE ANNISTON, FORT PAYNE, AND ASHVILLE AREAS, NORTHEAST ALABAMA

By PRESTON E. CLOUD, JR.

ABSTRACT

The Anniston, Fort Payne, and Ashville areas are in the Northeast Alabama district near the south end of the Valley and Ridge province. Bauxite occurs with kaolin in two deposits in the Anniston area, three in the Fort Payne area, and one in the Ashville area. Elsewhere in each of the three areas, kaolin deposits without associated bauxite occur sparingly.

Bauxite was mined from one deposit in the Fort Payne area in 1917–18, and from the one deposit in the Ashville area in 1941–42. Total production amounted to about 300 tons and 800 tons, respectively. In addition, kaolin has been mined intermittently since the early 1900's in the Fort Payne area, and minor amounts of both kaolin and brown iron ore have been produced in the Anniston area.

Bauxite, kaolin, and associated unconsolidated sediments in each of the three areas appear to fill sinklike depressions in underlying carbonate rocks of early Paleozoic age. A fossil flora, probably of early Tertiary age, was collected from lignite lenses in the unconsolidated sediments in two areas: a deposit of kaolin in the Anniston area, and a deposit of bauxite and kaolin and a deposit of kaolin, both in the Fort Payne area.

INTRODUCTION

Three small, widely separated areas of the Northeast Alabama district, which are described in this report, are of minor economic importance as a source of bauxite or kaolin. These three areas—Anniston, Fort Payne, and Ashville—are each at a considerable distance from the center of greatest concentration of deposits in the district—the Rock Run and Goshen Valley areas (Cloud, 1966)—and even within the confines of the areas themselves, deposits are small and scattered. Bauxite has been produced only from the Hebble mine in the Ashville area and the consolidated Klondike mine in the Fort Payne area, and it is present in negligible amounts at two other localities in the Fort Payne and Anniston areas. Small tonnages of kaolin also have been produced from the latter two areas, but kaolin

has not been mined in the Ashville area. Kaolin mainly has been used locally in making jugs, churns, firebrick, and similar items.

Fieldwork was done in 1943 as part of the U.S. Geological Survey's program of evaluation of the Nation's resources of aluminum ore. The reader should bear in mind that names of properties and operators date from that time and may no longer be applicable.

ACKNOWLEDGMENTS

Fieldwork in the Anniston area was greatly facilitated by the help of C. S. Martin, president of the M. and H. Valve and Fitting Co.; A. N. Nagel of the Monsanto Chemical Co.; and C. D. Pace of Oxford, Ala. Information on the abandoned mines in the Fort Payne area was furnished by Houston Stout of Fort Payne and by Ralph Patterson of the Southern Refractories Co., Fort Payne. The Hebble mine, in the Ashville area was first called to the author's attention by R. W. Smith, district engineer, U.S. Bureau of Mines. Mr. J. C. Hebble showed the author around the mine and furnished information about exploratory work done near it.

ANNISTON AREA

The Anniston area is in south-central Calhoun County, near the south end of the Valley and Ridge province in the Northeast Alabama bauxite district (fig. 1). The area mapped covers 10 square miles in and immediately adjacent to Anniston, the county seat. Fieldwork was done in 1943.

Topographically, most of the area mapped is a broad basin at an altitude of 700 to 800 feet near the headwaters of a stream that drains southward into Choccolocco Creek.The basin is partly bounded on the south of Coldwater Mountain (1,727 ft), on the southeast and east by Choccolocco Mountain (1,300 to 1,600 ft), on the northeast by Blue Mountain (1,500 ft), and on the northwest by low discontinuous ridges.

GEOLOGY

The Anniston area is on the northwest limb of a long tightly compressed complex anticline. The anticline can be traced for more than 25 miles, and extends almost to the Georgia boundary. One of the major thrust faults of the Valley and Ridge province cuts the northwest limb of the anticline and passes through the Anniston area. Movement along the thrust fault was to the northwest.

The Anniston area is underlain by the Weisner Quartzite, Shady Dolomite, and Rome Formation, all of Early Cambrian age, in normal sequence, thrust westward over dolomitic limestone of the Conasauga Limestone, of Middle and Late Cambrian age. On the west are nor-

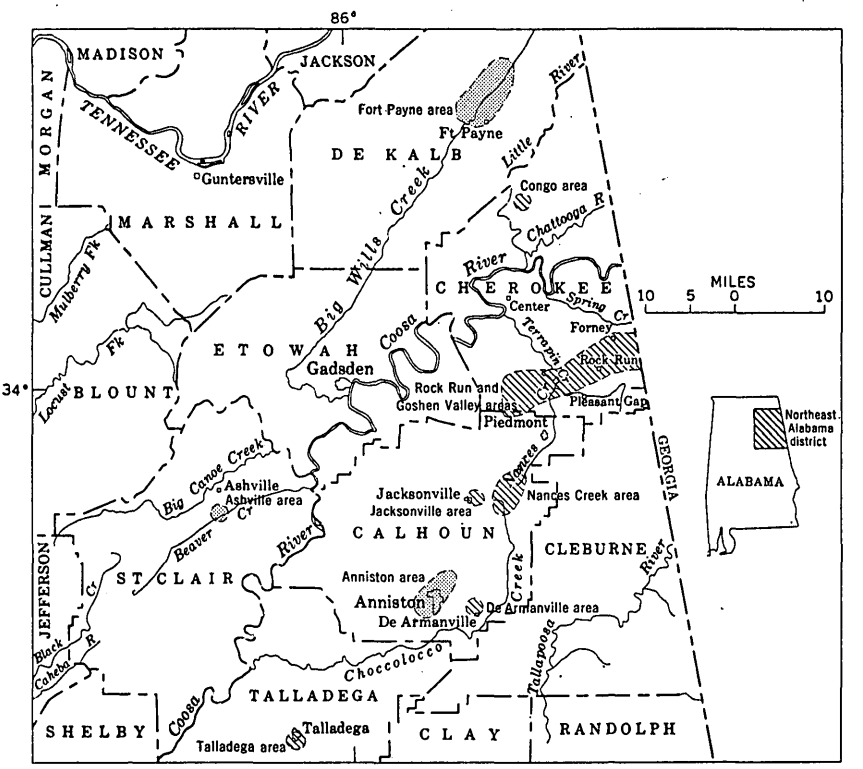

FIGURE 1.—**The Anniston, Fort Payne, and Ashville areas and other areas in the Northeast Alabama bauxite district.**

mally succeeding dolomites of the Copper Ridge Dolomite of Late Cambrian age (pl. 1). Rocks of Early Cambrian age in the central part of the area are complexly folded, but regional dip in the area mapped, in general, is to the northwest. Bedrock geology is largely obscured by unconsolidated sediments of Cenozoic age. These consist of (1) sand and clay containing plants of probably early Tertiary age, (2) later fluviatile gravel and sand, (3) capping gravel and sand of somewhat younger age, and (4) Quaternary alluvium.

The unconsolidated sediments and the municipal area obscure bedrock geology and make interpretation difficult. These hindrances, together with the limited time available for the work, have doubtless led to inaccuracies in the geologic mapping (pl. 1).

STRATIGRAPHY

The Paleozoic stratigraphy of the Anniston area is generally similar to that of the Rock Run and Goshen Valley areas of the Northeast Alabama bauxite district (Cloud, 1966), and the following discussion is restricted to differences between the areas. Evidence does not warrant

estimates of the thicknesses of formations, which probably approximate those in the Rock Run and Goshen Valley areas.

LOWER CAMBRIAN

WEISNER QUARTZITE AND SHADY DOLOMITE

The Weisner Quartzite consists of arenites of varying character similar to those in the Rock Run area.

The base of the Shady Dolomite in the Anniston area consists of a sand and breccia zone which suggests a reworked regolith. The zone is composed principally of grain- to granule-sized rounded to angular pieces of sandstone or quartzite. Locally pebble- to boulder-sized angular fragments make up a part of the zone. The thickness of the zone is unknown, but it is probably variable; measurements of exposures suggest that it does not exceed a few tens of feet. The sand and breccia zone is exposed above the Weisner Quartzite with erosional unconformity near the center of the NE¼ sec. 5, T. 16 S., R. 8 E. It is also exposed along road cuts on both sides of Quintard Avenue in the SW¼ sec. 32, T. 15 S., R. 8 E., in a cut on the Birmingham Division of the Southern Railroad east of the Woodstock Washer mine, and at the intersection of Fair Way and C Streets where chert is in place.

The lower part of the Shady Dolomite, above the basal sand and breccia zone, consists of variegated clay shale beds which closely resemble shale of the Rome Formation. The variegated beds consist of banded maroon, gray, yellow, buff, and cream-colored silty clay shale about 100 feet thick, overlain by laminated cream-colored clayey silt, with mauve bands and streaks about 50 feet thick. Their appearance suggests derivation from ribboned silty carbonate rocks by decalcification. This part of the Shady is well exposed on the southwest side of a county road to De Armanville, southeast of 10th Street and northwest of Fair Way; at the northeast corner of the football field at 18th Street and Christine Avenue; and in a roadcut where U.S. Highway 78 swings west from Clydesdale Street just southwest of the city limits. In the old Woodstock Washer iron mine, zones of true shale in mauve to purplish-red colors are interbedded with zones of clay shale and silt which represent decalcified carbonate rocks near the base of the Shady Dolomite.

Variegated shale which is probably a part of the Shady is shown with a question mark on the map in the SE¼SE¼ sec. 11, T. 16 S., R. 7 E. Here a small isolated knob is underlain by purplish-red to maroon, mauve, and buff shale and siltstone which strongly resemble the Rome. The shale and siltstone are considered to be a part of the Shady instead of the Rome for the following reasons: (1) They differ from typical shale of the Rome Formation in being finely and abun-

dantly vesicular as though being residual from a calcareous rock, (2) they occur at some distance from the nearest outcrop known to be Rome and are surrounded by rocks interpreted as being the Shady, and (3) the Rome Formation, unlike the Shady, commonly crops out even in topographically low places, but here the knob is surrounded by alluvium.

Siliceous residuum from the Shady Dolomite occurs in great variety. It is characteristic of the weathered surface of any part of the formation but is most abundant in the upper part, especially where the Shady is thrust over the Conasauga Limestone. The siliceous residuum consists of (1) sandy and silty siliceous aggregates of varying texture, color, and degree of porosity, which resemble thoroughly leached sandy and silty dolomites or dolomitic siltstones, (2) nodules or concretions varying in size and in composition from true chert to quartzite, (3) brittle to rotten chalky chert resembling residuum of the Longview and Newala Limestones, and (4) nondescript stony-looking chert of a generalized type, except that some is very dark gray to black and known only from the Shady. Residuum from the Shady along and above the thrust fault contact with the Conasauga is extremely resistant and makes a prominent minor ridge that extends southwest from the southwestern part of the area mapped for at least 1½ miles. A breccia zone is at the base of this ridge and is well exposed in the railroad cut in the SW¼NW¼SE¼ sec. 11, T. 16 S., R. 7 E.

ROME FORMATION

The Rome Formation consists principally of nonresistant purplish-red and buff shale with minor thin siltstone and sandstone beds. Topographically it occupies a lowland characterized by small rounded knobs. Nonresistant though the Rome is, it crops out persistently even in the lowest parts of the area. For this reason the Rome Formation is generally assumed not to occur beyond the limits defined by outcrops, and isolated strata lithologically similar to the Rome, but well outside these limits, probably represent the lower part of the Shady Dolomite.

MIDDLE AND UPPER CAMBRIAN

CONASAUGA LIMESTONE

The Conasauga Limestone in the Anniston area is represented only by carbonate rocks, and shale characteristic of the lower part of the formation is not known. Whether this is due to omission by faulting or to facies changes has not been established. If the carbonate rocks represent only the upper part of the Conasauga, then the part of the formation which is of Middle Cambrian age may not be present

in outcrop, and therefore only rocks of Early and Late Cambrian age may be present in this area.

The Conasauga was mapped on the basis of a residuum that includes columnar quartz aggregates and cellular siliceous oolite which elsewhere are characteristic of residuum derived from the dolomitic limestones of the upper part of the formation. However, considerable true chert was also found in the area mapped as Conasauga, presumably being in large part left from the erosional retreat of the overlying Copper Ridge Dolomite.

UPPER CAMBRIAN

COPPER RIDGE DOLOMITE

Only the lower part of the Copper Ridge Dolomite is within the limits of the Anniston area. The residuum contains a typical assemblage of chert, including rough cavernous chert which yields small gibbous trilobite heads and a planispirally coiled gastropod. The basal pipe-chert facies of the formation was not mapped separately because chertified digitate stromatolites, characteristic of the facies, are extremely restricted in occurrence in the area. The Copper Ridge Dolomite is the only part of the Knox Group present.

CENOZOIC

EARLY TERTIARY(?)

Plant-bearing clay and silt, sand, and minor gravel beds of probable early Tertiary age occur in the western part of the city of Anniston and suburban Mechanicsville (pl. 1) where they appear to occupy depressions that probably originated as sinkholes. The original sequence of deposition and thickness of the beds is unknown, for they now lie at random attitudes in small areas topographically suggestive of large breached sinks. The largest of these is the Eulaton Pike prospect (pl. 2).

The clay beds include hard nonplastic kaolin, soft semiplastic to plastic kaolin, lignitic kaolin, and sandy clay. The various types of clay are mixed with sand and silt by intertonguing and slumping. Granule gravels are locally interbedded with clay, but most gravel overlies clay with an angular unconformity and at the base contains angular pebbles of hard clay. The overlying gravel is somewhat younger than the clay and associated materials, and, at least in the Eulaton Pike deposit, it is clearly postslump, for it overlies the upturned edges of clay beds like a blanket.

Fossil plants were first collected from the kaolin beds at the Eulaton Pike prospect in November 1942, when C. Fagan of Anniston took D. M. Coulter, of the U.S. Bureau of Mines, and the author to see

them. In June 1943, additional collections were made by R. W. Brown and K. M. Waagé, of the U.S. Geological Survey. Brown (written commun., July 14, 1943) reported that "the general aspect of the assemblage * * * is that of a Tertiary flora, but whether this is Midway [Paleocene] or Wilcox [Eocene] is uncertain." Significant floral species listed were cf. *Glyptostrobus europaeus* (Brongniart) Heer, *Dryophyllum tennesseensis* Berry, *Banksia tenuifolia* Berry, *Cinnamomum oblongatum* Berry, and cf. *Asplenium eolignitica* Berry. Plants were collected from outcrops of kaolin only at the Eulaton Pike prospect, but similar clay and associated materials crop out at three other places: the Carter Street, 14th Street, and Parkwin Street prospects. Plant fragments were seen at all prospects.

Reconnaissance traverses disclosed a sand of probable early Tertiary age outside the area mapped in the SE¼SE¼NE¼ sec. 10, T. 16 S., R. 7 E., and clay, as well as sand, occurs for a mile or two to the southwest in small deposits.

FLUVIATILE GRAVEL AND SAND

Recognizably fluviatile gravel and sand is well exposed at the John B. LaGarde gravel and sand pits in northeast Anniston, at gravel and sand pits on the north in adjacent Fort McClellan, and along the top and northwest side of the ridge that extends southwestward to the Mobile Division line of the Southern Railroad. The presence of channeled beds, cross-bedded lenses, and discontinuous layers having abrupt textural variations and many local unconformities suggests that there are deposits of a stream flowing in a northeast or southwest direction parallel to the ridge and the strike of the gravel. The gravel consists principally of rounded pebbles and cobbles of sandstone and quartzite from the Weisner, but pebbles of quartz are also abundant, and pebbles and cobbles of rounded to subrounded chert are not uncommon. Small lenses of very sandy clay occur randomly in the gravel and sand but are not common. Detailed work was not done on the fluviatile gravel and sand because reconnaissance failed to reveal nonsilty or large clay deposits in them.

The formation strikes roughly northeast. The average dip on exposures is about 30° NW., but a 400-foot deep well (well 14, pl. 1) was in gravel all the way to the bottom, which suggests regional dip closer to 45° NW. The formation has apparently undergone some slumping, tilting, or dislocation since deposition. The age of the fluviatile gravel and sand is uncertain, and no direct evidence bearing on the question was found.

CAPPING GRAVEL AND SAND QUATERNARY ALLUVIUM

The gravel and sand unit which caps discontinuous low ridges is probably reworked. Its relations are obscure, and gravel of more than one age and type may have been mapped together. The unit is tentatively regarded as younger than the fluviatile gravel and sand and was probably derived from them. It is clearly older than the Quaternary alluvium which consists in part of its reworked elements.

The capping gravel and sand may have been spread over an area of subdued topography as a blanket deposit near the end of an erosion cycle by a major stream which wandered over a broad flood plain. This stream may have been the same one which earlier had deposited the fluviatile gravel and sand.

Alluvium covers a large part of the Anniston area. It is mainly sandy to clayey river alluvium, slope wash, and undifferentiated cover of Quaternary age.

CENOZOIC SEQUENCE OF EVENTS

Following a long unrecorded period in which formations of Paleozoic age were deformed and brought to approximately their present positions, a lake or lakes were formed in early Cenozoic time on low-lying land underlain by the Conasauga Limestone at the west side of Anniston. If more than one lake was present, some may have been as small as an individual sinkhole. One lake, or part of a larger lake, probably extended at least from northeast of the center of sec. 1, T. 16 S., R. 7 E., southwestward through secs. 1 and 11 to the east side of sec. 10, T. 16 S., R. 7 E., in and adjacent to Mechanicsville and the west part of Anniston. The inferred length is thus a little more than 2 miles, and it was probably at least half a mile wide. The topographic environment was such that beds of fairly pure kaolin were deposited along with beds of sand, silt, and lignitic clay. Leaves, fruits, and stem fragments of plants of Midway or Wilcox age were buried with the clay.

A period of deep chemical weathering followed deposition of these lacustrine sediments, and caverns were formed in the underlying carbonate rocks. By collapse, these caverns formed sinks which trapped the overlying clay and sand in miscellaneous disarray.

Rejuvenation of the drainage system in the area resulted in the deposition of more than 30 feet of fluviatile sand and gravel in the channel of at least one major stream. In the late stages of the fluvial cycle, a stream or streams redistributed parts of the preexisting channel deposits as a gravel blanket over a broad flood plain. This was succeeded by uplift, degradation, and alluvial deposition.

DEEP WELLS

Data from deep wells drilled in the south and east parts of Anniston have been useful in mapping. Most of the wells penetrated material interpreted as belonging to the Shady Dolomite, and two may have penetrated to, or nearly to, the Weisner Quartzite. The locations of these wells are shown on plate 1, and logs of the drilling are shown graphically on figure 2. Unless otherwise noted on figure 2, the driller's logs for these holes were given from memory by Mr. C. D. Pace of Anniston, who drilled all the deep wells in the area between 1922 and 1943.

The following interpretations can be made from the drill logs. Wells 1, 3, 7, 8, and 10 were probably in the Shady Dolomite throughout. Well 2 may have bottomed in the Weisner Quartzite, but it more likely penetrated to the base of the Shady and not quite into the Weisner. McCalley (1897, p. 694, quoting Walter Crafts) reported that the lower 8 feet of the Woodstock well (well 2) was in "sandstones; with cavities," and interpreted these as belonging to the Weisner. The description may also refer to the lower vuggy siliceous aggregate ("jasperoid") or to basal sandstone of the Shady Dolomite; but in any instance, it is certain that the water was derived from one or the other if C. R. Martin (oral commun., 1942) was correct in stating that the water obtained was freestone water (meaning free of $CaCO_3$). Well 4 lacks a record. Well 5 is near the contact between the Rome Formation and the Shady Dolomite, and near the top it may be in the Rome; but the red shale or clay recorded from the base almost certainly is a part of the Shady Dolomite, and the well may have been in Shady throughout. Well 6, the well at Moore Street between 11th and 12th Streets, is said to have been an artesian well, which would suggest derivation of its water from the Weisner. Well 9 may have been in Quaternary alluvial gravel along Snow Creek for most of its depth but probably bottomed in the Shady Dolomite, and it may have been in the Shady for a greater thickness than the record suggests. Well 11 was in shale of the Rome Formation throughout. Well 13 penetrated about 375 feet of shale of the Rome Formation and bottomed in the Shady. Wells 12 and 14 were in fluviatile gravel and sand of probable Cenozoic age.

BAUXITE AND KAOLIN DEPOSITS

Two bauxite and four kaolin deposits compose the known potential aluminum ore resources of the Anniston area. Bauxite has been reported from two additional localities which were not seen. These were at Fort McClellan (Jones, 1940, p. 63) and under Quintard Avenue between 8th and 10th Streets (C. S. Martin, oral commun. 1942). The locations of prospects are shown on plate 1.

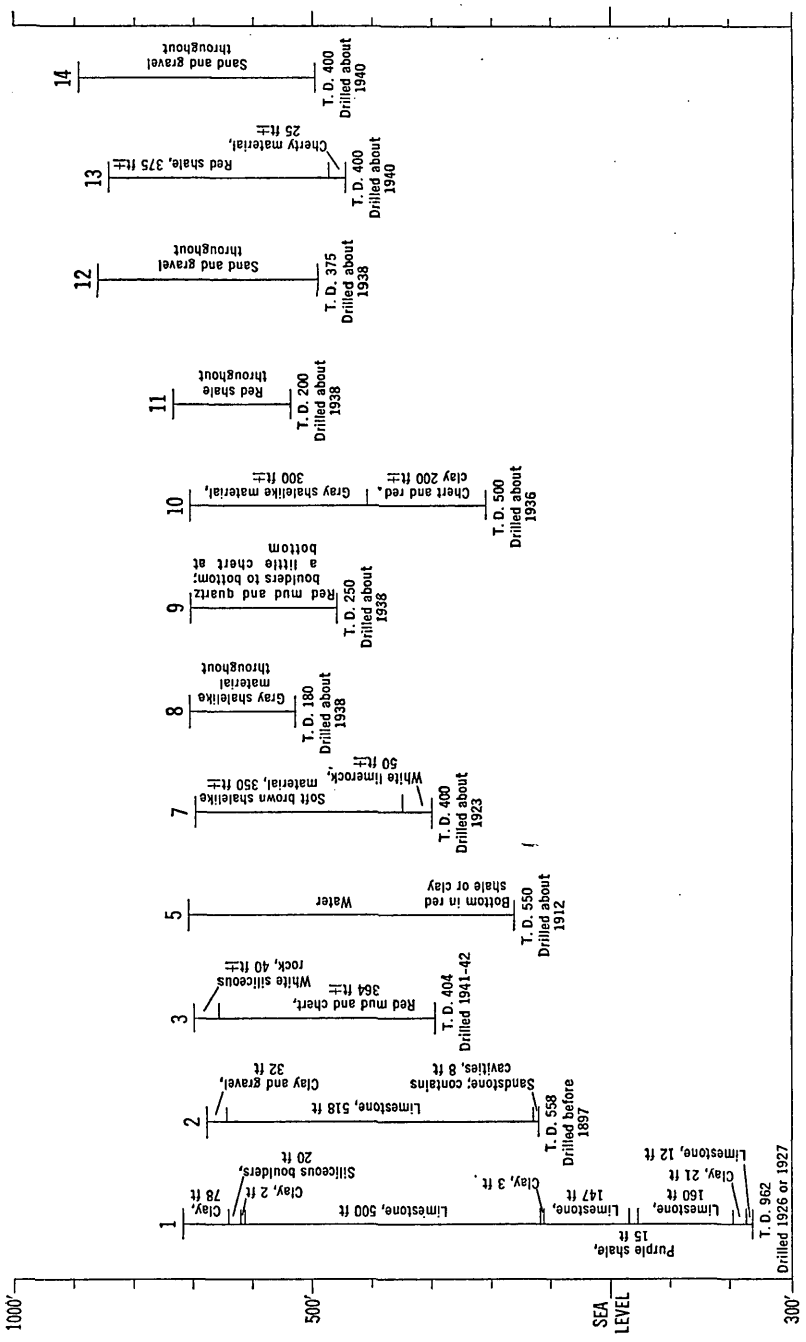

FIGURE 2.—Logs of deep wells at Anniston. See table on facing page for explanation.

Explanation for figure 2

[Unless otherwise noted, these records were furnished from memory by Mr. C. D. Pace. T.D., approximate total depth, in feet]

Well (Nos. correspond to those shown in fig. 2)	Name or owner of well	Remarks
1	Monsanto Chemical Co	Log quoted from company records by courtesy of Mr. J. R. Alexander.
2	Old Woodstock well	Log quoted from McCalley (1897, p. 694) as furnished to him by Mr. Walter Crafts.
3	Kilby Steel Co., well 2	
4	Kilby Steel Co., well 1	Said to have been drilled by the Gray Artesian Well Co., Pensacola, Fla., about 1922. No record available.
5	Anniston Manufacturing Co. well	Driller unknown; incomplete record given by Mr. C. D. Pace.
6	Old Ingram Mule Barn well	Drilled before 1900; said by Mr. E. C. Knowlton of the Anniston Water Department to have been a flowing well that yielded Anniston's water supply for many years. No record available.
7	Alabama Ice Co. well	
8	Anniston Gas Plant well	
9	Anniston Steam Laundry well	
10	Calhoun County Creamery well	
11	Dishman Lumber Co. well	
	John B. LaGarde:	
12	Well 1	
13	Well 2	
14	Well 3	

SKINNER BAUXITE DEPOSIT

Location.—The prospect is within the abandoned Skinner iron mine, or Skinner Banks, as it was called also, in the SE¼NE¼SE¼ sec. 12, T. 16 S., R. 7 E., and NW¼SW¼NW¼SW¼ sec. 7, T. 16 S., R. 8 E. The old mine consists of four major open pits extending from one pit west of the south end of Zinn Parkway, now the city dump, for about 1,000 feet to the southwest, beyond the Anniston city limits (fig. 2). The pits lie on the west slope of Coldwater Mountain, near its northern extremity, just below a prominent break in slope. They are at an altitude of about 850 to 950 feet.

Geologic setting.—The bauxite and clay body is surrounded by residuum from carbonate rocks that represent the lower part of the Shady Dolomite stratigraphically not far above the Weisner Quartzite. The Shady Dolomite here forms the west limb of a low anticline. The bauxite and kaolin probably fill an ancient sinkhole in the dolomite.

Development.—The Skinner Banks were mined for iron ore for many years. The pits are mined out and abandoned. Bauxite was present in small amounts but was never mined. Mr. C. S. Martin, of Anniston, reported that when he was managing the property for the old Woodstock Iron and Steel Co. some years ago, he gave an option on the bauxite to a Mr. Groves of Birmingham and that Mr. Groves or his agent had a number of holes drilled in the vicinity of the mines. Data on location of drill holes and the results of drilling have apparently been lost, but it may be assumed that no significant quantities of high-grade bauxite were found. Some test pits also were dug, but in 1943 they existed only as very shallow depressions. At only one pit, dug between mines 3 and 4, was bauxite found in the peripheral debris.

Bauxite and kaolin.—The bauxite ranges from hard to soft, nonpisolitic to pisolitic, and cream-colored through salmon pink to brick red, the pisolites typically being darker than the matrix. Some of the matrix of pisolitic bauxite is very dense and has a horny or chalcedonic appearance, suggesting silication of bauxite to form secondary kaolinite. Quartz is present locally in thin veinlets and tiny vugs that are visible under a hand lens.

The results of chemical analyses indicate that most of the bauxite is low grade. The following analyses in percent, of samples, probably from the southwesternmost of the Skinner mines (No. 1, fig. 2), were furnished through the courtesy of F. N. Williams of the Monsanto Chemical Co.:

Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Loss on ignition
43. 55	10. 15	22. 88	2. 07	22. 55
44. 45	10. 20	21. 74	2. 21	21. 40
44. 61	11. 30	20. 02	1. 97	22. 10

An analysis of a random sample from the mines furnished by W. P. Cowan of Piedmont, Ala., is as follows: 44.64 percent Al_2O_3, 28.00 percent SiO_2, 4.09 percent Fe_2O_3, and 2.05 percent TiO_2, with 18.77 percent loss on ignition. Three analyses given by Jones (1940, p. 65), however, suggest the former presence of high-grade bauxite at this prospect.

The maximum inferred extent of the deposit (pl. 1) is about 125,000 square feet. The bauxite and kaolin do not underlie the entire area but occur as relatively thin patches separated by barren residuum derived from the Shady Dolomite. In places, the relation between the bauxite and the residuum suggests that pinnacles of dolomite originally extended up through the accumulations of iron ore, bauxite, and kaolin on a karst surface.

The best exposures of bauxite and kaolin at the prospect are in the walls of the four open pits of the old Skinner iron mines. They are described in order from southwest to northeast.

Mine 1 is about 300 feet in diameter and 50 feet deep. It is an open pit with an outlet at the northwest but contains a little water in the bottom the year round. Clays interpreted as residual from the Shady Dolomite occur in parts of the north, northwest, and south walls, slumped debris intervening. Red to white pisolitic bauxite and pisolitic limonite as much as 35 feet thick crop out for 175 feet along the east wall. The upper surface of the bauxite dips 20° N. under 1 to 30 feet of overlying gravel and sand. Bauxite is restricted to the east wall.

Mine 2 (pl. 1) is about 400 feet long, trending irregularly northeast; it is about 150 feet wide and about 50 feet deep. The open pit is drained through the northeast corner but holds a little water during the rainy season. Bauxite is exposed in the north, south, and east sides of the pit. Across the entire south end of the mine nonpisolitic to crudely pisolitic bauxite and bauxitic clay 25 to 40 feet thick are mixed with silty clay. The bauxite is brown, red, yellow, or white. It is overlain by 3 to 15 feet of gravel. In the north wall a lenticular bed of soft white and pink pisolitic bauxite about 20 feet wide and 5 feet thick is exposed under 10 feet of gravel. In the east wall, bauxite about 15 feet thick is exposed for about 50 feet; it is overlain by 8 to 12 feet of quartzite gravel. This bauxite is also pisolitic and varies from hard to soft and red to white. The pisolites are commonly fer-

ruginous, brownish red, and powdery; the matrix is white dense horny-looking clay. Free silica is present as quartz druses in thin veinlets and tiny vugs. In the west wall, between the exposures of bauxite in the north and south walls, are clays that are probably residual from carbonate rocks of the Shady Dolomite.

Mine 3 is about 350 feet long in an east-west direction, about 150 feet wide, and about 40 feet deep. It is drained through the northwest corner and is always dry. Bauxite is exposed in the walls of the pit; it is about 5 feet thick at the west side of the outlet in the northwest corner, about 8 feet thick in the extreme west wall, about 22 feet thick in the central part of the south wall, and 30 feet thick in the east wall. The bauxite is mostly cream colored, granular to nonpisolitic, and has small salmon-colored patches, but in the west wall the bauxite is crudely pisolitic. Clays inferred to be residual from the Shady Dolomite can be seen all across the north wall and between the outcrops of bauxite in the south wall, suggesting that the bauxite remaining in this mine is but a patchy veneer against barren residual clays.

Mine 4 is in part used as a city dump. Where the walls can be seen, only residual clay is exposed. The clay appears to strike about east-west and to stand on end.

STRINGFELLOW BAUXITE DEPOSIT

Location.—The Stringfellow bauxite deposit is in the SE¼NW¼ sec. 5, T. 16 S., R. 8 E., in the vicinity of the Susie Parker Stringfellow Memorial Hospital for the Tubercular in municipal Anniston. The deposit lies at an altitude of about 800 feet near the foot of the southwest slope of a long irregular spur trending southwesterly from Blue Mountain.

Geologic setting.—The bauxite deposit is in an area underlain by strata of the lower part of the Shady Dolomite and probably fills an ancient sinkhole.

Bauxite and kaolin.—The bauxite in this deposit is hard, pisolitic, red to buff in color, and crumbly. Bauxitic clay is soft, crudely pisolitic, and pink, tan, or white. It grades into nonpisolitic bauxitic clay. The kaolin is hard, white or pink, and gritty in places. A composite sample of bauxitic material from the roadcut on 18th Street, analyzed by the U.S. Bureau of Mines contained 39.97 percent Al_2O_3, 35.87 percent SiO_2, 4.16 percent Fe_2O_3 and 2.27 percent TiO_2, with 17.73 percent ignition loss.

The principal outcrop is in a cut bank on the north side of 18th Street, midway between Christine and Leighton Avenues. A second outcrop is about 115 feet S. 20° E. from the bank, in an alleyway. A third outcrop is 20 to 40 feet southwest of the second, in a lot vacant in 1943.

The bauxite exposed on 18th Street extends from 170 feet southeast of Leighton Avenue, southeastward for 50 feet, and has a maximum thickness of about 10 feet. Bauxite is overlain by about 25 feet of tangentially laminated sand, silt, and pebble- to granule-sized gravel in discontinuous layers capped by ferruginous sandstone. The gravel is composed of quartz and hard white to pink kaolin. It extends for 120 feet southeast beyond the bauxite. It strikes about N. 10° W. and dips 15°–30° E. The exposures of bauxite in the alleyway and vacant lot immediately south of 18th Street consist of similar bauxitic material. Sand beds intervening between the last-named exposures strike N. 40° W. and dip 25° SW.

Minor amounts of bauxite and kaolin are exposed along 19th Street on the north side of Stringfellow Hospital. At the north gate of the hospital a gravel bed which has a matrix of bauxitic clay strikes about N. 50° E. and dips 30°–50° SE. At the northwest corner of the football field an excavation along 19th Street exposed a gravel bed which contains pebbles of gritty hard kaolin. The bed strikes about N. 80° E. and dips 15° S.

East of these exposures at the northeast corner of the football field capping gravel and sand of Cenozoic age rest upon variegated clay shales of the Shady Dolomite. The gravel strikes N. 60° W. and dips 5°–10° N.

Data are inadequate to warrant speculation as to the size and shape of the bauxite deposit. Except for the southwest-dipping sand bed in the alley south of 18th Street, the outcrops appear to be part of the inward-dipping rims of a large basin which underlies parts of the Stringfellow Hospital grounds and the football and baseball fields to the east. Projection of the rim as essentially symmetrical gives the inferred limits of the deposit shown on plate 1. If the structure had about the limits shown, and an essentially symmetrical dip, a drill hole between the two ball fields at 18th Street and Christine Avenue would have to penetrate 100 to 200 feet of overburden before reaching bauxite.

EULATON PIKE KAOLIN DEPOSIT

Location.—The Eulaton Pike prospect is in the NE¼ sec. 11, T. 16 S., R. 7 E. (pls. 1 and 2). It is on the west side of a low strike ridge in a conspicuous topographic basin strongly suggesting a breached sinkhole. It lies at an altitude of about 770 to 800 feet.

Geologic setting.—Clay residual from dolomitic limestone of the Conasauga Limestone underlies and surrounds a deposit of sand, sandy clay, and kaolin. Some of the kaolin contains fossil plants identified by R. W. Brown as probably Paleocene or early Eocene age (p. O7)

and Cloud and Brown, 1944, p. 1466). The deposit is 1,000 to 2,000 feet northwest of the inferred trace of a major low-angle thrust fault.

Development.—Clay and sand have been mined from several small open pits at this locality (pl. 2).

Kaolin.—Kaolin occurs in beds 1 to 8 feet thick, but the beds are broken and mixed with sand, sandy clay, and silt beds. They are unpredictable as to attitude and continuation. The dips and strikes shown on plate 2 were selected at random from many observations and indicate that the strike boxes the compass, and the dip ranges from 30° to 80° in any direction. In parts of the south side of the deposit, the dips are suggestive of a peripheral inward-dipping structural feature; but when the prospect as a whole is considered, the picture becomes one of a jumbled mass of slumped blocks.

The amount of material trapped in this probable sink is large, but kaolin containing more than 30 percent alumina probably does not exceed 5 or 10 percent of the total volume. The extent of the deposit is fairly closely established by the presence of residual chert-bearing clays. Chert of the Conasauga Limestone is locally exposed within the kaolin and sand body (pl. 2), and depth to residual clay, or the Conasauga Limestone, is probably not great in any part of the sink.

Most of the kaolin is white, hard, and nonplastic, with a considerable admixture of soft, semiplastic light-gray to dun-colored kaolin. Mauve, purplish, and reddish-colored kaolin occurs in relatively small, discontinuous lenses or irregular bodies. No bauxite is present. Samples of various types of the clay were analyzed by the U.S. Bureau of Mines, and the results, in percent, are tabulated below:

	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Loss on ignition
White kaolin	36.9	47.0	0.8	2.3	13.0
Purple kaolin	35.1	44.8	4.9	2.3	12.9
Soft dun-colored kaolin	34.7	48.4	1.0	2.5	13.0
Lignitic clay	32.9	49.5	1.0	2.5	13.3

CARTER STREET KAOLIN DEPOSIT

Location.—The Carter Street kaolin deposit is in the NE¼NW¼ NW¼ sec. 12, T. 16 S., R. 7 E. at an altitude of about 800 feet.

Geologic setting.—Kaolin occupies a small basinlike reentrant which has been cut into the crest of a minor ridge from the southeast. The ridge is capped by gravel but is underlain by carbonate rocks of the Conasauga Limestone. The deposit is 800 to 1,300 feet northwest of the inferred trace of a major low-angle thrust fault.

Kaolin.—Kaolin from this deposit is hard white and nonpisolitic; no bauxite is present. A sample from the alley at 1024 Carter Street

was analysed by the U.S. Bureau of Mines, as follows: 38.4 percent Al_2O_3, 45.4 percent SiO_2, 0.4 percent Fe_2O_3, and 2.0 percent TiO_2 with 13.8 percent loss on ignition.

Kaolin and sand are exposed in a small area closely surrounded by residual materials of the Conasauga Limestone. The kaolin probably constitutes only a minor proportion of the total volume of the deposit, and a significant tonnage is unlikely. The possible extent of the deposit is shown on plate 1. Surface indications are meager. Thirty feet west of the west side of Carter Street, in a closed-off alleyway south of the residence at 1024 Carter Street, a sand bed striking N. 80° E. and dipping 75° N. is overlain by hard white kaolin of unknown thickness. The kaolin extends along the north side of the alleyway from 90 to 120 feet west of Carter Street. The maximum vertical exposure is 4 feet. In a ditch on the east side of Carter Street 180 feet N. 30° E. from there sandy hard white kaolin also crops out.

14TH STREET KAOLIN DEPOSIT

Location.—The 14th Street deposit is directly north of the Carter Street prospect and mostly in the NW¼SW¼SW¼ sec. 1, T. 16 S., R. 7 E. The only kaolin exposed is on 14th Street immediately west of Carter Street at an altitude of about 780 feet.

Geologic setting.—Kaolin is exposed at the northwest side of a breached sinklike basin on the west slope of a gravel-capped strike ridge which is underlain by carbonate rocks of the Conasauga Limestone. By analogy with plant-bearing clays at the Eulaton Pike prospect, the kaolin is probably of early Tertiary age. The deposit is 1,500 to 2,500 feet northwest of the inferred trace of a major low-angle thrust fault.

Kaolin.—Gritty nonpisolitic hard white kaolin is exposed for about 10 feet along a ditch about 2 feet deep at the south side of 14th Street and about 180 feet west of Carter Street. On the north side of 14th Street opposite this exposure, similar kaolin crops out in two places at the base of a low bank. All three exposures of kaolin are surrounded by sand. The attitude of the kaolin or the sand could not be determined.

Because of lack of exposures, the area of possible extension shown on plate 1 is extremely tentative; but there is probably no considerable volume of kaolin at this site.

PARKWIN STREET KAOLIN DEPOSIT

The Parkwin Street prospect is in the S½SW¼NE¼ and N½NW¼ SE¼ sec. 1, T. 16 S., R. 7 E., on a gullied northwest-facing slope west of Parkwin Street near 17th Street. The deposit is at an altitude of 720 to 750 feet.

Geologic setting.—Kaolin crops out in gullies on a gravel-capped strike ridge which is underlain by carbonate rocks of the Conasauga Limestone. The deposit is 600 to 1,700 feet northwest of the inferred trace of a major low-angle thrust fault.

Kaolin.—Kaolin is well exposed in three gullies which are 150 to 600 feet west of Parkwin Street and largely restricted to the area between 17th and 18th Streets. The gullies range in depth from 3 to 10 feet. Kaolin crops out almost continuously along the gullies for distances of 45, 70, and 140 feet, respectively; but it is interbedded with lenses of sand and silt. The maximum thickness of kaolin exposed is about 5 feet. Where it could be determined, the strike varies, and steep to vertical dips predominate.

The kaolin is predominantly white, but some of it is mauve, chocolate colored, or purple. It is almost grit free to sandy, hard to soft, and nonplastic to semiplastic. No bauxite is present. A composite sample from the gully nearest Parkwin Street was analysed by the U.S. Bureau of Mines, as follows: 39.5 percent Al_2O_3, 44.6 percent SiO_2, 0.5 percent Fe_2O_3, and 1.5 percent TiO_2, with 14.2 percent loss on ignition.

The kaolin crops out over a considerable area, and it might constitute as much as 20 percent of the total volume of the sand and clay. This suggests a considerable volume of kaolin at this site, but near-vertical attitudes and abrupt lithologic changes are to be anticipated and may completely nullify hopes of a large high-grade deposit. The inferred limits of the body are shown on plate 1.

FORT McCLELLAN DEPOSIT

A deposit of kaolin on the Fort McClellan military reservation was reported by Jones (1940, p. 63). The deposit was not located, although two days were spent looking for it. Lloyd's Gap, the locality mentioned by Jones, was unknown to those contacted in 1942. Officials of Fort McClellan suggested the gravel and sand pits at the northern Anniston city limits, but the clay in these pits was sandy. The general location of the pits is shown on plate 1. Mr. C. Fagan, of Anniston, and his father thought the prospect was near the head of a tributary to Snow Creek in the outcrop area of the Weisner Quartzite. However, the only material suggestive of bauxite in this vicinity was a nodular clay ironstone found in two small pits shown on plate 1 as the Snow Creek prospect.

QUINTARD AVENUE DEPOSIT

Bauxite similar to that at the Skinner prospect was exposed somewhere between 8th and 10th Streets in excavations made while Quintard Avenue was being built, according to C. S. Martin (oral commun.,

Oct. 7, 1943), of Anniston, who was formerly in charge of mining at the Skinner iron mines.

FORT PAYNE AREA

The Fort Payne area is in central DeKalb County, in the Valley and Ridge province of northeastern Alabama. It is the northernmost area in the Northeast Alabama bauxite district (fig. 1) and extends northeastward from the latitude of Fort Payne for about 8 miles, parallel to the regional strike. Two bauxite and two kaolin deposits, one of which contained a small quantity of bauxitic clay, constitute the known aluminous material in this area. The locations of the deposits are shown on figure 3. About 1 square mile at each of three localities was mapped during the 4 days spent studying the area in 1943.

PREVIOUS WORK

The geology of that part of northeastern Alabama which includes the Fort Payne area was described in considerable detail by McCalley (1897) and later somewhat revised by Butts (1926). The bauxite and kaolin deposits of the area were discovered and mined some years later than those of the major producing areas in the Northeast Alabama district and were described briefly by Jones (1940, p. 31–32).

GEOLOGY

Reconnaissance study in the Fort Payne area in general confirms the structure shown on the geologic map of Alabama by Butts (1926). The Fort Payne area lies along the breached and faulted crest of the Big Wills anticline between the Lookout Mountain syncline to the east and the Sand Mountain syncline to the west. A persistent strike fault on the east side of Dugout Valley disrupts the symmetry of the anticlinal feature and throws Copper Ridge Dolomite at the center of the anticline up against the younger Chickamauga Limestone to the west. Dugout Valley and the valley of Big Wills Creek are both underlain by the Chickamauga Limestone, representing the Middle and Upper Ordovician. West of Dugout Valley the Chickamauga is succeeded by the Red Mountain Formation (Silurian), the Chattanooga Shale (Devonian and Mississippian), and the Fort Payne Chert (Mississippian). The Fort Payne is succeeded to the west by beds of later Mississippian age. East of the strike fault the section apparently extends eastward in virtually unbroken succession from the Copper Ridge Dolomite stratigraphically upward to formations of Pennsylvanian age on Lookout Mountain. The regional dip east of the fault is estimated to average 30°–40° E.

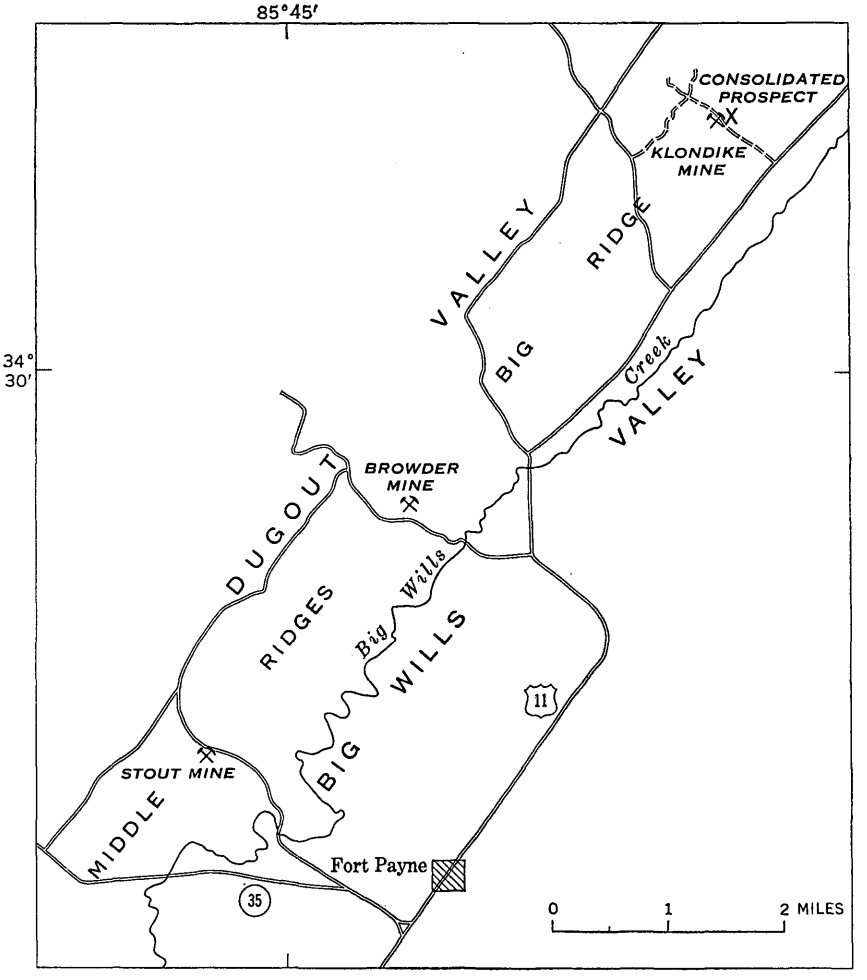

FIGURE 3.—Bauxite and clay deposits in the Fort Payne area.

STRATIGRAPHY

The stratigraphic section of interest in the occurrence of bauxite and kaolin consists of carbonate rocks of the Knox Group, of Cambrian and Ordovician age, and pockets of clay of probable early Tertiary age which apparently fill sinkholes. The formations of the Knox Group have been described (Cloud, 1966) and are considered here only insofar as they differ significantly. No gravel units of Cenozoic age were found, but scattered round pebbles of chert and quartzite on some of the hilltops suggest their former presence.

CAMBRIAN AND ORDOVICIAN

KNOX GROUP

The Knox Group in the Fort Payne area consists of the Copper Ridge Dolomite, the Chepultepec Dolomite, and, at the top, the Longview Limestone. The Copper Ridge and the Chepultepec have each been divided into an upper and lower zone on the basis of particular residual elements.

Copper Ridge Dolomite.—A cryptozoon zone at the base of the exposed section of the Knox Group probably is nearly equivalent to the digitate stromatolite (gymosolen) zone at the base of the Copper Ridge Dolomite in southern Cherokee County. Cavernous chert, similar to that which elsewhere carries fossils characteristic of the main part of the Copper Ridge, was found near the top of and for some distance stratigraphically above the cryptozoon zone, but no fossils were found in the chert in the limited time available for search. It has been designated the zone of nondescript chert and is discussed further in the section below.

Chepultepec Dolomite.—Fossiliferous cherts, residual from the upper part of the Chepultepec Dolomite, occupy an easily mapped zone; but the sandstones normally at the base and near the middle of the Chepultepec are very poor in the Fort Payne area. The area between the zone of fossiliferous chert in the Chepultepec Dolomite and the cryptozoon zone in the underlying Copper Ridge Dolomite can be divided into two zones. The lower, the zone of nondescript chert, is assigned to the Copper Ridge; and the upper, called the zone of oolitic chert, is assigned to the Chepultepec. The formation boundary may be anywhere within these two zones; however, it is arbitrarily placed at the contact between them because thin local sandstones were found near the top and bottom of the oolitic zone and because this boundary is convenient for mapping and assigns approximately equal thicknesses to the two formations.

Longview Limestone.—The Longview Limestone is identified on the basis of blocky finely granular stony-looking dirty white to light-gray chert that contains the diagnostic Longview gastropod *Lecanospira*. The ropy chert typical of the Longview in southern Cherokee County is not typical in the Fort Payne area.

As a result of present mapping, the position of the contact between the Chepultepec Dolomite and the Longview Limestone has been moved to the west of that shown by Butts (1926) on the Alabama State map. Collections of the diagnostic fossil, *Lecanospira*, were made in an area extending from one-third to almost half way into the belt of hills on the west side of Big Wills Creek which were mapped as Chepultepec by Butts. On the State map this boundary is placed close to Big Wills Creek.

TERTIARY(?)

The deposits of probable early Tertiary age are small and consist mainly of sandy and nonsandy kaolin together with bauxite, lignitic clay, and, in a few places, lignite. The deposits, as elsewhere in the Appalachian region, appear to fill ancient sinkholes in carbonate rocks of the Knox Group and are lithologically distinct from the chert-bearing sandy clays, residual from the Chepultepec Dolomite and Longview Limestone which surround them in the Fort Payne area.

Badly macerated fossil floras were collected by the author from lignitic clay and lignite at the Stout and Browder mines (fig. 3). The fossil material was examined by R. W. Brown (written commun., Oct. 29 and Nov. 1, 1943), who identified the conifer cf. *Glyptostrobus europaeus* (Brongniart) Heer in the collection from the Stout mine. This form was also found in the Anniston area, Alabama. Fragments of dicotyledons too poorly preserved for identification were found in both collections, but those from the Stout mine were better preserved. The forms were analogous, and Brown (written commun., Oct. 29, 1943) stated that the "outline and venation of one or two of them [from the Stout mine] are comparable to that in some Anniston specimens," and he concluded that the age of this collection is the same as the material from Anniston, "namely Late Cretaceous or early Tertiary, with the indications pointing strongly toward early Tertiary."

BAUXITE AND KAOLIN DEPOSITS

Two bauxite and two kaolin deposits constitute the known high-alumina material of the Fort Payne area. Bauxite was mined and shipped from the Consolidated Klondike bauxite mine and was exposed in test pits at the Consolidated or Burkhart prospect but not in minable quantities. Clay was mined from the Browder or Ladd mine and the Stout mine. Bauxitic clay is also authentically reported to have been present at the Stout mine in small quantities.

Mapping was restricted to the immediate vicinity of known occurrences of bauxite and kaolin, and no prospecting was done in the intermediate areas. The possibility remains, therefore, that bauxite might be found by exploration in or beyond the intervening areas along the strike. The optimum area for such exploration lies near the stratigraphic middle of the belt underlain by strata of the Knox Group, more specifically between the top of the zone of oolitic chert in the Chepultepec Dolomite and the lower part of the *Lecanospira* zone of the Longview Limestone. The area is parallel to and roughly half a mile east of the major strike fault on the east side of Dugout Valley.

CONSOLIDATED KLONDIKE BAUXITE MINE

Location.—The Consolidated Klondike mine is near the center of the E½SW¼NW¼ sec. 10, T. 6 S., R. 9 E. The mine is at the foot of the northeast side of a spur extending from a discontinuous strike ridge and is on the southwest side of a narrow valley. The bottom of the pit is at an altitude of 970 feet; top of the pit is at 1,020 feet.

Geologic setting.—The Chepultepec Dolomite, probably the upper part of the formation not far above a conspicuous zone of oolitic cherts, underlies the immediate area of the mine (fig. 4). The bauxite and kaolin of probable early Tertiary age fill an ancient sinklike depression in the Chepultepec. A chert breccia cemented by brown iron ore crops out immediately west and south of the mine. The breccia probably indicates either local faulting or slumping of cemented surficial material.

Development.—The mine is 130 to 160 feet long, about 120 feet wide, and 60 feet deep from the bottom to the top at the west side, and it opens to the east. Jones (1940, p. 31) referred to it as the Consolidated No. 1 mine and stated that "about 300 tons of ore were shipped from this mine in 1917–18, to Hamilton, Ontario." Judging from the size of the opening, a total of considerably more than 300 tons of material was removed from it, and, as there is little bauxite visible on the dumps, the bauxite was presumably a very minor part of the body. The pit appeared to be mined out when visited in 1942.

Many test pits have been dug within 200 feet of the mine. Bauxite or grit-free kaolin has been found on the dumps of only two pits, one about 75 feet northeast and one about 150 feet east-northeast of the east end of the mine. All pits are slumped and partly filled in, concealing the material originally exposed. A piece of 4½-inch casing protrudes from the center of a pit about 175 feet north of the mine, suggesting that some drilling has been done in the vicinity, but the results are unknown.

Bauxite and kaolin.—The highest grade materials found in the present investigation were samples from the mine and the two pits to the northeast. In the mine, slightly bauxitic clay, sample C1, was exposed at one place in the northwest wall and was surrounded by cherty residual clay. Nonpisolitic slightly bauxitic clay, sample C2, was obtained from the floor of the mine at the east end; similar bauxitic clay was exposed at several other places in the floor. A cream-colored pisolitic pebble-type bauxite, sample C3, was obtained from the dump of the pit 75 feet northeast of the mine. The following chemical analyses of these samples were made by the U.S. Bureau of Mines.

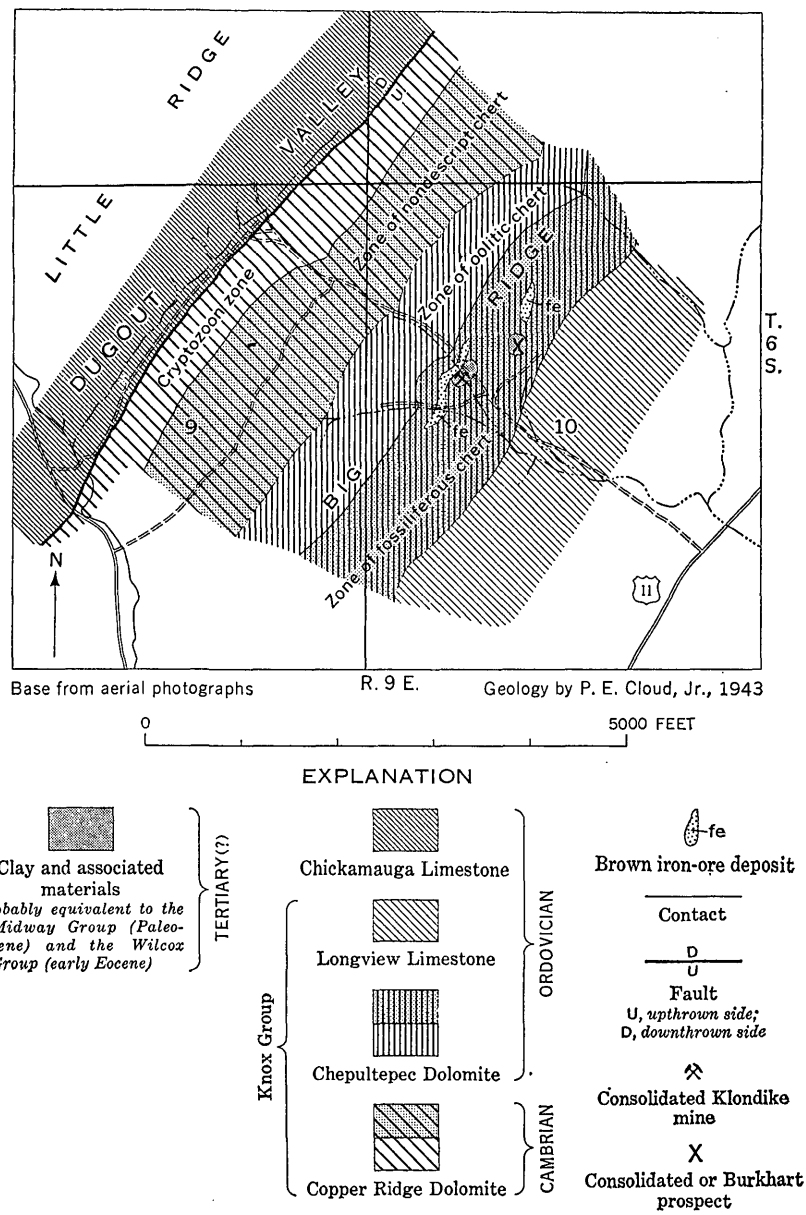

FIGURE 4.—Geology of the environs of the Consolidated Klondike mine, Fort Payne area.

Chemical analyses, in percent, of bauxite from the Consolidated Klondike mine

Sample	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Loss on ignition
C1	46. 8	23. 5	2. 6	4. 0	22. 4
2	42. 1	36. 1	1. 2	2. 7	17. 5
3	59. 6	1. 6	1. 3	3. 4	32. 8

An analysis of average high-grade white ore was given by Jones (1940, p. 31) as follows: 60.8 percent Al_2O_3, 3.2 percent SiO_2, 1.0 percent Fe_2O_3, and 2.2 percent TiO_2, with 32.8 percent loss on ignition.

CONSOLIDATED OR BURKHART BAUXITE PROSPECT

Location.—The Consolidated or Burkhart prospect is in the NW¼SE¼NW¼ sec. 10, T. 6 S., R. 9 E., about 650 feet northeast of the Consolidated Klondike mine (fig. 4); it is also called the Consolidated No. 2 (Jones, 1940, p. 31). The prospect occupies a poorly defined area on the west side, the bottom, and the east side of a small hollow on the southeast slope of a prominent segment of a discontinuous strike ridge. It is at an altitude of about 1,000 to 1,040 feet.

Geologic setting.—The Chepultepec Dolomite underlies the prospect and is probably a stratigraphically slightly higher part of the formation than that at the Klondike mine. At the crest of the ridge on which the prospect lies, pieces of sandstone were found in the surface rubble, suggesting that the deposit may be close to a sandstone lens in the Chepultepec. Limonite-cemented chert breccia is exposed in some test pits at the prospect and in tunnels and pits north of the main pit.

The bauxite is surrounded by clay of probable early Tertiary age which fills a sinklike depression in the Chepultepec, but there is no indication that any significant amount of either bauxite or clay remains in place at this locality.

Development.—A great many shallow test pits dot the slopes at this prospect. The main pit is about 100 feet long and 20 to 30 feet wide, and smaller additional pits have been put down in each end of it. About 150 feet to the southwest a shallow narrow trench about 100 feet long also has been dug. Ferruginous and siliceous bauxite lies on the dumps about many of the test pits, and cream-colored pebble-type bauxite similar in appearance to sample C3 at the Klondike mine was found mixed with cherty debris at the edge of a trench about 100 feet north of the large pit. At most pits only cherty or ferruginous debris is exposed in the walls and on dumps.

Bauxite and kaolin.—Most of the bauxite is hard, pisolitic, ferruginous, and orange to pink or red; minor amounts are cream-colored

pebble bauxite and light-pink bauxite. Chemical analyses were made by the U.S. Bureau of Mines of the following four samples: C4, bauxite from the wall of a test pit 50 feet south of the main pit; C5, pink bauxite from a pit 125 feet northeast of the main pit; C6, a composite sample from the dump of a pit 140 feet north of the main pit; and C7, white pebble bauxite from the trench about 100 feet north of the main pit.

Chemical analyses, in percent, bauxite from the Consolidated prospect

Sample	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Loss on ignition
C4	47.0	18.2	4.7	3.5	25.8
5	47.3	10.4	11.5	2.8	26.4
6	50.9	3.8	11.5	3.6	29.2
7	58.3	2.5	3.7	4.0	31.9

It is doubtful whether bauxite was ever shipped from this prospect, and it may be questioned whether an ore body is present. In no part of any test pit is bauxite in place, and in several pits isolated boulders and pebbles of bauxite are enclosed by ferruginous material and gritty clays which suggest that they were part of a blanket of slope wash. If the bauxite is largely slope wash, the remnants of its source may lie concealed nearby, or the original ore body may have been completely eroded. The latter is suggested by the concentration of the bauxite rubble at the lower part of the hill slope.

BROWDER OR LADD MINE

Location.—The Browder, or Ladd, mine is in the center of the W½NW¼SE¼ sec. 30, T. 6 S., R. 9 E. It lies at an altitude of 930 to 960 feet in the bottom of a ravine between steep but low hills. The location of the mine is shown on figure 5.

Geologic setting.—Kaolin with some lignite and lignitic clay fills a sinklike depression in the Longview Limestone. The kaolin body is surrounded by residual clay from the Longview that contains abundant chert.

Development.—The Browder mine was about 300 feet in diameter in 1943 and about 20 feet deep. It was operated by the Southern Refractories Co. According to Ralph Patterson (oral commun., 1943), the kaolin was sold as fullers earth, or an ingredient of fire clay. The mine is described by Jones (1940, p. 32) as the Ladd mine, but locally it is known also as the Browder mine.

Kaolin and lignite.—Most of the kaolin in this deposit is a gritty plastic white to lavender clay. No chemical analyses of the clay are available, but probably little of it contains more than 30 percent Al_2O_3

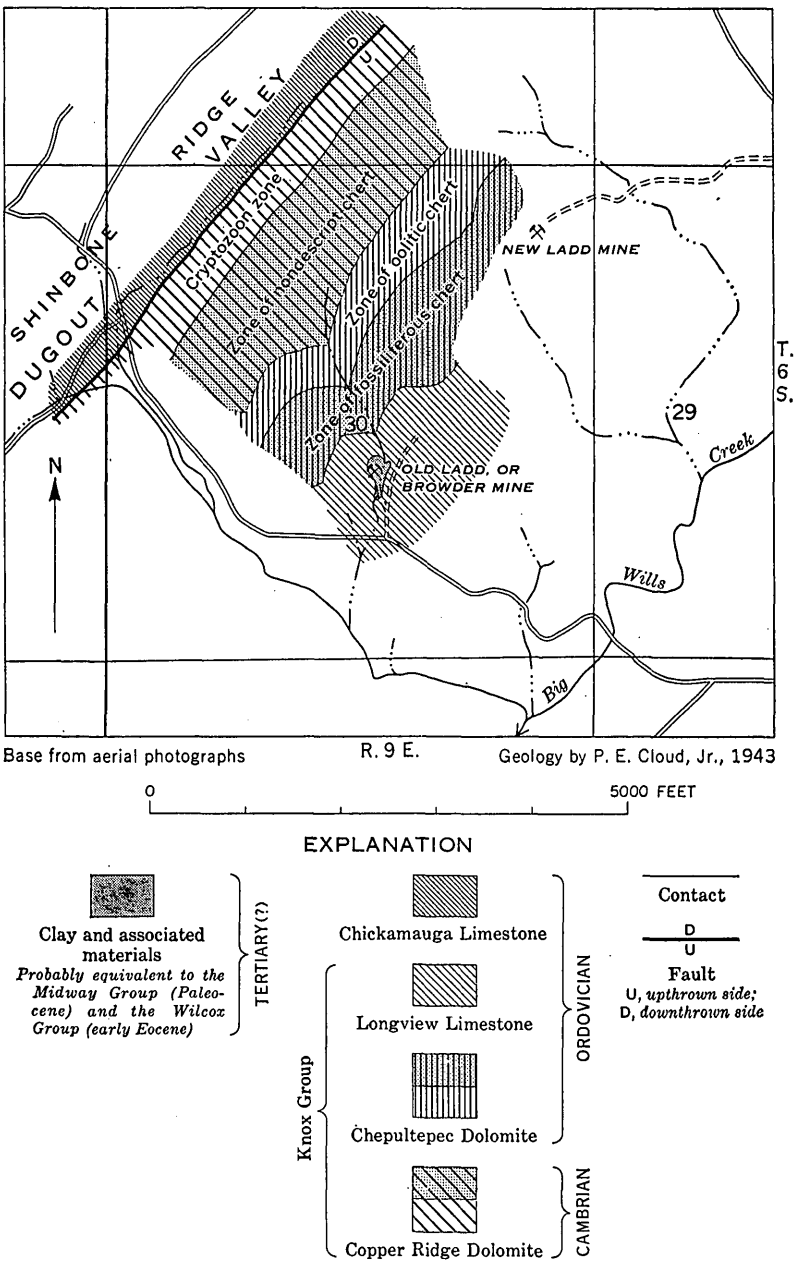

FIGURE 5.—Geology of the environs of the Browder or Ladd mine, Fort Payne area.

because the amount of quartz is high throughout. A considerable amount of quartz, less than 5 μ in diameter, and some illite were detected in samples examined by X-ray analysis. Neither bauxite nor pisolitic clay is present in the deposit.

Lignite, cut by stringers of lignitic clay, is exposed in the central part of the north wall of the mine. The lignite is crowded with badly macerated plant remains. A collection of these was examined by R. W. Brown (written commun., Oct. 29, 1943) who stated that the forms were not identifiable but were similar in their general aspect to the collection from the Stout mine.

New Ladd mine.—During the early 1950's a second mine, called the New Ladd mine, was opened about half a mile to the northeast in the NE¼NE¼ sec. 30, T. 6 S., R. 9 E. This mine is also in the Longview Limestone but may be stratigraphically somewhat lower than the Browder mine. Clay from the mine was not investigated but was reported to be a light-colored kaolin.

STOUT FIRE CLAY MINE

Location.—The Stout mine is in the S½SW¼NE¼SE¼ sec. 2, T. 7 S., R. 8 E., in the bottom of a ravine on the northwest side of a small spur. The bottom of the mine is at an altitude of 880 feet, and the top of the highest wall is at 940 feet.

Geologic setting.—A deposit of kaolin with a small amount of bauxitic clay and lignite occurs along the contact between the two zones of the Chepultepec Dolomite (fig. 6). A few hundred feet to the north brown iron ore crops out on a hill at approximately the same stratigraphic position.

Development.—The Stout mine consists of two open pits, one on the north side of a ravine that exposed the kaolin and a smaller one on the south side. The mine was abandoned in about 1915, and when seen in 1943, the walls were overgrown and obscured by slope wash. The walls of the north pit were 8 to 15 feet high at that time, but according to Houston Stout (oral commun., Oct. 1943), son of the original owner, the bottom of the pit was filled with 20 to 30 feet of debris. The south pit was a maximum of about 50 feet deep at the southeast corner. Both pits drain into the ravine. When the mine was in operation the clay was shipped to Fort Payne for use in making firebrick and glazed jugs and churns.

Bauxitic clay, kaolin, and lignite.—Bauxitic clay was found only near the original bottom of the southeast wall of the north pit, close to the ravine. The bauxitic clay consisted of pisolites in a soft claylike matrix. The bed was reported by Jones (1940, p. 31) to have been about 2 feet thick, overlain by about 4 feet of "black clay, carrying lignite in pockets" and underlain by red and white clay which was ex-

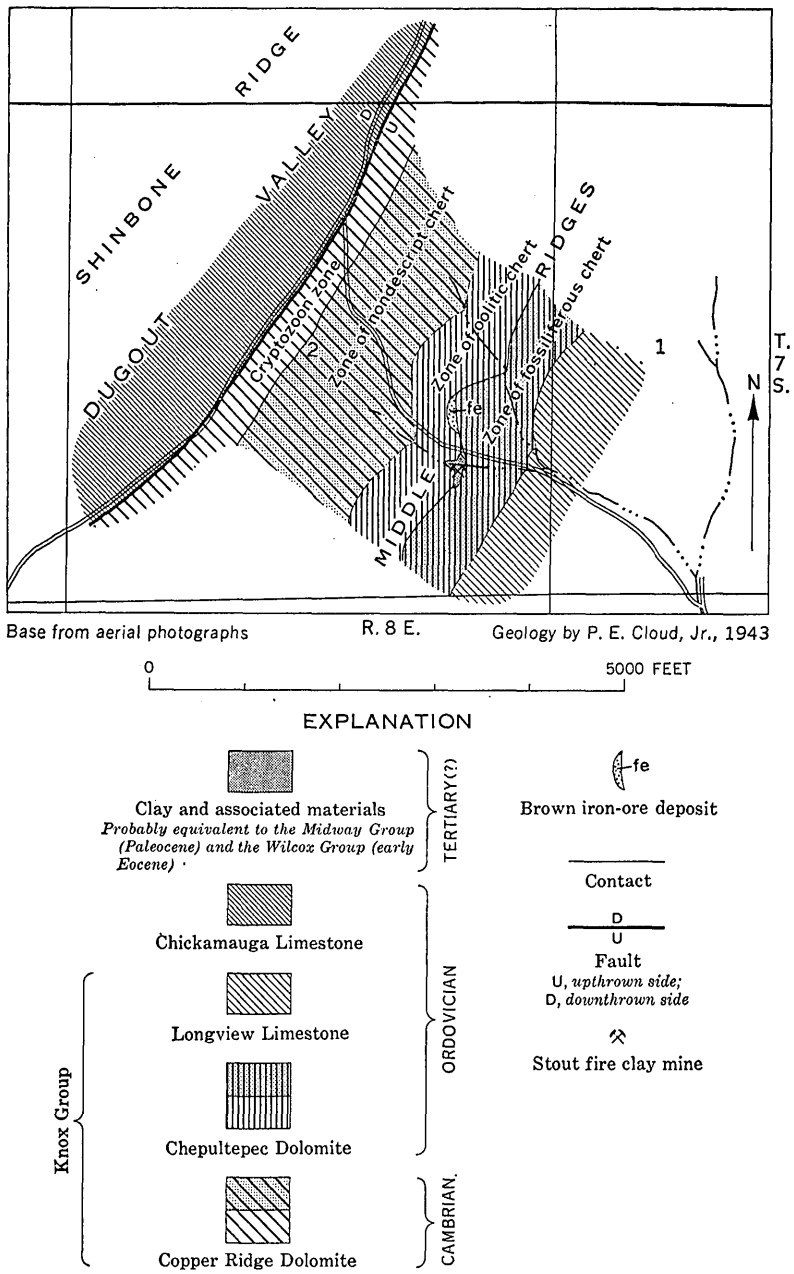

FIGURE 6.—Geology of the environs of the old Stout fire clay mine, Fort Payne area.

posed to a depth of 6 feet. According to Houston Stout (oral commun., Oct. 1943), only a few bushels of bauxitic clay was present.

Most of the kaolin remaining in the deposit is below the two pits and west of them. In the north, south, and east walls of the mine silty, chert-bearing residual clay is exposed in many places and indicates that the kaolin has been largely mined out in these directions. Gritscarce plastic bluish-white kaolin crops out in the ravine about 175 feet west of the old pits. A composite sample of kaolin from the ravine analysed by the U.S. Bureau of Mines contained 33.9 percent Al_2O_3, 49.4 percent SiO_2, 2.9 percent Fe_2O_3, and 2.1 percent TiO_2, with 11.8 percent loss on ignition.

In addition to the lignite originally overlying the bauxitic clay, lignitic clay was exposed in the northwest corner of the north pit, near the bottom of the pit; in a gully in the bottom of the south pit, 125 feet and 138 feet to 144 feet south of the ravine; and in a small cut in a bank 90 feet south of the ravine and 20 feet east of the south pit. At the last locality a poorly preserved fossil flora of probable early Tertiary age was collected by the author. The flora is discussed on page O22.

ASHVILLE AREA

The Ashville area is in north-central St. Clair County in the westernmost part of the Northeast Alabama bauxite district (fig. 1). The only known occurrences of bauxite and kaolin are in the valley of Beaver Creek about 3 miles south of Ashville, the county seat. The Hebble mine was opened in the only deposit of commercial interest. Because of limited time, studies were restricted to the environs of the known deposits of bauxite and kaolin.

GEOLOGY

Stratigraphic units in the Ashville area are not significantly different from their correlatives in the Rock Run area and elsewhere in northeast Alabama. Bauxite is associated with unconsolidated materials of probable early Tertiary age, filling sinklike depressions in underlying carbonate rocks of the Knox Group.

On the geologic map of Alabama, Butts (1926) indicated that the Rome Formation abuts the Chepultepec and Copper Ridge Dolomites (or the Bibb, Ketona, and Brierfield Dolomites) for about 75 miles along Cahaba and Beaver Creek Valleys without an intervening fault. Butts (1926, p. 70–71) explained the anomalous sequence as the expression of a great unconformity. The study on which the present report is based confirmed the sequence involved but leads to rejection of the suggested unconformity. That the Copper Ridge Dolomite is immediately adjacent to the Rome Formation a short distance north

of the Hebble mine was proved by fossils. Northeast of the Ashville area cherty residuum of the Knox Group is exposed in place within 100 yards of shale and sandstone of the Rome Formation that crop out along a county road in the SW¼ sec. 35, T. 13 S., R. 5 E., south of Permeter Creek and about 2 miles northwest of the Greensport ferry crossing. However, inasmuch as the supposedly missing rocks occur both west and east from this belt, they could be missing here as a result of unconformity only if the Copper Ridge Dolomite fortuitously happened to overlap an eroded anticline exactly at its crest for the full length of the belt. This "disconformity" probably represents instead a normal fault, in which the Copper Ridge is dropped down to the east against Rome on the west (fig. 7).

BAUXITE AND KAOLIN DEPOSITS

Deposits consisting mainly of kaolin, with some sandy clay, silt, or bauxite, are exposed in four localities on low knolls in a valley which is generally covered by a thin surficial alluvium of Quaternary age. The kaolin and associated unconsolidated sand and sandy clay are probably of Midway (Paleocene) and Wilcox (early Eocene) age, and they are enveloped by a residuum derived from the Longview Limestone or the Chepultepec Dolomite. Bauxite is present in two of the localities. The larger of the two has been mined and is discussed below. The smaller deposit appears to be merely a concentration of ferruginous bauxite float. Fossil plants and lignitic clay were not found in any of the four localities.

HEBBLE MINE

Location.—The mine is in the NE¼SE¼NW¼SE¼ sec. 20 T. 14 S., R. 4 E., and extends into the SE¼NE¼NW¼SE¼ sec. 20. It is about 3 miles south of Ashville, St. Clair County, Ala., by county roads as shown on the Cox Gap 7½-minute quadrangle map and in part on figure 7. It lies at the top of a low, very gentle knoll on the north slope of the valley of Beaver Creek. Relief of the ground surface in the immediate vicinity of the mine and the test pits does not exceed 10 or 15 feet. The top of the mine is 640 feet above mean sea level. The water level as of October 1943 was at an altitude of 625 feet; dry bottom in the mine in April 1942 was at an altitude of 615 feet.

Geologic setting.—The knoll bearing the Hebble deposit is covered with a cherty sandy clay similar to residual materials derived from the Longview and Newala Limestones elsewhere in northeast Alabama. Similar cherty clays were exposed in test pits around the mine at depths of 1 to 4 feet. The Newala Limestone crops out south of the mine near Beaver Creek (fig. 7), and if this part of the stratigraphic succession is unbroken in the Ashville area, most of the

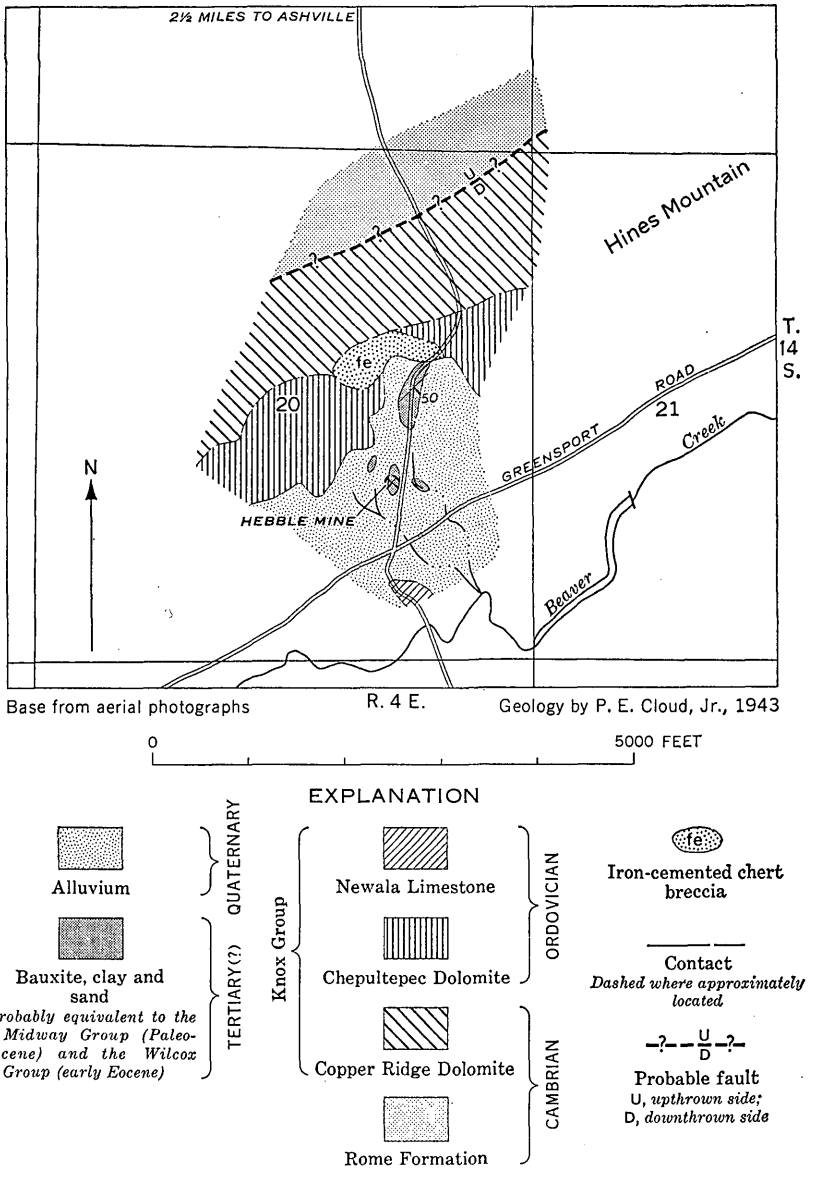

FIGURE 7.—Reconnaissance geologic map of the environs of the Hebble mine, Ashville area.

Quaternary alluvial cover conceals the Longview Limestone, which, with the overlying Newala, normally occupies valleys.

Structural features such as faults, joint systems, or sandy beds in the Longview could not be seen in the area, largely because of the cover of alluvium; but clays of Tertiary age at the Hebble mine and at the deposit almost due north of it along the road may possibly both occupy parts of a small north- to northeast-trending fault which served as a zone of accelerated ground-water movement and leaching. This possibility is supported by the bedding attitude in the mine and in the deposit to the north.

Development.—The Hebble mine is about 100 feet long in a north-south direction, 15 feet wide, and 20 to 25 feet deep. The south end slopes up to a haulage track. A small rotary kiln was set up just east of the track to dry the ore before shipping. The locations of the mine, test pits, and appurtenances are shown on figure 8.

The deposit was discovered when a water well was dug, and bauxite was mined in 1941 and 1942 by J. C. Hebble, the owner. About 800 tons of bauxite, averaging 55 percent alumina, 7 to 8 percent silica, and 8 to 10 percent iron oxide was shipped to the Dalecarlia Filter Plant, Bethesda, Md., during this period for use in water filtration. Mining was discontinued because of lack of a market for small tonnages of high-iron bauxite, not because the deposit was exhausted.

A few holes have been drilled by private companies. The results of this drilling are not known in detail, but the following information was furnished by J. C. Hebble (oral commun., April 29, 1942). North of the mine, holes were augered in the bottoms of some of the test pits, the deepest proving bauxite to a depth of about 50 feet. An auger hole 15 feet west of the mine penetrated kaolin only. South of the mine two holes were augered to depths of about 30 feet in the bottoms of two shallow pits shown at the south margin of figure 8. Kaolin, but no bauxite, was penetrated in these holes. Along an east-west line about 250 feet south of the mine and mostly west of it, the Republic Mining and Manufacturing Co. (now Aluminum Co. of America) put down 11 test pits and auger holes about 25 feet apart. Mr. Hebble stated that no bauxite was found. The debris about the holes consists of chert fragments and clayey silt. One of the pits was still open to a depth of about 15 feet in 1943, but no bauxite or kaolin could be seen.

Bauxite and kaolin.—The bauxite and kaolin appear to form a tabular body which strikes N. 50° E. and dips 85° W. The long narrow open-pit mine nearly parallels the strike. The deposit is similar in composition along its length but varies from bauxite on the east to kaolin on the west. On the east side of the mine ferruginous pisolitic

bauxite is exposed in the walls and the stripped areas. In a few places it includes interbedded thin silt and silty clay lenses. The bauxite grades westward into a zone that was the part of the deposit mined and which is exposed at the south end of the mine. The zone consists of large boulderlike masses, or dornicks, of hard pisolitic bauxite in a softer bauxitic clay matrix. In the west wall and stripped area hard white and red kaolin, some bauxitic clay and nonpisolitic bauxite, and a few dornicks of bauxite are exposed; these grade westward into soft, plastic kaolin.

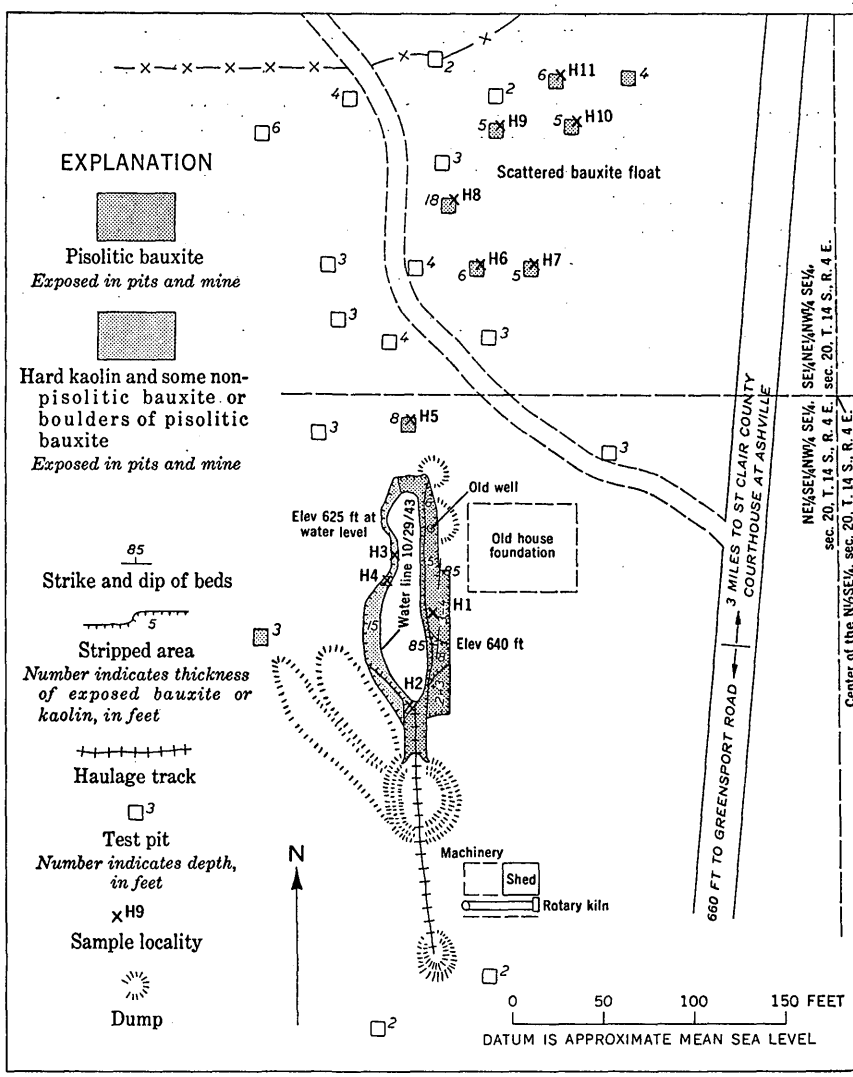

FIGURE 8.—The Hebble bauxite mine, Ashville area.

The highest grade bauxite and most of the ore shipped appears to have been pisolitic bauxite (the so-called dornick ore) taken from the interval between the bedded ferruginous bauxite at the east and the kaolin at the west. Chemical analyses, in percent, of the three main types of material and of samples from the localities shown on figure 8 were made by the U.S. Bureau of Mines and are as follows:

Type of material or sample No.	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	Loss on ignition
Pisolitic bauxite	60. 5	2. 1	1. 4	3. 7	32. 3
Ferruginous bauxite	40. 7	5. 2	29. 7	2. 1	21. 1
Kaolin	38. 3	44. 1	. 7	3. 4	13. 6
H1	41. 3	6. 3	27. 4	2. 3	22. 0
2	37. 5	37. 3	7. 2	2. 2	15. 2
3	39. 9	38. 4	1. 7	3. 9	15. 7
4	60. 6	1. 9	1. 6	2. 3	33. 2
5	53. 4	6. 6	8. 9	2. 5	28. 1
6	42. 8	3. 3	27. 6	2. 9	22. 7
7	49. 6	9. 0	10. 4	2. 8	26. 8
8	46. 3	4. 6	20. 5	3. 2	24. 5
9	45. 2	17. 1	12. 1	2. 5	22. 5
10	49. 5	4. 0	16. 4	2. 5	26. 6
11	37. 9	10. 5	27. 7	2. 2	20. 4

The exact size and shape of the deposit are unknown, and additional drill holes and test pits are needed to define it. Bauxite is exposed in many test pits north of the mine, suggesting continuation in that direction; kaolin occurs in pits and holes east and south of it (fig. 8). A line of drill holes or pits along the east side of the mine might indicate a more symmetrical deposit, grading into kaolin again, to the east, and possibly significantly wider than shown by stripping. The total depth to which the bauxite extends is also unknown.

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