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282. SOME MIDDLE EOCENE, LOWER EOCENE, AND PALEOCENE FORAMINIFERAL FAUNAS FROM WEST FLORIDA[1]

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ABSTRACT

This discussion of the lithology and microfauna of the clastic facies of the Eocene and Paleocene rocks of Florida is based mainly on data obtained from the study of many cores taken in the Oil City Corporation Walton Land and Timber Co. well 1, Walton County, Fla. Although the fauna of the middle Eocene rocks in western Florida is composed mainly of species that have been reported from rocks of equivalent age in the western Gulf Coast, its distinctive appearance is due to the marked difference in the dominant species, and the poor representation of a few species that are diagnostic in the western area. The assemblages of small Foraminifera in the lower Eocene rocks are composed, mainly, of specimens of species that have been described from outcrops of the Wilcox Group in Alabama. The microfauna of the clastic facies of the Paleocene in western Florida is informally called the "Tamesí fauna" in this report. This fauna is particularly important because it contains abundant specimens of 12 species of pelagic forms and because **Globorotalia velascoensis**, a diagnostic species of the Velasco (Paleocene) Formation of Mexico, is also diagnostic of the "Tamesí fauna." On the basis of the environmental preference of Recent analogous pelagic forms, the preferential environment of similar Recent benthonic forms, and the lithologic character of the containing sediments, it is inferred that the "Tamesí fauna" developed in a subtropical, open-sea environment.

The effect of temperature, salinity, bathymetry, and associated factors on the distribution of Recent pelagic species of Foraminifera has been discussed by several authors. Similar controls were probably effective during Paleocene time. The presence of certain species of pelagic Foraminifera in one Paleocene unit, and their absence in another, is therefore not necessarily an index to the relative position of the units in the vertical time sequence. The stratigraphic distribution of the benthonic species of the "Tamesí fauna" in western Florida is usually in accord with their stratigraphic distribution in the Paleocene beds in other parts of the Gulf Coast. Consequently, on the basis of the foregoing environmental and distributive data, it is suggested that the "Tamesí fauna" of the clastic lithofacies of the Paleocene in western Florida represents an interval of geologic time that is about equivalent to the interval represented by the Clayton, Porters Creek, and Naheola formations of Alabama and correlative stratigraphic units in other parts of the Gulf region. It is believed that the outer neritic Paleocene sediments of west Florida grade northward into the inner-neritic Paleocene sediments that crop out in Alabama. Fifty-seven species of Foraminifera that are characteristic of the cored Paleocene section in the Walton well, and recorded from 37 other wells distributed across northwestern Florida and southern Georgia, are discussed and figured. Two species are described as new: **Eponides libertyensis** and **Cibicides libertyensis**.

1 Publication authorized by the Director, U. S. Geological Survey

INTRODUCTION

Eocene deposits of pre-Jackson age in the subsurface strata of Florida can be readily separated into two clearly defined units on the basis of lithologic character, microfaunal assemblages, and geographic distribution. In this paper I informally classify these units as carbonate and clastic, although some lenses of carbonate sediments are irregularly interbedded with the clastic. The carbonate sediments are found on the peninsula and extend as far west as the Aucilla River. The clastic rocks occupy the panhandle region and extend northward into Alabama and southwestern Georgia. Near the eastern border of the clastic rocks in Jackson, Leon, and Wakulla counties, two major structural features, the Chattahoochee Anticline (Stephenson and Veatch, 1915, p. 57) and the Suwannee Strait (Dall and Harris, 1892, p. 122), strongly influenced the sedimentation and disturbed the normal stratigraphic sequence during Eocene and later Tertiary times. Few wells have been drilled in this critical area; therefore little is known of the probable intergradation of the two types of sediments. The carbonate facies and its faunal groups have been discussed in several published reports (Cole, 1941, 1942, 1944, and 1945; Applin, P. L. and E. R., 1944; Applin and Jordan, 1945; and Levin, 1957), but few deal with the clastic sediments of west Florida and their faunal populations. Applin and Applin (1944) and Applin and Jordan (1945) published brief accounts of the Paleocene fauna of the clastic unit, and Cole (1938 and 1945) discussed the Paleocene fauna of the clastic facies, and presented faunal data on other parts of the Eocene section from Jackson, Leon, and Wakulla counties. In 1932, the Oil City Corporation, Walton Land and Timber Company well 1 (text fig. 1, No. 1) was drilled near DeFuniak Springs, Walton County, Fla. Cores were taken at frequent intervals in this well, and provide a fairly complete and representative record of the faunal sequence and the depositional history of the clastic rocks of Eocene age in western Florida. The accurate depth measurements of the rather closely spaced cores in the Walton well are helpful in evaluating and interpreting the stratigraphic sequence of the faunal and lithologic components of the cutting samples, which are the major source of data on the early Tertiary sediments in most wells in western Florida. The faunal and lithologic data provided by the cores

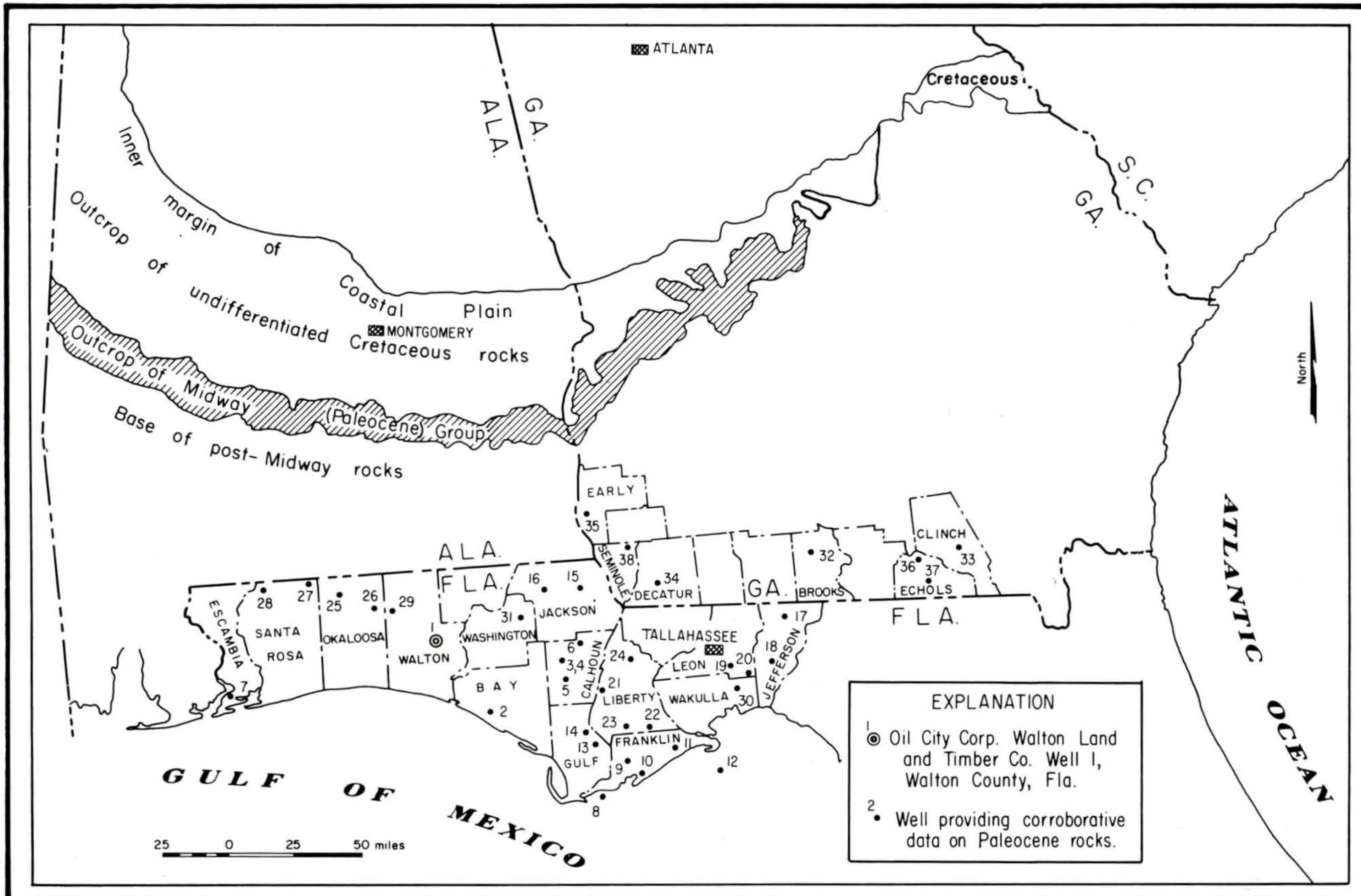


FIGURE 1

Index map of parts of the Southeastern States showing the location of wells that penetrated Paleocene rocks containing the "Tamesí fauna."

taken from the Walton Land and Timber Company well 1 are the basis of the present report, but additional, corroborative information on Paleocene deposits was obtained from cutting samples from the wells (text fig. 1) in Florida and southern Georgia which are here listed.

No. on map (text fig. 1)	County	Name of Well
		Florida
1	Walton	Oil City Corp. Walton Land and Timber Co. well 1
2	Bay	Magnolia Petroleum Co. State Block 4B, well 1
3	Calhoun	Pure Oil Co. St. Andrew's Bay Properties Co. well 2
4	Calhoun	Pure Oil Co. International Paper Co. well 1
5	Calhoun	Pure Oil Co. International Paper Co. well 2
6	Calhoun	D. E. L. Byers Hardaway Construction Co. well 1
7	Escambia	Zach Brooks & Co. Caldwell-Garvin *et al.* Unit well 1
8	Franklin	Magnolia Petroleum Co. State Block 5B well 1A
9	Franklin	Pure Oil Co. H. C. Lister well 1
10	Franklin	Pure Oil Co. Gex-Lewin well 3
11	Franklin	Pure Oil Co. St. Joe Paper Co. well 2
12	Franklin	The California Co. and Coastal Petroleum Co. State Lease 224A, well 2
13	Gulf	Pure Oil Co. C. C. Hopkins well 1
14	Gulf	Pure Oil Co. Kate Gaskins well 1
15	Jackson	Mrs. Mamie Hammonds *et al.* Granberry well 1
16	Jackson	Humble Oil & Refining Co. W. C. Tindel well 1
17	Jefferson	Southern States Oil Corp. Miller and Gossard well 1
18	Jefferson	Coastal Petroleum Co. E. P. Larsh well 1
19	Leon	Central Florida Oil & Gas Co. Rhodes well 1
20	Leon	Stanolind Oil & Gas Co. St. Joe Paper Co. well 1A
21	Liberty	Pure Oil Co. Neal Lumber Co. well 1
22	Liberty	Pure Oil Co. Gex-Lewin well 1
23	Liberty	Gulf Coast Drilling and Exploration Co. U.S.A. well 1
24	Liberty	R. T. Adams St. Joe Paper Co. well 1
25	Okaloosa	The California Co. Blackman Unit well 1
26	Okaloosa	Sun Oil Co. Brady-Belcher Unit well 2
27	Santa Rosa	The California Co. Santa Maria Unit well 1
28	Santa Rosa	Gulf Oil Corp. C. H. Bray *et al.* Unit well 1
29	Walton	Sun Oil Co. Brady-Belcher Unit well 3
30	Wakulla	Brown and Ravlin V. G. Phillips well 1
31	Washington	Chipley Oil Co. Dekle well 1
		Georgia
32	Brooks	D. E. Hughes E. M. Rogers well 1B
33	Clinch	H. L. Hunt Alice Musgrove well 1
34	Decatur	H. L. Hunt Metcalf well (Herrick, 1961, p. 153)
35	Early	Sun Oil Co. R. V. Ellis well 1 (Herrick, 1961, p. 194)
36	Echols	Humble Oil & Refining Co. Bennett and Langsdale well 1
37	Echols	Hunt Oil Co. Superior Pine Products Co. well 4
38	Seminole	Mont Warren *et al.* W. E. Harlow well 1 (Herrick, 1961, p. 355)

The primary object of this report is to present an account of the microfauna of the Paleocene sediments of west Florida, and to offer an interpretation of the relations of this fauna to the closely similar Velasco fauna of Mexico, and to other Paleocene microfaunal groups in the northern and western parts of the Gulf Coastal Plain. In order to adequately demonstrate the stratigraphic relationships of the Paleocene section to the overlying Eocene deposits, however, a brief account of the middle and lower Eocene faunal and lithologic sequence in the Walton County well is included.

MICROFAUNA OF THE CLAIBORNE, MIDDLE EOCENE

Diagnostic Species of Large Foraminifera

In the middle and lower Eocene deposits of the Gulf Coast, a few species of larger Foraminifera are especially valuable in correlation studies because of their wide geographic distribution and short stratigraphic range. In 1938, Gravell and Hanna published an account of several Tertiary large foraminiferal correlation zones which they traced across Mississippi and Alabama into west Florida.

The youngest middle Eocene zone of Gravell and Hanna (1938, p. 1007) is the "*Lepidocyclina (Polylepidina)* zone." They consider this zone "one of the most useful in the correlation of the Gulf Coast Claiborne since it is found from eastern Texas to Florida." It is recorded by them (1938, p. 993, fig. 3) from the Walton Land and Timber Company well in Walton County, and from the Hammonds Granberry well in Jackson County, Florida. Applin and Applin (1944, fig. 27) also record *Lepidocyclina (Polylepidina) antillea* from the Walton County well, and mention its occurrence (1944, p. 1694) in wells in Nassau County and Jefferson County, Florida. Cole (1938, p. 46-48) records its occurrence in the Granberry well in Jackson County, mentions its presence (1944, p. 25 and 26) in a well "drilled by the Calhoun Oil and Gas Company northwest of Clarksville in Calhoun County," and in the same bulletin (p. 60), extends the "*Lepidocyclina (Polylepidina)* zone" east into Nassau County, Florida, where the species appears in the Lake City carbonate facies of the middle Eocene accompanied by *Dictyoconus americanus* (Cushman) and a small foraminiferal assemblage typical of the carbonate biofacies. Recently Herrick (1961) listed *Lepidocyclina (Polylepidina) antillea* from a number of wells drilled on the coastal plain area of southeastern Georgia.

As indicated by the plotted log (text fig. 2), few cores and little lithologic and paleontologic data were obtained through the first 700 feet of hole drilled in the Walton well. The description of the section therefore begins with the core taken at 755-757 feet which contained abundant specimens of *Lepidocyclina (Polylepidina) antillea* Cushman = *L. (P.) gardnerae* Cole and *Operculinoides wilcoxi* (Heilprin) = *Operculinoides sabinensis* Cole. As mentioned above, Applin and Applin (1944) and Gravell and Hanna (1938) record the *Lepidocyclina (Polylepidina)* Zone from this well, and Gravell and Hanna trace the zone west into southern Alabama, southern Mississippi, and southeastern Louisiana. The westernmost occurrence in Florida is from the Zach Brooks and Company Caldwell-Garvin *et al.* Unit well 1, sec. 31, T. 23, R. 31 W., Escambia County, where *L. (P.) antillea, Operculinoides wilcoxi,* and *Discocyclina (Proporocyclina) flintensis* (Cushman) = *D. (P.) perpusilla* (Vaughan) are all present in cuttings (2175-2190 ft.). In their discussion of the *Lepidocyclina (Polylepidina)* Zone, Gravell and Hanna (1938, p. 1008) state that they have found this faunal association at many places.

Small Foraminiferal Assemblages

The general appearance of the microfaunal assemblages found in sediments of Claiborne age in northwest Florida is quite different from that of the better known and well documented faunal groups of more westerly parts of the Gulf Coast area. However, the change is not due to the introduction of many new species. Rather, it is the result of changes in grouping and dominance, and to the abundant representation of some species that are rare in the more westerly areas. In these respects the fauna of the clastic facies of the middle Eocene of Florida differs sharply from that of the carbonate facies in which the species are generally either new or closely related to Eocene species of Cuba and more southerly areas bordering on the Gulf of Mexico. Gravell and Hanna (1938, p. 1006-1007) mention the east-west variation in Claiborne microfaunas in their discussion of the *Eponides yeguaensis* and *Ceratobulimina eximia* zones. *Ceratobulimina* can be used as a marker for the top of the Cook Mountain across Texas and Louisiana into western Mississippi, but is rare to absent in the Claiborne sediments of wells farther to the east. *Eponides yeguaensis* is also recorded from Texas to western Mississippi but is comparatively rare in the more easterly extension of sediments of Claiborne age. In his report on well sections of southern and southeastern Georgia, Herrick (1961) also indicates this variation by selecting *Cibicides westi* as a widely distributed, representative species of the Lisbon. Presumably, the middle Eocene faunas of west Florida reflected the influence of their environment and responded to such changes in depositional conditions as the finer grain size of the sediments, reduction in quantity of terrestrial material, higher ratio of calcium carbonate, and probably differences in temperature, bathymetry, and salinity as well. As already mentioned, a few species of larger Foraminifera appear at intervals as reliable zonal markers from Texas east to the Atlantic seaboard, but many of the smaller species of Foraminifera seem to have been less adaptable.

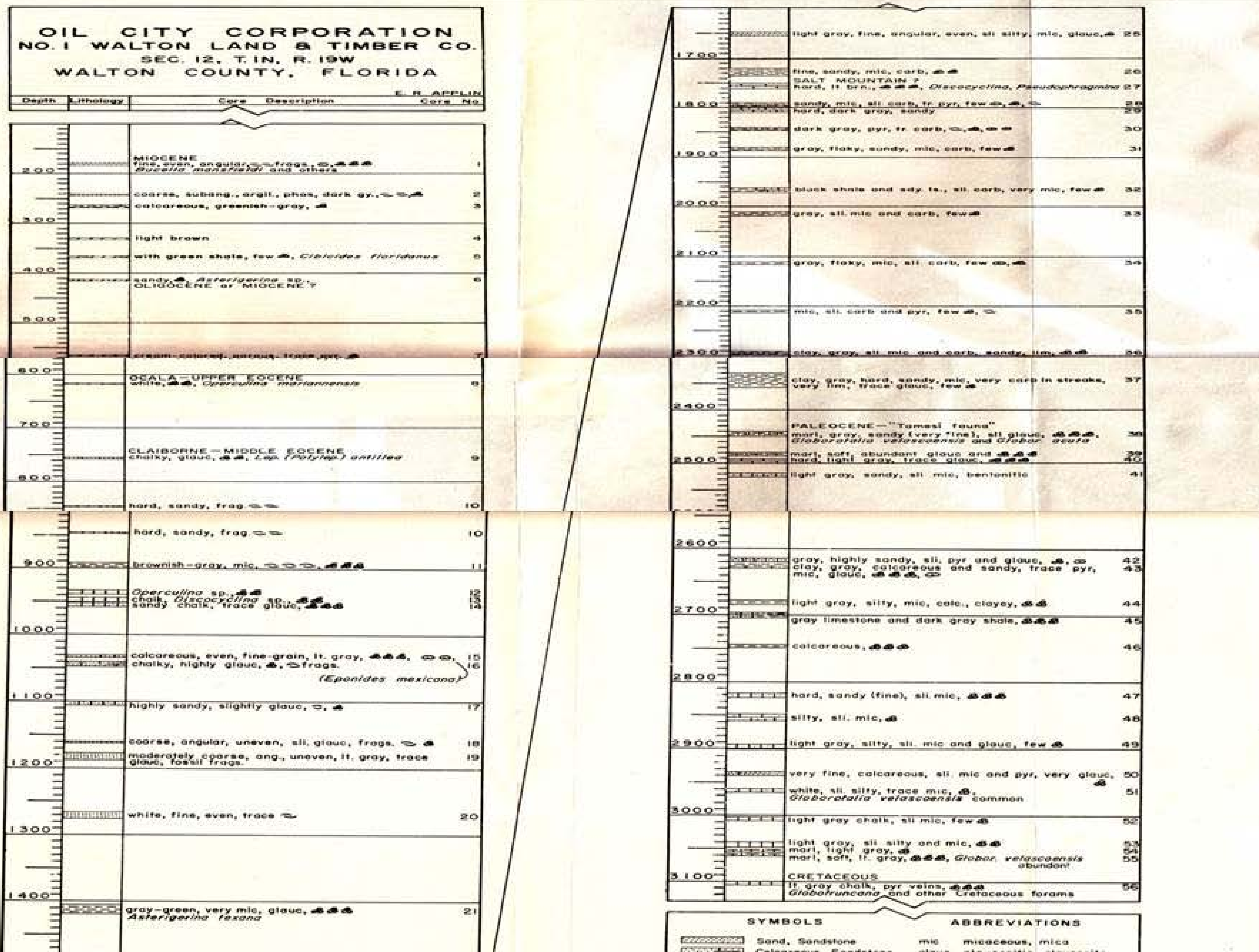
Because, as mentioned above, nearly all the Claiborne species of smaller Foraminifera have been described and figured, no illustrations of the Claiborne forms will be published in this report, but specimens of all species listed will be deposited with the collections of the U. S. National Museum. Several species of larger Foraminifera that were found in the cored section of middle and lower (?) Eocene sediments in the Walton well will be described by Dr. W. Storrs Cole in a separate report.

CLAIBORNE SECTION IN THE WALTON LAND AND TIMBER COMPANY WELL 1

The faunal record of middle Eocene sediments in the Walton well begins with the "*Lepidocyclina (Polylepidina)* zone" of Gravell and Hanna. As these authors (1938, p. 987, fig. 1) indicate that the zone may represent a time period roughly equivalent to the middle part of the Cook Mountain Formation of the Texas Claiborne, it is inferred that no record of the top of the Claiborne section was provided by cores taken in

TEXT FIGURE 2

PLOTTED LOG OF OIL CITY CORP. WALTON LAND AND TIMBER CO. WELL 1



this well. Core 9 (755-757 ft.) and Core 10 (847-848 ft.) are composed of highly sandy, greenish gray chalky limestones and chalky, fine- to medium-grained, sharply angular, glauconitic sand. Core 9 contains many specimens of several species of larger Foraminifera including the species for which the zone was named, *L.* (*Polylepidina*) *antillea* Cushman. Core 10 is a sandy coquina of comminuted organic debris too poorly preserved to be identified, even generically. Core 11 (892-900 ft.) was a light brownish gray, weakly micaceous clay. This material contained a large number of small Foraminifera and ostracodes, abundant specimens of very small, probably immature gastropods, and some carbonaceous material. The microfauna obtained from this core may be considered a subzone of the *Lepidocyclina* (*Polylepidina*) Zone. The characterizing fauna of this subzone is given below. Dominant species are shown by asterisks.

Ammobaculites mauricensis Howe
Ammobaculites sp.
Spiroplectammina mississippiensis (Cushman) Cushman and Todd
**Textularia dibollensis* Cushman and Applin
**Quinqueloculina mauricensis* Howe
**Quinqueloculina harrisi* Howe and Roberts
Robulus alatolimbatus (Gümbel) Bergquist
Nonion inexcavatum (Cushman and Applin) Ellisor
Epistominella atlantisae Cushman
Uvigerina cf. *U. blancocostata* Cole
Globorotalia bullbrooki Bolli
Eponides mexicanus (Cushman) Cushman (dwarf forms)
**Discorbis georgianus* Cushman and Herrick
Siphonina claibornensis Cushman
Gyroidina soldani octocamerata Cushman and G. D. Hanna

The lithology of the core sample would indicate that the sediments were finer textured, more calcareous, and less glauconitic than characteristic deposits of similar age in more westerly areas. The presence of many molds of several species of miliolids would also indicate very shallow-water depositional conditions.

Cores taken between 933 and 957 feet were composed of sandy, finely crystalline dolomite, and chalky, fine-grained sandstone. They contained abundant tests of several species of larger Foraminifera and some specimens of smaller Foraminifera. All fossils, however, were preserved as soft chalky molds, and for this reason few small Foraminifera could be identified specifically. Small Foraminifera recorded from a core taken at 944-951 feet are listed below. They are considered to be a part of the zonal group listed above.

Anomalina umbonata Cushman
Nonionella spissa Cushman
Globorotalia bullbrooki Bolli
Robulus sp.
Globulina gibba d'Orbigny
Eponides mexicanus (Cushman) Cushman

As shown by the sample log, a core (no. 15) of loosely consolidated, light-gray, highly sandy chalk was cut at 1030 to 1033 feet. This core contained many specimens of several species of smaller Foraminifera and ostracodes. Because of species similarities, this faunal group is believed to be closely allied to the two previously listed faunas, although the presence of several species of planktonic forms would suggest somewhat deeper-water conditions of deposition. Species of Foraminifera from this depth are as follows. Those with asterisks are dominant.

Textularia cf. *T. adalta* Cushman
Textularia dibollensis Cushman and Applin
Quinqueloculina sp.
Robulus alatolimbatus (Gümbel) Bergquist
Dentalina sp.
Lagena cf. *L. ouachitaensis alabamensis* Bandy
**Gyroidina soldani octocamerata* Cushman and G. D. Hanna
**Eponides mexicanus* (Cushman) Cushman var.
Siphonina claibornensis Cushman
Globorotalia bullbrooki Bolli
Globorotalia centralis Cushman and Bermudez
Globigerina parva Bolli
Globigerina cf. *G. trilocularis* d'Orbigny
Cibicides sassei Cole
Cibicides blanpiedi Toulmin
**Discorbis tallahattensis subnitens* Bandy
Globulina gibba d'Orbigny
Nonion planatum Cushman and Thomas

Note — Specimens listed as *Eponides mexicanus* var. are dwarf forms.

Core no. 16, at 1040-1047 feet, also contained a moderately well-preserved and well represented faunal assemblage which is closely related to those previously discussed. The fauna of cores 15 and 16, however, show some interesting variations, particularly in the introduction of many specimens of several species of planktonic Foraminifera.

**Discorbis tallahattensis subnitens* Bandy
**Eponides mexicanus* (Cushman) var.
Robulus alatolimbatus (Gümbel) Bergquist
**Textularia dibollensis stavensis* Bandy
Gyroidina soldani octocamerata Cushman
Cibicides westi Howe
Globorotalia centralis Cushman and Bermudez
Globorotalia bullbrooki Bolli
Globorotalia cf. *G. menardii* (d'Orbigny)
Globigerina sp. (Howe, 1939, p. 84)
Fragments of *Discocyclina* also present.

Cores 17 to 21 (1100-1408 ft.) were composed mainly of chalky, fine-grained sands in which the fossil material was soft and fragmental. Few determinable specimens of Foraminifera were found in the washed concentrates. Core 19 (1177-1189 ft.) contained a few poorly preserved specimens of a small camerinid, a few specimens of *Asterigerina* sp., and some fragments of a fragile-shelled bivalve. Core 21 (1406-1418 ft.) was the next core in downward sequence that contained a moderately large representation of Foraminifera. This fauna was strongly dominated by specimens of *Asterigerina texana* (Stadnichenko). To separate this faunal group from the assemblages previously discussed I hereby name this the *Asterigerina* Zone of the Claiborne group of west Florida. It probably represents a part of Claiborne time roughly equivalent to some part of the Mount Selman of Texas.

Core 21, 1406-1418 ft.:

**Asterigerina texana* (Stadnichenko) strongly dominant
Robulus alatolimbatus (Gümbel) Bergquist
Nonionella jacksonensis spiralis Bandy
Eponides mexicanus (Cushman) var. rare
Gyroidina soldani octocamerata Cushman and G. D. Hanna
Globorotalia centralis Cushman and Bermudez
Globorotalia parva Bolli
Nonion planatum Cushman and Thomas

LOWER EOCENE, WILCOX SECTION IN THE WALTON WELL

The cores described above are assigned to the Claiborne Group, but the fauna of core sample no. 22 suggests an early Eocene, Wilcox age, for the host sediments. If this interpretation is correct, the contact between the middle and lower Eocene would fall within the 100 feet of unsampled section between core 21 (1406-1418 ft.) and core 22 (1506-1518 ft.).

Lower Eocene marine sediments containing faunas of smaller Foraminifera are comparatively rare in the eastern Gulf Coastal region. However, Toulmin (1941), Cushman and Ponton (1932), Cushman and Garrett (1939), and Cushman (1944, a, b) described faunas of small Foraminifera from outcrops of several formations of Wilcox age in Alabama. A comparison with these described faunal groups would seem to indicate that the fauna listed below is probably Wilcox in age, although some species described from middle Eocene formations are also present.

The Lagenidae, arenaceous Foraminifera, and specimens of *Globigerina* and *Globorotalia* are predominant in the faunal assemblage. Although most of the species have been recorded from the Wilcox, one very common form, i.e., *Marginulina variata* Hussey, was described from the Cane River Eocene of Louisiana and has not been recorded from any other formation in the Gulf Coastal area so far as is known to this writer.

Specimens listed as *Trochammina* cf. *T. howei* are closely similar to that species in general form and chamber arrangement but, like all the arenaceous species listed from this sample, the tests are coarsely arenaceous and rough textured. The chambers are more globular and the test is less compressed than in typical specimens of the species.

Faunal assemblage

Reophax cf. *R. curtus* Cushman
**Ammobaculites midwayensis* Plummer
Ammobaculites expansus Plummer
Haplophragmoides sphaeriloculus Cushman
**Trochammina* cf. *T. howei* Cushman
**Robulus magnificus* Toulmin
Robulus knighti Toulmin
**Robulus wilcoxensis* Cushman and Ponton
**Marginulina variata* Hussey
Nodosaria cf. *N. longiscata* d'Orbigny
Nodosaria sp.
Dentalina wilcoxensis Cushman
Dentalina eocenica Cushman
Dentalina cf. *D. granti* (Plummer) Plummer
Bolivina wilcoxensis Cushman
Angulogerina wilcoxensis Cushman and Ponton
Valvulineria scrobiculata (Schwager) Cushman
**Eponides dorfi* Toulmin
**Siphonina wilcoxensis* Cushman
Asterigerina sp.
**Globigerina triloculinoides* Plummer
**Globigerina spiralis* Bolli
Globorotalia rex Martin (rare)
**Globorotalia perclara* Loeblich and Tappan
Globorotalia elongata Bolli
Anomalinoides umboniferus (Schwager) Cushman
Chilostomelloides eocenicus Cushman

Also there are specimens of two noncalcareous microfossils. One is globular in shape, and closely resembles *Orbulina* in appearance, and the other is similar in size and texture, but disk shaped, equally and gently biconvex, sharply angular and narrowly keeled at the periphery. H. R. Bergquist (personal communication, 1963) has suggested that these fossils might be spumelline Radiolaria, and that the spherical specimens "could be species of the genus *Cenosphaera*, and the biconvex form might belong to the genus *Periphaena*."

Core 23, 1536-1544 feet, was lithologically similar to the preceding, but the fauna was less abundant and less diversified. Some species common in the preceding assemblage were missing, and a few species were added.

Faunal assemblage

**Eponides dorfi* Toulmin
**Gaudryina* cf. *G. cubana* Cushman and Bermudez
**Robulus magnificus* Toulmin
Robulus wilcoxensis Cushman and Ponton
**Marginulina* cf. *M. toulmini* Cushman
Osangularia expansa Toulmin
**Nodosaria latejugata* Gümbel
Chrysalogonium lanceolum Cushman and Bermudez
Globigerina spiralis Bolli

Globorotalia perclara Loeblich and Tappan
**Globorotalia aequa* Cushman and Renz

Core 24, 1590 to 1600 feet, was also a greenish-gray, argillaceous sand, but the sand was fine and even grained, and contained some green, dull-brown and dark-gray grains in addition to the dominant grains of clear quartz. A trace of mica, about 10 percent glauconite, and a few specimens of Foraminifera were also present. Small specimens of *Robulus* sp. were most common. Core 25, 1648 to 1654 feet, was like the preceding in lithologic character and also contained a meager fauna of poorly preserved specimens of Foraminifera, mainly *Anomalina* cf. *A. ammonoides* (Reuss) Plummer, and *Valvulineria wilcoxensis* Cushman and Ponton. A part of this core was very hard and highly calcareous.

A core (no. 26) of gray, micaceous, finely sandy clay was taken at 1720-1730 feet. Fauna collected at this depth was as follows.

Ammobaculites cf. *A. coprolithiformis* (Schwager) Cushman
**Trochammina* cf. *T. texana* Cushman and Waters (all specimens crushed and distorted)
Nodosaria latejugata Gümbel
Robulus cf. *R. midwayensis* (Plummer) Cole and Gillespie
Marginulina toulmini Cushman
**Globigerina triloculinoides* Plummer
**Globigerina inaequispira* Subbotina
Globorotalia angulata White
Globorotalia elongata Glaessner
Globorotalia wilcoxensis Cushman and Ponton

Core 27 (1752-1761 ft.) was a hard, light-brown, coquinitic limestone, composed chiefly of generally calcitized fragments of shell material, echinoid spines, bryozoans, and many worn specimens of two species of larger Foraminifera, and a species of smaller Foraminifera, *Vaginulina* cf. *V. longiforma* (Plummer) Cushman. About 10 percent glauconite, and about 15 percent fine, angular, clear quartz sand were also present.

This limestone was originally believed to represent a part of the Salt Mountain Limestone of Alabama and was so recorded by Applin and Applin (1944, fig. 27). This correlation was based largely on the general character of the limestone, its position within the lower Eocene section and the presence of abundant specimens of *Discocyclina* and *Pseudophragmina*. A similar limestone and fauna was recorded by Cole (1938, p. 22, 23) from the Modisett Drilling Company, Granberry well no. 1, 1402-1600 feet, Jackson County, Florida. This limestone was also assigned to the Salt Mountain. No change has been made in these correlations, but it is now known that the two species of larger Foraminifera that characterize the fauna of the limestone in the Walton well have not been previously recognized in sediments of the Gulf Coastal region. These species will be discussed by Cole in a forthcoming publication.

Cores 28 through 37, 1790 to 2357 feet (*see* log), were composed chiefly of dark-gray, moderately hard, finely laminated, micaceous, carbonaceous, and pyritic shale. Some limestone was cored at 1800-1810 and 1926-1971 feet. The limestone at 1800 feet was highly indurated, somewhat phosphatic, and showed several calcite veins perpendicular to the width of the core. Faulting may be indicated. The core taken at 1962-1971 feet was also, in part, a dark-gray limestone that contained a large amount of mica and many small inclusions of limonite. A small fauna was obtained from the shale portion of this core. It consisted of shell fragments and a few specimens of Foraminifera and ostracodes. Determinable Foraminifera found in the shale cores taken between the depths 1790 to 2357 feet are as follows:

Trochammina cf. *T. texana* Cushman and Waters
Trochammina cf. *T. diagonis* (Carsey) Cushman and Waters
Robulus cf. *R. midwayensis* (Plummer) Cushman
Robulus inornatus (d'Orbigny) Toulmin
Marginulina tuberculata (Plummer) Cushman and Bermudez
Chrysalogonium granti (Plummer) Toulmin
Bulimina ovata d'Orbigny
Ceratobulimina sp.
Globigerina triloculinoides Plummer
Globorotalia acuta Toulmin
Cibicides sp.

Core 37, 2330-2357 feet, is the deepest core to which a Wilcox age assignment is given. The point of contact between the sediments of Wilcox and of Paleocene age cannot be recorded, as no cores were taken between 2357 feet and core 38, 2440-2450 feet. A definite Paleocene microfauna was found in the latter core. The precise top of the Paleocene sediments would fall within the 83 feet of section on which no data are available.

PALEOCENE BIOFACIES OF WESTERN FLORIDA

General Discussion

In the publication by Applin and Applin (1944), this Florida biofacies was referred to (p. 1704) as the "Tamesí fauna" and the same terminology will be used in the present report. The name was originally introduced by Dumble and Applin (1924, p. 339) to indicate beds that contained the "Velasco" fauna of Mexico to which these authors assigned a lower Eocene age. Cushman and Trager (1924) considered the fauna, described as "Velasco," to be Cretaceous in age. Since the term "Tamesí" was originally used to represent a Tertiary faunal group corresponding to the Velasco, it seemed logical to designate the similar Paleocene fauna of Florida as the "Tamesí fauna." In spite of its scientific significance, there are few published references to the Tamesí biofacies of the Paleocene sediments of Florida. In 1938, Dr. Cole described the lithologic and microfaunal features of a well drilled in Jackson County, Florida, and reported (p. 23) that a core taken at 1761-1768 feet "contained an excellent fauna of undoubted upper Midway age." He figured 15 species, mainly benthonic forms. Applin and Applin (1944) briefly discussed the Paleocene sediments of west Florida and called attention to the resemblance of the microfauna to that of the Velasco of Mexico. They figured (1944, pl. 5) three of the characteristic planktonic species and one benthonic form. Applin and Jordan (1945) listed some of the characteristic species, and described and figured two new benthonic forms, common in the faunal assemblage.

In the Tamesí biofacies of the Paleocene of Florida, from 50 to 75 percent of micropopulation is composed of planktonic specimens, especially near the base of the formation where these forms are particularly abundant. So far as known to the writer, there is only one other Paleocene fauna in the Gulf Coast region in which planktonic species of Foraminifera are dominant. The exception is that of a part of the Midway section of Tehuacana Creek, Limestone County, Texas, on which Kellough (1959) published a preliminary report. She discussed the fluctuating character of the sea and noted the abundance of specimens of planktonic Foraminifera in the deep-water facies. The planktonic species, however, are limited to those represented also in the more shallow-water facies of the same section.

During the last few years there have been many published accounts of microfaunas composed, in part, of planktonic species of Foraminifera. Loeblich and Tappan (1957b) described Paleocene and early Eocene planktonic Foraminifera from the Gulf and Atlantic Coastal plains. However, they did not include the Paleocene fauna of northwest Florida which does not crop out, but is found in all wells drilled to sufficient depths, across the panhandle area, from Escambia County on the west into Jefferson County, which forms the eastern boundary of this biofacies. East and south of Jefferson County, the Cedar Keys Formation, a carbonate biofacies of the Paleocene of Florida, probably represents the equivalent stratigraphic level, and to the north, in southern Georgia and Alabama, the largely benthonic microfaunas of the Porters Creek Clay and Clayton Formation presumably take the place of the highly planktonic Tamesí fauna of west Florida. Herrick (1961, p. 153, 194, 355) indicates an extension of the Tamesí fauna into southwestern Georgia through his record of a "Tamesí (Velasco) fauna" in the basal part of the Paleocene section in three wells in southern and southwestern Georgia. A fauna listed by Herrick (1961, p. 96) from a core taken in a well in Chatham County, Ga., may also be related to the Tamesí fauna. I found a Tamesí fauna in these and other Georgia wells listed on page 47 in this report.

The planktonic character of the Tamesí fauna and its geographic location along the northeastern border of the Gulf of Mexico should make it highly valuable in interregional and international correlation problems. Moreover, the fauna is strikingly uniform in character and composition throughout the region from which it is here described, suggesting deposition in a continuous sedimentary unit.

Occurrence of *Globorotalia velascoensis*

Typical specimens of *G. velascoensis* are very common in the lower portion of the clastic section of the Paleocene of Florida, but cores in the Walton well would indicate that specimens of the similar form *G. actua,* rare in the lower part of the section, become relatively abundant in the highest or youngest portion of the section, about 500 feet above the base. Loeblich and Tappan apparently did not find typical specimens of *Globorotalia velascoensis* in the Paleocene Gulf Coastal sediments which they discussed (1957b, p. 176), since they state, "The typical *velascoensis* does not range far north of its type region in Mexico although it does occur in Trinidad." It would seem, therefore, that the Florida occurrence indicates a notable extension of the geographic distribution of the species.

In his discussion of the occurrence of this species in the Mexican section, White (1928b, p. 281) states, "This is the most characteristic species of the Velasco, and occurs as an abundant form from slightly above the base of the formation to beyond the limits of the Velasco as dealt with in this paper," and White (1928a, p. 177) defines the stratigraphic upper limit of his study as "near the middle of the Velasco." Loeblich and Tappan (1957b, p. 175, fig. 27) indicate the presence of the species in the upper Velasco of Mexico also.

White also states (1928b, p. 281) that specimens of *Globorotalia velascoensis* disappear a short distance above the base of the Velasco in Mexico. In the Walton Land and Timber Company well no. 1, there are 39 feet of unsampled section between core 55 that contains the Tamesí fauna with abundant specimens of *G. velascoensis,* and core 56, in which the fauna is Late Cretaceous in age.

Paleoecology of the Tamesí Fauna

The Tamesí fauna of northwest Florida and the Velasco fauna of Mexico were apparently deposited under closely similar conditions. In both areas the sediments are chiefly light-colored marls that contain very little terrigenous detritus, and the fauna in both areas contains abundant specimens of planktonic Foraminifera, although specimens of many benthonic species are also present. In both faunas *G. velascoensis* and the similar form *G. acuta* are key microfossils.

A number of factors indicate that the Paleocene sediments of west Florida accumulated in a subtropical, open-sea environment. Information used to reconstruct the paleoecology of the Tamesí fauna is based on published accounts of the effect of water temperature, density, salinity, bathymetry, and associated factors on recent analogous species. Reports by Bandy (1961), Emiliani (1954), Lowman (1949), Norton (1930), and Stone (1956) were particularly helpful. The lithologic character of the sediments in which the Tamesí fauna was buried supplements this data. The most striking feature of the Tamesí fauna is the abundant representation of pelagic forms. Bandy (1961, p. 6) stated that "among foraminifera, percentages of planktonic specimens are highest on the outer shelf and in the upper bathyal zone." Crickmay, Ladd, and Hoffmeister (1941) have demonstrated that the abundance of globigerine forms does not necessarily indicate a deep-water environment; however, the Florida fauna contains 12 planktonic species that are common to abundant in the assemblage. Bandy also suggests (p. 7) that since "planktonic species are variable in their amount of tolerance for environmental variations, . . . their numbers decline toward the more variable inshore waters." Size is also a contributing factor in the assumption of an open-sea environment for the Tamesí fauna. A comparison of Florida species of Globigerinas and Globorotalias with groups of specimens of the same species occurring in Texas and Alabama Paleocene assemblages showed that the Florida specimens averaged twice the size of the forms with which they were compared. This is again an indication of an open-sea environment since Stone (1956, p. 369) states, "Variations in size and abundance have no direct relationship to depth, but the presence of pelagic forms indicate open-sea conditions," and "Abundance and size are closely related to circulating currents of the ocean, the most abundant specimens and the largest sizes occurring within the direct influence of ocean currents." The size of the Florida specimens may also provide some data in regard to probable conditions of temperature and salinity, since Stone (1956, p. 362) states that "sizes of foraminifera were found to decrease northward and southward from the Caribbean area." In regard to salinity the same author states that "the size of the organisms is probably not affected by salinities within the range of 34 to 37 parts per thousand, but the larger individuals tend to favor salinity between 36 and 37 parts per thousand."

So far, only the planktonic species have been considered. However, the benthonic specimens, although relatively less abundant, also contributed helpful data through the representation of specimens of *Eponides, Cibicides, Robulus, Marginulina, Dentalina,* and *Bulimina* that are common in the assemblage, and which Lowman (1949) in his study of the distribution of Recent species in the Gulf of Mexico believes are indicative of mid-neritic to inner bathyal environments, or of deposition from the mid-continental shelf outward onto the upper part of the continental slope. This hypothesis would seem to conform reasonably well with the data provided by the planktonic species. The lithology would also seem to be conformable. Cores taken through the Paleocene section in the Walton well no. 1 consist mainly of light-colored marls and some limestones, containing very little terrigenous detritus. These highly calcareous, fine-textured sediments yield washed concentrates composed almost entirely of specimens of Foraminifera, although very minor amounts of quartz in grains of silt size were present in cores taken between 2849 and 2951 feet in the Walton well, and a core of argillaceous, calcareous and highly glauconitic siltstone was cut at 2935-2940 feet. Considering all the data presented above, the writer offers the opinion that the Paleocene sediments of west Florida were deposited in clear, warm, well-aerated waters, on and near the outer part of the continental shelf.

Biostratigraphic Correlation of the Tamesí Fauna

Some faunal data obtained from cores taken in the Paleocene section of the Walton Land and Timber Company well no. 1 of Florida and stratigraphic correlations suggested by the author are at variance with some of the statements made and with some of the Paleocene correlations presented by Loeblich and Tappan (1957). This variance is probably due to the fact that Loeblich and Tappan presumably based their stratigraphic conclusions mainly on the presence or absence of certain species of planktonic Foraminifera that they had found in selected Paleocene outcrop samples. No data on the subsurface Paleocene sections of Florida or Georgia were included in their report on the Gulf Coastal Region.

Loeblich and Tappan (1957b, p. 177) present a correlation table of Paleocene strata of the Gulf and Atlantic Coastal regions "based on the included planktonic species." In the table the authors demonstrate their views on the relationship of the American and Mexican Paleocene formations to European stages, and on page 176 (1957b) they state, "The Danian stage of the lower Paleocene . . . is represented by the lower Velasco formation of Mexico; the Kincaid and Wills Point formations, Midway group of Texas; the Pine Barren and McBryde members of the Clayton formation, lower part of the Midway group of Alabama, and the Brightseat formation of Maryland." "The lower Landenian stage (Thanetian substage) or middle Paleocene . . . in Alabama . . . consists of the Porters Creek clay and Naheola formation, the upper part of the Midway group as previously recognized. The upper Landenian stage . . . represents the most controversial part of the section. On the basis of the placement elsewhere of the *G. velascoensis* zone as the uppermost Paleocene, and in view of the greater faunal break above than below this zone, it is here regarded as upper Paleocene. This zone includes the upper Velasco of Mexico," and ". . . the Salt Mountain limestone of Alabama," in the Gulf Coastal region.

The geographical range of *G. velascoensis* in the Velasco Formation of Mexico and in the Tamesí fauna of Florida has been discussed earlier in this paper, and it will be recalled that Loeblich and Tappan did not find specimens of *G. velascoensis* in the Gulf Coastal region. It is, therefore, difficult to understand the assignment of the Salt Mountain Limestone to the "*G. velascoensis* Zone," or the restriction of the zone to the "upper Velasco" of Mexico and the upper Paleocene of the Gulf Coastal area. In the Florida sequence, specimens of this species increase in abundance with depth and are most abundant in the lower part of the section. Only 12 of the 57 species included in the Tamesí faunal list are recorded from the Salt Mountain Limestone of Alabama.

Loeblich and Tappan (1957b, p. 175) also state, "In Sweden, Denmark, Russia, the near East, Egypt, the American Gulf and Atlantic coasts, and Trinidad, no angular or keeled *Globorotalia* are found in the lower Paleocene. They do occur in middle and upper Paleocene strata in these and other areas . . ."

The vertical range of *G. velascoensis* in the Paleocene section of west Florida was discussed earlier in this paper. This distinctly angular and keeled form occurs throughout the Paleocene section and is particularly abundant in the deepest core taken, 39 feet above the Cretaceous, where it is accompanied by 16 other species of Foraminifera recorded from the "lower Paleocene" (of Loeblich and Tappan) from other Gulf Coastal areas. (See fig. 2.) From studies of Velasco sections in Mexico, I am also able to confirm White's statement, previously given, regarding the range of the species in the Paleocene Velasco section of Mexico. If the statements of Loeblich and Tappan, quoted above, were universally correct, then lower Paleocene strata are not present, either in northwest Florida or in Mexico, unless the few feet indicated by White for Mexico (1928b, p. 281), and some part of the missing 39 feet of section in the Walton well of Florida could represent remnants of deposits of early Paleocene time.

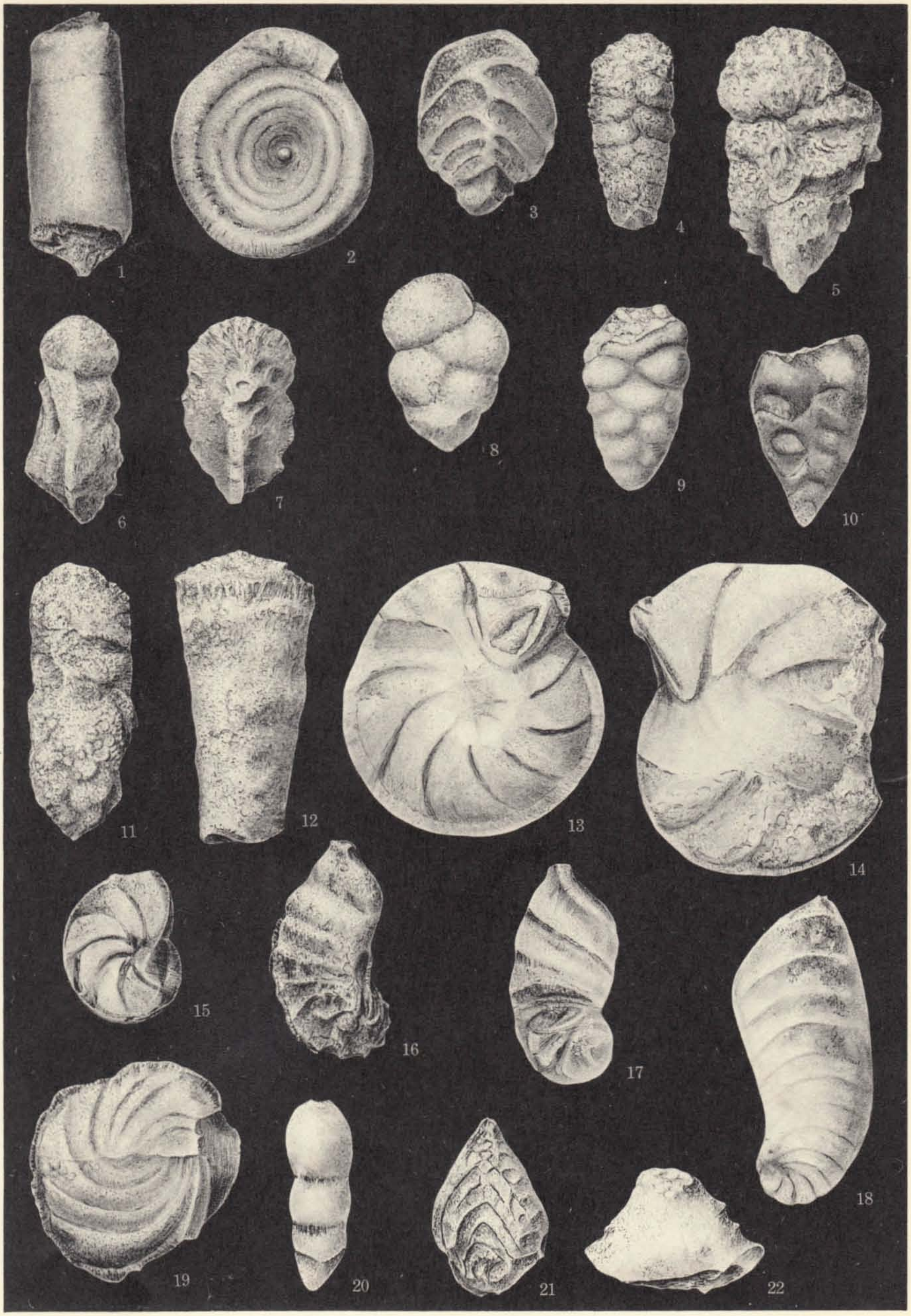
Referring again to the correlation table presented by Loeblich and Tappan (1957b, p. 177), it will be noted that the Clayton Formation was placed at the base of the Paleocene in Alabama. In this connection it is interesting to note that in Herrick's account (1961) of wells in southwestern Georgia he records a marl containing a "Tamesí fauna" in the basal part of his stratigraphic division, "Paleocene; Midway Group, Clayton Formation" in the Sun Oil Co., R. V. Ellis well no. 1 in Early County (p. 194), Mont Warren *et al.*, W. E. Harlow no. 1, Seminole County (p. 355), and the Hunt Oil Co., Metcalf no. 1 in Decatur County (p. 153). These sediments directly overlie the Cretaceous. The stratigraphic position of the Tamesí fauna containing *Globorotalia velascoensis* and other keeled globorotaliids does not conform with the time ranges attributed to them by Loeblich and Tappan as they are found below, or at the base of, the Clayton Formation. According to Loeblich and Tappan, keeled *Globorotalia* are not found in sediments older than Middle Paleocene, and they also state that the Clayton Formation is early Paleocene in age.

Loeblich and Tappan apparently assumed that time was the controlling factor in the stratigraphic distribution of certain species of planktonic Foraminifera, as indicated by their statement regarding the strati-

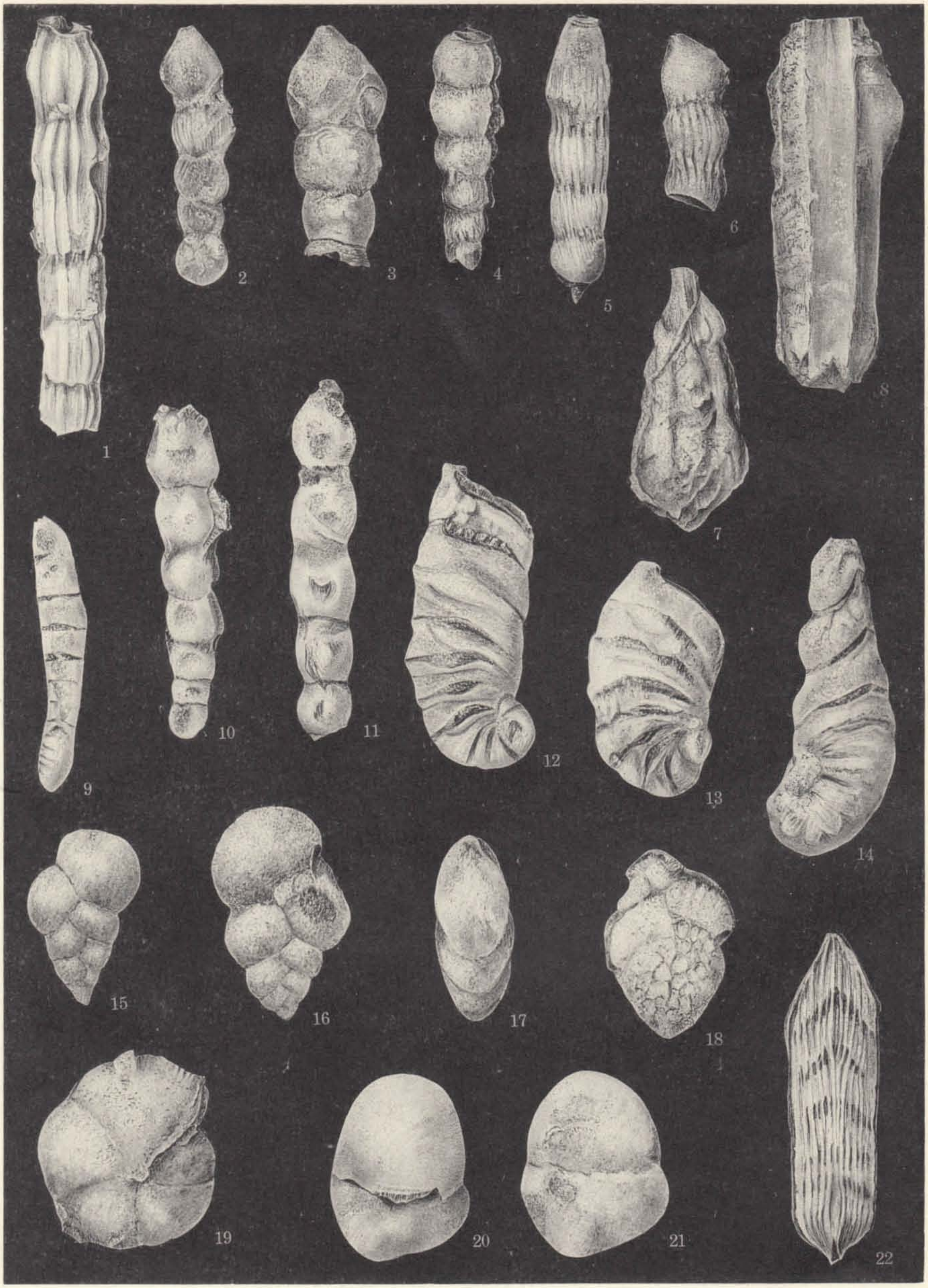
EXPLANATION OF PLATE 1

All figured specimens, unless otherwise stated, are from Oil City Corporation, Walton Land and Timber Company, well no. 1, Walton County, Florida.

Figs.		Page
1.	*Bathysiphon eocenicus* Cushman and G. D. Hanna. USNM 640489. Core no. 50, 2935-2940 feet. × 32	57
2.	*Ammodiscus* cf. *A. cretaceus* (Reuss) Cushman. USNM 640490. Core no. 55, 3055-3061 feet. × 32	57
3.	*Spiroplectammina plummerae* Cushman. USNM 640491. Cuttings 2225 feet, Central Oil and Gas Company, well no. 1, Leon County, Florida. × 63	58
4.	*Textularia plummerae* Lalicker. USNM 640492. Core no. 42, 2615-2620 feet. × 32	58
5.	*Gaudryina soldadoensis* Cushman and Renz. USNM 640494. Core no. 55, 3055-3061 feet. × 32	58
6, 7.	*Clavulinoides midwayensis* Cushman. 6, USNM 640495; 7, USNM 640496. Core no. 55, 3055-3061 feet. × 40	58
8.	*Dorothia retusa* (Cushman) Cushman. USNM 640499. Core no. 55, 3055-3061 feet. × 40	59
9.	*Marssonella oxycona* (Reuss) Cushman. USNM 640498. Core no. 55, 3055-3061 feet. × 40	59
10.	*Tritaxilina cubensis* Cushman and Bermudez. USNM 640502. Cuttings 2675 feet, Brown and Ravlin, V. G. Phillips, well no. 1, Wakulla County, Florida. × 23	59
11.	*Schenckiella alabamensis* Cushman. USNM 640501. Core no. 44, 2679-2685 feet. × 32	59
12.	*Adhaerentia* cf. *A. midwayensis* Plummer. USNM 640503. Core no. 51, 2960-2965 feet. × 32	59
13.	*Robulus midwayensis* (Plummer) Cole and Gillespie. USNM 640505. Core no. 55, 3055-3061 feet. × 32	59
14.	*Robulus pseudomamilligerus* (Plummer) Cushman. USNM 640506. Core no. 46, 2744-2749 feet. × 32	60
15.	*Robulus alabamensis* Cushman. USNM 640509. Core no. 39, 2480-2486 feet. × 32	60
16, 17.	*Marginulina tuberculata* (Plummer) Cushman and Bermudez. 16, USNM 640511; 17, USNM 640512. Core no. 43, 2620-2626 feet. × 32	60
18.	*Marginulina jarvisi* Cushman. USNM 640510. Core no. 39, 2480-2486 feet. × 32	60
19.	*Robulus insulsus* Cushman. USNM 640508. Core no. 39, 2480-2486 feet. × 63	60
20.	*Rectoglandulina manifesta* (Reuss). USNM 640525. Core no. 44, 2679-2685 feet. × 32	62
21.	*Palmula delicatissima* (Plummer) Cushman. USNM 640532. Core no. 39, 2480-2486 feet. × 40	62
22.	*Ramulina* cf. *R. aculeata* (d'Orbigny) Wright. USNM 640535. Core no. 43, 2620-2626 feet. × 32	63



Applin: middle Eocene, lower Eocene, and Paleocene, west Florida



Applin: middle Eocene, lower Eocene, and Paleocene, west Florida

graphic distribution of keeled forms of *Globorotalia*. However, Bandy (1961) and Boltovskoy (1962) have shown that temperature, salinity, density and related factors are highly important in the geographic distribution of Recent species of planktonic Foraminifera. As previously stated, Bandy found that planktonic species are highly variable in their tolerance of such environmental changes, and Boltovskoy was successful in using selected species of planktonic Foraminifera as indicators of different water masses in the South Atlantic. Bandy (1961, p. 7) also stated that "Tropical globorotaloids . . . show a more restricted occurrence than tropical globigerinids." It seems reasonable to assume, therefore, that Paleocene planktonic species might also have exhibited similar variations in tolerance. Some species common in outer shelf conditions and subtropical temperatures might be missing in inner shelf, nearshore, and more northerly, cooler-water environments. Similar reasoning would explain the marked increase in pelagic specimens unaccompanied by any change or increase in pelagic species that was noted in the deep-water facies of the Texas Midway section now being described by Kellough.

Published records show that nearly all of the benthonic species and about half of the planktonic forms that occur in the Tamesí fauna of Florida have been recorded also from Paleocene outcrop sections of other Gulf Coastal areas. The stratigraphic and geographic distribution of the species listed from the Tamesí fauna of west Florida is shown in table 1. The table shows that the stratigraphic position of nearly all the Florida species corresponds to the stratigraphic position within the Paleocene recorded for the same fossils in other Gulf Coastal areas. This would seem to indicate that all of the Paleocene section, or the lower and middle divisions as defined by Loeblich and Tappan, is represented in the west Florida Paleocene sediments.

Conclusions

In view of the points discussed above, the writer believes that the absence of *Globorotalia velascoensis* and other keeled globorotaliids, and the greatly reduced planktonic populations of the outcropping Paleocene sediments of Alabama, and most of the subsurface Paleocene microfossiliferous deposits of Georgia are not necessarily indicative of a difference in the stratigraphic position of the containing beds. On the contrary, the changes noted are probably the result of environmental differences which produced conditions unfavorable or less favorable to many of the planktonic species common in the Tamesí fauna. The author suggests that the relatively deep, clear, and warm-water conditions which existed over the west Florida region in Paleocene time were conducive to the production of sediments containing a fauna favoring a warm water, outer neritic and upper bathyal environment, and that these deposits graded northward into the inner neritic biofacies represented by the sediments and faunal pop-

EXPLANATION OF PLATE 2

All figured specimens, unless otherwise stated, are from Oil City Corporation, Walton Land and Timber Company, well no. 1, Walton County, Florida.

Figs.		Page
1.	*Dentalina pseudoobliquestriata* (Plummer) Cushman. USNM 640513. Core no. 39, 2480-2486 feet. × 32	61
2.	*Nodosaria monile* Hagenow. USNM 640523. Core no. 50, 2935-2940 feet. × 40	62
3, 4.	*Dentalina plummerae* Cushman. 3, USNM 640516; 4, USNM 640517. Core no. 55, 3055-3C61 feet. × 32	61
5, 6.	*Nodosaria velascoensis* Cushman. 5, USNM 640521; 6, USNM 640522. Core no. 55, 3055-3061 feet. × 32	62
7, 8.	*Nodosaria affinis* Reuss. 7, USNM 640519; 8, USNM 640520. Core no. 50, 2935-2940 feet. 7, × 44; 8, × 23	61
9.	*Dentalina colei* Cushman and Dusenbury. USNM 640515. Core no. 39, 2480-2486 feet. × 32	61
10, 11.	*Chrysalogonium eocenicum* Cushman and Todd. 10, USNM 640518; 11, USNM 640530. Core no. 55, 3055-3061 feet. × 63	62
12, 13, 14.	*Vaginulina longiforma* (Plummer) Cushman. 12, USNM 640527; 13, USNM 640528; 14, USNM 640529. Core no. 39, 2480-2486 feet. × 32	62
15.	*Chiloguembelina morsei* (Kline) Loeblich and Tappan. USNM 640538. Core no. 55, 3055-3061 feet. × 80	63
16.	*Chiloguembelina trinitatensis* (Cushman and Renz) Beckmann. USNM 640536. Core no. 38, 2440-2450 feet. × 80	63
17.	*Bulimina (Desinobulimina) quadrata* Plummer. USNM 640540. Core no. 44, 2679-2685 feet. × 32	64
18.	*Bolivinoides velascoensis* (Cushman) Cushman. USNM 640539. Cuttings 2870-2900 feet, Gulf Coast Drilling and Exploration Company, U. S. A. Forestry Service, well no. 1, Liberty County, Florida. × 63	63
19.	*Pullenia quinqueloba angusta* Cushman and Todd. USNM 640557. Core no. 43, 2620-2626 feet. × 63	65
20, 21.	*Allomorphina paleocenica* Cushman. 20, USNM 640555; ventral view. 21, USNM 640556; dorsal view. Core no. 43, 2620-2626 feet. × 63	65
22.	*Frondicularia naheolensis* Cushman and Todd. USNM 640533. Core no. 39, 2480-2486 feet. × 40	63

TABLE 1.—Geographic and stratigraphic distribution of the Tamesí fauna in Paleocene sediments of the Gulf Coastal Region, United States, Mexico, Trinidad, and Cuba[1]

	Texas		Arkansas		Mississippi		Alabama			Georgia	W. Florida[2]		Mexico	Trinidad		Cuba	Ala.
Tamesí fauna	Kincaid	Wills Point	Midway Fm., L. Part	Midway Fm., U. Part	Clayton Fm.	Porters Creek Clay	Clayton Fm.	Porters Creek	Naheola	Clayton Fm.	L. Part	U. Part	Velasco Fm.	L. Lizard Springs	Soldado Rock	Madruga	Salt Mt. Ls.[3] Wilcox[3]
Bathysiphon eocenicus	×	×									×						
Ammodiscus cretaceus		×									×		×				
Spiroplectammina plummerae		×	×		×			×		×		×					
Textularia plummerae		×					×					×					×
Gaudryina cf. *G. soldadoensis*					×		×					×			×		
Clavulinoides midwayensis	×	×	×	×		×	×			×	×	×					
Marssonella oxycona					×		×				×			×			×
Dorothia retusa											×		×	×			
Schenckiella alabamensis					×		×					×					
Tritaxilina cubensis							×				×					×	
Adhaerentia cf. *A. midwayensis*						×	×				×						
Robulus midwayensis	×	×	×	×			×	×	×	×	×						×
Robulus pseudomamilligerus	×	×		×		×	×			×		×					
Robulus insulsus		×						×				×					
Robulus alabamensis	×	×		×			×		×	×		×					
Marginulina jarvisi												×	×				
Marginulina tuberculata	×	×				×		×	×			×				×	
Dentalina pseudoobliquestriata	×		×	×			×	×			×	×					
Dentalina colei	×	×	×	×		×	×	×	×	×		×					×
Dentalina plummerae	×	×	×	×		×	×	×			×	×					
Nodosaria affinis	×	×	×	×	×		×	×	×	×	×	×		×			
Nodosaria velascoensis											×		×	×			
Nodosaria monile											×		×	×			
Chrysalogonium eocenicum	×	×	×	×			×	×			×			×			
Rectoglandulina manifesta	×	×	×	×			×	×		×		×	×				× (?)
Vaginulina longiforma		×	×	×				×	×	×		×					
Palmula delicatissima		×				×	×	×				×					
Frondicularia naheolensis		×		×				×	×		×	×					
Ramulina cf. *R. aculeata*		×	×	×	×		×	×				×					
Chiloguembelina trinitatensis												×			×		
Chiloguembelina morsei	×	×				×	×				×						
Bolivinoides velascoensis											×		×				
Bulimina quadrata		×		×			×			×		×					
Gyroidinoides subangulatus		×	×	×			×	×		×	×	×					
Eponides plummerae		×		×			×			×		×					
Eponides libertyensis											×						
Eponides waltonensis											×	×					
Alabamina wilcoxensis	×	×	×	×			×	×	×	×		×					×
Allomorphina paleocenica	×	×		×				×				×					
Pullenia quinqueloba angusta	×	×		×	×	×	×	×			×	×					×
Globigerina triloculinoides	×	×	×	×	×	×	×	×	×		×	×	×	×			×
Globigerina velascoensis												×	×	×			
Globorotalia trinidadensis												×		×			
Globorotalia pseudobulloides	×	×	×	×			×	×	×		×		×	×			
Globorotalia velascoensis											×		×	×			
Globorotalia acuta		×						×	×	×	×	×	×	×			×
Globorotalia pseudomenardii								×		×	×		×	×			×
Globorotalia albeari											×					×	
Globorotalia angulata								×				×	×	×			×
Globorotalia compressa		×	×	×			×	×	×		×						×
Anomalinoides rubiginosus											×		×	×			
Anomalinoides umboniferus									×	×		×					
Planulina waltonensis											×						
Cibicides alleni	×	×	×	×		×	×	×		×	×	×					
Cibicides praecursorius	×	×	×	×			×	×	×	×		×					
Cibicides newmani	×		×					×				×					
Cibicides libertyensis											×						

1 From published reports of restricted occurrences   2 From cored Walton well section   3 Shown for comparison

ulations of the Clayton, Porters Creek, and Naheola formations of Alabama and southern Georgia. From Herrick's report on the occurrence of the Tamesí fauna in well sections of southwestern Georgia and from studies made by this author, it would also seem that depositional conditions similar to those postulated for west Florida extended into southwestern Georgia in early Paleocene time.

Biofacies changes similar to those suggested for Florida and more northerly portions of the Gulf Coastal area of the United States have also been observed in Mexican microfaunal assemblages of Paleocene age. The Velasco fauna is found in the Tampico-Panuco-Valles region of Mexico, whereas in northern Mexico, particularly in the vicinity of the Salado Arch, the Paleocene sediments contain a fauna closely similar, in all respects, to the fauna of the Midway Group of Texas.

REMARKS

In order to clearly demonstrate the characteristics of the Tamesí fauna of western Florida, specimens are illustrated here, although most of the species have already been described and figured from other areas. With few exceptions, figured specimens are from the Oil City Corporation, Walton Land and Timber Company well no. 1, Walton County, Florida. "Distribution" covers only published data on the occurrence of species in Paleocene deposits of the Gulf Coastal region of the United States and Mexico. Other occurrences are covered by synonymies. All species described were compared with types located in the National Museum collections in Washington, D. C.

To conserve space, the synonymies given in Cushman's comprehensive report on the Paleocene Foraminifera of the Gulf Coastal region (1951), and in his Upper Cretaceous Foraminifera of the Gulf Coastal region (1946) in which Velasco species were included, are not repeated.

All cores and cuttings on wells listed in this report have been released. Core samples on the Oil City Corporation, Walton Land and Timber Company well were sent to me at the time the well was drilled by Ray L. Estabrook and John Weinzerl, for whom I made a report on the well section. Illustrations of specimens were prepared by Elinor Stromberg, scientific illustrator, U. S. Geological Survey. The figured specimens are deposited in the U. S. National Museum, Washington, D. C.

Acknowledgments

The writer wishes to gratefully acknowledge the assistance and helpful criticism given by Ruth Todd and Doris Low during the progress of the study of the Tamesí fauna. The author also wishes to express her appreciation of the courtesy tendered by Mrs. Kellough in permitting her to briefly study the suite of slides demonstrating the faunal sequence of the Midway section of Tehuacana Creek, Limestone County, Texas, on which Mrs. Kellough is now completing a report. Thanks are also due to Stephen Herrick for the loan of the slide demonstrating the sequence of faunal groups found in the U. S. Geological Survey Test Hole no. 1, Chatham County, Georgia.

SYSTEMATIC DESCRIPTIONS

Family RHIZAMMINIDAE

Genus **Bathysiphon** M. Sars, 1872

Bathysiphon eocenicus Cushman and G. D. Hanna

Plate 1, figure 1

1927, *Bathysiphon eocenica* Cushman and G. D. Hanna, California Acad. Sci. Proc., 4th ser., v. 16, p. 210, pl. 13, figs. 2, 3.

1951, *Bathysiphon eocenica* Cushman and G. D. Hanna. Cushman, U. S. Geol. Survey Prof. Paper 232, p. 3, pl. 1, figs. 1, 2.

1953, *Bathysiphon eocenicus* Cushman and G. D. Hanna. Weiss, Jour. Paleontology, v. 29, no. 1, p. 5, pl. 1, fig. 2.

Discussion.—Fragments of this species are usually present, but never common in the Tamesí fauna. Specimens in the Walton well were found in concentrates from core 50, 2935-2965 feet, near the base of the section. Avnimelech (1952, p. 66) has stated that " . . . most of the species of *Bathysiphon* occur at depths greater than 1000 m." Since the fauna present in cores taken near the base of the section was particularly rich in planktonic specimens and species, the deep-water environmental preference of this species would seem to substantiate the open-sea environment postulated for most of the Paleocene deposits of western Florida.

Distribution.—Reported Tertiary range of species in Gulf Coastal area: Midway Group of Texas.

Family AMMODISCIDAE

Genus **Ammodiscus** Reuss, 1861

Ammodiscus cf. **A. cretaceus** (Reuss) Cushman

Plate 1, figure 2

1951, *Ammodiscus* cf. *A. cretaceus* (Reuss). Cushman, U. S. Geol. Survey Prof. Paper 232, p. 4, pl. 1, fig. 3.

Discussion.—Specimens were found in several cores taken in the Paleocene section of the Walton well no. 1, and the species is widely distributed in the Tamesí fauna of the Paleocene section in the wells listed on page 47 of this report.

Specimens found in the Tamesí fauna agree in all respects with those figured and described by Helen J. Plummer (1926, p. 63, pl. 13, fig. 1 a-d) as *Ammodiscus incertus* (d'Orbigny). Cushman (1951, p. 4) states that the forms figured by Mrs. Plummer "are probably the same as the forms," he "referred to *A.* cf. *A. cretaceus.*"

Haynes (1958, p. 58, pl. 15, figs. 3, 3a) figures *Involutina cretacea* from the Paleocene, Thanet Beds of England, and places *A. cretaceus* Cushman (1946) in the synonymy. Haynes' figures are also closely similar to the Tamesí specimens.

Distribution.—Reported Tertiary range in Gulf Coastal region: Wills Point of Texas.

Family TEXTULARIIDAE
Genus **Spiroplectammina** Cushman, 1927
Spiroplectammina plummerae Cushman
Plate 1, figure 3

1948, *Spiroplectammina plummerae* CUSHMAN, Maiyland Dept. Geol., Mines and Water Res., Bull. 2, p. 226, pl. 16, fig. 2.
1951, *Spiroplectammina plummerae* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 5, pl. 1, figs. 19, 20.

Discussion.—Specimens of this species, though never abundant, are a characteristic feature of faunal assemblages in the middle and lower parts of the Paleocene section of west Florida.

Distribution.—Reported Tertiary range of the species in the Gulf Coastal region: Midway Group of Texas; Midway Formation of Arkansas; Porters Creek Formation, Matthews Landing Marl Member, Alabama; and Clayton Formation, Chalybeate Limestone Member of Mississippi.

Genus **Textularia** Defrance, 1824
Textularia plummerae Lalicker
Plate 1, figure 4

1935, *Textularia plummerae* LALICKER, Cushman Lab. Foram. Research Contr., v. 11, p. 50, pl. 6, fig. 10.
1951, *Textularia plummerae* Lalicker. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 7, pl. 2, figs. 2, 3.
1952, *Textularia plummerae* Lalicker. DROOGER, Cushman Found. Foram. Research Contr., v. 3, pt. 2, p. 92, pl. 15, figs. 4a-5.
1956, *Textularia plummerae* Lalicker. HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 28, pl. 9, figs. 6a-c.

Discussion.—Specimens of this species are comparatively rare in the Tamesí fauna of Florida. Florida specimens have a more coarsely arenaceous wall structure, similar to that of the varietal form *T. plummerae* var. *arkansasana,* but the chambers are equal in width over the major portion of the test, giving the form the elongate, straight-sided appearance characteristic of the species.

Distribution.—Reported Tertiary range of the species in the Gulf Coastal region: Clayton Formation, Chalybeate Limestone Member of Alabama, and Midway Group of Texas.

Family VERNEUILINIDAE
Genus **Gaudryina** d'Orbigny, 1839
Gaudryina soldadoensis Cushman and Renz
Plate 1, figure 5

1942, *Gaudryina soldadoensis* CUSHMAN and RENZ, Cushman Lab. Foram. Research Contr., v. 18, p. 4, pl. 1, fig. 1.
1951, *Gaudryina soldadoensis* Cushman and Renz. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 8, pl. 2, figs. 8, 9.
1956, *Gaudryina soldadoensis* Cushman and Renz. HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 39, pl. 5, figs. 11, 12; pl. 9, fig. 7.

Discussion.—Florida specimens conform with plesiotypes identified and figured by Cushman (1951, pl. 2, fig. 3). Types are from the Paleocene, Soldado Rock Formation of Trinidad. The plesiotypes with which the Florida specimens were compared have a rough textured surface, and lack the strong compression shown by the type specimens from Trinidad. A form closely similar to the Florida specimens was described and figured by Kline (1943, pl. 7, fig. 14) from the Clayton Formation of Mississippi, and similar forms are present in the fauna of the Texas Midway section, now being described by Mrs. Kellough, who kindly permitted me to study the faunal assemblages from the Tehuacana Creek section on which she is preparing a paper.

Distribution.—The species is reported from the Clayton Formation of Alabama, and the Clayton Formation of Mississippi.

Genus **Clavulinoides** Cushman, 1936
Clavulinoides midwayensis Cushman
Plate 1, figures 6, 7

1936, *Clavulinoides midwayensis* CUSHMAN, Cushman Lab. Foram. Research Special Pub. 6, p. 21, pl. 3, figs. 9, 15.
1951, *Clavulinoides midwayensis* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 8, pl. 2, figs. 10-16.

Discussion.—*C. midwayensis* Cushman is common throughout the Paleocene section of northwest Florida. Specimens seem to be variable in regard to length of the triserial portion, and reduction in width of test in the uniserial part of the test. Surface is slightly roughened. The surface of specimens of the very similar form, *C. trilatera* (Cushman), common in Upper Cretaceous sediments of the Gulf Coast region, is usually very smooth.

C. midwayensis is very close to *C. trilatera* (Cushman) Cushman, which occurs in the Cretaceous but was described from the Velasco Shale of Mexico by Cushman (1926, p. 588, pl. 17, fig. 2). Said and Kenawy (1956, p. 126, pl. 1, fig. 39) report the occurrence of typical specimens of *C. trilatera* from the Paleocene of northern Sinai, Egypt.

Distribution.—In the Gulf Coastal region of the United States the species is recorded from the Clayton Formation, Chalybeate Limestone Member of Alabama; the Porters Creek Clay of Mississippi; the Midway Formation of Arkansas; and the Midway Group of Texas.

Family VALVULINIDAE
Genus **Marssonella** Cushman, 1933
Marssonella oxycona (Reuss) Cushman

Plate 1, figure 9

1860, *Gaudryina oxycona* REUSS, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber., v. 40, p. 229, pl. 12, fig. 3.

1946, *Marssonella oxycona* (Reuss). CUSHMAN, U. S. Geol. Survey Prof. Paper 206, p. 43, pl. 12, figs. 3-5.

1951, *Marssonella oxycona* (Reuss). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 9, pl. 12, fig. 21.

Discussion.—Specimens referred to this species were found in samples of the Paleocene in the west Florida wells listed on page 47, and were fairly common in the lower part of the Paleocene section in the Walton well.

Distribution.—Cushman and Jarvis (1932, p. 18) state that this is "a widely distributed and well characterized species." They record it (1932, p. 18) from the Lower Lizard Springs Formation of Trinidad, the Velasco Shale of Mexico and the Cretaceous of the Gulf Coastal region of the United States. Cushman also records this species from the basal part of the Midway Group of Alabama; and states that Kline reported a specimen from the uppermost Clayton Chalk in a hand-auger test hole drilled in Clay County, Mississippi. Cushman gives his opinion that both the Alabama and the Mississippi specimens may have been reworked from the Cretaceous.

Genus **Dorothia** Plummer, 1931
Dorothia retusa (Cushman) Cushman

Plate 1, figure 8

1926, *Gaudryina retusa* CUSHMAN, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 588, pl. 16, figs. 10a, b.

1946, *Dorothia retusa* (Cushman). CUSHMAN, U. S. Geol. Survey Prof. Paper 206, p. 46, pl. 13, figs. 1-4.

1956, *Dorothia retusa* (Cushman). SAID and KENAWY, Micropaleontology, v. 2, no. 2, p. 128, pl. 2, fig. 2.

Discussion.—This species is fairly common in the lower part of the Paleocene section of northwestern Florida. The Florida specimens agree perfectly with type specimens from the Velasco Shale of Mexico.

Genus **Schenckiella** Thalmann, 1942
Schenckiella alabamensis Cushman

Plate 1, figure 11

1940, *Listerella laevis* CUSHMAN (*not* Finlay), Cushman Lab. Foram. Research Contr., v. 16, p. 54, pl. 9, fig. 8.

1951, *Schenckiella alabamensis* CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 10, pl. 2, fig. 18.

Discussion.—Specimens of this species were found in core no. 44, 2679-2685 feet, in the middle part of the Paleocene section in the Walton well. Specimens are present, but not common, in the Tamesí fauna of other wells in northwestern Florida. The Florida specimens occurred in a silty marl in the Walton well, and the wall texture of the specimens is less smooth than on types of the species.

Distribution.—Clayton Formation of Alabama, and Clayton Formation of Mississippi.

Genus **Tritaxilina** Cushman, 1911
Tritaxilina cubensis Cushman and Bermudez

Plate 1, figure 10

1936, *Tritaxilina cubensis* CUSHMAN and BERMUDEZ, Cushman Lab. Foram. Research Contr., v. 12, pl. 10, figs. 24, 25.

1951, *Tritaxilina cubensis* Cushman and Bermudez. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 10, pl. 2, fig. 20.

Discussion.—Specimens were found in the lower part of the Paleocene section in the Walton well 1.

Distribution.—Cushman (1951) records the species from the Clayton Formation, Chalybeate Limestone Member of Alabama.

Family PLACOPSILINIDAE
Genus **Adhaerentia** Plummer, 1938
Adhaerentia cf. **A. midwayensis** Plummer

Plate 1, figure 12

Fragments of forms here referred to this species were fairly common in cores of silty limestone cut near the middle of the Paleocene section in the Walton well.

Distribution.—Types of the species are from an outcrop of the Clayton Formation in Alabama. Cushman (1951, p. 13) records its occurrence from the Chalybeate Limestone Member of the Clayton Formation of Alabama, and Porters Creek Clay of Mississippi.

Family NODOSARIIDAE
Genus **Robulus** Montfort, 1808
Robulus midwayensis (Plummer) Cole and Gillespie

Plate 1, figure 13

1926, *Cristellaria midwayensis* PLUMMER, Texas Univ. Bull. 2644, p. 95, pl. 13, fig. 5.

1951, *Robulus midwayensis* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 13, pl. 3, figs. 14-17.

1956, *Robulus midwayensis* (Plummer). NAKKADY, Micropaleontology, v. 5, no. 4, p. 458, pl. 1, fig. 7a-b.

1959, *Robulus midwayensis* (Plummer). HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 68, pl. 19, fig. 13; pl. 28, fig. 1.

Discussion.—Cushman (1951, p. 13) mentions the considerable variation shown by specimens included in this species. Specimens in the Florida Tamesí fauna are slightly less tumid, and the sutures and umbones are usually less highly elevated than on specimens common in samples studied from the Midway Group of Texas.

Distribution.—Occurrences reported by Cushman from the Gulf Coast region: Clayton, Porters Creek, and Naheola formations of Alabama; Midway Group of Texas; and Midway Formation of Arkansas. Toulmin (1941, p. 579) also records the species from parts of the Wilcox Formation of Alabama including the "uppermost portion" of the Salt Mountain Limestone. Herrick (1961) records the species from the subsurface, Paleocene, Clayton section of Georgia.

Robulus pseudomamilligerus (Plummer) Cushman

Plate 1, figure 14

1926, *Cristellaria pseudo-mamilligera* PLUMMER, Texas Univ. Bull. 2644, p. 98, pl. 7, fig. 11.

1951, *Robulus pseudo-mamilligerus* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 13, pl. 4, figs. 1-5.

1955, *Robulus pseudo-mamilligerus* (Plummer). HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 64, pl. 28, figs. 3a-b; pl. 34, fig. 7.

Discussion.—Specimens in the Florida Paleocene correspond most closely with paratypes from the basal Midway of Hunt County, Texas. In the Walton well, specimens are most common in concentrates from core no. 46, 2744-2749 feet in the middle portion of the Paleocene section. Most of the specimens have a somewhat worn appearance which may be due to poor preparation techniques.

Distribution.—Cushman (1951, p. 13) states that "the species is most common in the . . . middle portion of the Midway group of Texas." He records the species (p. 14) from the Clayton Formation of Alabama; the Midway Formation of Arkansas; the Midway Group of Texas; and states (p. 13) that it is also recorded "from the uppermost part of the Porters Creek clay of Mississippi." Herrick (1961) records the species from the subsurface, Clayton Formation of Georgia.

Robulus insulsus Cushman

Plate 1, figure 19

1947, *Robulus insulsus* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 23, p. 83, pl. 18, figs. 2, 3.

1951, *Robulus insulsus* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 16, pl. 5, figs. 1-3.

Discussion.— A few specimens of this species are usually present in samples containing the Tamesí faunal assemblage of west Florida. The Florida specimens are usually slightly larger than the types.

Distribution.—The species is reported from the Porters Creek Formation of Alabama, and the Midway Group of Texas.

Robulus alabamensis Cushman

Plate 1, figure 15

1944, *Robulus alabamensis* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 20, p. 33, pl. 5, fig. 13.

1951, *Robulus alabamensis* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 15, pl. 4, figs. 15, 16.

1955, *Robulus alabamensis* Cushman. WEISS, Jour. Paleontology, v. 29, no. 1, p. 9, pl. 2, figs. 11, 12.

1960, *Robulus alabamensis* Cushman. OLSSON, Jour. Paleontology, v. 34, no. 1, p. 9, pl. 2, fig. 1.

Discussion.—This species is common in parts of the Florida Paleocene section in which the Lagenidae are fairly well represented. Specimens in the Florida Paleocene section are most closely related to paratypes from the Coal Bluff Marl Member of the Naheola Formation of Alabama.

Distribution.—Cushman records its appearance in the Coal Bluff Marl Member of the Naheola Formation, and the Chalybeate Limestone Member of the Clayton Formation of Alabama; the Midway Formation of Arkansas; and the Midway Group of Texas. Recorded also by Herrick (1961) from the subsurface Clayton Formation of Georgia.

Genus **Marginulina** d'Orbigny, 1826

Marginulina jarvisi Cushman

Plate 1, figure 18

1926, *Cristellaria grata* CUSHMAN (*not* Reuss), Am. Assoc. Petroleum Geologists Bull., v. 10, p. 598, pl. 19, figs. 1a-b.

1946, *Marginulina jarvisi* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 206, p. 63, pl. 22, figs. 18-20.

Discussion.—This species is not abundant but is usually present in west Florida well sections containing a Tamesí fauna.

Distribution.—It is found also in the Velasco Shale of Mexico, and in the Lizard Springs Formation, near Guayaguayare, Trinidad, British West Indies.

Marginulina tuberculata (Plummer) Cushman and Bermudez

Plate 1, figures 16, 17

1926, *Cristellaria subaculeata* Cushman var. *tuberculata* PLUMMER, Texas Univ. Bull. 2644, p. 101, pl. 7, fig. 2; pl. 14, figs. 1a-c.

1951, *Marginulina tuberculata* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 17, pl. 5, figs. 11-13.

1956, *Hemicristellaria tuberculata* (Plummer). SAID and KENAWY, Micropaleontology, v. 2, no. 2, p. 130, pl. 2, fig. 15.

Discussion.—Specimen of *M. tuberculata* are fairly common in the upper part of the Paleocene section in the Walton well and are known to occur in the Tamesí fauna of other wells located in northwestern Florida. The Florida specimens conform with the description of the species in all respects except in the tuberculate character of the sutures. On most of the Florida forms, only a few scattered, beadlike tubercules are present on the initial, coiled portion of the test, and the sutures of the uncoiled chamber series are broad and elevated but not beaded. The sutures narrow abruptly near the peripheries where they are again broad, but low. However, on some specimens the sutures separating the early chambers of the uncoiled series are formed by a very low, continuous set of nodes. Similar irregularities in ornamentation are mentioned in the original description of the species, therefore the variations described above were not made the basis of a new species or variety.

Distribution.—Matthews Landing Marl Member of Porters Creek Formation and rare in Naheola of Alabama; Midway Group of Texas but largely confined to the upper part.

Genus **Dentalina** d'Orbigny, 1826

Dentalina pseudoobliquestriata (Plummer) Cushman

Plate 2, figure 1

1926, *Nodosaria pseudo-obliquestriata* PLUMMER, Texas Univ. Bull. 2644, p. 87, pl. 4, fig. 18.

1951, *Dentalina pseudo-obliquestriata* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 19, pl. 6, fig. 1-3.

Discussion.—Specimens from the Florida Tamesí fauna are closely similar to the type figured by Plummer and refigured by Cushman (1951, pl. 6, fig. 3). On the Florida specimens the sutures are only slightly constricted, and the chambers less inflated except close to the terminal end. These differences, however, are slight, and would not seem to warrant a varietal designation.

Distribution in the Gulf Coastal region.—Pine Barren Member of the Clayton Formation of Alabama; the Matthews Landing Marl Member of the Porters Creek Formation of Alabama; Midway Formation of Arkansas; and the Midway Group of Texas.

Dentalina colei Cushman and Dusenbury

Plate 2, figure 9

1934, *Dentalina colei* CUSHMAN and DUSENBURY, Cushman Lab. Foram. Research Contr., v. 10, p. 54, pl. 7, figs. 10-12.

1951, *Dentalina colei* Cushman and Dusenbury. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 19, pl. 6, figs. 8-10.

1955, *Dentalina colei* Cushman and Dusenbury. WEISS, Jour. Paleontology, v. 29, no. 1, p. 10, pl. 2, fig. 28.

1960, *Dentalina colei* Cushman and Dusenbury. OLSSON, Jour. Paleontology, v. 34, no. 1, p. 13, pl. 2, fig. 18.

Discussion.—Specimens of this species are found in the Tamesí fauna of northwest Florida. The species is present in cores taken near the top of the Paleocene section in the Walton well no. 1.

Distribution.—Porters Creek Clay of Mississippi; Porters Creek Formation, Naheola Formation, and Clayton Formation of Alabama; Midway Formation of Arkansas; and Midway Group of Texas. Herrick (1961) records the species from the subsurface, Clayton Formation of Georgia.

Dentalina plummerae Cushman

Plate 2, figures 3, 4

1940, *Dentalina plummerae* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 16, p. 57, pl. 10, figs. 7-9, 19 (?).

1951, *Dentalina plummerae* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 20, pl. 6, figs. 11-15.

1956, *Dentalina plummerae* Cushman. HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 79, pl. 13, figs. 13, 14.

1960, *Dentalina plummerae* Cushman. OLSSON, Jour. Paleontology, v. 34, p. 14, pl. 2, fig. 19.

Discussion.—Specimens of this small, delicate species are usually present, but rare, in the Tamesí fauna of the Paleocene sediments of northwest Florida.

Distribution.—Species has been reported from the Porters Creek and Clayton formations of Alabama; the Porters Creek Clay of Mississippi; the Midway Formation of Arkansas; and Midway Group of Texas.

Genus **Nodosaria** Lamarck, 1812

Nodosaria affinis Reuss

Plate 2, figures 7, 8

1845, *Nodosaria affinis* REUSS, Versteinerungen böhm. Kreideformation, pt. 1, p. 26, pl. 13, fig. 16.

1951, *Nodosaria affinis* Reuss. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 23, pl. 7, figs. 3-6.

1955, *Nodosaria affinis* Reuss. WEISS, Jour. Paleontology, v. 29, no. 1, p. 11, pl. 3, fig. 7.

1956, *Nodosaria affinis* Reuss. HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 85, pl. 5, figs. 1, 2, 4, 5; pl. 15, figs. 1, 2, 4.

Discussion.—The species has a wide geographic and long stratigraphic range. In the Paleocene section of the Walton well no. 1, specimens are present in cores taken at several depths, and specimens and fragments are present in nearly all well sections in northwest Florida that contain a Tamesí fauna.

Distribution.—In Paleocene sediments of the Gulf Coastal region, Naheola, Porters Creek, and Clayton formations of Alabama; Midway Formation of Arkansas; and Midway Group of Texas; and Clayton Formation of Mississippi. Reported also by Herrick (1961) from the subsurface, Clayton Formation of Georgia.

Nodosaria velascoensis Cushman

Plate 2, figures 5, 6

1926, *Nodosaria fontannesi* Berthelin, var. *velascoensis* CUSHMAN, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 504, pl. 18, fig. 12.

1946, *Nodosaria velascoensis* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 206, p. 73, pl. 26, figs. 27-30.

Discussion.—Cushman (1946, p. 73) mentions the common occurrence of this form in the Velasco Shale of Mexico, and it has always seemed to this writer to be one of the diagnostic species of that formation. In the Tamesí fauna of Florida, specimens are fairly common, but fragmentary.

Distribution.—It has previously been reported only from the Velasco Shale of Mexico, and from the pit at Lizard Springs, near Guayaguayare, southeastern Trinidad.

Nodosaria monile Hagenow

Plate 2, figure 2

1842, *Nodosaria monile* HAGENOW, Neues **Jahrb**., p. 568.

1946, *Nodosaria monile* Hagenow. CUSHMAN, U. S. Geol. Survey Prof. Paper 206, p. 75, pl. 27, fig. 9.

Discussion.—Specimens in the Tamesí fauna of Florida seem to conform with paratypes from the lower Lizard Springs Formation of Trinidad, and the Velasco Shale of Mexico. The Florida specimens have few chambers, all bulbous in shape, and show little change in size between the initial and terminal ends. Sutures are strongly depressed, chambers very distinct.

Distribution.—The species has not been previously recorded from the Gulf Coastal region.

Genus **Chrysalogonium** Schubert, 1907

Chrysalogonium eocenicum Cushman and Todd

Plate 2, figures 10, 11

1946, *Chrysalogonium eocenicum* CUSHMAN and TODD, Cushman Lab. Foram. Research Contr., v. 22, p. 53, pl. 9, figs. 3-5.

1951, *Chrysalogonium eocenicum* Cushman and Todd. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 25, pl. 7, figs. 13-15.

Discussion.—Many fragments of this form were found in concentrates from cores taken in the lower part of the Paleocene section in the Walton County well.

Distribution.—The species is recorded from the Porters Creek and Clayton formations of Alabama; the Midway Formation of Arkansas; and the Midway Group of Texas.

Genus **Rectoglandulina** Loeblich and Tappan, 1955

Rectoglandulina manifesta (Reuss)

Plate 1, figure 20

1851, *Glandulina manifesta* REUSS, Haidinger's Naturwiss. Abh., v. 4, pt. 1, p. 22, pl. 1, fig. 4.

1951, *Pseudoglandulina manifesta* (Reuss). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 25, pl. 7, figs. 16, 17.

1955, *Pseudoglandulina manifesta* (Reuss). WEISS, Jour. Paleontology, v. 29, no. 1, p. 12, pl. 3, figs. 8, 9.

Discussion.—This species is present, but not common in the Tamesí fauna of northwest Florida. Specimens from the Tamesí fauna of Florida most closely resemble paratypes from Alabama in the Cushman Collection.

Distribution.—In Paleocene sediments of the Gulf Coastal region, the species is reported from the Porters Creek and Clayton formations of Alabama; the Midway Formation of Arkansas; and the Midway Group of Texas.

Genus **Vaginulina** d'Orbigny

Vaginulina longiforma (Plummer) Cushman

Plate 2, figures 12, 13, 14

1926, *Cristellaria longiforma* PLUMMER, Texas Univ. Bull. 2644, p. 102, pl. 13, fig. 4.

1951, *Vaginulina longiforma* (Plummer). CUSHMAN, U. S. Prof. Paper 232, p. 28, pl. 8, figs. 10-15.

Discussion.—This species is common in the upper part of the Paleocene section in the Walton well and is frequently present in the Tamesí faunal assemblages of the other Florida wells listed on page 47 of this report. The species is variable in contour. Both long slender forms (pl. 2, figs. 12, 14) and relatively broad forms (pl. 2, fig. 13) are often represented by many specimens in the same faunal asemblage, although the long variety is more common in the Florida Paleocene section, and in the Midway of Texas. A species, closely similar to the long variety mentioned above, was recorded by White (1928a, p. 206, pl. 29, fig. 4) as *V. trilobata,* from the Velasco Shale of Mexico, where it is present throughout the Velasco section, and common in the middle portion.

Distribution.—Cushman (1951, p. 28) states that this species "should . . . make a good index fossil for the upper part of the Paleocene." He records *V. longiforma* from the Porters Creek and Naheola formations of Alabama; the Midway Formation of Arkansas; and from the Wills Point Formation, upper member of the Midway Group of Texas. Herrick (1961) records the species from the subsurface, Clayton Formation of Georgia.

Genus **Palmula** Lea, 1833

Palmula delicatissima (Plummer) Cushman

Plate 1, figure 21

1926, *Frondicularia delicatissima* PLUMMER, Texas Univ. Bull. 2644, p. 120, pl. 5, fig. 4.

1951, *Palmula delicatissima* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 29, pl. 7, figs. 33-35.

Discussion.—A few specimens of this form are found in the upper part of the Tamesí fauna.

Distribution.—Cushman notes (1951, p. 29) that the species "is apparently characteristic of the upper portion of the Paleocene of Texas and Alabama and is recorded from the Porters Creek Clay of Mississippi." Cushman also recorded specimens from the Chalybeate Limestone, basal member of the Clayton Formation of Alabama.

Genus **Frondicularia** Defrance, 1824

Frondicularia naheolensis Cushman and Todd

Plate 2, figure 22

1942, *Frondicularia naheolensis* CUSHMAN and TODD, Cushman Lab. Foram. Research Contr., v. 18, p. 33, pl. 6, figs. 5, 6.

1951, *Frondicularia naheolensis* Cushman and Todd. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 30, pl. 8, figs. 24, 25.

Discussion.—This species is often present in Tamesí faunal assemblages that contain many specimens of species belonging to the Nodosariidae. It occurs in the upper part of the subsurface Paleocene section of northwestern Florida. Specimens conform with the types in all respects except in size, the Florida specimens averaging larger.

Distribution in the Gulf Coastal region.—Porters Creek Formation of Alabama; Midway Formation of Arkansas; and Midway Group of Texas.

Family POLYMORPHINIDAE

Genus **Ramulina** Rupert Jones, 1875

Ramulina cf. **R. aculeata** (d'Orbigny) Wright

Plate 1, figure 22

1951, *Ramulina* cf. *R. aculeata* (d'Orbigny). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 36, pl. 10, figs. 24-26.

Discussion.—Fragmentary specimens of a form apparently related to the above are found in many samples of the Tamesí fauna. Like the form figured and discussed by Mrs. Plummer (1926, p. 127, pl. 8, fig. 7) the surface of the Florida specimens is smooth. Specimens are also slightly compressed and the stolon tubes are usually represented only by very short projections, as on the figure given. Florida specimens most closely resemble types in the Cushman Collection from Sumter County, Alabama.

Distribution in Paleocene sediments of Gulf Coast.—Porters Creek and Clayton formations of Alabama; Clayton Formation of Mississippi; Midway Formation of Arkansas; and Wills Point, upper part of the Midway of Texas.

Family HETEROHELICIDAE

Genus **Chiloguembelina** Loeblich and Tappan, 1956

Chiloguembelina trinitatensis (Cushman and Renz) Beckmann

Plate 2, figure 16

1942, *Gümbelina trinitatensis* CUSHMAN and RENZ, Cushman Lab. Foram. Research Contr., v. 18, p. 8, pl. 2, fig. 8.

1951, *Gümbelina trinitatensis* Cushman and Renz. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 38, pl. 11, fig. 9.

1955, *Gümbelina* cf. *G. trinitatensis* Cushman and Renz (?). WEISS, Jour. Paleontology, v. 29, no. 1, p. 13, pl. 3, fig. 14.

1956, *Gümbelina trinitatensis* (Cushman and Renz). HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 120, pl. 3, fig. 10; pl. 17, figs. 11, 12, 14, 15, 24-25.

1957, *Chiloguembelina trinitatensis* (Cushman and Renz). BECKMANN, U. S. Natl. Mus. Bull. 215, p. 91, pl. 21, fig. 7; text-fig. 15 (43-45).

Discussion.—Specimens of this species are found in the Tamesí fauna of west Florida. The types are from the Paleocene, Soldado Rock Formation of Trinidad. It has not previously been recorded from other areas.

Chiloguembelina morsei (Kline) Loeblich and Tappan

Plate 2, figure 15

1943, *Gümbelina morsei* KLINE, Mississippi Geol. Survey Bull. 53, p. 44, pl. 7, fig. 12.

1951, *Gümbelina morsei* Kline. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 38, pl. 11, fig. 10.

1956, *Chiloguembelina midwayensis* LOEBLICH and TAPPAN (part) (*not* Cushman), Jour. Washington Acad. Sci., v. 46, no. 11, p. 340.

1957, *Chiloguembelina morsei* (Kline). LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 179, pls. 40, figs. 2a, b; 41, fig. 4; 42, figs. 1a, b; 43, figs. 2, 6a, b.

Discussion.—This species seems to be less common than *C. trinitatensis* in the Tamesí fauna. It is found in lower part of the Paleocene section in the Walton well.

Distribution.—The species was described from the Porters Creek Clay of Mississippi, and is recorded also from the Clayton Formation of Alabama, and the Midway Group of Texas.

Subfamily HETEROHELICINAE

Genus **Bolivinoides** Cushman, 1927

Bolivinoides velascoensis (Cushman) Cushman

Plate 2, figure 18

1925, *Textularia velascoensis* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 1, pt. 1, p. 18, pl. 3, figs. 1a-c.

1946, *Bolivinoides velascoensis* (Cushman). CUSHMAN, U. S. Geol. Survey Prof. Paper 206, p. 114, pl. 48, fig. 16.

Discussion.—Specimens from the Tamesí fauna of northwestern Florida conform in every respect with the type from the Velasco Shale of Mexico. This is the first recorded occurrence in southern United

States. The species is similar in many respects to *Bolivinoides trinitatensis* Cushman and Jarvis which was described from the Paleocene of Lizard Springs Formation of Trinidad (Cushman and Jarvis, 1928, p. 99). *B. trinitatensis* was recorded by Said and Kenawy (1956, p. 141) from Paleocene deposits of the northern part of the Sinai Peninsula, Egypt. These authors mention that *B. trinitatensis* is also recorded from Danian samples of Nekhl and Giddi.

Distribution.—Velasco Formation of Mexico, and Tamesí fauna in Paleocene sediments of northwestern Florida.

Family BULIMINIDAE

Genus **Bulimina** d'Orbigny, 1826

Subgenus **Desinobulimina** Cushman and Parker, 1940

Bulimina (Desinobulimina) quadrata Plummer

Plate 2, figure 17

1926, *Bulimina (Ellipsobulimina) quadrata* PLUMMER, Texas Univ. Bull. 2644, p. 72, pl. 4, figs. 4, 5.

1951, *Bulimina (Desinobulimina) quadrata* Plummer. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 41, pl. 11, figs. 27-30.

1960, *Bulimina quadrata* Plummer. OLSSON, Jour. Paleontology, v. 34, no. 1, p. 31, pl. 4, fig. 27.

Discussion.—This species is restricted to the upper part of the Paleocene section in the Walton well and common in the Tamesí fauna of northwestern Florida. Cushman also reports that it is very common in some of the Paleocene samples which he examined from other areas on the Gulf Coast.

Distribution.—Chalybeate Limestone Member of the Clayton Formation of Alabama; Midway Formation of Arkansas; and Midway Group of Texas. The species is also recorded by Herrick (1961) from the subsurface Clayton Formation of Georgia.

Family ROTALIIDAE

Genus **Gyroidinoides** Brotzen, 1942

Gyroidinoides subangulatus (Plummer) Olsson

Plate 4, figures 7, 8

1926, *Rotalia soldanii* (d'Orbigny) var. *subangulata* PLUMMER, Texas Univ. Bull. 2644, p. 154, pl. 12, fig. 1.

1951, *Gyroidina subangulata* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 51, pl. 14, figs. 14, 15.

1956, *Gyroidina subangulata* (Plummer). SAID and KENAWY, Micropaleontology, v. 2, no. 2, p. 149, pl. 5, fig. 9.

1960, *Gyroidinoides subangulata* (Plummer). OLSSON, Jour. Paleontology, v. 34, no. 1, p. 36, pl. 5, figs. 24, 25.

Discussion.—This species is fairly common in the Tamesí fauna. The Florida specimens conform with the types and agree perfectly, in all details, with those from the Naheola Formation of Alabama.

Distribution.—It has been recorded from the Clayton and Porters Creek formations of Alabama; the Midway Formation of Arkansas; and the Midway Group of Texas.

Genus **Eponides** Montfort, 1808

Eponides plummerae Cushman

Plate 4, figures 1, 2

1948, *Eponides plummerae* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 24, p. 44, pl. 8, fig. 9.

1951, *Eponides plummerae* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 52, pl. 14, figs. 20, 22.

1960, *Eponides plummerae* Cushman. OLSSON, Jour. Paleontology, v. 34, no. 1, p. 36, pl. 5, figs. 21-23.

Discussion.—This species is fairly common in the Tamesí fauna.

Distribution.—Chalybeate Limestone Member of the Clayton Formation of Alabama; Midway Formation of Arkansas; and Midway Group of Texas.

Eponides libertyensis n. sp.

Plate 4, figures 3, 4

Description.—Test small; dorsal side flat, sometimes with early chambers in trochoid coil forming a central, conical projection; final convolution compressed, flange-like in appearance, several final chambers sometimes showing a tendency to resume a trochoid arrangement; ventral side convex, only chambers of final coil visible; chambers distinct, eight or nine in final convolution, increasing slowly in size as added; walls finely perforate, perforations coarser on ventral face; periphery entire, bordered by a thin, narrow keel; sutures limbate, flush with the surface, very gently curved on dorsal face, sinuous on ventral face, and terminating centrally in a small, very low boss filling the umbilicus; aperture, a small curved opening on the periphery and extending as a narrow slit along the base of the final chamber on the ventral side of the test.

Dimensions.—Diameter 0.32 to 0.48 mm.; thickness 0.19 to 0.26 mm.

Discussion.—Species is most closely similar to *E. beaberleae* McLean, described from the Eocene, Wilcox(?) of New Jersey, but differs in lacking a lobulate periphery, in having a less pronounced keel, less convexity of ventral face, low sutures and in its more finely perforate wall structure. The species is very common in the Tamesí fauna of wells located in Liberty County, Florida.

Holotype.—USNM no. 640550. Paratypes, USNM no. 640551. From Core no. 42, 2615-2620 ft., Oil City Corporation, Walton Land and Timber Company well no. 1, Walton County, Florida.

Eponides waltonensis Applin and Jordan

Plate 4, figures 5, 6

1945, *Eponides waltonensis* APPLIN and JORDAN, Jour.

Paleontology, v. 19, no. 2, p. 142, pl. 19, figs. 5a-c.

Discussion.—This species is common in the lower part of the Paleocene section cored in the Walton well and is rare to common in the Tamesí fauna of other wells located in northwestern Florida. Since number 2 of the volume of the publication in which the original description was given is no longer available, the description is repeated below.

"Test usually almost equally and gently biconvex, some specimens strongly convex dorsally, gently convex ventrally; all coils visible on dorsal face, with about three and one half coils present in mature forms; periphery acute, slightly keeled; sutures distinct, not raised, gently curved; chambers numerous, 10 to 12 usually present in final coil, not inflated, increasing very gradually in size as added; walls very finely perforate; umbilical area filled with low boss; aperture narrow, elongate, extending from umbilicus to point just ventral to periphery, where it broadens into low arch. Diameter 0.50 mm, average thickness 0.17 mm." *E. waltonensis* is similar to *E. lotus*, but the chambers on the latter species are more lobulate, and expand rapidly near the end of the final whorl on mature forms. *E. waltonensis* is more finely perforate and the sutures only slightly oblique giving the chambers a nearly cube-shaped appearance. Herrick (1961) records the occurrence of *E. lotus* from the Clayton Formation of many well sections in Georgia.

Distribution.—The species has not been reported from other areas. Hypotypes from core 55, 3055-3061 feet, in the Oil City Corporation, Walton Land and Timber Company well no. 1, Walton County, Florida. USNM nos. 640547, 640548.

Family CASSIDULINIDAE

Genus **Alabamina** Toulmin, 1941

Alabamina wilcoxensis Toulmin

Plate 3, figures 1, 2

1941, *Alabamina wilcoxensis* TOULMIN, Jour. Paleontology, v. 15, p. 603, pl. 81, figs. 10-14, text-figs. 4A-C.

1951, *Alabamina wilcoxensis* Toulmin. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 57, pl. 16, figs. 6, 7.

1956, *Alabamina wilcoxensis* Toulmin. SAID and KENAWY, Micropaleontology, v. 2, no. 2, p. 152, pl. 6, fig. 18.

1956, *Alabamina wilcoxensis* Toulmin. HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 141, pl. 7, figs. 1-5.

Discussion.—This species is common in the top of the Paleocene section in the Walton well. Florida specimens are generally more involute than the types, and are most closely similar to specimens from the Midway of Soldado Rock, Trinidad.

Distribution in Paleocene sediments of the Gulf Coast region.—Porters Creek, Naheola and Clayton formations of Alabama; Midway Formation of Arkansas; and Midway Group of Texas. Herrick (1961) records this species from the subsurface, Clayton Formation of Georgia.

Family CHILOSTOMELLIDAE

Genus **Allomorphina** Reuss, 1850

Allomorphina paleocenica Cushman

Plate 2, figures 20, 21

1948, *Allomorphina paleocenica* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 24, p. 45, pl. 8, fig. 10.

1951, *Allomorphina paleocenica* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 58, pl. 16, figs. 19-22.

Discussion.—This species is present, but not common, in the Tamesí fauna of northwestern Florida.

Distribution.—In the Gulf Coastal area the species has been reported from the Paleocene sediments of the Porters Creek Formation of Alabama; the Midway Formation of Arkansas; and the Midway Group of Texas.

Genus **Pullenia** Parker and Jones, 1862

Pullenia quinqueloba angusta Cushman and Todd

Plate 2, figure 19

1943, *Pullenia quinqueloba* (Reuss) var. *angusta* CUSHMAN and TODD, Cushman Lab. Foram. Research Contr., v. 19, p. 10, pl. 2, figs. 3, 4.

1951, *Pullenia quinqueloba* (Reuss) var. *angusta* Cushman and Todd. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 59, pl. 17, fig. 6.

Discussion.—The subspecies is common in the upper portion of the Walton well no. 1, and is usually present in the Tamesí fauna of wells drilled in northwestern Florida. It is sometimes accompanied by many specimens of *Pullenia coryelli* White, a species described from the Velasco Shale of Mexico. *P. coryelli* is locally common but does not seem to have been as widely distributed as the subspecies figured.

Distribution.—*P. quinqueloba angusta* is reported from the Porters Creek Formation of Alabama; the Porters Creek and Clayton formations of Mississippi; the Midway Formation of Arkansas; and the Midway Group of Texas.

Family GLOBIGERINIDAE

Subfamily GLOBIGERININAE Carpenter, 1862

Genus **Globigerina** d'Orbigny, 1826

Globigerina triloculinoides Plummer

Plate 3, figures 7, 8

1926, *Globigerina triloculinoides* PLUMMER, Texas Univ. Bull. 2644, p. 134-135, pl. 8, figs. 10a-c.

1951, *Globigerina triloculinoides* Plummer. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 60, pl. 17, figs. 10, 11.

1953, *Globigerina triloculinoides* Plummer. HAMILTON, Jour. Paleontology, v. 27, no. 2, p. 223, pl. 30, fig. 19, pl. 31, fig. 13.

1957, *Globigerina triloculinoides* Plummer. LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 183, pls. 40, figs. 4a-c; 41, figs. 2a-c; 42, figs. 2a-c; 43, figs. 5a-c; 8a-9c; 45, figs. 3a-c; 46, figs. 1a-c; 47, figs. 2a-c; 52, figs. 3-7; 56, figs. 8a-c; 62, figs. 3a-4c.

1959, *Globigerina triloculinoides* Plummer. HAMILTON and REX, U. S. Geol. Survey Prof. Paper 260-W, p. 792, pl. 252, fig. 2.

1959, *Globigerina triloculinoides* Plummer. NAKKADY, Micropaleontology, v. 5, no. 4, p. 461, pl. 3, figs. 5a-c.

1960, *Globigerina triloculinoides* Plummer. HOFKER, Contr. Cushman Found. Foram. Research, v. 11, pt. 3, p. 76, text-figs. 21, 24-28.

1960, *Globigerina triloculinoides* Plummer. SAID, Micropaleontology, v. 6, no. 3, p. 282, pl. 1, fig. 15.

1960, *Globigerina triloculinoides* Plummer. OLSSON, Jour. Paleontology, v. 34, no. 1, p. 43, pl. 7, figs. 22-24.

1961. *Globigerina triloculinoides* Plummer. SAID and KERDANY, Micropaleontology, v. 7, no. 3, p. 336, pl. 1, figs. 9a-c.

Discussion.—The species is common to abundant in all cores taken in the Paleocene section in the Walton well. Cuttings from wells drilled into the Paleocene section of northwestern Florida also contain many specimens of this species.

Like all the globigerine forms found in the Walton well Paleocene section, specimens close to and at the base of the section average larger than specimens of the same species occurring in higher, or younger parts of the same section.

Distribution.—Cushman records the species from the Naheola, Porters Creek, and Clayton formations of Alabama; the Porters Creek Clay of Mississippi; the Midway Formation of Arkansas; and the Midway Group of Texas. The same species was also recorded by White as *G. pseudotriloba* and *G. triangularis* from the Velasco Formation of Mexico.

Globigerina velascoensis Cushman

Plate 3, figures 3, 4

1925, *Globigerina velascoensis* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 1, pt. 1, p. 19, pl. 3, fig. 6.

1928, *Globigerina velascoensis* Cushman. WHITE, Jour. Paleontology, v. 2, no. 3, p. 196, pl. 28, figs. 2a, b.

1945, *Globigerina velascoensis* Cushman. APPLIN and JORDAN, Jour. Paleontology, v. 19, no. 2, p. 146, pl. 19, fig. 7.

1957, *Globigerina velascoensis* Cushman. BOLLI, U. S. Natl. Mus. Bull. 215, p. 71, pl. 15, figs. 9-11.

Discussion.—This species is similar to *G. triloculinoides* but is more compact, and the final chamber is compressed laterally; dorsal side flat to slightly convex. Typical specimens are common in the Tamesí fauna of Florida.

Distribution.—Species was described from the Velasco Shale of Mexico, and is also recorded from the lower Lizard Springs Formation of Trinidad.

Family GLOBOROTALIIDAE

Genus **Globorotalia** Cushman, 1927

Globorotalia trinidadensis Bolli

Plate 3, figures 12, 13

1957, *Globorotalia trinidadensis* BOLLI, U. S. Natl. Mus. Bull. 215, p. 73, pl. 16, figs. 19-23.

Discussion.—Bolli separates this species from *G. pseudobulloides* (Plummer) on the basis of larger size and more chambers in the final whorl. The Florida specimens conform with the types in these features, and it was also noted that chambers in the final whorl enlarge slowly in size, while those of *G. pseudobulloides* usually show a marked increase in size near the termination of the final whorl. The early coils are low trochoid, the final whorl planispiral. The species is very common in the upper part of the Paleocene section in the Walton well, and is common also in the Tamesí fauna found in cutting samples of many other wells in northwest Florida.

Distribution.—The species was described from the lower Lizard Springs Formation of Trinidad, and has not been previously recorded from the Gulf Coastal region.

Globorotalia pseudobulloides (Plummer) Loeblich and Tappan

Plate 3, figures 16, 17

1926, *Globigerina pseudo-bulloides* PLUMMER, Texas Univ. Bull. 2644, p. 133, pl. 8, figs. 9a-c.

1951, *Globigerina pseudo-bulloides* Plummer. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 60, pl. 17, figs. 7, 8.

1953, *Globigerina pseudobulloides* Plummer. HAMILTON, Jour. Paleontology, v. 27, no. 2, p. 223, pl. 31, figs. 10, 11.

1956, *Globigerina pseudobulloides* Plummer. HAYNES, Cushman Found. Foram. Research, Contr., v. 7, pt. 3, p. 99, pl. 17, figs. 12a-b; pl. 18, fig. 10.

1957, *Globorotalia pseudobulloides* (Plummer). LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 192, pls. 40, figs. 3a-c, 9a-c; 41, figs. 1a-c; 42, figs. 3a-c; 43, figs. 3a-4c; 44, figs. 4-6c; 45, figs. 1a-2c; 46, figs. 6a-c.

1959, *Globigerina pseudobulloides* Plummer. HAMILTON and REX, U. S. Geol. Survey Prof. Paper 260-W, p. 791, pl. 252, fig. 3.

1960, *Globigerina pseudobulloides* Plummer. HOFKER, Cushman Found. Foram. Research, Contr., v. 11, pt. 3, p. 77, text-figs. 17-20, 22, 23, 36-38.

1960, *Globorotalia pseudobulloides* (Plummer). OLSSON, Jour. Paleontology, v. 34, no. 1, p. 46, pl. 9, figs. 19-21.

Discussion.—This is a common to abundant species in the Tamesí fauna of northwestern Florida. Many of the Florida specimens have four instead of five chambers visible on the ventral face. This is true also of many paratype specimens studied from the U. S. National Museum Collections. The Florida specimens average about twice the size of paratypes from other Gulf Coast localities.

Stratigraphic distribution in Gulf Coastal region.—Porters Creek, Naheola and Clayton formations of Alabama; Midway Formation of Arkansas; and the Midway Group of Texas. Loeblich and Tappan (1957b, p. 192) record the species from the Clayton, Porters Creek and Naheola formations of Alabama; and from the Wills Point and Kincaid formations of the Midway Group of Texas.

Globorotalia velascoensis (Cushman) Cushman

Plate 3, figures 20, 21

1925, *Pulvinulina velascoensis* CUSHMAN, Cushman Lab. Foram. Research Contr., v. 1, pt. 1, p. 19, pl. 3, figs. 5a-c.

1926, *Pulvinulina velascoensis* Cushman. CUSHMAN, Am. Assoc. Petr. Geologists Bull., v. 10, p. 608, pl. 21, figs. 9a, b.

1927, *Globorotalia velascoensis* (Cushman). CUSHMAN, Jour. Paleontology, v. 1, no. 2, p. 169, pl. 27, figs. 7-9.

1928, *Globorotalia velascoensis* (Cushman). WHITE, *idem.*, v. 2, no. 4, p. 281, pl. 38, figs. 2a-c.

1932, *Globotruncana arca* CUSHMAN and JARVIS (*not* Cushman), U. S. Natl. Mus. Proc., v. 80, art. 14, p. 50, pl. 15, figs. 7a-c.

1937, *Globorotalia aragonensis* Nuttall var. *caucasica* GLAESSNER, Publ. Paleont. Lab. Moscow Univ., Studies in Micropaleontology, v. 1, fasc. 1, p. 31, figs. 6a-c.

1945, *Globorotalia velascoensis* (Cushman). APPLIN and JORDAN, Jour. Paleontology, v. 19, no. 2, p. 146, pl. 19, figs. 8a, b.

1949, *Globorotalia (Truncorotalia) velascoensis* (Cushman). CUSHMAN and BERMUDEZ, Cushman Lab. Foram. Research Contr., v. 25, pt. 2, p. 41, pl. 8, figs. 4-6.

1953, *Globorotalia velascoensis* (Cushman). HAMILTON, Jour. Paleontology, v. 27, no. 2, p. 231, pl. 30, figs. 16-18, 23, pl. 31, figs. 24, 28-31.

1956, *Globorotalia velascoensis* (Cushman). HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 181, pl. 24, figs. 2a-b.

1957, *Globorotalia velascoensis* (Cushman). LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 196, pl. 64, figs. 1a-2c.

1959, *Globorotalia velascoensis* (Cushman). HAMILTON and REX, U. S. Geol. Survey Prof. Paper 260-W, p. 794, pl. 252, figs. 18-20.

1960, *Globorotalia velascoensis* (Cushman). SAID, Micropaleontology, v. 6, no. 3, p. 284, pl. 1, figs. 2a-c.

1961, *Globorotalia velascoensis* (Cushman). SAID and KERDANY, Micropaleontology, v. 7, no. 3, p. 330, pl. 1, figs. 10a-c.

Discussion.—As stated earlier in this report, this species is abundant in the deepest core taken in Paleocene sediments in the Walton well no. 1 (core 55, 3055-3061 feet). Core 56, cut at 3105 feet, contains a microfauna definitely Cretaceous in age. Specimens of this typical form are also common in cores from this well taken at higher levels but become gradually less common in the younger beds where they are replaced in dominance by the similar form *G. acuta* Toulmin. This is a common species in the Tamesí fauna of west Florida.

Distribution.—The species was described from the Velasco Shale and was listed by Cushman (1927, p. 169) as one of the characteristic species of the Velasco fauna of Mexico. Cushman (1927, p. 169) states, "This species is probably the most abundant one of the Velasco shale, especially of the lower and middle portions." In addition to the Florida occurrence, Herrick (1961, p. 96) records the species from a core taken at 1414-1435 feet in the No. 1, U. S. Geological Survey Test Hole (observation well) at Fort Pulaski, Cockspur Island, Chatham County, Georgia. The same author also records a "Tamesí fauna" from wells in southwestern Georgia listed on page 47 of this report.

Globorotalia acuta Toulmin

Plate 3, figures 18, 19

1941, *Globorotalia wilcoxensis* Cushman and Ponton, var. *acuta* TOULMIN, Jour. Paleontology, v. 15, no. 6, p. 608, pl. 82, figs. 6-8.

1951, *Globorotalia wilcoxensis* Cushman and Ponton var. *acuta* Toulmin. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 61, pl. 17, figs. 12a-13c.

1953, *Globorotalia velascoensis* (Cushman) var. *acuta* (Toulmin). HAMILTON, Jour. Paleontology, v. 27, no. 2, p. 231, pl. 31, figs. 32, 33.

1956, *Globorotalia velascoensis* (Cushman) var. *acuta* (Toulmin). HAQUE, Mem. Geol. Survey of Pakistan, v. 1, p. 182, pl. 4, figs. 3a-c, 5a-c.

1957, *Globorotalia acuta* Toulmin. LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 185, pls. 47, figs. 5a-c; 55, figs. 4a-5c; 58, figs. 5a-c.

Discussion.—This species is common in the Tamesí fauna of Florida. In the Walton well, it is common in all cores taken in the Paleocene section and becomes more abundant with depth. However, in relation to *G. velascoensis*, *G. acuta* becomes steadily less dominant in the middle and lower portions of the Paleocene section where *G. velascoensis* is the dominant form. Loeblich and Tappan (1957b, p. 186) record the occurrence of the species from the Velasco Shale of Mexico.

Distribution.—Cushman (1951, p. 61) records its occurrence in the Naheola and Porters Creek formations of Alabama, and the Midway Group of Texas. The species was described from the Salt Mountain Limestone of Alabama.

Globorotalia pseudomenardii Bolli

Plate 3, figures 14, 15

1926, *Pulvinulina membranacea* CUSHMAN (*not Planulina membranacea* Ehrenberg), Am. Assoc. Petroleum Geolog sts Bull., v. 10, no. 6, p. 608, pl. 21, figs. 10a-b.

1928, *Globorotalia membranacea* WHITE (*not* Ehrenberg), Jour. Paleontology, v. 2, p. 280, pl. 38, figs. 1a-c.

1941, *Globorotalia membranacea* TOULMIN (*not* Ehrenberg), Jour. Paleontology, v. 15, no. 6, p. 608, pl. 82, figs. 4, 5.

1946, *Globorotalia membranacea* CUSHMAN (*not* Ehrenberg), U. S. Geol. Survey Prof. Paper 206, p. 152, pl. 63, fig. 5.

1949, *Globorotalia membranacea* CUSHMAN and BERMUDEZ (*not* Ehrenberg), Cushman Lab. Foram. Research Contr., v. 25, pt. 2, p. 34, pl. 6, figs. 16-18.

1955, *Globorotalia* cf. *membranacea* HOFKER (*not* Ehrenberg), Rep. McLean Foram. Lab., no. 2, p. 14, pl. 4.

1957, *Globorotalia pseudomenardii* BOLLI, U. S. Natl. Mus. Bull. 215, p. 77, pl. 20, figs. 14-17.

1957, *Globorotalia pseudomenardii* Bolli. LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 193, pls. 45, figs. 10a-c; 47, figs. 4a-c; 49, figs. 6a-c; 54, figs. 10a-13c; 59, figs. 3a-c; 60, figs. 8a-c; 63, figs. 1a-c.

1959, *Globorotalia pseudomenardii* Bolli. NAKKADY, Micropaleontology, v. 5, no. 4, p. 462, pl. 4, figs. 3a-c.

1960, *Globorotalia pseudomenardii* Bolli. OLSSON, Jour. Paleontology, v. 34, no. 1, p. 47, pl. 9, figs. 10-12.

1961, *Globorotalia pseudomenardii* Bolli. SAID and KERDANY, Micropaleontology, v. 7, no. 3, p. 329, pl. 1, figs. 5a-c.

Discussion.—This species is another very common planktonic form in the Tamesí fauna of Florida. In cores from the Walton well it is abundant in the lower part of the Paleocene section.

Distribution.—Cushman (1946, p. 153) states that "the species [*Globorotalia membranacea* (Ehrenberg) White] is often very abundant in the . . . Velasco shale of Mexico." Loeblich and Tappan (1957b, p. 193) also record *G. pseudomenardii* from the Velasco Formation of Mexico, and from the Porters Creek Formation, *Ostrea thirsae* beds of the Nanafalia Formation, and the Salt Mountain Limestone of Alabama. Herrick (1961) records *G. membranacea* from the Clayton Formation in a number of well sections in Georgia.

Globorotalia albeari Cushman and Bermudez

Plate 3, figures 5, 6

1949, *Globorotalia albeari* CUSHMAN and BERMUDEZ, Cushman Lab. Foram. Research Contr., v. 25, pt. 2, p. 33, pl. 6, figs. 13-15.

1951, *Globorotalia albeari* Cushman and Bermudez. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 61, pl. 24, figs. 13-15.

Discussion.—This species is common in the lower part of the Paleocene section in the Walton well of Florida, and some specimens of the species are usually present in cutting samples of wells in west Florida that contain a Tamesí fauna.

Distribution.—The species was described from the Paleocene, Madruga Formation of Cuba, and has not previously been reported from any other Gulf Coast area.

Globorotalia angulata (White) Bolli

Plate 3, figures 10, 11

1928, *Globigerina angulata* WHITE, Jour. Paleontology, v. 2, no. 3, p. 191, pl. 27, figs. 13a-c.

1957, *Globorotalia angulata* (White). BOLLI, U. S. Natl. Mus. Bull. 251, p. 47, pl. 7, figs. 7-9.

1957, *Globorotalia angulata* (White). LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 187, pls. 45, figs. 7a-c; 48, figs. 2a-c; 50, figs. 4a-c; 55, figs. 2, 6, 7; 58, figs. 2a-c; 64, figs. 5a-c.

1959, *Globorotalia angulata* (White). NAKKADY, Micropaleontology, v. 5, no. 4, p. 461, pl. 4, figs. 1a-c.

1960, *Globorotalia angulata* (White). OLSSON, Jour. Paleontology, v. 34, no. 1, p. 44, pl. 8, figs. 14-16.

Discussion.—White (1938, p. 192) mentions that the species is present but rare, from "the base of the Velasco up into the lower part of the middle portion of that formation." Its occurrence in the Tamesí fauna seems to be similar. It is rare, but persistent in occurrence, both stratigraphically and geographically in the west Florida Paleocene sediments.

Distribution.—Loeblich and Tappan record the species from the Velasco Formation of Mexico; the Porters Creek Formation and the Salt Mountain Limestone of Alabama.

Globorotalia compressa (Plummer) Bronnimann

Plate 3, figures 9a, b

1926, *Globigerina compressa* PLUMMER, Texas Univ. Bull. 2644, p. 135, pl. 8, fig. 11.

1951, *Globigerina compressa* Plummer. CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 60, pl. 17, fig. 9.

1952, *Globorotalia compressa* (Plummer). BRONNIMANN, Bull. Am. Paleontology, v. 34, no. 140, p. 25, pl. 2, figs. 19-24.

1953, *Globigerina compressa* Plummer. HAMILTON, Jour. Paleontology, v. 27, no. 2, p. 221, pl. 31, figs. 14, 15.

1957, *Globorotalia compressa* (Plummer). LOEBLICH and TAPPAN, U. S. Natl. Mus. Bull. 215, p. 188, pls. 40, figs. 5a-c; 41, figs. 5a-c; 42, figs. 5a-c; 44, figs. 9a-10c.

1960, *Globigerina compressa* (Plummer). HOFKER, Cushman Found. Foram. Research, Contr., v. 11, pt. 3, p. 78, 79, text-figs. 35a-c.

1960, *Globorotalia compressa* (Plummer). OLSSON, Jour. Paleontology, v. 34, no. 1, p. 45, pl. 8, figs. 20-22.

Discussion.—This species is rare in the Tamesí fauna of west Florida. A few specimens were found in the lower part of the cored Paleocene section of the Walton well.

Distribution.—The species was described from the upper part of the Midway of Texas. Cushman records it also from the Porters Creek and Naheola formations of Alabama, and from the Midway Formation of Arkansas. Loeblich and Tappan record the species from the Danian of Sweden, the Wills Point (upper Midway) of Texas, and the Clayton Formation of Alabama.

Family ANOMALINIDAE

Genus **Anomalinoides** Brotzen, 1942

Anomalinoides rubiginosus (Cushman)

Plate 4, figures 20, 21

1926, *Anomalina rubiginosa* CUSHMAN, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 607, pl. 21, figs. 6a-c.

1945, *Anomalina rubiginosa* Cushman. APPLIN and JORDAN, Jour. Paleontology, v. 19, no. 2, p. 147, pl. 20, fig. 4.

1946, *Anomalina rubiginosa* Cushman. CUSHMAN, U. S. Geol. Survey Prof. Paper 206, p. 156, pl. 64, figs. 4-6.

Discussion.—This species is common in the upper part of the Paleocene section cored in the Walton well no. 1. Florida specimens are coarsely porous, but usually lack the coarse "pits" and other surface irregularities shown on some figured specimens from Trinidad. However, a few Florida specimens display similar features.

Distribution.—Cushman (1946, p. 156) states that it "is a common and well-marked species in the Velasco shale of Mexico, and it occurs in typical form in the material from Trinidad." Its presence in the Paleocene sediments of west Florida is the only recorded Paleocene occurrence in the Gulf Coastal region of the United States.

Anomalinoides umboniferus (Schwager)

Plate 4, figures 18, 19

1883, *Discorbina umbonifera* SCHWAGER, Palaeontographica, v. 30, pal. Teil, p. 126, pl. 27 (4), fig. 14.

1951, *Anomalina umbonifera* (Schwager). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 62, pl. 17, figs. 16a-b.

1956, *Anomalina umbonifera* (Schwager). SAID and KENAWY, Micropaleontology, v. 2, no. 2, p. 153, pl. 6, figs. 17a-c.

Discussion.—Florida specimens assigned to this species conform with types from the Naheola Formation of Alabama. Specimens are found in the top of the Paleocene section in the Walton well, and have been occasionally noted in the Tamesí faunal assemblages of other wells located in northwestern Florida.

Distribution.—Cushman records the species from the Naheola Formation of Alabama. Herrick (1961) also records the species from the Clayton Formation in a number of well sections in Georgia.

Family CIBICIDIDAE

Subfamily PLANULININAE Bermudez, 1952

Genus **Planulina** d'Orbigny, 1826

Planulina waltonensis Applin and Jordan

Plate 4, figures 13, 14

1945, *Planulina waltonensis* APPLIN and JORDAN, Jour. Paleontology, v. 19, no. 2, p. 147, pl. 20, figs. 5a-c.

Discussion.—This form was described from the Paleocene sediments of west Florida and has not been recorded from other areas. The types are from a cutting sample in a well in Wakulla County, but specimens are present also in the bottom part of the Paleocene section in the Walton well, Walton County, Florida, and have been found in the Tamesí fauna of the other wells listed from west Florida. Some specimens have a small keel, a feature not included in the original description. The species is similar to some paratypes of *Anomalina acuta* as figured by Cushman (1951, pl. 18, figs. 5, 6), but *P. waltonensis* is strongly evolute, the chambers are wider, and the walls more finely perforate. Herrick (1961) lists *A. acuta* as present in the Clayton Formation in a number of well sections in Georgia. The original description of *P. waltonensis* is quoted below.

"Test much compressed, evolutely coiled, early whorls clearly shown on dorsal side, about two and one half coils visible; ventral side umbilicate; periphery acute, but not keeled; chambers distinct, numerous, about 14 present in adult coil, of uniform shape, not inflated, increasing very gradually in size as added; sutures moderately curved, limbate, raised slightly above surface of test; sutures on ventral side often terminating in small bead at umbilicus, which is partially filled with clear shell material; walls finely perforate; aperture a small opening with slight lip, at base of final chamber on median line. Average diameter 0.55 to 0.60 mm., height 0.08 mm."

Subfamily CIBICIDINAE Cushman, 1927
Genus **Cibicides** Montfort, 1808
Cibicides alleni (Plummer) Plummer
Plate 4, figures 15, 16

1926, *Truncatulina alleni* PLUMMER, Texas Univ. Bull. 2644, p. 144, pl. 10, figs. 4a-c.
1951, *Cibicides alleni* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 66, pl. 18, figs. 16, 17.
1955, *Cibicides alleni* (Plummer). HAQUE, Mem. Geol. Survey of Pakistan, p. 207, pl. 16, figs. 1a-c; pl. 33, figs. 3a-c.
1959, *Cibicides alleni* (Plummer). NAGAPPA, Micropaleontology, v. 5, no. 2, text-fig. 11, pl. 7, figs. 15a-c.

Discussion.—This species is fairly well represented in the Tamesí fauna of the upper part of the Paleocene section of west Florida.

Distribution.—Recorded from the Porters Creek and Clayton formations of Alabama; the Porters Creek Clay of Mississippi; Midway Formation of Arkansas; and the Midway Group of Texas.

Cibicides praecursorius (Schwager) Cushman and Ponton
Plate 4, figures 9, 10

1883, *Discorbina praecursoria* SCHWAGER, Palaeontographica, v. 30, Pal. Theil, p. 125, pl. 24 (4), fig. 12; pl. 29 (6), fig. 16.
1951, *Cibicides praecursorius* (Schwager). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 65, pl. 19, figs. 1a-6b.
1956, *Cibicides praecursorius* (Schwager). SAID and KENAWY, Micropaleontology, v. 2, no. 2, p. 155, pl. 7, figs. 8a-c.

Discussion.—The species is common in the upper part of the Paleocene section of the Walton well and specimens are usually found in the Tamesí faunal assemblages of wells in northwestern Florida.

Distribution.—The species is reported from the Porters Creek, Naheola and Clayton formations of Alabama; the Midway Formation of Arkansas; and the Midway Group of Texas. Herrick (1961) records the species from the Paleocene Clayton Formation from many well sections in Georgia.

Cibicides newmanae (Plummer) Cushman and Todd
Plate 4, figures 11, 12

1926, *Discorbis newmanae* PLUMMER, Texas Univ. Bull. 2644, p. 138, pl. 9, figs. 4a-c.
1951, *Cibicides newmanae* (Plummer). CUSHMAN, U. S. Geol. Survey Prof. Paper 232, p. 66, pl. 19, figs. 12-14.

Discussion.—Some specimens of this species are usually present in Tamesí faunal assemblages of west Florida. In the cored section of the Walton well their occurrence is restricted to the upper part of the Paleocene.

Distribution.—The species has been recorded from the Porters Creek Formation of Alabama; the lower part of the Midway Formation of Arkansas; and the Midway Group of Texas. Herrick records it from the subsurface Clayton Formation of Georgia.

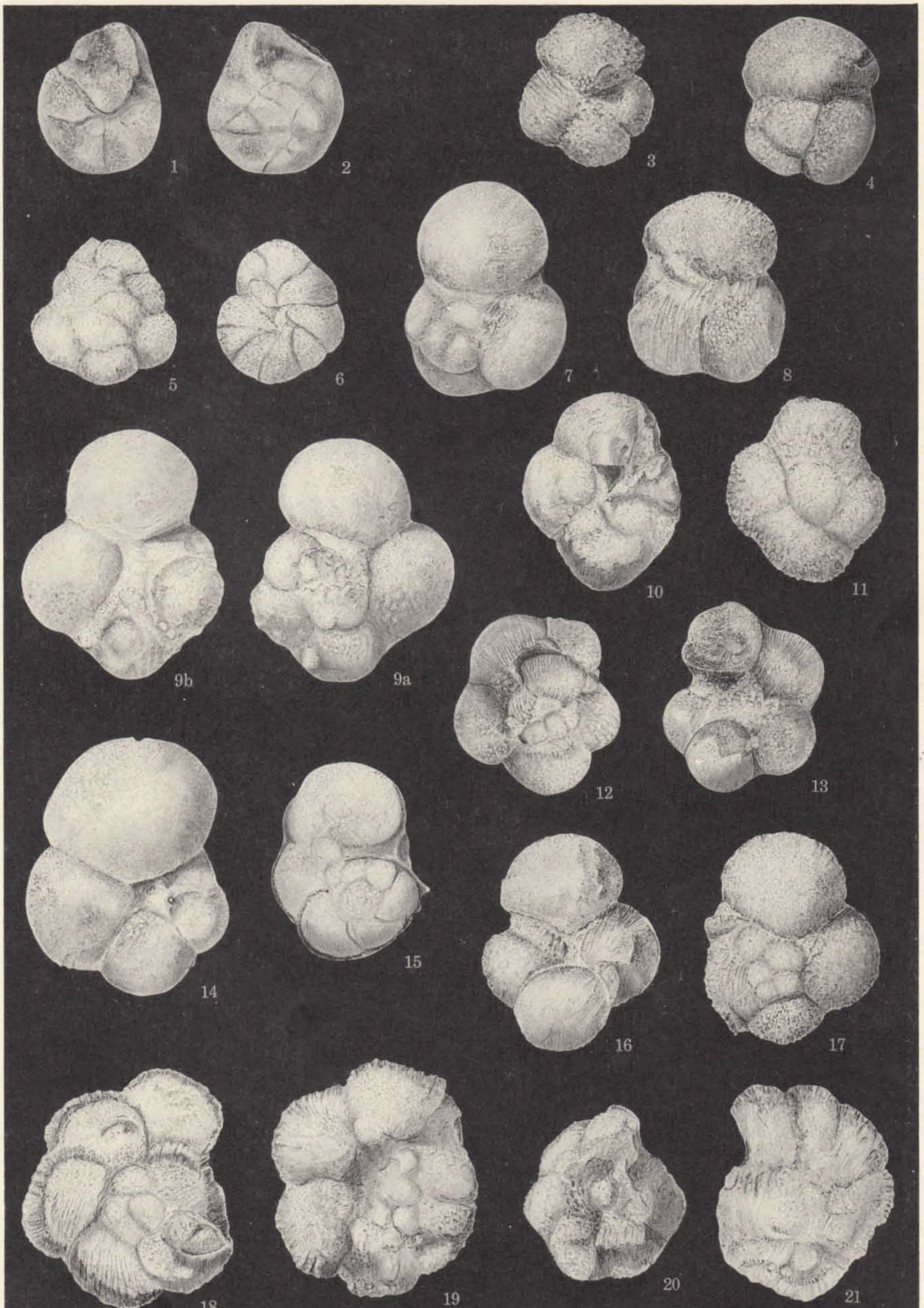
Cibicides libertyensis n. sp.
Plate 4, figures 17a, b

Description.—Test compressed; dorsal face evolute,

EXPLANATION OF PLATE 3

All figured specimens, unless otherwise stated, are from Oil City Corporation, Walton Land and Timber Company, well no. 1, Walton County, Florida.

FIGS.		PAGE
1, 2.	*Alabamina wilcoxensis* Toulmin. 1, USNM 640553; ventral view. 2, USNM 640554; dorsal view. Core no. 38, 2440-2450 feet. × 63	65
3, 4.	*Globigerina velascoensis* Cushman. 3, USNM 640549; ventral view. 4, USNM 640534; dorsal view. Core no. 38, 2440-2450 feet. × 63	66
5, 6.	*Globorotalia albeari* Cushman and Bermudez. 5, USNM 640570; dorsal view. 6, USNM 640571; ventral view. Core no. 55, 3055-3061 feet. × 63	68
7, 8.	*Globigerina triloculinoides* Plummer. 7, USNM 640558; dorsal view. 8, USNM 640559; ventral view. Core no. 38, 2440-2450 feet. × 63	65
9.	*Globorotalia compressa* (Plummer) Bronnimann. USNM 640574. a, dorsal view; b, ventral view. Core no. 55, 3055-3061 feet. × 63	68
10, 11.	*Globorotalia angulata* (White) Bolli. 10, USNM 640572; ventral view. 11, USNM 640573; dorsal view. Core no. 43, 2620-2626 feet. × 63	68
12, 13.	*Globorotalia trinidadensis* Bolli. 12, USNM 640560; dorsal view. 13, USNM 640561; ventral view. Core no. 44, 2679-2685 feet. × 40	66
14, 15.	*Globorotalia pseudomenardii* Bolli. 14, USNM 640568; ventral view. 15, USNM 640569; dorsal view. Core no. 55, 3055-3061 feet. × 63	68
16, 17.	*Globorotalia pseudobulloides* (Plummer) Loeblich and Tappan. 16, USNM 640562; ventral view. 17, USNM 640563; dorsal view. Core no. 55, 3055-3061 feet. × 63	66
18, 19.	*Globorotalia acuta* Toulmin. 18, USNM 640566; dorsal view. 19, USNM 640567; ventral view. Core no. 43, 2620-2626 feet. × 63	67
20, 21.	*Globorotalia velascoensis* (Cushman) Cushman. 20, USNM 640564; ventral view. 21, USNM 640565; dorsal view. Core no. 55, 3055-3061 feet. × 40	67



Applin: middle Eocene, lower Eocene, and Paleocene, west Florida

Applin: middle Eocene, lower Eocene, and Paleocene, west Florida

all chambers visible; ventral side involute; dorsal surface, flat to slightly convex, ventral side convex; periphery narrowly rounded; sutures gently curved, limbate, flush with the surface on dorsal face, elevated on ventral face, broadening and thickening near the umbilicus; chambers eight to ten in final evolution, increasing slowly in size as added; walls flat, finely punctate, perforations coarser on ventral face; aperture a narrow opening at the base of last-formed chamber, on the periphery and extending downward toward the umbilicus.

Dimensions.—Diameter 0.29 to 0.45 mm.; thickness 0.16 to 0.19 mm.

Discussion.—The species is named for Liberty County, Florida, as wells penetrating Paleocene sediments in that county contain a very abundant, and well diversified Tamesí fauna in which this species is very common.

Distribution.—The species is common in the Tamesí fauna of Florida, and was common in the cored sequence of the Walton well near the base of the Paleocene section.

Holotype.—USNM 640542. Paratype 640531. From core no. 55, 3055-3061 ft., Oil City Corporation, Walton Land and Timber Company well no. 1, Walton County, Florida.

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EXPLANATION OF PLATE 4

All figured specimens, unless otherwise stated, are from Oil City Corporation, Walton Land and Timber Company, well no. 1, Walton County, Florida.

Figs.		Page
1, 2.	*Eponides plummerae* Cushman. 1, USNM 640545; dorsal view. 2, USNM 640546; ventral view. Core no. 39, 2480-2486 feet. × 63	64
3, 4.	*Eponides libertyensis* n. sp. 3, USNM 640550; dorsal view, holotype. 4, USNM 640551; ventral view, paratype. Core no. 42, 2615-2620 feet. × 63	64
5, 6.	*Eponides waltonensis* Applin and Jordan. 5, USNM 640547; dorsal view. 6, USNM 640548; ventral view. Core no. 55, 3055-3061 feet. × 63	64
7, 8.	*Gyroidinoides subangulatus* (Plummer) Olsson. 7, USNM 640543; dorsal view. 8, USNM 640544; ventral view. Core no. 38, 2440-2450 feet. × 80	64
9, 10.	*Cibicides praecursorius* (Schwager) Cushman and Ponton. 9, USNM 640493; ventral view. 10, USNM 640497; dorsal view. Core no. 38, 2440-2450 feet. × 63	70
11, 12.	*Cibicides newmanae* (Plummer) Cushman and Todd. 11, USNM 640500; ventral view. 12, USNM 640504; dorsal view. Core no. 39, 2480-2486 feet. × 80	70
13, 14.	*Planulina waltonensis* Applin and Jordan. 13, USNM 640507; dorsal view. 14, USNM 640514; ventral view. Cuttings 2675 feet, Brown and Ravlin, Phillips well no. 1, Wakulla County, Florida. × 63	69
15, 16.	*Cibicides alleni* (Plummer) Plummer. 15, USNM 640524; ventral view. 16, USNM 640526; dorsal view. Core no. 38, 2440-2450 feet. × 63	70
17.	*Cibicides libertyensis* n. sp. *a*, USNM 640542; dorsal view, holotype; *b*, USNM 640531; ventral view, paratype. Core no. 55, 3055-3061 feet. × 63	70
18, 19.	*Anomalinoides umboniferus* (Schwager). 18, USNM 640575; ventral view. 19, USNM 640537; dorsal view, crushed specimen. Core no. 39, 2480-2486 feet. × 80	69
20, 21.	*Anomalinoides rubiginosus* (Cushman). 20, USNM 640541; dorsal view. 21, USNM 640552; ventral view. Core no. 39, 2480-2486 feet. × 63	69

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WHITE, M. P., 1928a, Some index Foraminifera of the Tampico Embayment area of Mexico (Part I): Jour. Paleontology, v. 2, no. 3, p. 177-215, text-fig. 1, table, pls. 27-29.

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CONTRIBUTIONS FROM THE CUSHMAN FOUNDATION
FOR FORAMINIFERAL RESEARCH
VOLUME XV, PART 2, APRIL, 1964

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the Foraminifera that have come to hand.

ASANO, KIYOSHI. The Palaeogene, *in* Geology of Japan, compiled on the occasion of the sixtieth birthday of Professor Teiichi Kobayashi.—Univ. Tokyo Press, 1963, p. 129-140, text figs. 11, 12 (map, diagram), charts 10-12.—Many of the formations and groups are characterized by Foraminifera.

AYALA-CASTANARES, AGUSTIN. Sistematica y distribucion de los Foraminiferos Recientes de la Laguna de Terminos, Campeche, Mexico.—Univ. Nac. Auto. de Mexico, Instit. Geol., Bol. No. 67, pt. 3, 1963, p. 1-130, pls. 1-11, text figs. 1-60 (maps, tables).—Qualitative and quantitative analysis of living and total faunas, based on 86 bottom samples taken within and in the entrances to a nearly enclosed lagoon. Environmental factors are plotted, and distribution and abundance patterns are mapped for many individual species. Nearly 90 species (none new) are recorded and illustrated.

BANDY, ORVILLE L. Foraminiferal trends associated with deep-water sands, San Pedro and Santa Monica basins, California.—Jour. Paleontology, v. 38, No. 1, Jan. 1964, p. 138-148, text figs. 1-5 (map, graphs).—Analysis of species in 3 cores, 1 on the basin floor and 2 on a sea-fan, reveal the existence of 4 major groups of species: 3 groups of indigenous species and 1 of species displaced from the inner and outer shelves.

BARBIERI, FRANCESCO, and ZANZUCCHI, GIORGIO. La stratigrafia della Valle di Roccaferrara (Appennino Parmense).—Atti Soc. Ital. Sci. Nat., Milano, v. 102, No. 2, June 1963, p. 155-210, pls. 18-35, text figs. 1-10 (geol. map, photos), distrib. table.—Smaller Foraminifera reported and illustrated from Oligocene and Cenomanian beds in allochthonous sequences.

BASTIEN, M. TH., and SIGAL, J. Contribution à l'étude paléontologique de l'Oxfordien Supérieur de Trept (Isère).—Trav. Lab. Géol. Lyon, n. ser., No. 8, 1962, p. 83-123, pls. 5-8, text fig. 4 (graph), table 2 (range chart).—Illustrated systematic catalog of 59 species of Foraminifera (1 new and 22 indeterminate). Range chart also included.

BEBOUT, DON G. Desmoinesian Fusulinids of Missouri.—Missouri Div. Geol. Survey and Water Resources, Rept. of Investig. No. 28, Sept. 1963, p. 1-79, pls. 1-8, text figs. 1-8 (map, correl. table, columnar sections, distrib. chart, graphs), tables 1-17.—Eighteen species, 3 new.

BERGGREN, WILLIAM A. Review and discussion: Fundamentals of mid-Tertiary stratigraphical correlation by F. E. Eames *et al.*—Micropaleontology, v. 9, No. 4, Oct. 1963, p. 467-473, text fig. 1 (correl. chart).—Includes historical review of usage of European stage names.

CARALP, MICHELLE, and JULIUS, CHARLES. Présence du genre *Bolivinoides* Cushman (Foraminifère) dans le Miocène supérieur sud-aquitain.—C. R. S. Soc. Géol. France, fasc. 8, Nov. 4, 1963, p. 265, 266, text figs. 1, 2.—*Bolivinoides vasconiensis* nov. sp.

CHISAKA, TAKESHI. Fusulinids from the vicinity of Maiya Town, Kitakami Mountainland, and Upper Permian Fusulinids of Japan.—Chiba Univ., Jour. College of Arts and Sci., v. 3, No. 4, Sept. 1962, p. 519-551, pls. 1-8, text fig. 1 (map), geol. map, tables 1-25.—Twenty species, 6 new.

CLOSS, DARCY. Foraminiferos e Tecamebas da Lagoa dos Patos (R. G. S.).—Univ. Rio Grande do Sul, Escola Geol. de Porto Alegre, Bol. No. 11, 1963, p. 1-130, pls. 1-13, text figs. 1-18 (maps, table, graphs, occur. and abund. chart).—Illustrated systematic catalog and chart of occurrence and frequency of 41 species (1 new) of Foraminifera and 9 of Thecamoebina. Study based on 170 samples taken within a nearly enclosed lagoon at depths between 0.5 and 8 meters, under salinities ranging from 0 to 28 o/oo.

COLE, W. STORRS, and APPLIN, ESTHER R. Problems of the geographic and stratigraphic distribution of American middle Eocene larger Foraminifera.—Bull. Am. Paleontology, v. 47, No. 212, Jan. 17, 1964, p. 1-48, pls. 1-11, tables 1-6.—Includes illustrations of 17 species (2 new) from Florida, Georgia, Jamaica, and France.

COLTRO, R. La facies di Polizzi dell'Eocene alloctono della Sicilia Centro-Settentrionale.—Riv. Ital. Pal. Stratig., v. 69, No. 2, 1963, p. 167-232, pls. 12-16, text figs. 1, 2 (map, geol. section), tables 1-3 (distrib. tables, columnar chart, graphs, planktonic zonation).—Five of the planktonic zones in the lower and middle Eocene of the West Indian section are recognized, and many Foraminifera are illustrated.

CORDEY, W. G. The genera *Brotzenia* and *Voorthuysenia* (Foraminifera) and Hofker's classification of the Epistomariidae.—Palaeontology, v. 6, pt. 4, Dec. 1963, p. 653-657, pl. 93, text figs. 1, 2.—Specimens from the Oxford Clay reveal that, in kind of toothplate, there are no differences between species referred to *Brotzenia* and those referred to *Voorthuysenia;* thus *Brotzenia* is emended to include *Voorthuysenia* as a synonym.

CRESPIN, IRENE. Lower Cretaceous Foraminifera in Buckabie No. 1 well.—Australia Bur. Min. Res., Geol. Geophys., Petroleum Search Subsidy Acts, Publ. No. 41, 1962, p. 33-43.—Lists of species.

Lower Cretaceous arenaceous Foraminifera of Australia.—Australia Bur. Min. Res., Geol. Geophys., Bull. No. 66, March 1, 1963, p. 1-110, pls. 1-18, tables 1, 2.—Illustrated systematic catalog includes 76 species, 23 new and 13 indeterminate.

DARBY, DAVID G., and HOYT, JOHN H. An Upper Miocene fauna dredged from tidal channels of coastal Georgia.—Jour. Paleontology, v. 38, No. 1, Jan. 1964, p. 67-73, pls. 17, 18, text fig. 1 (map). —Includes 3 Foraminifera, described as new.

DIVINO-SANTIAGO, (MRS.) PAZ. Planktonic foraminiferal species from west side of Tarlac Province, Luzon Central Valley.—Philippines Bur. Mines, Rept. of Investig. No. 47 (mimeo.), Feb. 1963, p. 1-27, text figs. 1, 2 (maps), tables 1-5.—Tables show occurrence and frequency of over 40 species of Miocene planktonics.

EAMES, F. E., BANNER, F. T., BLOW, W. H., and CLARKE, W. J. Notes on some current lower Miocene transatlantic correlations.—Revue de Micropaléontologie, v. 6, No. 2, Sept. 1963, p. 120-122.

ESPITALIÉ, J., and SIGAL, J. Epistominidae du Lias Supérieur et du Bajocien du Bassin de Majunga (Madagascar). Les genres *Lamarckella* et *Garantella* Kapt.-Tchern. et *Reinholdella* Brotzen.—Revue de Micropaléontologie, v. 6, No. 2, Sept. 1963, p. 109-119, pls. 1, 2.—Five species, 3 new.

FREUDENTHAL, HUGO D., LEE, JOHN J., and PIERCE, STANLEY. Growth and physiology of Foraminifera in the laboratory: Part 2—A tidal system for laboratory studies on eulittoral Foraminifera.—Micropaleontology, v. 9, No. 4, Oct. 1963, p. 443-448, text figs. 1-5 (photos), tables 1, 2.—Indications that brine conditions resulting from repeated flooding and evaporation of water on tidal flats serve as a stimulus for reproduction of arenaceous species.

GONZALES, BENJAMIN A. Foraminiferal analyses on measured section along the Tarao (Jarao) and Tanian Rivers, southwestern Iloilo.—Philippines Bur. Mines, Rept. of Investig. No. 46 (mimeo.), Feb. 1963, p. 1-35, text figs. 1, 2 (map, columnar sections), tables 1-4.—Six zones, based on planktonic species, are tentatively recognized and used in correlation with the West Indian zonation. Age is Tertiary *f* and *g* (middle Miocene to early Pliocene?).

HANZAWA, SHOSHIRO. Notes on three Cretaceous foraminiferal genera, *Asterorbis, Orbitocyclina,* and *Pseudorbitella.*—Jour. Geol. Soc. India, v. 4, 1963, p. 26-34, pls. 1-3, text figs. 1-6 (outline drawings of juvenaria).—One species of *Asterorbis* (including all the others as synonyms), 3 species of *Orbitocyclina,* and 1 of *Pseudorbitella.*

HANZAWA, SHOSHIRO, and MURATA, MASAFUMI. The paleontologic and stratigraphic considerations on the Neoschwagerininae and Verbeekininae, with the descriptions of some fusulinid Foraminifera from the Kitakami Massif, Japan.—Sci. Repts. Tohoku Univ., 2nd Ser. (Geol.), v. 35, No. 1, Aug. 5, 1963, p. 1-31, pls. 1-20, text figs. 1-10 (graphs), tables 1-5.

HANZLIKOVA, EVA. *Globotruncana helvetica posthelvetica* n. subsp. from the Carpathian Cretaceous. —Vestnik Ustred. Ustavu Geol., roc. 38, cislo 5, 1963, p. 325-328, pls. 1, 2, text figs. 1, 2 (graphs). —Of middle Turonian to early Senonian age, with some accompanying species illustrated and listed.

HEDLEY, R. H. Cement and iron in the arenaceous Foraminifera.—Micropaleontology, v. 9, No. 4, Oct. 1963, p. 433-441, pl. 1, tables 1-5.—Suggests the possibility that iron and possibly calcium are incorporated in the organic cement.

HERB, RENÉ. Geologie von Amden, mit besonderer Berücksichtigung der Flyschbildungen.—Matériaux pour la Carte Géologique de la Suisse, Commission Géol. Suisse, Bern, n. f., Lieferung 114, 1962, p. 1-130, pls. 1-3 (geol. map, geol. sections), text figs. 1-23 (maps, columnar sections, range chart, drawings, photographs, geol. sections), tables 1-4.—Includes many lists of Foraminifera from the Cretaceous and Eocene.

HOARE, R. D. Permian fusulinids from the Sunflower Reservoir area of northern Nevada.—Jour. Paleontology, v. 37, No. 6, Nov. 1963, p. 1143-1149, pls. 153, 154, text fig. 1 (columnar section).—Six species, 3 new.

HOFKER, J. Foraminifera from the Cretaceous of South-Limburg, Netherlands. LXI. *Globigerina kozlowskii* Brotzen and Pozaryska in the "Post-Maestrichtian" of the quarry Curfs near Houthem and of the Canal Albert in Belgium.—Natuurhist. Maandblad, Jrg. 51, No. 9, Sept. 26, 1962, p. 129, 130, 1 text fig.

LXII. Once again planktonic Foraminifera from the Tuff Chalk of Maastricht.—Natuurhist. Maandblad, Jrg. 51, No. 10, Oct. 29, 1962, p. 146, 147.

LXIII. Some Rotaliid Foraminifera from the lower Paleocene above the Maestrichtian Tuff Chalk.—Natuurhist. Maandblad, Jrg. 52, No. 1, Jan. 30, 1963, p. 6-9, text figs. 1-7.—Six species, 1 new.

LXIV. The initial stages of *Orbitoides apiculata*

(Schlumberger) and *Lepidorbitoides minor* Schlumberger and the difference between the lateral chambers of these two species.—Natuurhist. Maandblad, Jrg. 52, No. 3, March 28, 1963, p. 40-43, text figs. 1-10.

LXV. Some Polymorphinidae.—Natuurhist. Maandblad, Jrg. 52, No. 4, April 25, 1963, p. 55, 56, text figs. 1-6.—Six species, 5 new.

LXVI. Once again *Pararotalia tuberculifera* (Reuss). —Natuurhist. Maandblad, Jrg. 52, No. 6, June 27, 1963, p. 80-82, text figs. 1-6.—Because it possesses a simple wall and lacks a complicated toothplate, this species does not belong in the Rotaliidae.

LXVII. The taxonomic position of *Siderolites calcitrapoides* Lamarck.—Natuurhist. Maandblad, Jrg. 52, No. 7-8, Aug. 29, 1963, p. 109-114, text figs. 1-10.—Discussion of relationships with *Pararotalia* and *Calcarina*.

Einige planktonische Foraminiferen aus dem borealen europäischen Oligozän.—Neues Jahrb. Geol. Paläont. Abh., Band 118, heft 2, Sept. 1963, p. 197-206, text figs. 1-14.—Six species of *Globigerina*, indicating correlation with the *Globorotalia opima opima* zone of Trinidad.

IACCARINO, S. Il Pliocene Inferiore del Rio Lombasino (S. Andrea Bagni-Parma).—Riv. Ital. Pal. Stratig., v. 69, No. 2, 1963, p. 261-282, pl. 1, text fig. 1 (map and geol. section), graph.—Includes lists of species and illustrations of 3 species of *Globorotalia*.

INDANS, JULIJA. Foraminiferen-Faunen aus dem Miozän des Niederrheingebietes.—Fortschritte Geol. Rheinland und Westfalen, Band 6, Dec. 1962, p. 19-81, pls. 1-12, text figs. 1, 2 (map, distrib. table), tables 1, 2.—Illustrated systematic catalog includes 166 species, none new, reported from about 30 borings.

KAPTARENKO-CHERNOUSOVA, O. K., GOLJAK, L. M., ZERNETHKIJ, B. F., KRAEVA, E. JA., and LIPNIK, E. S. Atlas Kharakternykh Foraminifer Jury, Mela i Paleogena Platformennoj Chasti Ukrainy. —Akad. Nauk Ukrain. SSR, Kiev, Instit. Geol. Nauk, ser. strat. paleont., vyp. 45, 1963, p. 1-200, pls. 1-47.—Illustrated systematic catalog includes 104 species, subspecies, and varieties in the Jurassic, 99 in the Cretaceous, and 102 in the Paleogene. Four species and 1 subspecies are new.

KECSKEMETI, T. Morphogenetik der Gruppe von *Nummulites perforatus* aus dem Bakony-Gebirge (German summary of Hungarian text).—Bull. Hungarian Geol. Soc., v. 93, No. 3, July-Aug. 1963, p. 356-362, text figs. 1-3 (drawings, diagrams, graphs).—Occurrence of 4 species in the Lutetian.

KNAUFF, WOLFGANG. Zur Mikrofauna im Mittel-Lias niederrheinischer Bohrungen.—Fortschritte Geol. Rheinland und Westfalen, Band 6, Dec. 1962, p. 219-228, pls. 1, 2, text fig. 1 (map).—Lists and illustrations of Foraminifera assemblages.

KOCH, EDWIN, and BLISSENBACH, ERICH. Las Capas Rojas del Cretáceo Superior-Terciario en la región del curso medio del rió Ucayali, Oriente del Perú. —Bol. Soc. Geol. Peru, tomo 39, 1962, p. 7-137, pls. 1-3, text figs. 1-21 (maps, columnar sections, drawings, graphs, range chart, correl. table).—A few Foraminifera in association with abundant *Chara*.

KUSTANOWICH, S. Distribution of planktonic Foraminifera in surface sediments of the south-west Pacific Ocean.—New Zealand Jour. Geol. Geophys., v. 6, No. 4, Aug. 1963, p. 534-565, pls. 1-3, text figs. 1-12 (maps, graphs, occur. chart).—Five faunas, ranging from a cold south-central fauna northward to a warm sub-equatorial fauna, are represented graphically according to their species composition and abundance. Most of the species are illustrated.

LAGOUSSIS-SIDERIS, VIR. Addition to the knowledge of the Foraminifera of the Neogene of Aegina (in Greek with English summary).—Praktika Akad. Athenon, tom. 37, 1962, p. 309-318, pls. 1, 2.—List of 138 species (1 new) from the Pliocene, a few illustrated.

LEE, JOHN J., and FREUDENTHAL, HUGO. Neglected Amoebas in culture.—Natural History, v. 72, No. 10, Dec. 1963, p. 54-61, illustr.—Stages in life cycles illustrated by photomicrographs of *Rosalina floridana* and *Allogromia*.

LEE, JOHN J., FREUDENTHAL, HUGO D., MULLER, WILLIAM A., KOSSOY, VICTOR, PIERCE, STANLEY, and GROSSMAN, RICHARD. Growth and physiology of Foraminifera in the laboratory. Part 3—Initial studies of *Rosalina floridana* (Cushman).—Micropaleontology, v. 9, No. 4, Oct. 1963, p. 449-466, pls. 1-3, text figs. 1-6 (photomicrographs, graphs, diagrams), tables 1-4.—Correlation is shown between morphology and size on the one hand and nutrition and the life cycle on the other.

MALZ, HEINZ. Mikropaläontologie—über ihre Arbeitsweise und Anwendung.—Natur und Museum, Frankfurt a. M., Band 93, Heft 6, June 1, 1963, p. 201-208, text figs. 1-9.

MARLOWE, J. I., and VILKS, G. Marine geology, eastern part of Prince Gustaf Adolf Sea, District of Franklin (Polar Continental Shelf Project).—Geol. Survey Canada, Paper 63-22, 1963, p. 1-23, figs. 1-3 (maps), tables I, II.—Qualitative and quantitative analysis of Foraminifera (over 50 species) in bottom sediments from depths between 4½ and 125 meters.

MEHES, KALMAN. A new *Nummulites* species from Hungary.—Jour. Paleontology, v. 37, No. 6, Nov. 1963, p. 1289-1291, pl. 182, table 1.—*Nummulites rozlozsniki* n. sp. from the Londonian (Ypresian) stage.

MURTHY, N. G. K., and SASTRI, V. V. Foraminifera from the Sriperumbudur Beds near Madras.—Rec. Geol. Survey India, v. 89, pt. 2, 1962, p. 445-456, pls. 12, 13, text fig. 1 (map).—Twelve arenaceous species (3 new and 4 indeterminate) from Lower Cretaceous beds.

PAGHIDA, NATALIA. Microfauna din Buglovianul de pe Dreapta Prutului.—Anal. Stiint. Univ. "Al. I. Cuza" Iasi, (n. ser.), sect. 2, tom 6, fasc. 4, Anul 1960, Supl., p. 315-329, pls. 1, 2 (drawings, columnar sections).—Three new Miocene Foraminifera described and many species listed from Buglovian of Romania.

PASINI, M. Alcuni Fusulinida della serie del Monte Auernig (Alpi Carniche) e loro significato stratigrafico.—Riv. Ital. Pal. Stratig., v. 69, No. 3, 1963, p. 337-382, pls. 21-26, text figs. 1-3 (correl. chart, map, geol. section, range chart).—Includes one new species.

PODOBINA, V. M. New information on Senonian Foraminiferal complexes of eastern regions of West Siberian Lowland (in Russian).—Akad. Nauk SSSR, Sibirskoe Otdel., Geol. Geofiz., No. 7, 1963, p. 40-49, map, correl. chart.—Senonian is divided into 4 subdivisions, each with characteristic species.

REISS, Z. Reclassification of perforate Foraminifera.—Israel Geol. Survey, Bull. No. 35, 1963, p. 1-111, pls. 1-8, 1 chart.—An important monographic study in which classification is based fundamentally on layering, whether single or double. Five superfamilies, 54 families (3 new) and 54 subfamilies (8 new) are described, and their genera (with synonyms) are listed. Many of the discussed diagnostic features are illustrated by thin section photographs. On a chart are indicated stratigraphic ranges of families and subfamilies and possible phyletic relationships between them. New are the families Chiloguembelinidae, Boreloididae, and Eponidopsidae and the subfamilies Robuloidinae, Schubertiinae, Conorbininae, Asterigerinatinae, Rosalininae, Heminwayininae, and Pararotaliinae, and 3 new names are given: Rosalinidae for Discopulvinulinidae, Stainforthiinae for Hyalovirgulinidae (part), and Epistominellinae for Pseudoparrellinae. *Valvalabamina* gen. nov. (type species *Rotalina lenticula* Reuss 1845, emend. Harris and McNulty 1956) is erected.

ROSS, G. C. Chromatographic technique for alcohol-preserved foraminiferal material.—Micropaleontology, v. 9, No. 4, Oct. 1963, p. 442.—To determine amino acids in the shell cement.

SAITO, TSUNEMASA. Miocene planktonic Foraminifera from Honshu, Japan.—Sci. Repts. Tohoku Univ., 2nd Ser. (Geol.), v. 35, No. 2, Nov. 20, 1963, p. 123-209, pls. 53-56, text figs. 1-15 (maps, correl. charts, columnar section), tables 1-16.—Eight zones (all but two identical with those of the Venezuela zonation) are recognized in the sedimentary basins in Honshu. An illustrated catalog includes 65 species, 2 new. Ranges in Japan are indicated, and occurrence and abundance in 15 local regions are shown.

SAMANIEGO, (MRS.) REMEDIOS M. Smaller Foraminifera from the Ligao-Malacbalac and Libon-Pantao Road sections in Western Albay.—Philippines Bur. Mines, Rept. of Investig. No. 45 (mimeo.), Feb. 1963, p. 1-39, text figs. 1, 2 (maps, geol. sections), tables 1-6.—Tables show occurrence and frequency of planktonic and benthonic species in an interval from Tertiary f_3 to Tertiary *g* (late Miocene to early? Pliocene).

SAMANTA, B. K. Two new species of *Discocyclina* (Foraminifera) from the upper Eocene of Assam, India.—Palaeontology, v. 6, pt. 4, Dec. 1963, p. 658-664, pls. 94, 95.

SCHERP, HORST. Foraminiferen aus dem Unteren und Mittleren Zechstein Nordwestdeutschlands, inbesondere der Bohrung Friedrich Heinrich 57 bei Kamp-Lintfort.—Fortschritte Geol. Rheinland und Westfalen, Band 6, Dec. 1962, p. 265-329, pls. 1-12, tables 1-3.—Illustrated systematic catalog includes 96 species (28 new and 23 indeterminate) and 16 subspecies (all new). Vertical distribution and abundance are indicated for selected species.

SCOTT, G. H. Uniformitarianism, the uniformity of nature, and paleoecology.—New Zealand Jour. Geol. Geophys., v. 6, No. 4, Aug. 1963, p. 510-527.—"Although we use the present as a key to the past, we should not forget that hidden in the past record are further keys . . ."—Glaessner, 1955.

SEIGLIE, GEORGE A. Una nueva especies del genero *Globigerina* del Reciente de Venezuela.—Bol. Instit. Oceanografico Univ. de Oriente, Cumana, Venezuela, v. II, No. 1, Dec. 1963, p. 89-92, pl. 1. —*G. bermudezi,* a small species with arched final chamber, from off western end of Peninsula of Araya.

SEIGLIE, GEORGE A., and BERMUDEZ, PEDRO J. Distribucion de los Foraminiferos del Golfo de Cariaco. —Bol. Instit. Oceanografico Univ. de Oriente, Cumana, Venezuela, v. II, No. 1, Dec. 1963, p. 7-87, maps 1-24, 2 graphs.—Quantitative analysis based on about 120 samples taken between depths of 1 and 189 meters, results in recognition of 7 benthonic foram zones, one subdivided into 2 subzones. Distribution and abundance (as percentage of total) are plotted on maps.

SHENG, JIN-CHANG. The marine Permian formations and their fusulinid zones of southwest China.—Scientia Sinica, v. 12, No. 6, 1963, p. 885-890.

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