

CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

NO. 255. A PALEOCENE FORAMINIFERAL FAUNA FROM THE COAL BLUFF MARL MEMBER OF THE NAHEOLA FORMATION OF ALABAMA*

BY JOSEPH A. CUSHMAN

The fauna described here is from material collected by F. Stearns MacNeil, from the uppermost Paleocene in the creek bottom, just west of the store at Caledonia, about $\frac{1}{4}$ mile south of the center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Alabama. The deposits have been considered the lower part of the Coal Bluff beds of Langdon and the Ackerman formation of Cooke, but have recently been designated by the Geological Survey the Coal Bluff marl member of the Naheola formation.

In various respects this fauna is distinctive in this section of the Paleocene and Wilcox Eocene. There are numerous Miliolidae, a group which is very rare in the lower part of the Eocene and the Upper Cretaceous. In this respect and also in some of the species, the fauna resembles somewhat the lower middle Eocene of the Paris Basin. These species are, however, mostly small in size.

The fauna contains a number of hitherto undescribed species and varieties, and should make a good assemblage for correlation purposes in this general region. The known ranges in America are given for the various species. The species are mostly figured.

Family TEXTULARIIDAE

Genus *SPIROPLECTAMMINA* Cushman, 1927

SPIROPLECTAMMINA WILCOXENSIS Cushman and Ponton (Pl. 5, fig. 1)

Spiroplectammina wilcoxensis CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 51, pl. 7, fig. 1.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 78, pl. 13, figs. 1, 2.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 571, pl. 78, fig. 1.—CUSHMAN, Amer. Journ. Sci., vol. 242, 1944, p. 8, pl. 1, figs. 1, 2; Contr. Cushman Lab. Foram. Res., vol. 20, 1944, p. 19, pl. 3, figs. 26, 27.

Typical specimens of the species are common in this material. The

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type locality for this species is the Wilcox Eocene, 1 mi. N. of Ozark, Ala. It is recorded from the Bashi, Hatchetigbee, Nanafalia, and Tuscahoma formations and Salt Mountain limestone of Alabama, the Aquia formation of Virginia, and the Vincentown sand of New Jersey.

Genus *TEXTULARIA* DeFrance, 1824

TEXTULARIA MIDWAYANA Lalicker, var. *PANSA* Cushman, n. var. (Pl. 5, fig. 2)

Variety differing from the typical in the somewhat broader and more tapering form, the test more compressed, and the apertural face flatter and only slightly convex.

Holotype of variety (Cushman Coll. No. 40356) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about ¼ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

Family MILIOLIDAE

Genus *QUINQUELOCULINA* d'Orbigny, 1826

QUINQUELOCULINA PLUMMERAE Cushman and Todd (Pl. 5, fig. 3)

Quinqueloculina plummerae CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 25, pl. 5, fig. 2.

Quinqueloculina ferussacii PLUMMER (not D'ORBIGNY), Univ. Texas Bull. 2644, 1926, (1927), p. 161, pl. 12, fig. 10.

A number of specimens of this species described from the Naheola formation of Alabama occur in this material.

QUINQUELOCULINA ALABAMENSIS Cushman, n. sp. (Pl. 5, fig. 4)

Test small, about 2½ times as long as broad, periphery angled; chambers with the basal end protruding, apertural end with a short cylindrical neck, chambers triangular in transverse section with the peripheral angle with a thickened ridge; sutures slightly if at all depressed; wall smooth; aperture at the end of the short neck, with a very slight thickening and a small, simple tooth on the inner border.

Length of holotype, 0.47 mm.; breadth 0.20 mm.

Holotype (Cushman Coll. No. 40360) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about ¼ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

The species somewhat resembles *Q. mauricensis* Howe from the Cook Mountain formation of Louisiana, but is smaller, more elongate, the keels sharper, and the chambers more angled.

QUINQUELOCULINA PULCHERRIMA Cushman, n. sp. (Pl. 5, fig. 5)

Test very small, less than twice as long as broad, periphery rounded

or subangular; chambers inflated, basal end little if at all projecting, apertural end without a neck, obliquely truncate; sutures depressed; wall ornamented with numerous fine, but distinct, longitudinal costae, the channels between with slight transverse ridges; aperture elliptical, with a slight thickening of the lip, and a simple elongate tooth on the inner margin.

Length of holotypé, 0.28 mm.; breadth 0.16 mm.

Holotype (Cushman Coll. No. 40362) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

QUINQUELOCULINA cf. **CIRCULARIS** Bornemann (Pl. 5, fig. 6)

A single specimen of this peculiar form was found. In some respects it resembles forms that have been assigned to Bornemann's species, but is evidently not the same. The surface of our specimen is finely striate. More specimens are necessary for a complete description.

Genus **SPIROLOCULINA** d'Orbigny, 1826

SPIROLOCULINA ALABAMENSIS Cushman, n. sp. (Pl. 5, fig. 8)

Test small, 2 to $2\frac{1}{2}$ times as long as broad, slightly concave in the early portion, periphery flat, sharply angled at the margins; chambers few, rapidly increasing in size as added, of equal width throughout, strongly projecting at the base, extending into a prominent neck at the apertural end; sutures distinct, depressed; wall glistening but roughened with irregular, short, longitudinal, incised lines, with occasionally a longitudinal costa on the peripheral face; aperture quadrangular, with a short, simple tooth on the inner margin.

Length 0.35-0.40 mm.; breadth 0.15-0.25 mm.; thickness 0.07-0.08 mm.

Holotype (Cushman Coll. No. 40365) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

Spiroloculina alabamensis seems related to the Paris Basin Eocene *Spiroloculina*s figured by Terquem in 1882 in its general asymmetrical form due to the rapid increase in size of chambers. It is distinguished from *S. pertusa* Terquem, which it most closely resembles, by its different type of ornamentation and its more distinctly concave early portion.

Genus *TRILOCULINA* d'Orbigny, 1826*TRILOCULINA NATCHITOCHENSIS* Howe (Pl. 5, fig. 7)

Triloculina natchitochensis Howe, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 38, pl. 3, figs. 3-5.

Specimens in our material seem to be identical with this species described from the Cook Mountain formation of Louisiana. We have for comparison very typical specimens from the Cook Mountain formation, 2½ mi. S. of Quitman, Clarke Co., Miss.

TRILOCULINA NATCHITOCHENSIS Howe, var. *DECA* Cushman, n. var.
(Pl. 5, figs. 9, 10)

Variety differing from the typical in the more inflated chambers, less developed neck, but definite, thickened lip, wall highly decorated with slightly curved and somewhat irregular costae.

Holotype of variety (Cushman Coll. No. 40370) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about ¼ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This form may prove to be a distinct species.

TRILOCULINA ALABAMENSIS Cushman, n. sp. (Pl. 5, fig. 11)

Triloculina inflata TERQUEM (not d'ORBIGNY), Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 165, pl. 17 (25), figs. 4-6.

Test small, about twice as long as broad, periphery broadly rounded; chambers inflated, the base extending back in a broad curve, apertural end obliquely truncate without a neck, broadest near the base, tapering gradually to the apertural end; sutures distinct, depressed; wall smooth; aperture semicircular, with a distinct lip and a simple or slightly bifid tooth on the inner margin.

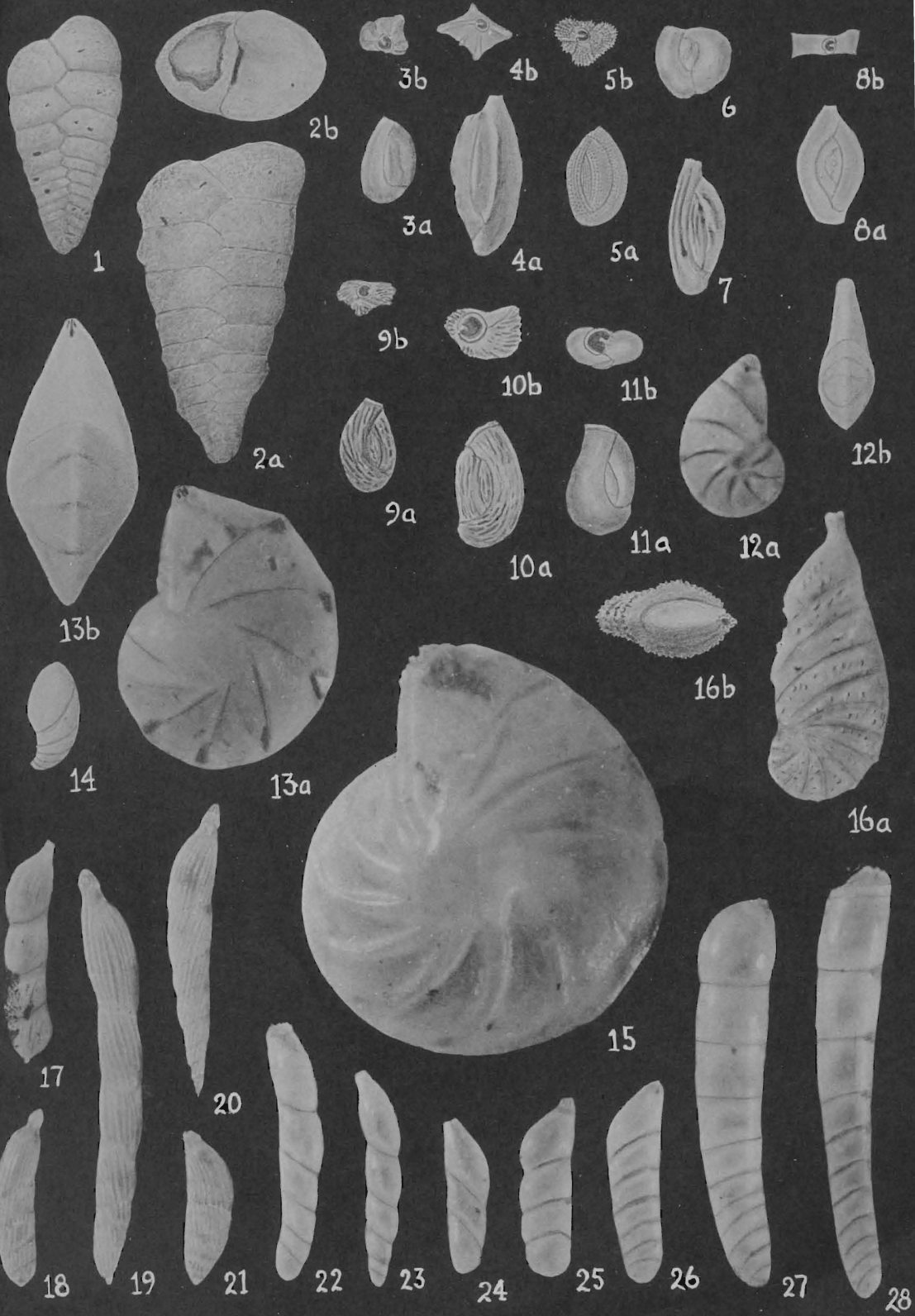
Length of holotype, 0.33 mm.; breadth 0.18 mm.

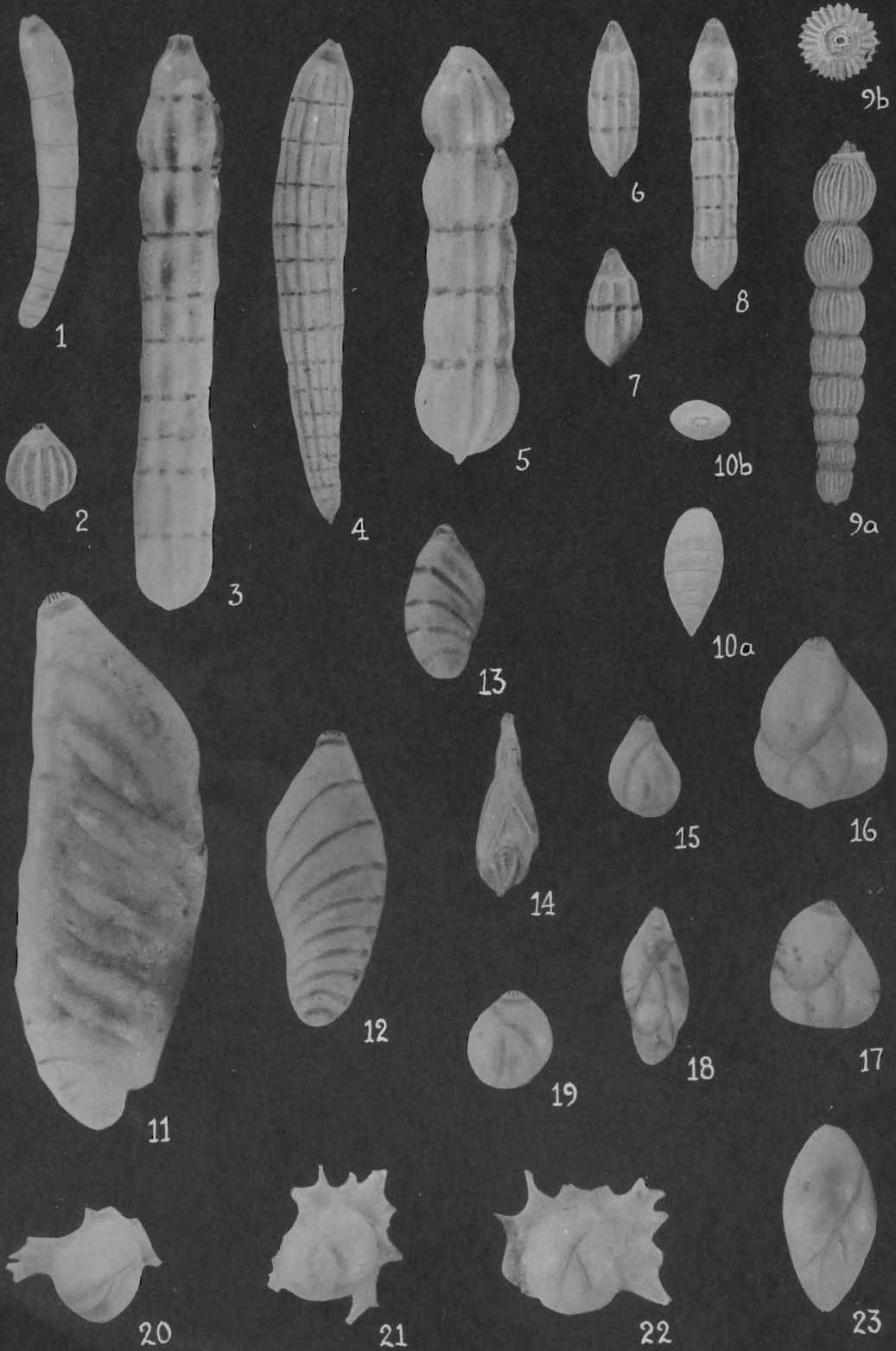
EXPLANATION OF PLATE 5

(Figs. 13, 15, 16, × 50; others, × 60)

a, front view; *b*, apertural view

FIG. 1. *Spiroplectammia wilcoxensis* Cushman and Ponton. 2. *Textularia midwayana* Lalicker, var. *pansa* Cushman, n. var. Holotype. 3. *Quinqueloculina plummerae* Cushman and Todd. 4. *Q. alabamensis* Cushman, n. sp. Holotype. 5. *Q. pulcherrima* Cushman, n. sp. Holotype. 6. *Q. cf. circularis* Bornemann. 7. *Triloculina natchitochensis* Howe. 8. *Spiroloculina alabamensis* Cushman, n. sp. Holotype. 9, 10. *Triloculina natchitochensis* Howe, var. *deca* Cushman, n. var. 9, Holotype; 10, Paratype. 11. *T. alabamensis* Cushman, n. sp. Holotype. 12. *Planularia toddae* Cushman, n. sp. Holotype. 13. *Robulus alabamensis* Cushman, n. sp. Holotype. 14. *Marginulina eximia* Neugeboren. 15. *Robulus midwayensis* (Plummer). 16. *Marginulina toulmini* Cushman, n. sp. Holotype. 17. *Dentalina naheolensis* Cushman and Todd. 18-21. *D. alabamensis* Cushman, n. sp. 19, Holotype; 18, 20, 21, Paratypes. 22-24. *D. wilcoxensis* Cushman. 25-28. *D. colei* Cushman and Dusenbury.





Holotype (Cushman Coll. No. 40374) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This is not the same as d'Orbigny's species from the Recent and late Tertiary of Europe. It is apparently identical with the form figured by Terquem from the middle Eocene of the Paris Basin.

Family LAGENIDAE

Genus ROBULUS Montfort, 1808

ROBULUS MIDWAYENSIS (Plummer) (Pl. 5, fig. 15)

(For references, see these Contributions, vol. 18, 1942, p. 26.)

This species occurs in the Paleocene, Midway of Texas and Naheola of Alabama, and in the Wilcox Eocene, Nanafalia formation and Salt Mountain limestone of Alabama. Typical specimens occur in our material.

ROBULUS ALABAMENSIS Cushman, n. sp. (Pl. 5, fig. 13)

Robulus sp. CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 55, pl. 9, fig. 23.

Test small for the genus, umbonate, close coiled, periphery with the area of each adult chamber slightly flattened, sharply angled but not carinate; chambers numerous, 8 to 10 in the final coil, distinct, of uniform shape, increasing gradually and regularly in size as added, the apertural angle translucent; sutures distinct, nearly tangential, very slightly curved, not depressed; wall smooth, polished; aperture radiate, with a slight opening at the upper end of the ventral face.

Diameter of holotype, 0.70 mm.; thickness 0.40 mm.

Holotype (Cushman Coll. No. 40378) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

EXPLANATION OF PLATE 6

(Figs. 2-5, $\times 22$; 1, 10, 14, $\times 60$; others, $\times 50$)

a, front view; *b*, apertural view

FIG. 1. *Dentalina eocenica* Cushman, n. sp. Holotype. 2-5. *Nodosaria affinis* Reuss. 2, Megalospheric proloculum. 3, 5, Megalospheric. 4, Microspheric. 6-8. *N. lat-ejugata* Gümbel, var. 9. *N. macneilli* Cushman, n. sp. Holotype. 10. *Lingulina minuta* Cushman, n. sp. Holotype. 11-13. *Vaginulina longiforma* (Plummer). Showing various stages in development. 14. *Frondicularia* sp. 15-17. *Guttulina problema* d'Orbigny. 18. *G. wilcoxensis* Cushman and Ponton. 19. *Globulina gibba* d'Orbigny. 20-22. *G. rotundata* (Bornemann). 23. *Pyrulina cylindroides* (Roemer).

This species seems related to *R. pondi* Cushman of the Upper Cretaceous, but differs in the fewer chambers, the periphery not nodose, and the center more umbonate. It is probably the same as the form referred to above from the Midway of Alabama.

Genus **PLANULARIA** Defrance, 1824

PLANULARIA TODDAE Cushman, n. sp. (Pl. 5, fig. 12)

Astacolus jugleri TOULMIN (not REUSS), Journ. Pal., vol. 15, 1941, p. 580, pl. 78, figs. 27, 28.

Planularia sp. CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 27, pl. 5, fig. 8.

Test small, compressed, very slightly umbonate, periphery subacute; chambers distinct, later ones tending to become more elongate, increasing very gradually in size as added; sutures distinct, very slightly curved, somewhat thickened, not depressed; wall smooth, polished; aperture radiate, at the peripheral angle.

Length of holotype, 0.45 mm.; breadth 0.27 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 30380) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This species differs from "*Cristellaria jugleri* Reuss" in its much smaller size, much less elongate form, slight increase in length of the chambers, and less curved ventral face. Occasional specimens become more elongate like Reuss' species, but in all other respects are similar to the type of our species.

Genus **MARGINULINA** d'Orbigny, 1826

MARGINULINA TOULMINI Cushman, n. sp. (Pl. 5, fig. 16)

Vaginulinopsis brantlyi TOULMIN (not *Hemicristellaria brantlyi* GARRETT), Journ. Pal., vol. 15, 1941, p. 583, pl. 79, figs. 8-10.

Marginulina sp. CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 20, 1944, p. 21, pl. 4, fig. 4.

Test elongate, compressed, the early portion close coiled, later adult portion uncoiled, periphery in the adult becoming nearly straight; chambers distinct, 6 to 8 in the coiled portion, rapidly increasing in size, the adult uncoiled portion consisting of 3 or 4 chambers increasing gradually in height but not in width; sutures distinct, slightly curved, raised, with a row of small tubercles of clear shell material increasing in number in the uncoiled portion; wall mostly smooth except for the sutural beading, the last one or two chambers in the adult

occasionally with a few, small, slightly elongate tubercles; aperture radiate, at the outer peripheral angle, in the adult with a slight neck.

Length of holotype, 1.00 mm.; breadth 0.37 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 40383) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This species differs from *Hemicristellaria brantlyi* Garrett in the sutural ornamentation which does not project out at the sides, and in the smaller and not keeled test. The differences are very apparent when specimens are compared. We are indebted to both Toulmin and Garrett for type specimens of their material. The species has previously been recorded from the Salt Mountain limestone of Alabama and the Aquia formation of Virginia.

MARGINULINA EXIMIA Neugeboren (Pl. 5, fig. 14)

Marginulina eximia NEUGEBOREN, Verh. Mitth. Siebenbürg. Ver. Nat., Jahrg. 2, 1851, p. 129, pl. 4, fig. 17.—CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 54, pl. 7, fig. 8.—CUSHMAN, l. c., vol. 15, 1939, p. 56, pl. 9, figs. 27, 28.—BECK, Journ. Pal., vol. 17, 1943, p. 597, pl. 104, figs. 15, 16.—KELLEY, Bull. Amer. Assoc. Petr. Geol., vol. 27, 1943, p. 8 (list).—MARTIN, Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. 3, No. 3, 1943, p. 11 (list).

A single specimen found in the material examined is typical. It has been recorded in America from the Eocene, Wilcox formation of Alabama, Anita shale and Lodo formation of California, material from Cowlitz River, Washington, and from Eocene of deep sea cores off the east coast of the United States.

Genus DENTALINA d'Orbigny, 1826

DENTALINA NAHEOLENSIS Cushman and Todd (Pl. 5, fig. 17)

Dentalina delicatula CUSHMAN, var. *naheolensis* CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 30, pl. 5, figs. 14, 15.

This form seems to be distinct from the Cretaceous species, *D. delicatula* Cushman. It was described from the Paleocene, Naheola formation, of Alabama. Typical specimens occur in our material.

DENTALINA ALABAMENSIS Cushman, n. sp. (Pl. 5, figs. 18-21)

Test slender, initial end pointed, sometimes with a slight spine, gently tapering, one side nearly straight or slightly concave, the other slightly convex; chambers few, distinct, the last ones in the adult slightly inflated, earlier ones small and slightly coiled; sutures distinct, earlier ones strongly oblique and slightly curved, becoming slightly

depressed and less oblique in the adult; wall with very fine, strongly oblique costae over the entire surface; aperture radiate at the peripheral margin with a distinct neck.

Length up to 1.12 mm.; diameter 0.12-0.15 mm.

Holotype (Cushman Coll. No. 40389) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This species is fairly common in our material, and the early stages show a considerable range of variation. It differs from *D. naheolensis* Cushman and Todd in the acute initial end with very oblique sutures and prominent oblique costae.

DENTALINA WILCOXENSIS Cushman (Pl. 5, figs. 22-24)

Dentalina wilcoxensis CUSHMAN, Amer. Journ. Sci., vol. 242, 1944, p. 8, pl. 1, figs. 5, 6; Contr. Cushman Lab. Foram. Res., vol. 20, 1944, p. 22, pl. 4, fig. 10.

Dentalina sp. CUSHMAN and TODD, l. c., vol. 18, 1942, p. 30, pl. 5, fig. 20.

This species, recently described from the Wilcox Eocene, Bashi formation, of Alabama, and recorded from the Aquia formation of Virginia and the Naheola formation of Alabama, occurs in typical form in our material.

DENTALINA EOCENICA Cushman, n. sp. (Pl. 6, fig. 1)

Nodosaria pauperata PLUMMER (not D'ORBIGNY), Univ. Texas Bull. 2644, 1926 (1927), p. 79, pl. 4, fig. 11.

Dentalina cf. *pauperata* CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 29, pl. 5, figs. 17, 18.

Test small, slender, slightly curved, increasing very slightly in diameter; chambers distinct, but only slightly inflated in the later portion, increasing gradually and rather regularly in size as added, the last-formed one in the adult nearly twice as high as broad; sutures distinct, depressed slightly in the later portion, earlier ones slightly oblique, later ones nearly at right angles to the long axis of the test; wall smooth; aperture radiate, terminal, nearly in the center of the terminal face.

Length 0.75-0.85 mm.; diameter 0.12-0.14 mm.

Holotype (Cushman Coll. No. 40393) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This small species seems to be the same as that recorded by Mrs.

Plummer from the upper part of Midway of Texas and by Cushman and Todd from the Paleocene, Naheola formation, of Alabama. It differs from *Dentalina pauperata* d'Orbigny of the Miocene of the Vienna Basin in its smaller size, rounded instead of pointed and spinose base, less inflation of the chambers, and the very slightly projecting instead of strongly pointed apertural end.

DENTALINA COLEI Cushman and Dusenbury (Pl. 5, figs. 25-28)

Vaginulina legumen (LINNÉ), var. *elegans* COLE (not d'ORBIGNY), Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 21, pl. 3, figs. 10, 11.

Dentalina colei CUSHMAN and DUSENBURY, Contr. Cushman Lab. Foram. Res., vol. 10, 1934, p. 54, pl. 7, figs. 10-12.—PARR, Journ. Roy. Soc. W. Australia, vol. 24, 1937-38, p. 76, pl. 1, fig. 8.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 584, pl. 79, fig. 12.—BECK, l.c., vol. 17, 1943, p. 598, pl. 105, fig. 18.—CURRAN, Bull. Amer. Assoc. Petr. Geol., vol. 27, 1943, pp. 1378, 1381 (lists).—MARTIN, Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. 3, No. 3, 1943, p. 10 (list).

The above references, although from the Eocene, may not all be identical with this species. It occurs in the Eocene of Mexico, California, Washington, Alabama, and New Jersey.

The species is quite different from the preceding as figures will show. It is much larger, the earlier sutures are more oblique, the aperture at one side, and the chambers much lower.

Genus NODOSARIA Lamarck, 1812

NODOSARIA AFFINIS Reuss (Pl. 6, figs. 2-5)

(For references, see these Contributions, vol. 18, 1942, p. 58.)

This species, abundant in the upper part of the Upper Cretaceous, occurs also in the Paleocene, Midway of Texas, Alabama, and Trinidad. It is found in the Naheola formation of Alabama, and recorded from the Wilcox Eocene. It is to be found under numerous names in the literature.

NODOSARIA LATEJUGATA Gümbel, var. (Pl. 6, figs. 6-8)

Numerous small specimens with comparatively few chambers, similar to those figured, occur in our material. The same form occurred in the Wilcox Eocene of Alabama (Cushman and Ponton, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 58, pl. 7, fig. 15).

NODOSARIA MACNEILI Cushman, n. sp. (Pl. 6, fig. 9)

Nodosaria paupercula TOULMIN (not REUSS), Journ. Pal., vol. 15, 1941, p. 588, pl. 79, figs. 29, 30.

Test slightly tapering, nearly straight, of rather few chambers, basal end rounded; chambers inflated, later ones nearly spherical and more

separated; sutures of the early portion little if at all depressed, gradually becoming deeply depressed in the adult; wall ornamented with numerous longitudinal costae, as many as 20 in the adult chambers; aperture radiate, terminal, with a prominent, slightly tapering neck.

Length of holotype, 1.17 mm.; diameter 0.20 mm.

Holotype (Cushman Coll. No. 40402) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This species differs from the Cretaceous *N. paupercula* Reuss which it resembles, in the much smaller size, less tapering test, and finer and more numerous costae. Toulmin recorded it from the Wilcox Eocene of Alabama. It is named for Mr. F. Stearns MacNeil, who collected the material.

Genus LINGULINA d'Orbigny, 1826

LINGULINA MINUTA Cushman, n. sp. (Pl. 6, fig. 10)

Test minute, about twice as long as broad, compressed, tapering from the acute initial end to the greatest breadth at the middle of the last-formed chamber, thence narrowing to the bluntly angled, apertural end; chambers few, increasing rapidly in size as added, strongly overlapping; sutures distinct, not depressed, at right angles to the long axis of the test; wall smooth; aperture terminal, radiate, not projecting.

Length of holotype, 0.35 mm.; breadth 0.15 mm.; thickness 0.12 mm.

Holotype (Cushman Coll. No. 40404) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This species differs from *L. glabrata* Hantken from the Eocene of Hungary, which it most resembles, in its much smaller size, more tapering and less compressed test, and relatively higher chambers.

Genus VAGINULINA d'Orbigny, 1826

VAGINULINA LONGIFORMA (Plummer) (Pl. 6, figs. 11-13)

Cristellaria longiforma PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 102, pl. 13, fig. 4.

Our specimens show considerable variation, but appear to be the same as that described and figured by Mrs. Plummer from the upper part of the Midway of Texas.

Genus **FRONDICULARIA** DeFrance, 1826**FRONDICULARIA** sp. (Pl. 6, fig. 14)

The single specimen figured is evidently a freak, and may belong to *F. midwayensis* Cushman (Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 63, pl. 10, figs. 34, 35). It is probably a specimen with an arrested development, but the shape and ornamentation resemble the early chambers of the above species.

Genus **LAGENA** Walker and Jacob, 1798**LAGENA** cf. **STRIATO-PUNCTATA** Parker and Jones

A few specimens with highly ornate costae resemble this species.

LAGENA cf. **ACUTICOSTA** Reuss

A single specimen with rather high longitudinal costae may belong to this species.

Family **POLYMORPHINIDAE**Genus **GUTTULINA** d'Orbigny, 1839**GUTTULINA PROBLEMA** d'Orbigny (Pl. 6, figs. 15-17)

This species, from the records, is widely distributed with a long geologic range. It has been recorded from the Eocene of many areas, and perhaps more than one species is represented.

GUTTULINA WILCOXENSIS Cushman and Ponton (Pl. 6, fig. 18)

Guttulina wilcoxensis CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 60, pl. 8, figs. 1, 2.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 80, pl. 14, figs. 8, 9.—CUSHMAN, l. c., vol. 20, 1944, p. 23; Amer. Journ. Sci., vol. 242, 1944, p. 9, pl. 1, fig. 8.

This species was described from the Eocene beds of Wilcox age from 1 mi. N. of Ozark, Ala. It has been recorded from the Bashi formation of Alabama and the Aquia formation of Virginia. Typical specimens occur in our material.

Genus **GLOBULINA** d'Orbigny, 1839**GLOBULINA GIBBA** d'Orbigny (Pl. 6, fig. 19)

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

Globulina gibba CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 63, pl. 11, fig. 6.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 594, pl. 80, fig. 9.—CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 7, pl. 2, fig. 4.—CUSHMAN and TODD, l. c., vol. 18, 1942, p. 34, pl. 6, figs. 13, 14.—CUSHMAN and STEGFUS, Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 409, pl. 16, fig. 26.—CUSHMAN and APPLIN, Contr. Cushman Lab. Foram. Res., vol. 19, 1943, p. 35, pl. 7, fig. 19.—CUSHMAN, l. c., vol. 20, 1944, p. 23, pl. 4, figs. 17, 18; Amer. Journ. Sci., vol. 242, 1944, p. 9, pl. 1, figs. 9, 10.

The above references are to the most recent records from the lower

and middle Eocene. They include the Yegua formation of Texas, the Salt Mountain limestone, Nanafalia, Tuscahoma, Hatchetigbee, and Bashi formations of Alabama, Aquia formation of Virginia, and Kreyenhagen shale of California. It is also recorded from formations of Paleocene age in Texas, Alabama, and Trinidad. Our specimens are typical.

GLOBULINA ROTUNDATA (Bornemann) (Pl. 6, figs. 20-22)

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

Some interesting fistulose specimens referable to this species occur in some numbers in our material.

Genus **PYRULINA** d'Orbigny, 1839

PYRULINA CYLINDROIDES (Roemer) (Pl. 6, fig. 23)

Polymorphina cylindroides ROEMER, Neues Jahrb. für Min., 1838, p. 385, pl. 3, fig. 26.—H. B. BRADY, PARKER, and JONES, Trans. Linn. Soc., vol. 27, 1870, p. 221, pl. 39, fig. 6.

Pyrulina cylindroides CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 56, pl. 14, figs. 1-5.—CUSHMAN, Tenn. Div. Geol., Bull. 41, 1931, p. 40, pl. 6, figs. 7, 8; Bull. 161, U. S. Nat. Mus., pt. 2, 1933, p. 39, pl. 9, fig. 13; Special Publ. No. 5, Cushman Lab. Foram. Res., 1933, pl. 22, fig. 14.—PARR and COLLINS, Proc. Roy. Soc. Victoria, vol. 50 (n. ser.), pt. 1, 1937, p. 198, pl. 13, fig. 7.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 61, pl. 10, fig. 37.—TAPPAN, Journ. Pal., vol. 14, 1940, p. 114, pl. 18, fig. 1.—TOULMIN, l. c., vol. 15, 1941, p. 594, pl. 80, fig. 10.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 19, 1943, p. 62, pl. 11, fig. 2.—CUSHMAN, l. c., vol. 20, 1944, p. 9, pl. 2, fig. 16.

Although, from the records, this species has a wide range from Cretaceous to Recent, the only record for this part of the Tertiary is that of Toulmin from the Salt Mountain limestone of Alabama. Rather typical specimens occur in our Alabama material. It may have been included under other names. Mrs. Plummer's "*Polymorphina ovata* d'Orbigny" from the Midway of Texas may belong here (Univ. Texas Bull. 2644, 1926 (1927), p. 124, pl. 6, fig. 10).

Genus **GLANDULINA** d'Orbigny, 1826

GLANDULINA ABBREVIATA Neugeboren (Pl. 7, fig. 1)

Glandulina abbreviata NEUGEBOREN, Verh. Mitth. Siebenburg, Ver. Nat., Jahrg. 1, 1850, p. 48, pl. 1, fig. 1; Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 68, pl. 1, fig. 1.—CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 64, pl. 8, fig. 9.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 81, pl. 14, fig. 10.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 594, pl. 80, fig. 11.

All the American records for this species are from the Eocene, Wilcox group, of Alabama.

Genus PSEUDOPOLYMORPHINA Cushman and Ozawa, 1928

PSEUDOPOLYMORPHINA WILCOXENSIS Cushman and Ponton (Pl. 7, fig. 2)

Pseudopolymorphina wilcoxensis CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 61, pl. 8, figs. 5, 6.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 81, pl. 14, fig. 11.—CUSHMAN, l. c., vol. 20, 1944, p. 23, pl. 4, fig. 19.

This species is recorded from the Wilcox Eocene, Tuscahoma sand and Bashi formation of Alabama and the Aquia formation of Virginia. Our specimens in the present collection are typical.

Genus SIGMOMORPHINA Cushman and Ozawa, 1928

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

(Pl. 7, fig. 3)

(For earlier references, see these Contributions, vol. 19, 1943, p. 37.)

Sigmomorphina semitecta (REUSS), var. *terquemiana* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 20, 1944, p. 24, pl. 4, fig. 15.

There are a number of records for this species in the American Eocene, including the Jackson of Georgia and Alabama, Cook Mountain formation of Louisiana, Yegua formation of Texas, Naheola formation of Alabama, and Aquia formation of Virginia. Typical specimens occur in the present collection.

SIGMOMORPHINA WILCOXENSIS Cushman and Ponton (Pl. 7, fig. 4)

Sigmomorphina wilcoxensis CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 61, pl. 8, fig. 7.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 595, pl. 80, fig. 15.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 35, pl. 6, fig. 15.

This species is known from the Eocene, Tuscahoma sand and Salt Mountain limestone of Alabama, and the Paleocene, Naheola formation of Alabama. It is very rare in the present material.

SIGMOMORPHINA cf. WILLIAMSONI (Terquem) (Pl. 7, fig. 5)

The figured specimen is the only one found in our material. It is much smaller than the Recent and Miocene forms, and has apparently not been recorded from formations older than the Miocene. Its form, however, is very close to that of this species.

Genus POLYMORPHINELLA Cushman and Hanzawa, 1936

POLYMORPHINELLA sp. (Pl. 7, fig. 6)

The single specimen figured seems to be biserial in its early stages, and uniserial later. Toulmin described two species of this genus from the Eocene, Salt Mountain formation, of Alabama, but our specimen is very different.

Family NONIONIDAE

Genus NONIONELLA Cushman, 1926

NONIONELLA INSECTA (Schwager)

Anomalina insecta SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 128, pl. 28 (5), figs. 1, 2.

Nonionella insecta CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 65, pl. 8, figs. 13, 14.—GLAESSNER, Problems of Paleontology, Moscow Univ., vols. 2-3, 1937, p. 368.—CUSHMAN, U. S. Geol. Survey Prof. Paper 191, 1939, p. 29, pl. 8, fig. 1.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 597, pl. 80, fig. 22.

This species was described from the middle Eocene of northern Africa. It is recorded in the American Wilcox Eocene of Alabama in the Tuscahoma sand, the Hatchetigbee marl, and the Salt Mountain limestone. Very few and poorly preserved specimens have been found in our material.

Family HETEROHELICIDAE

Genus EOUVIGERINA Cushman, 1926

EOUVIGERINA EXCAVATA Cushman (Pl. 7, fig. 7)

Eouvigerina excavata CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 66, pl. 11, fig. 18.—CUSHMAN and TODD, l. c., vol. 18, 1942, p. 35, pl. 6, figs. 20, 21.—CUSHMAN, Amer. Journ. Sci., vol. 242, 1944, p. 10, pl. 1, fig. 18.

This species seems to be a characteristic one, occurring in the Paleocene, Midway and Naheola, of Alabama, and the Eocene, Bashi formation of Alabama. Our specimens are typical.

Genus SIPHOGENERINOIDES Cushman, 1927

SIPHOGENERINOIDES ELEGANTA (Plummer) (Pl. 7, fig. 8)

Siphogenerina eleganta PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 126, pl. 8, fig. 1.

Siphogenerinoides eleganta CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 66, pl. 11, fig. 17.—CUSHMAN and RENZ, l. c., vol. 18, 1942, p. 8.

This small but distinctive species seems to be a characteristic one of this part of the American section. It is recorded from the Paleocene, Midway, of Texas, Alabama, and Trinidad. Our specimens are typical.

Family BULIMINIDAE

Genus ROBERTINA d'Orbigny, 1846

ROBERTINA WILCOXENSIS Cushman and Ponton (Pl. 7, fig. 9)

Robertina wilcoxensis CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 66, pl. 8, fig. 19.—CUSHMAN and PARKER, l. c., vol. 12, 1936, p. 96, pl. 16, fig. 13.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 82, pl. 14, fig. 16.—CUSHMAN and TODD, l. c., vol. 18, 1942, p. 36, pl. 6, figs. 22, 23.—CUSHMAN, Amer. Journ. Sci., vol. 242, 1944, p. 11, pl. 1, fig. 17.

Records for this species include the Paleocene, Naheola formation,

and the Wilcox Eocene, Tuscahoma sand and Bashi formation of Alabama. A single specimen was found in our material.

Genus *ENTOSOLENIA* Ehrenberg, 1848

ENTOSOLENIA cf. *APICULATA* (Reuss) (Pl. 7, fig. 10)

The figured specimen with a prominent internal tube may be assigned to this species. It is the only one found in this material.

ENTOSOLENIA cf. *LAEVIGATA* (Reuss) (Pl. 7, fig. 12)

Keeled specimens, similar to those recorded from the Paleocene, Naheola formation of Alabama (Cushman and Todd, Contr. Cushman Lab. For. Res., vol. 18, 1942, p. 37, pl. 6, fig. 27), occur in our material.

ENTOSOLENIA CRUMENATA Cushman (Pl. 7, fig. 12)

(For references, see these Contributions, vol. 18, 1942, p. 37.)

The known range of this species includes the Paleocene, Naheola formation, of Alabama, and the lower Oligocene of Alabama and Mississippi. Our specimens are very similar to the ones from the Naheola formation.

Genus *VIRGULINA* d'Orbigny, 1826

VIRGULINA cf. *WILCOXENSIS* Cushman and Ponton

One broken specimen in this material is probably this species, and is quite different from the following one.

VIRGULINA ALABAMENSIS Cushman, n. sp. (Pl. 7, fig. 13)

Test about 3 times as long as broad, fusiform, somewhat compressed, periphery rounded, very slightly lobulate, little if any twisting in the early stages, adult with 8-10 biserial chambers; chambers distinct, very slightly if at all inflated, biserial, much higher than broad; sutures distinct, very strongly oblique, very slightly curved, little if at all depressed; wall smooth, finely perforate; aperture comma-shaped, broadest at the outer end.

Length 0.42-0.60 mm.; breadth 0.12-0.15 mm.; thickness 0.07-0.08 mm.

Holotype (Cushman Coll. No. 40445) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This species is nearest to *V. acuta* (d'Orbigny) from the Miocene of the Vienna Basin, but differs from it in the much smaller size, the sutures not depressed, early portion less twisted, and the periphery

less lobulated. It is fairly common in this material, and should make a good index fossil.

Genus **BOLIVINA** d'Orbigny, 1839

BOLIVINA MIDWAYENSIS Cushman (Pl. 7, fig. 14)

Bolivina midwayensis CUSHMAN, Special Publ. No. 6, Cushman Lab. Foram. Res., 1936, p. 50, pl. 7, fig. 12; Special Publ. No. 9, 1937, p. 45, pl. 6, figs. 11-13; Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 67, pl. 11, fig. 22; Amer. Journ. Sci., vol. 242, 1944, p. 11, pl. 1, figs. 22, 23.

The records for this species are from the Paleocene, Midway of Texas and Alabama, and the Wilcox Eocene, Bashi formation of Alabama. Our specimens are typical.

BOLIVINA CRENULATA Cushman (Pl. 7, figs. 15, 16)

Bolivina crenulata CUSHMAN, Special Publ. No. 6, Cushman Lab. Foram. Res., 1936, p. 50, pl. 7, fig. 13; Special Publ. No. 9, 1937, p. 53, pl. 6, figs. 33, 34.

The types of this species are from the Eocene of Hungary, and it is also recorded from the Eocene of the Blue Marl of Biarritz, France. Our specimens in the Alabama material seem to be identical.

BOLIVINA BUDENSIS (Hautken) (Pl. 7, fig. 17)

(For references, see Special Publ. No. 9, 1937, p. 47.)

This species is found in the Eocene of Hungary and France. Our specimens from Alabama are identical with topotypes. It has not previously been recorded from America.

Genus **ANGULOGERINA** Cushman, 1927

ANGULOGERINA WILCOXENSIS (Cushman and Ponton) (Pl. 7, fig. 18)

Pseudovigerina wilcoxensis CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 66, pl. 8, fig. 18.

Angulogerina wilcoxensis CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 84, pl. 14, figs. 24, 25.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 599, pl. 80, fig. 30.

This species is known from the Wilcox Eocene of Alabama in the Tuscahoma, Bashi, and Hatchetigbee formations, and the Salt Mountain limestone. Typical specimens occur in this material.

ANGULOGERINA VIRGINIANA Cushman (Pl. 7, fig. 19)

Angulogerina virginiana CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 20, 1944, p. 25, pl. 4, fig. 23.

This species, recently described from the Eocene, Aquia formation, of Virginia, occurs in typical form in the Alabama material.

Family **ROTALIIDAE**

Genus **SPIRILLINA** Ehrenberg, 1843

SPIRILLINA cf. **VIVIPARA** Ehrenberg (Pl. 7, fig. 21)

A single specimen in this material is identical with that figured

from the Paleocene, Naheola formation, of Alabama (Cushman and Todd, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 38, pl. 7, fig. 1).

SPIRILLINA SELSEYENSIS Heron-Allen and Earland (Pl. 7, fig. 20)

(For references, see these Contributions, vol. 18, 1942, p. 38.)

The types are from the Eocene of England. In America it has been recorded from the Wilcox Eocene, Tuscahoma sand, and the Paleocene, Naheola formation, of Alabama. The specimens in this material are typical.

Genus PATELLINA Williamson, 1858

PATELLINA sp. (Pl. 7, fig. 22)

The single specimen found seems not to have been described, but must await the finding of more specimens to warrant a full description.

Genus DISCORBIS Lamarck, 1804

DISCORBIS MIDWAYENSIS Cushman, var. **TRINITATENSIS** Cushman and Renz

(Pl. 7, fig. 23)

Discorbis midwayensis CUSHMAN, var. *trinitatensis* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 10, pl. 3, fig. 5.

Two specimens identical with this variety from the Paleocene, Midway, of Trinidad, occur in the Alabama material.

Genus LAMARCKINA Berthelin, 1881

LAMARCKINA NAHEOLENSIS Cushman and Todd (Pl. 7, fig. 25)

Lamarckina naheolensis CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 39, pl. 7, figs. 5-7.

This species, recently described from the Paleocene, Naheola formation, of Alabama, occurs commonly and in typical form in this material. It should prove to be a good index fossil.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA AEQUILATERALIS (Plummer) (Pl. 7, fig. 24)

Rotalia aequilateralis PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 155, pl. 12, fig. 3.

Gyroïdina subangulata CUSHMAN and TODD (not PLUMMER), Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 40, pl. 7, figs. 11, 12.

This species, according to Mrs. Plummer, is most common in the upper part of the Midway of Texas. The form referred to above from the Naheola formation of Alabama should also be referred to *G. aequilateralis* which is a flatter species, with more chambers and quite distinct from *G. subangulata*. It occurs in typical form in the Alabama material.

Genus EPONIDES Montfort, 1808

EPONIDES LOTUS (Schwager) (Pl. 7, fig. 26)

(For references, see these Contributions, vol. 18, 1942, p. 40.)

This species is widely distributed in the Eocene of Africa, Europe, East Borneo, and America. In America it has been recorded from the Eocene of Cuba and California, from the Eocene, Aquia formation of Virginia, and Bashi formation of Alabama, and from the Paleocene, Naheola formation of Alabama. In the present material it is common in typical form.

Genus SIPHONINA Reuss, 1850

SIPHONINA WILCOXENSIS Cushman (Pl. 7, fig. 27)

(For references, see these Contributions, vol. 20, 1944, p. 27.)

The records for this species include the Wilcox Eocene, Nanafalia, Tuscahoma, and Bashi formations and Salt Mountain limestone of Alabama, and the Hatcherigbee formation of Mississippi. It also occurs in the Aquia formation of Virginia. There are also records from the Eocene of California. It is common in the present material.

Family AMPHISTEGINIDAE

Genus ASTERIGERINA d'Orbigny, 1839

ASTERIGERINA PRIMARIA Plummer (Pl. 7, fig. 28)

Asterigerina primaria PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 157, pl. 12, fig. 8.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 606, pl. 81, fig. 22.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 41, pl. 7, fig. 18.

Rare specimens occur in the Alabama material, but are not fully grown. It was described from the Paleocene, Midway, of Texas and recorded from the Naheola formation and Salt Mountain limestone of Alabama.

Family CASSIDULINIDAE

Genus PULVINULINELLA Cushman, 1926

PULVINULINELLA OBTUSA (Burrows and Holland) (Pl. 7, fig. 29)

Pulvinulina exigua H. B. BRADY, var. *obtusa* BURROWS and HOLLAND, Proc. Geol. Assoc., vol. 15, 1897, p. 49, pl. 2, fig. 25.—PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 151, pl. 11, fig. 2.

Pulvinulinella exigua (H. B. BRADY), var. *obtusa* CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 71, pl. 9, fig. 9.—JENNINGS, Bull. Amer. Pal., vol. 23, No. 78, 1936, p. 34, pl. 4, fig. 4.—HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 81, pl. 11, figs. 4-6.

Pulvinulinella obtusa CUSHMAN and GARRETT, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 87, pl. 15, figs. 12, 13.—CUSHMAN and RENZ, l. c., vol. 18, 1942, p. 11, pl. 2, fig. 16.—CUSHMAN and TODD, l. c., vol. 18, 1942, p. 42, pl. 7, figs. 19, 20.—CUSHMAN, l. c., vol. 20, 1944, p. 27, pl. 4, fig. 32; Amer. Journ. Sci., vol. 242, 1944, p. 14, pl. 2, figs. 7, 8.

The types are from the Eocene, Thanet Beds, of England. In America it occurs particularly commonly in the Paleocene, Midway of Texas and Trinidad and Naheola formation of Alabama. In the Wilcox Eocene it occurs in the Bashi formation of Alabama and in the Aquia formation of Virginia.

Genus *PARRELLA* Finlay, 1939

PARRELLA MACNEILI Cushman, n. sp. (Pl. 7, figs. 30, 31)

Test small, close coiled, trochoid, consisting of about 4 chambers in the adult whorl, periphery acute, slightly keeled and serrate; chambers fairly distinct, increasing rapidly in size as added, the last-formed one strongly inflated on the ventral side, making up nearly half the surface of the test; sutures indistinct, tangential, little if at all depressed; wall slightly papillate in the umbonal region of the ventral side, on the dorsal side papillate along the sutures; aperture fairly large, ventral, with a rounded, somewhat triangular lip curved on the outer side making a rounded indentation into the ventral face.

Diameter 0.35-0.45 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 40479) from the Paleocene, Coal Bluff marl member of Naheola formation, creek bottom, just W. of store at Caledonia, about $\frac{1}{4}$ mi. S. of center of sec. 29, T. 11 N., R. 10 E., Wilcox Co., Ala.

This species differs from *P. expansa* Toulmin from the Salt Mountain limestone of Alabama in the fewer chambers, more oblique sutures, and ornate test.

Genus *EPISTOMINOIDES* Plummer, 1934

EPISTOMINOIDES MIDWAYENSIS Plummer (Pl. 8, fig. 1)

Epistominoides midwayensis PLUMMER, Amer. Midland Nat., vol. 15, 1934, p. 605, pl. 24, fig. 4.—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 42, pl. 7, figs. 21, 22.

This species is known only from the Paleocene, Kincaid formation of Texas and Naheola formation of Alabama. A single specimen was found in the present material.

Family *GLOBIGERINIDAE*

Genus *GLOBIGERINA* d'Orbigny, 1826

GLOBIGERINA COMPRESSA Plummer (Pl. 8, fig. 2)

(For references, see these Contributions, vol. 18, 1942, p. 44.)

This species, described from the Paleocene, Midway, of Texas, has also been recorded from the Paleocene, Naheola formation, of Alabama; the Eocene, Hornerstown formation of New Jersey; and the

Salt Mountain limestone of Alabama. It is also recorded from the Eocene of the Caucasus region. The specimens from the present material are typical.

GLOBIGERINA PSEUDO-BULLOIDES Plummer (Pl. 8, fig. 3)

(For references, see these Contributions, vol. 18, 1942, p. 43.)

This species, according to the records, has the same range as the preceding. It is rare in the present material.

GLOBIGERINA TRILOCULINOIDES Plummer (Pl. 8, fig. 4)

Globigerina triloculinoides PLUMMER, Univ. Texas Bull. 2644, 1926 (1927), p. 134, pl. 8, fig. 10.—JENNINGS, Bull. Amer. Pal., vol. 23, No. 78, 1936, p. 193, pl. 31, fig. 10.—GLAESSNER, Problems of Paleontology, Moscow Univ., vols. 2-3, 1937, p. 382, pl. 4, fig. 33.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 72, pl. 12, fig. 15.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 607, pl. 82, fig. 3.—THALMANN, Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. 3, No. 1, 1942, p. 13 (list).—MARTIN, l. c., vol. 3, No. 3, 1943, p. 10 (list).—BECK, Journ. Pal., vol. 17, 1943, p. 609, pl. 108, figs. 2, 3.—KELLEY, Bull. Amer. Assoc. Petr. Geol., vol. 27, 1943, p. 11 (list).—CURRAN, l. c., pp. 1378, 1381 (lists).—CUSHMAN, Amer. Journ. Sci., vol. 242, 1944, p. 15, pl. 2, figs. 11, 12.

There are more records for this species than for the two preceding ones, including the Eocene of California and Washington, as well as East Borneo.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA WILCOXENSIS Cushman and Ponton, var. **ACUTA** Toulmin

(Pl. 8, fig. 5)

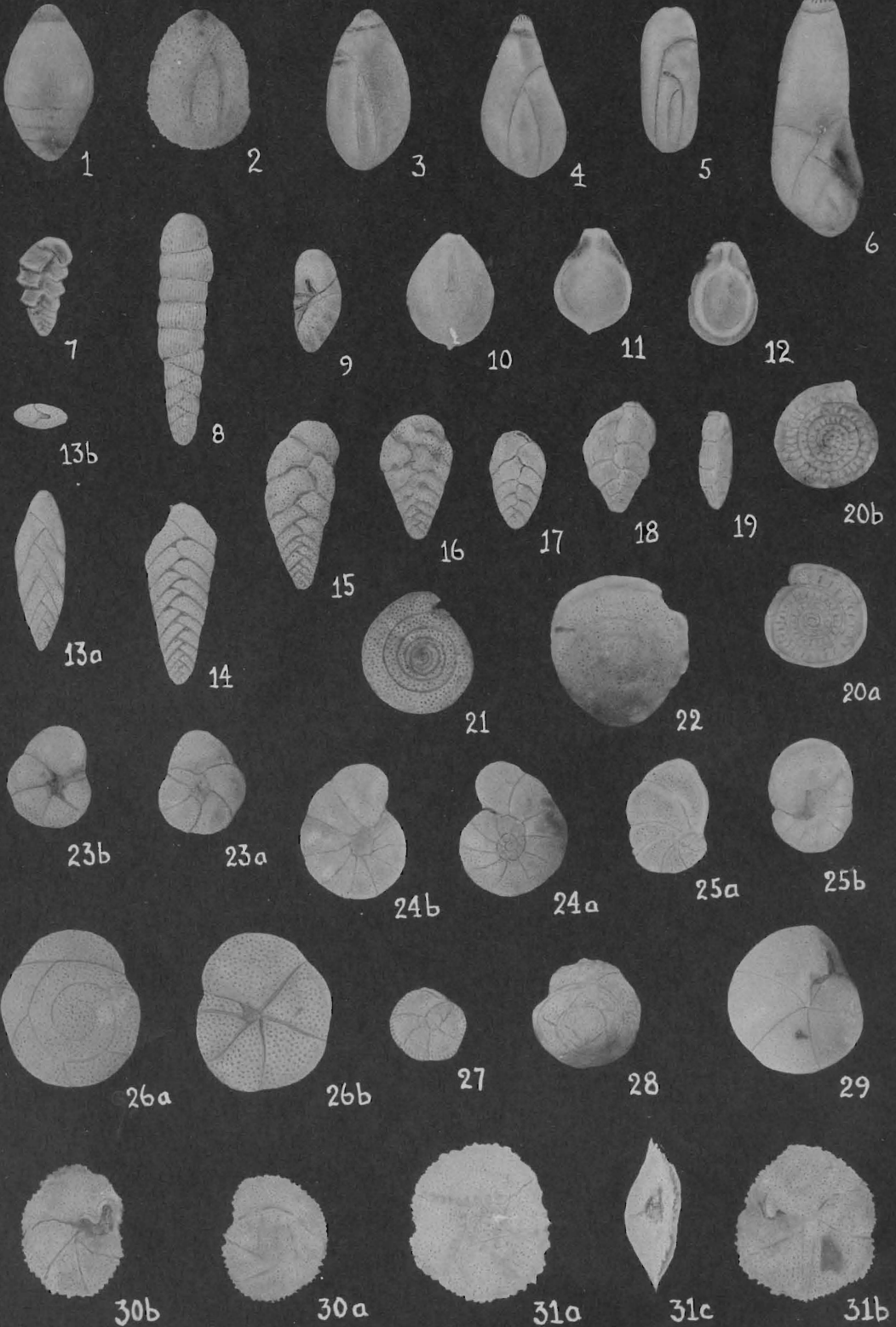
Globorotalia wilcoxensis CUSHMAN and PONTON, var. *acuta* TOULMIN, Journ. Pal.,

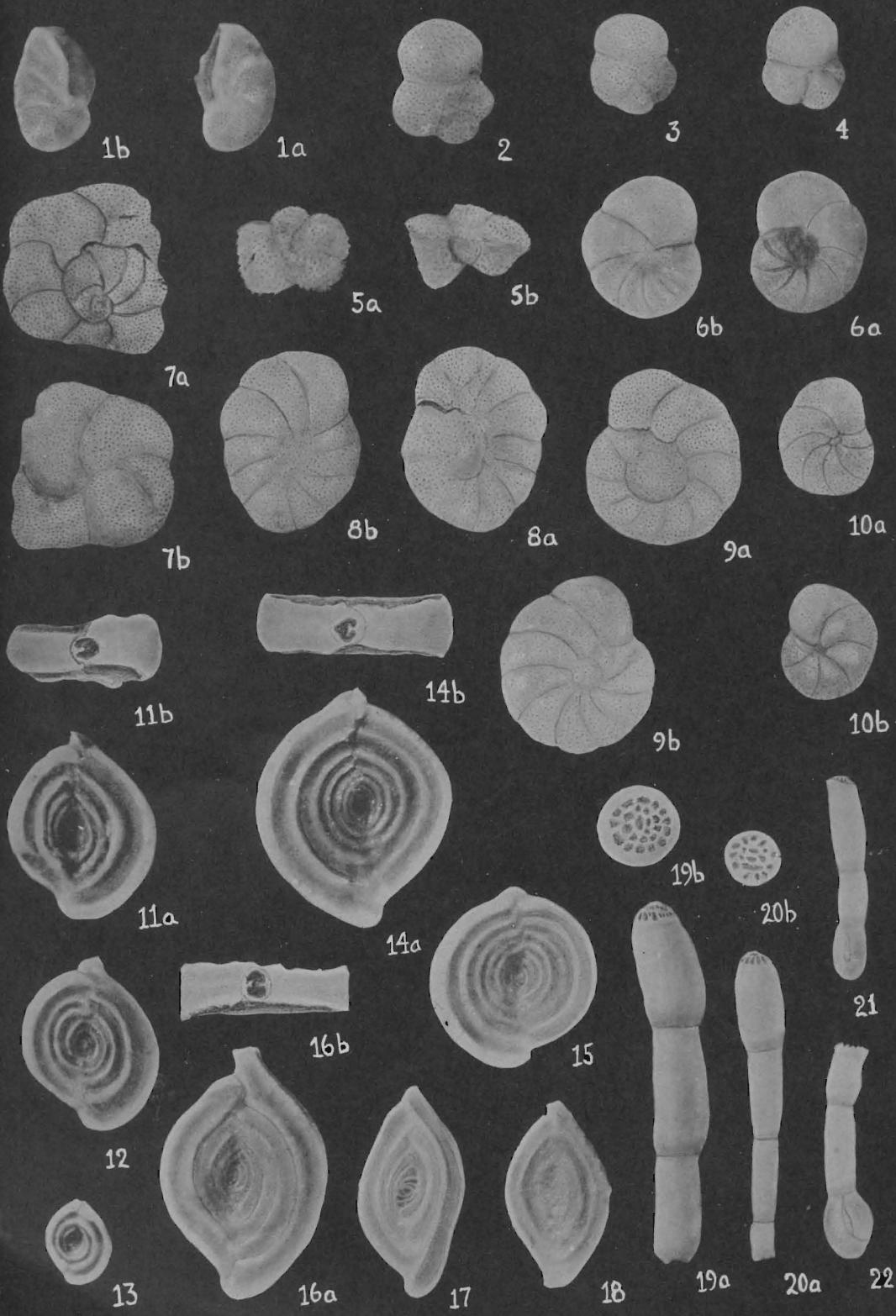
EXPLANATION OF PLATE 7

(Figs. 1, 2, $\times 50$; others, $\times 60$)

a, dorsal view; *b*, ventral view; *c*, peripheral view; except as otherwise noted.

FIG. 1. *Glandulina abbreviata* Neugeboren. 2. *Pseudopolymorphina wilcoxensis* Cushman and Ponton. 3. *Sigmomorphina semitecta* (Reuss), var. *terquemiana* (Fornasini). 4. *S. wilcoxensis* Cushman and Ponton. 5. *S. cf. williamsoni* (Terquem). 6. *Polymorphinella* sp. 7. *Eowigerina excavata* Cushman. 8. *Siphogenerinoides eleganta* (Plummer). 9. *Robertina wilcoxensis* Cushman and Ponton. 10. *Entosolenia cf. apiculata* (Reuss). 11. *E. cf. laevigata* (Reuss). 12. *E. crumenata* Cushman. 13. *Virgulinella alabamensis* Cushman, n. sp. Holotype. *a*, front view; *b*, apertural view. 14. *Bolivina midwayensis* Cushman. 15, 16. *B. crenulata* Cushman. 17. *B. budensis* (Hantken). 18. *Angulogerina wilcoxensis* (Cushman and Ponton). 19. *A. virginiana* Cushman. 20. *Spirillina selseyensis* Heron-Allen and Earland. 21. *S. cf. vivipara* Ehrenberg. 22. *Patellina* sp. 23. *Discorbis midwayensis* Cushman, var. *trinitatensis* Cushman and Renz. 24. *Gyroidina aequilateralis* (Plummer). 25. *Lamarckina naeolensis* Cushman and Todd. 26. *Eponides lotus* (Schwager). 27. *Siphonina wilcoxensis* Cushman. 28. *Asterigerina primaria* Plummer. 29. *Pulvinulinella obtusa* (Burrows and Holland). 30, 31. *Parrella macneili* Cushman, n. sp. 30, Paratype; 31, Holotype.





vol. 15, 1941, p. 608, pl. 82, figs. 6-8.—CUSHMAN and RENZ, Contr. Cushman Lab. For. Res., vol. 18, 1942, p. 12, pl. 3, fig. 2.—CUSHMAN, Amer. Journ. Sci., vol. 242, 1944, p. 15, pl. 2, figs. 16, 17.

The records for this variety include the Wilcox Eocene, Salt Mountain limestone and Bashi formation, of Alabama and the Paleocene, Midway, of Trinidad. It occurs in some numbers in our Alabama material.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA UMBONIFERA (Schwager) (Pl. 8, fig. 6)

(For references, see these Contributions, vol. 20, 1944, p. 27.)

In America, this species is known from the Wilcox Eocene, Tuscahoma sand and Bashi formation of Alabama, and Aquia formation of Virginia. Similar specimens occur in the present material.

Genus CIBICIDES Montfort, 1808

CIBICIDES PRAECURSORIUS (Schwager) (Pl. 8, figs. 7, 8)

Discorbina praecursoria SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 125, pl. 27 (4), fig. 12; pl. 29 (6), fig. 16.

Cibicides praecursorius CUSHMAN and PONTON, Contr. Cushman Lab. For. Res., vol. 8, 1932, p. 72, pl. 9, fig. 14.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 88.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 610, pl. 82, figs. 19-21.—CUSHMAN and RENZ, Contr. Cushman Lab. For. Res., vol. 18, 1942, p. 13, pl. 3, fig. 9.—CUSHMAN and TODD, l. c., vol. 18, 1942, p. 45, pl. 8, figs. 17-20.—CUSHMAN, l. c., vol. 20, 1944, p. 28, pl. 4, fig. 28; Amer. Journ. Sci., vol. 242, 1944, p. 18, pl. 2, figs. 23, 24.

The American records for this species are from the Paleocene, Midway of Trinidad, and Naheola formation of Alabama; and the Wilcox Eocene, Tuscahoma sand, Bashi formation, and Salt Mountain limestone of Alabama, and the Aquia formation of Virginia. It is fairly common in the present material.

EXPLANATION OF PLATE 8

(Figs. 11-18, $\times 35$; 19-22, $\times 55$; others, $\times 60$)

a, dorsal view; *b*, ventral view; except as otherwise noted.

FIG. 1. *Epistominoides midwayensis* Plummer. 2. *Globigerina compressa* Plummer. 3. *G. pseudo-bulloides* Plummer. 4. *G. triloculinoides* Plummer. 5. *Globorotalia wilcoxensis* Cushman and Ponton, var. *acuta* Toulmin. *a*, dorsal view; *b*, side view. 6. *Anomalina umbonifera* (Schwager). 7, 8. *Cibicides praecursorius* (Schwager). 9. *C. howelli* Toulmin. 10. *C. blanpiedi* Toulmin. 11-13. *Spiroloculina alabastra* Cushman and Ellisor, n. sp. 11, Holotype. *a*, front view; *b*, apertural view. 12, 13, Paratypes. 13, Young. 14, 15. *S. texana* Cushman and Ellisor, n. sp. 14, Holotype. *a*, front view; *b*, apertural view. 15, Paratype. 16-18. *S. jucunda* Cushman and Ellisor, n. sp. 16, Holotype. *a*, front view; *b*, apertural view. 17, 18, Paratypes. 19-22. *Poroarticulina glabra* Cushman, n. gen., n. sp. 19, Holotype; 20-22, Paratypes. *b*, *b*, end views of apertures enlarged.

CIBICIDES HOWELLI Toulmin (Pl. 8, fig. 9)

(For references, see these Contributions, vol. 20, 1944, p. 28.)

According to the records, this species occurs in the Paleocene, Midway, of Trinidad, and in the Wilcox Eocene, Nanafalia, Tuscahoma, and Bashi formations and Salt Mountain limestone of Alabama, the Vincentown sand of New Jersey, and the Aquia formation of Virginia, and is also recorded from the Hatchetigbee formation. Typical specimens occur in the present material.

CIBICIDES BLANPIEDI Toulmin (Pl. 8, fig. 10)

Cibicides blanpiedi Toulmin, Journ. Pal., vol. 15, 1941, p. 609, pl. 82, figs. 11-13.—

CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 46, pl. 8, figs. 13-15.—CUSHMAN, Amer. Journ. Sci., vol. 242, 1944, p. 18, pl. 2, fig. 20.

A single small specimen, apparently of this species, occurred in the material: It was compared with paratypes, and is more roughened and smaller, but otherwise similar.

The records include the Paleocene, Naheola formation, and the Wilcox Eocene, Salt Mountain limestone, Nanafalia and Bashi formations, of Alabama.

NO. 256. THREE NEW SPECIES OF *SPIROLOCULINA*
FROM THE MIDDLE OLIGOCENE OF TEXAS.

By JOSEPH A. CUSHMAN AND ALVA C. ELLISOR

The following three species from the middle Oligocene of Texas are previously undescribed. The descriptions and figures are given in advance of a complete faunal description of the foraminiferal assemblage.

SPIROLOCULINA ALABAstra Cushman and Ellisor, n. sp. (Pl. 8, figs. 11-13)

Test about 1½ times as long as broad, strongly concave, periphery flat or somewhat convex, distinctly thickened at the margins and sometimes irregularly serrate in the adult, in the young the margins are thin, sharp, and strongly raised and curved inward resembling the petals of a rose; chambers numerous, as many as 12, evenly curved and of about equal width and thickness throughout, projecting bluntly at the basal end, at the apertural end extending into a short broad neck; sutures depressed, distinctly defined by the raised peripheral margins of the earlier chambers; wall smooth, polished; aperture circular, surrounded by a thickened rim, with a short, broad, simple tooth on the inner margin.

Length 0.70-0.80 mm.; breadth 0.45-0.62 mm.; thickness 0.20-0.25 mm.

Holotype (Cushman Coll. No. 40503) from the middle Oligocene, 9183-9214 feet (*Heterostegina* zone), Humble Oil & Refining Co. Well No. 1-B Houston Farms Development Co., Halls Bayou, Brazoria County, Texas.

This species differs from *S. excavata* d'Orbigny in the very deeply channeled surface and the high peripheral margins. Occasional specimens show a faint longitudinal costa on the middle of the periphery, most prominent nearest the neck.

SPIROLOCULINA TEXANA Cushman and Ellisor, n. sp. (Pl. 8, figs. 14, 15)

Test only slightly longer than broad, slightly concave in the early portion, periphery flat or slightly convex, distinctly thickened and raised at the margins; chambers distinct, numerous, as many as 17, very gradually increasing in size as added, evenly curved and of equal width and thickness throughout, each chamber appearing channeled in front view due to the raised peripheral margins, chambers projecting slightly and about equally at both ends; sutures distinct, depressed, defined by the raised peripheral rims of the previous chambers; wall smooth except slightly roughened by minute discontinuous lines parallel to the curvature of the chambers; aperture small, circular, with a thickened rim and a short, broad, simple tooth on the inner margin.

Length 0.70-0.95 mm.; breadth 0.57-0.77 mm.; thickness 0.20-0.25 mm.

Holotype (Cushman Coll. No. 40507) from the middle Oligocene, 9183-9214 feet (*Heterostegina* zone), Humble Oil & Refining Co. Well No. 1-B Houston Farms Development Co., Halls Bayou, Brazoria County, Texas.

This species differs from *S. alabastra* Cushman and Ellisor in the much more rounded and symmetrical form, larger number of chambers, and less deeply channeled surface.

SPIROLOCULINA JUCUNDA Cushman and Ellisor, n. sp. (Pl. 8, figs. 16-18)

Test $1\frac{1}{2}$ to 2 times as long as broad, concave in the early portion, periphery flat, distinctly angled at the margins; chambers rapidly increasing in size as added, of equal width throughout, the central portion somewhat depressed and channeled, the outer ridge overlapped by the succeeding chamber, projecting in a blunt point at the basal end, extending into a long cylindrical neck at the apertural end; sutures distinct, depressed; wall smooth; aperture circular, at the end

of the neck, with a very slight inward projection on the inner margin.

Length 0.85-1.00 mm.; breadth 0.45-0.68 mm.; thickness 0.17-0.20 mm.

Holotype (Cushman Coll. No. 40510) from the middle Oligocene, 5630-52 core-feet (*Heterostegina* zone), Humble Oil & Refining Co. No. 1 Woodburn, Genoa, Harris County, Texas.

This species differs from *S. canaliculata* d'Orbigny in being much broader and less deeply channeled on the surface, and in its stout neck instead of the slender, compressed one of *S. canaliculata*.

NO. 257. *POROARTICULINA*, A NEW GENUS OF
FORAMINIFERA.

BY JOSEPH A. CUSHMAN

The Roumanian Miocene has many very ornate and highly developed forms of the Miliolidae. Therefore it may not be surprising to find a new genus in the material.

Genus *POROARTICULINA* Cushman, new genus

Genoholotype: *Poroarticulina glabra* Cushman, n. sp.

Test with the early chambers triloculine, later ones in a uniserial, rectilinear series; aperture in the adult terminal, cribrate. Miocene.

This genus differs from *Articulina*, from which it was undoubtedly derived, by the character of the aperture. In the early stages the aperture is toothed, then later with a few pores, and in the adult with a projecting area with numerous irregularly rounded pores.

POROARTICULINA GLABRA Cushman, n. sp. (Pl. 8, figs. 19-22)

Test elongate, early portion triloculine, adult with a series of uniserial chambers, circular in transverse section; chambers of the early portion slightly angled, not inflated, later adult ones cylindrical, increasing gradually in length and diameter; sutures slightly depressed; wall smooth; aperture in the early stages with a tooth, later a series of irregular pores, and in the adult the curved apertural end with numerous irregularly rounded pores. Length 1.25-1.85 mm.; diameter 0.18-0.22 mm.

Holotype (Cushman Coll. No. 40350) from the Miocene of Bujtur, Roumania. So far as known, this is the only species having these characters.