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Foraminifera of the type section of the Archusa marl of Mississippi (Eocene, Claiborne group, Wautubbee formation)

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Department:

FORAMINIFERA OF THE TYPE SECTION OF THE ARCHUSA MARL OF MISSISSIPPI (EOCENE, CLAIBORNE GROUP, WAUTUBBEE FORMATION)

BY

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THESIS

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ABSTRACT

The type locality of the Archusa marl member of the Wautubbee formation is situated south of Quitman, Clarke County, Mississippi. Stratigraphically, the unit falls within the middle Eocene Claiborne group, being roughly equivalent to the upper part of the Lisbon formation of Alabama and the lower part of the Cook Mountain. The marl falls within the Ostrea sellaeformis zone and the zone of "Ceratobulimina eximia." The type section consists of 48 feet of sandy marls, with a thin oyster bed near the middle.

The Archusa foraminifera fauna consists of 87 species and varieties, belonging to 49 genera and 18 families. These, together with the associated fauna and lithic constitution of the marl, indicate deposition in a partly enclosed marine embayment of moderate depth (40-60 fathoms). A previously unrecognized depositional subcycle, within the Archusa marl member, involved shallowing and deepening of the embayment, the oyster bed representing the period of shallowest water.

INTRODUCTION

The primary purpose of this study has been to describe the foraminifera of the type section of the middle Eocene Archusa marl of Mississippi, a stratigraphic unit with a previously unstudied microfauna. A paleobiological and biostratigraphic analysis of the foraminiferal fauna and associated microfossils at that locality undertaken as a correlated problem, was intended to furnish evidence for regional interpretation of the geological relationships of the unit. A subsidiary purpose of the study was an attempt to discover zonal subdivisions within the stratigraphic unit.

Several related projects were involved in the problem. Two field trips were made, to collect samples and to measure and describe the stratigraphic section. One semester was spent in washing samples and segregating microfossils. Another semester was spent in identification of foraminifera and in analyzing their occurrences.

The study resulted in the recognition of 87 species of forminifera, belonging to 49 genera and 18 families, of which 71 are positively or tentatively identified. Evidence from these microfossils and the associated fauna agrees with evidence from other sources regarding geological history of the area, and shows a depositional subcycle that has not been previously recorded. No zonation within the Archusa marl was discernible.

Acknowledgments: Mr. W. R. Higgs, Instructor in Geology, Missouri School of Mines and Metallurgy, called the writer's attention to the existence of the Archusa marl problem. The following students at the same institution aided in various ways: Mr. B. G. Deaver assisted in segregating and sorting microfossils; Mr. J. A. Martin aided in the

field and constructively criticized the manuscript; Mr. L. C. Martin generously took his automobile on the second trip to the area, and assisted in the field; Mr. A. R. Nelson drew the map and profile section (figures 1, 2); Mr. A. F. Vondrasek aided in the field. Mrs. D. L. Frizzell assembled the plates, and furnished editorial assistance. The over-all project was directed by Dr. Don L. Frizzell.

METHODS AND TECHNIQUE

The methods used in this project are standard; and no new techniques were introduced. Evaluation of the results reported here, however, require some explanation of methods and techniques, especially as these are somewhat different from those often employed.

Sampling and description of samples

Spot samples were taken at intervals of three feet or less, the surface having been cleaned prior to sampling. The sample interval in the upper portion of the section was not consistent, as it was necessary to sample each different lithic unit. The method of channel sampling was not used because the occurrence and relative abundance of microfossils cannot be adequately determined in that way.

About a half cubic foot of material was taken in each sample. Sample size varies in detailed micropaleontological studies, from a minimum of 250 grams (in areas where transportation is difficult) to a possible maximum of a cubic foot or more. Samples from the Archusa marl were regarded as sufficient for an unusually large washed fraction, as well as duplicate material for lithological description.

The section was measured with a tape, the sample levels having

been established with a Jacob's staff. The outcropping beds were described in the field, and the samples were described in the laboratory, using a stereoscopic microscope at 20 diameters magnification.

Preparation of samples

A standard fraction of roughly 500 grams of each sample was washed for micropaleontological examination. This amount, twice that normally used for zonal studies, was selected in order to obtain a maximum representation of species. The samples were soaked for several days in large pans of water, a small amount of sodium bicarbonate having been used as the dispersing agent. Washing was by double decantation, so that the finest and most delicate foraminifera would be preserved. After drying, the washed residues were sifted into screen fractions of +10, +20, +40, +60, +80, +100 and -100 mesh (to the inch) for optimum efficiency in examination. Attempts at concentrating the foraminifera by flotation in carbon tetrachloride were unsuccessful.

Preparation of slides

Twenty samples were washed, and all microfossils were extracted and mounted in slides. Although the number of specimens from each sample varied, several hundred were found in each. Specimens from 15 samples were separated according to species and mounted in 60-square distribution slides, each slide showing approximate abundance of specimens in the sample. The remainder, in the loose mounts, were used for estimating the abundance of the specimens more accurately. In addition to the distribution slides, separate species slides were made of all units contained in the section on Systematic Descriptions.

Method of illustration

A camera lucida was not available until after the drawings had been completed. Another method therefore was used to draw the illustrations of plates 1-5: The left eye is placed at the right ocular of a stereoscopic microscope, a piece of paper being within vision of the right eye and at the right side of the microscope. The specimen is moved to the extreme right of the microscope field. The image of the specimen, as seen on the paper, is traced for outline and location of details. The drawing is then completed by free-hand sketching.

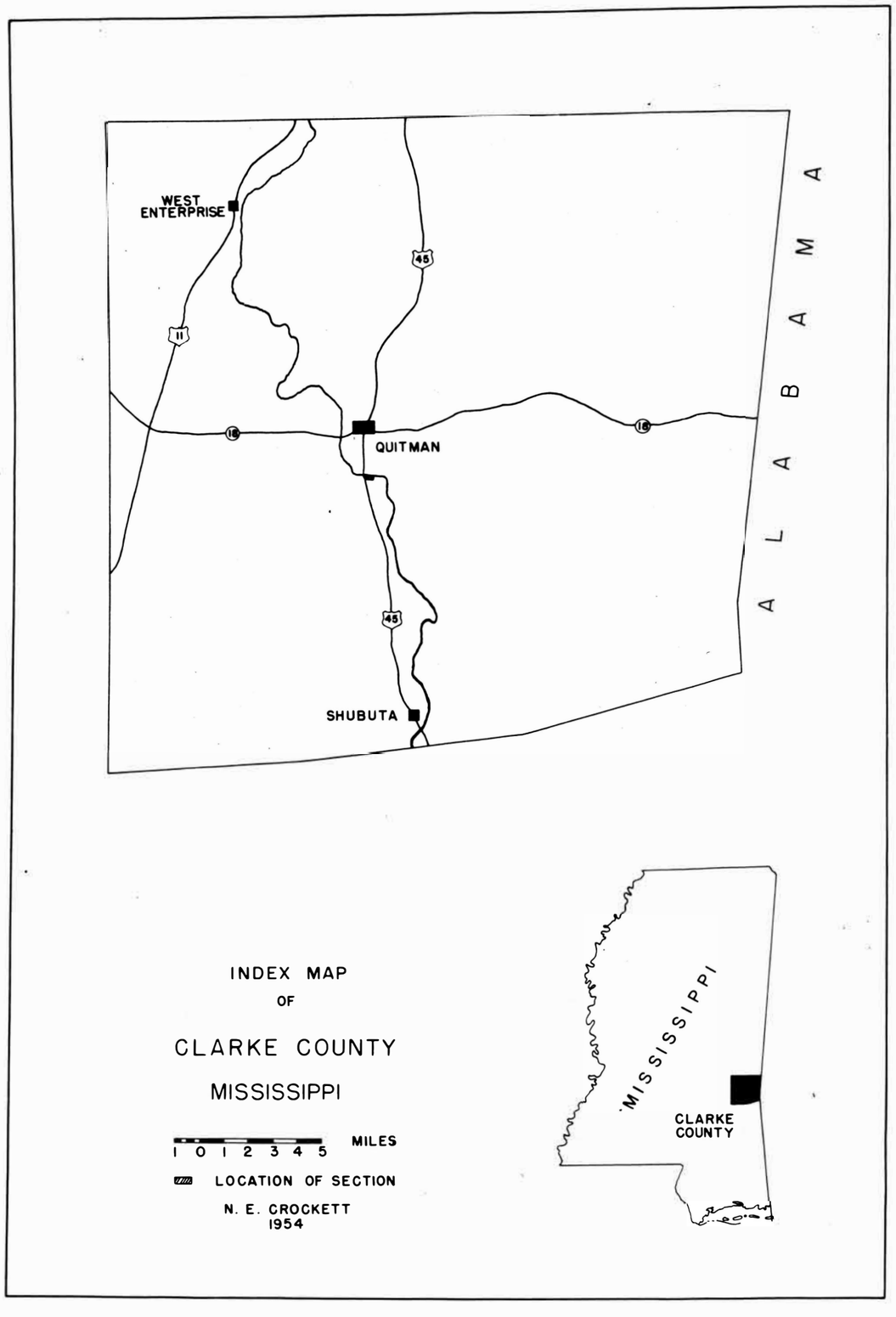
Specimens were measured with the aid of a camera lucida. The dimensions of the specimen were sketched and measured. The actual size of the specimen was computed by dividing the camera lucida measurement by the microscope magnification (ocular X objective).

DESCRIPTION OF LOCALITY

The type section of the Archusa marl member of the Wautubbee formation is situated in Clarke County, Mississippi, two miles south of the town of Quitman on U.S. Highway 45, where the highway crosses the Chickasawhay River (see figure 1). More precisely, the location may be described as in the SW$\frac{1}{4}$ of the SE$\frac{1}{4}$ of Section 14, T. 2 N., R. 15 E. The section is exposed in a bluff at the south end and east side of the bridge, where a small stream drops across the exposure.

Samples were collected, and the section measured, by the writer in August, 1953, during the period of low river level. In addition, the area was revisited in February, 1954, in company with J. A. Martin, L. C. Martin, and A. F. Vondrasek.

Figure 1. Index map of Clarke County, Mississippi, showing location of type section of Archusa marl.



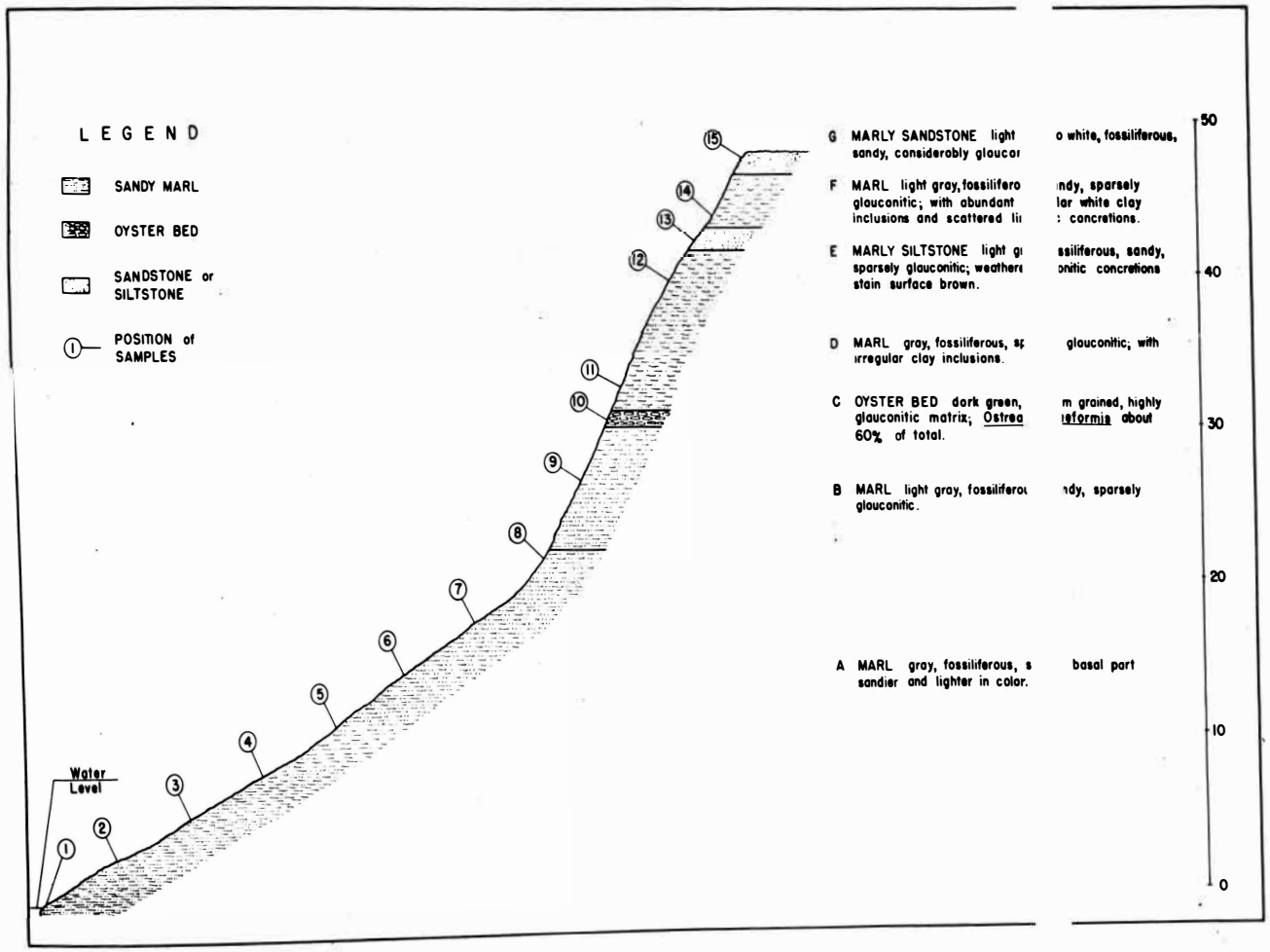


Figure 2. Profile columnar chart.

DESCRIPTION OF SECTION

Description of outcrop

The type section of the Archusa marl is composed of seven distinct beds. The measured section agrees essentially with the description by Thomas (1942). Its top is one foot below the level of the road, and its base is the level of the Chickasawhay River at low water. Neither contact of the member is exposed at the type locality. The following beds were exposed (see also figure 2).

Bed	Feet	
G	1.5	Marly sandstone--light gray, fossiliferous, indurated, considerably glauconitic.
F	3.5	Marl--light gray, fossiliferous, sandy, and sparsely glauconitic, with abundant irregular white clay inclusions and weathered limonite concretions.
E	1.5	Marly siltstone, light gray, fossiliferous, indurated, forming tip of falls, sparsely glauconitic with irregular white clay inclusions.
D	10.5	Marl, gray, fossiliferous, sandy and sparsely glauconitic, with white clay inclusions.
C	1.0	Oyster bed--dark green, medium grained, highly glauconitic sandy matrix; *Ostrea sellaeformis* makes up 60% of total.
B	8.0	Marl--light gray, fossiliferous, sandy, sparsely glauconitic.
A	22.0	Marl--gray fossiliferous, sparsely glauconitic; basal part sandier and lighter in color.

48 feet total thickness.

Descriptions of samples

SAMPLE 1

Unwashed sample: Marl--fossiliferous, creamy, sandy, fine sand size, sparsely glauconitic, with a few white clay inclusions, about 5% mica flakes.

Washed residue: Fine, chiefly clear, angular quartz grains (80%), glauconite pillow-shaped, small (about 3%); muscovite, small (about 2%); with shell fragments (about 12%).

Associated fauna: Sponge spicules (few); ostracodes (abundant; 3 kinds smooth, 4 kinds ornamented, 1 "winged" kind); echinoid spines (abundant; 2 kinds); bryozoans (few; 2 kinds); shell fragments (few).

Acid residue: Dissolves readily in dilute hydrochloridic acid; 50% or more dissolved.

SAMPLE 2

Unwashed sample: Marl--fossiliferous, buff-gray, fiberous, fine sand size, with a few limonitic concretions, sparsely glauconitic.

Washed residue: Fine; quartz grains clear, angular, (about 80%); glauconite small (about 3%); muscovite small (about 1%); with shell fragments and associated microfossils (about 12%).

Associated fauna: Sponge spicules (very few); ostracodes (abundant; 3 kinds smooth, 2 kinds with spines, 1 kind "winged"); echinoid spines (common; 2 kinds); shell fragments (few).

Acid residue: Sample dissolves readily in hydrochloric acid, leaving approximately 40% insoluble residue.

SAMPLE 3

Unwashed sample: Marl--fossiliferous, cream color, sandy, with abundant white clay inclusions, sparsely glauconitic, small amount of mica flakes visible.

Washed residue: Chiefly clear, angular, fine quartz grains (about 80%); small amount of muscovite present; with glauconitic and limonitic concretions (minor amount); shell fragments and associated microfossils make up remainder.

Associated fauna: Sponge spicules (few, tetraxon); ostracodes (abundant, 2 kinds ornamented, 2 kinds smooth, 1 kind "winged"); echinoid spines (abundant, 2 kinds); 1 fish tooth; bryozoans (rare, encrusting); corals (rare); shell fragments (abundant); scaphopods (rare).

Acid residue: Dissolves readily, leaving a residue of about 40%.

SAMPLE 4

Unwashed sample: Marl--light gray, very fossiliferous, with many pelecypods, sandy; with abundant white clay inclusions; sparsely glauconitic; very few mica flakes present.

Washed residue: Fine; with abundant clear, angular, fine quartz grains (75%); glauconite small (approximately 2%); with muscovite flakes (about 1%) and very fine limonitic concretions; remainder of residue consists of shell fragments and associated fauna.

Associated fauna: Sponge spicules (few, tetraxon); oxtracodes (abundant; 3 kinds smooth, 3 kinds ornamented, 1 kind "winged"); echinoid spines (abundant; 3 kinds); pelecypods (few); scaphopods (few, 2 kinds); shell fragments (abundant); bryozoans (rare).

Acid residue: Does not dissolve as readily as previous samples;

residue about 60%.

SAMPLE 5

Unwashed sample: Marl--light-gray, slightly more indurated than previous samples, sandy, sparsely glauconitic; fossiliferous, with many pelecypods, corals, and shell fragments; with few limonitic concretions.

Washed residue: Fine; clear, angular fragments of quartz predominant, some iron stained; glauconite slightly more than in previous samples; muscovite present in small amounts; limonitic concretions slightly more abundant than in previous samples; shell fragments abundant.

Associated fauna: Gastropods (abundant; 3 kinds high-spired, 4 kinds low-spired); ostracodes (abundant; 1 kind "winged", 3 kinds smooth, 3 kinds ornamented); echinoid spines (abundant; 3 kinds); pelecypods (few; 2 kinds); scaphopods (few; 2 kinds); sponge spicules (rare; tetraxon); shell fragments (abundant).

Acid residue: Dissolves readily in hydrochloric acid, leaving about 50% residue.

SAMPLE 6

Unwashed sample: Marl--dirty-gray, sandy, friable, sparsely glauconitic; mica flakes rare; fossiliferous, with few shell fragments.

Washed residue: Fine; clear angular quartz fragments (about 75%); glauconite small, pillow-shaped (2%); mica flakes rare (less than 1%); shell fragments abundant (about 15%).

Associated fauna: Gastropods (common; 3 kinds high spired, 3 kinds low spired); ostracodes (common; 2 kinds smooth, 1 with spines);

echinoid spines (abundant; 2 kinds); pelecypods (common; 3 kinds); scaphopods (common; 2 kinds); sponge spicules (rare; tetraxon); diatoms (rare; replaced by pyrite).

Acid residue: Dissolves rapidly, leaving 40% residue.

SAMPLE 7

Unwashed sample: Marl--light-gray, sandy, fossiliferous, sparsely glauconitic; few limonitic stains, with occasional limonitic concretions; very few mica flakes visible.

Washed residue: Major part very fine; quartz fine, angular, clear, with occasional medium size rounded grains (about 80%); glauconite scarce, pillow-shaped (less than 3%); mica scarce (less than 2%); shell fragments and associated fauna (approximately 12% of residue); unidentified material makes up remainder of residue.

Associated fauna: Bryozoans (rare); gastropods (common; 4 kinds high spired, 2 kinds low spired); echinoid spines (common; 2 kinds); scaphopods (rare; smooth); ostracodes (abundant; 2 kinds smooth, 1 kind with spines, 1 "winged"); corals (rare); sponge spicules (rare).

Acid residue: Sample dissolves readily in hydrochloric acid, leaving residue of about 50%.

SAMPLE 8

Unwashed sample: Marl--light-gray, friable, sandy, fossiliferous, very sparsely glauconitic; with few irregular white clay inclusions; mica flakes few but slightly more than in previous sample.

Washed residue: Fine; quartz clear, angular (about 70%); mica flakes small (about 5%); glauconite small, pillow-shaped (less than 2%); shell fragments and associated fauna (20%); unidentified material

makes up remainder of residue.

Associated fauna: Ostracodes (abundant; 2 kinds smooth, 1 kind with spines; 1 "winged"); gastropods (rare; high spired); pelecypods (rare; smooth); sponge spicules (rare; tetraxon and "cheval de frise").

Acid residue: Sample dissolves readily in hydrochloric acid, leaving a residue of about 50%.

SAMPLE 9

Unwashed sample: Marl--light gray, fossiliferous, friable; sparsely glauconitic; very few mica flakes observed.

Washed residue: Fine; quartz fine grained, clear, angular (80%); glauconite small, pillow-shaped (approximately 3%); mica flakes small (less than 2%); shell fragments (about 10%); unidentified material making up remainder of residue.

Associated fauna: Echinoid spines (abundant, 2 kinds); ostracodes (abundant; 2 kinds smooth, 1 kind "winged"); sponge spicules (rare, tetraxon); pelecypods (rare, smooth).

Acid residue: Dissolves readily, leaving a residue of approximately 50%.

SAMPLE 10

Unwashed sample: Oyster bed--green, unconsolidated; matrix of clear, medium size, rounded quartz grains; glauconite grains larger than in previous samples, pillow-shaped; with numerous limonitic concretions; 40% or more of sample composed of Ostrea sellaeformis.

Washed residue: Quartz medium grained, well rounded in most grains, others angular, about one-third of quartz grains stained with limonite (approximately 35%); glauconite pillow-shaped (15%); limonite

concretions abundant (approximately 10%); fragments and Ostrea make up remainder of sample.

Associated fauna: Bryozoans (rare); scaphopods (rare, 2 kinds); corals (rare); pelecypods (common); ostracodes (rare); echinoid spines (rare); shell fragments (abundant).

Acid residue: Sample reacts very fast with acid, leaving approximately 60% of sample.

SAMPLE 11

Unwashed sample: Marl--light-gray, fossiliferous, sandy, friable, sparsely glauconitic; with many irregular white clay inclusions; very few mica flakes visible; weathered surface shows some limonitic stains.

Washed residue: Fine; clear, angular, quartz fragments (80%); glauconite, small, pillow-shaped (approximately 5%); mica flakes small (about 3%); shell fragments (10%).

Associated fauna: Bryozoans (common; 3 kinds); ostracodes (common; 1 "winged", 2 kinds smooth, 1 kind with spines); echinoid spines (common; 2 kinds); pelecypods (rare; 2 kinds); sponge spicules (very rare); shell fragments (numerous; 2 kinds).

Acid residue: Dissolves readily in dilute hydrochloric acid, leaving a residue of approximately 60%.

SAMPLE 12

Unwashed sample: Marl--light gray, sandy, fossiliferous, friable, sparsely glauconitic; with a few white clay inclusions; very few mica flakes present.

Washed residue: Fine; predominantly clear, angular quartz (about 80%); glauconite fine, pillow-shaped (approximately 3%); mica flakes

scarce (about 1%); shell fragments (10%).

Associated fauna: Gastropods (abundant; 3 kinds high spired, 2 kinds low spired); ostracodes (common; 2 kinds smooth, 3 kinds with spines); echinoid spines (common; 2 kinds); pelecypods (common; 2 kinds); scaphopods (rare); sponge spicules (rare; tetraxon).

Acid residue: Dissolved readily, leaving approximately 50% insoluble residue.

SAMPLE 13

Unwashed sample: Marly siltstone--light-gray on fresh surface, weathering to red-brown, fossiliferous, sparsely glauconitic; few shell fragments present.

Washed residue: Fine; limonitic concretions (about 10%); indurated particles (about 15%); angular quartz grains, some iron stained (about 75%; glauconite small, sparse, pillow-shaped (approximately 5%); mica flakes rare (around 1%).

Associated fauna: Gastropods (abundant; 5 kinds high spired, 2 kinds low spired); pelecypods (common; 2 kinds); bryozoans (rare); ostracodes (abundant; 3 kinds smooth, 2 kinds with spines, 1 kind "winged"); scaphopods (rare); sponge spicules (common; tetraxon); echinoid spines (common; 2 kinds); pteropods (rare).

Acid residue: Does not break down readily in acid, but after twenty minutes approximately 40% of sample dissolved.

SAMPLE 14

Unwashed sample: Marl--light gray, fossiliferous, sandy, sparsely glauconitic; with abundant white clay inclusions and scattered limonitic inclusions; a few flakes of mica present.

Washed residue: Fine; with a few limonitic concretions; quartz

fragments angular, mainly clear, but some stained (about 75%); glauconite pillow-shaped, small (about 3%); shell fragments (approximately 17%); mica flakes rare (less than 1%).

Associated fauna: Gastropods (abundant; 4 kinds high spired, 1 kind low spired); pelecypods (common; 3 kinds); bryozoans (2 kinds, rare); otoliths (rare; 3 kinds); echinoid spines (common; 2 kinds); echinoid plates (rare); ostracodes (abundant; 3 kinds, 1 kind smooth, 1 kind "winged", 1 kind with spines); corals (rare).

Acid residue: Breaks down readily in acid; leaving about 50% residue.

SAMPLE 15

Unwashed sample: Marly sandstone--light-gray to white, well indurated, massive; fossiliferous; considerably glauconitic.

Washed residue: Fine; quartz clear, angular (approximately 75%); glauconite fine to medium size, pillow-shaped (about 10%); mica flakes small (less than 2%); shell fragments (around 3%); limonitic concretions containing stained quartz and glauconite (approximately 8%); unidentified material making up remainder.

Associated fauna: Gastropods (abundant; 1 kind high spired, 2 kinds low spired); echinoid spines (abundant; 3 kinds); pelecypods (common; 3 kinds); ostracodes (abundant; 2 kinds smooth, 1 kind "winged", 1 kind ornamented); bryozoans (common); scaphopods (common; 2 kinds); pteropods (common; 2 kinds); sponge spicules (very rare).

Acid residue: Does not break down readily in acid, but after twenty minutes left about 70% residue.

STRATIGRAPHY

The following summary has been compiled from available literature, but is based chiefly on the work of Grim (1936) and Thomas (1942).

Proposal of the Archusa marl

The Archusa marl was proposed by Thomas (1942) as the basal member of the Wautubbee formation of Lowe (1919) (see Table 1). As defined, the member includes all beds in eastern Mississippi above the Kosciusko formation and below the Potterchitto member. The type locality is the exact bluff on Chickassawhay River described in the present report (see Description of Locality). Prior to the work of Thomas, the Wautubbee had been regarded as a member of the extensive Lisbon formation, and in early literature was frequently termed "Lisbon", "Lisbon marl", or "typical Lisbon".

Field relationships

The Archusa marl of eastern Clarke County is lenticular and contains bodies of non-glauconitic sand, but elsewhere it is a persistent homogeneous unit. In weathered exposures, calcium carbonate has been leached from the sandy marls, and the residual material is a dark-red, sparsely glauconitic sand, with an abundance of irregular clay inclusions. Where deeply weathered, the marl closely resembles some of the weathered non-marine Claiborne sands.

The lower Archusa-Kosciusko contact is disconformable and sharply defined. The transition from non-marine deposition is marked by a one-half to three foot section in which the two facies are mixed in heterogeneous fashion. The basal part of the Archusa contains small blocks and inclusions of material from the beds be-

Table 1. Subdivisions of the Wautubbee formation in eastern Mississippi (data from Thomas, 1942).

Wautubbee formation	Gordon Creek shale (15'-25')
	Potterchitto member (12'-30')
	Archusa marl (45'-60')

low, and small lenses and pockets of marl are found in the uppermost few feet of the Kosciusko.

The overlying Potterchitto-Archusa contact is conformable and gradational. The thickness relationships show that the type Potterchitto section is at least in part contemporaneous with the upper part of the Archusa marl in Jasper and Clarke counties.

The Archusa marl maintains a thickness of 45 to 60 feet in Clarke, Jasper, and southeastern Newton counties, which lie to the northwest of Clarke. In the central part of Newton County, the formation lenses out, but reappears as a 15 foot lens in northeastern Scott and northwestern Newton counties. It is at least in part a lateral equivalent of the Shipps Creek shale, a non-marine member of the Wautubbee formation. The Archusa marl extends eastward into Alabama, although its presence has not been recognized in publication. W. D. Chawner (unpublished manuscript, 1945) has recognized a combined Potterchitto-Archusa unit, with a thickness comparable to the interval in eastern Mississippi. As in Mississippi, the upper member of the Wautubbee formation in Alabama is the Gordon Creek shale, with a thickness of about 15 to 30 feet.

Conditions of deposition

Deposition of the Wautubbee formation was initiated by an advance of the sea over the Kosciusko deltaic plain. The maximum northern extent of the sea was to the present latitude of southwestern Attala County, in the central part of the State. This transgression was not simultaneous throughout the area, but began in eastern Mississippi and extended gradually northward to its maximum limit.

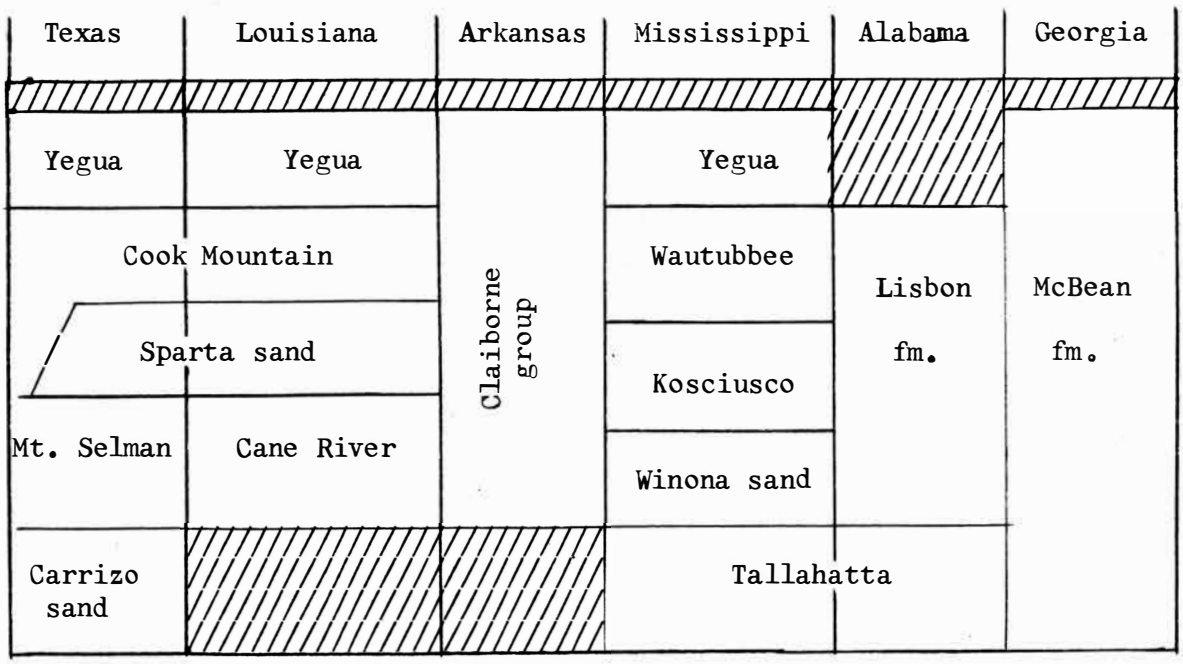
Environmental conditions, during the time interval when the Wautubbee formation accumulated, varied from neritic to littoral and non-marine. Subsidence in the area was not uniform, as shown by lateral variation in thickness of beds and lithic constitution of the strata. In the eastern part of the State, subsidence was usually rapid enough to maintain marine conditions. Shallowing, however, occurred during deposition of the Archusa marl. Subsidence in western Mississippi was not rapid enough to maintain marine conditions, even though it was more marked than to the east. More rapid deposition filled the area so completely that marine conditions were generally uncommon.

The Archusa marl was deposited relatively near shore. Abundant large oysters (Ostrea sellaeformis), the moderately shallow water foraminiferal fauna, and the clay inclusions, glauconite, and angular quartz grains agree in supporting this inference. Absence of bedding and homogeneity of the marl imply rather rapid deposition and a generally uniform environment. A slight regression with accompanying shallowing of water, during deposition of this member, as shown by the Oyster bed (figure 2, bed C), and by the shallow water foraminifera in strata above and below the oyster bed.

Correlation and zonal position

The Wautubbee formation, of which the Archusa marl is the basal member, is included in the upper part of the Claiborne group, and is equivalent to part of the Auversian stage of Europe. It is usually correlated as follows (Cooke, Gardner, and Woodring, 1943; see Table 2): It is equivalent to the middle part of the McBean formation of Georgia, the upper part of the undifferentiated Lisbon formation of

Table 2. Correlation of formations of the Claiborne group in the Gulf Coast area. (From Cooke, Gardner, and Woodring, 1943.)



Alabama, the lower part of the Cook Mountain formation and the Sparta sandstone of Louisiana and East Texas, and the lower part of the Cook Mountain formation of Central Texas.

The Archusa marl is within the zone of Ostrea sellaeformis, this characteristic oyster occurring throughout the member and extending upward through the Potterchitto member and into the basal few feet of the Gordon Creek shale. At least the upper part of the Archusa marl (samples 12-15) is within the zone of "Ceratobulimina eximia" (= C. stellata Bandy) (see Table 3). The range of this smaller foraminifer in eastern Mississippi is sporadic, however, so its absence in lower Archusa strata is not conclusive evidence as to zonal position of the unit.

Table 3. Position of foraminiferal zones in the Claiborne formations of the Gulf Coast area (after Gravell and Hanna, 1938).

Group	Formations	Zones: Mississippi, Alabama, Florida (first appearance in wells)
Claiborne	Cockfield	Nonionella cockfieldensis
	Yegua	Eponides yeguaensis
	Cook Mountain	"Ceratobulimina eximia" Camerina (large) Lepidocyclina (Polylepidina)
	Sparta	
	Weches	Discocyclina advena
	Queen City	
	Reklaw	

FAUNAL RELATIONSHIPS

Analysis of foraminiferal fauna

Eighty-seven species of foraminifera were identified in the samples studied. These belong to 49 genera and 18 families. Sixty-two species are definitely identified, nine are tentatively referred to described species, and 16 remain unidentified. A number of the unidentified and tentatively identified forms probably are new.

The following analysis of occurrences, listed by families in systematic arrangement, is shown in another way in the accompanying check list (Table 4). The check list is tabulated in order of highest occurrence, for possible use in subsurface correlation in the area.

Saccamminidae: The family is poorly represented in the Archusa marl, occurring near the middle of the section. Very rare specimens belong to a single species.

Lituolidae: Rare lituolids were encountered in the basal part of the section. Five species are present, belonging to three genera.

Textulariidae: Members of the family Textulariidae are rare to moderately rare in the Archusa section, except for strata adjacent to the oyster bed. These forms are believed to mark shallowing water. Two genera are represented by four species.

Miliolidae: Miliolids range from rare to common in the section, occurring most abundantly in strata adjacent to the oyster beds. They definitely indicate relatively shallow water. Nine species are present, belonging to three genera.

Ophthalmidiidae: A single species of Cornuspira was found. It is rare throughout the section, but is moderately common in the

Table 4. Check list of Archusa marl foraminifera. (Plotted according to highest occurrence.)

The symbols for relative abundance have the following approximate numerical values:

VR (very rare)	-	1-2	specimens
R (rare)	-	3-5	"
MR (moderately rare)	-	6-10	"
MC (moderately common)	-	11-15	"
C (common)	-	16-20	"
VC (very common)	-	21-30	"
A (abundant)	-	31-50	"
VA (very abundant)	-	50 plus	"

	SAMPLES (see figure 2)														
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Bolivina broussardi	MC	VC	VR	VR				MR	R	VR			VR		
Bolivina sp.	VR						VR						VR		
Bolivina taylori	MC							VR			VR	R	VR		
Ceratobulimina stellata	VR	VR	MR	MR											
Cibicides danvillensis	VC	VA	VA	VA	VA	R	VA	VA	A	VA	VA	VA	VA	A	VA
Cibicides mauricensis	VC	VC	VA	VA	VC	VR	MR	VA	R	R	R	C	A	VC	C
Cibicides pseudoungerianus lisbonensis	A	VC								VR	C	A	A	MC	A
Cibicides truncatus	R	VA	VA	R	R	VR	VA	VA	MR	R	MR	A	VA	VC	VA
Discorbis alveata stavensis	MC	A	VC	R	VA		VR	A	VC	C	MR	R			
Eponides cf. lisbonensis	R	MR	R	MR				MR	R	MR					
Globigerina ouachitaensis	VR	R	MR	MR	MR		R	VR	R	MC	MR	MC	MR	MR	MR
Guttulina hantkeni	VR	VR	VR	VR				VR			VR		VR		
Guttulina wilcoxensis	VR	VR	R	R			MR		VR	MR		VR	R	VR	
Gyroidina octacamerata	VA	MC	VC	A	A		C	VA	VA	R	MC	A	A	A	VA
Lagena wallacei	VR	VR	VR	R	R			VR		VR	VR	VR		VR	VR
Loxostomum wilcoxense	VR							VR							
Nonion advenum	MR	MR	MC	MR	VR	VR	MR	MR	R	VR	VR	R	MR		R
Nonion mauricensis	VR	VC	A	VR	A		MC	R	R	MR	VC	VC	MR	MR	VC
Nonion planatum	VC	VC	A	A	MC		A	A	VA	VA	A	VA	VA	VA	A
Nonionella jacksonensis	VR									R	VR		R	VR	
Nonionella spissa	R	MR	A	VC	R		C	R	VR		R	A	A	VC	A
Quinqueloculina mauricensis	VR	R		R			A	VC		MR		VR			
Robulus sp.	R	R	MR	R	VR		VR	MR	R	R	R	R			R

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Siphonina claibornensis	A	VA	VA	VA	VA	R	VA	VA	A	VA	VC	A	A	VA	A
Spiroplectammina mississippiensis alabamensis	R	MR	MR	MC	A		VC	R		VR		VR	MR	R	VR
Textularia sp.	VR														
Triloculina garretti	VR	C	MR	R	C		A	C	C	C	R	VR	VR		
Triloculina mindenensis	C	MC	MR	C			MR	VC	MR	VC	MR	R	VR		
Anomalina umbonata		MC		VR			VC	VA	VA	MR	VR		MR		
Bulimina byramensis		A	MC	MC				R	R	VR	VR	R	R		VR
Cassidulina subglobosa		VR		VR								VR			
Cibicides westi		VC	VC	MR	A		MC	MR	R	MR	R	C	VC	VC	VA
Cibicidina sp.		VR			MR		VR	R	VR		R	VR	R	MR	R
Cornuspira olygogyra		VR	VR	VR	R		VR	MC	R	VR		VR			
Dentalina communis		VR							VR						
"Discorbis" hemisphaerica		VC	MR	R	MR		R	R	VR	VR	VR	C	VR	R	VR
Entosolenia globosa		VR													
Entosolenia marginata		VR													
Globorotalia claibornensis		VR					VR					VR	VR		R
Globulina sp.		MC	VR	R	MC		MR	MR	R	R	R	MR	R	R	MC
Guttulina sp. A		MR			R			VR	VR	MR	MR	MR	R	R	MC
Guttulina sp. B		R				VR	MR	VR	VR	MC	R	C		VR	MR
Hantkenina longispina		VR	VR		VR										
Lagena lisbonensis		VR		VR								VR		VR	
Massilina aff. mauricensis		VR			VR		C								
Nodosaria cf. ewaldi		VR													
Planularia winniana		VR	R		VR			VR	R	VR	VR	R		VR	VR
Polymorphina jacksonensis		VR	VR	R	R	VR	VR	VR	VR	R	VR	R			VR
Pseudobulimina glaessneri		VR						VR							
Quinqueloculina sp.		VC	A	MC	MC		VR		R	VR					
Reussella sp.		R													
Textularia mauricensis		R	VR	VR	MR			A	MC	R					
Triloculina paulocostata		R			VR		MR	MR							
Glandulina sp.			R				VR	C	C	VR	VR	R	R		
Globigerina danvillensis			VR	VR	VR		VR	R	R		R	VR	R	VR	C
Guttulina cf. problema			R	R	VR		MR	MC	R		MR	MR		VR	MR
Lagena mississippiensis			VR												
Nodosaria cf. longiscata			R												
Quinqueloculina hermosa			R		VC		R	VC	MC	VC	C				
Spirillina vicksburgensis			VR					VR							
Spiroplectammina dibollensis			VC	MC		VR	VC	MC	MR	VC	MR				
Buliminella basistriata				VR					VR						
Cyclammina sp. B				VR				VR		R			VR	VR	
Globorotalites crassatus densus				R	VR		R		R	VR	VR	R	VR	VR	R
Textularia cf. claibornensis				VR	VR						VR	VR	VR		VR
Triloculina sp.				VR			VR								
Globulina aff. rotundata					VR							VR			
Planulina sp.					MR										
Quinqueloculina harrisi					VC			VR							
Stilostomella sp.					R				VR	VR	VR	MR	R	VR	VR
Bulimina elongata							VR		VR						
Virgulina dibollensis							VR	VC	R	VR					

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Bolivina louisiana								R							
Cibicides lobatulus								VR	R	MR	A	A	A	C	MC
Cyclammina sp. A								VR	VR	VR		VR	VR		
Dentalina cf. jacksonensis								VR	VR	VR	VR				
Haplophragmoides sp.								VR	VR						
Lagena fenestrissima								VR							
"Marginulina" jugosa								VR	MC						
Proteonina difflugiformia								VR		VR					
Haplophragmoides mauricensis									VR	MC					
Ammobaculites hockleyensis										VR					
Trochammina claibornensis										VR					
Polymorphinid? indet.											VR				
Gümbelitria columbiana													VR		
Pseudoglandulina sp.													R		
Lagena laevis															VR

shallower water strata adjacent to the oyster bed.

Trochamminidae: The family Trochamminidae is represented by a single specimen.

Lagenidae: Lagenids are rare to moderately rare, in the section, and sporadically distributed. Twelve species were identified, belonging to seven genera.

Polymorphinidae: The family Polymorphinidae also has sporadic distribution, its members ranging from rare to moderately rare. Four genera were recognized, with ten species.

Nonionidae: Two nonionid genera were identified in the Archusa samples, with six species. Occurrence is from rare to common.

Heterohelicidae: A single specimen of Gumbelitria was found near the base of the section.

Buliminidae: Members of the family Buliminidae occur sporadically throughout the section, ranging from rare to moderately rare. Fourteen species are recognized, belonging to nine genera.

Ellipsoidinidae: A single ellipsoidinid species was rare to very rare in the lower eight samples of the section.

Rotaliidae: Rotaliids were found throughout the section, ranging from rare to abundant and comprising an important part of the assemblage. Five genera were identified, with eight species.

Cassidulinidae: The genus Cassidulina is represented by rare and sporadic occurrence of a single species. The other member of the Cassidulinidae, Ceratobulimina stellata Bandy, is restricted to the upper four samples and is indicative of the "Ceratobulimina eximia" zone.

Globigerinidae: Specimens of this pelagic family were rare in

occasional samples. One genus and two species are recognized.

Hantkeninidae: The Hantkeninidae, also pelagic, is represented by rare and sporadic occurrences of a single species.

Globorotaliidae: Globorotaliids, forming another pelagic group, occur rarely throughout the section. Two genera, with two species, are recognized.

Anomalinidae: The family Anomalinidae is well represented in the Archusa marl. Ten species were found, belonging to four genera, specimens occurring commonly in the samples.

Associated microfauna

The necessarily limited scope of this study restricted the writer's efforts mainly to the foraminifera of the section. Associated microfossils were picked from all samples, however, and their abundance and general description are listed in the preceding section on Descriptions of samples. The following summaries are intended to supplement those detailed lists.

Diatoms: Two large, pyritized, coscinodiscoid diotoms were found in sample 6. It is possible that special treatment, somewhat similar to that used by Middour (Frizzell and Middour, 1951) in the study of Paleocene Radiolaria, would result in the recovery of an appreciable diatom flora.

Sponge spicules: Calcareous spicules were found rarely in samples throughout the section. Two main types occurred, a tetraxon spicule and a tiny aberrant kind with many radiating arms ("cheval de frise").

Corals: Solitary corals occur rarely and sporadically throughout the section, and were most numerous in the sample from the oyster

bed.

Echinoid spines: Spines of echinoids are common throughout the section. No other echinoderm remains were encountered.

Bryozoans: Rare bryozoans were found in occasional samples throughout the section, and are most common in the relative shallow water strata above the oyster bed.

Mollusks: Immature and minute pelecypods are common in the upper part of the section, being rare or absent below. Gastropods were lacking in the lower four samples and in material from the oyster bed and adjacent strata. Elsewhere they are common. A few pteropods, presumably pelagic gastropods, were found near the top of the section. Scaphopods (possibly broken pteropods) occur rarely and sporadically throughout the section.

Ostracodes: Several different kinds of ostracodes were found in each sample except the highest. They occur in considerable variety, and are common to abundant in the Archusa strata.

Otoliths: Several otoliths were found in sample 14.

Relationships with faunas of other units

Comparisons were made with the foraminiferal faunas of other formational units, in most cases from published illustrations, to show the apparent relationships of the Archusa assemblage. Differences in faunal content obviously are caused either by differences in age or divergence in facies, however, so percentage in common cannot be taken as an invariable index to age relationship.

Lower formations: The Aquia formation, Wilcox group, of Maryland has a recorded total of 78 species (Shifflett, 1948), five of which are common to the Archusa marl. This is six per cent of the

fauna of each formation.

Within the Claiborne group, the Tallahatta formation of Alabama contains 52 species (Bandy, 1949), with 11 species common to the Archusa marl. This is 22 per cent of the Tallahatta fauna and 12 per cent of the Archusa fauna.

The fauna of the Cane River formation of Louisiana, another Claiborne unit, has a fauna of 133 species (Hussey, 1949). Only three of these are common to the Archusa marl, that is, two per cent of the Cane River fauna and three per cent of the Archusa fauna.

Several slides of foraminifera from the Wheelock formation near Bryan, Texas, were examined. The lower Claiborne "greensand" sample showed 50 species, 18 of which are common to the Archusa marl. This is 36 per cent of the Wheelock fauna and 20 per cent of the Archusa fauna.

Higher formations: The fauna of the Gosport formation, Claiborne group, of Alabama (Bandy, 1949) consists of 28 species, with 16 species common to the Archusa fauna. This is 57 per cent of the fauna of the Gosport and 18 per cent of that of the Archusa marl.

Stratigraphically still higher, the Moodys Marl of the Jackson group of Mississippi (Cushman and Todd, 1945) has a recorded fauna of 89 species of foraminifera. The 10 species in common with the Archusa marl constitute 11 per cent of the fauna of each unit.

The undifferentiated "Jackson formation" of Mississippi (Berquist, 1942) has a fauna of 225 species, of which 11 are common to the Archusa marl. This is five per cent of the Jackson fauna and 12 per cent of the fauna of the Archusa marl.

Comparable relationships are apparent with the fauna of the "Jackson formation" of Louisiana (Howe and Wallace, 1932). One hundred and fifteen species are reported from that formation, of which nine species are common to the Archusa marl. This is eight per cent of the Jackson fauna and ten per cent of the Archusa fauna.

Equivalent units: The fauna of the Lisbon formation of Alabama (Bandy, 1949) consists of 83 species. Of these, 30 species are common to the Archusa marl, constituting 37 per cent of the Lisbon fauna and 36 per cent of the Archusa fauna.

The Cook Mountain formation of Louisiana (Howe, 1939) has 35 species, from a total of 170 in the formation, common to the Archusa marl. This is 21 per cent of the Cook Mountain fauna, and 40 per cent of the fauna of the Archusa marl.

Seventy-six species have been reported from the McBean formation of Georgia (Cushman and Herrick, 1945). The 11 species common to the Archusa marl constitute 15 per cent of the McBean fauna and 11 per cent of the Archusa fauna.

Paleoecology

The Archusa marl is believed to have been deposited in a partly enclosed basin. Only five genera of pelagic foraminifera are present in the section (Gumbelitria, Globigerina, Hantkenina, Globorotalia, and Globorotalites), and these range from rare to extremely rare. Moreover, pteropods are rare, and other pelagic elements are missing from the associated fauna. The assemblage is not typical of open-sea conditions. The fauna, on the other hand, is not characteristic of brackish water (compare Miller, 1950, 1952). Although Nonionella suggests somewhat lowered salinity, most of the genera indicate a

normal marine benthonic environment.

Moderately cool water temperature is suggested by the foraminiferal fauna. Arenaceous foraminifera are scarce, so cold water cannot be inferred. Neither does the formation contain larger foraminifera, nor alcyonarian sclerodermites in the associated fauna, so warm water cannot be postulated.

A moderate depth is inferred for the embayment in which the Archusa marl was deposited, probably 40 to 60 fathoms, with shallowing during part of the time of deposition. Moderately cool water, at this latitude, suggests a depth of that magnitude. Also, the presence of miliolids negates the possibility of deep water, as does the absence of abundant specimens of the Lagenidae, Polymorphinidae, and Buliminidae. On the other hand, the absence of echinoid, ophiuroid, and asteroid plates implies an appreciable depth of water, as these may have been dissolved immediately upon deposition.

The bathymetric history of this part of the Archusa marl, as indicated by the foraminiferal assemblage and associated microfossils, is as follows:

(a) Water of moderate depth (40 to 60 fathoms).

(b) Decreasing depth, indicated by the increasing abundance of miliolids.

(c) Relatively shallow water, shown by the presence of the oyster bed.

(d) Increasing depth, demonstrated by the abrupt discontinuation of the oyster bed.

(e) Water of moderate depth, evidenced by the decrease

in miliolids and a return to a normal benthonic assemblage.

SYSTEMATIC DESCRIPTIONS

Family SACCAMMINIDAE

PROTEONINA DIFFLUGIFORMIS (H.B.Brady)

Plate 1, figure 1

Reophax difflugiformis Brady, 1879, Quart. Jour. Micr. Sci., 19:51, pl. 4, figs. 3 a-b; 1884, Challenger Rept., Zool., 9:289, pl. 30, figs. 1-5.

Proteonina difflugiformis (Brady). Rhumbler, 1903, Arch. Prot., 3:245, text figs. 80 a-b.--Cushman, 1910, U. S. Nat. Mus., Bull., 71(1):42, text figs. 40-41; 1927, Cushman Lab. Foram. Research, Contr., 2(4):82, pl. 10, fig. 1.--Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:29, pl. 1, figs. 9-10.

Description: Test medium size, arenaceous, a single elongate oval or pyriform chamber with short neck tapering gradually from body of chamber, length about twice breadth; wall white, thick, medium grained, moderately well sorted, finely cemented; aperture medium size, terminal, subcircular, simple.

Occurrence: Found in samples 6 and 8.

Family LITUOLIDAE

HAPLOPHRAGMOIDES MAURICENSIS (Howe & Ellis)

Plate 1, figures 2a, 2b

Haplophragmoides mauricensis Howe & Ellis, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:30, pl. 1, figs. 3-5.

Description: Test medium size, arenaceous, planispiral, somewhat involute, medium thick, subcircular; periphery broadly rounded,

slightly scalloped in early portion, becoming moderately scalloped in later portion; 7 to 8 chambers in last whorl, increasing gradually in size, last chamber tending to become uniserial; sutures distince, radial, slightly curved, flush in early portion, slightly depressed in later part; wall smooth, medium grained, poorly sorted, large amount of cement gives subvitreous luster; aperture an arch at base of convex septal face.

Occurrence: Found in samples 6 and 7.

HAPLOPHRAGMOIDES species

Plate 1, figures 3a, 3b

Description: Text medium size, arenaceous, planispiral, subcircular, much compressed, apparently completely involute with slight umbilicus; chambers and sutures indistinct; wall brown, coarse grained, poorly sorted, with minimum amount of yellowish brown cement; aperture not visible on specimens examined.

Occurrence: Found in samples 7 and 8.

AMMOBACULITES HOCKLEYENSIS (Cushman & Applin)

Plate 1, figures 4a, 4b

Ammobaculites cf. A. foliaceus Brady. Dumble, 1924, Amer. Assoc. Petr. Geol., Bull., 8:443.

A. hockleyensis Cushman & Applin, 1926, Amer. Assoc. Petr. Geol., Bull., 10:163, pl. 6, figs. 2 a-b.--Ellisor, 1933, ibid., 17(11):10, pl. 7, fig. 11.--Cushman, 1935, U. S. Geol. Survey, Prof. Paper, 181:6, pl. 1, figs. 2 a-b.

Description: Test medium size, arenaceous, early part planispiral and close coiled, later tending to become uncoiled, length a-

bout twice breadth, much compressed; periphery slightly irregular, rounded; 6 chambers visible, not inflated; sutures distinct, radial; wall medium grained, well sorted, with little cement; aperture not visible on specimen.

Occurrence: Found in sample 6.

CYCLAMMINA species A

Plate 1, figures 5a, 5b

Description: Test medium size, arenaceous, planispiral, involute, slightly higher than wide, moderately compressed, umbilicus slightly excavated; periphery smooth, rounded; chambers numerous, not inflated, 12 in last whorl; sutures slightly marked, flush, radial and slightly curved; wall thin, fine grained, well sorted, abundant cement giving vitreous luster to exterior; aperture not visible.

Occurrence: Found in samples 3, 4, 6, 7, and 8.

CYCLAMMINA species B

Plate 1, figures 6, 7

Description: Test medium size, arenaceous, planispiral, slightly evolute, relatively low (lesser diameter/greater diameter ratio 68%), moderately inflated; periphery broadly rounded, smooth to slightly scalloped; 9-11 chambers in last whorl (typically 9); sutures narrow, slightly sinuous, indistinct; wall very fine grained, white, cement predominant; aperture a low slip at base of septal face, apparently with two or more large supplementary pore apertures.

Occurrence: Found in samples 2, 3, 6, 8, and 12.

Family TEXTULARIIDAE

SPIROPLECTAMMINA sp. cf. S. DIBOLLENSIS (Cushman & Applin)

Plate 1, figures 8a, 8b, 8c, 9

?Textularia dibollensis Dumble, 1924, Amer. Assoc. Petr. Geol., Bull., 8:443 (nomen nudum).

?T. dibollensis Cushman & Applin, 1926, Amer. Assoc. Petr. Geol., Bull., 10:165, pl. 6, figs. 12-14.--Ellisor, 1933, ibid., 17(11):, pl. 1, fig. 4.--Cushman, 1935, U. S. Geol. Surv., Prof. Paper, 181:8, pl. 1, figs. 13-16.

Description: Test medium size, arenaceous, planispiral in early part, later biserial, short, broad, elliptical in cross section, slightly compressed in early portion, angle of test 65°; initial coil distinct, rounded, small, 5 chambers visible, later chambers numerous with sides nearly parallel, 8 tiers of chambers, chambers not distinct in early portion, apparently low, broad, later chambers distinct, inflated, higher; sutures distinct in later portion, depressed, indistinct in early part, apparently flush; wall fine grained, with much cement, surface moderately smooth; aperture a broad shallow arch at base of septal face.

Occurrence: Found in samples 5-10, 12, and 13.

SPIROPLECTAMMINA MISSISSIPPIENSIS (Cushman)
var. ALABAMENSIS (Cushman)

Plate 1, figures 10a, 10b

Textularia mississippiensis Cushman var. alabamensis Cushman, 1923, U. S. Geol. Surv., Prof. Paper, 133:17, pl. 1, fig. 4.--Howe, 1928, Jour. Paleontology, 2:175 (check list).

--Ellisor, 1933, Amer. Assoc. Petr. Geol., Bull. 17(11):, pl. 1, fig. 6.--Cushman, 1935, U. S. Geol. Surv., Prof. Paper, 181:7, pl. 1, figs. 5-6.--Davis, 1941, Jour. Paleontology, 15:150, pl. 25, figs. 2-3.--Cushman and McGlamery, 1942, U. S. Geol. Surv., Prof. Paper, 197-B: 66.

Spiroplectammina mississippiensis var. alabamensis (Cushman). Cushman & Todd, 1945, Cushman Lab. Foram. Research, Contr., 21:80, pl. 13, fig. 2.

Description: Test small, arenaceous, broadly tapering, compressed, thickest in middle, rhomboidal in end view, peripheral edge serrate, sharp, angle of test 30°; early chambers planispiral, later becoming biserial; initial coil small, distinct, with 5 chambers; later portion broad and not increasing uniformly as added; with 11 tiers of chambers; sutures distinct, slightly depressed, straight, oblique, forming angle of 40° with horizontal; wall finely grained, with large amount of cement, smooth; aperture small, arched, at base of septal face.

Occurrence: Found in samples 1-4, 6, 8, 9, and 11-15.

TEXTULARIA sp. cf. T. CLAIBORNENSIS (Weinzierl & Applin)

Plate 1, figures 11a, 11b

?Textularia claibornensis Weinzierl & Applin, 1929, Jour. Paleontology, 3:392, pl. 44, fig. 1.

T. cf. Claibornensis Weinzierl & Applin. Cushman & Todd, 1948, Cushman Lab. Foram. Research, Contr., 24(2):27, pl. 5, figs. 3-4.

Description: Test medium size, arenaceous, elongate, biserial, angle of test 35°, oval in section in later part, slightly compressed

in early portion; chambers in early portion low, much higher in later half, last 6 make up half test, 8 or more tiers of chambers; sutures distinct only in later portion, depressed, oblique, forming 15° angle with horizontal; wall smooth, medium grained, well sorted, with much cement; aperture broad, shallow, at base of septal face.

Occurrence: Found in samples 1, 3, 4, 5, 11, and 12.

Remarks: The apparent resemblance of the drawing to that for Textularia mauricensis is misleading.

TEXTULARIA sp. cf. T. MAURICENSIS (Howe)

Plate 1, figures 12a, 12b

?Textularia mauricensis Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:31, pl. 1, figs. 16-19.

Description: Test large, arenaceous, elongate biserial, elliptical in end view, early portion slightly compressed, tapering, with 80° angle of test adult portion thicker with sides nearly parallel; with 10 or more tiers of chambers, later 5 making up half of test, chambers inflated, higher in later portion of test, earlier chambers not distinct; sutures distinct, depressed, oblique, forming 15° angle with horizontal; wall coarse grained, with much cement; aperture in semicircular reentrant at base of septal face.

Occurrence: Found in samples 6-8, and 11-14.

Remarks: The figure shows too many chambers, as the specimen is somewhat indistinct. The apparent resemblance of the drawing to that for T. cf. claibornensis is misleading.

Howe's specimens do not show the initial part, so identification is not certain.

TEXTULARIA species

Plate 1, figures 13a, 13b

Description: Test medium size, arenaceous, biserial, tapering, compressed; chambers distinct in later part of test, inflated, embracing, early chambers gradually increasing in size as added, last 4 show rapid increase and comprise half of test; sutures distinct only in later portion of test, depressed, medium grained; aperture not visible.

Occurrence: A single specimen was found in sample 15.

Family MILIOLIDAE

QUINQUELOCULINA HARRISI (Howe & Roberts)

Plate 1, figures 14a, 14b

Quinqueloculina harrisi Howe & Roberts, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:35, pl. 2, figs. 13-15. --Bandy, 1949, Bulls. Am. Pal., 32(131):19, pl. 1, figs. 5 a-c.

Description: Test comparatively small, calcareous-imperforate, quinqueloculine, broad, smooth, oval, moderately inflated; periphery broadly rounded; chambers moderately inflated; sutures distinct, moderately depressed; wall smooth; aperture semicircular, without neck, tooth platelike, moderately broad, large, simple.

Occurrence: Found in samples 8 and 11.

The species was described from the Cook Mountain formation (Claiborne) of Louisiana, and was recorded by Bandy from the Lisbon formation (Claiborne) of Alabama.

QUINQUELOCULINA MAURICENSIS (Howe)

Plate 1, figures 15a, 15b

Quinqueloculina mauricensis Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:35, pl. 4, figs. 8-10.--Cushman & Todd, 1945, Cushman Lab. Foram. Research, Contr., 21:12, pl. 3, figs. 5-6.--Bandy, 1949, Bulls. Am. Pal., 32(131):20, pl. 1, figs. 8 a-c.

Description: Test small, calcareous-imperforate, quinqueloculine, oval, length about twice breadth, moderately thick, subtriangular in cross section, apertural end with short neck; periphery slightly keeled; chambers distinct, slightly inflated, somewhat triangular in cross section; sutures distinct, slightly depressed; wall smooth; aperture oval, with small simple tooth.

Occurrence: Found in samples 4, 6, 8-9, 12, 14, and 15.

QUINQUELOCULINA HERMOSA (Cole)

Plate 1, figures 16a, 16b

Quinqueloculina hermosa Cole, 1927, Bulls. Am. Pal., 14(51):13, pl. 2, figs. 28-29.--Bandy, 1949, ibid., 32(131):19, pl. 1, figs. 7 a-c.

Description: Test large, calcareous-imperforate, quinqueloculine, elongate, oval, length about twice breadth, subtriangular in cross section, moderately inflated; periphery rounded; chambers narrow, about uniform width; sutures distinct, depressed; wall brownish; aperture terminal, at end of short neck, circular, with small simple tooth.

Occurrence: Found in samples 5-9, 11, and 13.

The species was described from the middle Eocene of Mexico, and has been recorded by Bandy from the Lisbon formation (Claiborne) of

Alabama.

QUINQUELOCULINA species

Plate 1, figures 17a, 17b

Description: Test small, calcareous-imperforate, quinqueloculine, elongate, oval, slightly inflated, with distinct thin keel; chambers distinct, subtriangular, slightly inflated, becoming thinner toward apertural end; wall smooth; aperture elliptical, at end of moderately long thin neck, without tooth.

Occurrence: Found in samples 6, 7, 9, and 11-14.

MASSILINA sp. aff. M. MAURICENSIS (Howe & Ellis)

Plate 1, figures 18a, 18b

?Massilina mauricensis Howe & Ellis, 1939, La. Geol. Survey, Geol. Bull., 14:36, pl. 3, figs. 14-16.

Description: Test large, calcareous-imperforate, massiline, broadly oval, very much compressed; periphery sharp, smooth; chambers apparently in single plane; sutures distinct, slightly depressed; walls thin, with fine punctae parallel to sutures, surface appears granular due to punctae.

Occurrence: Found in samples 9, 11, and 14.

TRILOCULINA GARRETTI (Howe)

Plate 2, figures 1a, 1b, 1c

Triloculina garretti Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:37, pl. 2, figs. 3-5.

Description: Test triloculine, calcareous-imperforate, with arenaceous exterior, elongate, moderately slender, compressed; chambers rounded; sutures depressed but partly obscured by arenaceous

coating; apertural end extended into cylindrical neck; aperture subcircular, with tooth.

Occurrence: Found in samples 3-9 and 11-15.

TRILOCULINA MINDENENSIS (Howe)

Plate 2, figures 2a, 2b, 2c

Triloculina mindenensis Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:37, pl. 3, figs. 11-13.

Description: Test triloculine, calcareous-imperforate, length about twice width; periphery broadly rounded; chambers inflated; sutures slightly depressed; wall smooth; aperture terminal, large, semicircular, with short broad tooth.

Occurrence: Found in samples 3-9, and 12-15. The species was described from the Cook Mountain formation (Claiborne) of Louisiana.

TRILOCULINA PAULOCOSTATA (Cushman & Garrett)

Plate 1, figures 19a, 19b

Triloculina paulocostata Cushman and Garrett, 1934, Cushman Lab. Foram. Research, Contr., 10(3):67-70, pl. 9, figs. 6-7.

Description: Test small, elongate, oval, length about twice breadth, periphery rounded, elliptical in cross section, moderately compressed, surface ornamented by distinct coarse longitudinal costae, in general tend to parallel the periphery, costae bifurcate; chambers and sutures indistinct; aperture terminal, at end of short neck, circular, with rounded lip and thin short simple tooth.

Occurrence: Found in samples 8-9, 11, and 14. The species was described from the Cook Mountain formation (Claiborne) of

Louisiana.

Remarks: The identification of this form is not completely certain, but is supported by the stratigraphic relationships of the Archusa marl. Cushman and Garrett did not mention an apertural tooth, but their figures do not clearly show its absence. The types show a subtruncate base and slightly finer costae than in the Mississippi specimens.

TRILOCULINA species

Plate 2, figures 3a, 3b

Description: Test small, calcareous-imperforate, triloculine, broad, oval, slightly inflated, length slightly greater than width; periphery smooth, acute; chambers broad, moderately inflated, uniformly wide, subtriangular, with slight crenulation parallel to periphery; wall thin, smooth; aperture large, semielliptical, without neck or tooth.

Occurrence: Found in samples 9 and 12.

Family OPHTHALMIDIIDAE

CORNUSPIRA OLYGOGYRA Hantken

Plate 2, figures 5a, 5b

Cornuspira olygogyra Hantken, 1875, K. Ungar. Geol. Anst., Mitt. Jahrb., 4(1):20, pl. 1, fig. 10.--Cushman, 1935, U. S. Geol. Surv., Prof. Paper, 181:15, pl. 4, fig. 14.--Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:39, pl. 3, figs. 9-10.

Description: Test small, calcareous-imperforate, planispiral, subcircular, lesser diameter/ greater diameter ratio 88%, much compressed; periphery smooth, rounded; test consisting of oval tube en-

larging gradually in initial part, rapidly in later portion, sides of tube slightly rounded; wall smooth, glossy; apertural end higher than broad, aperture the open end of tube.

Occurrence: Found in samples 4, 6-9, and 11-14.

Family TROCHAMMINIDAE

TROCHAMMINA CLAIBORNENSIS (Howe)

Plate 2, figures 4a, 4b, 4c

Trochammina claibornensis Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:40, pl. 4, figs. 11-12.

Description: Test small, arenaceous, trochoid, inflated; periphery lobate, broadly rounded; chambers numerous, about 9, 4 chambers of last whorl comprise most of test; wall medium grained, well cemented, white, earlier portion brown; sutures distinct, depressed; aperture indistinct, apparently opening into umbilical area.

Occurrence: Found only in sample 6.

Family LAGENIDAE

ROBULUS species

Plate 2, figures 7a, 7b

Description: Test medium size, calcareous-perforate, planispiral, biconvex, subcircular, lesser diameter/greater diameter ratio 34%, moderately inflated, with clear central boss; periphery smooth and acute; 8 chambers in last whorl, increasing uniformly in size; sutures distinct, radial, slightly curved, thickening toward periphery; wall smooth, moderately thin; aperture radiate, at peripheral angle.

Occurrence: Found in samples 1, 4-9, and 11-15.

PLANULARIA WINNIANA (Howe & Ellis)

Plate 2, figures 6a, 6b

Planularia winniana Howe and Ellis, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:42, pl. 4, fig. 7.

Description: Test calcareous-perforate, planispiral, much compressed; 6 chambers visible, becoming more elongate as added; sutures clear, broad, slightly curved, wall smooth; aperture simple, radiate.

Occurrence: Found in samples 1-2, 4-8, 11, and 13-14.

"MARGINULINA" JUGOSA (Cushman & Thomas)

Plate 2, figure 9

Robulus jugosus Cushman and Thomas, 1930, Jour. Paleontology, 4(1):36, pl. 3, figs. 4a-b.--Cushman & Applin, 1943, Cushman Lab. Foram. Research, Contr., 19:34, pl. 7, fig. 14.--Bandy, 1949, Bulls. Am. Pal., 32(131):61, pl. 9, figs. 3a-b.

Description: Test calcareous-perforate, uncoiling planispiral, somewhat oval, little compressed; periphery with blunt keel; chambers distinct, 4 visible; sutures distinct, raised, beaded; wall smooth except for beads; aperture terminal, radiate, at peripheral margin of septal face.

Occurrence: Found in samples 8-9.

DENTALINA COMMUNIS (d'Orbigny)

Plate 2, figures 8a, 8b

Nodosaria (Dentalina) communis d'Orbigny, 1826, Ann. Sci. Nat., 7:254.--Cushman, 1913, U. S. Nat. Mus., Bull., 71(3):54, pl. 28, figs. 1-2.

Dentalina communis (d'Orbigny). Van den Broeck, 1876, Soc. Belg. Micr., Ann., 2:91, pl. 2, fig. 5.--Cushman & Todd, 1945, Cushman Lab. Foram. Research, Sp. Publ., 15:20, pl. 3, fig. 13.--Shifflett, 1948, Maryland, Dept. Geol. Mines Water Resources, Bull.

Description: Test small, calcareous-perforate, uniserial, elongate, elliptical in cross section; margin slightly scalloped in early portion, becoming moderately scalloped in later portion, initial chamber rounded; 5 chambers, height approximately equal to width; sutures distinct, oblique in earlier portion (angle of 30° with horizontal), last suture nearly horizontal; aperture terminal, eccentric, radiate.

Occurrence: Found in samples 7 and 14.

DENTALINA sp. cf. D JACKSONENSIS (Cushman & Applin)

Plate 2, figure 16

?Nodosaria jacksonensis Cushman & Applin, 1926, Amer. Assoc. Petr. Geol., Bull. 10:170, pl. 7, figs. 14-16.--Cushman, 1927, Jour. Paleontology, 1:153, pl. 24, fig. 3.--Cole, 1928, Bulls. Am. Pal., 14(53):208, pl. 3, fig. 12.

Description: Test calcareous-perforate, uniserial, elongate, gently curved, circular in cross section; outer margin lobate, inner margin less lobate; chambers increasing gradually in size as added, height approximately twice breadth; sutures distinct, oblique (forming angle of 20° with horizontal), moderately depressed; surface smooth; aperture terminal, rounded.

Occurrence: Found in samples 5-8.

NODOSARIA sp. cf. N. EWALDI (Reuss)

Plate 2, figure 14

?Nodosaria ewaldi Reuss, 1851, Zeitschr. deutsch. geol. Ges., 3:58, pl. 3, fig. 2.

"Nodosaria ewaldi Reuss?" Cushman, 1935, U. S. Geol. Surv., Prof. Paper, 181:22, pl. 9, fig. 2.--Cushman & Dusenbury, 1934, Cushman Lab. Foram. Research, Contr., 10(3), pl. 7, fig. 21.

Description: Test small, calcareous-perforate, uniserial, elongate, straight; chambers smooth, cylindrical; sutures distinct, transverse, slightly depressed; wall smooth; aperture round, terminal.

Occurrence: A single broken specimen was found in sample 14.

NODOSARIA sp. cf. N. LONGISCATA d'Orbigny

Plate 2, figure 17

?Nodosaria longiscata d'Orbigny, 1846, Foram. foss. bassin Tert. Vienne, p. 32, pl. 1, figs. 10-12.--Howe & Wallace, 1932, La. Dept. Conserv., Geol. Bull., 2:35, pl. 7, fig. 8.--Howe, 1939, ibid., 14:47, pl. 5, fig. 10.--Bergquist, 1942, Mississippi State Geol. Surv., Bull., 49:46, pl. 4, fig. 26.--Bandy, 1949, Bulls. Am. Pal., 32(131):55, pl. 7, fig. 10.

Description: Test calcareous-perforate, uniserial, very elongate; two cylindrical chambers present; suture distinct, transverse; wall smooth, rather thick; aperture round, with slight lip.

Occurrence: Found only in sample 13.

PSEUDOGLANDULINA species

Plate 2, figure 15

Description: Test small, calcareous-perforate, uniserial, subovate, circular in cross section, greatest diameter slightly above middle, initial end pointed; chambers few, greatly overlapping, last chamber making up 80% of test; sutures distinct, thin, transverse; walls thin, smooth; aperture terminal, radiate.

Occurrence: Found only in sample 3.

Remarks: This form is somewhat similar to P. ovata (Cushman and Applin) (1926, Am. Assoc. Petr. Geol., Bull., 10:169, pl. 7, figs. 12-13), but cannot be identified with that species on the basis of the limited material at hand.

LAGENA FENESTRISSIMA (Howe & Ellis)

Plate 2, figure 10

Lagena fenestrissima Howe & Ellis, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:50, pl. 6, fig. 18.

Description: Test small, calcareous-perforate, unilocular, ovate, circular in cross section, greatest diameter slightly below center, lesser diameter/greater diameter 57%; surface ornamented by numerous small subhexagonal pits, giving spongy appearance to surface; aperture round, at end of short neck (apparently broken).

Occurrence: Found only in sample 8.

LAGENA LAEVIS (Montagu)

Plate 2, figure 12

Vermiculum laeve Montagu, 1803, Test. Brit., p. 524.

Lagena laevis (Montagu). Williamson, 1848, Ann. Mag. Nat.

Hist. [2] 1:12, pl. 1, figs. 1-2.--Cushman, 1935, U. S. Geol. Surv., Prof. Paper, 181:22, pl. 9, figs. 3-4.--Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:50, pl. 6, fig. 12.--Bergquist, 1942, Miss. Geol. Surv., Bull. 49:51, pl. 5, figs. 7-8.

Description: Test small, calcareous-perforate, unilocular; chamber ellipsoidal, slightly smaller at base than at top, with thin moderately short neck flaring to small lip; wall smooth, with ultrafine low pustules; aperture circular, apparently extremely finely radiate.

Occurrence: A single specimen was found in sample 1.

LAGENA LISBONENSIS (Cushman & Todd)

Plate 2, figure 13

Lagena costata var. amphora Reuss. Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:49, pl. 6, fig. 15.

L. lisbonensis Cushman & Todd, Cushman Lab. Foram. Research, Contr., 24:30 pl. 5, fig. 22.

Description: Test small, calcareous-perforate, unilocular, elongate, tapering from the greatest width near base to thin elongate neck; wall ornamented with thin and rather high costae, 6 costae extending whole length of test, becoming somewhat spiral toward neck; aperture terminal.

Occurrence: Found in samples 2, 4, 12, and 14.

LAGENA MISSISSIPPIENSIS (Cushman & Todd)

Plate 2, figure 11

Lagena mississippiensis Cushman & Todd, 1948, Cushman Lab.

Foram. Research, Contr., 24(2):30, pl. 5, fig. 24.

Description: Test small, pyriform, greatest width slightly below middle, base apparently somewhat truncate, apertural end tapering with slight cylindrical neck; wall ornamented with 10 longitudinal costae, rather thick and with numerous radiating tabular portions; aperture small, terminal, simple.

Occurrence: Found only in sample 13.

LAGENA WALLACEI (Bandy)

Plate 2, figure 18

Lagena sp. B. Howe & Wallace, 1932, La. Dept. Conserv., Geol. Bull., 2:30, pl. 6, fig. 10.--Bergquist, 1942, Mississippi Geol. Surv., Bull., 49:53, pl. 5, fig. 26.

L. wallacei Bandy, 1949, Bulls. Am. Pal., 32(131):57, pl. 7, fig. 19.

Description: Test small, calcareous-perforate, unilocular, varying from globular to ellipsoidal, with neck, circular in cross section; surface ornamented with 30-35 fine evenly spaced longitudinal costae; neck long, slightly tapering, with evenly spaced transverse rings, broken in figured specimen; aperture circular, at end of neck.

Occurrence: Found in samples 1-2, 4-6, 8, and 11-15. The species was described from the Mint Springs marl (Oligocene, Vicksburg group), but apparently is identical with that found in the Archusa marl.

Remarks: The Archusa species resembles a form identified by Howe (1939, p. 52, pl. 6, fig. 19) as Lagena striata (d'Orbigny)

variety strumosa Reuss, but has more rings on the neck and differs in outline.

Family POLYMORPHINIDAE

GUTTULINA HANTKENI (Cushman & Ozawa)

Plate 2, figures 19a, 19b

Polymorphina acuta Hantken, 1881, K. Ungar. geol. Anstalt, Mitt. Jahrb., 4:60, pl. 8, fig. 4 (not of Roemer, 1838, d'Orbigny, 1846, nor d'Orbigny, 1852).

Guttulina hantkeni Cushman & Ozawa, 1930, U. S. Nat. Mus., Proc., 77(6):33, pl. 5, figs. 4-6.--Cushman & Dusenbury, 1934, Cushman Lab. Foram. Research, 1942, 10:60, pl. 8, fig. 5.--Cushman & Todd, 1942, ibid., 18:34, pl. 6, figs. 11-12.--Curran, 1943, Amer. Assoc. Petr. Geol., Bull., 27:181.--Cushman & Todd, 1946, Cushman Lab. Foram. Research, Contr., 22:56, pl. 10, fig. 2.

Description: Test medium size, calcareous-perforate, pointed oval, moderately inflated, greatest width slightly below center; chambers ovate, markedly inflated, first visible chamber broadly rounded and projecting, later chambers overlapping about half; wall smooth; aperture terminal, radiate.

Occurrence: Found in samples 3, 5, 8, and 12-15.

GUTTULINA sp. cf. G. PROBLEMA (d'Orbigny)

Plate 2, figures 21a, 21b

Guttulina cf. problema d'Orbigny. Cushman & Herrick, 1945, Cushman Lab. Foram. Research, Contr., 21(3):60, pl. 9, fig. 25.

Description: Test small, calcareous-perforate, subdeltoidal, triangular with rounded sides; chambers ovate, elongated, inflated; sutures distinct, depressed; wall smooth, glossy; aperture terminal, radiate.

Occurrence: Found in samples 1-2, 4-5, 7-9, and 11-13.

Cushman and Herrick figured an apparently identical form from the McBean formation of Georgia.

GUTTULINA WILCOXENSIS (Cushman & Ponton)

Plate 2, figures 20a, 20b

Guttulina wilcoxensis Cushman & Ponton, 1932, Cushman Lab. Foram. Research, 8(3): 60, pl. 8, figs. 1-2.

Description: Test medium size, calcareous-perforate, elongate, fusiform, composed of five chambers, inflated, length about three times breadth; sutures distinct, slightly depressed; wall smooth, finely perforate; aperture terminal, radiate.

Occurrence: Found in samples 2-4, 6-7, 9, and 12-15.

GUTTULINA species A

Plate 3, figures 1a, 1b

Description: Test small, calcareous-perforate, ovate, subtriangular in end view, greatest diameter slightly below center, early chambers projecting, broadly rounded; chambers few, distinct, elongate, extending almost back to base, subtriangular in end view; sutures distinct, thin, flush; aperture terminal, radiate.

Occurrence: Found in samples 1-8, 11, and 14.

GUTTULINA species B

Plate 3, Figures 2a, 2b

Description: Test small, calcareous-perforate, ovate, elongate, inflated; chambers few, elongate, oval in end view; sutures distinct, thin; wall smooth; aperture terminal, radiate.

Occurrence: Found in samples 1-2, 4-10, and 14.

GLOBULINA sp. aff. G. ROTUNDATA (Bornemann)

Plate 3, figure 3

Guttulina problema d'Orbigny. Cushman & Ponton, 1932, Cushman Lab. Foram. Research, Contr., 8(3):61, pl. 8, figs. 3, 4 a-c? (fistulose form only; not of d'Orbigny).

Globulina gibba d'Orbigny. Bergquist, 1942, Miss Geol. Surv., Bull., 49:55, pl. 6, figs. 8-9 (not of d'Orbigny).

G. rotundata (Bornemann). Bergquist, 1942, Miss. Geol. Surv., Bull., 49:56-57.--Cushman, 1951, U. S. Geol. Surv., Prof. Paper, 232:33, pl. 9, figs. 29-33 (especially fistulose specimens of figs. 31 & 33).

Description: Test small, calcareous-perforate, globular, with fistulose (encrusting?) projections; chambers few (apparently 3); sutures thin, indistinct; surface smooth; aperture not visible.

Occurrence: Found in samples 4 and 11.

Apparently identical forms, especially with the marked fistulosity, range from Midway to Jackson groups in the Gulf Coast (Cushman; Bergquist).

Remarks: This may be conspecific with the following species, but is tentatively separated because of its extreme fistulosity.

GLOBULINA species

Plate 3, figures 6a, 6b

Globulina gibba d'Orbigny. Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:53, pl. 6, figs. 25-26 (not of d'Orbigny).

Description: Test small, calcareous-perforate, ovate, inflated, base broadly rounded, smooth, apertural end pointed; chambers few, elongate, inflated, extending back to base; sutures distinct, thin, flush; aperture terminal, radiate.

Occurrence: Found in samples 1-9, and 11-14.

Apparently identical forms have been figured by Howe from the Cook Mountain formation (Claiborne) of Louisiana.

POLYMORPHINA JACKSONENSIS (Cushman)

Plate 3, figures 4a, 4b

Polymorphina jacksonensis Cushman, 1926, Cushman Lab. Foram. Research, Contr., 3:35, pl. 5, figs. 3 a-b.

Sigmomorphina jacksonensis (Cushman). Cushman & Ozawa, 1930, U. S. Nat. Mus., Proc., 77(6):123, pl. 32, figs. 2 a-b.-- Howe & Wallace, 1932, L. Dept. Conserv., Geol. Bull., 2:49, pl. 8, fig. 2.

Description: Test medium size, calcareous-perforate, biserial in adult stage, subtriangular in outline, angle of test approximately 40°, much compressed; periphery smooth, rounded; chambers elongate, narrow, of uniform width; sutures distinct, slightly depressed, straight; wall smooth, with 5 narrow closely spaced vertical striations at center; aperture terminal, radiate.

Occurrence: Found in samples 1, and 4-14.

Remarks: This apparently is identical with forms generally accepted as Sigmomorphina jacksonensis. Specimens from the Wheelock formation of Central Texas, believed to be conspecific with the Archusa form, however, reach an adult Polymorphina stage.

GLANDULINA species

Plate 3, figure 7

Description: Test small, calcareous-perforate, uniserial, ovate, longer than broad, circular in cross section, widest toward apertural end; chambers few, overlapping, indistinct, earlier chambers faintly biserial (visible only in rare specimens); sutures indistinct; wall smooth; aperture radiate, terminal.

Occurrence: Found in samples 3-9 and 13.

POLYMORPHINID? indet.

Plate 3, figures 8a, 8b, 8c

Description: Test small, calcareous-perforate, ovate, much compressed, plan of growth indistinct; periphery smooth, rounded; chambers distinct, 3 in number, slightly inflated; sutures distinct, slightly curved, depressed; wall smooth; aperture not observed.

Occurrence: A single specimen was found in sample 5.

Remarks: This form has uncertain affinities, and may be teratological. It is included here only for completeness.

Family NONIONIDAE

NONION ADVENUM (Cushman)

Plate 3, figures 5a, 5b

Nonionina advena Cushman, 1922, U. S. Geol. Surv., Prof. Paper,

129-F, p. 139, pl. 32, fig. 8; 1923, ibid., 133, p. 50. --Cushman & Applin, 1926, Amer. Assoc. Petr. Geol., Bull., 10:181, pl. 10, figs. 16-17.

Nonion advena (Cushman). Howe, 1928, Jour. Paleontology, 2:175 (check list).--Cole & Gillespie, 1930, Bulls. Amer. Pal., 15(57b):132, pl. 2, fig. 15.--Cushman, 1935, U. S. Geol. Surv., Prof. Paper 181, p. 30, pl. 11, fig. 1-4.--Cushman & McGlamery, 1938, ibid., 189-D, p. 106, pl. 24, figs. 22-23.--Cushman, 1939, ibid., 191, p. 9, pl. 20, figs. 3-4. --Cushman & McGlamery, 1942, ibid., 197-B, p. 69, pl. 5, fig. 8.--Applin & Jordan, 1945, Jour. Paleontology, 19:129-130 (check lists).--Cushman, 1945, Cushman Lab. Foram. Research, 21:5, pl. 1, fig. 15.--Bandy, 1949, Bulls. Am. Pal., 32(131):101-102(71-72), pl. 14(10), figs. 8 a-b.

Nonion advenum (Cushman). Cushman & Herrick, 1945, Cushman Lab. Foram. Research, Contr., 21(3):61-62, pl. 10, fig. 9.

Description: Test small, calcareous-perforate, planispiral, completely involute, subcircular, lesser diameter/greater diameter ratio about 84%, moderately compressed; periphery rounded, initial part smooth, becoming moderately scalloped in later part; chambers distinct, 9 to 11 in last whorl, increasing slowly and uniformly in size as added; sutures distinct, curved, slightly sigmoid, inner portion excavated and broadened; umbilical area with large rounded clear projecting boss; aperture a narrow arch at base of septal face.

Occurrence: Found in samples 1 and 3-15.

NONION MAURICENSIS (Howe & Ellis)

Plate 3, figures 9a, 9b

Nonion mauricensis Howe & Ellis, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:57, pl. 8, figs. 1-2.--Cushman & Todd, 1945, Cushman Lab. Foram. Research, Contr., 21:15, pl. 3, figs. 27-28.--Bandy, 1949, Bulls. Am. Pal., 32(131):73, pl. 10, figs. 12 a-b.

Description: Test small, calcareous-perforate, planispiral, completely involute, subcircular, lesser diameter/greater diameter ratio about 80%; periphery smooth in early portion, later becoming slightly scalloped; chambers distinct, subtriangular, moderately inflated; sutures distinct, radial, moderately depressed, slightly curved; surface smooth except for strongly papillate umbilicus; aperture not seen.

Occurrence: Found in samples 1-9 and 11-15.

The species has been recorded from the Cook Mountain formation of Louisiana and Mississippi and the Lisbon formation of Alabama.

NONION PLANATUM (Cushman & Thomas)

Plate 3, figures 10a, 10b

Nonion planatum Cushman & Thomas, 1930, Jour. Paleontology, 4:37, pl. 3, figs. 5 a-b.--Cushman & Dusenbury, 1934, Cushman Lab. Foram. Research, Contr., 10:60, pl. 8, figs. 6 a-b.--Cushman & Applin, 1943, ibid., 19:37, pl. 7, fig. 24.

N. "planatus" Cushman & Thomas. Bandy, 1949, Bulls. Am. Pal., 32(131):74, pl. 11, figs. 1 a-b.

Description: Test small, calcareous-perforate, planispiral,

completely involute, moderately compressed, subcircular, lesser diameter/greater diameter ratio approximately 80%; periphery smooth, broadly rounded, very slightly scalloped; chambers distinct, moderately inflated, 9 in last whorl, increasing uniformly in size; sutures distinct, thin, radial, slightly curved, flush in early stages, slightly depressed in later part; wall smooth, finely perforate; aperture a crescent slit at base of septal face.

Occurrence: Found in samples 1-9 and 11-14.

NONIONELLA JACKSONENSIS (Cushman)

Plate 3, figures 11a, 11b, 11c

Nonionella jacksonensis Cushman, 1933, Cushman Lab. Foram. Research, Contr., 9:10, pl. 1, figs. 23 a-c.

Description: Test calcareous-perforate, planispiral, greater diameter about twice lesser diameter, ventral side involute with chambers ending at umbilical region; periphery rounded; chambers distinct, 8 to 9 in final whorl, becoming increasingly elongate in later portion, inner end of last chamber extending across umbilical area; sutures distinct, flush; aperture at base of apertural face, low.

Occurrence: Found in samples 2-3, 5-6, and 15.

Nonionella jacksonensis was described from the "Jackson formation" of Alabama.

NONIONELLA SPISSA (Cushman)

Plate 3, figures 12a, 12b, 12c

Nonionella hantkeni spissa Cushman, 1931, Cushman Lab. Foram. Research, Contr., 7:58, pl. 7, fig. 13; 1939, U. S. Geol.

Surv., Prof. Paper, 191:30, pl. 8, fig. 5.--Cushman & Herrick, 1945, Cushman Lab. Foram. Research, Contr., 21: 63, pl. 10, fig. 12.

Nonionella spissa Cushman. Bandy, 1949, Bulls. Am. Pal., 32(131):78, pl. 11, figs. 2 a-b, 4 a-c.

Description: Test small, calcareous-perforate, planispiral, slightly evolute on one side, subovate, lesser diameter/greater diameter ratio about 62%, width/greater diameter ratio about 49%; periphery nearly smooth, rounded; chambers distinct, elliptical, elongate, 9 in last whorl, increasing slowly and uniformly in size as added; sutures distinct, thin, slightly curved, very little depressed except in later portion of test; surface smooth; umbilicus with papillae on involute side; aperture not observed.

Occurrence: Found in samples 1-5, 7-9, and 11-14.

The species has been recorded from the McBean formation of Georgia.

Family HETEROHELICIDAE

GÜMBELITRIA COLUMBIANA (Howe)

Plate 3, figure 13

Gümbelitria columbiana Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:62, pl. 8, figs. 12-13.--Cushman & Todd, 1945, Cushman Lab. Foram. Research, Contr., 21(1):16, pl. 4, fig. 3.

Description: Test small, calcareous-perforate, triserial, pyramidal, angle of test approximately 40°; chambers nearly spherical, increasing gradually as added, in about 6 whorls; surface rough; aperture not visible.

Occurrence: Found only in sample 3.

The species was described from the Cook Mountain formation of Louisiana, and has also been recorded from the Lisbon formation of Alabama.

Family BULIMINIDAE

BULIMINELLA BASISTRIATA (Cushman & Jarvis)
var. NUDA (Howe & Wallace)

Plate 3, figure 14

Buliminella basistriata Cushman & Jarvis var. nuda Howe & Wallace, 1932, La. Dept. Conserv., Geol. Bull., 2:60, pl. 11, fig. 4.--Bergquist, 1942, Miss. Geol. Surv., Bull., 49:64, pl. 7, fig. 7.

Description: Test small, calcareous-perforate, elongate trochoid, with greatest width usually toward apertural end; about 7 chambers in last whorl, fairly distinct, slightly inflated; sutures distinct, slightly depressed; wall smooth; aperture very large, broadest on inner end, slightly oblique.

Occurrence: Found in samples 7 and 12.

BULIMINA BYRAMENSIS (Cushman & Todd)

Plate 3, figures 15a, 15b

Bulimina byramensis Cushman & Todd, 1946, Cushman Lab. Foram. Research, Contr., 22:91, pl. 15, figs. 25-26.--Bandy, 1949, Bulls. Am. Pal., 32(131):133, pl. 25, figs. 14 a-b.

Description: Test small, calcareous-perforate, triserial, triangular in cross-section, straight or slightly twisted pyramidal or tapering at both ends, initial end subacute, greatest width above

middle; angles rounded, sides flat or slightly concave; chambers not inflated, in 5 to 7 whorls; sutures oblique, flush, slightly curved; wall smooth; aperture small, loop-shaped.

Occurrence: Found in samples 1, 3-8, and 12-14.

The species was described from the Byram marl (Oligocene) of Mississippi, and has been recorded by Bandy from the Mint Springs marl (Oligocene) of Alabama.

BULIMINA ELONGATA (d'Orbigny)

Plate 3, figure 16

Bulimina elongata d'Orbigny, 1846, foram. foss. bassin tert. Vienne, p. 187, pl. 11, figs. 19-20.--Cushman & Parker, 1937, Cushman Lab. Foram. Research, Contr., 13:49, pl. 7, figs. 2-3; 1947, U. S. Geol. Surv., Prof. Paper, 210-D: 108, pl. 25, figs. 15, 17 (not figs. 14, 16).--Bandy, 1949, Bulls. Am. Pal., 32(131):134, pl. 25, fig. 15.

(Not B. elongata d'Orbigny, 1801, nomen nudum.)

Description: Test small, calcareous-perforate, triserial, elongate, tapering, greatest diameter at apertural end, initial end rounded; 5 whorls, last making up more than half test; chambers rounded, moderately inflated, increasing rapidly in size as added, twisted triserial so that chambers do not appear in vertical tiers; sutures distinct, curved depressed; wall smooth; aperture loop-shaped, oblique, in oval depression in septal face.

Occurrence: Found in samples 7 and 9.

The species was described from the Miocene of the Vienna Basin, and has been reported from the Miocene of Austria. The Archusa form is identified from its similarity to a figure of a specimen from the

Jackson Eocene of Alabama (Bandy).

PSEUDOBULIMINA GLAESSNERI (Howe & Roberts)

Plate 3, figures 17a, 17b.

Pseudobulimina glaessneri Howe & Roberts, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:81, pl. 11, figs. 9-11. --Cushman & Todd, 1945, Cushman Lab. Foram. Research., Contr., 21:20, pl. 14, figs. 19-20.--Bandy, 1949, Bulls. Am. Pal., 32(131):85, pl. 13, figs. 2 a-c.

Description: Test small, calcareous-perforate, trochoid, early part involute, later part evolute with a small set of chambers on concave side varying in size; about 10 chambers in last whorl, increasing gradually in size as added; sutures distinct and slightly depressed in later portion, flush in early portion; wall smooth; aperture oblique to plane of coiling, loop-shaped.

Occurrence: Found in samples 8 and 14.

The species was described from the Cook Mountain formation (Claiborne) of Louisiana, and has been recorded from the Lisbon formation (Claiborne) of Alabama.

ENTOSOLENIA GLOBOSA (Montagu)

Plate 3, figures 23a, 23b

Vermiculum globosum Montagu, 1803, Test, Brit., p. 523.

Lagena globosa (Montagu). Cushman, 1923, U. S. Nat. Mus., Bull., 104(4):20, pl. 4, figs. 1-2.

Entosolenia globosa (Montagu). Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:64, pl. 9, fig. 25.

Description: Test small, calcareous-perforate, unilocular,

subglobular; wall smooth, translucent; internal tube not attached at inner end; aperture terminal, apparently circular.

Occurrence: Found only in sample 14.

The species has been recorded by Howe from the Cook Mountain formation of Louisiana.

Remarks: Numerous fossil forms have been identified with the species, many of which are not conspecific with the Recent form. The Archusa specimen is regarded as identical with the form illustrated by Howe.

ENTOSOLENIA MARGINATA (Montagu)
var. LISBONENSIS (Cushman & Todd)

Plate 3, figures 22a, 22b

Entosolenia marginata (Montagu) var. lisbonensis Cushman & Todd, 1948, Cushman Lab. Foram. Research, Contr., 24(2): 33, pl. 6, fig. 13.

Description: Test small, calcareous-perforate, unilocular, oval in outline, elliptical in cross-section; periphery smooth, with distinct keel; surface with numerous fine hair-like striations parallel to keel; aperture elliptical, open, with distinct lip.

Occurrence: Found only in sample 14.

The variety was described from the "Cook Mountain formation" of Mississippi.

VIRGULINA DIBOLLENSIS (Cushman & Applin)

Plate 3, figures 25a, 25b

Virgulina dibollensis Cushman & Applin, 1926, Amer. Assoc. Petr. Geol., Bull., 10:168, pl. 7, fig. 7.--Cushman, 1932, Cushman Lab. Foram. Research, Contr., 8:21, pl. 2, fig. 14;

1935, U. S. Geol. Surv., Prof. Paper, 181:36, pl. 14, figs. 1-3.--Bandy, 1949, Bulls. Am. Pal., 32(131):136, pl. 26, figs. 9 a-b.

Description: Test calcareous-perforate, initially triserial, later biserial, elongate, slender, length about four times breadth, somewhat compressed laterally, usually twisting, up to 90°, initial end rounded, greatest breadth near apertural end; periphery rounded, scalloped; chambers distinct, last 3 making up half test; sutures distinct, depressed; aperture elongate, well up on septal face.

Occurrence: Found in samples 6-9.

The species has been recorded from the Jackson Eocene of Texas and Alabama.

BOLIVINA BROUSSARDI (Howe & Roberts)

Plate 3, figures 18a, 18b

Bolivina broussardi Howe & Roberts, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:65, pl. 9, fig. 7-8.

Description: Test very small, calcareous-perforate, biserial, moderately compressed, thickest along median line, widest slightly above center; periphery smooth, acute; 7-8 tiers of chambers, chambers enlarging gradually as added; sutures distinct in later part of test, clear, arcuate, thickest at top of arc, flush; aperture elongate, narrow.

Occurrence: Found in samples 3, 6-8, and 12-15.

The species was described from the Cook Mountain formation of Louisiana.

BOLIVINA LOUISIANA (Howe)

Plate 3, figures 19a, 19b

Bolivina louisiana Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:66, pl. 9, figs. 5-6.--Cushman & Todd, 1945, Cushman Lab. Foram. Research, Contr., 21(4):96, pl. 15, fig. 16.

Description: Test small, calcareous-perforate, biserial, thickest at middle, thinning toward periphery; periphery serrate; chambers numerous, distinct, slightly inflated, periphery of each produced into sharp angle in later portion of test; sutures distinct, slightly depressed, curved; wall smooth, with distinct perforations; aperture elongate, narrow, extending almost length of septal face.

Occurrence: Found only in sample 8.

The species was described from the Cook Mountain formation of Louisiana, and has been recorded from the Moodys marl member of the "Jackson formation" of Mississippi.

BOLIVINA TAYLORI (Howe)

Plate 3, figures 20a, 20b

Bolivina taylori Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:67, pl. 9, figs. 9-10.--Cushman and Applin, 1943, Cushman Lab. Foram. Research, Contr., 19:39, pl. 7, fig. 27.--Cushman and Todd, 1945, ibid., 21(1):17, pl. 4, fig. 9; 1945A, ibid., 21(4):97, pl. 15, fig. 21.

Description: Test small, calcareous-perforate, biserial, length about $2\frac{1}{2}$ times breadth, compressed ovate in end view; periphery smooth, rounded; chambers of uniform shape, increasing regularly in size as added; sutures distinct, limbate, strongly arched, oblique,

flush; wall smooth; aperture elongate, narrow.

Occurrence: Found in samples 3-5, 8, and 15.

The species was described from the Cook Mountain formation of Louisiana, and has been recorded from the Yegua formation of Texas.

BOLIVINA species

Plate 3, figures 21a, 21b

Description: Test small, calcareous-perforate, biserial, tapering, angle of test approximately 25°, much compressed, thickest at middle; periphery smooth, sharply rounded, last 2 chambers with thin translucent keel; chambers distinct, increasing uniformly in size; sutures distinct, thin, first half nearly horizontal, then forming angle of about 40° with horizontal near outer edge; wall smooth; aperture long, narrow, at base of septal face and extending well up on face.

Occurrence: Found in samples 3, 9, and 15.

LOXOSTOMUM WILCOXENSE (Cushman & Ponton)

Plate 3, figures 24a, 24b

Loxostomum wilcoxense Cushman & Ponton, 1932, Cushman Lab. Foram. Research, Contr., 8:67, pl. 9, figs. 3 a-c.

Description: Test calcareous-perforate, biserial, elongate, slender, sides nearly parallel; periphery rounded; chambers numerous, 10 or more tiers, very slightly inflated in later portion, of uniform size and shape, last few only slightly larger than earlier chambers; sutures distinct, slightly depressed in later part, straight; wall smooth; aperture elliptical, terminal.

Occurrence: Found only in sample 8.

The species was described from the Wilcox group of Alabama.

REUSSELLA species

Plate 4, figures 1a, 1b

Description: Test small, calcareous-perforate, triserial, short, pyramidal, triangular in cross section, widest at apertural end, sides slightly concave, peripheral angles sharp; chambers numerous; sutures distinct, flush; wall smooth; aperture not observed.

Occurrence: Found only in sample 14.

Remarks: A search of available literature has shown no described species that appear to be identical with this distinctive form.

Family ELLIPSOIDINIDAE

STILOSTOMELLA species

Plate 4, figure 2

?Ellipsonodosaria sp. Cushman, 1946, Cushman Lab. Foram. Research, Sp. Publ., 16:30, pl. 6, fig. 9.

Description: Test small, calcareous-perforate, uniserial, elongate, tapering, gently curved, initial end rounded; periphery smooth in early portion becoming scalloped in later portion; 10 chambers, distinct, subglobular, length and width about equal except last chamber which is slightly longer than wide; sutures distinct, broad, flush in early portion, depressed in later part, of clear material with former neck exposed and giving appearance (when moistened) of internal tube; wall smooth, glossy; aperture with cylindrical neck and lip.

Occurrences: Found in samples 1-7 and 11.

Family ROTALIIDAE

SPIRILLINA VICKSBURGENSIS (Cushman)

Plate 4, figures 3a, 3b

Spirillina vicksburgensis Cushman, 1935, Cushman Lab. Foram. Research, Contr., 11:34, pl. 5, fig. 6.--Cushman & Todd, 1946, ibid., 22:96, pl. 16, fig. 11.--Bandy, 1949, Bulls. Am. Pal., 32(131):17, pl. 1, figs. 1 a-c.

S. sp. Howe, 1939, La. Dept. Conserv., Geol. Bull., 14: 72, pl. 10, fig. 22.

Description: Test small, calcareous-perforate, an evolute planispiral tube; periphery obliquely truncate, dorsal side somewhat broader than ventral; wall hyaline, white; ventral side transversely and finely striate, causing spiral sutures to appear crenulate.

Occurrences: Found in samples 8 and 13.

The species has been recorded from the lower Oligocene of Alabama, and an apparently identical form was reported by Howe from the Cook Mountain formation of Louisiana.

DISCORBIS ALVEATA (Cushman) var. STAVENSIS (Bandy)

Plate 4, figures 7a, 7b, 7c

Discorbis alveata stavensis Bandy, 1949, Bulls. Am. Pal., 32(131):95, pl. 16, figs. 1a-c.

Description: Test small, calcareous-perforate, trochoid, planoconvex, dorsal side conical, ventral side nearly flat; periphery acute, with slight keel, smooth in early part becoming moderately scalloped in later portion; chambers distinct, about 5 in last whorl, increasing gradually in size as added; sutures distinct, curved,

oblique, flush on dorsal side, on ventral side nearly radial, slightly curved, depressed; wall smooth except for secondary material added to umbilicus; aperture narrow, at umbilical end of chamber, partly covered by plate.

Occurrence: Found in samples 4-9 and 11-15.

This variety was described from the Gosport formation of Alabama.

"DISCORBIS" HEMISPHAERICA (Cushman)

Plate 4, figures 4a, 4b, 4c

Discorbis hemisphaerica Cushman, 1931, Cushman Lab. Foram. Research, Contr., 7:59, pl. 7, figs. 14 a-c; 1935, U. S. Geol. Surv., Prof. Paper, 181:43, pl. 16, fig. 13 a-c.--Ellisor, 1933, Amer. Assoc. Petr. Geol., Bull., 17(11):, pl. 3, figs. 17-18.--Bergquist, 1942, Miss. Geol. Surv., Bull., 49:84, pl. 8, figs. 19-20.--Bandy, 1949, Bulls. Am. Pal., 32(131):96-97, pl. 16, figs. 2 a-c.

Description: Test small, calcareous-perforate, trochoid, hemispherical, dorsal side strongly convex, ventral side slightly convex with double row of chambers in umbilical area; periphery slightly lobate, with low rounded keel; chambers 4 in last whorl; sutures distinct, oblique, slightly depressed; wall distinctly perforate; aperture a large opening on ventral side, extending from periphery to umbilicus, with distinct lip.

Occurrence: Found in samples 1-9, and 11-14.

The species was described from the Jackson Eocene of Mississippi, recorded from the Yazoo clay (Jackson) of Alabama, and the "Jackson formation" of Mississippi.

Remarks: The original figure does not show the sutures between the primary and secondary chambers of the ventral side of the test. This feature, illustrated by Bandy, shows well on the Archusa forms. As Bandy has pointed out, the species is very different from typical Discorbis, and resembles the genus Tretomphalus.

GYROIDINA OCTACAMERATA (Cushman & Hanna)

Plate 4, figures 9a, 9b, 9c

Gyroidina soldanii d'Orbigny var. octacamerata Cushman & Hanna, 1927, Calif. Acad. Sci., Proc., [4] 16:223, pl. 14, figs. 15:18.--Cole, 1927, Bulls. Am. Pal., 14(51):29, pl. 2, figs. 22-24.--Cushman & Schenck, 1928, Univ. Calif., Dept. Geol. Sce., Bull., 17:312, pl. 44, figs. 3-5.--Weinzierl & Applin, 1929, Jour. Paleontology, 3(4):406.--Cushman & Thomas, 1930, ibid., 4:40, pl. 4, figs. 2-3.--Cushman, 1935, U. S. Geol. Surv. Prof. Paper, 181:45, pl. 18, figs. 4 a-b.

Valvulineria octacamerata (Cushman & Hanna). Bandy, 1949, Bulls. Am. Pal., 32(131):84, pl. 13, figs. 1 a-c.

Description: Test small, calcareous-perforate, trochoid, subcircular, lesser diameter/greater diameter ratio about 83%, dorsal side flattened, ventral convex, strongly umbilicate; periphery slightly scalloped, broadly rounded; with about 3 whorls, last-formed whorl with 8-9 chambers (most commonly 8), chambers distinct, increasing gradually in size as added; sutures distinct, thin, slightly impressed, on dorsal side somewhat oblique, on ventral side nearly radial, slightly curved; wall smooth and polished; aperture a low

arch extending along base of septal face from near periphery to umbilicus.

Occurrence: Found in samples 1-9, and 11-15.

The species has been recorded from the Jackson Eocene of Alabama, as well as from the Eocene of Mexico and California.

Remarks: As Bandy observed, G. octacamerata seems to be a species rather than a variety. The apertural lip, figured by Bandy, is a variant character and not consistent in the species. Moreover, it is not a "valvulinerian flap," and the species cannot be referred to Valvulineria.

EPONIDES sp. cf. E. LISBONENSIS (Bandy)

Plate 4, figures 5a, 5b, 5c

?Eponides lisbonensis Bandy, 1949, Bulls. Am. Pal., 32(131):87, pl. 14, figs. 2 a-c.

Description: Test medium size, calcareous-perforate, trochoid, subcircular, unequally biconvex, dorsal side more convex than ventral; periphery sharply rounded; $2\frac{1}{2}$ whorls, 9-10 chambers in last whorl, chambers distinct, gradually increasing in size as added; sutures distinct, medium wide, very oblique and flush on dorsal side, on ventral side radial, slightly curved, depressed, extending into moderately deep umbilicus; surface smooth, rather finely but conspicuously perforate; aperture a low arch extending from near umbilicus to near periphery.

Occurrence: Found in samples 6-8 and 12-15.

Eponides lisbonensis was described from the Claiborne group of Alabama.

SIPHONINA CLAIBORNENSIS (Cushman)

Plate 4, figures 8a, 8b, 8c

Siphonina claibonensis Cushman, 1927, U. S. Nat. Mus., Proc., 72(20):4, pl. 3, fig. 5.--Cushman & Thomas, 1929, Jour. Paleontology, 3:181, pl. 24, fig. 2.--Cushman & Dusenbury, 1934, Cushman Lab. Foram. Research, Contr., 10:62.--Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:76, pl. 10, figs. 4-6, 10-11.--Cushman & Applin, 1943, Cushman Lab. Foram. Research, Contr., 19:42, pl. 8, fig. 7.--Cushman & Todd, 1945, ibid., 21:19.

Description: Test small, calcareous-perforate, trochoid, nearly circular, lesser diameter/greater diameter ratio about 82%, much compressed; periphery sharp, slightly scalloped, keel with numerous evenly spaced denticulations; chambers distinct, slightly inflated; sutures distinct, thin, strongly oblique, curved on dorsal side, nearly radial, slightly curved, depressed on ventral side; wall ornamented by numerous small spinose processes; aperture a narrow elongate elliptical slit, with distinct lip.

Occurrence: Found in samples 1-15.

The species was described from the "Lisbon formation" of Mississippi, and has been reported from the Cook Mountain formation of Louisiana.

Family CASSIDULINIDAE

CERATOBULIMINA (CERATOCANCRIS) STELLATA (Bandy)

Plate 4, figures 10a, 10b, 10c, 11

Ceratobulimina eximia (Rzehak) (in part). Howe, 1939, La. Dept.

Conserv., Geol. Bull., 14:80, pl. 11, figs. 12-13 (synonymy in part only).--Hussey, 1949, Jour. Paleontology, 23:139 (synonymy in part only). (Not Pulvinulina eximia Rzehak.)

C. (Ceratocancris) stellata Bandy, 1949, Bulls. Am. Pal., 32(131):86, pl. 17, figs. 6 a-c (March 4, 1949).

C. limbata Hussey, 1949, Jour. Paleontology, 23:139 (March 30, 1949).

Description: Test medium size, calcareous-perforate, oval in side view, longer than broad, biconvex, both sides markedly convex, with deep umbilicus; periphery very slightly lobulate in later portion, smooth in early part of last whorl; 8 chambers in last whorl, increasing gradually in size as added, with distinct stellate callused areas on inner ventral sides; dorsal sutures oblique, limbate and slightly raised, later sutures with conspicuous angle near inner end, becoming flush at periphery; ventral sutures radial and depressed between thickened ends of chambers; aperture an arch extending into septal face, covered by a distinct plate.

Occurrence: Found in samples 12-15.

The species was described from the Lisbon formation of Alabama, and has been recorded from the Cane River formation of Louisiana.

Remarks: This species, under the erroneous name "Ceratobulimina eximia", is an important index fossil in the Claiborne beds of the Gulf Coast.

CASSIDULINA SUBGLOBOSA (Brady)

Plate 4, figures 12a, 12b

Cassidulina subglobosa Brady, 1881, Quart. Jour. Micr. Sci., [NS] 21:60; 1884, Rept. Voy. Challenger, Zool., 9:430, pl. 54, figs. 17 a-c.--Galloway & Morrey, 1929, Bulls. Am. Pal., 15(55):40, pl. 6, fig. 6.--Galloway & Heminway, 1941, N. Y. Acad. Sci., Sci. Surv. Puerto Rico and Virgin Islands, 3(4):425, pl. 32, figs. 2 a-c.--Bandy, 1949, Bulls. Am. Pal., 32(131):140, pl. 26, figs. 7 a-b.

Description: Test small, calcareous-perforate, subglobular, oval in side view, length almost equal to width; chambers few in last whorl, slightly inflated; sutures distinct, slightly depressed; surface smooth; aperture small, narrow, extending onto septal face, oblique to plane of coiling.

Occurrence: Found only in sample 14.

Remarks: This species has been identified from numerous localities and ages from Eocene to Recent. The Archusa form is identical with that recorded by Bandy from the Jackson Eocene of Alabama, but probably is not conspecific with most of the forms listed in the synonymy above.

Family GLOBIGERINIDAE

GLOBIGERINA DANVILLENSIS (Howe & Wallace)

Plate 4, figures 13a, 13b, 13c

Globigerina danvillensis Howe & Wallace, 1932, La. Dept. Conserv., Geol. Bull., 2:74, pl. 10, figs. 9 a-b.

Description: Test small, calcareous-perforate, very low

trochoid; periphery lobate; chambers few, about 8 to 10 on dorsal side, 4 to 6 chambers in last whorl (most commonly 5), almost spherical; sutures depressed; wall finely spinose; aperture an almost circular opening on ventral side but not centered on periphery.

Occurrence: Found in samples 1-5, 7-9, and 11-13.

The species was described from the Jackson Eocene of Louisiana.

GLOBIGERINA OUACHITAENSIS (Howe & Wallace)

Plate 4, figures 14a, 14b, 14c

Globigerina ouachitaensis Howe & Wallace, 1932, La. Dept. Conserv., Geol. Bull., 14:83, pl. 12, figs. 18-19.--Bandy, 1949, Bulls. Am. Pal., 32(131):121, pl. 23, figs. 4 a-c.

Description: Test medium size, calcareous-perforate, trochoid, subglobular, with convex spire; periphery lobate; chambers spheroidal, about 10, 4 in last whorl, slightly enlarging but increasing rapidly in dorso-ventral thickness; sutures distinct, deeply depressed; wall coarsely perforate; aperture high, opening into umbilical area.

Occurrence: Found in samples 1-9 and 11-15.

The species was described from the Jackson Eocene of Louisiana, and has been recorded from the Cook Mountain formation of the same area.

Family HANTKENINIDAE

HANTKENINA LONGISPINA (Cushman)

Plate 4, figure 17

Hantkenina longispina Cushman, 1924, U. S. Nat. Mus., Proc., 66:2, pl. 2, fig. 4; 1925, Amer. Assoc. Petr. Geol.,

Bull., 9(2):299, pl. 7, fig. 3.--Cole, 1927, Bulls. Am. Pal., 14(51):24, pl. 4, fig. 7.--Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:85, pl. 12, fig. 23.

Description: Test small, calcareous-perforate, planispiral, compressed; periphery lobulate, with long spines; chambers inflated, 5 in last whorl, increasing rapidly in size, 2 showing long hollow spine at center (other chambers show evidence of broken spines); sutures distinct, much depressed, nearly radial, slightly curved; wall smooth, distinctly perforate; aperture not seen.

Occurrence: Found in samples 11, 13, and 14.

The species has been reported from the Guayabal formation of Mexico.

Family GLOBOROTALIIDAE

GLOBOROTALIA CLAIBORNENSIS (Howe)

Plate 4, figures 16a, 16b, 16c

Cancris claibornensis Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:78, pl. 10, figs. 20-21.--Cushman, 1942, Cushman Lab. Foram. Research, Contr., 18:86, pl. 22, figs. 5-7.--Bandy, 1949, Bulls. Am. Pal., 32(131):81, pl. 12, figs. 2 a-c.

Description: Test small, calcareous-perforate, trochoid, subcircular, lesser diameter/greater diameter ratio about 75°, biconvex, much compressed, ventral side less convex than dorsal; periphery with distinct narrow keel; test with 2 whorls, last with 5 chambers; chambers distinct, moderately inflated, enlarging rapidly as added, last makes up approximately 40% of entire test; sutures distinct, strongly

curved, flush dorsally, on ventral side depressed, slightly curved, radial; umbilical area and aperture covered by plate extending from last chamber.

Occurrence: Found in samples 1, 3-4, 9, and 14.

The species was described from the Cook Mountain formation of Louisiana, and has been recorded from the Lisbon formation of Alabama.

Remarks: The Archusa specimens appear to be identical with Howe's species. However, they are not congeneric with Cancris auricularis (Fichtel and Moll), the type of Cancris, but agree instead with the characters of the genus Globorotalia.

GLOBOROTALITES CRASSATUS (Cushman) var. DENSUS (Cushman)

Plate 4, figures 15a, 15b, 15c

Pulvinulina crassata densa Cushman, 1925, Amer. Assoc. Petr. Geol., Bull., 9(2):301, pl. 7, fig. 4.

Globorotalia crassata densa (Cushman). Cushman & Barksdale, 1930, Stanford Univ., Dept. Geol., Contr., 1(2):68, pl. 12, fig. 8.--Cole, Bulls. Am. Pal., 14(51):34, pl. 1, figs. 7-8.--Bandy, 1949, ibid., 32(131):80, pl. 12, figs. 4 a-c.

Description: Test small, calcareous-perforate, trochoid, planoconvex, dorsal side slightly convex to nearly flat, ventral side very strongly convex; periphery moderately scalloped, abruptly rounded; chambers few, 4 in last whorl, slightly inflated dorsally and strongly on ventral side, increasing uniformly in size as added; sutures distinct, curved and slightly depressed dorsally, nearly radial and

strongly depressed on ventral side; wall moderately rough, spinose; aperture an elongate arch from umbilicus to middle of septal face, with slight lip.

Occurrence: Found in samples 1-7, 9, and 11-12.

The variety was described from the Eocene of Mexico. In addition, it has been recorded from the Tallahatta formation (Claiborne) of Alabama, and the middle Eocene of California.

Family ANOMALINIDAE

ANOMALINA UMBONATA (Cushman)

Plate 5, figures 1a, 1b, 1c

Anomalina umbonata Cushman, 1925, Amer. Assoc. Petr. Geol., Bull., 9:300, pl. 7, figs. 5-6; 1927, Jour. Paleontology, 1:170, pl. 27, figs. 10-11.--Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:86, pl. 13, figs. 6-8.--Bandy, 1949, Bulls. Am. Pal., 32(131):102, pl. 18, figs. 3 a-c.

Description: Test planoconvex, calcareous-perforate, trochoid, subcircular, dorsal side with central plug, ventral side with large raised umbo; periphery smooth in early portion, lobulate in later part; about 12 chambers in last whorl; sutures distinct, curved, slightly depressed, on dorsal side fused in early portion to make umbonal mass; wall perforate; aperture an arch at base of septal face, extending back at least on chamber dorsally.

Occurrence: Found in samples 3, 5-9, 12, and 14.

The species was described from the Eocene of Mexico, and has been recorded from the Cook Mountain formation of Louisiana and from Eocene and Oligocene beds of Alabama.

PLANULINA species

Plate 5, figures 2a, 2b, 2c

Description: Test small, calcareous-perforate, very low trochoid, very much compressed, subcircular, lesser diameter/greater diameter ratio approximately 80%; periphery moderately scalloped, with keel; $2\frac{1}{2}$ whorls, 11 chambers in last whorl, chambers distinct, gradually increasing in size as added; sutures distinct, raised and thickened on dorsal side, ventrally strongly curved, radial, moderately raised; wall smooth except for sutures, with small deep umbilicus; aperture not observed.

Occurrence: Found only in sample 11.

Remarks: This species is very distinctive and markedly unlike any described form that has been found. It may be new.

CIBICIDES LOBATULUS (Walker & Jacob)

Plate 5, figures 3a, 3b, 3c

Nautilus lobatulus Walker & Jacob, in Kanmacher, 1798, Adam's Essays, ed. 2, p. 642, pl. 14, fig. 36.

Cibicides lobatulus (Walker & Jacob). Cushman & Todd, 1945, Cushman Lab. Foram. Research, Contr., 21(4):105, pl. 16, figs. 23-24.

Description: Test medium size, calcareous-perforate, trochoid, oval, planoconvex, dorsal side flat or slightly concave, ventral side convex; periphery scalloped, becoming almost lobulate in later chambers of some specimens, keeled; 8 chambers in last whorl; sutures distinct, curved, flush on dorsal side in early portion becoming slightly depressed in later portion, depressed on ventral side; wall smooth

but with distinct medium sized perforations; aperture a slit at base of septal face, with slight lip, extending back one chamber on dorsal side.

Occurrence: Found in samples 1-8.

The species was described from the Recent of England, and has been reported from the Moodys marl of Mississippi.

CIBICIDES PSEUDOUNGERIANUS (Cushman)
var. LISBONENSIS (Bandy)

Plate 5, figures 4a, 4b, 4c

Cibicides pseudoungerianus lisbonensis Bandy, 1949, Bulls. Am. Pal., 32(131):108, pl. 20, figs. 1a-b.

Description: Test calcareous-perforate, trochoid, nearly equally biconvex, ventral side slightly more convex, subcircular in outline; periphery slightly lobulate, with distinct narrow keel; about 10 chambers; sutures indistinct, dorsal sutures wider than ventral; wall coarsely perforate; aperture a low arch at base of septal face, extending backward one chamber on dorsal side.

Occurrence: Found in samples 1-6 and 14-15.

The variety was described from the Lisbon formation of Alabama.

CIBICIDES TRUNCATUS (Bandy)

Plate 5, figures 5a, 5b, 5c

Cibicides truncatus Bandy, 1949, Bulls. Am. Pal., 32(131):111, pl. 19, figs. 2 a-c.

Description: Test calcareous-perforate, trochoid, circular, dorsal side slightly convex or flat, ventral side a truncated cone, with small shallow umbilicus; periphery acute, even in early portion,

last chambers becoming lobulate; chambers 7 to 8, increasing in size slowly as added; sutures distinct, flush, strongly curved on dorsal side, on ventral side curved, slightly depressed, narrower than dorsal sutures; wall smooth, perforate; aperture at periphery and base of septal face, with lip, extending onto dorsal side and backward along spiral suture for distance of 2 chambers.

Occurrence: Found in samples 1-15.

The species was described from the Lisbon formation of Alabama.

CIBICIDES WESTI (Howe)

Plate 5, figures 6a, 6b, 6c

Cibicides westi Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:86, pl. 13, figs. 20-22.--Cushman & Herrick, 1945, Cushman Lab. Foram. Research, Contr., 21:72, pl. 11, fig. 15.--Bandy, 1949, Bulls. Am. Pal., 32(131):112, pl. 20, figs. 7 a-c.

Description: Test small, calcareous-perforate, trochoid, plano-convex, dorsal side nearly flat, ventral side conical; periphery angular and slightly lobate; 8 chambers in last whorl; sutures distinct, curved on dorsal side, sigmoid on ventral; wall smooth, finely perforate; aperture a small arch at periphery.

Occurrence: Found in samples 1-9 and 11-14.

The species was described from the Cook Mountain formation of Louisiana, and has been recorded from the Lisbon formation of Alabama.

CIBICIDINA DANVILLENSIS (Howe & Wallace)

Plate 5, figures 7a, 7b, 7c

Cibicides danvillensis Howe & Wallace, 1932, La. Dept. Conserv.,

Geol. Bull., 2:77, pl. 14, fig. 5.--Cushman & Herrick, 1945, Cushman Lab. Foram. Research, Contr., 21:72, pl. 11, fig. 14.--Cushman, 1946, ibid., Sp. Publ., 16:39, pl. 39, figs. 7-8.

Cibicidina danvillensis (Howe & Wallace). Bandy, 1949, Bulls. Am. Pal., 32(131):92, pl. 14, figs. 7 a-c.

Description: Test calcareous-perforate, trochoid, planoconvex, dorsal side nearly flat, ventral side convex; periphery subangular; chambers 8 to 9 (8 most commonly), rapidly increasing in size, last few overlapping umbilical area; sutures distinct, slightly limbate on ventral side; wall punctate; aperture peripheral with slight lip.

Occurrence: Found in samples 1-15.

The species was described from the Jackson Eocene of Louisiana. It has also been recorded from the Jackson Eocene of Alabama, and from the McBean formation of Georgia.

CIBICIDINA MAURICENSIS (Howe & Roberts)

Plate 5, figures 9a, 9b, 9c

Cibicides mauricensis Howe & Roberts, in Howe, 1939, La. Dept. Conserv., Geol. Bull., 14:87, pl. 13, figs. 4-5.

Cibicidina mauricensis (Howe & Roberts). Bandy, 1949, Bulls. Am. Pal., 32(131):93, pl. 15, figs. 3 a-c.

Description: Test small, calcareous-perforate, trochoid, subcircular, planoconvex, ventral side moderately convex, with small central clear boss, dorsal side slightly concave in some specimens with small central boss; periphery subacute; chambers 9 to 10, increasing evenly in size; sutures distinct, curved; wall smooth; aperture periph-

eral, extending on dorsal side along base of last three chambers.

Occurrence: Found in samples 1-15.

The species was described from the Cook Mountain formation of Louisiana, and has been recorded from the Lisbon formation of Alabama.

CIBICIDINA species

Plate 5, figures 8a, 8b, 8c

Description: Test calcareous-perforate, trochoid, biconvex; periphery acute, smooth in early portion, tending toward lobulate in later portion; 7 chambers in last whorl, moderately inflated ventrally, flattened dorsally, increasing uniformly but rapidly as added; sutures distinct, curved, depressed on ventral side, flush on dorsal side; wall smooth; aperture a slit opening into umbilicus, with plate, extending back on dorsal side a distance of one chamber.

Occurrence: Found in samples 1-5, 7-9, 11, and 14.

REFERENCES CITED

(Exclusive of synonymic entries.)

Bandy, O. L., 1949. Eocene and Oligocene foraminifera from Little Stave Creek, Clarke County, Alabama. Bulls. Am. Pal., 32(131): 1-211, pls. 1-27. (With bibliography of 54 entries, largely on foraminifera.)

Bergquist, H. R., 1942. Scott County fossils, Jackson foraminifera and Ostracoda. Miss. Geol. Surv., Bull., 49:1-146, pls. 1-11.

Cooke, C. W., Gardner, J., and Woodring, W. P., 1943. Correlation of Cenozoic formations of the Atlantic and Gulf Coastal Plain and the Caribbean region. Geol. Soc. Amer., Bull., 54:1713-1723, 1 pl.

Cushman, J. A., and Herrick, S. M., 1945. The foraminifera of the type locality of the McBean formation. Cushman Lab. Foram. Research, Contr., 21(3):55-73, 4 pls.

_____and Todd, R., 1945. Foraminifera of the type locality of the Moodys marl member of the Jackson formation of Mississippi. Cushman Lab. Foram. Research, Contr., 21(4):79-106, pls. 13-16.

Frizzell, D. L., and Middour, E. S., 1951. Paleocene Radiolaria from southeastern Missouri. Univ. Mo., School of Mines & Met., Bull., Tech. Ser., 77:1-41, pls. 1-3, 1 map.

Grim, R. E., 1936. The Eocene sediments of Mississippi. Miss. Geol. Surv., Bull., 30:1-240, pls. 1-3, text figs. 1-25, histograms a-o, 1-66.

Howe, H. V., 1939. Louisiana Cook Mountain Eocene foraminifera. La. Dept. Conserv., Geol. Bull., 14:1-122, pls. 1-15, tables 1-2.

_____and Wallace, W. E., 1932. Foraminifera of the Jackson Eocene at Danville Landing on the Ouachita, Catahoula Parish, Louisiana. La. Dept. Conserv., Geol. Bull., 2:1-118, pls. 1-15, text figs. 1-2.

Hussey, K. M., 1949. Louisiana Cane River Eocene foraminifera. Jour. Paleontology, 23:109-144, pls. 25-29.

Lowe, E. N., 1919. Mississippi, its geology, geography, soils, and mineral resources. Miss. Geol. Surv., Bull., 14:1-346, text figs. 1-21.

Miller, D. N., Jr., 1950. An ecological study of the foraminifera of Mason Inlet, North Carolina. Missouri School of Mines and Metallurgy, Master of Science Thesis.

_____, 1953. Ecological study of the foraminifera of Mason Inlet, North Carolina. Cushman Found. Foram. Research, Contr., 4(2): 41-63, pls. 7-10, text figs. 1-4, tables 1-2.

Shifflett, E., 1948. Eocene stratigraphy and foraminifera of the Aquia formation. Maryland Geol. Surv., Bull., 3:1-93, pls. 1-5, text figs. 1-21.

Thomas, E. P., 1942. The Claiborne. Miss. Geol. Surv., Bull., 48:1-96, pls. 1-2, text figs. 1-26, profiles A-E. (With bibliography of 29 entries.)

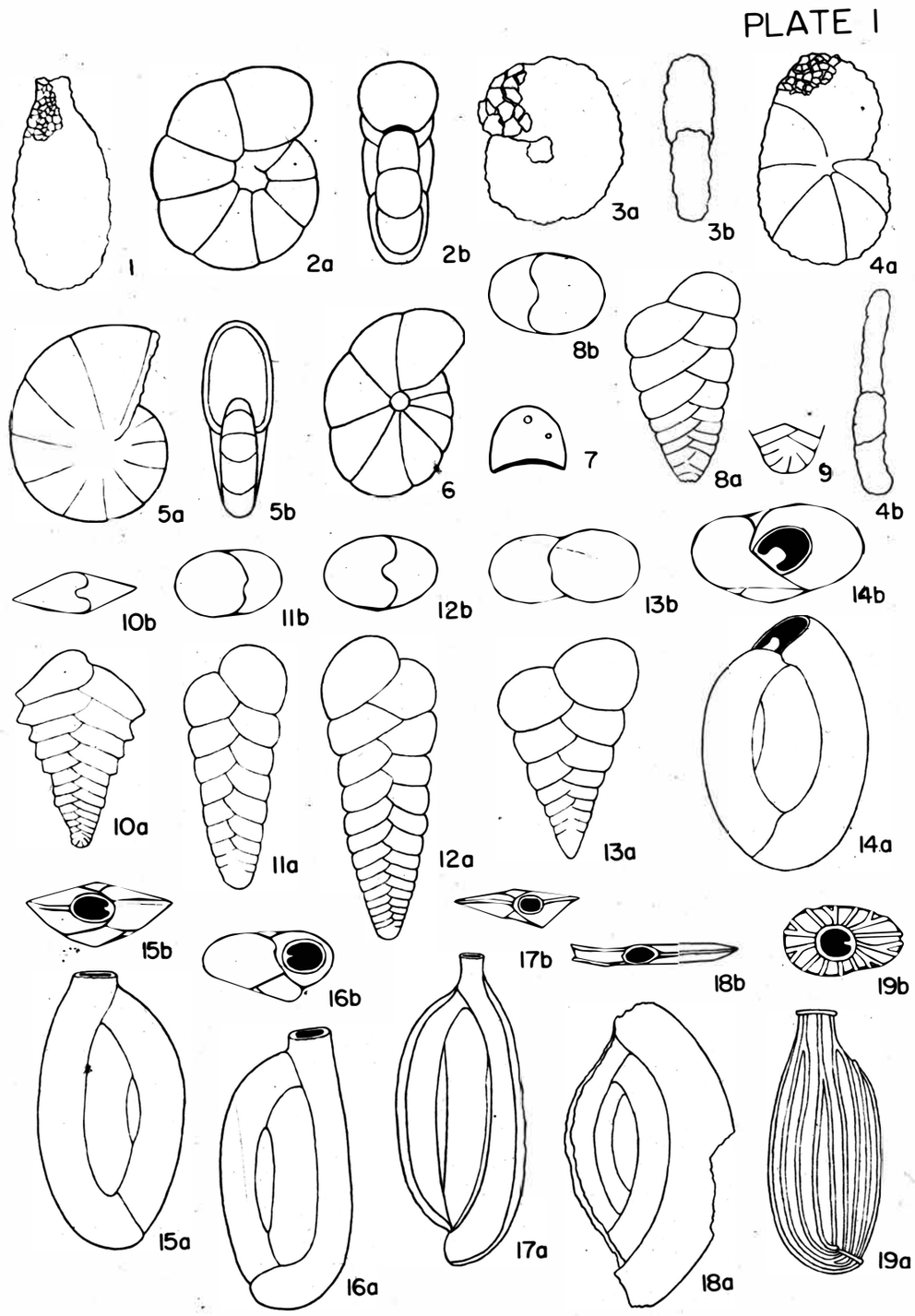
EXPLANATION OF PLATE 1

Families saccamminidae, Lituolidae, Textulariidae, Miliolidae (part)

(All measurements approximate)

Figures

1. Proteonina difflugiformis (H. B. Brady); length, 0.62 mm.
2a-2b. Haplophragmoides mauricensis Howe & Ellis; greater diameter, 0.41 mm.
3a-3b. H. sp.; greater diameter, 0.13 mm.
4a-4b. Ammobaculites hockleyensis Cushman & Applin; greater diameter, 0.50 mm.
5a-5b. Cyclammina sp. A; greater, 0.71 mm.
6, 7. C. sp. B.
Fig. 6, greater diameter, 0.52 mm. Fig. 7, septal face of another specimen.
8a-8c, 9. Spiroplectammina sp. cf. S. dibollensis (Cushman & Applin). Fig. 8, length, 0.54 mm. Fig. 9, initial part of another specimen.
10a-10b. S. mississippiensis (Cushman) var. alabamensis (Cushman); length, 0.51 mm.
11a-11b. Textularia sp. cf. T. claibornensis Weinzierl & Applin; length, 0.58 mm.
12a-12b. T. sp. cf. T. mauricensis Howe; length, 1.69 mm.
13a-13b. T. sp.; length, 0.66 mm.
14a-14b. Quinqueloculina harrisi Howe & Roberts; length, 0.73 mm.
15a-15b. Q. mauricensis Howe; length, 0.72 mm.
16a-16b. Q. hermosa Cole; length, 0.69 mm.
17a-17b. Q. sp.; length, 0.70 mm.
18a-18b. Massilina sp. aff. M. mauricensis Howe & Ellis; length, 0.74 mm.
19a-19b. Triloculina paulocostata Cushman & Garrett; length, 0.69 mm.



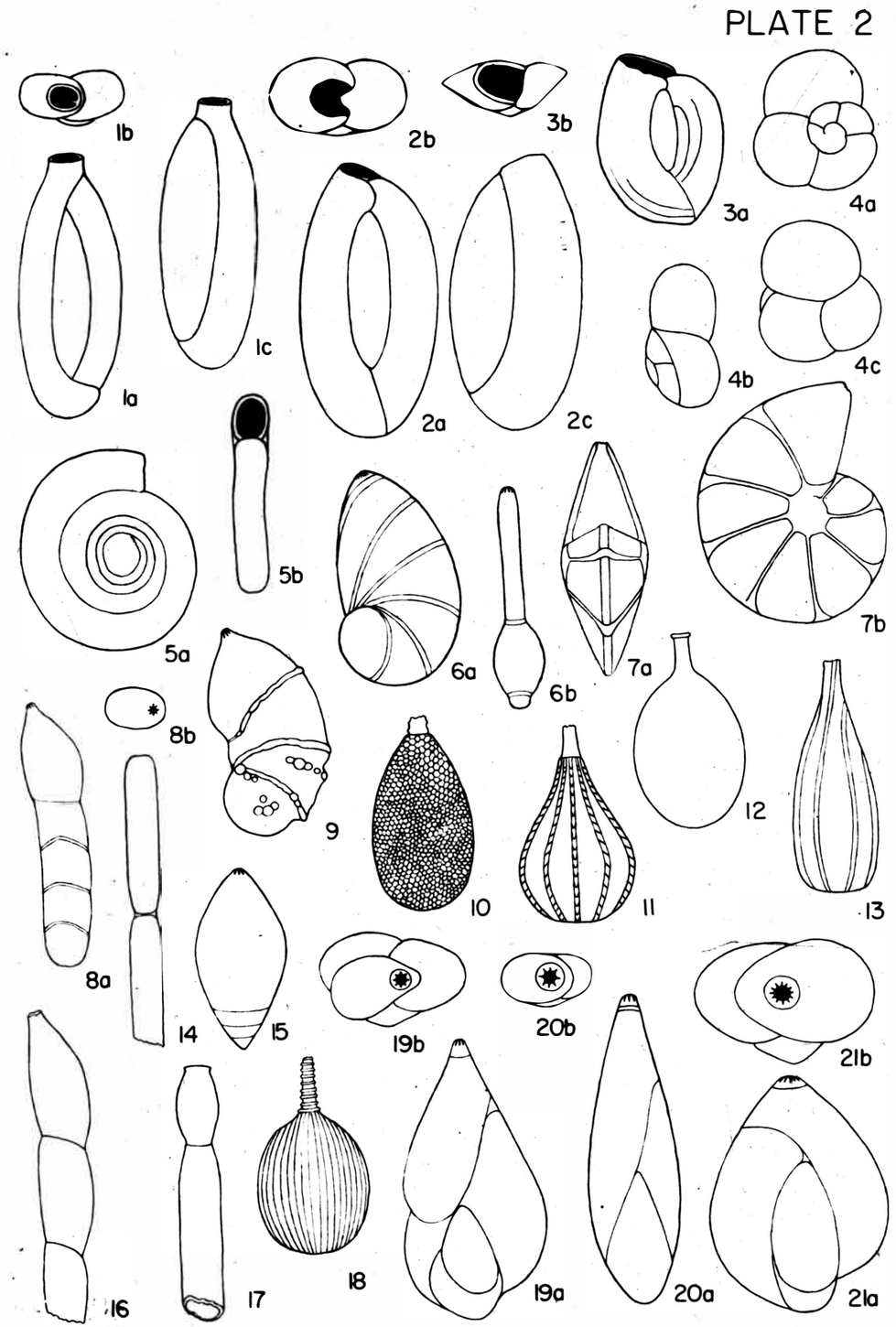
EXPLANATION OF PLATE 2

Families Miliolidae (continued), Ophthalmidiidae, Trochamminidae, Lagenidae, Polymorphinidae (part)

(All measurements approximate)

Figures

1a-1c. Triloculina garretti Howe; length, 0.69 mm.
2a-2c. T. mindenensis Howe; length, 0.68 mm.
3a-3b. T. sp.; length, 0.28 mm.
4a-4c. Trochammina claibornensis Howe; greater diameter, 0.24 mm.
5a-5b. Cornuspira olygogyra Hantken; greater diameter, 0.69 mm.
6a-6b. Planularia winniana Howe & Ellis; greater diameter, 0.51 mm.
7a-7b. Robulus sp.; greater diameter, 0.52 mm.
8a-8b. Dentalina communis (d'Orbigny); length, 0.47 mm.
9. "Marginulina" jugosa (Cushman & Thomas); length, 0.44 mm.
10. Lagena fenestrissima Howe & Ellis; length, 0.45 mm.
11. L. mississippiensis Cushman & Todd; length, 0.32 mm.
12. L. laevis (Montagu); length, 0.37 mm.
13. L. lisbonensis Cushman & Todd; length, 0.27 mm.
14. Nodosaria sp. cf. N. ewaldi Reuss; length, 0.61 mm.
15. Pseudoglandulina sp.; length, 0.37 mm.
16. Dentalina sp. cf. D. jacksonensis (Cushman & Applin); length, 0.77 mm.
17. Nodosaria sp. cf. N. longiscata d'Orbigny; length, 0.85 mm.
18. Lagena wallacei Bandy; length, 0.42 mm.
19a-19b. Guttulina hantkeni Cushman & Ozawa; length, 0.72 mm.
20a-20b. G. wilcoxensis Cushman & Ponton; length, 0.70 mm.
21a-21b. G. sp. cf. G. problema d'Orbigny; length, 0.48 mm.



EXPLANATION OF PLATE 3

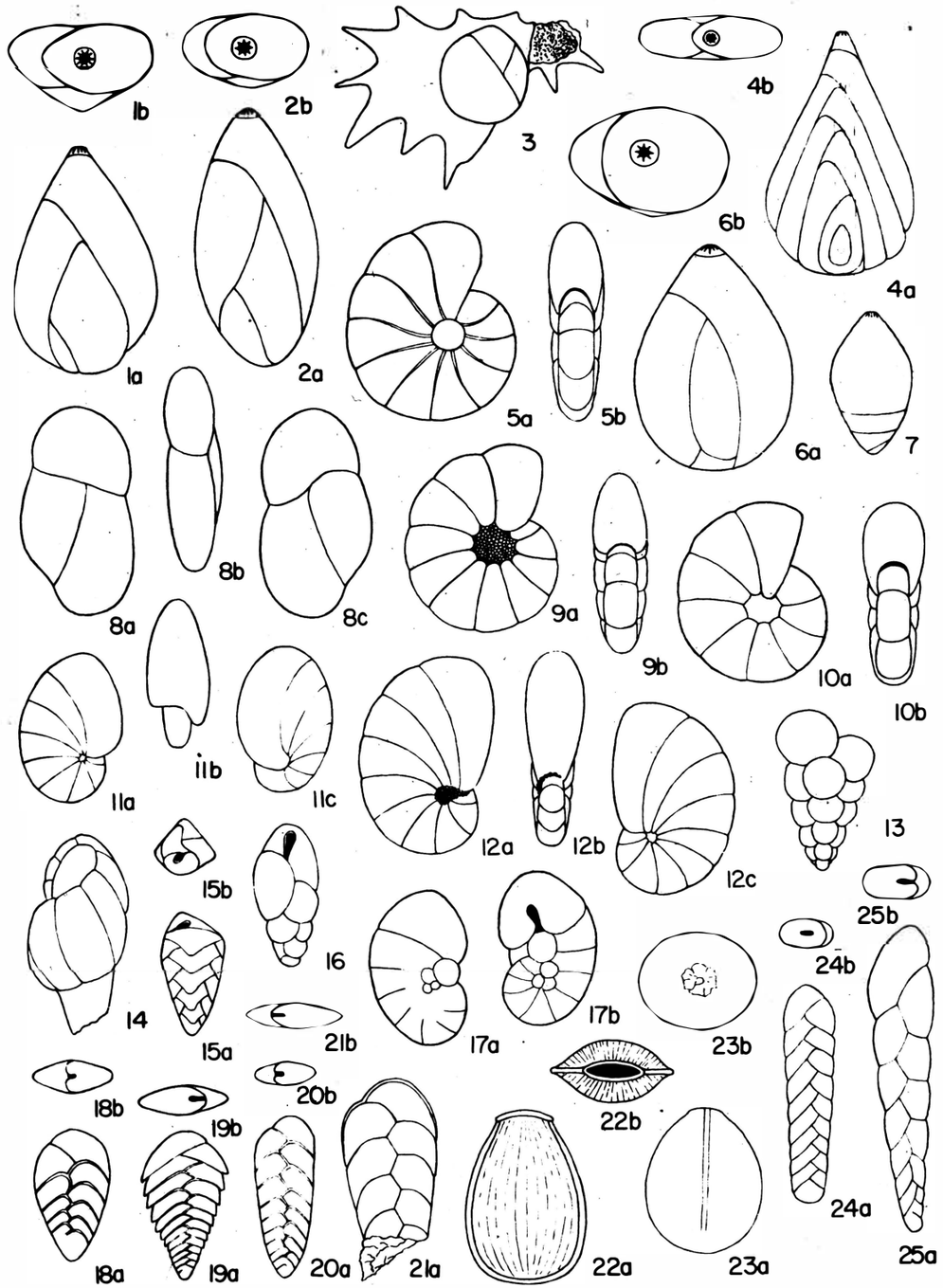
Families Polymorphinidae (continued), Nonionidae, Heterohelicidae, Buliminidae (part)

(All measurements approximate)

Figures

1a-1b. Guttulina sp. A; length, 0.54 mm.
2a-2b. G. sp. B; length, 0.54 mm.
3. Globulina sp. aff. G. rotundata (Bornemann); length of fistulose portion, 0.70 mm.
4a-4b. Polymorphina jacksonensis Cushman; length, 0.69 mm.
5a-5b. Nonion advenum (Cushman); greater diameter, 0.26 mm.
6a-6b. Globulina sp.; length, 0.42 mm.
7. Glandulina sp.; length, 0.48 mm.
8a-8c. Polymorphinid? indet.; length, 0.47 mm.
9a-9b. Nonion mauricensis Howe & Ellis; greater diameter, 0.33 mm.
10a-10b. N. planatum Cushman & Thomas; greater diameter, 0.46 mm.
11a-11c. Nonionella jacksonensis Cushman; greater diameter, 0.29 mm.
12a-12c. N. spissa Cushman; greater diameter, 0.39 mm.
13. Gümbelitria columbiana Howe; length, 0.24 mm.
14. Buliminella basistriata Cushman & Jarvis var. nuda Howe & Wallace; length, 0.31 mm.
15a-15b. Bulimina byramensis Cushman & Todd; length, 0.20 mm.
16. B. elongata d'Orbigny; length, 0.36 mm.
17a-17b. Pseudobulimina glaessneri Howe & Roberts; greater diameter, 0.28 mm.
18a-18b. Bolivina broussardi Howe & Roberts; length, 0.18 mm.
19a-19b. B. louisiana Howe; length, 0.28 mm.
20a-20b. B. taylori Howe; length, 0.20 mm.
21a-21b. B. sp.; length, 0.35 mm.
22a-22b. Entosolenia marginata (Montagu) var. lisbonensis Cushman & Todd; length, 0.21 mm.
23a-23b. E. globosa (Montagu); length, 0.19 mm.
24a-24b. Loxostomum wilcoxense Cushman & Ponton; length, 0.32 mm.
25a-25b. Virgulina dibollensis Cushman & Applin; length, 0.70 mm.

PLATE 3



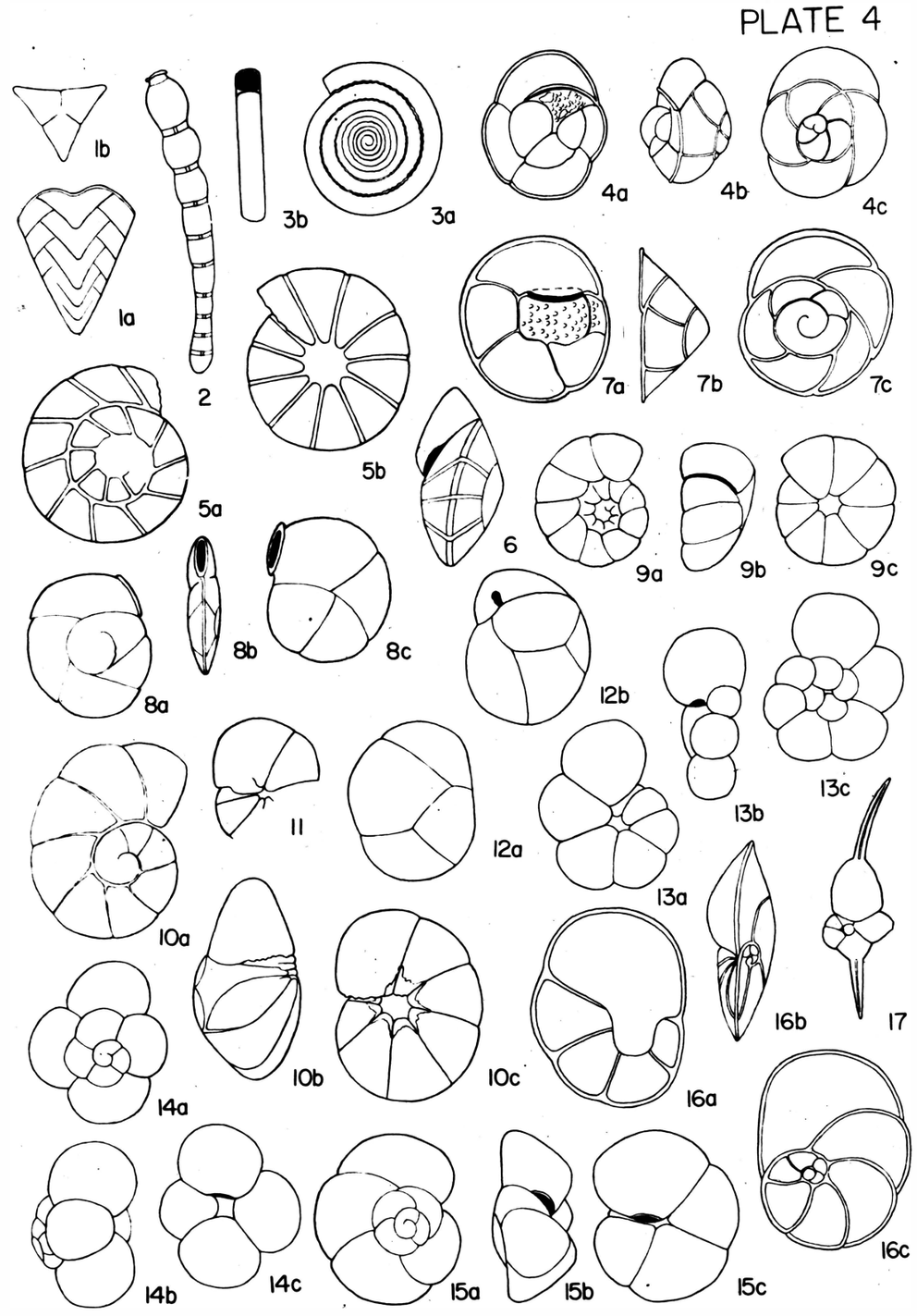
EXPLANATION OF PLATE 4

Families Buliminidae (continued), Ellipsoidinidae, Rotaliidae, Cassidulinidae, Globigerinidae, Hantkeninidae, Globorotaliidae

(All measurements approximate)

Figures

1a-1b. Reussella sp.; length, 0.30 mm.
2. Stilostomella sp.; length, 0.84 mm.
3a-3b. Spirillina vicksburgensis Cushman; greater diameter, 0.24 mm.
4a-4c. "Discorbis" hemisphaerica Cushman; greater diameter, 0.35 mm.
5a-5b, 6. Eponides sp. cf. E. lisbonensis Bandy. Fig. 5, greater diameter, 0.71. Fig. 6, apertural view of another specimen.
7a-7c. Discorbis alveata Cushman var. stavensis Bandy; greater diameter, 0.36 mm.
8a-8c. Siphonina claibornensis Cushman; greater diameter, 0.41 mm.
9a-9c. Gyroidina octacamerata (Cushman & Hanna); greater diameter, 0.41 mm.
10a-10c, 11. Ceratobulimina (Ceratocancris) stellata Bandy. Figure 10, greater diameter, 0.58 mm. Figure 11, another specimen from Wheelock formation, 10 miles west of Bryan, Texas, showing plate over aperture.
12a-12b. Cassidulina subglobosa Brady; greater diameter, 0.19 mm.
13a-13c. Globigerina danvillensis Howe & Wallace; greater diameter, 0.28 mm.
14a-14c. G. ouachitaensis Howe & Wallace; greater diameter, 0.28 mm.
15a-15c. Globorotalites crassatus (Cushman) var. densus (Cushman); greater diameter, 0.26 mm.
16a-16c. Globorotalia claibornensis (Howe); greater diameter, 0.33 mm.
17. Hantkenina longispina Cushman; greater diameter (including spines), 0.49 mm.



EXPLANATION OF PLATE 5

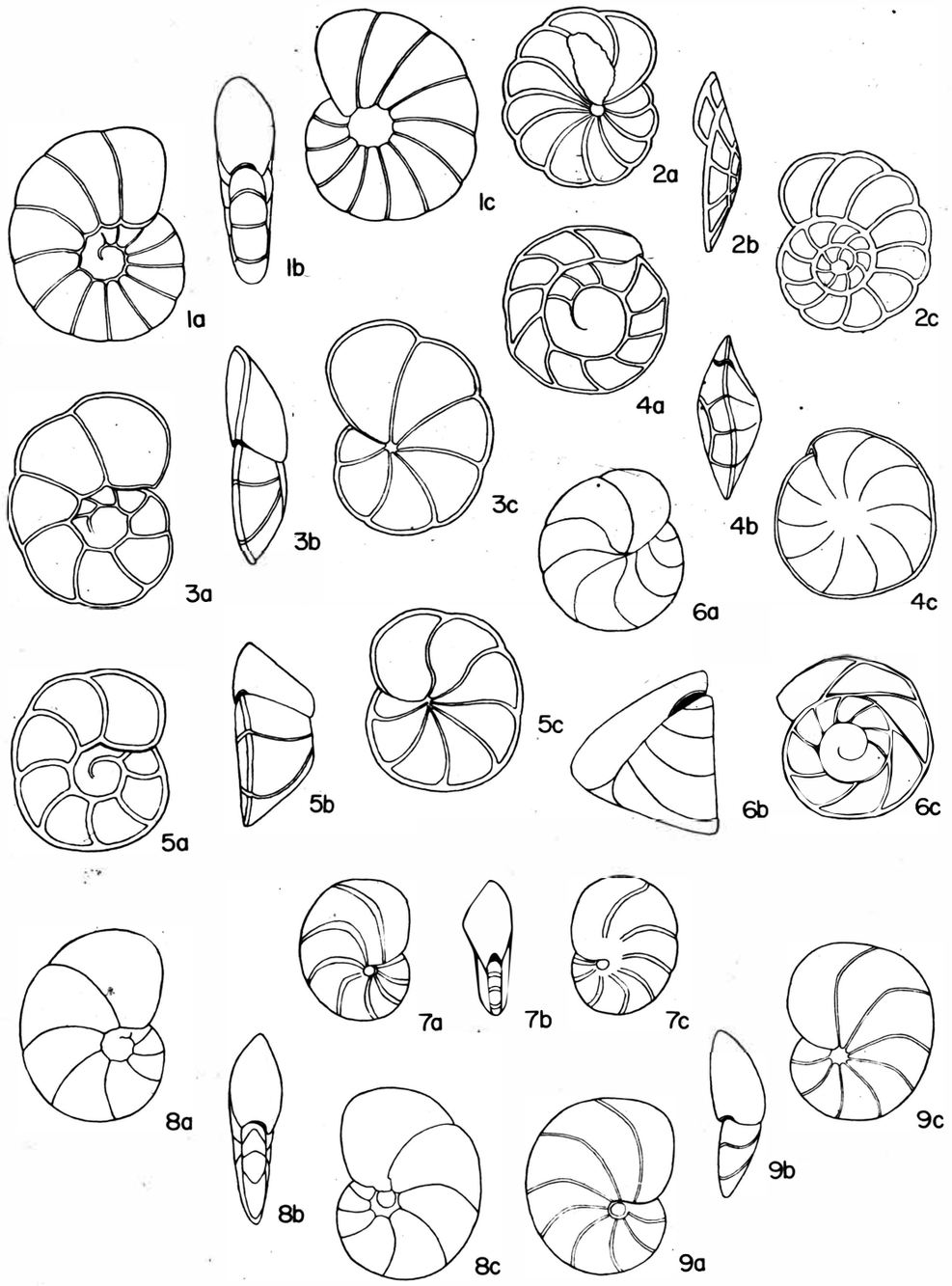
Family Anomalinidae

(All measurements approximate)

Figures

1a-1c. Anomalina umbonata Cushman; greater diameter, 0.42 mm.
2a-2c. Planulina sp.; greater diameter, 0.35 mm.
3a-3c. Cibicides lobatulus (Walker & Jacob); greater diameter, 0.52 mm.
4a-4c. C. pseudoungerianus (Cushman) var. lisbonensis Bandy; greater diameter, 0.36 mm.
5a-5c. C. truncatus Bandy; greater diameter, 0.31 mm.
6a-6c. C. westi Howe; greater diameter, 0.44 mm.
7a-7c. Cibicidina danvillensis (Howe & Wallace); greater diameter, 0.34 mm.
8a-8c. C. sp.; greater diameter, 0.40 mm.
9a-9c. C. mauricensis (Howe & Roberts); greater diameter, 0.31 mm.

PLATE 5



Vita

Nathan Eugene Crockett was born July 26, 1923 in Huntington, West Virginia. He received his elementary education in the Huntington area and graduated from Huntington East High School in June, 1942.

He served $3\frac{1}{2}$ years with the U. S. Navy in the Pacific Theater from 1942 to 1946.

In 1946 he entered Marshall College, Huntington, West Virginia and graduated in June, 1950, receiving a Bachelor of Science degree.

He was recalled to active duty with the U. S. Navy in October, 1950 and served in the Atlantic Theater until January, 1952.

In January, 1952 he enrolled in Missouri School of Mines and graduated in August, 1953, receiving a duplicate Bachelor of Science degree in geology. He enrolled as a graduate student in September, 1953.