

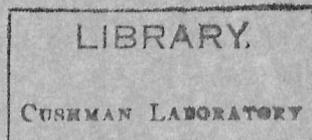
CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

VOLUME 21, PART 1
March, 1945

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1945



CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

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These Contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

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For continuation of this series, see back cover page.

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CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

265. A FORAMINIFERAL FAUNA FROM THE TWIGGS
CLAY OF GEORGIA.

BY JOSEPH A. CUSHMAN

So little is known of the foraminiferal faunas of many of our Tertiary and Cretaceous subdivisions that any additions may prove useful. The material noted here was collected from the Twiggs clay, usually referred to as the basal member of the Barnwell formation. I owe my thanks to Mr. F. Stearns MacNeil, who collected the material, for the opportunity to study the fauna. Since this study was completed, additional material has been received from Mr. Philip E. LaMoreaux. This will be studied later and the results compared with the fauna noted here.

The fauna of this Twiggs clay material, while evidently of Jackson age, does not contain many of the typical Jackson foraminifera that one would expect to find. On the other hand some of the species are very unusual, as the genera have not previously been recorded earlier than the Miocene. The entire fauna is composed of very small foraminifera, many of them of only about one-half normal size for the species and evidently representing peculiar ecologic conditions. The almost entire absence of the Lagenidae, but fairly numerous Polymorphinidae, is difficult to explain. At first it almost seemed as though this were a brackish water fauna, but the occurrence of some Globigerinidae rather does away with this possibility. Further studies will undoubtedly add to the information given here.

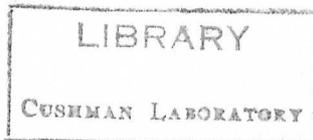
The material is from a marly zone in about the middle of the Twiggs clay as exposed in a gully at the head of a branch of Lamars Creek, 4.5 miles southeast of Sandersville, on the old Oconee road, Washington Co., Georgia.

Family SACCAMMINIDAE

Genus PROTEONINA Williamson, 1858

PROTEONINA EOCENICA Cushman, n. sp. (Pl. 1, figs. 1, 2)

Test small, compressed, pyriform, base broadly rounded, tapering gradually to the broadly truncate apertural end, elliptical in transverse section; wall coarsely arenaceous with a chitinous cement and distinctly reddish brown color, surface fairly smooth; aperture termi-



nal, without a definite neck, elliptical. Length 0.22-0.25 mm.; breadth 0.18-0.20 mm.; thickness 0.10-0.12 mm.

Holotype (Cushman Coll. No. 42524) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species differs from *P. compressa* Cushman and McCulloch in the more elongate form, more tapering apertural end, and elliptical aperture. The species is common in this material and shows very little variation in size or other characters.

PROTEONINA PROLIXA Cushman, n. sp. (Pl. 1, fig. 3)

Test small, elongate, slightly tapering, about 2 to 2½ times as long as wide, circular in transverse section, base broadly rounded, thence tapering very gradually to the somewhat truncate apertural end; wall arenaceous, surface fairly smooth, with a light brownish cement; aperture terminal, circular. Length 0.15-0.20 mm.; diameter 0.07-0.08 mm.

Holotype (Cushman Coll. No. 42527) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species differs from *P. difflugiiformis* (H. B. Brady) in the slender, elongate test, gradually tapering shape, and small size. This species is not nearly as common as the preceding but the specimens are very constant in size and shape.

Genus MILLETTELLA Rhumbler, 1903

MILLETTELLA EOCENICA Cushman, n. sp. (Pl. 1, fig. 4)

Test minute, nearly circular in outline, plano-convex, dorsal side slightly convex, ventral side flattened or concave, periphery subacute, tending to become slightly angled or even spinose; wall finely arenaceous with a yellowish brown cement, surface slightly roughened; aperture small, circular, on the ventral side near one end of the test in a deep, rounded depression. Diameter 0.12-0.15 mm.; thickness 0.07-0.08 mm.

Holotype (Cushman Coll. No. 42529) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species is close to *M. spinata* Cushman and Cahill from the Miocene of North Carolina, but is not so definitely spinose, and is plano-convex instead of biconvex as in that species. This is the first record for the genus earlier than the Miocene.

MILLETTELLA ELONGATA Cushman, n. sp. (Pl. 1, fig. 5)

Test minute, about 1½ times as long as broad, biconvex, periphery

broadly rounded, ends rounded; wall very finely arenaceous with a yellowish brown cement, very smoothly finished surface; aperture near one end of the test on the ventral side in a slight, semicircular depression. Length 0.12 mm.; breadth 0.08 mm.; thickness 0.08 mm.

Holotype (Cushman Coll. No. 42531) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This is a distinctive species differing from other species in its elongate form and very smooth surface. It is rare in this material.

Genus LEPTODERMELLA Rumbler, 1935

LEPTODERMELLA ARENATA (Cushman) (Pl. 1, fig. 6)

Pseudarcella arenata CUSHMAN, Bull. 4, Florida State Geol. Survey, 1930, p. 15, pl. 1, fig. 3.—CUSHMAN and PONTON, Bull. 9, 1932, p. 39.—CUSHMAN and CAHILL, U. S. Geol. Survey, Prof. Paper 175-A, 1933, p. 6, pl. 1, fig. 5.—CUSHMAN, Special Publ. No. 5, Cushman Lab. Foram. Res., 1933, pl. 2, fig. 14.—CUSHMAN and McCULLOCH, Allan Hancock Pacific Exped., vol. 6, 1939, p. 43, pl. 2, fig. 4.
Leptodermella arenata CUSHMAN, Foraminifera, 3rd. Ed., 1940, Key, pl. 2, fig. 14.

This species, originally described from the Miocene of Florida and later recorded from the Miocene of North Carolina and living off the coast of Ecuador, appears in typical form in this Twiggs clay material. Only a few specimens were found but they represent various stages and appear entirely identical with the types with which they have been compared.

Family LAGENIDAE

Genus LAGENA Walker and Jacob, 1798

LAGENA HEXAGONA (Williamson) (Pl. 1, fig. 7)

A single specimen from the Twiggs clay is very similar to the one figured from the Eocene, Cooper marl, of South Carolina (Cushman, U. S. Geol. Survey Prof. Paper 181, 1935, p. 23, pl. 9, fig. 10). There is some question as to the generic position of some of these species. This seems to be a *Lagena* rather than an *Entosolenia*.

Family POLYMORPHINIDAE

Genus GUTTULINA d'Orbigny, 1839

GUTTULINA CAUDATA d'Orbigny (Pl. 1, fig. 8)

Guttulina caudata d'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 266; Prodrôme de Paleont., vol. 2, 1850, p. 408.—FORNASINI, Boll. Soc. geol. Ital., vol. 19, 1900, p. 137, text fig. 2.—CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 36, pl. 6, figs. 4, 5.—COLE, Bull. 6, Florida State Geol. Survey, 1931, p. 29, pl. 4, fig. 11.—CUSHMAN and PONTON, Bull. 9, 1932, p. 65, pl. 9, figs. 16, 17.

d'Orbigny recorded this species from the Eocene of Grignon, France, and it has been recorded from the Miocene and Pliocene of Florida. A single typical specimen was found in the Twiggs clay material.

Genus **GLOBULINA** d'Orbigny, 1839**GLOBULINA GIBBA** d'Orbigny (Pl. 1, fig. 9)

(For references, see these Contributions, vol. 19, 1943, p. 35.)

This common species was found in the Twiggs clay material but, like most of the other species, the specimens are very small.

GLOBULINA MÜNSTERI (Reuss) (Pl. 1, fig. 11)

(For references, see CUSHMAN, U. S. Geol. Survey Prof. Paper 181, 1935, p. 27.)

Rare specimens of small size were found in this material. The species has already been recorded from the Eocene, Ocala limestone, of Georgia and Alabama and from the Eocene of a core from the Atlantic (Contr. Cushman Lab. For. Res., vol. 15, 1939, p. 61, pl. 10, fig. 38).

GLOBULINA INAEQUALIS Reuss (Pl. 1, fig. 10)

(For references, see CUSHMAN, U. S. Geol. Survey Prof. Paper 181, 1935, p. 26.)

This species is recorded from the Coastal Plain area from Eocene to Miocene. As with other species, the Twiggs clay specimens are unusually small.

Genus **SIGMOMORPHINA** Cushman and Ozawa, 1928**SIGMOMORPHINA JACKSONENSIS** (Cushman) (Pl. 1, fig. 12)

Polymorphina jacksonensis CUSHMAN, Contr. Cushman Lab. For. Res., vol. 2, pt. 2, 1926, p. 35, pl. 5, fig. 5.

Sigmomorphina jacksonensis CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 123, pl. 32, fig. 2.—HOWE and WALLACE, Louisiana Geol. Bull. No. 2, 1932, p. 49, pl. 8, fig. 2.—CUSHMAN, U. S. Geol. Survey Prof. Paper 181, 1935, p. 28, pl. 10, figs. 1-4.—HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 54, pl. 7, fig. 3.

This species is a characteristic one of the Jackson and Claiborne Eocene of the Gulf Coastal Plain region. There are a few, apparently young, specimens in the Twiggs clay material.

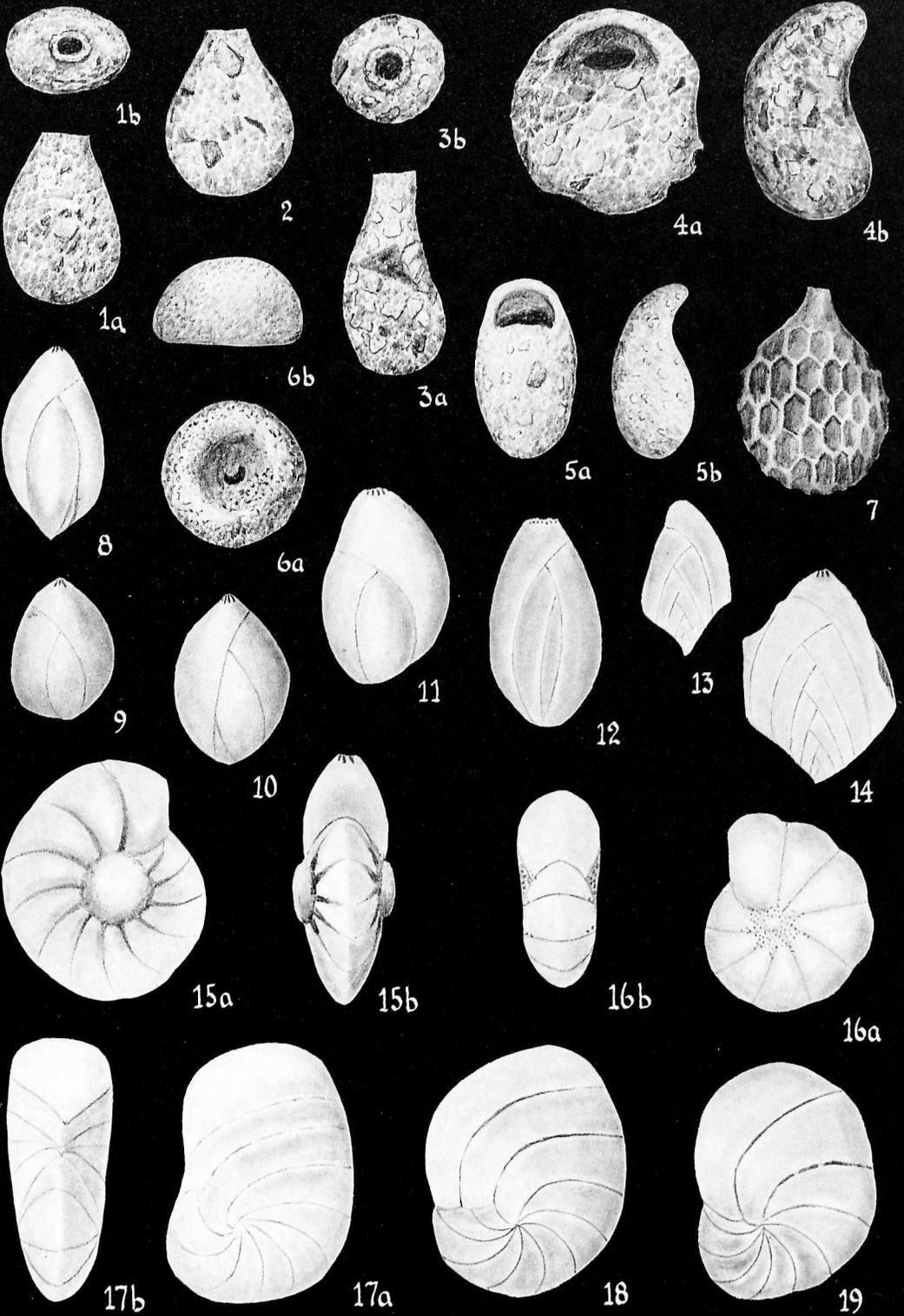
Genus **POLYMORPHINA** d'Orbigny, 1826**POLYMORPHINA FRONDEA** (Cushman) (Pl. 1, fig. 13)

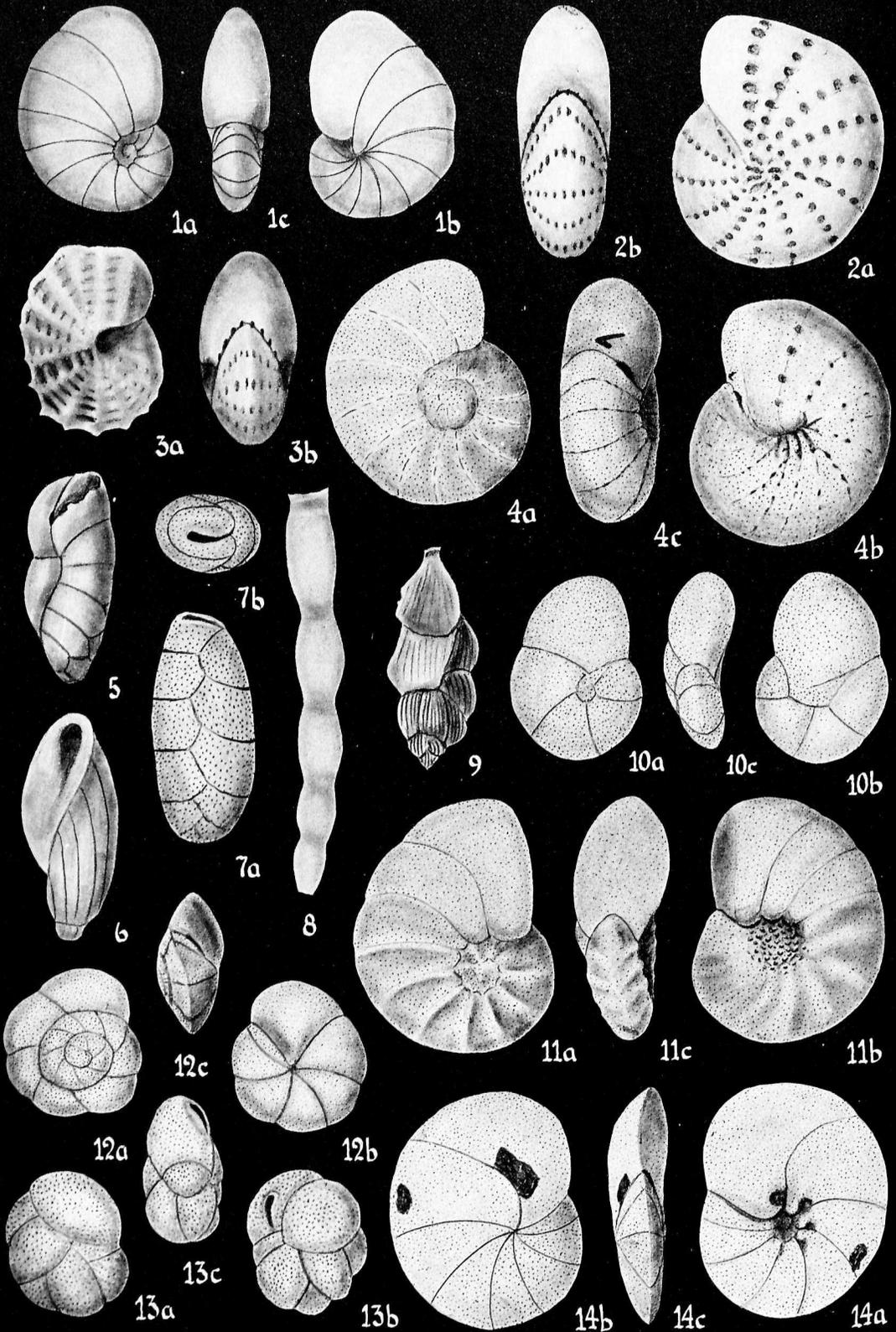
(For references, see CUSHMAN and MCGLAMERY, U. S. Geol. Survey Prof. Paper 197-B, 1942, p. 68.)

EXPLANATION OF PLATE 1

(Unless otherwise noted, all figures $\times 100$.)

Figs. 1, 2. *Protonina eocenica* Cushman, n. sp. 1, Holotype. *a*, front view; *b*, apertural view. 2, Paratype. 3. *P. proluxa* Cushman, n. sp. *a*, front view; *b*, apertural view. $\times 150$. 4. *Millettella eocenica* Cushman, n. sp. *a*, apertural view; *b*, side view. $\times 150$. 5. *M. elongata* Cushman, n. sp. *a*, apertural view; *b*, side view. 6. *Leptodermella arenata* (Cushman). *a*, apertural view; *b*, side view. 7. *Lagena hexagona* (Williamson). $\times 150$. 8. *Guttulina caudata* d'Orbigny. 9. *Globulina gibba* d'Orbigny. 10. *G. inaequalis* Reuss. 11. *G. münsteri* (Reuss). 12. *Sigmomorphina jacksonensis* (Cushman). 13. *Polymorphina frondea* (Cushman). 14. *P.* sp. 15. *Nonion advenum* (Cushman). *a*, front view; *b*, peripheral view. 16. *N. inexcavatum* (Cushman and Applin). *a*, front view; *b*, peripheral view. 17-19. *N. whitsettense* (Cushman and Applin), var. *insuetum* Cushman, n. var. 17, Holotype. *a*, front view; *b*, peripheral view. 18, 19, Paratypes, showing less developed adult stages.





Most of the records for this species are from the Oligocene, but Bermudez records it from the Eocene of Cuba. The figured specimen is the only one found in the Twiggs clay material.

POLYMORPHINA sp. (Pl. 1, fig. 14)

A single incomplete specimen is here figured for the record. It does not seem to belong to any of the species described from the American Tertiary.

Family **NONIONIDAE**

Genus **NONION** Montfort, 1808

NONION ADVENUM (Cushman) (Pl. 1, fig. 15)

(For references, see CUSHMAN and McGLAMERY, U. S. Geol. Survey Prof. Paper 197-B, 1942, p. 69.)

This well characterized species, widely distributed in the Oligocene and Eocene of the Gulf Coastal Plain area, is the most common species in this Twiggs clay material. Like other species in this material, the specimens are only about half the usual size.

NONION WHITSETTENSE (Cushman and Applin), var. **INSUETUM** Cushman, n. var.
(Pl. 1, figs. 17-19)

Variety differing from the typical in the adult chambers which tend to uncoil and form a rectilinear series.

Holotype of variety (Cushman Coll. No. 42550) from the Twiggs clay of Jackson Eocene age, from gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

The early stages of this variety are similar to those of the typical form from the Jackson Eocene of Texas, and, like the typical form, there seem to be traces of retral processes, but they are not well developed and the species is kept in *Nonion*. Unlike most of the other species of this material, this one is close to normal size.

NONION INEXCAVATUM (Cushman and Applin) (Pl. 1, fig. 16)

Nonionina advena CUSHMAN, var. *inexcavata* CUSHMAN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 182, pl. 10, figs. 18, 19.

EXPLANATION OF PLATE 2

(Unless otherwise noted, all figures $\times 100$.)

(Unless otherwise noted, *a*, dorsal view; *b*, ventral view; *c*, peripheral view.)

FIG. 1. *Nonionella* cf. *hantkeni* (Cushman and Applin). 2. *Elphidium twiggsanum* Cushman, n. sp. *a*, front view; *b*, peripheral view. 3. *E. fastigiatum* Cushman, n. sp. *a*, front view; *b*, peripheral view. 4. *Elphidioides americanus* Cushman, n. gen., n. sp. 5. *Robertina* cf. *angusta* (Cushman). 6. *Buliminella elegantissima* (d'Orbigny). $\times 150$. 7. *Virgulina minutissima* Cushman, n. sp. $\times 180$. *a*, front view; *b*, apertural view. 8. *Ellipsonodosaria* sp. 9. *Angulogerina ocalana* Cushman. 10. *Valvulineria georgiana* Cushman, var. *compacta* Cushman, n. var. 11. *V. jacksonensis* Cushman, var. *dentata* Cushman, n. var. 12. *Eponides minimus* Cushman. $\times 150$. 13. *Cassidulina twiggsana* Cushman, n. sp. $\times 150$. 14. *Cibicides praeconcentricus* Cushman, n. sp.

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Nonion inexcavatum ELLISOR, l. c., vol. 17, No. 11, 1933, pl. 2, fig. 7.—CUSHMAN, U. S. Geol. Survey Prof. Paper 181, 1935, p. 30, pl. 11, figs. 5-8; Prof. Paper 191, 1939, p. 7, pl. 2, fig. 4.

This species has a wide distribution in the Jackson and Claiborne Eocene of the Atlantic and Gulf Coastal Plain regions of the United States. The very few specimens found in the Twiggs clay material were much smaller than the general average of specimens from other localities.

Genus **NONIONELLA** Cushman, 1926

NONIONELLA cf. **HANTKENI** (Cushman and Applin) (Pl. 2, fig. 1)

The single specimen figured seems most nearly related to this Eocene species but has fewer and somewhat broader chambers. In some respects it resembles *Nonion florinense* Cole from the Eocene of Mexico. More specimens are necessary to place it with certainty.

Genus **ELPHIDIUM** Montfort, 1808

ELPHIDIUM TWIGGSANUM Cushman, n. sp. (Pl. 2, fig. 2)

Test small, strongly compressed, periphery rounded, margin not lobulated, gently biconvex in peripheral view, umbilical region not depressed; chambers averaging 12 to 15 in the last-formed coil, distinct, not inflated, very gradually increasing in size as added; sutures distinct, little if at all depressed, marked by very short but distinct retral processes, averaging 9 in number; wall thick, smooth; aperture consisting of a few rounded openings at the base of the apertural face. Length 0.38-0.42 mm.; breadth 0.30-0.32 mm.; thickness 0.15-0.17 mm.

Holotype (Cushman Coll. No. 42554) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species differs from *E. poeyanum* (d'Orbigny) in having the umbilicus not depressed, in the larger number of chambers and fewer retral processes.

ELPHIDIUM FASTIGIATUM Cushman, n. sp. (Pl. 2, fig. 3)

Test small, compressed, periphery subacute to slightly rounded, margin not lobulated, gently biconvex in peripheral view, umbilical region slightly raised in some specimens, flattened in others; chambers averaging 14 to 16 in the last-formed coil, rather indistinct, not inflated, very gradually increasing in size as added; sutures distinct, tending to become slightly raised, marked by relatively large retral processes, averaging 4 to 5 in number; wall thick, somewhat roughened by the prominent sutures and retral processes; aperture a low opening at the base of the apertural face. Length 0.25-0.30 mm.; breadth 0.20-0.23 mm.; thickness 0.12-0.15 mm.

Holotype (Cushman Coll. No. 42556) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species differs from *E. poeyanum* (d'Orbigny) in the prominent and raised sutures and retral processes, larger number of chambers, and much fewer retral processes.

Genus **ELPHIDIOIDES** Cushman, new genus

Genoholotype: *Elphidioides americanus* CUSHMAN, n. sp.

Test trochoid, dorsal side showing the early coils, ventral side involute; sutures with semicircular openings and retral processes; wall calcareous, perforate; aperture consisting of a low opening on the ventral side at the base of the last-formed chamber with a supplementary opening, irregularly V-shaped, toward the base of the apertural face.

This genus is apparently related to *Faujasina* and *Polystomellina* but has very different apertural characters.

ELPHIDIOIDES AMERICANUS Cushman, n. sp. (Pl. 2, fig. 4)

Test rounded, about as long as wide, biconvex, periphery rounded, entire, the middle of both sides flattened, on the ventral side even slightly concave; chambers rather indistinct, not inflated, 10 to 12 in the adult whorl, increasing very gradually in size as added; sutures slightly if at all depressed, marked by small, rounded or semicircular openings and very slight retral processes; wall finely perforate, aperture consisting of a low opening at the base of the apertural face of the last-formed chamber toward the ventral side and a secondary opening, narrow and elongate, in the lower part of the ventral face, often making a V-shaped opening due to a secondary slit to one side. Length 0.35-0.38 mm.; breadth 0.35-0.38 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 42558) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species is fairly common in this material and evidently represents a new genus of the Nonionidae.

Family **BULIMINIDAE**

Genus **BULIMINELLA** Cushman, 1911

BULIMINELLA ELEGANTISSIMA (d'Orbigny) (Pl. 2, fig. 6)

(For references, see CUSHMAN and CAHILL, U. S. Geol. Survey Prof. Paper 175-A, 1933, p. 23.)

Numerous specimens of this widely ranging species occur in this material. Like other species they are very small, the largest measuring only 0.22 mm. in length which is about half the normal size.

Genus **ROBERTINA** d'Orbigny, 1846**ROBERTINA** cf. **ANGUSTA** (Cushman) (Pl. 2, fig. 5)

A few specimens of small size were found in the Twiggs clay material. They resemble this species, widely distributed in the Oligocene, but are slightly narrower and more slender. In this respect they resemble *R. mcguirti* Howe from the Claiborne Eocene, but are not the same as the type specimen in other characters. They may represent a new species, but specimens are too few and not complete enough to warrant a description.

Genus **BULIMINA** d'Orbigny, 1826**BULIMINA** cf. **COOPERENSIS** Cushman

A single, very small and slightly broken, specimen seems to belong to this species.

Genus **VIRGULINA** d'Orbigny, 1826**VIRGULINA** **MINUTISSIMA** Cushman, n. sp. (Pl. 2, fig. 7)

Test very small, short and broad, rounded in end view, slightly tapering toward the apertural end which is somewhat truncate, initial end broadly rounded; chambers few, increasing very slightly in size as added; sutures slightly depressed, slightly curved, nearly at right angles to the elongate axis; wall smooth; aperture terminal, elongate. Length 0.16-0.20 mm.; breadth 0.08-0.10 mm.

Holotype (Cushman Coll. No. 42565) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species is of unusual shape and very small and is rather common in this material. It differs from *V. wilcoxensis* Cushman and Ponton in the more cylindrical shape, smaller size, and more evenly shaped chambers.

Genus **BOLIVINA** d'Orbigny, 1839**BOLIVINA** **JACKSONENSIS** Cushman and Applin

(For references, see Special Publ. No. 9, Cushman Lab. Foram. Res., 1937, p. 57.)

Very small specimens in this material seem to belong to this species.

BOLIVINA **JACKSONENSIS** Cushman and Applin, var. **STRIATELLA** Cushman and Applin

(For references, see Special Publ. No. 9, Cushman Lab. Foram. Res., 1937, p. 58.)

Finely striate specimens occur with the typical form, as is usual.

Genus **ANGULOGERINA** Cushman, 1927**ANGULOGERINA** **OCALANA** Cushman (Pl. 2, fig. 9)

Angulogerina ocalana CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 14, pl. 1, fig. 30; U. S. Geol. Survey Prof. Paper 181, 1935, p. 41, pl. 16, figs. 7, 8.

Specimens of this species are rather common in this Twiggs clay material but, like other species, the specimens are much smaller than normal.

Family ELLIPSOIDINIDAE

Genus ELLIPSONODOSARIA A. Silvestri, 1900

ELLIPSONODOSARIA sp. (Pl. 2, fig. 8)

The single specimen figured is the only one found in this material. It is very small and needs more specimens for specific identification.

Family ROTALIIDAE

Genus VALVULINERIA Cushman, 1926

VALVULINERIA GEORGIANA Cushman, var. COMPACTA Cushman, n. var.
(Pl. 2, fig. 10)

Variety differing from the typical in the shorter and broader chambers, more overlapping on the inner margin on the dorsal side, and more sharply angled periphery of the last-formed chamber.

Holotype of variety (Cushman Coll. No. 42574) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This variety is rare but seems to be related to *V. georgiana* Cushman from the Tertiary of cores from the Atlantic.

VALVULINERIA JACKSONENSIS Cushman, var. DENTATA Cushman, n. var.
(Pl. 2, fig. 11)

Variety differing from the typical in the more excavated ventral side, a more definite tooth-like lip above the aperture, and the raised sutures on the dorsal side, especially in the early portion.

Holotype of variety (Cushman Coll. No. 42572) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This variety is closely allied to *V. jacksonensis* of the Jackson Eocene. It also somewhat resembles *V. floridana* Cushman known from the Miocene of Florida, but appears to be more closely related to the Eocene species.

Genus EPONIDES Montfort, 1808

EPONIDES MINIMUS Cushman (Pl. 2, fig. 12)

Eponides minima CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 17, pl. 2, fig. 8; U. S. Geol. Survey Prof. Paper 181, 1935, p. 47, pl. 19, fig. 3.—CUSHMAN and McMASTERS, Journ. Pal., vol. 10, 1936, p. 514, pl. 76, fig. 2.—BECK, l. c., vol. 17, 1943, p. 608, pl. 108, figs. 16, 17, 19.—KELLEY, Bull. Amer. Assoc. Petr. Geol., vol. 27, 1943, p. 11 (list).—CURRAN, l. c., pp. 1379, 1381 (lists).

This species described from the Eocene, Cooper marl, of South Carolina has been recorded from the Eocene of California and Washington. It is common in the Twiggs clay material but like other species is much smaller than the typical, measuring on the average but 0.12 mm., or about one-half the usual size.

EPONIDES cf. **JACKSONENSIS** (Cushman and Applin)

A single specimen found in this material is close to the types of this species from Texas, but the chambers on the dorsal side are slightly more inflated and the coils somewhat broader than in some of the specimens, although these seem to be variable characters.

Genus **CASSIDULINA** d'Orbigny, 1826**CASSIDULINA TWIGGSANA** Cushman, n. sp. (Pl. 2, fig. 13)

Test minute, nearly equally biconvex, periphery rounded, lobulated; chambers distinct, strongly inflated, about four pairs or less making up the final whorl, alternating, each extending over rather prominently onto the opposite side at the periphery, increasing gradually in size as added; sutures slightly depressed, fairly distinct; wall smooth, coarsely perforate; aperture elongate, in the ventral face of the last-formed chamber. Diameter 0.10-0.12 mm.; thickness 0.06 mm.

Holotype (Cushman Coll. No. 42579) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species most closely resembles *C. chipolensis* Cushman and Ponton but differs in the less inflated chambers, less depressed sutures, and coarsely perforate test.

Family **ANOMALINIDAE**Genus **CIBICIDES** Montfort, 1808**CIBICIDES** cf. **MISSISSIPPIENSIS** (Cushman)

A single specimen seems to belong to this species which is widely distributed in formations of Jackson Eocene age.

CIBICIDES PRAECONCENTRICUS Cushman, n. sp. (Pl. 2, fig. 14)

Test strongly compressed, plano-convex, dorsal side flattened or slightly concave, ventral side slightly convex, periphery acute, entire; chambers slightly if at all inflated, increasing rapidly in size as added, 6 to 7 in the adult whorl, the last-formed ones on the dorsal side with a distinct lobe at the inner angle with a slight re-entrant behind; sutures distinct, slightly limbate, not depressed, strongly curved in the earlier stages, less so in the adult; wall smooth, rather coarsely perforate; aperture narrow, at the base of the last-formed chamber on the dorsal side. Length 0.30-0.35 mm.; breadth 0.25-0.28 mm.; thickness 0.08-0.10 mm.

Holotype (Cushman Coll. No. 42582) from the Twiggs clay of Jackson Eocene age, gully at head of branch of Lamars Creek, 4.5 miles SW. of Sandersville, on old Oconee road, Washington Co., Ga.

This species differs from *C. concentricus* (Cushman) in the much

less developed lobes and re-entrants, less convex ventral side, and somewhat broader chambers.

266. A FORAMINIFERAL FAUNA FROM THE LISBON FORMATION OF ALABAMA

BY JOSEPH A. CUSHMAN AND RUTH TODD

Very little has been published on the foraminifera of the Lisbon formation of the Claiborne Eocene. To give data for correlation the following notes and descriptions of new species and varieties are given. The fauna is very closely related to that described by Howe from the Cook Mountain formation of Louisiana. The dominant species is a fairly large species of *Asterigerina*, described here, and this should prove to be an index fossil. A few species represented by too few or poorly preserved specimens are not included in this paper and must await more and better material before they can be satisfactorily identified.

The material used is from the Lisbon horizon of Claiborne Bluff on the Alabama River, Monroe Co., Ala., collected in 1908 by Dr. T. Wayland Vaughan.

Family SACCAMMINIDAE

Genus *PROTEONINA* Williamson, 1858

PROTEONINA DIFFLUGIFORMIS (H. B. Brady) (Pl. 3, fig. 1)

A few specimens, similar to the one figured, occur in this material. It is a widely ranging species and was recorded from the Cook Mountain formation of Louisiana.

Family LITUOLIDAE

Genus *HAPLOPHRAGMOIDES* Cushman, 1910

HAPLOPHRAGMOIDES sp. (Pl. 3, fig. 2)

The single specimen figured is the only representative of this species. It may possibly be the coiled stage of *Ammobaculites huneri* Howe.

Family VERNEUILINIDAE

Genus *GAUDRYINA* d'Orbigny, 1839

GAUDRYINA GEOMETRICA Howe, juv.?

A single rather poorly preserved specimen may possibly be the young of this species described from the Cook Mountain formation.

Family MILIOLIDAE

Genus *QUINQUELOCULINA* d'Orbigny, 1826*QUINQUELOCULINA YEGUAENSIS* Weinzierl and Applin (Pl. 3, figs. 3, 4)

Quinqueloculina seminulum STADNICHENKO (not LINNÉ), Journ. Pal., vol. 1, 1927, p. 226, pl. 38, fig. 28.

Quinqueloculina yeguaensis WEINZIERL and APPLIN, Journ. Pal., vol. 3, 1929, p. 393, pl. 44, fig. 4.—CUSHMAN and THOMAS, l. c., vol. 4, 1930, p. 34, pl. 3, figs. 1, 2.—HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 36, pl. 2, fig. 8.—ISRAELSKY, Proc. 6th Pac. Sci. Congress, 1939, p. 572, pl. 2, figs. 2, 3.—CUSHMAN and APPLIN, Contr. Cushman Lab. Foram. Res., vol. 19, 1943, p. 31, pl. 7, fig. 7.

This is one of the commonest species in the Lisbon material. It has been recorded from the Claiborne Eocene of Texas and Louisiana and from the Eocene of California.

QUINQUELOCULINA MAURICENSIS Howe (Pl. 3, figs. 5, 6)

Quinqueloculina mauricensis HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 35, pl. 4, figs. 8-10.—CUSHMAN and APPLIN, Contr. Cushman Lab. Foram. Res., vol. 19, 1943, p. 32, pl. 7, fig. 8.

The types of this species are from the Claiborne, Cook Mountain formation, of Louisiana and it occurs also in the Yegua formation of Texas. A number of specimens apparently of this species occur in the Lisbon material.

QUINQUELOCULINA MAURICENSIS Howe.var. *LISBONENSIS* Cushman and Todd, n. var. (Pl. 3, figs. 7, 8)

Variety differing from the typical in the surface which is finely and irregularly striate and the angles which are somewhat less angled.

Holotype of variety (Cushman Coll. No. 42593) from the Lisbon formation of the Claiborne Eocene, Claiborne Bluff, Alabama River, Monroe Co., Ala.

This variety is less common than the typical form.

Genus *TRILOCULINA* d'Orbigny, 1826*TRILOCULINA GARRETTI* Howe (Pl. 3, fig. 9)

Triloculina garretti HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 37, pl. 2, figs. 3-5.

Several specimens from the Lisbon material are evidently identical with this species described from the Cook Mountain formation of Louisiana. The wall is made up of fine, arenaceous grains of very even size and the test is fragile. There is some considerable variation in our specimens in the aperture which may be at the end of a short neck, as in the typical specimens, or the final chamber may not reach to the end of the test.

TRILOCULINA PAULOCOSTATA Cushman and Garrett (Pl. 3, fig. 10)

Triloculina paulocostata CUSHMAN and GARRETT, Contr. Cushman Lab. Foram. Res.,

vol. 10, 1934, p. 69, pl. 9, figs. 6, 7.—Howe, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 38, pl. 3, fig. 7.

This species seems to be a characteristic one of this part of the Claiborne Eocene, already recorded from the Cook Mountain formation, and occurring in typical form in our Lisbon material.

Family LAGENIDAE

Genus **ROBULUS** Montfort, 1808

ROBULUS ALATO-LIMBATUS (Gümbel) (Pl. 3, fig. 11)

(For references, see these Contributions, vol. 19, 1943, p. 33.)

The only representatives of this species are very young specimens. It is a widely ranging form in the Eocene and has been recorded from the Cook Mountain formation of Louisiana, the Yegua formation of Texas, the Guayabal formation of Mexico, and the Jackson Eocene of the Gulf Coastal region.

There are young specimens of a number of other species of *Robulus* but not enough to make identification possible.

Genus **LENTICULINA** Lamarck, 1804

LENTICULINA THETA Cole (Pl. 3, fig. 12)

Lenticulina theta COLE, Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 14, pl. 1, fig. 17.

A single specimen, here figured, is very similar to the type figure from the Guayabal formation of Mexico.

Genus **DENTALINA** d'Orbigny, 1826

DENTALINA sp. (Pl. 3, figs. 13, 14)

Only a few specimens were found. Without more specimens to give the full specific characters it is difficult to assign them to a definite species.

Genus **LAGENA** Walker and Jacob, 1798

LAGENA cf. **SUBSTRIATA** Williamson (Pl. 3, fig. 15)

A few specimens occur in this material. They have long necks and are very finely costate, in these two characters resembling Williamson's figures. The species has probably been referred to as "*L. striata* (d'Orbigny), var. *strumosa* Reuss", but is not the same as that figured by Reuss. More material of this and numerous other species is needed to show the amounts of variation in the various species.

Family POLYMORPHINIDAE

Genus **GUTTULINA** d'Orbigny, 1839

GUTTULINA LISBONENSIS Cushman and Todd, n. sp. (Pl. 3, figs. 16, 17)

Test about as broad as long, base rounded, only slightly compressed, somewhat triserial in section; chambers strongly inflated, adult ones failing to extend back to the initial end, each one, as added, farther

away from the base; sutures distinct, depressed; wall smooth; aperture terminal, radiate. Length 0.58-0.65 mm.; breadth 0.50-0.60 mm.; thickness 0.40-0.45 mm.

Holotype (Cushman Coll. No. 42611) from the Lisbon formation of the Claiborne Eocene, Claiborne Bluff, Alabama River, Monroe Co., Ala.

This is a distinctive species of the Lisbon differing from *G. irregularis* (d'Orbigny) in the narrower base and the chambers removed from the base much earlier in their development.

GUTTULINA cf. CAUDATA d'Orbigny (Pl. 3, figs. 18, 19)

Specimens resembling this species, but lacking a definite basal spine, occur in some numbers in our material. There is a tendency for the base to be pointed in various degrees. The species is fairly common in the middle Eocene of France.

GUTTULINA IRREGULARIS (d'Orbigny) (Pl. 3, figs. 20, 21)

(For references, see U. S. Geol. Survey Prof. Paper 181, 1935, p. 24.)

This species is common in the Lisbon material and shows comparatively little variation. It is also recorded by Howe from the Cook Mountain formation.

Genus **GLOBULINA** d'Orbigny, 1839

GLOBULINA GIBBA d'Orbigny (Pl. 3, fig. 22)

(For references, see these Contributions, vol. 19, 1943, p. 35.)

Numerous specimens occur in this material and seem typical.

GLOBULINA ROTUNDATA (Bornemann)

(For references, see U. S. Geol. Survey Prof. Paper 181, 1935, p. 27.)

Less common than the preceding, but fairly numerous, this species shows no great amount of variation in this material.

GLOBULINA sp. (Pl. 3, fig. 23)

Rare specimens, similar to that figured, occur in this material but are not enough to warrant a specific determination.

Genus **SIGMOMORPHINA** Cushman and Ozawa, 1928

SIGMOMORPHINA MINDENENSIS Howe (Pl. 3, figs. 24, 25)

Sigmomorphina mindenensis HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 55, pl. 6, figs. 23, 24.

The figured specimens are all that have been found in the Lisbon material. The young stage is very similar to that of the type figure, and the broken specimen, showing the section, also seems to belong to this species described from the Cook Mountain formation of Louisiana.

SIGMOMORPHINA JACKSONENSIS (Cushman), var. **COSTIFERA** (Cushman)

(Pl. 3, fig. 26)

Polymorphina jacksonensis CUSHMAN, var. *costifera* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, 1926, p. 35.

Sigmomorphina jacksonensis CUSHMAN, var. *costifera* CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 123, pl. 32, fig. 3.—ELLISOR, Bull. Amer. Assoc. Petr. Geol., vol. 17, No. 11, 1933, pl. 7, fig. 1.—CUSHMAN, U. S. Geol. Survey Prof. Paper 181, 1935, p. 28, pl. 10, figs. 5, 6.—HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 54, pl. 7, fig. 1.

A single, but typical, specimen was found in the Lisbon material. The variety is known from the Jackson Eocene from numerous localities, and from the Claiborne Eocene, Gosport sand of Alabama and Cook Mountain formation of Louisiana.

SIGMOMORPHINA SEMITECTA (Reuss), var. **TERQUEMIANA** (Fornasini)

(For earlier references, see these Contributions, vol. 19, 1943, p. 37; and additional records, vol. 20, 1944, pp. 24, 41.)

Rare specimens of this widely ranging variety occur in the Lisbon material.

Family **NONIONIDAE**Genus **NONION** Montfort, 1808**NONION PLANATUM** Cushman and Thomas (Pl. 3, fig. 29)

(For references, see these Contributions, vol. 19, 1943, p. 37, and Journ. Pal., vol. 18, 1944, p. 370, pl. 60, fig. 15.)

This species was described from the Claiborne Eocene of Texas and seems to be a characteristic one of this portion of the Eocene, both in the Gulf Coastal Plain region and on the West Coast. It is common in the Lisbon material.

NONION FLORINENSE Cole (Pl. 3, figs. 30, 31)

Nonion florinense COLE, Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 22, pl. 4, fig. 4.—CUSHMAN, U. S. Geol. Survey Prof. Paper 191, 1939, p. 5, pl. 1, figs. 17, 18.—HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 57, pl. 7, figs. 17, 18.

A few specimens from the Lisbon were compared with autotypes of this species described from the Guayabal formation of Mexico and seem identical. Howe also records it from the Cook Mountain formation of Louisiana.

NONION MAURICENSIS Howe and Ellis (Pl. 3, figs. 27, 28)

Nonion mauricensis HOWE and ELLIS, in Howe, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 57, pl. 8, figs. 1, 2.

Specimens apparently identical with this species, described from the Cook Mountain formation of Louisiana, are common in this material.

Genus **NONIONELLA** Cushman, 1926**NONIONELLA HANTKENI** (Cushman and Applin) (Pl. 3, figs. 32, 33)

(For references, see U. S. Geol. Survey Prof. Paper 191, 1939, p. 30.)

Rare specimens in the Lisbon material seem identical with this species which is largely confined to the Jackson Eocene.

NONIONELLA cf. JACKSONENSIS Cushman

A single specimen from the Lisbon is very close to this species. It has been recorded from the Cook Mountain formation by Howe.

NONIONELLA MAURICENSIS Howe (Pl. 3, figs. 34, 35)

Nonionella mauricensis HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 59, pl. 7, figs. 19-21.

A few specimens from the Lisbon may be referred to this species described from the Cook Mountain formation of Louisiana. The Lisbon specimens seem to have a few more chambers than the type figure and are not as rounded in edge view.

Family HETEROHELICIDAE

Genus GÜMBELINA Egger, 1899

GÜMBELINA MAURICIANA Howe and Roberts (Pl. 4, fig. 2)

Gümbelina mauricana HOWE and ROBERTS, in HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 62, pl. 8, figs. 9-11.

A very few specimens apparently of this species, described from the Cook Mountain Eocene of Louisiana, occur in our Lisbon material.

GÜMBELINA GARRETTI Howe (Pl. 4, fig. 1)

Gümbelina garretti HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 61, pl. 8, fig. 14.

Two specimens, one of which is figured, are very similar to the figure given by Howe of this species from the Cook Mountain Eocene of Louisiana.

Genus GÜMBELITRIA Cushman, 1933

GÜMBELITRIA COLUMBIANA Howe (Pl. 4, fig. 3)

Gümbelitra columbiana HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 62, pl. 8, figs. 12, 13.

This very small species, described from the Cook Mountain Eocene of Louisiana, is common in the Lisbon material. It is difficult to distinguish these from *G. cretacea* Cushman from the upper part of the Cretaceous and it may be possible that these and the Gümbelinas already noted are reworked Cretaceous forms.

Family BULIMINIDAE

Genus ROBERTINA d'Orbigny, 1846

ROBERTINA OVIGERA (Terquem) (Pl. 4, fig. 4)

Bulimina ovigera TERQUEM (part), Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 108, pl. 11 (19), figs. 17, 20 (not figs. 18, 19).

Robertina ovigera CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 12, 1936, p. 98, pl. 16, fig. 15.

This species occurs at several localities in the middle Eocene of the Paris Basin. Our specimens are very similar although the apertural end is slightly less broad. The species has fewer chambers and is not as slender as *R. mcguirti* Howe.

Genus BULIMINA d'Orbigny, 1826

BULIMINA SIMPLEX Terquem (Pl. 4, fig. 5)

Bulimina simplex TERQUEM, Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 109, pl. 11 (19), figs. 23 (24?).—CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 67, pl. 9, fig. 4.

Specimens from the Lisbon material have been compared with Terquem's species from the middle Eocene of the Paris Basin and seem very similar. They have the broad aperture and the tapering test characteristic of this species.

BULIMINA TRIGONA Terquem (Pl. 4, fig. 6)

Bulimina trigona TERQUEM, Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 110, pl. 11 (19), figs. 28, 29.—CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 67, pl. 9, fig. 5.

Rare specimens, one of which is figured, are very close to this species described by Terquem from the middle Eocene of the Paris Basin. It is characterized by the rapidly tapering test and the large proportion of the test made by the last whorl.

Genus VIRGULINA d'Orbigny, 1826

VIRGULINA DIBOLLENSIS Cushman and Applin (Pl. 4, fig. 7)

(For references, see Special Publ. No. 9, Cushman Lab. Foram. Res., 1937, p. 7.)

This is one of the most abundant species in the Lisbon fauna. Specimens agree well with the types of this species which is known mostly from the Jackson Eocene but has been recorded with some question from the Bashi formation of the Wilcox Eocene. The early stages somewhat resemble *V. zetina* Cole but the adults are much more slender and have more and lower chambers.

VIRGULINA cf. ZETINA Cole (Pl. 4, fig. 8)

A single specimen, here figured, has the short, broad form and twisted test characteristic of this species described from the Guayabal formation of Mexico and recorded from the middle Eocene of Mexico and the United States, with a single record from the Oligocene.

Genus BOLIVINA d'Orbigny, 1839

BOLIVINA TAYLORI Howe (Pl. 4, fig. 9)

Bolivina taylori HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 67, pl. 9, figs. 9, 10.—CUSHMAN and APPLIN, Contr. Cushman Lab. Foram. Res., vol. 19, 1943, p. 39, pl. 7, fig. 27.

Specimens of this small species are common in the Lisbon material.

The types are from the Cook Mountain formation of Louisiana and it has been recorded from the Yegua formation of Texas.

Genus **BITUBULOGENERINA** Howe, 1934

BITUBULOGENERINA ELLISI Howe (Pl. 4, fig. 10)

Bitubulogenerina ellisi Howe, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 69, pl. 8, figs. 36, 37.

The single specimen figured is the only one found in our Lisbon material. It is evidently identical with this species described from the Cook Mountain Eocene of Louisiana.

Family **ROTALIIDAE**

Genus **PATELLINA** Williamson, 1858

PATELLINA sp.

A single specimen from the Lisbon is the only record and specific identification must await the finding of more specimens.

Genus **DISCORBIS** Lamarck, 1804

DISCORBIS PETALIFERA (Howe) (Pl. 4, fig. 11)

Bulimina (?) *petalifera* Howe, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 63, pl. 9, figs. 22, 23.

Numerous specimens of this interesting species were found in the Lisbon material. The holotype is from the Cook Mountain formation of Louisiana where it was evidently rare. Specimens show four or five chambers in the adult whorl and the young stages show a trochoid spiral. The peculiar ornamentation of the dorsal side is somewhat similar to that of *Discorbis globulo-spinosa* Cushman of the Jackson Eocene but more highly developed. It should make a good index fossil for this part of the Claiborne Eocene.

Genus **EPONIDES** Montfort, 1808

EPONIDES MEXICANUS (Cushman) (Pl. 4, figs. 12, 13)

(For references, see these Contributions, vol. 19, 1943, p. 41.)

This is a species of the middle Eocene described from the Tantoyuca formation of Mexico and recorded from the Guayabal formation of Mexico, the Cook Mountain formation of Louisiana, and the Yegua formation of Texas. It has also been recorded from the Eocene of Venezuela and California.

EPONIDES GUAYABALENSIS Cole, var. **YEGUAENSIS** Weinzierl and Applin

(Pl. 4, fig. 14)

Eponides guayabalensis COLE, var. *yeguaensis* WEINZIERL and APPLIN, Journ. Pal., vol. 3, 1929, p. 406, pl. 42, fig. 2.—CUSHMAN and DUSENBURY, Contr. Cushman Lab. Foram. Res., vol. 10, 1934, p. 62, pl. 9, fig. 1.—CUSHMAN and APPLIN, l. c., vol. 19, 1943, p. 42, pl. 8, figs. 5, 6.

This variety is typical of the Yegua formation of Texas and has been

recorded from the Eocene, Poway conglomerate, of California. A few typical specimens were found in the Lisbon material.

Genus SIPHONINA Reuss, 1850

SIPHONINA CLAIBORNENSIS Cushman

(For references, see these Contributions, vol. 19, 1943, p. 42.)

This is a characteristic species of the Claiborne Eocene, recorded from Texas, Louisiana, and California. A number of typical specimens occurred in our Lisbon material.

Genus CANCRIS Montfort, 1808

CANCRIS CLAIBORNENSIS Howe

Cancris claibornensis HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 78, pl. 10, figs. 20, 21.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 86, pl. 22, figs. 5-7.

This species, described from the Cook Mountain formation of Louisiana, has also been recorded from the Cook Mountain of Mississippi and is apparently a good index fossil for this part of the Eocene. Typical specimens are common in the Lisbon material.

Family AMPHISTEGINIDAE

Genus ASTERIGERINA d'Orbigny, 1839

ASTERIGERINA LISBONENSIS Cushman and Todd, n. sp. (Pl. 4, figs. 15-18)

Test trochoid, biconvex, ventral side more strongly convex than the dorsal, periphery acute or very slightly keeled, ventral side with a large, clear, prominent umbo; chambers somewhat indistinct in the adult, less so in the younger stages, 9 or 10 in the final whorl, on the ventral side with the supplementary chambers comparatively large and broad; sutures indistinct in the adult except the spiral suture of the dorsal side which is very prominent, thickened and slightly raised; surface smooth on the dorsal side, in the adult with the ventral side having the earlier half prominently beaded; aperture ventral, low, at the base of the apertural face of the last-formed chamber. Diameter 0.60-0.75 mm.; thickness 0.30-0.35 mm.

Holotype (Cushman Coll. No. 42664) from the Lisbon formation of the Claiborne Eocene, Claiborne Bluff, Alabama River, Monroe Co., Ala.

This species differs from *A. texana* (Stadnichenko) in the acute or slightly keeled test, more prominent spiral suture and the broader supplementary chambers. It is abundant in the Lisbon material and should be a good index fossil.

Family CASSIDULINIDAE

Genus PSEUDOBULIMINA Earland, 1934

PSEUDOBULIMINA GLAESSNERI Howe and Roberts (Pl. 4, figs. 19, 20)

Pseudobulimina glaessneri HOWE and ROBERTS, in HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 81, pl. 11, figs. 9-11.

This species, described from the Cook Mountain formation of Louisiana, is present in the Lisbon material. The form is evidently allied to the Cassidulinidae and closely related to *Ceratobulimina*.

Family ANOMALINIDAE

Genus CIBICIDES Montfort, 1808

CIBICIDES SASSEI Cole

(For references, see these Contributions, vol. 19, 1943, p. 46.)

This species is common in the Lisbon material. It was described from the Eocene, Guayabal formation, of Mexico, and has been recorded from the Yegua formation of Texas and the Cook Mountain formation of Louisiana. It has also been recorded from the Eocene of California.

CIBICIDES MAURICENSIS Howe and Roberts

Cibicides mauricensis HOWE and ROBERTS, in HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 87, pl. 13, figs. 4, 5.

Specimens which seem to be like the type figures of this species described from the Cook Mountain formation of Louisiana, occur rather sparingly in the Lisbon material.

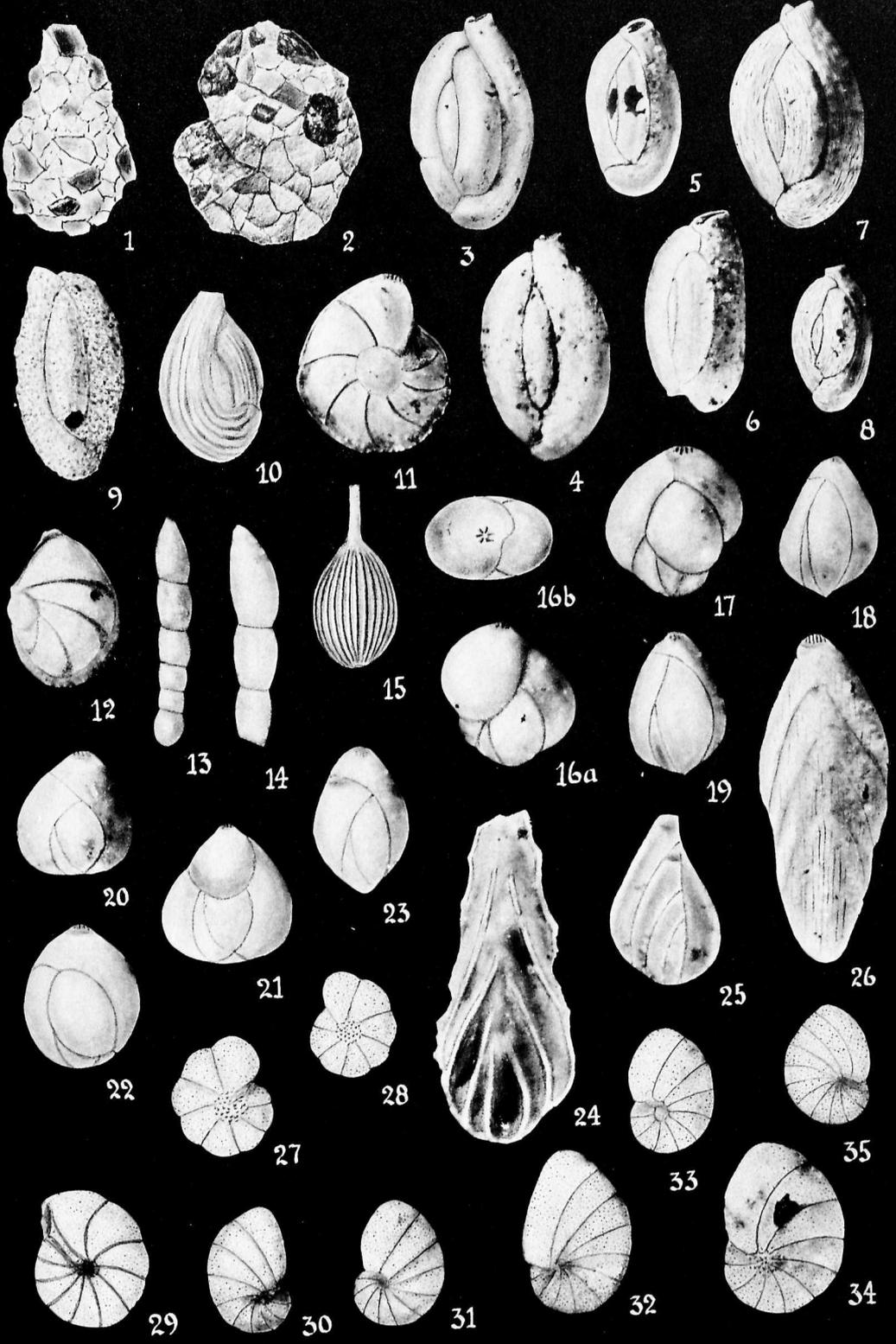
CIBICIDES HOWEI Cushman and Todd, n. sp. (Pl. 4, fig. 21)

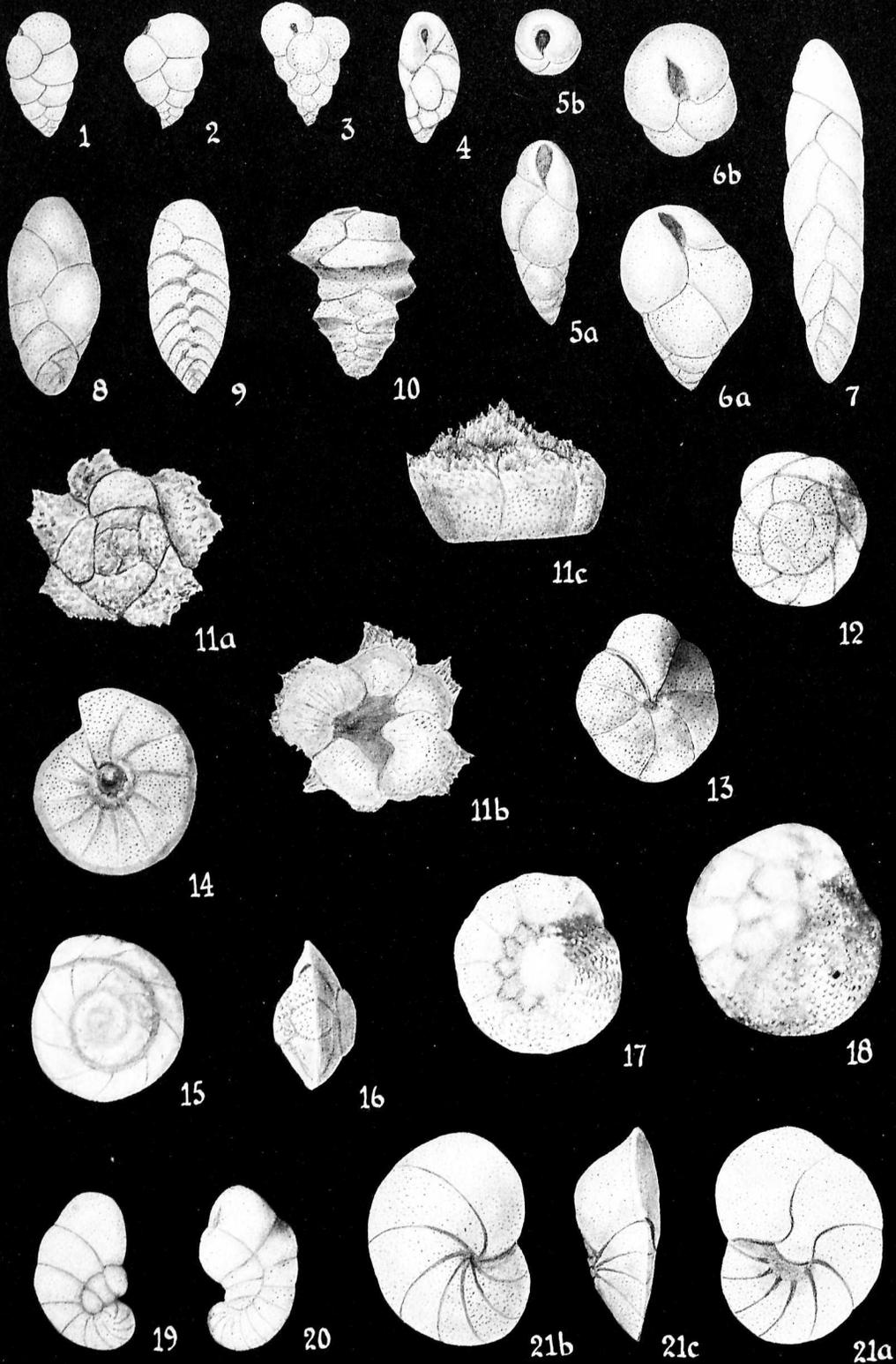
Discorbis (?) *yeguaensis* HOWE (not WEINZIERL and APPLIN), Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 75, pl. 13, figs. 15-17.

Test almost completely involute, plano-convex, dorsal side flattened or even slightly concave, ventral side strongly convex, periphery acute; chambers distinct, 8 or 9 in the adult whorl, gradually increasing in

EXPLANATION OF PLATE 3

FIG. 1. *Protonina difflugiformis* (H. B. Brady). × 100. 2. *Haplophragmoides* sp. × 100. 3, 4. *Quinqueloculina yeguaensis* Weinzierl and Applin. × 40. 5, 6. *Q. mauricensis* Howe. × 40. 7, 8. *Q. mauricensis* Howe, var. *lisbonensis* Cushman and Todd, n. var. 7, Holotype. × 60. 8, Paratype. × 40. 9. *Triloculina garretti* Howe. × 60. 10. *T. paucocostata* Cushman and Garrett. × 80. 11. *Robulus alato-limbatus* (Gümbel). × 60. 12. *Lenticulina theta* Cole. × 40. 13, 14. *Dentalina* sp. × 60. 15. *Lagena* cf. *substriata* Williamson. × 100. 16, 17. *Guttulina lisbonensis* Cushman and Todd, n. sp. × 40. 16, Holotype. a, front view; b, apertural view. 17, Paratype. 18, 19. *G. cf. caudata* d'Orbigny. × 40. 20, 21. *G. irregularis* (d'Orbigny). × 40. 22. *Globulina gibba* d'Orbigny. × 40. 23. *Globulina* sp. × 40. 24, 25. *Sigmomorphina mindenensis* Howe. × 40. 24, Broken specimen showing interior arrangement of chambers. 25, Early stage. 26. *S. jacksonensis* (Cushman), var. *costifera* (Cushman). × 40. 27, 28. *Nonion mauricensis* Howe and Ellis. × 60. 29. *N. planatum* Cushman and Thomas. × 60. 30, 31. *N. florinense* Cole. × 60. 32, 33. *Nonionella hantkeni* (Cushman and Applin). 32, × 60. 33, × 40. 34, 35. *N. mauricensis* Howe. 34, × 60. 35, × 40.





size as added; sutures distinct, not depressed, distinctly limbate, strongly curved; wall smooth; aperture on the dorsal side with a very slightly developed, overhanging lip. Length 0.25-0.32 mm.; breadth 0.22-0.25 mm.; thickness 0.10-0.13 mm.

Holotype (Cushman Coll. No. 42672) from the Lisbon formation of the Claiborne Eocene, Claiborne Bluff, Alabama River, Monroe Co., Ala.

This is not the same as *Discorbis yeguaensis* Weinzierl and Applin, differing in the strongly curved sutures, different shaped chambers, and the aperture on the dorsal side. It is named in honor of Dr. Henry V. Howe whose work on the Cook Mountain formation of Louisiana has been very useful in the study of this Lisbon material.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand:

- Colom, G.** Nuevas Especies y Subespecies de Foraminiferos Fosiles de Mallorca.—Bol. Real Soc. Española Hist. Nat., vol. XLI, 1943, pp. 317-335, pls. XXI-XXVI.—There are 13 species and subspecies noted, all new.
- Sobre el Genero *Fascispira* A. Silvestri, 1939, y su Distribucion Estratigrafica y Geografica.—L. c., pp. 399-407, text figs. 1-9.—The two known species of this genus are discussed and figured.
- Foraminiferos de las Margas Burdigalienses de la Sierra de Cazorla.—L. c., pp. 409-424, pl. XXVII, text figs. 1-4.—Numerous foraminifera are noted and a few figured, none new.
- Caudri, C. M. Bramine.** The Larger Foraminifera from San Juan de los Morros, State of Guarico, Venezuela.—Bull. Amer. Pal., vol. 28, No. 114, July 16, 1944, pp. 1-54, pls. 1-5, 2 text figs., chart.—Seven species are described, two new; and

EXPLANATION OF PLATE 4

FIG. 1. *Gümbelina garretti* Howe. $\times 100$. 2. *G. mauriciana* Howe and Roberts. $\times 100$. 3. *Gümbelitra columbiana* Howe. $\times 100$. 4. *Robertina ovigera* (Terquem). $\times 60$. 5. *Bulimina simplex* Terquem. $\times 80$. a, front view; b, apertural view. 6. *B. trigona* Terquem. $\times 80$. a, front view; b, apertural view. 7. *Virgulina dibollensis* Cushman and Applin. $\times 100$. 8. *V. cf. zetina* Cole. $\times 100$. 9. *Bolivina taylori* Howe. $\times 80$. 10. *Bitubulogenerina ellisi* Howe. $\times 100$. 11. *Discorbis petalifera* (Howe). $\times 100$. a, dorsal view; b, ventral view; c, peripheral view. 12. 13. *Eponides mexicanus* (Cushman). $\times 40$. 12, Dorsal view. 13, Ventral view. 14. *Eponides guayabalensis* Cole, var. *yeguaensis* Weinzierl and Applin. $\times 40$. Ventral view. 15-18. *Asterigerina lisbonensis* Cushman and Todd, n. sp. 15, Holotype. Dorsal view. 16-18, Paratypes. 16, Peripheral view. 17, 18, Ventral views. 15-17, $\times 40$. 18, $\times 60$. 19, 20. *Pseudobulimina glaessneri* Howe and Roberts. $\times 60$. 19, Dorsal view. 20, Ventral view. 21. *Cibicides howei* Cushman and Todd, n. sp. $\times 100$. a, dorsal view; b, ventral view; c, peripheral view.

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two new generic names proposed, *Hexagonocyclina* (genotype *Discocyclina cristensis* Vaughan) and *Ranikothalia* (genotype *Nummulites nuttalli* (Nuttall, 1926), Davies, 1927).

- Thompson, M. L. and A. K. Miller.** The Permian of southernmost Mexico and its fusulinid faunas.—*Journ. Pal.*, vol. 18, No. 6, Nov. 1944, pp. 481-504, pls. 79-84. —Twelve species are included, of which 8 are new.
- Tappan, Helen.** New Names for two Foraminiferal Homonyms.—*L. c.*, p. 560. New names proposed: *Ammobaculites dentonensis* n. sp. for *A. variabilis* Tappan (not Brady), and *Nodosaria graysonensis* n. sp. for *N. bifurcata* Tappan (not d'Orbigny).
- Applin, Paul L. and Esther R. Applin.** Regional Subsurface Stratigraphy and Structure of Florida and Southern Georgia.—*Bull. Amer. Assoc. Petr. Geol.*, vol. 28, No. 12, Dec. 1944, pp. 1673-1753, 5 pls., 38 text figs.—Numerous foraminifera are referred to and a number figured, 12 of which are new.
- Thompson, M. L.** Pennsylvanian Morrowan Rocks and Fusulinids of Kansas.—*Univ. Kansas Publ., State Geol. Survey Kansas, Bull.* 52, pt. 7, Dec. 30, 1944, pp. 409-431, pls. 1, 2, text figs. 1, 2.—Describes and figures 4 species and a variety, all but one new.
- Palmer, Dorothy K.** Notes on the Foraminifera from Bowden, Jamaica.—*Bull. Amer. Pal.*, vol. 29, No. 115, Jan. 3, 1945, pp. 1-82, pls. 1, 2.—There are 171 species and varieties noted, 8 new. Interesting notes are given on the fauna and the ecologic relationships.
- Frizzell, Don L.** Dimensions, whorls, and chamber counts in the foraminiferal family Camerinidae.—*Journ. Pal.*, vol. 19, No. 1, Jan. 1945, p. 75, 2 text figs.—Notes on the above characters are given.
- Maher, John C. and Paul H. Jones.** Ground Water and Geologic Structure of Natchitoches Area, Louisiana.—*Bull. Amer. Assoc. Petr. Geol.*, vol. 29, No. 1, Jan. 1945, pp. 23-44, 8 figs.—A list of foraminifera is given.

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