1967

The Foraminifera and Paleoecology of the Blufftown Formation (Upper Cretaceous), of Georgia and Eastern Alabama.

Rashel Nikravesh

Louisiana State University and Agricultural & Mechanical College

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THE FORAMINIFERA AND PALEOEKOLOGY OF THE  
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OF GEORGIA AND EASTERN ALABAMA.  

Louisiana State University and Agricultural and  
Mechanical College, Ph.D., 1967  
Geology  

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THE FORAMINIFERA AND PALEOECOLOGY OF THE
BLUFFTOWN FORMATION (UPPER CRETAEOUS),
OF GEORGIA AND EASTERN ALABAMA

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Geology

by

Rashel Nikravesh
Lic., Tehran University, Iran, 1960
M.Sc., the Ohio State University, 1963
May, 1967
PLEASE NOTE:
Plate and Figure pages are not original copy. They tend to "curl". Filmed in the best possible way.

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ABSTRACT

The Upper Cretaceous shale units recognized as Blufftown Formation exposed in eastern Alabama and western Georgia have been sampled for foraminiferal content. The lower 150 feet of the section is represented by unfossiliferous sandstone; the upper 220 feet of the section consists of argilaceous, fossiliferous marl.

Fifty two species of foraminifers belonging to 31 genera are herein described, illustrated, and their stratigraphic ranges determined. Of these, one subspecies, one genus, and three species are described as new.

Two distinctive foraminiferal groups are recognized: one consisting of only benthonic forms (Upper and lowermost Middle Blufftown), the other of associated benthonic and planktonic foraminifers (middle and upper part of Middle Blufftown). Arenaceous families Lituolidae and Ataxophragmiidae constitute a smaller number of benthonic individuals, whereas calcareous families Anomaliniidae, Cibicididae, and Nodosariidae constitute the greater number.

It is believed that the Blufftown Formation represents a deposit formed under fluctuating marine conditions.
wherein only the more tolerant species could survive. Thus, the distribution of the foraminiferal assemblages is not uniform throughout the section.

On the basis of lithologic and biologic characters, three different zones can be recognized within the Blufftown Formation: (1) the Lower Blufftown consisting of unfossiliferous, cross-bedded, coarse sand; (2) the Middle Blufftown consisting of glauconitic and/or calcareous silty shale containing Lenticulina pseudosecans and other planktonic and benthonic forms; and (3) the Upper Blufftown consisting of lignitic silty shale containing Lenticulina pseudosecans with Ammobaculites suboretaceus and lacking other benthonic and planktonic foraminifers.

Foraminiferal assemblages indicate that the sands of Lower Blufftown were deposited in water from 0 to 35 feet deep, with temperatures ranging, probably, from $30^\circ$ to $35^\circ$ F, and salinity ranging from 18 to 20 parts per thousand. The clayey Middle Blufftown is believed to represent deposition in a transgressive sea, from 35 to 600 feet deep, with temperatures that ranged from $40^\circ$ to $50^\circ$ F, and with salinity of 35 to 36 parts per thousand. The silty Upper Blufftown is believed to have been deposited in a regressive sea.

On the basis of foraminifers and diagnostic mega-fossils, the age of the Blufftown Formation is considered to be Upper Santonian to Lower Campanian.
INTRODUCTION

The Blufftown Formation of Georgia includes a lower 150 feet of unfossiliferous sandstone and an upper 220 feet of fossiliferous dark gray siltstone and shale. Overlying the Blufftown are the sands of Cusseta and underlying it are the shales and siltstones of the Eutaw Formation. Westward in Alabama the Blufftown grades laterally into the Lower Selma Chalk; eastward in central Georgia it thins and finally pinches out.

This study is concerned with the foraminiferal faunules from the Blufftown Formation in eastern Alabama and western Georgia. The objective is three-fold: (1) to evaluate the current regional correlation of the Blufftown Formation; (2) to determine the environmental factors which controlled the presence, distribution, and absence of the assemblages in different facies; and (3) to illustrate the foraminiferal assemblages of the Blufftown Formation.
PREVIOUS WORK

Details of the early work on the Cretaceous of Georgia is found in Veatch and Stephenson (1911). Table 1 gives the development of the subdivisions of the Cretaceous in Georgia.

The name Blufftown was proposed by Veatch (1909, p. 86), for strata exposed near Blufftown (now abandoned) in northwestern Stewart County. The type locality is a series of high bluffs overlooking the Chattahoochee River (Fig. 1), about 0.2 miles west of the former Post Office at old Blufftown and a mile southwest of Upper Bradley Place.

In Georgia, the thick basal sand beneath the clayey part of the Blufftown Formation lies on dark shales of the Eutaw Formation, a sequence not similar to that in central and western Alabama. Cooke (1943, p. 18, 19) assigned this sand to the Blufftown Formation. Ray (unpublished, in Eargle, 1955, p. 32), however, has placed it in the Eutaw.

The first adequate geological map of Georgia showing separation of the Cretaceous series into formational units is by Eargle (1955). In his report the term Blufftown includes a lower sand and an upper marl member.
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Table 1.- Development of Cretaceous classification of Georgia
Fig. 1.- Type locality of the Blufftown Formation (CR-9) along the bank of the Chattahoochee River, 0.2 miles west of the former Post Office at old Blufftown and about 30 miles south of Columbus, Georgia.
AREAL EXTENT

The outcrops of the Blufftown Formation in Georgia occupy a 40 mile wide belt from the Chattahoochee River Valley to the valley of the Flint River (Fig. 2). East of the Flint River, the Blufftown Formation is indistinguishable from the underlying Eutaw Formation and the overlying Cusseta Sand. In western Chattahoochee County and north-central Stewart County the formation is about 8 miles wide; in the Flint River Valley the width of the outcropping belt is only about 1½ miles. According to Eargle (1955, p. 33) this narrowing of the belt is due to thinning of the Formation eastward but may also indicate some overlap by the Cusseta Sand. Moreover, fine sands of the Upper Blufftown become coarse in an easterly direction from eastern Chattahoochee County and thus become difficult to distinguish from the coarse sands of the Cusseta Sand.

LITHOLOGY AND CONTACTS

In the Chattahoochee River Valley, the Blufftown Formation consists of two lithologic units: (1) a basal sand 150 feet thick which is coarse-grained, cross-bedded, micaceous, unfossiliferous and (2) a silty clay unit 220 feet thick which is dark gray, highly micaceous, lignitic, and fossiliferous. Eastward
the basal sand decreases in thickness to about 75 feet and the silty clay to about 185 feet. In addition the upper clay member grades laterally into unfossiliferous coarse sand that is difficult to distinguish from either the basal sand unit of the Blufftown Formation or the overlying Cusseta Sand. Westward the formation grades laterally into the lower part of the Selma Chalk.

The contacts between the silty clay of the Middle Blufftown and the basal sand unit (Fig. 3), and also between the upper part of the Upper Blufftown and overlying Cusseta Sand are irregular and probably represent diastems. The contact between the basal sand member of the Blufftown Formation and the upper Eutaw (Fig. 4) has been reported as an uncomformity by Stephenson and Monroe (1938, p. 1644), but is believed by the writer to be conformable as criteria indicating an uncomformable contact could not be detected in the field.
Fig. 2. - Geologic map of Georgia after Earle (1955)
Fig. 3.- Uneven contact between the basal sand of the Slufftown and overlying clayey unit, on U. S. Highway 27 (27-10) along a pit 0.5 miles south of the Fourglass overpass.

Fig. 4.- Conformable contact between the basal unit of the Slufftown formation and underlying silt formation on U. S. Highway 27 immediately south of the Barn Pond underpass (27-8).
LOCALITIES STUDIED

Samples for this study were collected along U. S. Highway 27 (Figs. 6, 7), the Chattahoochee River (Figs. 6, 8), and at Upper Bradley Place (Fig. 8). A description of each sample is given in the Appendix. Figure 5 shows the area from which samples were collected.

U. S. Highway 27 Roadcut: The contact between the Blufftown Formation and overlying Cusseta Sand is exposed in several road cuts along U. S. Highway 27; however, the most accessible one is in the north side of a railroad cut immediately west of the town of Cusseta (Fig. 7). Here, 20 feet of the Blufftown Formation, consisting of very fine, micaceous sand burrowed by Halymenites major, is overlain by coarse-grained, cross-bedded sand of the Cusseta. At the base of this section, a 2 foot or less thickness of a dark gray, micaceous, lignitic, silty shale of the Blufftown contains many impressions of fossils, mainly pelecypods. Microfossils are very rare in this section, and are mainly molds and casts of micro-mollusks and ostracodes.

One and a half miles west of Cusseta, on the east side of U. S. Highway 27, 25 feet of the Blufftown and 2 to 3 feet of the Cusseta Sand are exposed (Figs. 7, 9; locality 27-2). The Blufftown Formation in this section is very much like the previous section.
About 1.25 miles northwest of Cusseta along an irrigation ditch on the east side of U. S. Highway 27, 5 feet of Blufftown silty clay is exposed, and contains molluscan shell hash (Fig. 6, locality 27-3). In addition to the macrofossils, samples from this locality yield good assemblages of ostracodes.

Two adjacent hills composed of Blufftown sediments, consisting of 35 to 40 feet of micaceous clay and 5 to 7 feet of the sandy upper part of the formation, are exposed about 0.75 miles north of the intersection of Georgia Highway 26 and U. S. Highway 27, on the west side of the road (Figs. 10, 7, localities 27-4, 27-5). Anomia argentaria, Trigonia sp., Nucula sp., and Lucina sp. are very common at the base of these sections. Microfossils, and Exogyra ponderosa bored by sponges, are abundant throughout the argilaceous part of these sections.

The remainder of the outcrops along U. S. Highway 27 yield sandy samples in which neither micro- nor macrofossils are present (Figs. 11, 7, localities 27-6 through 27-15).

The contact between the Blufftown clay and the sands of the basal unit is exposed in a sand pit on the east side of the U. S. Highway 27, about a mile south of Hourglass overpass (Figs. 2, 7, locality 27-10).

The contact between the Blufftown Formation and Eutaw is exposed immediately south of the Marn Road
underpass on the east side of U. S. Highway 27 (Fig. 7, locality 27-8).

**Chattahoochee River and Snake Shoals localities:**
Along the Chattahoochee River, from Big Bend in southwest Chattahoochee County to the Blufftown bluffs in northwestern Stewart County, most of the exposed river banks are laminated clay that contain numerous fossiliferous ledges. Locally the beds are very sandy, as at Snake Shoals a mile northwest of the type locality, where molds of large ammonites embedded in calcareous sandstone ledges have been reported by Eargle (1955, p. 34). These banks at present are covered in part by heavy vegetation, and in part by the rise of the water level due to the damming of the river in late 1959 at Fort Gaines, Georgia.

Near the site of old Blufftown, which is the type locality of the formation, the sediments consist of fossiliferous silty clays and thin beds of very fine-grained sand which grade upward into coarser grained sand.

Because samples collected from the Chattahoochee River localities yield most of the microfauna studied in this report, detailed lithologic and micropaleontologic data are given in tables 2 through 8.
Upper Bradley Place: Samples collected from this locality are from the upper argilaceous part of the formation. Detail description of each sample is given in the Appendix.
Fig. 5.- Location map showing the area from which samples were collected.
Fig. 6.—Index map showing localities from which samples studied for this report were collected.
Fig. 7.- Locality map along U. S. Highway 27 from which samples studied in this report were collected. No vertical scale is used for lithologic sections.
Fig. 8.- Map showing localities along the Chattahoochee River and the Upper Bradley Place from which samples studied in this report were collected. No vertical scale is used for lithologic sections.
Fig. 9.- Locality 27-2 on U. S. Highway 27, one mile west of the town of Cusseta, showing 25 to 30 feet of the uppermost Blufftown, consisting of an upper sandy and a lower clayey units. Impressions of pelecypods can be found in the clayey unit.
Fig. 10.- Typical marine clay and sands of the Blufftown exposed on west side of U. S. Highway 27, 2.3 miles northwest of the town of Cusseta. Laminated dark gray fossiliferous marine clay grades upward into the upper sandy part of the formation (locality 27-4).

Fig. 11.- The lower sand unit of the Blufftown exposed on east side of the road on U. S. Highway 27 in the vicinity of Harmony Church (locality 27-11).
Feet Cusseta

| CR10-1  | Sand, medium to coarse, micaceous, buff, not fossiliferous |
| CR10-2  | |
| CR10-3  | |
| CR10-4  | Shale, sandy, micaceous, lignitic, laminated, gray to buff, fossiliferous (Foraminifera, Ostracoda, and micromollusks) |
| CR10-5  | |
| CR10-6  | |
| CR10-7  | Shale, silty, micaceous, laminated, gray, fossiliferous (Foraminifera, Ostracoda, micromollusk, and echinoid teeth) |
| CR10-8  | |
| CR9-1   | Shale, silty, micaceous, laminated, gray, fossiliferous (arenaceous foraminifers) |
| CR9-2   | |
| CR9-3   | Shale, calcareous, micaceous, glauconitic, laminated, gray, fossiliferous (planktonic foraminifera) |
| CR9-4   | |
| CR9-5   | |
| CR9-6   | Shale, calcareous, micaceous, laminated, gray, fossiliferous (Exogyra ponderosa) |
| CR9-7   | |
| CR9-8   | |
| CR9-9   | |
| CR9-10  | Shale, silty, micaceous, laminated, gray, fossiliferous (Ostracodes abundant, foraminifers rare) |
| CR9-11  | |
| CR9-12  | |
| CR9-13  | Shale, sandy, micaceous, glauconitic, gray to dark green, laminated, fossiliferous (Very small foraminifers) |
| CR9-14  | |

Table 2. Type locality of the Blufftown Formation on the east side of the Chattahoochee River, 36 miles south of Columbus, Georgia. In this section Upper and part of Middle Blufftown are exposed. Standard lithologic symbols are used. Fossil symbols: Ostracoda, Planktonic foraminifers, Arenaceous foraminifers, Benthonic foraminifers, Micromollusk, Exogyra, Echinoid teeth, and vertebrate fragments.
Table 3.- Section on Snake Shoals, west bank of Chattahoochee River, 33 miles south of Columbus, Georgia. In this section the Middle part of the Blufftown Formation is exposed. (See table 2 for legend.)

Table 4.- Section on south bank of Chattahoochee River, one and half miles north of Snake Shoals. In this section the lower part of the Middle Blufftown is exposed. (See table 2 for legend.)

Table 5.- Section at Banks Landings, left bank of Chattahoochee River, 3 miles north of Snake Shoals. In this section the lower part of the Middle Blufftown is exposed. (See table 2 for legend.)
Table 6.- Section exposed on Planters Landing, left bank of Chattahoochee River, 25 miles south of Columbus, Georgia. In this section the lower part of the Middle Blufftown is exposed. (See table 2 for legend.)

Table 7.- Section on Race Passes, south bank of Chattahoochee River, one mile east of Big Bend, 22 miles south of Columbus, Georgia. In this section lowermost part of Middle Blufftown contact and uppermost part of the Lower Blufftown are exposed. (See table 2 for legend.)

Table 8.- Section on Chimney Bluff, south bank of Chattahoochee River, 2 miles east of Big Bend and 21 miles south of Columbus, Georgia. In this section Lower sands of Blufftown Formation is exposed. (See table 2 for legend.)
METHODS OF INVESTIGATION

Field procedures

One hundred and fifty-two samples of the Lower, Middle, and Upper Blufftown Formation from eastern Alabama and western Georgia (Fig. 5) were collected in December and January of 1965-66. At each outcrop, samples taken at 3 to 5 feet intervals, modified to include all changes in lithology.

The samples collected from road outcrops were not fresh and therefore did not yield many foraminifers. The Chattahoochee River exposures, however, are freshly cut and supplied 99 percent of the foraminiferal fauna studied in this report. The Blufftown outcrops along Alabama Highway 26 between Union Springs, Alabama, and Columbus, Georgia, reported by other investigators, are now heavily covered with vegetation, wherein sampling was inadvisable. However, west of the Union Springs, Alabama, exposures of Selma Chalk appear. The interfingering contact between the Selma Chalk and the Blufftown Formation reported by Eargle (1955) must therefore be located not far from the town of Union Springs, Alabama.

Laboratory procedures

Fifteen hundred grams of each sample was soaked in varsol for 18 hours. After the varsol was decanted,
the sample was immersed immediately in hot water and was allowed to soak for 24 hours, which reduced it to a thick sludge of clay, fine sand, mica, and microfossils. To remove the clay, the sludge was then washed through a nested series of 20- 40- 60-, and 200-mesh micropaleontological screens which had been dipped in a water solution of methylene Blue. The resulting clay-free residue was transferred from the screens onto filter paper, dried in an oven, weighed, and stored in labelled sand sample bags.

Residues from each sample collected were split with an Otto sample splitter, to one-eighth of the original volume. This cut was then put into a Frantz Isodynamic magnetic separator (1.5 Amp., 0.5 degree declination). Microfossils and sands constituted the concentration of low specific gravity material; mica and rock fragments were concentrated on the high specific gravity side. The high specific gravity concentrates were examined for microfossil content. A complete separation was possible when glauconite was not present in the cut.

The low specific gravity concentrate was picked completely under the binocular microscope for the microfossils present. The foraminifers removed were transferred to micropaleontological slides, identified, and counted. Specimens suitable for illustrations were chosen and transferred to separate one-compartment
slides. The latter have been deposited in the Henry Howe Microfossil Collection, Geology Department, Louisiana State University. A part of each residue, and some untreated remainder of all samples bearing original field designation, have been deposited with the L. S. U. Geology Department Museum Collection.

The photographs illustrating the foraminiferal species were taken with a Leitz microscope equipped with an ultrapak illuminator, using Kodak plus X-120 film. Individual negatives were enlarged and printed on glossy paper, assembled into plates and retouched where needed.

FACIES OF THE UPPER CRETACEOUS SEDIMENTS AND THE STRATIGRAPHY OF THE BLUFFTOWN FORMATION

The Upper Cretaceous sediments of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia appear at the surface as an arcuate belt, concave to the northwest, which truncates the southern end of the Appalachian Highlands. This band is 500 miles long, and has a maximum width of 75 miles. The maximum thickness is estimated to be about 2300 feet (Stephenson and Monroe, 1938, p. 1641).

The Tuscaloosa Formation, which is the lowestmost part of the Upper Cretaceous in eastern Gulf region, extends and thins eastward from Mississippi to Georgia. The overlying Eutaw Formation extends eastward with little change in lithology or thickness.
The Eutaw Formation in eastern Mississippi and Alabama is overlain unconformably by that part of the Selma Chalk below the Arcola Limestone Member, which itself extends as argilaceous chalk from west-central Alabama eastward to Union Springs, Alabama, where it begins to intertongue with the sandy part of the Blufftown Formation (Stephenson and Monroe, 1938, p. 1645) (see Fig. 12).

The basal 150 feet of the Blufftown Formation consists of coarse pebbly sands which extends westward as a tongue beneath an eastward-extending tongue of argilaceous Selma Chalk. The tongue of impure, Lower Selma Chalk extends eastward to Seale, Alabama, where it merges into calcareous clays of the Blufftown Formation, and still farther east in Georgia into typical argilaceous marine sand. The upper part of the Blufftown Formation extends westward from the Chattahoochee River region as a thinning tongue of fine marine sand (in part indurated to layers of calcareous concretionary sandstone) to Union Springs, Alabama. West of Union Springs it grades into the Selma Chalk at about the stratigraphic position of the Arcola Limestone Member.

On the basis of lithologic and corresponding biologic characters the Blufftown Formation can be divided into three zones (see chart 1, in pocket): (1) the Lower Blufftown, consisting of 150 feet of unfossiliferous,
cross-bedded, coarse sand; (2) the Middle Blufftown, consisting of 200 (+) feet of glauconitic and/or calcareous silty shale which is characterized by the abundance of *Lenticulina pseudosecans*, other benthonic and planktonic foraminifers, and lack of *Ammobaculites subcretaceus*; and (3) the Upper Blufftown, consisting of 30 feet of silty, lignitic shale containing *Lenticulina pseudosecans* with *Ammobaculites subcretaceus*, and 15 feet of unfossiliferous sands.
Fig. 12.- Stratigraphic and age relations of the Upper Cretaceous Formations of Mississippi, Alabama and western Georgia (Mississippi, western and central Alabama after Stephenson and Monroe, 1938, eastern Alabama and western Georgia from the writer's conclusions).
The approximately 10,000 identifiable foraminifera recovered from the Upper and Middle Blufftown of Georgia were assigned to 31 genera and 52 species. No fossils were collected from the Blufftown of eastern Alabama where only the uppermost unfossiliferous portion of the formation is exposed. The relative paucity of specimens along U. S. Highway 27 in Georgia is attributed to leaching by groundwater.

Benthonic foraminifers account for 90.3 percent, and planktonic foraminifers for only 9.7 percent of the specimens collected. A discussion of the species in the two major environmental groups follows:

**Benthonic.** The species *Lenticulina pseudosecans* (51.40%), *Anomalinaoides henbesti* (13.6%) and *Ammobaculites subcretaceus* (10.5%), account for about 75.5 percent of the total number of specimens in the samples collected. The first two species occur in almost every unit sampled, and are among the long-ranging Upper Cretaceous forms in the North American Gulf Coastal region. *L. pseudosecans* has been reported from beds of Austin, Taylor, and Navarro age; *A. henbesti* has been found in beds of Taylor and Navarro age. *A. subcretaceus*, however, is found only in the Upper Blufftown, which gives it a greater stratigraphic range than has been reported previously.
Species contributing a smaller percentage of the specimens collected are *Hoeglundina supracretacea* (4.5%), *H. sp.* (0.3%), *Citharina wadei* (0.7%), and *C. texana* (0.7%). *Citharina texana* has been reported from beds of Austin age, while *C. wadei* is found only in beds of Taylor and Navarro age.

*Vaginulinopsis austinana* and its various subspecies have been described from the Austin Chalk of Texas, and seem to be restricted stratigraphically to beds of Santonian age. The new subspecies described in this report, constituting 1.1 percent of the total number of foraminifers collected, however, seems to be restricted geographically but not stratigraphically. It is present only in the Blufftown Formation of Georgia but ranges from beds of lowermost Middle to uppermost Middle Blufftown Formation.

*Kyphopyxa christneri* (1.1%) has been reported from beds of Austin and Taylor age.

Arenaceous foraminifers, excluding *Ammobaculites subcretaceus* account for 3.1 percent of the total number of foraminifers collected, of which 0.3 percent belong to *Gaudryina rudita* and 2.8 percent to *G. sp.* (new sp.). *G. rudita* occurs in the Middle Blufftown and has been reported from beds of Austin, Taylor, and Navarro age; *G. sp.* occurs only in the middle part of the Middle Blufftown Formation.
**Planktonics.**—A group of species of planktonic foraminifers accounts for 8.1 percent of the specimens collected. *Globigerillinoïdes aspera* (2.5%), *Globoetruncana cretacea* (1.6%), and *G. fomnica* (1.1%) are cosmopolitan in distribution, and are long-ranging Upper Cretaceous forms (Austin through Navarro). *G. marginata* (1.2%) ranges from Santonian to Upper Campanian. These species are common in most of the samples collected from the Middle Blufftown. The range of *G. concavata* (0.1%) is considered to be restricted to Upper Coniacian to Lower Santonian by Bandy (1967, p. 17), and to Lower Santonian to Upper Campanian by Douglas and Sliter (1966, p. 97). This species is found only in the lowermost part of the Middle Blufftown.

*Heterohelix*, included here in the planktonics, is represented by two species, account for 1.5 percent of the total number of foraminifers collected. The range of both species is reported to be from Upper Turonian through Maestrichtian.

*Planoglobulina eggeri glabrata* accounts for 0.1 percent of the specimens collected, and is found only in the lowermost part of Middle Blufftown. This species is considered to be indicative of Upper Santonian through Lower Maestrichtian age.
The remaining 10 species identified, representing about 4.4 percent of the total number of foraminifers collected, have a long range in the Upper Cretaceous of Gulf Coastal region.

CORRELATION AND AGE DETERMINATION

Correlation and age determination of the Blufftown Formation can be fairly well determined on the basis of micro- and macrofossils content. The most important microfossil found is *Exogyra ponderosa* which is regarded as an index fossil of the Lower Selma (Upper Austin and Lower Taylor).

The nine long-ranging (Austin to Navarro) species (*Globigerillinosoides aspera*, *Heterohelix striata*, *Globotruncanera cretacea*, *G. fornicata*, and *Valvulineria allomorphinoides*) occur in the Middle and/or Upper Blufftown. Four other species (*Frondicularia verneuiliana*, *Nodosaria obscura*, *Citharina wadei*, and *Lenticulina muensteri*) occur in the uppermost Middle or Upper Blufftown. Due to the long range of these species, they can not be used in age determination.

Two Austin species (*Anomalina austinana* and *Globotruncanera concavata*) occur in the lowermost Middle Blufftown. Since the youngest recognized *Globotruncanera concavata* is considered to be of Santonian age, it is concluded that the lower part of the Middle Blufftown
is of Santonian age. Too, because the stratigraphic positions of *Citharina texana* and *Kyphopyxa christneri* are stable, they have been given special value in age determination of the Upper Cretaceous beds of Texas by Gimbrede (1961, p. 25, and 1962, p. 1122). Since *Citharina texana* became extinct at the end of Austin, the lower portion of the Middle Blufftown in which *C. texana* is abundantly found is considered to be of Austin (Upper Santonian) age. This age determination is supported by the presence of *Kyphopyxa christneri* in its maximum abundance in the lower portion of the Middle Blufftown. Therefore, the upper part of the Middle Blufftown and the Upper Blufftown are considered to be of Lower Taylor age.

Species of Taylor to Navarro age (*Anomalinooides henbesti*, *Valvulinoria umbilicatula*, *Heterohelix globulosa*, *Haplophragmoideas rugosa*, and *Gaudryina rudita*) occur in the middle and the upper part of the formation. Since these species belong only to Navarro age (*Vaginulina jarvisi*, *Nodosaria delicatula*, and *Ceratobulimina cretacea*) and constitute about 0.2 percent of the total population of foraminifers in the Blufftown Formation, their presence is not considered significant in age determination of the formation.

The ranges of the new species, genus, and subspecies are not yet completely known.

Those species not included in table 9 are either too poorly represented for their ranges to be considered
important, or the few specimens available are so poorly preserved as to make the identification questionable or impossible.

On the basis of the similarities of macro- and microfaunas of the Blufftown Formation listed above, the writer concludes that the lower 200 feet of the formation is of Upper Austin (Santonian) age, and that the upper 150 (plus) feet of the formation is of Lower Taylor (Lower Campanian) age.

The Blufftown Formation is probably the equivalent of the Coffee Sand (Herrick, 1956, p. 7), which in western Mississippi overlies the Tombigbee Sand and which grades eastward into the Lower Selma Chalk of Alabama. It is equivalent to the Mooreville Chalk of eastern Mississippi and that part of the Selma Chalk up to the top of the Arcola Limestone Member in western and central Alabama (Stephenson and Monroe, 1938, p. 1653), and the lower part of it to the upper part of the Austin Chalk of Texas (Herrick, 1956, p. 7).

Table 10 and figure 12 show a generalized stratigraphic section and a tentative correlation with Gulf Coast equivalents.
Table 9.— Generalized chart showing the reported ranges of the most common species of the Blufftown Formation compared with the distribution of these species in the formation.
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<td>Tuscaloosa</td>
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Table 10.- Generalized stratigraphic section and tentative correlation of Upper Cretaceous of Gulf Coast region.
1= Herrick, 1956  2= Stephenson & Monroe, 1938
BATHYMETRIC INTERPRETATION OF THE BLUFFTOWN FORMATION

Lithologic variation in the Gulf Coast Upper Cretaceous can be correlated with foraminiferal population variations. These rocks and fossils record a history of changing sedimentary environments ranging from deep-water marine to near-shore marine to continental.

As a means of determining the bathymetry of various parts of the Blufftown Formation, a faunal analysis of the fossiliferous part of the collection from Blufftown Formation has been made. In reconstructing the bathymetry of the Blufftown Sea by means of this faunal analysis it is assumed that:

(1) The available relative abundance of foraminiferal assemblages established in the laboratory approximates their actual abundance.

(2) The tolerance of foraminiferal assemblages and their ecology during Upper Cretaceous time was the same as their Recent congener.

(3) The foraminiferal distribution of the Blufftown Formation approximates a normal distribution curve.

(4) There is no error in sampling procedure used in the field.

In the open ocean, the only ecological barrier to foraminiferal migration is that of temperature (Tappan,
In a shallow and fluctuating sea, barriers include intervening sediments, and changes of salinity at river mouths, in addition to temperature control (Tappan, 1962, p. 122).

Because of the various types of barriers in shallow water environments, many interrelated factors may affect the foraminiferal distribution, and the order or degree of their importance is difficult to determine. However, the most critical controlling agent for establishment of different populations in the Blufftown Sea is believed to have been fluctuation of depth and the type of bottom sediments present.

The majority of the Upper Cretaceous sediments of Georgia are relatively shallow water deposits, as shown by the poorly-sorted, intertonguing marine, lignitio, and non-marine beds. The near-shore, shallow-to brackish water deposits of the Blufftown Formation commonly contain only one or two species of foraminifers. Because of the lessened competition, these one or two species are numerous as individuals in areas in which the food supply apparently was sufficient. The complete elimination of a species is frequently preceded by the production of smaller, stunted forms. This is shown by *Anomalinoideas henbesti* (CR9-6) and *Ammobaculites subcretaceus* (CR9-2).

A more diversified fauna occurs in the slightly deeper and more offshore portion of the Blufftown Formation.
Although these are not true bathyal or abyssal deposits, they do contain some species of planktonic foraminifera. As planktonic tests may be carried into shallow water deposits by ocean currents, their presence suggests an open sea condition during much of the Upper Cretaceous.

More than half of the foraminiferal species in the Blufftown Formation occur in more than one lithology and display corresponding intraspecific morphological differences (varietal).

In a study of Recent Foraminifers (Loeblich & Tappan, 1953, p. 14) the character of bottom sediments was considered as the most important factor in the distribution of benthonic foraminifera. The narrow sandy beach area is sparsely populated. The littoral mud zone also contains relatively few species, probably due to a deficiency of oxygen because of decaying organic matter, whereas the sublittoral clayey zone contains more diversified assemblages.

In the Blufftown Formation of Georgia, similar bio-lithologic zones appear to be evident. The lignitic sandy marine strata of the lower Middle (CR-5, CR-4) and Upper Blufftown (CR10-4 to CR10-7) represent a supralittoral environment, containing no fauna to a poor fauna of one or two species of ostracodes, micro-mollusks, and foraminifers (Ammobaculites and Lenticulina). A littoral mud zone is represented by silty shales,
(CR-6, CR-7, CR10-8, CR9-1 and CR9-2) and has an extremely limited calcareous and arenaceous fauna and few micro-mollusks. The sublittoral Middle clayey part of the Blufftown shows the most diversified fauna of the section and contains numerous calcareous benthonic (Nodosaria, Lenticulina, Frondicularia, Planulina, etc.) and planktonic genera associated with a few ostracodal species (CR9-3 to CR9-14 S8, & CR8). The sandy deposits of the Lower Blufftown Formation (CR-2 and CR-3) contain no fossils of any kind, and probably represent a beach zone in which vigorous wave action and/or low salinity may have been responsible for the paucity of the organic remains.

In order to establish an approximate depth range for the sea at the time of formation of the Blufftown sediments, one must depend on information available on Recent foraminiferal assemblages. The following should be noted before a final interpretation is made:

Unfossiliferous sandstones of the Lower Blufftown are unconformably overlain by a fossiliferous marine siltstone of the Middle Blufftown, indicating the presence of a regressive sea, an interval of non-deposition and/or erosion, and finally transgression of the sea over the area.

Modern members of the family Nodosariidae including Lenticulina, Marginulinopsis, Vaginulina, Dentalina.
Nodosaria, Frondicularia, and Kyphopyxa are characteristic of the continental shelf; their occurrence in abundance in the Blufftown Formation indicates a depth range of 50-100 fathoms (300-600 feet) (Peterson, Gauger, Lankford, 1953, p. 20), and a temperature of 41° to 70° F (Glaessner, 1947, p. 185).

Most living species of Dentalina and Marginulinopsis are common in waters deeper than 60 fathoms (360 feet), but seldom occur in waters exceeding 3000 fathoms (18,000 feet) (Peterson, Gauger and Lankford, 1953, p. 20).

Living Frondicularia are common in waters of warm to subtropical climates, and range in depth from 80 to 600 fathoms (480 to 2400 feet) (Peterson, Gauger and Lankford, 1953, p. 20).

The occurrence of the pelagic foraminifers Globotruncana and Heterohelix suggests open sea conditions and warm waters 500 to 3000 fathoms (3000 to 18,000 feet) in depth (ibid, p. 20). The absence of pelagic forms from the upper and lowermost parts of the formation suggests restriction of water circulation in this area, and the resultant restriction of the free circulation of these forms.

Trochaminoides are common in the innermost parts of modern bays, from low tidal level to a depth of 30 fathoms (180 feet) (ibid, p. 20). The occurrence of a few of these forms in the lower part of the Middle Blufftown suggests the shallowing of the Blufftown Sea
at the time of deposition of this part of the Middle Blufftown.

The absence of arenaceous assemblages in the Middle Blufftown and their presence in the Upper and lower-most sandy part of the Middle Blufftown Formation indicates a cool, shallow environment during early and late Blufftown time. The percentage ratio between calcareous and arenaceous species (86.4:13.6) indicates a marine environment with a high pH, or possibly initiation of non-marine conditions.
SUMMARY AND CONCLUSIONS

(1) The Blufftown Formation represents a deposit under fluctuating marine conditions, in which only the more tolerant species could survive. The lack of a great variety of species and the presence of a few species of a great abundance support the above interpretation.

(2) In addition, on the basis of the bathymetry of the foraminifers in the samples studied, the writer concludes that the Blufftown Formation represents 1½ cycles of deposition under a shallow fluctuating sea (see table 1). The basal sand member of the formation was deposited by a regressive sea after deposition of the Eutaw Formation. After a short period of non-deposition and/or erosion, the sea transgressed over the area and deposited the silty clays of the Middle Blufftown. The Upper Blufftown silts and sands indicate another shallowing and regression of the sea from western Georgia and eastern Alabama.

(3) Faunal differences between the Blufftown Formation and other equivalent formations is believed to be facies controlled.

(4) The planktonic-benthonic ratio of 8.1:91.9 accompanied by the arenaceous-calcareous ratio of 13.6:86.4 indicates deposition in the
littoral part of an open ocean. The abundance of a group of species belonging to the families Nodosariidae, associated with the rotaliform species, indicate environmental conditions of 10 to 100 fathoms (60 to 600 feet) of water depth, 35 to 36.5 parts per thousand bottom salinity, and 40° to 50° F bottom temperature. These conditions existed throughout most of Blufftown time, except for the Upper and Lower parts of the formation which represent a shallowing and cooling of the Blufftown sea, and finally its complete regression at the end of Blufftown time.

(5) On the basis of lithologic and corresponding biologic characters the Blufftown Formation can be divided into three zones: Lower Blufftown, an unfossiliferous sandy unit; Middle Blufftown, a glauconitic and/or calcareous unit characterized by the presence of Lenticulina pseudosecans and other benthonic and planktonic foraminifers and the absence of Ammobaculites subcretaceus; and the Upper Blufftown, characterized by the presence of Ammobaculites subcretaceus and the lack of other species.
(6) The Lower and lowermost Middle Blufftown is considered to be of Upper Santonian age. The upper portion of the Middle Blufftown and the Upper Blufftown are considered to be of Lower Campanian age.
Table 11.- Environment of deposition interpreted on the basis of lithology and fossil content of the Blufftown Formation and underlying Eutaw.
Anomalinoides henbesti  
Bulimina sp.  
Ceratobulimina cretacea  
*Citharina texana  
*Citharina wadei  
*Dentalina lorneiana  
Frondicularia goldfussi  
*Frondicularia verneuliana  
*Gaudryina rudita  
Gaudryina sp. (new species)  
*Globigerillinoides aspera  
*Globotruncana cretacea  
*Globotruncana concavata  
*Globotruncana fornicata  
*Globotruncana marginata  
*Globotruncana ventricosa  
Globulina lacrima  
Gutulina sp.  
*Gyridinoides depressa  
*Gyridinoides globosa  
Haplophragmoides rugosa  
*Heterohelix globulosa  
**"Heterohelix" strata  
*Hoeglundina supracretacea  
Hoeglundina sp. (new species)  
*Kyphopyxa christneri  
*Lenticulina muensteri  
*Lenticulina pondi  
*Lenticulina pseudosecans  
*Lenticulina stephensoni  
*Lagena sp.  
Nodosaria affinis  
Nodosaria delicatula  
*Nodosaria obscura  
Nonionella austina  
Oolina sp.  
Planoglobulina eggeri glabrata  
Planulina tennesseensis  
Planulina taylorensis  
*Rugoglobigerina sp.  
*Trachelinella watersi  
Trochaminoides sp.  
*Vaginulinopsis austina (new subspecies)  
*Vaginulina jarvisi  
*Vaginulina taylorana  
*Valvulineria allomorphinoides  
*Valvulineria infrequens  
*Valvulineria nelsoni  
*Valvulineria cf. v. umbilicatula  
*New genus and new species

Table 12.- Foraminiferal list, collected from the Blufftown Formation. (* indicates the species which were found in the type locality of the Blufftown Formation).
SYSTEMATICS

Preface to Systematics

The synonymies listed in this section on systematics are incomplete in the sense that reference is not made to every instance a taxon has appeared in print; rather, only the name of the taxon has been documented.

All type material is deposited in the H. V. Howe Collection, Louisiana State University, Baton Rouge, Louisiana. Paratypes of all new species are deposited at Louisiana State University, Geology Museum.

Phylum Protozoa

Subphylum Sarkodina Hertwig and Lesser, 1874

Class Rhizopoda Von Slebold, 1843

Order Foraminifera Eichwald, 1830

Suborder Textulariina Delage and Herovard, 1896

Superfamily Lituolacea de Blainville, 1825

Family Lituolidae de Blainville, 1825

Subfamily Lituolinae de Blainville, 1825

Genus Ammobaculites Cushman, 1910

Ammobaculites subcretaceus Cushman and Alexander

Plate 6, Fig. 12
Ammobaculites subcretacea Cushman and Alexander, 1930, Cushman Lab. Foram. Res., Contr., vol. 6, pt. 1, p. 6, pl. 2, figs. 9, 10; Trujillo, 1960, Jour. Paleontology, vol. 34, no. 2, p. 307, pl. 43, figs. 11a, b.


Remarks: Test small and very fragile; earlier portion shows a closed coil in this section and in individual specimens; later portion uncoiled and uniserial; sutures indistinct; aperture is obscured in all specimens.

Occurrence: Found only in the upper 35 feet of the fossiliferous Upper Blufftown.

Geologic range: This species has been reported from the Eagle Ford Shale of Texas (Turonian), Woodbine (Cenemonian) of the Gulf Coast, and Middle Turonian of California.
**Diameter:** Length of the specimen 0.132mm, width of the coiled portion 0.048mm, width of the uncoiled portion 0.12mm.

Figured specimens deposited HVH Collection #8471, 8472.

Subfamily Haplophragmoidina Maync, 1952

Genus *Haplophragmoides* Cushman, 1910

*Haplophragmoides rugosa* Cushman & Waters

Plate 6, Figs. 5, 6, 7


**Occurrence:** Found only in the lower part of the Upper Blufftown and not in great abundance.

**Geologic range:** Has been reported from Taylor and Navarro beds of the Gulf Coastal region.
**Genus** *Trochamminoides* Cushman, 1910

*Trochamminoides* sp.

Plate 6, Figs. 9, 10, 11

**Remarks:** Test closely coiled evolute, periphery rounded; chambers about 8 in the last-formed coil, slightly overlapping, giving the periphery a lobulate appearance; sutures distinct, and depressed, especially in the last-formed coil; wall arenaceous; aperture obscured. This specimen shows a close resemblance to *Trochamminoides velascoensis* Cushman, except for the aperture which is obscured near the periphery in Cushman's species, but which can not be located at all in the specimens from the Blufftown Formation. However, if this species proves to be *T. velascoensis*, then the idea that *T. velascoensis* is only found in the Velasco shale of Mexico, reported by Cushman, 1946, has to be revised.

**Occurrence:** Specimens refered to as *Trochamminoides* sp. are found in the lowermost Middle Blufftown of Georgia.

**Diameter:** Diameter 0.132mm, thickness 0.048mm.

Figured specimen deposited HVH Collection #8474.
Family Ataxophragmiidae Schwager, 1877
Subfamily Verneulininae Cushman, 1911
Genus Gaudryina d'Orbigny, 1839

Gaudryina rudita Sandige
Plate 6, Figs. 1, 2


Gaudryina pupoides d'Orbigny. Carsey 1926, Univ. Texas, Bull., 2612, p. 27-28, pl. 4, fig. 5 (not of d'Orbigny).


Occurrence: This species is very abundant in the Middle Blufftown.

Geologic range: Has been reported from beds of Austin, Navarro, and Taylor age of the Gulf Coastal Region.

Diameter: Length 0.096mm, width 0.048mm.

Figured specimens deposited HVH Collection #8475, 8476.

Gaudryina sp. (new species)

Plate 6, Figs. 3, 4, 8

Description: Test somewhat longer than broad, very slightly arcuate, early portion long, triangular and triserial, adult portion short and biserial; faces of the triangular section concave inwardly; chambers distinct except in the early portion which are compressed and less distinct; sutures in the adult portion distinct and depressed, less so in the early portion; wall finely arenaceous; aperture areal and semicircular near the inner margin of the last-formed chamber.

Remarks: This species resembles G. soldadoensis Cushman and Renz, except for the aperture which is a round opening near the inner margin of the last-formed chamber and is more interiomarginal in the former while it is areal and semicircular in the latter species.

Occurrence: It occurs only in the lower part of the Middle Blufftown.

Diameter: Length 0.30mm, width of adult portion 0.156mm.
Figured specimens deposited HVH Collection #8477, 8478, 8479, 8480, 8481, 8482.

Suborder Rotaliina Delage and Hérovard, 1896
Superfamily Nodosariacea Delage and Hérovard, 1896
Family Nodosariidae Delage and Hérovard, 1896
Subfamily Nodosariinae Ehrenberg, 1838

**Lenticulina** Lamarck, 1804

**Lenticulina münsteri** (Roemer)

Plate 7, Figs. 7, 8

**Robulina münsteri** Roemer, 1839, Verstein. norddeutchen Oolithegebirges, Nachtrag., p. 48, pl. 20, fig. 29.


**Robulus münsteri** (Roemer). Cushman, 1932, Jour. Paleontology, vol. 6, no. 4, p. 334, pl. 50, figs. 2a, b; 1941, Cushman Lab. Foram. Research, Contr., vol. 17, pt. 3, p. 58, pl. 15, fig. 6; 1944, idem, vol. 20, pt. 21, p. 85, pl. 13, fig. 7; 1946, U. S. Geol. Survey, Prof. Paper 206, p. 53, pl. 17, figs. 3-9.

Cushman and Hedberg, 1941, Cushman Lab. Foram. Research, Contr., vol. 17, pt. 4, p. 36, pl. 21, figs. 14a, b.


Frizzell, 1954, Bureau Econ. Geol., Report of Invest., Univ. Texas, no. 22, p. 81, pl. 8, figs. 1a, 1b, 2, 3, 4.
**Occurrence:** This species is very common in the samples collected from the type locality of the Blufftown Formation. It is less abundant in the other localities from which samples were collected for this study.

**Geologic range:** It has been reported many times from beds of Taylor and Austin age in the Gulf Coastal region.

**Diameter:** Diameter 0.180mm.

Figured specimen deposited HVH Collection #8484.

*Lenticulina pondi* (Cushman)

Plate 7, Figs. 3, 4


**Occurrence:** It is found only in the lowermost silty part of the Upper Blufftown.

**Geologic range:** *Lenticulina pondi* has been reported from beds of Taylor and Navarro age from the Gulf Coastal region.

**Diameter:** Diameter of the figured specimen 0.17mm.

Figured specimen deposited HVH Collection #8485.
Lenticulina Pseudosecans (Cushman)

Plate 7, Figs. 1, 2 and Plate 6, Figs. 18, 19


Occurrence: Present throughout the Middle and Upper Blufftown Formation, where it shows great variety both in size and character.

Geologic range: Has been reported from beds of Navarro age in the Gulf Coastal region. Its presence in great abundance at the upper portion of the Upper Blufftown, and the decline in density in the lower portion of the Upper Blufftown is considered to be diagnostic in age determination of the Blufftown Formation.

Diameter: Diameter 0.180mm.

Figured specimens deposited HVH Collection #8486, 8487.

Lenticulina stephensoni (Cushman)

Plate 7, Figs. 5, 6

Robulus stephensoni Cushman, 1939, Cushman Lab. Foram.

Res., Contr., vol. 15, p. 90, pl. 16, figs. 2, 3; idem, 1941, vol. 17, pt. 3, p. 63, pl. 16, figs. 6a, b;
Remarks: The keeled periphery of this species in the samples collected from the Blufftown Formation is not very well developed.

Occurrence: Its vertical distribution in the samples collected is restricted to samples from the uppermost clayey part of the Middle Blufftown.

Geologic range: Has been reported from the beds of Taylor and Navarro age from the Gulf Coastal region.

Diameter: Diameter of the figured specimen 0.144 mm. Figured specimen deposited HVH Collection #8488.

**Dentalina** d'Orbigny, 1826

**Dentalina lorneiana** D'Orbigny

Plate 6, Fig. 14


**Nodosaria lorneiana** (d'Orbigny). Reuss, 1845, Verstein. bohm. Kreideformation, pt. 1, p. 27, pl. 8, fig. 5. Franke, 1925, Greifswald Univ., Geol.-Palaeont. Inst., Abh., vol. 6, p. 34, pl. 3, fig. 12.

**Occurrence:** It is found only in the lower part of the Middle Blufftown.

**Geologic range:** Specimens refered to this species occur in the beds of Austin, Taylor, and the lower part of Navarro Group.

**Diameter:** Length of the figured specimen 0.084mm, width 0.012mm.

Figured specimen deposited HVH Collection #8489.

**Nodosaria Lamarck, 1812**

**Nodosaria obscura** Reuss

Plate 6, Fig. 13

**Nodosaria obscura** Reuss, 1845, Verstein. böhm. Kreideformation, pt. 1, p. 26, pl. 13, figs. 7-9; Franke, 1925, Greifswald Univ., Geol.-Palaeont. Inst., Abh.,

Occurrence: In the Blufftown Formation this species occurs in the lower part of the Middle Blufftown.

Geologic range: Specimens referred to this species have been reported from beds of Austin, Taylor and Navarro age.

Diameter: Length 0.08mm, width 0.024mm.

Figured specimen deposited HVH Collection #8491.

_Nodosaria delicatula_ (Cushman)

Plate 3, Fig. 8

Remarks: Test slender, sutures are distinct, slightly depressed, and straight; initial chamber in most specimens is broken, and initial spine can not be seen.

Occurrence: Specimens referred to this species are not very common in the Blufftown Formation and are restricted to the uppermost portion of the formation.

Geologic range: This species has been reported from the beds of Navarro age in the Gluf Coastal region.

Diameter: Length of the figured specimen 0.180mm, width 0.025mm.

Figured specimen deposited HVH Collection #8490.

Nodosaria affinis Reuss

Plate 7, Fig. 9

Nodosaria affinis Reuss, 1845, Verstein böh. Kreideformation, pt. 1, p. 26, pl. 13, fig. 16; Franke, 1925, Griefswald Univ., Geol.-Palaeont. Inst., Abh. vol. 6, p. 37, pl. 3, fig. 25; Berry & Kelly, 1929, U. S. Nat. Mus., Proc., vol. 76, art. 19, p. 6,

**Nodosaria vertebralis** Batsch var. **austinensis** Carsey, 1926, Univ. Texas, Bull., no. 2612, p. 31, pl. 7, fig. 12.

**Nodosaria marla** Carsey, 1926, Univ. Texas, Bull., no. 2612, p. 34-35, pl. 4, fig. 6.

Remarks: A complete specimen of this species is rare in the Blufftown Formation. However, broken specimens of all the parts are available making the identification possible.

Occurrence: In the Blufftown Formation, however, this species occur only in the lower 100 feet of the Middle Blufftown and is not found in higher horizons.

Geologic range: Specimens referable to this species have been reported from beds of Austin, Taylor and Navarro age.

Diameter: Length of the figured broken specimen approximately 0.4mm, width 0.06mm.

Figured specimen deposited HVH Collection #8492.

*Frondicularia* Defrance, 1826

*Frondicularia goldfussi* Reuss

Plate 8, Figs. 1, 2

206, p. 87, pl. 34, figs. 18-20, pl. 35, figs. 1-2; Cushman & Hedberg, 1941, Cushman Lab. Foram. Res., Contr., vol. 17, p. 91, pl. 22, figs. 7-10; Cushman & Deaderick, 1944, Jour. Paleontology, vol. 18, p. 335, pl. 52, figs. 11-12; Frizzell, 1954, Univ. Texas, Bureau Econ. Geol., Report of Invest., no. 22, p. 98, pl. 12, figs. 28-29.

**Occurrence:** In the Blufftown Formation specimens referable to this species occur only in the lowermost portion of the Middle Blufftown.

**Geologic range:** This species has been reported from beds of Austin and Taylor age from the Gulf Coastal region.

**Diameter:** Length of the figured specimen 0.4mm, width 0.2mm.

Figured specimens deposited HVH Collection #8493, 8494.

**Frondicularia verneuiliana** d'Orbigny

Plate 7, Fig. 15

*Frondicularia verneuiliana* d'Orbigny, 1840, Soc. Géol. France Mem., 1st ser., vol. 4, p. 20, pl. 1, figs. 32, 33; Brown, 1853, Annals and Mag. Nat. History, 2d ser., vol. 12, p. 241, pl. 9, fig. 5; Cushman, 1930, Cushman Lab. Foram. Res., Contr., vol. 6, p. 36, pl. 5, figs. 5, 6; 1936, idem, vol. 12, p. 19, pl. 4, fig. 11; Cushman & Deaderick, 1942, idem, vol. 18, p. 61, pl. 13, fig. 9; Cushman & Todd, 1943,

Remarks: Specimens refered to this species in the Blufftown Formation have sutures which are curved concavely toward aperture or are straight instead of being straight or curved convexly toward aperture, as figured by most of the early authors.

Occurrence: Found only in the middle and lower part of the Middle Blufftown.

Geologic range: This species has been reported from beds of Austin, Taylor, and Navarro age along the Gulf Coastal region.

Diameter: Length of the figured specimen 0.24mm, thickness 0.06mm.

Figured specimens deposited HVH Collection #8495, 8496.

**Kyphopyxa** Cushman, 1929

*Kyphopyxa* christneri (Carsey)

Plate 7, Fig. 14

**Frondicularia** christneri Carsey, 1926, Univ. Texas, Bull., no. 2612, p. 41, pl. 6, fig. 7.

fig. 1-7; Church, 1929, Jour. Paleontology, vol. 3, p. 411, no figure; Cushman, 1930, Cushman Lab. Foram. Res., Contr., vol. 6, p. 33, pl. 4, fig. 20; p. 58, pl. 12, fig. 2; Cushman and Hedberg, 1930, idem, p. 65, pl. 9, fig. 5; Vanderpool, 1930, Jour. Paleontology, vol. 4, p. 254, 255, no figure; Cushman, 1930, Cushman Lab. Foram. Res., Special Pub., no. 2, pl. 3, fig. 2; Plummer, 1931, Univ. Texas, Bull. 3101, p. 168-171, pl. 12, figs. 9-19; Cushman, 1932, Jour. Paleontology, vol. 6, p. 336, pl. 50, figs. 11, 12; 1933, Cushman Lab. Foram. Res., Special Pub., no. 5, pl. 21, figs. 1, 2; Loetterle, 1937, Nebraska Geol. Survey, Bull., 2d ser., vol. 12, p. 29, pl. 4, fig. 1; Cushman & Deaderick, 1942, Cushman Lab. Foram. Res., Contr., vol. 18, p. 62, pl. 14, figs. 1-7; Cushman, 1944, idem, vol. 20, p. 89, pl. 13, figs. 23, 24; 1946, U. S. Geol. Survey, Prof. Paper, 206, p. 92, 93, pl. 38, figs. 12-17, pl. 39, figs. 1-12; Frizzell, 1954, Univ. Texas, Bureau Econ. Geol., Report of Invest., no. 22, p. 101, pl. 13, figs. 29-33.


**Kyphopyxa Cushman** Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 345, Text-fug. 1; Cushman,
1946, U. S. Geol. Survey, Prof. Paper, 206, p. 93, pl. 38, fig. 9.

Remarks: This species presents various test outlines. The author feels that this character is not sufficient to base a new species. For this reason, in this paper, *Kyphopyxa undulata* Loetterle and *K. cushmani* Albritton and Phleger is considered synonymous with *K. christneri*.

Occurrence: It occurs most abundantly in the lower and middle part of the Middle Blufftown.

Geologic range: This species has been reported from beds of Austin and Taylor age in the Gulf Coastal region.

Diameter: Length of the specimen 0.3mm, width 0.12mm, thickness 0.02mm.

Figured specimens deposited HVH Collection #8497, 8498.

Genus *Lagena* Walker and Jacob, 1798

*Lagena* sp.

Plate 6, Fig. 15

Description: Test rounded, uniserial, globular, with a small basal pore which may be the root of a basal spine; wall calcareous, finely hispid; aperture terminal on a long neck.

Remarks: This specimen shows close similarity to *Lagena hispida* Reuss, except that the neck is longer and surface is less hispid.

Occurrence: Not very common in the samples studied, being limited to the lower part of the Middle Blufftown.
Diameter: Length of the figured specimen 0.035mm, diameter 0.024mm.

Figured specimen deposited HVH Collection #8499.

Genus Vaginulina d'Orbigny, 1826

Vaginulina jarvisi (Cushman)

Plate 7, Fig. 17


Remarks: Specimens identified herein as Vaginulina jarvisi have been compared with topotypes of the species in the Louisiana State University Research Collection.

Occurrence: It occurs only in the lower part of the Middle Blufftown.

Geologic range: This species has been reported from the Upper Cretaceous ? (now considered Paleocene) of Lizard Spring, Trinidad, the Velasco Shale of Mexico, and beds of Navarro age of Texas.
Diameter: Length of the figured specimen 0.20mm, diameter 0.07mm.

Figured specimens deposited HVH Collection #8500, 8501.

Vaginulina taylorana Cushman
Plate 7, Figs. 18, 19, 20

Vaginulina taylorana Cushman, 1938, Cushman Lab. Foram.
Res., Contr., vol. 14, pt. 2, p. 36, pl. 5, fig. 19;
Cushman & Deaderick, 1944, Jour. Paleontology, vol. 18,
p. 334, pl. 52, fig. 4; Cushman, 1946, U. S. Geol.
Survey, Prof. Paper, 206, p. 81-82, pl. 28, figs.
28-29; Frizzell, 1954, Univ. Texas, Bureau Econ.
Geol., Report of Invest., no. 22, p. 94, pl. 10, fig.
53.

Occurrence: Found in the Middle Blufftown.
Geologic range: Has been reported from beds of Taylor age in the Gulf Coastal region.

Diameter: Length of the figured specimens 0.40mm, width 0.08mm.

Figured specimens deposited HVH Collection #8502, 8503.

Genus Vaginulinopsis Silvestri, 1904

Vaginulinopsis austinana new subsp.
Plate 7, Figs. 10, 11, 12, 13

Description: Test elongate, compressed, early chambers planispiral, involute, nonumbonate, later chambers uniserial; dorsal margin curved, ventral margin slightly
lobulate; chambers distinct both in early and later portions, not inflated, increasing in size as added; sutures distinct, straight in early portion, slightly curved in later portions, somewhat limbate, with a boss-like thickening toward the middle of the suture line on both sides; wall smooth except for the sutural thickening; aperture radiate.

Remarks: This subspecies of *Vaginulinopsis austinana* differs from *V. austinana* (Cushman) in lacking a large umbo in the coiled portion, and in possessing more distinct septal sutures and chambers in the early coiled portion; it differs from *V. austinana aescens* (Cushman) in lacking a distinct keel; and it differs from *V. austinana directa* (Cushman) in lacking a straight dorsal margin. However, the basic and diagnostic difference between this new subspecies *V. austinana* and other subspecies is in the absence of an unbonate coiled portion.

Occurrence: It occurs abundantly in the lower and middle parts of the Middle Blufftown Formation.

The types are from the type locality of the Blufftown Formation, in the Chattahoochee River Valley, about the middle part of the section (CR9-5).

Diameter: Length of the holotype 0.36mm, width of the uncoiled portion 0.12mm, diameter of the planispiral portion 0.12mm.

Figured holotype deposited at HVH Collection #8504, paratype #8505.
Genus *Citharina* d'Orbigny, 1839

*Citharina texana* (Cushman)

Plate 8, Figs. 5, 9, 10 and Plate 7, Fig. 16


**Vaginulina simondsi** Carsey, Moreman, 1927, Jour. Paleontology, vol. 1, p. 98, pl. 16, fig. 1 (not of Carsey).


**Vaginulina regina** Plummer, 1931, Texas Univ., Bull., no. 3101, p. 162, pl. 10, fig. 22.


Remarks: Specimens referred to this species in the Blufftown Formation show a wide variation in outline, and ornamentation of the test. The younger specimens are compressed, with the margins nearly parallel; older specimens are less compressed, with tapering sides, and a convex inner margin. Test ornamentation ranges from 5 to 6 longitudinal coastae on each side in younger tests,
increasing in number and thickness of coastae as individual grows older, and finally in some, the coastae becoming bifurcated.

**Occurrence:** It is found abundantly in the lower and middle part of the Middle Blufftown, becomes rare in the upper part of the Middle Blufftown, and is completely absent in the Upper Blufftown.

**Geologic range:** According to Cushman (1946) and Cushman and Deaderick (1942) this species is characteristic of formations of Upper Austin age.

**Diameter:** Length ranges from 0.54 mm to 0.78mm, width 0.15mm, and thickness 0.2mm.

Figured specimens deposited HVH Collection #8506, 8507.

**Citharina wadei** (Kelley)

Plate 8, Figs. 3, 4


**Vaginulina cf. V. simondsii** Cushman, 1931, Tennessee Div. Geol., Bull., no. 41, p. 34, pl. 4, figs. 8a-b.
*Vaginulina webervillensis* Carsey. Cushman, 1931, idem, p. 33, pl. 4, fig. 6.


**Remarks:** In the specimens collected from the Blufftown, the sutures are straight to concave toward the apertural end, whereas the specimens figured by Cushman or Kelley show straight to convex sutures.

**Occurrence:** This species occurs only in the lower part of the Middle Blufftown.

**Geologic range:** Has been reported from beds of Taylor to Navarro age.

**Diameter:** Length of the figured specimen 0.20mm, width 0.12mm, thickness 0.01mm.

Figured specimens deposited HVH Collection #8508, 8509.

**Family Polymorphinidae d'Orbigny, 1839**

**Subfamily Polymorphininae d'Orbigny, 1839**

**Genus Guttulina d'Orbigny, 1839**

*Guttulina* sp.

Plate 6, Fig. 16

**Description:** Test elliptical, truncated at the base; chambers elliptical, inflated in the early portion, less inflated in the later part of the test, arranged in a quinqueloculine series, each succeeding chamber farther
removed from the base; sutures depressed, distinct; wall smooth; aperture radiate.

**Occurrence:** Specimens belonging to this species are not very abundant in the samples studied. They are distributed only in the Upper Blufftown Formation.

**Diameter:** Length of the figured specimen 0.036 mm, width 0.024 mm.

 Figured specimen deposited HVH Collection #8510.

**Globulina** d'Orbigny, 1830

**Globulina lacrime** (Reuss)

Plate 5, Fig. 16

**Polymorphina** (Globulina) *lacrime* Reuss, 1845, Verstein.

böhms. Kreideformation, pt. 1, p. 40, pl. 12, fig. 6; pl. 13, fig. 83; Egger, 1899, K. bayer. Akad. Wiss.


**Globulina lacrime** (Reuss), Reuss, 1851, Haidinger's

Naturwiss. Abh., vol. 4, p. 27, pl. 4, fig. 9; Cushman & Ozawa, 1930, U. S. Nat. Mus. Proc., vol. 77, art. 6, p. 77, pl. 19, figs. 1, 2; Cushman, 1931, Tennessee Div. Geol. Bull., no. 41, p. 40, pl. 6, figs. 9a-c; Loetterle, 1937, Nebraska Geol. Survey Bull., 2d ser., no. 12, p. 31, pl. 4, figs. 4a-b; Frizzell, 1943, Jour. Paleontology, vol. 17, p. 348, pl. 56, fig. 27; Cushman & Todd, 1943, Cushman Lab. Foram.
Remarks: The septal sutures are not very distinct in the specimens studied for this report.

Occurrence: It is not very common in the samples studied, and is limited to the Upper Blufftown Formation.

Geologic range: Has been reported from beds of Austin, Taylor, and Navarro age by earlier authors.

Diameter: Length of the figured specimen 0.12mm, width 0.03mm.

Figured specimen deposited HVH Collection #8511.

Family Glandulinidae Reuss, 1860
Subfamily Oolininae Loeblich & Tappan, 1961
Genus Oolina d'Orbigny, 1839

Oolina sp.
Plate 6, Fig. 17

Description: Test globular, slightly assymetrical; chamber uniserial, rounded, and inflated; wall finely perforated; aperture terminal, radiate; entosolenian tube extends from the apertural opening to the middle part of one side of the single chamber.

Occurrence: Specimens refered to this species are not very common in the samples studied, and occur only in the lower 100 feet of the Middle Blufftown Formation.
**Diameter:** Diameter of the figured specimen 0.06 mm.
Figured specimen deposited HVH Collection #8512.

**Superfamily Cassidulinacea d'Orbigny**

**Family Anomalinidae**

**Subfamily Anomalininae Cushman, 1927**

**Genus *Anomalinoides* Brotzen, 1942**

*Anomalinoides henbesti* (Plummer)

Plate 3, Figs. 2, 3, 4, 6, 7, 8

*Anomalina henbesti* Plummer, 1936. Univ. Texas Bull., no. 3501, p. 290, pl. 5, figs. 30-31; Cole, 1938
Fla. Dept. Cons., Geol. Bull., no. 16, p. 34, pl. 2, figs. 9, 10; Cushman & Goudkoff, 1944, Cushman Lab.
Foram. Res., Contr., vol. 20, p. 63, pl. 10, fig. 11;
Cushman, 1946, U. S. Geol. Survey, Prof. Paper, 206, p. 155, pl. 64, fig. 2; Frizzell, 1954, Univ. Texas,
Bureau Econ. Geol., Report of Invest., no. 22, p. 130, pl. 21, figs. 3a, 3b, 3c.

*Anomalina complanata* Reuss, Cushman, 1931, Tennessee
Div. Geol. Bull., no. 41, p. 60, pl. 11, figs. 7a, 7b, 7c (not of Reuss); Sandidge, 1932, Amer. Midland

*Anomalina semicomplanata* Cushman, 1938, Cushman Lab.
Foram. Res., Contr., vol. 14, pt. 3, p. 68, pl. 12, fig. 1; 1940, idem, vol. 16, pt. 2, p. 29, pl. 5, figs. 9a-c; Cushman & Hedberg, 1941, idem, vol. 17,
Remarks: It is considered to be a species of the genus Anomalinoidea rather than Anomalina because the aperture instead of being entirely peripheral, extends onto the apical side.

Occurrence: In the Blufftown Formation, this species was found abundantly in every unit sampled.

Geologic range: Has been reported from Upper Taylor and Lower Navarro beds.

Diameter: Diameter of figured specimens 0.06mm, thickness 0.012mm.

Figured specimens deposited HVH Collection #8513, 8514.

Genus Anomalina d'Orbigny, 1826

Anomalina austinana (Cushman)

Plate 3, Figs. 12, 13, 14


Remarks: Examination of this species under the petrographic microscope shows that the wall structure is granular, hence making the generic name Anomalina rather
than *Planulina*.

**Occurrence:** This species is found only in the lowermost portion of the Upper Blufftown.

**Geologic range:** It has been reported from beds of Austin age in the Texas region.

**Diameter:** Diameter of the figured specimens 0.13mm.

Figured specimen deposited HVH Collection #8515.

Family *Loxostomidae* Loeblich & Tappan, 1962

*Trachelinella* Montanaro Gallitelli, 1956

*Trachelinella watersi* (Cushman)

Plate 3, Fig. 5


**Remarks:** Most specimens referable to this species, recovered from the Blufftown Formation, are specimens with the apertural neck broken, giving a Bolivina-like appearance. A short apertural neck is visible at high magnification on some of the specimens.
Occurrence: In the samples studied, it occurs in the lower 100 feet of the Middle Blufftown Formation, a part which is considered Upper Austin in age. Therefore, the author feels that the range of this species has to be extended to include beds of Austin, Taylor, and Navarro age.

Geologic range: Trachelinella watersi has been reported from beds of Navarro age.

Diameter: Length of the figured specimens 0.06mm, width 0.02mm.

Figured specimen deposited HVH Collection #8516.

Family Nonionidae Schultze, 1854
Subfamily Nonioninae Schultze, 1854
Genus Nonionella Cushman, 1926
Nonionella austini ana Cushman

Plate 2, Fig. 17

Nonionella austini ana Cushman, 1933, Cushman Lab. Foram. Res., Contr., vol. 9, pt. 3, p. 57-58, pl. 7, figs. 2a-c; 1939, U. S. Geol. Survey, Prof. Paper 191, p. 27, pl. 7, figs. 1, 2; 1946, U. S. Geol. Survey, Prof. Paper 206, p. 100, pl. 43, figs. 18-20; Cushman & Deaderick, 1944, Jour. Paleontology, vol. 18, p. 33c, pl. 52, fig. 19; Frizzell, 1954, Univ. Texas, Bureau Econ. Geol., Report of Invest., no. 22, p. 107, pl. 15, figs. 8a-c.
Occurrence: It is not very common in the samples studied, being distributed only in the lower and middle part of the Middle Blufftown.

Geologic range: Nonionella austiniana has been reported from beds of Austin and Taylor age.

Diameter: Length of the figured specimens 0.06mm, width 0.02mm.

Figured specimen deposited HVH Collection #8517.

Family Osangulariidae Loeblich & Tappan, 1964

Gyroidinoides Brotzen, 1942

Gyroidinoides depressa (Alth)

Plate 5, Figs. 13, 14, 15


Rotalia cretacea Carsey, 1926, Texas Univ. Bull., no. 2612, p. 48, pl. 5, figs. 7a-b.

Gyroidina depressa (Alth). Cushman & Church, 1929, Calif. Acad. Sci., Proc., 4th ser., vol. 18, p. 515, pl. 41, figs. 4-5; Plummer, 1931, Univ. Texas, Bull., no. 3101, p. 190, pl. 13, fig. 3; Cushman, 1931, Tennessee Div. Geol. Bull., no. 41, p. 54, pl. 9, figs. 7, 8; 1931, Jour. Paleontology, vol. 5, p. 331, pl. 36, figs. 2a-c; Cushman & Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 46, pl. 14, fig. 1; Sandidge, 1932, Jour. Paleontology, vol. 6, p. 283,
pl. 43, figs. 16-18; Loetterle, 1937, Nebraska Geol. Survey, Bull., 2d ser., no. 12, p. 42, pl. 6, figs. 7a-c; Cushman & Hedberg, 1941, Cushman Lab. Foram. Res., Contr., vol. 17, p. 97, pl. 23, figs. 11-12; Cushman & Deaderick, 1942, idem, vol. 18, p. 64, pl. 15, figs. 14-16; Cushman & Todd, 1943, idem, vol. 19, p. 68, pl. 12, fig. 4; Cushman, 1946, U. S. Geol. Survey, Prof. Paper, 206, p. 139, pl. 58, figs. 1-4; Frizzell, 1954, Univ. Texas, Bureau Econ. Geol., Report of Invest., no. 22, p. 123, pl. 18, figs. 36a-c.

**Occurrence:** It is abundant only in the lower 150 feet of the Middle Blufftown.

**Geologic range:** It is reported from beds of Austin, Taylor, and Navarro age.

**Diameter:** Diameter of the figured specimen 0.06 mm, thickness 0.02 mm.

Figured specimen deposited HVH Collection #8518.

**Gyroidinoides globosa** (Hagenow)

Plate 5, Figs. 8, 9, 10

**Nonionina globosa** Hagenow, 1842, Neues Jahrb., p. 574, no figure.


**Occurrence:** It is common only in the lower 100 feet of the Middle Blufftown Formation.

**Geologic range:** Specimens referable to this species have been reported from beds of Austin and Taylor age, by earlier authors.

**Diameter:** Diameter of the figured specimen 0.024mm, thickness 0.02mm.

Figured specimen deposited HVH Collection #8519.
Superfamily Orbitoidacea Schwager, 1876
Family Cibicididae Cushman, 1927
Subfamily Planulininae Bermúdez, 1952
Genus Planulina d'Orbigny, 1826

**Planulina taylorensis** (Carsey)
Plate 4, Figs. 8, 9, 10

**Anomilina taylorensis** Carsey, 1926, Univ. Texas Bull., no. 2612, p. 47, pl. 6, figs. 1a, b.


**Remarks:** Petrographic examination of the wall structure confirms Cushman's transfer in 1931 of this species to the genus **Planulina**.

**Occurrence:** This species occurs only in the lower 50 feet of the Middle Blufftown Formation.
**Geologic range:** Has been reported from beds of Upper Austin, Taylor, and Navarro age.

**Diameter:** Diameter of the figured specimens 0.15mm.

Figured specimen deposited HVH Collection #8520.

**Planulina tennesseensis** W. Berry

Plate 3, Figs. 16, 17, 18


**Remarks:** Petrographic examination of the wall structure proved this species to be a member of the genus *Planulina* rather than *Anomalina*.

**Occurrence:** In the Blufftown Formation, however, it occurs only in the lower 100 feet of the middle portion of the formation.

**Geologic range:** Has been reported from the Coon Creek Tongue of the Ripley Formation (Navarro) of Tennessee, and from the Marlbrook Marl (Taylor) of Arkansas.

**Diameter:** Diameter of the figured specimens 0.06mm.

Figured specimens deposited HVH Collection #8521, 8522.
Subfamily Cibicidiidae Cushman, 1927

New genus

Plate 8, Figs. 6, 7, 11, 12, 13, 14

**Description:** Test attached, trochospiral to uniserial; wall calcareous perforate, radial microstructure; aperture areal in both coiled and uncoiled portions.

**Diameter:** Length of the type specimen 0.5mm, width of the coiled portion 0.25mm, width of the uncoiled portion 0.21mm.

Figured type specimen deposited HVII Collection #8543, paratypes Dept. Geology Museum, L. S. U., #8544, 8545.

New species

Plate 8, Figs. 6, 7, 11, 12, 13, 14

**Description:** Test attached, early portion trochospirally coiled, planoconvex, later portion uncoiled, with low uniserial chambers; spiral side flat, subevolute to evolute in early stage, umbilical side convex, involute; periphery with a non-porous keel; wall calcareous, perforate, radial microstructure; aperture close to the outer margin of the last-formed chamber and areal in both coiled and uncoiled portions.

**Occurrence:** It is found in Middle Blufftown Formation.

**Diameter:** Length of adult specimen 0.12mm, diameter of the coiled portion 0.06mm, width of the uncoiled portion 0.05mm.
Figured holotype deposited HVH Collection #8543, para-types #8544, 8545.

Superfamily Discorbacea Ehrenberg, 1838

Family Discorbidae Ehrenberg, 1838

Subfamily Baggininae Cushman, 1927

Genus *Valvulinieria* Cushman, 1927

*Valvulinieria allomorphinoides* (Reuss)

Plate 5, Figs. 1, 2, 3


*Discorbina allomorphinoides* (Reuss). Franke, 1925, Greifswald Univ. Geol.-palaeont. Inst., Abh., vol. 6, p. 91, pl. 8, figs. 11a-b; 1928, Preuss. Geol. Landesanstalt Abh., new ser., vol. 111, p. 189, pl. 18, figs. 7a, b.

*Discorbis allomorphinoides* (Reuss). Cushman, 1926, Amer. Petroleum Geol., Bull., vol. 10, p. 606, pl. 20, figs. 18, 19; pl. 21, fig. 5.

Occurrence: In the Blufftown Formation, however, it is not very common, and its distribution is limited to the lower 100 feet of the middle portion of the formation.

Geologic range: This species has been reported from beds of Austin, Taylor, and Navarro age.

Diameter: Diameter of the figured specimens 0.07 mm.

Figured specimens deposited nVH Collection #8523.

Valvulinera infrequens Morrow
Plate 5, Figs. 6, 7

Valvulinera infrequens Morrow, 1934, Jour. Paleontology, vol. 8, p. 197, pl. 30, figs. 3a-c; Cushman & Deaderick, 1942, Cushman Lab. Foram. Res., Contr., vol. 18, p. 64, pl. 15, figs. 17, 19; Cushman, 1944, idem, vol. 20, p. 95, pl. 14, fig. 22; Cushman, 1946, U. S. Geol. Survey, Prof. Paper, 206, p. 138, pl. 57, fig. 5; Frizzell, 1954, Univ. Texas, Bureau Econ. Geol., Report of Invest., no. 22, p. 123, pl. 18, figs. 35a-c.
Occurrence: In the Blufftown Formation it is common, and its distribution is limited to the lower 100 feet of the middle portion of the formation.

Geologic range: It has been reported from beds of Austin and Taylor age.

Diameter: Diameter of the figured specimens 0.08mm.

Figured specimens deposited HVH Collection #8524.

Valvulineria nelsoni (W. Berry)
Plate 5, Figs. 4, 5

Anomalina nelsoni W. Berry, 1929, in Berry & Kelley,
U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 14, pl. 21,
figs. 19-21; Cushman, 1940, Cushman Lab. Foram. Res.,
Contr., vol. 16, pt. 4, p. 27, pl. 5, figs. 1-2;
Cushman & Hedberg, 1941, idem, vol. 17, p. 99, pl. 23,
figs. 20a-c; Cushman & Todd, 1943, idem, vol. 19,
p. 81, pl. 12, fig. 13; Cushman & Deaderick, 1944,
Jour. Paleontology, vol. 18, p. 340, pl. 53, fig. 32;
Cushman, 1946, U. S. Geol. Survey, Prof. Paper, 206,
p. 154, pl. 63, figs. 8, 9; Frizzell, 1954, Univ.
Texas, Bureau Econ. Geol., Report of Invest., no. 22,
p. 131, pl. 21, figs. 4a-c.

Cibicides nelsoni Plummer, 1936, Univ. Texas Bull.,
vol. 3501, p. 288, pl. 5, figs. 1-6.

Valvulineria nelsoni Jennings, 1936, Bull. Amer. Paleon-
tologist, vol. 23, no. 78, p. 32, pl. 4, figs. 1a-c.
Occurrence: It is not very common, being found only in the lower 50 feet of the Middle Blufftown.

Geologic range: *V. nelsoni* has been reported from beds of Taylor and Navarro age.

Diameter: Diameter of the figured specimen 0.07mm.

Figured specimen deposited HVH Collection #8525.

**Valvulinerea** sp. cf. *V. umbilicata* (d'Orbigny)
Plate 5, Figs. 11, 12

**Rotalina umbilicata** d'Orbigny, 1840, Société Géologique France, Mém., vol. 4, no. 1, p. 32, pl. 3, figs. 4-6.

**Gyroidina umbilicata** (d'Orbigny). Cushman, 1931, Cushman Lab. Foram. Res., Contr., vol. 7, p. 43, pl. 6, fig. 3.


Occurrence: In the Blufftown Formation, it is not very common, being found only in the middle part of the formation.

Geologic range: It has been reported from beds of Taylor and Navarro age.

Diameter: Diameter of the figured specimen 0.06mm.
Figured specimen deposited HVH Collection #8526.

Superfamily Globigerinacea Carpenter, Parker, & Jones, 1862
Family Heterohelicidae Cushman, 1927
Subfamily Heterohelicinae Cushman, 1927
Genus Heterohelix Ehrenberg, 1843
Heterohelix globulosa (Ehrenberg)
Plate 2, Fig. 16

Textularia globolosa Ehrenberg, 1840, K. Preuss. Akad. Wiss. Berlin, Abh., p. 135, pl. 4, fig. 4b; Eley, 1859, Geology in the Garden, p. 194, pl. 2, fig. 9; pl. 9, fig. 9; Franke, 1928, Preuss Geol. Landesanstalt Abh., new ser., vol. 111, p. 134, pl. 12, fig. 11; Cushman, 1928, Jour. Paleontology, vol. 1, pl. 215, pl. 34, fig. 8.


vol. 17, p. 92, pl. 22, figs. 15a-b; Cushman & Todd, 1943, idem, vol. 19, p. 64, pl. 11, fig. 12; Cushman & Deaderick, 1944, Jour. Paleontology, vol. 18, p. 336, pl. 53, figs. 2-3; Cushman, 1946, U. S. Geol. Survey, Prof. Paper, 206, p. 105-106, pl. 45, figs. 9-15; Frizzell, 1954, Univ. Texas, Bureau Econ. Geol., Report of Invest., no. 22, p. 109, pl. 15, figs. 24-27.


Occurrence: In the Blufftown Formation it occurs in most of the samples collected.

Geologic range: Heterohelix globulosa has been reported from beds of Taylor and Navarro age.
Diameter: Length of the figured specimen 0.07mm, width 0.04mm.

Figured specimen deposited HVH Collection #8527.

"Heterohelix" striata (Ehrenberg)
Plate 2, Fig. 15

Wiss. Berlin, Abh., p. 135, pl. 4, figs. 1a, 2a, 3a; Cushman, 1928, Jour. Paleontology, vol. 1, p. 215, 216, pl. 34, fig. 4b; pl. 35, figs. 11, 14.

Remarks: Brönniamann and Brown (1953) placed this species in the genus *Pseudoguembelina*. With the exception of 2, specimens studied from the Blufftown Formation do not show the sutural aperture which characterized *Pseudoguembelina*. This may be due to the immaturity of the specimens.

Occurrence: It occurs in almost all the units sampled in the Blufftown Formation.

Geologic range: This species has been reported from beds of Austin, Taylor, and Navarro age.

Diameter: Length of the figured specimen 0.06mm, width 0.04mm.

Figured specimens deposited HVH Collection #8528.

Family Globotruncanidae Brotzen, 1942

Genus *Globotruncana* Cushman, 1927

*Globotruncana concavata* (Brotzen)

Plate 1, Figs. 7, 8, 9


Remarks: None of the specimens found in this collection are well enough preserved to show the complex tegillum with the marginal accessory apertures.

Occurrence: Globotruncanana concavata is not very abundant in the samples studied for this report. It is distributed only in the lower 20 feet of the Middle Blufftown.

Geologic range: Bolli (1957) considers the range of this species to be restricted to the upper part of Coniacian and Lower Santonian. Other workers consider the range from Santonian to Lower Campanian.

Diameter: Diameter of the figured specimen 0.13mm.

Figured specimens deposited HVH Collection #8529, 8530.

Globotruncanana cretacea (d'Orbigny)
Plate 2, Figs. 13, 14


Globotruncanana saratogensis (Applin), Brönniaman and Brown, 1956, Ecl. Geol. Helv., vol. 48, p. 544-545, pl. 21, figs. 1-3.
**Globotruncana globigerinoides** Brotzen, 1936, Sver.

Geol. Unders., ser. C, no. 396, p. 177, pl. 12, fig. 3;
Sacal & Deboule, 1957, Soc. Géol. France, Mém. 78,
p. 59, pl. 26, figs. 1–11.

**Rosalinella globigerinoides** (Brotzen), Schijfsma, 1946,
Meded. Geol. Sticht, Sec. 5, no. 7, p. 96, pl. 7,
figs. 9a–c.

**Globotruncana cretacea** (d'Orbigny) Barr, 1962, Paleontology, vol. 4, p. 567–568, pl. 69, fig. 9; pl. 72,
fig. 6; Van Hinte, 1963, Jahr. Geologisch, Bundesanstalt,
vol. 8, p. 85, pl. 6, fig. 3; Olsson, 1964, Micropaleontology, vol. 10, no. 2, p. 164, pl. 2, fig. 2.

**Remarks:** Most of the adult specimens of **Globotruncana cretacea** recognized in this study have an incipient double keel on the periphery. This structure does not appear in the younger specimens of this species. None of the specimens available show a complete tegillum structure with the accessory apertures.

**Occurrence:** In the Blufftown Formation, it appears in most of the units sampled, except in the sandy uppermost part of the formation.

**Geologic range:** Banner and Blow (1960) consider the range of **Globotruncana cretacea** from uppermost Turonian to Campanian.

**Diameter:** Diameter of the figured specimen 0.07mm.

Figured specimen deposited at HVH Collection #8531.
Globotruncana fornicata Plummer
Plate 1, Figs. 4, 5, 6


Globotruncana fornicata fornicata Plummer, Gandolfi, 1955, Amer. Paleontology Bull., vol. 36, p. 40, pl. 2, fig. 2; Dalbiez, 1955, Micropaleontology, vol. 1, p. 165-166, no figure; Brönnimann & Brown, 1956,

Globotruncana (Globotruncana) fornicata Plummer. Pessagno, 1960, Micropaleontology, vol. 6, p. 101, pl. 4, fig. 7; 1962, Micropaleontology, vol. 8, p. 362, pl. 4, figs. 4, 5, 11.

Remarks: Globotruncana fornicata exhibits considerable variation. The broadly curved chambers, and depression at the base of the dorsal part of the last chamber, distinguishes this species from most other double keeled Globotruncanas.

Occurrence: In the Blufftown Formation this species occurs in most of the units sampled, except the uppermost sandy part of the formation which was completely barren.

Geologic range: Bolli (1957) lists the range of G. fornicata in Trinidad a Santonian to possibly Lower Maestrichtian. Cita (1948) records the range of this species in Italy as Santonian to Maestrichtian.

Diameter: Diameter of the figured specimen 0.12mm. Figured specimen deposited HVH Collection #8532.
Globotruncana marginata (Reuss)
Plate 2, Figs. 1, 2, 3, 7, 8, 9

Rosalina marginata Reuss, 1845, Böhm. Kreide 1, p. 36, pl. 8, figs. 54, 74; pl. 13, fig. 68; 1854, Akad. Wiss. Wien, vol. 7, p. 59, pl. 26, fig. 1.


Remarks: There are many varieties to Globotruncana marginata. Reuss’s original description of this species was inadequate. Bolli et al. (1957, p. 46) have discussed some of the confusion and problems arising from the poorly
known type and have designated as a lectotype, a specimen originally illustrated by Reuss (1845, p. 13). The illustration of the designated lectotype, however, is very small and does not clearly show the features necessary to recognize the species.

**Occurrence:** In the Blufftown Formation *Globotruncana marginata* is fairly abundant. It occurs in every sample studied, except samples from the upper sandy part of the formation.

**Geologic range:** Edgell (1957), in his study of the Carnarvon Basin of north-western Australia, reports that *G. marginata* is restricted to beds of Santonian and Campanian age. Bolli (1957), however, proposes another lectotype from Turonian of Bohemia. Consequently, the range of this species at the present time is considered to be from Turonian to Campanian.

**Diameter:** Diameter of the figured specimens 0.08mm. Figured specimen deposited at HVH Collection #8534.

*S. ventricosa* White

Plate 1, Figs. 1, 2, 3


Sacal & Debourle, 1957, Soc. Géol. France, Mém. 78,
Occurrence: This species is not very common in the samples studied for this report. It is found only in the middle part of the formation.

Geologic range: Bolli (1957) states that Globotruncana ventricosa appears to be restricted to the Upper Santonian and Lower Campanian age beds.

Diameter: Diameter of the figured specimen 0.07mm.
Figured specimen deposited HVH Collection #8533.

Genus Rugoglobigerina Brönnimann, 1952

Rugoglobigerina sp.
Plate 2, Figs. 10, 11, 12

Description: Test small, low trochospiral coil, 2½ whorls; last whorl with only 4 chambers, which rapidly increase in size as added; chambers globular, inflated, and distinct; periphery not keeled; sutures depressed and distinct; wall calcareous, perforated, and finely rugose; aperture umbilical at the base of the last-formed chamber, rimmed with a thin lip. This species is similar to Rugoglobigerina kingi except that the number of chambers
in the last whorl are four whereas *R. kingi* is reported
to have five or more. This may indicate that the specimens
recovered from the Blufftown Formation are immature.

**Occurrence:** Specimens belonging to this species are
common in the Middle Blufftown.

**Diameter:** Diameter of the figured specimen 0.06 mm.

Figured specimen deposited HVH Collection #8535.

Family Planomalinae Bolli, Loeblich & Tappan, 1957

Genus *Globigerinelloides* Chushman & Ten Dam, 1948

*Globigerinelloides aspera* (Ehrenberg)

Plate 2, Figs. 4, 5, 6

*Rotalia aspera* Ehrenberg, 1854, Mikrogeologie, Leipzig,
p. 24, pl. 27, figs. 57, 58; pl. 31, fig. 44.

*Phanerostomum asperum* Ehrenberg, 1854, Mikrogeologie,
Leipzig, p. 23, pl. 30, figs. 26a-b.

Geol. Unders., no. 396, p. 170, pl. 13, fig. 2;
Schijfsma, 1946, Meded. Geol. Stichting, ser., sec. 5,
no. 7, p. 94, pl. 6, fig. 8; Bandy, 1951, Jour. Paleon-
tology, vol. 25, p. 508-509, pl. 75, fig. 3; Belford,
Geol. geog., Bull., no. 57, p. 91, pl. 25, figs.

*Planomalina aspera* (Ehrenberg). Barr, 1962, Paleontology,
Planomalina (Globigerinelloides) aspera aspers (Ehrenberg).


Occurrence: G. aspera is very common in the samples studied for this report and occurs in almost every unit sample studied.

Geologic range: There are numerous occurrences of this species in Senonian rocks from many areas of the world. It has a very wide stratigraphic and geographic range and, therefore, is not very useful stratigraphically.

Diameter: There is a great variety in the size of the specimens studied. Diameter of the adult specimen 0.03mm.

Figured specimen deposited HVH Collection #8536.

Planoglobulina Cushman, 1927

Planoglobulina eggeri glabrata (Cushman)

Plate 3, Fig. 1

Planoglobulina eggeri (Cushman) var. glabrata (Cushman).

Occurrence: In the samples studied for this report, it occurs only in the lower 30 feet of the Middle Blufftown.

Geologic range: Planoglobulina eggeri glabrata has been reported from beds of Austin and Taylor age.

Diameter: Length of the adult specimen 0.08mm, width of the adult 0.05mm.

Figured specimen deposited HVH Collection #8537.

Superfamily Robertinacea Reuss, 1850
Family Ceratobuliminidae Cushman, 1927
Genus Ceratobulimina Toula, 1915

Ceratobulimina cretacea Cushman & Harris
Plate 4, Fig. 11

Occurrence: In the samples studied for this report, it is not very abundant and is found in the uppermost part of the formation, below the sandy portion.

Geologic range: This species is reported from beds of Navarro age.

Diameter: Length of the figured specimen 0.06mm, width 0.04mm.

Figured specimen deposited HVH Collection #8538.

Subfamily Epistomininae Wedekind, 1937

Genus Hoeglundina Brotzen, 1948

Hoeglundina supracretacea (ten Dam)

Plate 4, Figs. 1, 2, 3, 4

Epistomina supracretacea ten Dam, 1948, Revue Inst.

Fran. Petrole, vol. 3, no. 6, p. 163, pl. 1, fig. 3;
(type from the Taylor Formation, Upper Cretaceous Texas).

Epistomina caracolla, Franke, 1925, (not Roemer), Geol.
Loetterle, 1937, Nebraska Geol. Survey Bull., 2d ser., no. 12, p. 62, pl. 11, fig. 2; Cushman & Hedberg, 1941, Cushman Lab. Foram. Res., Contr., vol. 17,
Remarks: The size of the umbilical umbo is variable in the specimens recovered from the Blufftown Formation. Also, due to the weathering, the dorsal sutures are more raised, and more than one of the accessory apertures are open.

Occurrence: Studied specimens are from the upper and middle portion of the Middle Blufftown Formation.

Geologic range: The species has been reported from the Campanian of Carlsbad, California, from the Campanian and Maastrichtian of the Gulf Coastal region, and the Upper Cretaceous of Europe. The figure ten Dam reproduced (no holotype was designated) is of a specimen from the Taylor (Campanian) near Adamsville, McNairy County, Tennessee.

Diameter: Diameter of the figured specimen 0.12mm.

Figured specimen deposited HVH Collection #8539.
**Hoeclundina sp. (new species)**

Plate 4, Figs. 5, 6, 7

**Description:** Test rotaloid, biconvex, with the umbilical area closed; chambers 6 to 7 in the last whorl, and increasing in size as added; septal sutures distinct, slightly raised and curved backward on the spiral side, straight on the umbilical side; wall calcareous; surface of the test unornamented; primary apertures lateromarginal and peripheral. This species shows a close similarity with *Hoeclundina lacunosa* (loeblich & Tappan), except for the surface ornamentation which is nodose and pit-like in *H. lacunosa* but is not present in the former species.

**Remarks:** The tests of the Blufftown specimens are badly weathered. This weathering may be the reason for the surface ornamentation to become obscure.

**Occurrence:** Studied specimens are from middle part of the Middle Blufftown.

**Diameter:** Diameter of the figured specimen 0.06mm.

Figured specimen deposited HVH Collection #8540.
Superfamily Buliminacea, Jones, 1875
Family Buliminidae Jones, 1875
Subfamily Bulimininae Jones, 1875
Genus *Bulimina* d'Orbigny, 1826

*Bulimina* sp.
Plate 3, Figs. 9, 10, 11

**Description:** Test small, elongated, triangular in section, slightly twisted on its elongate axis, broadest part near the apertural end, initial end bluntly pointed; chambers triserial, and distinct in the early portion, tending to become biserial and larger in size as added; sutures distinct, slightly depressed, wall ornamented with very fine, irregular costae; aperture loop-shaped at the inner margin of the last-formed chamber.

**Occurrence:** Specimens referable to this species are not very common in the samples studied, being limited to the lower 100 feet of the Middle Blufftown.

**Diameter:** Length of the megalospheric figured specimen 0.05mm, width of the apertural end 0.01mm.

Figured specimen deposited HVH Collection 8541, 8542.
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PLATE I
All figures are X160

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GLOBULINA LACRIMA Reuss

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DESCRIPTION OF LOCALITIES

Along Chattahoochee River:

CR-10.- The most southern hill of the type locality of the Blufftown Formation, along east bank of the River, about 36 miles south of Columbus, Georgia.

10-1.- 2 feet below the soil zone, probably 2-5 feet below the contact between uppermost sandy part of the Upper Blufftown and Cusseta Sand; no fossils of any kind except for the *Halymenites major* borings.

10-2.- seven feet below the soil zone, still in the uppermost portion of the Upper Blufftown Formation; not fossiliferous.

10-3.- twelve feet below the soil zone, still in the upper sandy portion of the formation; no fossils of any kind.

10-4.- seventeen feet below the soil zone, probably about 20 feet below the Contact; not fossiliferous.

10-5.- twenty-two feet below the soil zone, and one foot below the intertonguing sands of Upper Blufftown and clayey silts of the Middle Blufftown Formation. This sample yields abundant Foraminifera belonging to species, Ostracoda, and Mollusca.
10-6.- six feet below the intertonguing sands of Upper Blufftown and clayey silts of the Middle Blufftown Formation. This sample yields abundant echinoid teeth fragments, Mollusca, Ostracoda, and Foraminifera.

10-7.- eleven feet below the intertonguing contact; this sample yields abundant Foraminifera, Ostracoda, Mollusca, and Echinoids.

10-8.- sixteen feet below the interfingering contact; this sample yields abundant Foraminifera belonging to one species, and also few Ostracoda.

CR-9.- The northern hill of the type locality, along the east bank of the River, about 36 miles south of Columbus, Georgia, and 100 feet north of CR-10.

9-1.- two feet below the soil zone, about 18 feet below the base of the upper sandy portion. This sample yields an abundant arenaceous Foraminifera and Ostracoda.

9-2.- seven feet below the soil zone. This sample yields abundant planktonic Foraminifera in association with benthonic forms.
9-3.- twelve feet below the soil and probably about 28 feet below the base of the sandy upper portion of the Blufftown Formation. This sample yields few Foraminifera, but not very abundantly.

9-4.- seventeen feet below the soil zone. This sample is not fossiliferous.

9-5.- twenty-two feet below the soil zone, about 38 feet below the base of the upper sandy portion of the formation. This sample yields few Foraminifera assemblages.

9-6.- twenty-seven feet below the soil zone. This sample contains many Ostracoda and Foraminifera. Micro-mollusks are absent from this part of the formation.

9-7.- thirty-two feet below the soil zone, about 48 feet below the base of the sandy portion of the formation. This sample contains abundant Foraminifera.

9-8.- thirty-seven feet below the soil zone. This sample contains abundant benthonic assemblages. Planktonic Foraminifera are absent from this horizon.
9-9.- forty-two feet below the soil zone, about 58 feet below the base of the upper sandy portion of the formation. This sample yields an abundant planktonic and benthonic assemblage.

9-10.- forty-seven below the soil zone, about 63 feet below the base of the sandy portion of the Upper Blufftown Formation. This sample contains Ostracoda and Foraminifera.

9-11.- fifty-two feet below the soil zone. This sample is fossiliferous.

9-12.- fifty-seven below the soil zone. This sample yields Foraminifera and Ostracoda.

9-13.- sixty-two feet below the soil zone, about 79 feet below the base of the upper sandy portion. This sample contains few Foraminifera and Ostracoda. Foraminifera are especially very small in size.

9-14.- sixty-seven feet below the soil zone. This sample is fossiliferous, but not very abundantly.

SSH- Sanke Shoals, about 30 miles south of Columbus, Georgia, and about one mile north of the type locality, in the west bank of the River.
SSH-1.- three feet below the soil zone, probably about 90 feet below the base of the sandy portion of the Upper Blufftown Formation. Foraminifera and Ostracoda are extremely abundant in this sample.

SSH-2.- eight feet below the soil zone. This sample is abundant in Ostracoda and Foraminifera.

CR-8.- Three miles north of the type locality on the south bank of the River.

8-1.- one foot below the soil zone, about 2 feet above the *Exogyra ponderosa* ledge. This sample yields a good representative of both benthonic and planktonic Foraminifera.

8-2.- four feet below the soil zone, about 2 feet below the *Exogyra* ledge. This sample yields abundant planktonic and benthonic Foraminifera.

CR-7.- About 3 miles north of the Snake Shoals, at Banks Landings, on the Georgia side of the River.

7-1.- one foot below the soil zone. This sample yields a good number of Ostracoda, Foraminifera and vertebrate fragments.
7-2.- four feet below the soil zone; good fossil assemblages of Foraminifera and Ostracoda.

CR-6.- Planters Landings, about 25 miles south of Columbus, Georgia, on the east bank of the River.

6-1.- one foot below the soil zone; not fossiliferous.

6-2.- six feet below the soil zone. This sample is from the lower part of the Upper Blufftown and yields good Foraminifera.

CR-5.- Section on Big Bend about ½ mile north west of the Planters Landings.

5-1.- three feet below the soil zone; not fossiliferous.

CR-4.- One and half mile north of Planters Landings at Race Passes, a section along the south bank of the River.

4-1.- three feet below the soil zone. This sample yields Ostracoda only.

4-2.- four feet below the last sample. This sample does not contain fossils.

CR-3.- Chimney Bluff about 2 miles east of the Big Bend at south bank of the River.

3-1.- one foot below the soil zone; fossil molds only.
SSh-1.- three feet below the soil zone, probably about 90 feet below the base of the sandy portion of the Upper Blufftown Formation. Foraminifera and Ostracoda are extremely abundant in this sample.

SSh-2.- eight feet below the soil zone. This sample is abundant in Ostracoda and Foraminifera.

CR-8.- Three miles north of the type locality on the south bank of the River.

8-1.- one foot below the soil zone, about 2 feet above the Exogyra ponderosa ledge. This sample yields a good representative of both benthonic and planktonic Foraminifera.

8-2.- four feet below the soil zone, about 2 feet below the Exogyra ledge. This sample yields abundant planktonic and benthonic Foraminifera.

CR-7.- About 3 miles north of the Snake Shoals, at Banks Landings, on the Georgia side of the River.

7-1.- one foot below the soil zone. This sample yields a good number of Ostracoda, Foraminifera and vertebrate fragments.
7-2.- four feet below the soil zone; good fossil assemblages of Foraminifera and Ostracoda.

CR-6.- Planters Landings, about 25 miles south of Columbus, Georgia, on the east bank of the River.

6-1.- one foot below the soil zone; not fossiliferous.

6-2.- six feet below the soil zone. This sample is from the lower part of the Upper Bluff-town and yields good Foraminifera.

CR-5.- Section on Big Bend about ½ mile north west of the Planters Landings.

5-1.- three feet below the soil zone; not fossiliferous.

CR-4.- One and half mile north of Planters Landings at Race Passes, a section along the south bank of the River.

4-1.- three feet below the soil zone. This sample yields Ostracoda only.

4-2.- four feet below the last sample. This sample does not contain fossils.

CR-3.- Chimney Bluff about 2 miles east of the Big Bend at south bank of the River.

3-1.- one foot below the soil zone; fossil molds only.
3-2.- three feet below the soil zone; ostracodal molds present.

3-3.- six feet below the soil zone, below the contact between upper and lower Blufftown Formation; not fossiliferous.

3-4.- ten feet below the soil zone, about 4 feet below the contact; not fossiliferous.

CR-2.- One mile north of Chimney Bluff on the east bank of the River.

2-1.- three feet below the soil zone; not fossiliferous.

2-2.- to 2-4.- Not fossiliferous.

Upper Bradley Place Samples:

UB.- Upper Bradley Place, along a tributary of the Chattahoochee River.

UB-1 to UB-22 were collected along a stream running into the Chattahoochee River. The samples were collected irregularly where a change in lithology was observed. The samples covered an area of about a mile along the stream bank. On the basis of the Foraminifera collected it was concluded that this part of the section is of upper Middle and Upper Blufftown Formation.

Samples from U. S. Highway 27:

27-1.- Section along a railroad cut about one mile west of the town Cusseta. This section is designated as the type locality for the Cusseta Sand by Veatch.
27-1-1.- immediately below the uncomformable contact between Upper Blufftown and Cusseta Sand. This sample consists of sand and silts and is not fossiliferous.

27-1-2.- five feet below the contact the sample is still in the uppermost sandy portion of the Upper Blufftown and is not fossiliferous.

27-1-3.- ten feet below the contact, still in the sandy portion of the Upper Blufftown and is barren of fossils.

27-1-4.- fifteen feet below the contact, and not fossiliferous.

27-1-5.- twenty feet below the contact, first appearance of silty shale is noticed. This sample does not contain any fossil, but is abundant in impression of fossils, especially Pelecypoda.

27-2.- On a bent on U. S. Highway 27 going to Cusseta, 1½ miles from the town of Cusseta.

27-2-1.- two feet below the soil zone, still in the upper portion of the Upper Blufftown, and not fossiliferous.

27-2-2.- seven feet below the soil zone, the sample consists of sands and silts of the Upper Blufftown and is not fossiliferous.
27-2-3.- twelve feet below the soil zone, not fossiliferous. This sample contains lignite.

27-2-4.- seventeen feet below the soil zone, not fossiliferous.

27-2-5.- twenty-two feet below the soil zone and not fossiliferous.

27-2-6.- the first appearance of the silty shale of the Upper Blufftown occurs in this horizon (25 feet below the soil zone). This sample shows molds and impressions of Pelecypoda and Ostracoda.

27-2-7.- thirty feet below the soil zone the sample contains few Ostracoda and Pelecypoda.

27-3.- About 1/4 mile north of 27-2, along an irrigation ditch.

27-3-1.- six feet above the base of ditch the sample contains large hash of Mollusca and Ostracoda.

27-3-2.- two feet above the level of the ditch the sample contains Ostracoda and micro-mollusks.

27-4.- About 0.75 miles north of intersection of U. S. Highway 27 and Ga. 26, along a hill composed of silty shale, 35 to 40 feet high.
27-4-1.- One foot below a soil zone a sample was collected which believes to belong to the Upper Blufftown. This sample did not yield any fossils.

27-4-2.- Six feet below the soil zone the sample is silty and does not yield any fossils, except for some ostracodal and molluscan fragments.

27-4-3.- Ten feet below the soil zone, not fossil.

27-4-4.- Fifteen feet below the soil zone, the first appearance of the silty shale. This sample contains fossil molds, in addition to a few Ostracoda, Foraminifera, Mollusca, and Echinoid fragments.

27-4-5.- Twenty feet below the soil zone, the sample contains a shell hash in addition to many Exogyra ponderosa. Microfossils are limited to Ostracoda, and a few Foraminifera.

27-4-6.- Twenty-five feet below the soil zone, the sample consists of silty shale containing shell hash of micromollusks. Ostracoda are present in this horizon.

27-5.- Immediately north of the 27-4 stands a hill of about 50 feet high. Because of the heavy vegetation samples collected from this locality did not yield any fossils.
27-6.- A low hill about 2.1 miles south of Hourglass overpass on U. S. Highway 27.

27-6-1.- Three feet below the soil zone, possibly in the middle part of the Upper Blufftown. This sample does not contain any fossils.

27-6-2.- Three feet below the last sample, contained *E. ponderosa* and few Ostracoda.

27-10.- Half a mile north of 27-6, about 1 1/2 miles south of Hourglass overpass, in a sand pit on U. S. Highway 27, the contact between clayey part of the Upper Blufftown and lower sandy portion is exposed.

27-10-4.- One foot below the soil zone, still in the lowermost part of the Upper Blufftown. This sample is silty and does not contain fossils.

27-10-3.- Four feet below the soil zone and right on the contact between the upper clayey and lower sandy portions of the Blufftown Formation. This sample does not contain any fossil.

27-10-2.- Below the contact, in the sandy lower Blufftown Formation; this sample is not fossiliferous.
27-10-1.- three feet below the last sample in the sandy lower Blufftown Formation; this sample does not contain any fossils.

FB-3.- About 1.6 miles south of the Hourglass overpass a section of the lowermost Upper Blufftown is exposed. In this locality few microfaults are present.

FB-3-1.- about 2 feet below the soil zone a sample was collected. Not fossiliferous.

FB-3-2.- five feet below the soil zone, not fossiliferous.

FB-3-3.- eight feet below the soil zone, not fossiliferous.

FB-3-4.- eleven feet below the soil zone, not fossiliferous.

FB-3-5.- fourteen feet below the soil zone, not fossiliferous.

27-15.- About a half a mile south of Hourglass overpass a low hill composing of sands of lower Blufftown is exposed. Two samples at three feet intervals were collected. The section is not fossiliferous.

27-11.- About half a mile north of the Hourglass overpass around the Harmony Church area a low hill composed of sands of lower Blufftown is exposed. Three samples at three feet intervals were collected. The samples did not yield any fossils.
27-12.- About 100 feet north of the Division Road a section composed of lower Blufftown sands is exposed. Three samples at three feet intervals were collected. The section is not fossiliferous.

27-13.- About 1/2 mile north of the Division Road a hill composed of lower Blufftown sands is exposed. Three samples at three feet intervals were collected. The samples did not contain any fossils.

27-14.- One mile south of the Marn Road a section composed of lower Blufftown sands is exposed. Four samples at three feet intervals was collected. The samples did not contain any fossils.

27-9.- About half a mile south of the Marn Road a section composed of the sands of lower Blufftown is exposed. Two samples collected. The samples did not contain any fossils.

27-8.- Immediately south of the Marn Road a hill composed of the shales of Eutaw and sands of lower Blufftown is exposed. The contact is conformable. Two samples of the sands and four samples of the Shale were collected. The sands did not contain any fossils; the shale produced few fragments of Ostracoda.
VITA

Bashel Nikravesh was born in Kermanshah, Iran on August 23, 1939. She received most of her elementary education at Shahdaukht High School, Kermanshah, and graduated in 1956. She received her Licence degree from the University of Tehran, Teachers College in 1960, and she came to the United States with an Iranian Scholarship to work for higher degrees. She received her M. S. degree from the Ohio State University in 1963. After working one year on her Ph. D. at the Ohio State University she transferred to Louisiana State University in September, 1964 as a candidate for the Ph. D. degree, graduating in June, 1967.
EXAMINATION AND THESIS REPORT

Candidate: Rashel Nikravesh

Major Field: Geology


Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

March 31, 1967
Chart 1 - Vertical Distribution And Abundance Of Blufftown Fo...