Bauxite and Kaolin Deposits of the Irwinton District Georgia

GEOLOGICAL SURVEY BULLETIN 1199-J

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By WALTER B. LANG, WALTER C. WARREN, RAYMOND M. THOMPSON *and* ELIZABETH F. OVERSTREET

BAUXITE DEPOSITS OF THE SOUTHEASTERN UNITED STATES

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Distribution, occurrence, and resources of bauxite and kaolin

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By WALTER B. LANG, WALTER C. WARREN, RAYMOND M. THOMPSON, and ELIZABETH F. OVERSTREET

ABSTRACT

The Irwinton district is in the central part of Georgia at the inner margin of the Coastal Plain province. The oldest rocks exposed in the district are crystalline rocks of the Piedmont province. They are unconformably overlain by nonmarine sedimentary strata of Late Cretaceous age, including gravel, micaceous sand, and lenses of kaolin.

Bauxite has been found in a few of the kaolin lenses near the top of the sequence of these strata. During a long period prior to deposition of the overlying marine beds of the Claiborne and Jackson Groups (middle and upper Eocene), the Upper Cretaceous strata were subjected to subaerial erosion. The bauxite deposits are considered to have formed during this period. They range in thickness from a few inches to more than 10 feet and occupy areas ranging from a few square feet to more than 5 acres. Most of the known bauxite deposits lie along the valleys of Commissioners Creek and Big Sandy Creek in Wilkinson County. The kaolin lenses are much larger than the bauxite deposits; some of the lenses underlie more than 200 acres and are more than 20 feet thick.

Bauxite was discovered in the district in 1907 and was mined from 1910 to 1928. A few additional carloads of ore were shipped in 1941 and 1942, but no ore has been mined since that time. Reserves of high-grade bauxite are very small. Reserves of all grades of bauxite plus bauxitic clay may be about 400,000 long tons.

The Irwinton district is the principal source of high-grade kaolin in the United States. The presence of kaolin here has been known since early colonial time, and it has been mined continuously since 1897. Production in 1959 was 1,940,279 short tons. The reserves of kaolin are very large but have never been adequately measured. Reserves of first and second grade kaolin may be 67 to 84 million short tons. Kaolin of lower grade is present in larger quantity.

INTRODUCTION

The Irwinton district, near the center of Georgia and at the northwest edge of the Coastal Plain, is the principal domestic source of high-grade kaolin and has produced a small tonnage of bauxite.

Most of the district is in Twiggs, Wilkinson, and Washington Counties, but it extends into the southern parts of Baldwin and Hancock Counties (pl. 1). The district is drained by Ocmulgee and Oconee Rivers and their numerous tributaries, chief among which are Commissioners and Big Sandy Creeks. Total relief is less than 400 feet, but much of the district is rough country in which the divides stand 200 to 250 feet above the main creeks.

The data on which this report is based are the result of three studies of the geology of parts of the area shown on plate 1. The first of these studies—directed toward an evaluation of bauxite resources of the Cretaceous rocks—involved mapping, reconnaissance, and drilling and was done in 1941–42 by Walter B. Lang, assisted by M. W. Ellis. It was followed in 1943 by work by Walter C. Warren on both bauxite and kaolin in Wilkinson County and by a study by Raymond M. Thompson of kaolin in Washington and Twiggs Counties. The results of the work by Warren and Thompson are included in preliminary maps in the U.S. Geological Survey's Strategic Minerals Investigation series (Warren and Thompson, 1943; Thompson, 1943a, b). The present report is based on work done as part of a joint program by the U.S. Bureau of Mines and U.S. Geological Survey for bauxite exploration. In this report, the mapping by the three senior authors has been compiled on a single sheet and their preliminary reports, supplemented by other data, have been utilized by Elizabeth F. Overstreet in writing the text. All the cross sections appearing in the illustrations have been drawn by Overstreet from field notes by Lang.

HISTORY OF MINING

Bauxite was first discovered in the Irwinton district in 1907, the first shipment was reported to have been made in 1910, and the most recent shipment was made in 1942. Production was greatest from the time of discovery until 1928 when activity was suspended owing to exhaustion of the readily available high-grade ore and to the failure to find new deposits.

The records of annual shipments of bauxite on the Central of Georgia Railway from McIntyre, Wriley, and Toomsboro for the producing years of 1910 to 1928 are in part lost, but available information suggests that the total tonnage of all grades of bauxite produced in the district did not exceed 125,000 long tons. The largest producer reports 84,868 long tons as the total for the years 1910 to 1924. With the possible exception of the period 1916–18, the annual production probably never exceeded 12,000 long tons.

No shipments of bauxite were recorded from the district for 13 years after 1928. Total production recorded thereafter, which

amounted to approximately 400 tons, came mostly from the Washington mine 2 miles west of Irwinton. Production from that mine included shipments of 2 carloads in the autumn of 1941 and 8 carloads in the summer of 1942. An additional small tonnage was mined from the Freeman mine at about the same time.

Virtually all the kaolin mined in Georgia has come from the Irwinton district, especially in recent years. Kaolin has been known to occur in the district since the early settlement of the country. Smith (1929, p. 1) reports that kaolin from mines near Augusta and Macon was sent down the rivers to Savannah and presumably included the kaolin first shipped from this country to England in 1741. The exact location of the early mines is not known. Minton (1922, p. 271) reports that by 1766 "considerable quantities" of kaolin from Georgia, Florida, and the Carolinas were being shipped to the Wedgewood pottery in England.

When high-grade kaolin was discovered in England a few years later, kaolin mining in Georgia was interrupted for more than a century. Mining of kaolin in the Irwinton district was resumed in 1897 (Smith, 1929, p. 2) when Payne and Nelson opened a mine near Dry Branch, Twiggs County. Since 1900, when the Georgia Kaolin Co. began its operations in the district, production has steadily increased. The commercial importance of kaolin in Georgia is indicated by statistics compiled by the U.S. Bureau of Mines, which show the production for 1959 as 1,940,279 short tons or 77 percent of the total U.S. production (Polo and Brett, 1960, p. 337).

STRATIGRAPHY

PRE-CRETACEOUS

The rocks of pre-Cretaceous age in the Piedmont province are dominantly metamorphic, including schist, gneiss, and quartzite that are intruded by diabasic dikes of Triassic age and granite of late Paleozoic(?) age. The pre-Cretaceous rocks are exposed only in the northern part of the Irwinton district, where they are overlain unconformably by unconsolidated rocks of Cretaceous age. Rocks of pre-Cretaceous age were mapped together in this study and are shown on map as crystalline rocks undifferentiated.

CRETACEOUS

UPPER CRETACEOUS

The oldest rocks resting on the crystalline basement are unconsolidated to poorly consolidated nonmarine, generally light colored gravel, micaceous sand, and clay. When mapped by the authors in 1943, they were tentatively correlated with the Tuscaloosa Forma-

tion, but more recent work by Eargle (1955, p. 84) indicates that probably only their lower part is equivalent in age to the Tuscaloosa of western Georgia and that they may represent deposition throughout Late Cretaceous time.

These nonmarine sediments are designated "undifferentiated Cretaceous" because the upper Cretaceous rocks in central and eastern Georgia are so poorly exposed and contain so few fossils as to prevent subdivision or correlation with any of the formations of late Cretaceous age that crop out farther west.

The great bulk of the undifferentiated Cretaceous material consists of white and buff crossbedded and irregular deposits of angular coarse-grained varicolored quartz sand with interstitial kaolin and white mica. In some places, especially in Jones County northwest of the district, the bedding is nearly horizontal, although many of the units are internally crossbedded. Their overall dip is nevertheless southeastward, and Upper Cretaceous beds of marine origin crop out south of the district.

Kaolin lenses are fairly common. Most of the lenses are small, but some are large. Bauxite has been found only in the small- and medium-sized lenses and usually within 20 feet of the top of the sequence.

If terrestrial sediments of Paleocene or early Eocene age were deposited on top of the Cretaceous rocks in this district, as suggested by Bridge (1950, p. 187) as a generalization for the Southeastern States, they cannot be differentiated from the Cretaceous. Beds of early Eocene age occur downdip, south of the district, and their updip terrestrial equivalents probably are largely removed or reworked. Although kaolin lenses occur throughout the Cretaceous, bauxite only occurs at the top of those kaolin beds at the top of the formation.

TERTIARY

EOCENE

The only Tertiary rocks present in the Irwinton district consist of marine sediments representing the Claiborne Group (middle Eocene) and the Jackson Group (upper Eocene) and underlying nonmarine crossbedded red sand that fills channels cut into the Cretaceous surface.

When the Eocene strata were mapped by the three senior authors in 1941 to 1943, efforts were made to differentiate the Claiborne and Jackson groups, but more recent work by Cooke and MacNeil (1952, p. 22) indicates that some of the criteria formerly used to separate these units were unsound. In this report the Claiborne and Jackson

Groups are therefore treated as a single, undivided unit of Eocene age.

The underlying crossbedded channel sands are probably of middle Eocene age, inasmuch as they grade upward into the basal marine sands of the undivided Claiborne and Jackson Groups. The channel sands consist of reworked Cretaceous material; so, they are not easily distinguished from clay-ball sand of Cretaceous age; however, the channel sands are commonly dark red, and the base of a channel is locally marked by boulders of bauxite and kaolin. Some of the channels are more than 50 feet deep, but most of them are much shallower.

Marine beds of the Claiborne and Jackson Groups consist of sand, fuller's earth, shale, and limestone. Coarse-grained red sand 6 inches to 10 feet thick is commonly present at the base. The overlying lithologic units are lenticular. Two fuller's earth beds in Twiggs County are described by Cooke and Shearer (1918, p. 73): the upper bed is 20 feet thick; the lower, about 45 feet thick, is mined at Pike's Peak. Cooke and Shearer describe the fuller's earth as calcareous a few miles farther to the south. To the east, in Wilkinson County the fuller's earth beds are commonly thin and are interbedded with sand.

Thin limestone beds are present, particularly where they are protected from leaching by thick overburden. Thin remnants of Eocene strata capping hill tops are largely sand and clay, but the variety of lithologic types occurring in the Claiborne and Jackson sedimentary deposits is apparent from the following record of drill hole 28 in eastern Wilkinson County (pl. 1).

Log of drill hole 28

Depth (feet)		*Description*
From	*To*	
0	8	Soil, light buff, medium- to coarse-grained sandy.
8	18	Sand, contains red clay.
18	51	Fuller's earth, yellow-green, intercalated with thin silt beds.
51	80	Shale, dark-gray, soft, contains some glauconite.
80	85	Shale, dark-gray, intercalated with thin beds of hard, nearly white silt.
85	90	Shale, dark-gray, soft.
90	94	Sand, white, hard, shaly.
94	105	Shale, dark-gray, glauconitic.
105	112	Shale, dark, soft, interbedded with hard, shaly, light-colored sand.
112	117	Sand, cream-colored, soft, limy, fossiliferous.
117	126	Shale, dark-gray, fossiliferous.
126	129	Limestone, cream-colored, hard.
129	136	Shale, dark-gray, soft with a thin bed of hard siltstone at 133 feet.
136	147	Limestone, gray, hard, sandy, fossiliferous, glauconitic, interbedded with soft, dark, shale.

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Fossils contained in limestone from the 11-foot interval at the bottom of this hole are reported by F. S. MacNeil (written commun., 1958) to include the following forms:

Gastropoda:

Turritella cf. *T. ghigna* de Gregorio
Turritella aff. *T. obruta* Conrad

Pelecypoda:

Nuculana multilineata var. *coelatoides* (Harris)
Nuculana aff. *N. opulenta* Conrad and *N. regina-jacksonis* (Harris)
Glycymeris cf. *G. staminea* (Conrad)
Crassitella protexta Conrad
Pteria sp. cf. *P. limula* Conrad
Lucina sp. cf. *L. pandata* Conrad

Coral:

Flabellum cf. *F. cuneifornie* Lonsdale

MacNeil states that this fauna appears to be of Claiborne (middle Eocene) age. The overlying beds of Eocene age undoubtedly belong to the Jackson group.

QUATERNARY

PLEISTOCENE GRAVEL AND QUATERNARY ALLUVIUM

Extensive terraces present along the major streams were probably formed during the Pleistocene Epoch. Outside the district Pleistocene terrace gravel has been mapped near North Augusta and Belvedere, Ga., and along the highlands bordering Horse Creek valley, South Carolina (Lang, 1940, p. 45–46). Similar bedded and surficial gravel in the area of Trilby School in southern Baldwin County is probably also of Pleistocene age.

Within the Irwinton district a deposit of large boulders and cobbles of bauxitic clay or pisolitic kaolin in a sand matrix (fig. 1) is exposed in a roadcut along the old Milledgeville road near Little Black Creek where the creek forms the boundary between Wilkinson and Baldwin Counties. Beneath the sand and boulder bed is a basal "gravel" deposit of angular rock fragments that rests unconformably on sand of Cretaceous age. The sand enclosing the bauxite boulders and cobbles is nonfossiliferous and is similar in composition and texture to the Cretaceous sands. The sand, containing the pisolitic cobbles, and the underlying "gravel" occur in an area free of cover of Tertiary age and probably represent materials of Cretaceous age that were eroded and redeposited in a channel during Pleistocene time.

FIGURE 1.—Pisolitic kaolin boulders exposed along the old Milledgeville road, near Little Black Creek, Wilkinson County, Ga.

The valleys of the Oconee River and of the lower parts of its tributaries within the district formerly were deeply incised, but they are now partly filled with Quaternary alluvium over which the streams flow in meandering courses. This alluvium has not been mapped separately from the Cretaceous in Twiggs or Washington Counties except along the Oconee River.

STRUCTURE

The crystalline rocks exposed in the northern part of the Irwinton district were not mapped. The crystalline rocks are unconformably overlain by beds of Late Cretaceous and Eocene age which dip gently seaward and thicken in that direction. As measured on top of the Cretaceous, which locally is a highly irregular surface, the regional dip is southeastward about 15 feet to the mile. The dip of the surface of the crystalline rocks was not measured, but according to Eargle (1955, p. 87) is somewhat less steep than that measured to the west in Bibb County, where the dip is approximately 70 to 80 feet per mile.

BAUXITE AND KAOLIN DEPOSITS

Bauxite occurs in the Irwinton district as lenses that range in thickness from a few inches to more than 10 feet and underlie areas ranging in size from a few square feet to more than 5 acres. The

lenses occur within and at the top of larger lenses of kaolin in the uppermost part of the undifferentiated Cretaceous.

The bauxite is almost everywhere pisolitic. Almost all pisolites in high-grade bauxite are hard and are composed of gibbsite. Soft pisolites occur most commonly in bauxitic clay or kaolin and consist of kaolinite but have no appreciable content of gibbsite. Locally, the bauxite of highest grade occurs as small root-shaped fragments about half an inch in diameter and several inches long.

The color of the bauxite closely resembles that of the associated kaolin but may be slightly darker. The predominant colors are white, cream, gray, and buff. Pisolites in the lighter colored material are of varying sizes, and most of the larger ones are compound (fig. 2). Pisolites in most dark-red iron-stained bauxite are small. This relation seems to be common in the Irwinton district. Rarely, surfaces of bauxite occurring in this district exhibit numerous parallel lines of pisolites which vary in size and number in a manner that suggests bedding.

The kaolin deposits, like the bauxite deposits, are lenticular and range in size from pockets a few feet in diameter to lenses more than 20 feet thick that underlie areas as large as 200 acres. According to Kesler (1956, p. 548) most lenses are elongate and curved or

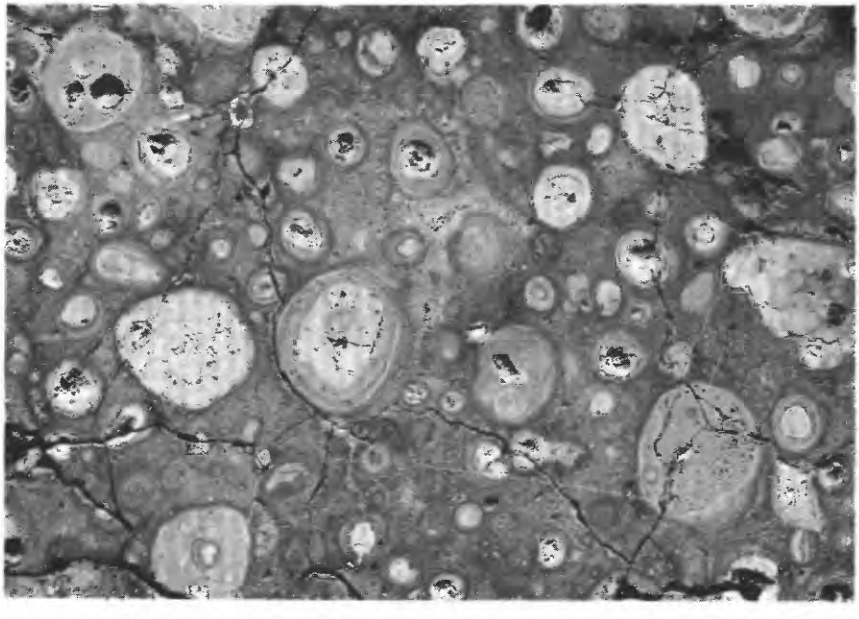

FIGURE 2.—Polished section of a dornick of pisolitic bauxite from the Washington mine, Irwinton district, Georgia. Natural scale.

sinuous. In some, the kaolin grades laterally or vertically into sandy kaolin or sand, and in others the kaolin varies in quality from place to place.

Unlike the bauxite deposits, the kaolin lenses do not appear to be restricted to the top of the sequence of Cretaceous strata, but the maximum depth to which they are present in commercial size is not known. Kesler (1956, p. 547) states that they occur to a depth of at least 175 feet below the top of the sequence.

The deposits of kaolin ordinarily differ from one another with respect to the physical properties that in large part determine the commercial value of such clay. This variation is true also of kaolin sampled from different parts of any one deposit. Analyses of samples that differ considerably in their physical properties commonly show no significant difference in chemical composition.

Impurities in the kaolin are quartz sand, iron oxides, titanium minerals, and a few resistant heavy minerals characteristic of crystalline rocks of the Piedmont. The iron content is nearly everywhere less than 1 percent; in some places the percentage of titania is somewhat higher. The content of quartz sand is extremely variable but is nowhere too large to be removed by washing.

Some of the kaolin is blocky and massive, some is thick bedded, and some is thin bedded. Some of it is rather soft and crumbly, whereas some is hard and breaks with a conchoidal fracture. It is rarely pisolitic.

Bauxite deposits which were reached by valley erosion in Pleistocene time are commonly capped with indurated rough-textured somewhat porous light-colored to white kaolin, bauxitic clay, or bauxite that is called chimney rock, which is used in the rural areas about Irwinton for foundation supports or chimneys. Where clay deposits lie 10 or more feet below the ground surface, the upper part of a bauxite deposit, when exposed to air, may become indurated to form chimney rock. Chimney rock generally does not contain more than 44 percent of alumina; its excavation requires drilling and blasting, and its preparation as an ore involves grinding. As a consequence chimney rock is usually discarded as waste material.

ORIGIN

The geologic history and probable origin of the bauxite and kaolin are considered to be as follows: Prior to deposition of the nonmarine undifferentiated Cretaceous strata in the Irwinton district, extensive deposits of highly argillaceous residual materials had accumulated as a result of long-continued weathering of crystalline rocks beneath

the floor of a preexisting peneplain that had become tilted eastward. During much of Late Cretaceous time the residual material was eroded and carried southward by streams to sites where it was deposited as irregularly sorted and bedded thick accumulations of sand and gravel and as lenses of kaolin.

In the interval between the end of the Cretaceous and deposition of the Claiborne Group, the uppermost Cretaceous strata were eroded to form an uneven surface. Where lenses of kaolin were exposed to weathering during the Paleocene-Eocene interval in a favorable climatic environment, bauxite is thought to have been formed by the removal of silica.

The bauxite may originally have been more extensive and subsequently has been eroded, for pebbles and cobbles of indurated low-grade bauxite occur as erratics in a number of places in the district. They have been observed resting on the unconformity between the Cretaceous and Eocene, within the undivided Eocene unit, in deposits of probable Pleistocene age, and as an accumulation of relatively resistant materials on the present ground surface.

MINERALOGY

The bauxite of the Irwinton district is a mixture of gibbsite, $Al(OH)_3$, and kaolinite, $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$, with minor impurities. X-ray diffraction analyses of bauxite, bauxitic clay, and kaolin from this district indicate that most, if not all, of the gibbsite and kaolinite are crystalline, not amorphous, even though these minerals are exceedingly fine grained. The chief impurity in the bauxite is silica, which occurs in kaolinite. Silica is present as quartz sand in very few deposits and was not found in tested samples. Some reworked deposits, however, contain admixed sand in appreciable amounts.

The kaolin of the deposits in the Irwinton district consists of the mineral kaolinite and varying amounts of quartz sand and minor amounts of other impurities. No halloysite or other nonkaolinitic clay minerals were observed in the tested samples. Two types of kaolinite can be distinguished in diffraction traces of oriented samples. One is a variety characterized by moderately high but narrow basal reflection peaks and prominent prism reflections. The other type is a variety, commonly termed fire clay, for which the basal reflection peaks are higher but relatively broader and the prism reflections are poor and not individually identifiable. Among the samples tested, those giving the fire-clay type of pattern all consisted of hard and blocky kaolin. The patterns representing promi-

nent prism reflections were given by kaolinite contained in softer kaolin and by kaolin in and associaetd with bauxite deposits.

Sand is an abundant impurity in some of the kaolin bodies, and all gradations exist between nonsandy kaolin and sandy clay. In kaolin to be processed, sand—along with mica and iron and titanium minerals—is commonly removed by washing.

MINES AND OUTCROPS

All the bauxite deposits so far discovered in the Irwinton district have been small, but some bauxite has been mined from all of them. They range in size from the Baum mine (p. J20), which yielded only 9 tons of ore, to the McIntyre mine (p. J25), which yielded about 50,000 tons. Some of the bauxite that was mined was of sufficiently high grade to qualify as aluminum ore at a time when no more than 7 percent of silica was tolerated by prospective users of such material, but most of it contained higher percentages of silica and, because of its low iron content, was largely used in the alum trade.

The locations of kaolin mines in the Irwinton district are shown on plate 1, together with the names, where known, of the mines and of the companies by which they were worked. The larger outcrops of kaolin are shown on the map by appropriate symbols. Most of the kaolin produced in this district is used in the paper, rubber, refractories, and pottery industries.

RESERVES OF BAUXITE

Evaluation of reserves of bauxite remaining in the Irwinton district must be based on the size of the deposits already discovered and the quality of the ore. A total of about 400,000 long tons of bauxite plus bauxitic clay is inferred to be present under less than 50 feet of overburden. Included in this estimate is an indicated reserve of 80,000 long tons of low-grade bauxite plus bauxitic clay remaining in the floors and in the immediate vicinity of old mines.

RESERVES OF KAOLIN

Data relating to total reserves of kaolin in the Irwinton district are far from complete, but they suggest presence of a very large tonnage. High-grade kaolin, particularly under a moderate overburden, constitutes only a small part of the total reserve, and kaolin suitable for special purposes is further restricted in quantity. The magnitude of the reserves of first- and second-grade kaolin may approximate 60 to 75 million long tons. This estimate is probably conservative but may nevertheless be greatly in error. No data are

available for amounts of sandy kaolin or other kaolin of inferior grade.

DRILLING

Drilling was done in 1942 with a truck-mounted power-driven core drill under two contracts negotiated by the U.S. Bureau of Mines. Under the first contract, 20 holes were drilled at sites chosen by the Geological Survey on four properties bordering old mines or in close proximity to reported showings of bauxite (Nos. 1 to 20, pl. 1). Under the second contract, 42 holes (Nos. 21 to 62) were drilled. Seven hand-auger holes were also bored in Twiggs County about 3 miles southeast of Dry Branch (pl. 1).

Samples of the cores were taken at 2- to 5-foot intervals if the cored material was uniform or closer together if changes were noted. Results of chemical analyses made by the Bureau of Mines laboratory are given in a report by Beck (1949) who was project engineer for the Bureau during part of the joint exploration program.

Some of the holes were drilled through a considerable thickness of overburden, but most were located either near outcrops of kaolin that showed indications of bauxite or where available information indicated that bauxite had been found. Where high-grade kaolin was penetrated, drilling was continued to a depth of 20 feet below the top of the kaolin.

The highest grade of material penetrated and its depth and thickness are shown on plate 1 for all holes outside the five drill sites. Following is a discussion of the materials at these sites.

DRILL SITE NO. 1

Drill site No. 1 is about 5½ miles northeast of Gordon and close to the north edge of Wilkinson County (pl. 1). Seven power-auger holes were drilled near the crest of a small spur within half a mile north of the General Refractories Co. kaolin mine (fig. 3). No bauxite was found, but pisolites were present in the upper part of kaolin from holes 21 and 23. Results of the drilling indicated, but did not delimit, a kaolin body between altitudes 410 and 445 feet above sea level. The body, which is overlain by a maximum of 70 feet of overburden, seems to extend continuously northward from the mine and may thicken east of the drill holes. West of a line between holes 21 and 26, the kaolin thins and probably grades laterally into thin beds of kaolin interstratified with sand or into sandy kaolin. Formations overlying the kaolin and interbedded sand and kaolin are of Eocene age and were laid down on a surface

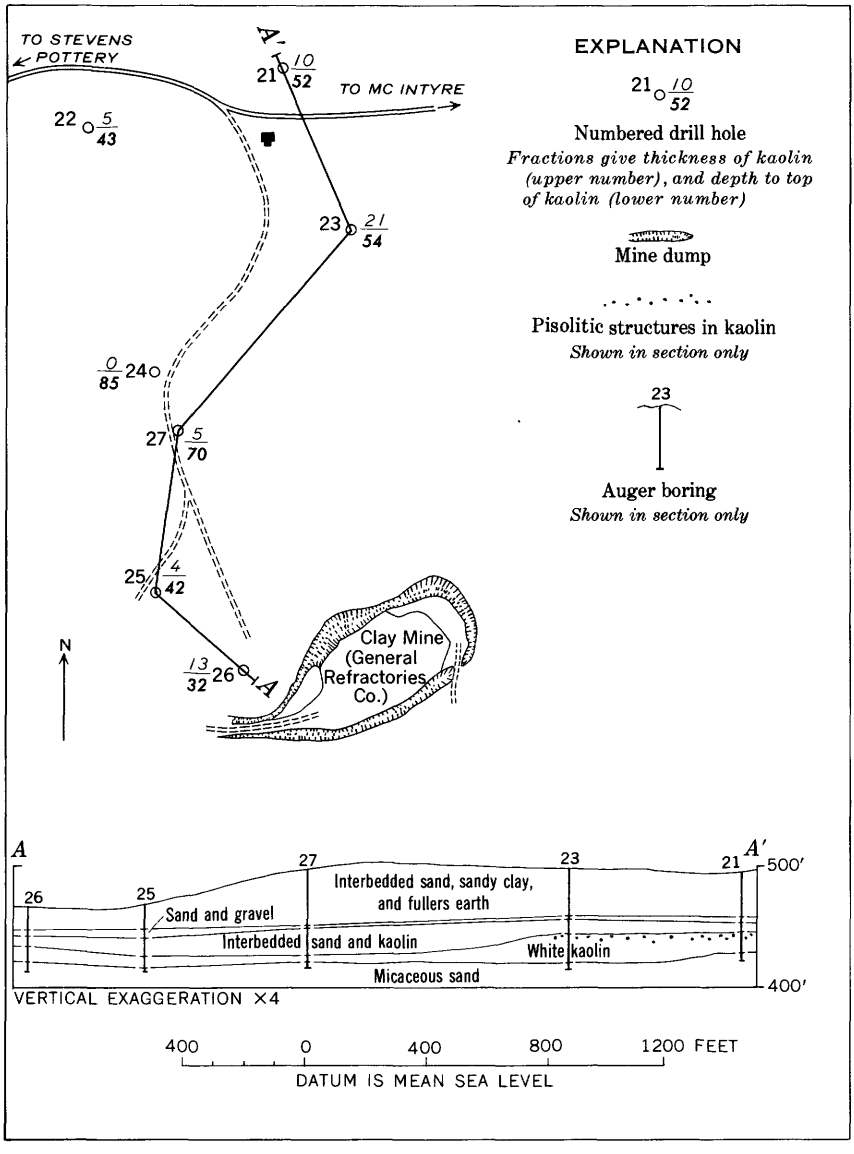

FIGURE 3.—Planetable map and section, drill site No. 1, Irwinton district, Georgia. Mapped by W. B. Lang and M. W. Ellis, 1942.

that is relatively even (section, fig. 3) compared to the surface of the kaolin.

The grade of the kaolin is highest—that is, it contains the least sand—where it is thickest. At a depth of 60 to 70 feet in hole 23 the kaolin contained an average of about 38 percent alumina, 45

percent silica, 1 percent iron oxides, and 3 percent titania (Beck, 1949, p. 10).

The overburden above the kaolin consists of unconsolidated sediments of Eocene age, primarily interbedded sand, sandy clay, and thin beds of yellow-green fuller's earth. A few fragments of bryozoa in a sand below the fuller's earth in hole 24 suggest that limestone of the Claiborne Group probably extended at least this far north. In many places a bed of coarse sand and gravel about 5 feet thick directly overlies kaolin or interbedded sand and kaolin and marks a major change in lithology. The kaolin body is underlain by micaceous sand typical of the undifferentiated Cretaceous.

DRILL SITE NO. 2

Drill site No. 2, about 3 miles southeast of Dry Branch, Twiggs County (pl. 1), was explored by seven hand-auger holes drilled along the valley wall of a small tributary to Big Sandy Creek. Kaolin crops out in several places along the tributary and the branch into which it empties. The hand-auger holes penetrated kaolin ranging in thickness from 1 to 9 feet. Only hole 1 went through the kaolin body and entered clayey sand below it. The locations of the holes and a section are shown on figure 4. The kaolin body seems to extend continuously along the tributary in the vicinity of the drill holes and may be a part of the kaolin body that crops out at two places along the east side of the road (pls. 1 and 4). The overburden, which thickens uphill from the drill holes, consists primarily of unconsolidated reddish to yellow sand and some clay.

No bauxite was found at this site, but part of the kaolin in holes 1, 2, 3, 4, and 6 is pisolitic. The extent of the pisolitic kaolin is indicated on the section, figure 4.

The deposit at site No. 2 is the westernmost occurrence of pisolitic material presumed to be in place at the top of the Cretaceous in the Irwinton district; all other such occurrences are in Wilkinson County. Reworked pisolitic boulders and cobbles that have also been found in Twiggs County are in overlying sandy clays of Eocene age. The pisolitic material at drill site No. 2 probably was originally bauxite that was formed in place and was later altered to kaolin by addition of silica.

DRILL SITE NO. 3

Drill site No. 3 is between Cowpen Branch of Big Sandy Creek and Georgia Highway 57 (pl. 1). The highest grade bauxite discovered in the drilling program in the Irwinton district was from hole 17 at this site.

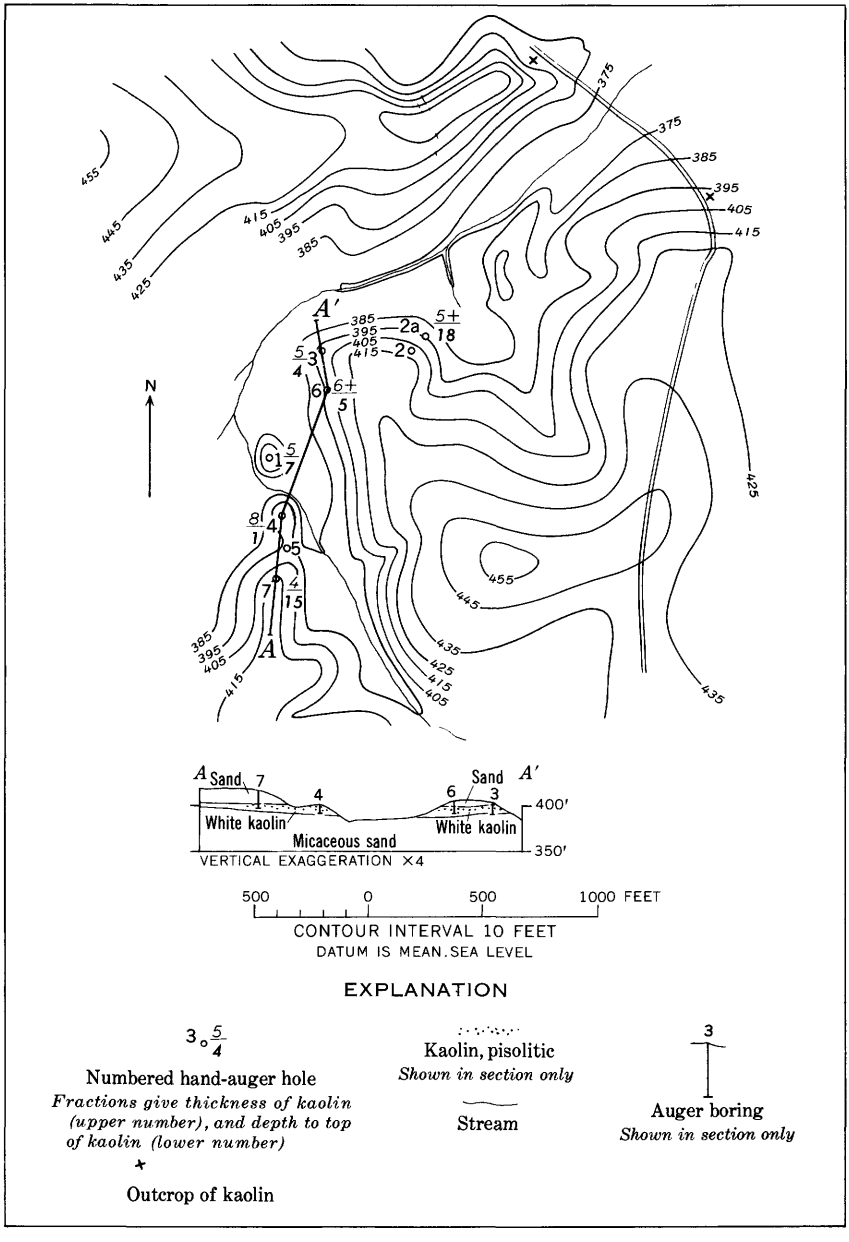

FIGURE 4.—Planetable map and section, drill site No. 2, Irwinton district, Georgia. Mapped by W. B. Lang and M. W. Ellis, 1942.

Five power-auger holes, spaced about 200 feet apart on the sloping crest of a small spur between two small tributaries (fig. 5), indicated a kaolin body containing several thin lenses of bauxitic clay and siliceous bauxite. The deposit, which ranges from 15 to 30 feet in total thickness, may extend as far as the outcrops of bauxite and kaolin and the old kaolin mine on the Dupree property on the east

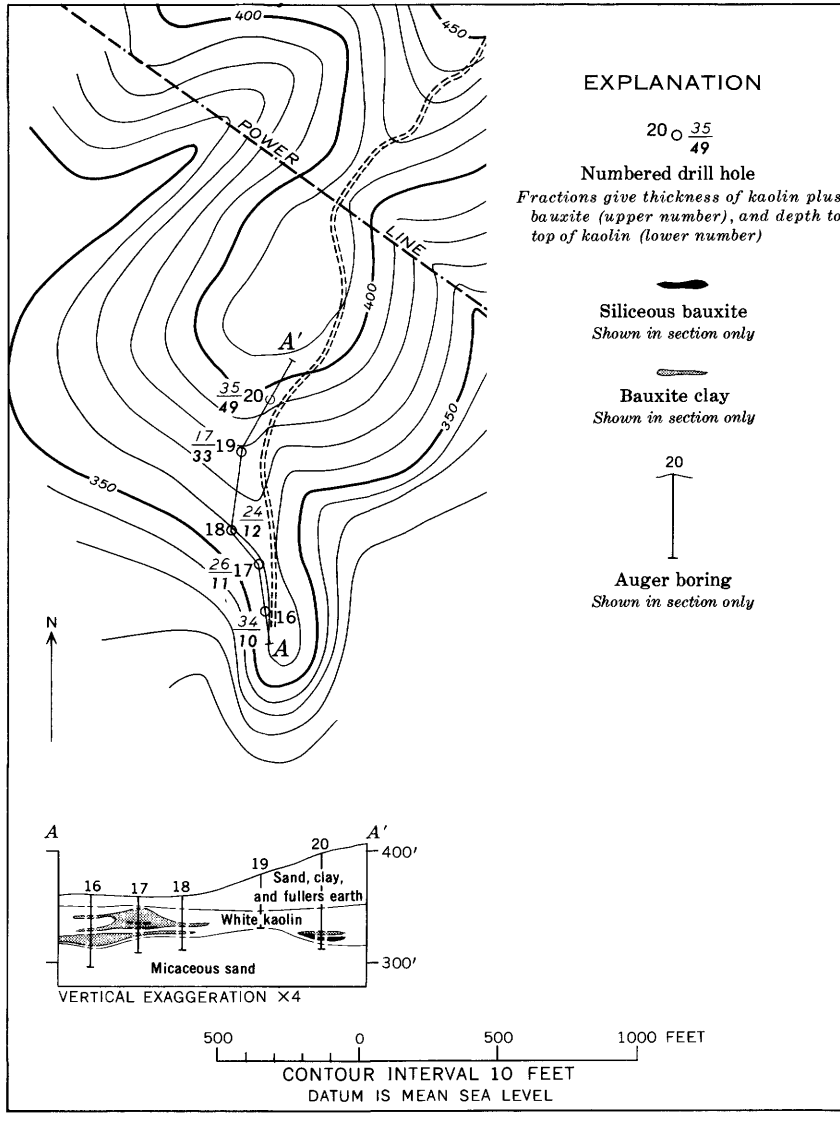

FIGURE 5.—Planetable map and section, drill site No. 3, Irwinton district, Georgia. Mapped by W. B. Lang and M. W. Ellis, 1942.

side of the tributary east of the spur (see p. J21 and pl. 1). The bauxite occurs as several thin lenses within a mass of high-grade kaolinite and is not continuous over a very large area. The interbedded kaolin and bauxite may represent materials reworked and redeposited separately at the site they now occupy and may represent a once-continuous bauxite deposit which was largely converted to kaolin by silication proceeding differentially along the more permeable horizontal planes. Both redeposition and silication probably were important processes, as there is a gradation from bauxitic clay to kaolin. Much of the bauxitic clay contains 40 to 44 percent alumina and 30 to 38 percent silica, and the kaolin contains 37 to 40 percent alumina and 41 to 45 percent silica.

Overburden above the kaolin and bauxite body consists of unconsolidated sand, sandy clay, and fuller's earth of Eocene age. The overburden thickens uphill, roughly in proportion to the altitude, because the top surface of the kaolin body is nearly flat.

DRILL SITE NO. 4

Of 10 power auger holes drilled at site No. 4, at Wheeler Branch, a tributary of Commissioners Creek about 3 miles west of Toomsboro (pl. 1), 9 were located on the divide east of that tributary and 1 on the slope west of it. Drilling data indicate a kaolin body, in part bauxitic, irregular in outline, and extremely variable in thickness. The thickest part of the deposit is on the west side of the divide at holes 2 to 5. Eastward, the deposit thins or disappears (fig. 6). A bauxite and kaolin body may extend under the divide roughly along a line from the vicinity of hole 4 to the Nadine mine (B–20, pl. 1) and to the bauxite outcrops in the tributary of Commissioners Creek east of Wheeler Branch. If so, however, only the featheredge of the deposit extends as far north as holes 6 to 10. The possibility that a thick body of bauxite and kaolin lies under the ridge can be tested by drilling a hole about midway along a line connecting hole 3 and the Nadine mine. The recorded thicknesses of kaolin and the depths at which it was penetrated (section *A–A'*, fig. 6) suggest that the pre-Claiborne surface was uneven and that the northern part of the body was eroded before deposition of the Tertiary sediments.

The only bauxitic material discovered was 11 feet of slightly bauxitic clay below a depth of 9 feet in hole 2. This material was overlain by 2 feet of kaolin and was underlain by about 4 feet of kaolin. The best quality of bauxitic material recorded was from an interval of 2 feet near the middle which contained 42.3 percent alumina, 34.4 percent silica, 0.8 percent iron oxide, and 2.3 percent titania (Beck, 1949, p. 6). The bauxitic clay probably grades

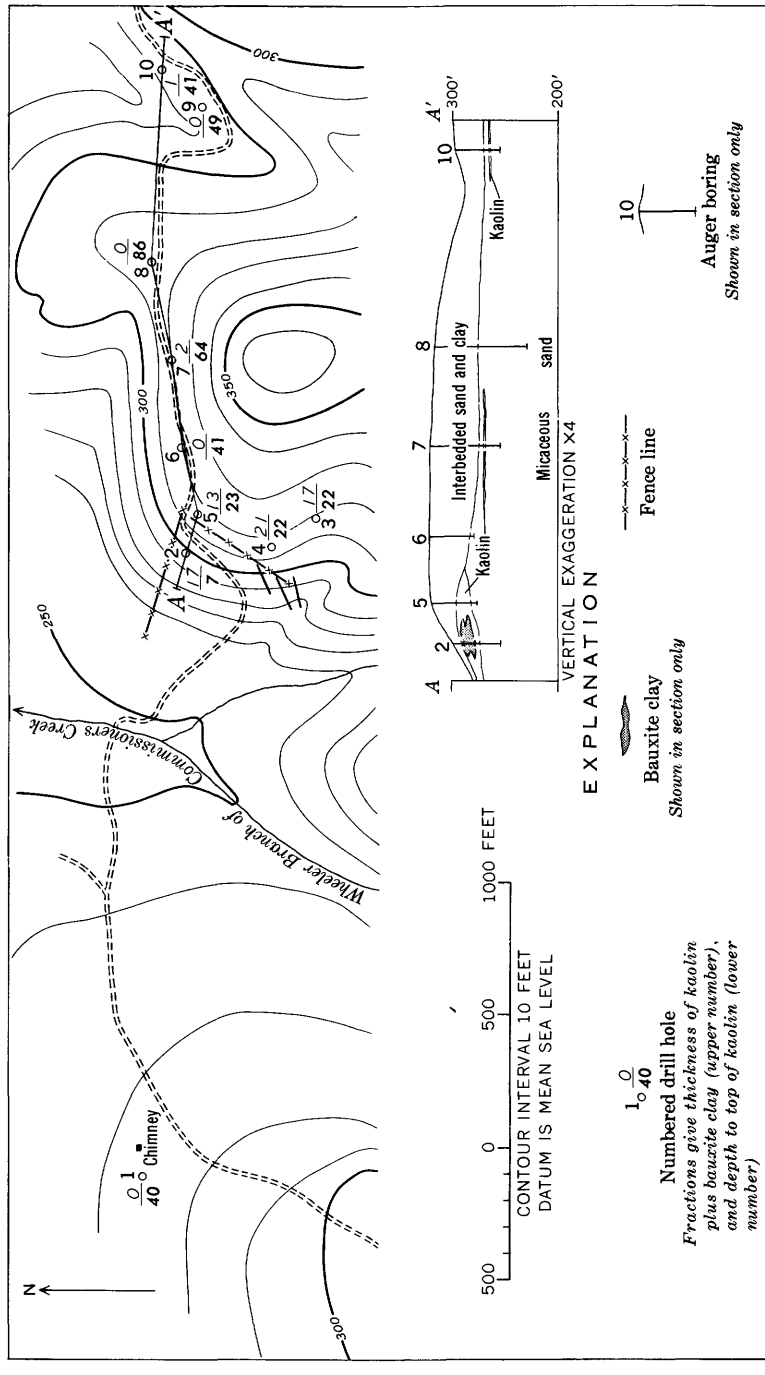

FIGURE 6.—Planetable map and section, drill site No. 4, Irwinton district, Georgia. Mapped by W. B. Lang and M. W. Ellis, 1942.

laterally into kaolin within 100 feet in all directions from hole 2. Only kaolin was present in holes 3, 4, or 5; therefore, the bauxitic material at hole 2 is not an extension of the bauxite at the Nadine mine. However, if kaolin is continuous under the divide, bauxite at the two localities may be erosional remnants of a once-continuous deposit. The kaolin at site No. 4 is rather uniform in composition and contains about 37 percent alumina and 45 percent silica and is high in titania—from 2.5 to 3 percent.

Overburden consists of unconsolidated sand and clay of Tertiary age, but few details of its lithology are recorded in logs of the drill holes.

DRILL SITE NO. 5

Five power-auger holes were drilled at site No. 5, about a mile north of Toomsboro on Edmonds Branch, a tributary of Commissioners Creek (pl. 1). Bauxitic clay was penetrated in hole 11, and kaolin in holes 11 and 12; neither of these materials was found in the other three holes. The kaolin in hole 12 was 3 feet thick and lay beneath about 22 feet of overburden (section *A–A′*, pl. 1). In hole 11 the thickness of the bauxitic clay plus the kaolin was 15 feet, and that of the overburden was 11 feet. The highest grade of bauxite penetrated was at a depth of 12.5 to 14.5 feet; it averaged 45.2 percent alumina, 31.2 percent silica, 1.3 percent iron oxides, and 2.5 percent titania (Beck, 1949, p. 7). The deposit does not seem to be connected with the kaolin and bauxite exposed in the prospect pits at localities B–14 and –15 (pl. 1), or in the Cannon mine (B–16, pl. 1), south and east of the deposit. The overburden is unconsolidated sand and clay of Tertiary age.

BAUXITE MINES AND PROSPECTS

Mines, prospects, and some outcrops of bauxite in Wilkinson County are shown on plate 1. No production of bauxitic material has been obtained from kaolin mines located elsewhere in the district. The known deposits were described first by Shearer (1917, p. 32–59) and later by Smith (1929, p. 158–284).

BUSH MINE

The Bush mine (B–1, pl. 1), is an open pit about 5 miles southeast of Irwinton on the south side of Big Sandy Creek. Bauxite was reportedly mined here for several months in 1925 by the Kalbfleisch (now American Cyanamid) Corp. The pit, which is now filled with water, measures about 90 by 90 feet. About 10 feet of overburden, mostly loose sand, underlain by kaolin is visible in the pit wall above

water level, but 6 feet of medium-grade cream-colored pebbly bauxite was at one time exposed in the walls. An additional area about half as large as the pit was stripped, but the material thereby uncovered was not mined. About 100 yards west of the mine, prospecting pits and stripped areas show some bauxitic clay. A large area to the southwest is only slightly higher topographically than the mine area and may have kaolin bodies, possibly containing bauxite lenses, under moderate overburden.

HIGHTOWER MINE

The Hightower mine (B–2, pl. 1), is about 4½ miles southeast of Irwinton on the north side of Big Sandy Creek. R. M. Lee of Gordon, Ga., who owns the mineral rights, reports that the Bauxite Co. of Alabama shipped two carloads of ore from this mine and that results of their drilling indicated 18,000 to 20,000 long tons of bauxite over an area of 3½ acres. The mine is only a foot or two above swamp level at the edge of an extensive terrace where the overburden is probably not more than 30 feet thick. About a third of a mile northwest of the mine, some high-grade bauxite is exposed in additional prospect pits at the edge of the terrace, but the available quantity seems to be small.

BAUM MINE

The Baum mine (B–3, pl. 1), on what is known as the Parker estate, is about 2 miles southeast of Irwinton on Bearcamp Branch. The mine yielded 9 long tons of high-grade ore from a small pocket of bauxite. Bauxitic clay is exposed in the walls of the pit, but prospecting is reported to have shown no extension of the body.

PROSPECT PIT (B–4)

A prospect (B–4, pl. 1) 2 miles south-southwest of Irwinton has been tested by three small pits and some auger holes. A 2-foot-channel sample of earthy bauxite was analyzed by the U.S. Bureau of Mines. The sample contained 54.1 percent Al_2O_3, 15.6 percent SiO_2, 0.7 percent Fe_2O_3, 1.9 percent TiO_2, and 26.6 percent loss on ignition. On top of the terrace a short distance northwest of the prospect, the thickness of the overburden reaches a maximum of about 50 feet.

FOUNTAIN MINE

Two pits at the Fountain mine (B–5, pl. 1), about 1½ miles southwest of Irwinton on the east side of a tributary to Lindsay Branch, have yielded possibly 10,000 long tons of bauxite. Little pockets of

high-grade ore are exposed in the wall of the north pit, and there may be considerable low-grade bauxite or bauxitic clay remaining on the east sides of the pits. The ground slopes upward gently for about 200 yards east of the pits. A little soil and chimney rock form the overburden.

UNDERWOOD MINE

Possibly 5,000 tons of bauxite was mined by the Republic Mining and Manufacturing Co. (now Aluminum Co. of America) from two deposits near the top of a small knoll at the Underwood mine (B–6, pl. 1), about 1½ miles southwest of Irwinton, north of a county road and northeast of Lindsay Branch. A small tonnage of bauxite, reported to contain 50 percent alumina, remains in the walls of the two pits, but there is no possibility of a significant extension of the bauxite into adjacent ground.

WASHINGTON MINE

At the Washington mine (B–7, pl. 1), about 2 miles southwest of Irwinton, south of a county road and west of Lindsay Branch, low-grade bauxite enclosing dornicks of high-grade bauxite is overlain by several feet of chimney rock. According to R. M. Lee, who owns the mineral rights, about 10 carloads of ore containing 54 to 56 percent alumina and less than 1.0 percent iron oxide were shipped from the mine by the Bauxite Co. of Alabama, and about 12 carloads were shipped by the Bethlehem Co. of St. Louis, Mo. This estimate seems to be somewhat excessive because of the small size of the pit.

The deposit of bauxite in the Washington mine, like most of the other deposits that have been discovered in the Irwinton district, occurs very close to the surface. The deposit was opened about 1942 but was never completely mined out, presumably because much of the ore was too high in silica. In the mine face, which is about 6 feet high, 2 to 3 feet of chimney rock overlies the bauxite. Just below the base of the cut the bauxite rests of kaolin. A polished section of a dornick from this mine is shown in figure 2.

DUPREE PROSPECT

Bauxite crops out in several places on the Dupree property (B–8, pl. 1), about 5 miles northwest of Irwinton at the head of a tributary to Cowpen Branch. Low-grade bauxite was found also in several holes put down during the drilling program at drill site No. 3. On most of this property the hillsides are steep, and the

overburden is excessive at short distances from outcrops of the bauxite.

McNEAL PROSPECT

On the McNeal prospect (B–9, pl. 1), about 5 miles west of Irwinton on the west side of Cowpen Branch, low-grade high-iron bauxite underlies about 10 acres on a terrace. Additional low-grade bauxite and bauxitic clay occur on the adjoining properties both up and down Cowpen Branch. The bauxite occurs as a thin surficial pavement, probably less than 1 foot thick. The deposit is unique, for it contains crystalline gibbsite that might be amenable to concentration by flotation, but the tonnage is not great enough to justify construction of a plant designed for that purpose. A slightly higher terrace to the west may be underlain by low-grade bauxite.

COLUMBIA MINE

Kaolin and bauxite were once mined by the Columbia Kaolin Co. from the Columbia mine (B–10, pl. 1), about 3½ miles south of Gordon. The mine was later reopened by Southern Clays, Inc., to be worked for kaolin. The only bauxite exposed in 1943 was high in iron and seemed to be transported material occurring in a stratigraphic zone younger than that in which it originated.

FITZPATRICK MINE

A partly mined lens of bauxite is exposed in the south wall of the Fitzpatrick mine (B–11, pl. 1), about 3 miles south of Gordon on the Gordon Clays tramline. This mine, which was worked primarily for kaolin, was abandoned by Gordon Clays, Inc., in 1929, but the kaolin mine just to the north was subsequently enlarged by Southern Clays, Inc., to include the northern part of the Fitzpatrick mine.

The bauxite exposed in the Fitzpatrick mine is capped by a few feet of chimney rock which in turn is overlain by several feet of sand of Eocene age. A 5-foot-channel sample of the bauxite remaining in the wall was analyzed by the U.S. Bureau of Mines at Tuscaloosa, Ala. The sample contained 50.4 percent Al_2O_3, 21.0 percent insoluble material, 1.0 percent Fe_2O_3, 2.0 percent TiO_2, and 24.2 percent loss on ignition. The overburden increases moderately northeast of the mine. As the area in the immediate vicinity of the mine has been prospected rather thoroughly for kaolin, there is little likelihood that any large body of bauxite remains.

FREEMAN MINE

The Freeman mine (B–12, pl. 1), about 2 miles southeast of Toomsboro on the south side of Commissioner Creek, was operated

until about 1943 by J. T. Nash but later became filled with water. Nash (oral commun.) reported that the alumina content of the bauxite averaged less than 50 percent, though higher grade ore was taken from small pockets. He estimated that the deposit originally contained at least 10,000 long tons of low-grade white bauxite and was of the opinion that additional ore may extend southward under a terrace, the top of which is about 40 feet higher than the body.

CASON MINE

About 20,000 long tons of high-grade bauxite is reported to have been mined by the National Bauxite Co. from the Cason mine (B–13, pl. 1), a pit on the south side of Commissioner Creek at the east edge of Toomsboro. When seen in 1943, the pit was full of water. The overburden consists largely of alluvial sand and is about 10 feet thick. A large area in the vicinity of this mine seems to be worth prospecting thoroughly, notwithstanding the possibility that water might be so troublesome as to discourage mining. The overburden upon any bauxite that might be discovered would be light.

CASON PROSPECT

A long face of bauxite was uncovered at the Cason prospect (B–14, pl. 1) on the west side of Edmonds Branch, half a mile north of Toomsboro. The bauxite, very little of which has been removed, is 6 feet thick. Groove samples from the upper 3 feet and the lower 3 feet of the ore body analyzed by the U.S. Bureau of Mines at Tuscaloosa showed the following percentages:

	Al_2O_3	Fe_2O_3	TiO_2	*Insoluble material*	*Ignition loss*
Upper	55.0	1.4	1.4	13.9	27.4
Lower	52.4	1.4	2.2	17.8	25.3

The terrace west of the prospect is about 35 feet above the top of the bauxite. Across Edmonds Branch low-grade bauxite containing dornicks of high-grade material is exposed in a small prospect pit.

PROSPECT PIT (B-15)

A prospect pit (B–15, pl. 1) on Salters Branch about 1 mile north of Toomsboro was dug on the southwest corner of the same terrace as the Cason prospect. A little low-grade bauxite can be seen on the dump, but the walls of the pit have slumped.

CANNON (OR TOOMSBORO) MINE

Low-grade bauxite, containing small pockets of high-grade ore, and a cap of a few feet of chimney rock are exposed in the walls of

the Cannon, or Toomsboro mine (B–16, pl. 1). The mining pit occupies about 3 acres about 1¼ miles north of Toomsboro, on the east side of Salters Branch and north of the prospect pit at locality 15. This mine was operated by the General Bauxite Co., and about 15,000 long tons of bauxite seem to have been removed. Some low-grade bauxite may have been left in the floor of the pit. The mine and two prospects (locs. 14 and 15) are on a terrace which seems to be a very favorable place to prospect for further ore.

OLD DUPONT MINE

The Old Dupont mine is about 1¼ miles northwest of Toomsboro, west of Salters Branch (B–17, pl. 1). The mine is small and probably did not yield more than 2,000 long tons of bauxite. However, prospect pits on the low knoll between the mine and the road suggest that much low-grade bauxite may be present.

PROSPECT PIT (B–18)

Some low-grade bauxite is exposed in a prospect pit on the west side of Pearsons Branch about two miles northwest of Toomsboro (B–18, pl. 1). West of the pit is a rather low terrace beneath which bauxite or kaolin, if present, would be under moderate overburden.

SHEPHERD MINE

The Shepherd mine (B–19, pl. 1), about 2½ miles northwest of Toomsboro, was opened as a bauxite mine by the Republic Mining and Manufacturing Co. Later, for a few months in 1943, the General Chemical Co. mined the deposit mainly for chimney rock and kaolin. A thin layer of bauxite is reported to underlie an area of several acres. The bauxite is less than 18 inches thick, and it is capped by 10 feet of chimney rock, which in turn is overlain by sand of Eocene age.

NADINE MINE

The Nadine mine (B–20, pl. 1) comprised three pits on the east side of a small branch about 3 miles west of Toomsboro. From two of these pits the General Bauxite Co. mined about 25,000 tons of bauxite. A small pit a quarter of a mile up the branch from these two seems to have yielded several additional carloads of low-grade bauxite. The overburden amounted to only a few feet in the two large pits. Some low-grade bauxite remains in the walls and possibly in the floors. The ground slopes moderately upward southeast of these pits, and bauxite may extend in this direction. Some low-grade bauxite also crops out across the branch, and bauxite

under considerable overburden may possibly extend westward to drill site No. 4.

ADKINS MINE

The Adkins mine (B–21, pl. 1), which was operated by the National Bauxite Co., is on the south side of a small knoll, about 3½ miles northwest of Toomsboro and a mile northwest of the Nadine mine. Possibly, 2,000 long tons of bauxite was obtained from this small mine. The bauxite is overlain by several feet of chimney rock in addition to overburden consisting of several feet of soil. Bauxite float at the west end of the knoll suggests that the land in its vicinity may be underlain by other bauxite bodies. The maximum overburden probably is not more than 20 feet.

McINTYRE (OR PARKER-HONEYCUTT-DANIELS) MINE

The McIntyre or Parker-Honeycutt-Daniels mine (B–22, pl. 1) comprises four open pits about 5 miles north of Irwinton and 1¼ miles north of Wriley. The Republic Mining and Manufacturing Co. (now Aluminum Co. of America) obtained approximately 50,000 long tons of bauxite from two of these pits on the southwest side of Dry Branch and some additional red bauxite from two pits on the northeast side. The ore body is mined out except for a considerable tonnage of low-grade bauxite which remains in the floor and has been partly covered by debris. An outcrop of very low-grade bauxitic material in the road a quarter of a mile southeast of the pits suggests that additional bodies of ore might be present in the immediate vicinity.

PROSPECT PIT (B–23)

A thin lens of low-grade bauxite, overlain by chimney rock 5 feet thick, is exposed in the walls of a prospect pit about 1½ miles west of McIntyre (B–23, pl. 1).

CRISWELL PROSPECT

The Criswell prospect (B–24, pl. 1) is about 5 miles northeast of Wriley on the edge of the Ocones River swamp, where bauxite is exposed in a pit nearly full of water, and chimney rock, underlain in places by bauxite, crops out on both sides of a small branch. This prospect is the only locality north of the valley of Commissioners Creek at which a body of bauxite that may be merchantable is known to be present, though bauxite and bauxitic clay crop out in several other places in that part of the Irwinton district. At all such places, dornicks of high-grade bauxite occurring in bauxitic

clays litter the slopes immediately surrounding the outcrops. A grab sample of bauxite from the Criswell prospect, analyzed by the U.S. Bureau of Mines at Tuscaloosa, Ala., contained 52.3 percent Al_2O_3, 16.5 percent insoluble material, 1.5 percent Fe_2O_3, 2.6 percent TiO_2, and 26.5 percent loss on ignition.

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