

CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

122. AN EOCENE FORAMINIFERAL FAUNA OF WILCOX
AGE FROM ALABAMA

By JOSEPH A. CUSHMAN and GERALD M. PONTON

Although the foraminifera of the basal Eocene of Texas have been published in considerable detail by Mrs. Plummer (Univ. Texas Bull. 2644, 1926 [1927]), and more or less is known of the Upper Eocene of the Jackson and Claiborne including large manuscripts now in press, very little has been done with the Wilcox foraminifera. A few scattered papers, mainly in these Contributions, have included species of certain genera from the Wilcox, but no complete faunas have been described. As a preliminary work on this group the present paper is offered.

Many of the species are new, and others have been referred to species published by Schwager from the Middle Eocene of northern Africa which in many respects is very much like this fauna from Alabama. Schwager's types now in Munich were studied in August last by the senior author. All the specimens are from a single locality, RR. cut 1 m. N. of Ozark, Ala. Some of the species here described as new have been noted at numerous localities of this same age, and most of them will undoubtedly be found to be index fossils for the Wilcox. Figures of all these species noted in this paper are given on the accompanying plates.

SPIROPLECTAMMINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 7, figs. 1 a, b)

Test broad, compressed, periphery subacute, early chambers coiled; chambers distinct, low and broad in the early portion, gradually and rather regularly increasing in height as added, slightly overlapping, later ones slightly inflated; sutures distinct, slightly depressed especially in the later portion, gently curved making a very slight angle with the horizontal; wall arenaceous

but rather smoothly finished; aperture a low curved opening at the base of the apertural face. Length of holotype 0.45 mm.; breadth 0.25 mm.; thickness 0.12 mm.

Holotype (Cushman Coll. No. 16184) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is a small odd form somewhat similar to many of the things that have been referred to *Textularia agglutinans* by various authors. The Wilcox species is, however, more compressed and much smaller than the typical Recent *Textularia agglutinans* d'Orbigny.

ROBULUS ISIDIS (Schwager) (Pl. 7, figs. 2 a, b)

Cristellaria isidis SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 110, pl. 26 (3), figs. 12 a-c.

Test closely coiled, compressed, slightly umbilicate, periphery with a very slight blunt keel; chambers few, usually only 5 or 6 in the last-formed coil, later ones very slightly inflated, of rather uniform shape, increasing slightly in size as added; sutures distinct, slightly curved, later ones very slightly depressed; aperture radiate, somewhat elongate, at the peripheral angle of the last-formed chamber. Length 1.10 mm.; thickness 1.40 mm.

This form here figured seems to be identical with the species described by Schwager from the Middle Eocene of North Africa.

ROBULUS WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 7, figs. 3 a, b)

Test compressed, close coiled except in the oldest portion where 1 or 2 chambers may become uncoiled, periphery in the earlier portion with a narrow blunt keel, in the adult chambers with the keel becoming obsolescent and the periphery rounded in the last chambers; chambers numerous, 9 or 10 in the last-formed coil of the adult, later ones slightly inflated and uncoiling, early ones of uniform shape, gradually increasing in size as added; sutures distinct, rather strongly curved, in the early portion limbate and raised, then becoming flush with the surface and in the adult slightly depressed; wall smooth except for the early raised sutures; aperture terminal, radiate in the adult, in the earlier chambers at the outer peripheral angle. Length 1.00-1.15 mm.; breadth 0.75-0.80 mm.; thickness 0.25-0.30 mm.

Holotype (Cushman Coll. No. 16186) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This species is rather noteworthy in the various stages it shows

in its development, from a test with distinctly raised limbate sutures to the adult in which the chambers are much inflated, somewhat uncoiling, and the sutures narrow and depressed. This form in its definite characters should be of use in determining this part of the formation.

MARGINULINA PACHYGASTER Gümbel (Pl. 7, figs. 4 a, b, 5)

Marginulina pachygaster GÜMBEL, Abhandl. kön. bay. Akad. Wiss. München, vol. 10, 1868 (1870), p. 632, pl. 1, fig. 60.

Test composed of a very few chambers, the earlier ones slightly coiled but quickly becoming nearly in a straight line, somewhat compressed in the early stages, but circular in transverse section in the adult; chambers distinct, all somewhat inflated, the adult ones very much so; sutures distinct, earlier ones oblique and slightly curved, in the adult nearly at right angles to the elongate axis, and depressed; wall smooth; aperture radiate, in the early stages at the peripheral angle, in the adult, central, terminal. Length 0.75-0.90 mm.; diameter 0.50 mm.

Gümbel described this species from the Eocene of southern Bavaria. It is characterized by the peculiar shape of the early portion and the later few chambers becoming rectilinear and much inflated. The figures show specimens of both the earlier stages and the adult.

MARGINULINA DUBIA (?) Neugeboren (Pl. 7, figs. 6 a, b)

The elongate, nearly straight form figured here is referred to this species of Neugeboren with some question. More typical specimens of smaller size have been referred to this species particularly from the Miocene of California. The Wilcox specimens are heavier in the characters of the wall, the whole test is larger, but the general form is very much the same.

MARGINULINA SUBBULLATA Hantken (Pl. 7, figs. 7 a, b)

Marginulina subbullata HANTKEN, A magy. kir. földt. int. évkönyve, vol. 4, 1875 (1876), p. 39, pl. 4, figs. 9, 10.—LIEBUS, Jahrb. Geol. Reichsanst., vol. 56, 1906, p. 354.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 3, 1925, p. 62, pl. 10, figs. 3 a, b.—COLE, Bull. Amer. Pal., vol. 14, 1927, No. 51, p. 14, pl. 5, fig. 10.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 85, pl. 12, fig. 20.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 99, pl. 10, fig. 8.—CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 3, pl. 1, fig. 7.—NUTTALL, Journ. Pal., vol. 6, 1932, p. 12.

Test subcylindrical, the initial end somewhat loosely coiled, later 2 or 3 chambers uniserial, very broadly elliptical in transverse section; chambers few, inflated, gradually increasing in size as added, considerably overlapping; sutures distinct, depressed, the early ones oblique, later ones nearly at right angles to the axis; wall smooth and polished; aperture radiate, at the peripheral angle. Length up to 1.25 mm.; breadth 0.50 mm.; thickness 0.45 mm.

This species was originally described by Hantken from the Lower Oligocene of Central Europe. It has been recorded from the Middle Eocene and the Lower Oligocene of Mexico and from the Miocene of Venezuela and California.

MARGINULINA EXIMIA Neugeboren (Pl. 7, figs. 8 a, b)

Marginulina eximia NEUGEBOREN, Verh. Mitth. siebenbürg. Ver. Nat., Jahrb. 2, 1851, p. 129, pl. 4, fig. 17.

Test elongate, the early portion slightly compressed, less so in the adult, periphery rounded; chambers distinct, those of the early portion loosely coiled, slightly if at all inflated, later ones much inflated and very broadly elliptical in transverse section; sutures distinct, later ones somewhat depressed, oblique; wall smooth and polished; aperture radiate, slightly projecting, at the peripheral angle. Length 0.60 mm.; breadth 0.20 mm.; thickness 0.16 mm.

This species is a small delicate one with the sutures strongly oblique throughout. It was originally described by Neugeboren from the Tertiary of Europe. Our specimens from the Wilcox are, however, very close to the originals in their form and general characters.

SARACENARIA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 7, figs. 9 a, b)

Test close coiled, the periphery bluntly angled or the earliest portion with a very slight keel; chambers few, distinct, increasing in length as added, the adult with a very broad apertural face, broadly elliptical in form and usually not symmetrical with the axis of the test; sutures distinct, flush with the surface, very slightly curved; aperture at the peripheral angle, extending down somewhat into the upper portion of the apertural face. Length 0.50 mm.; breadth 0.30 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 16191) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This Wilcox species is a rather peculiar one in the oblique character of the apertural face, at one side hardly breaking the contour of the test, at the other bulging strongly. The apertural face is smooth, but owing to the obliquity the base is irregularly placed in peripheral view. There is a considerable amount of variation in this particular character although none of the specimens are equally bilateral in their peripheral view.

DENTALINA JACKSONENSIS (Cushman and Applin) (Pl. 7, figs. 10, 11)

Nodosaria jacksonensis CUSHMAN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 170, pl. 7, figs. 14-16.—CUSHMAN, Journ. Pal., vol. 1, 1927, p. 153, pl. 24, fig. 3.—COLE, Bull. Amer. Pal., vol. 14, No. 53, 1928, p. 208 (8), pl. 3, fig. 12.—COLE and PONTON, Bull. 5, Fla. State Geol. Survey, 1930, p. 33, pl. 6, fig. 1.

Test elongate, tapering, straight or usually gently curved, initial end rounded with one or more spines, sides lobulate throughout, more strongly so in later growth; chambers subglobular, fairly numerous, inflated, the earlier ones gently subspherical, later ones becoming more elongate; sutures distinct, depressed, of clear shell material; wall smooth, usually polished; aperture somewhat projecting, slightly eccentric, radiate. Length of Wilcox specimens up to 1.10 mm.; diameter up to 0.25 mm.

This species recorded originally from the Jackson Eocene seems to be distributed in the earlier Eocene of America in the Claiborne and Wilcox. This is somewhat variable, but the general characters seem to show that it should be placed in the genus *Dentalina*. There is a considerable degree of variation in the depression of the sutures. Two of the extremes are shown in our figures. The initial spine is also subject to much variation in the amount of its development.

DENTALINA COMMUNIS (?) d'Orbigny (Pl. 7, figs. 12, 13)

Two specimens are here figured which show the general characters of a species which is fairly common in this Wilcox collection. They are referred with some question to d'Orbigny's species. In the megalospheric form, shown in figure 13, the initial end is rather broadly rounded, while the microspheric form, shown in figure 12, has a much more pointed and tapering early stage. The sutures are oblique, and the chambers become more elongate toward the adult portion. The aperture is always at the peripheral border. Length of Wilcox specimens up to 1.80 mm.; diameter 0.20 mm.

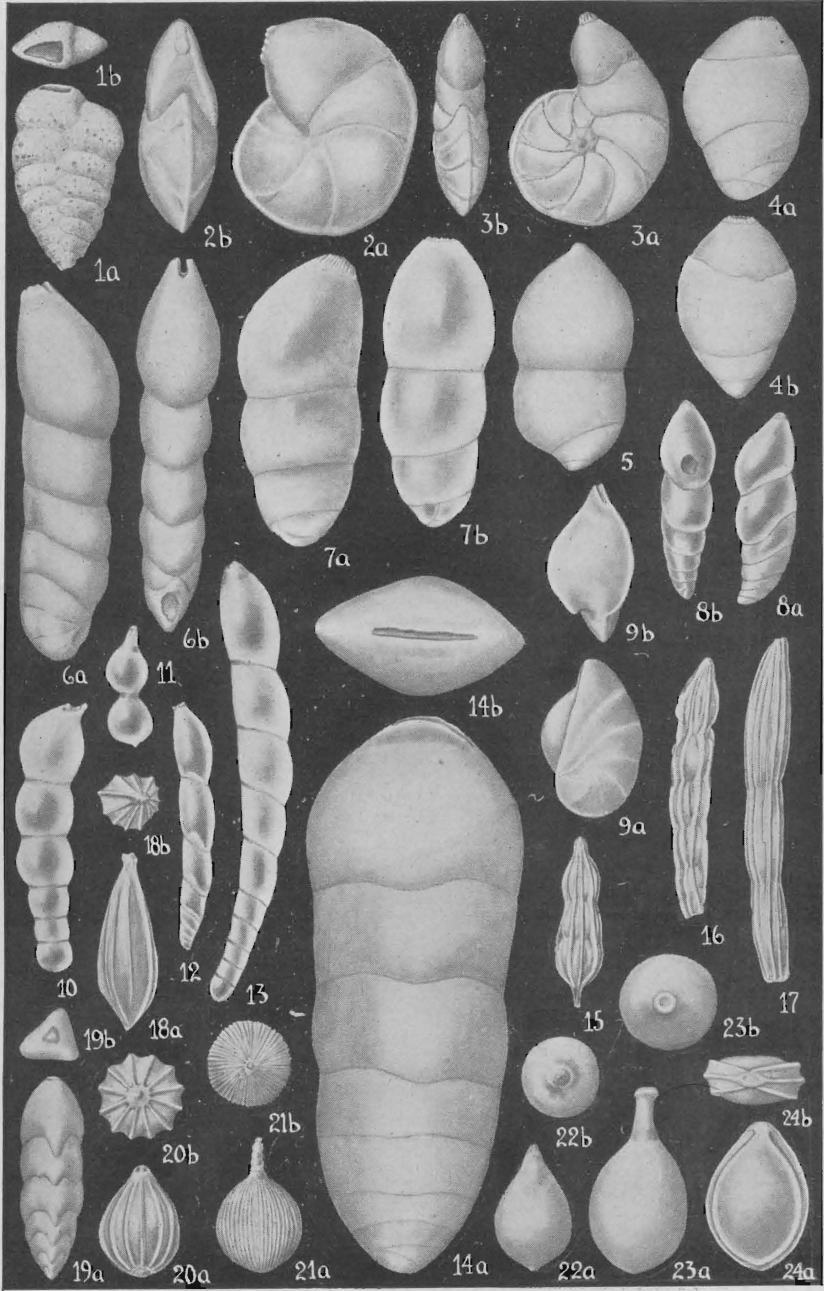
DENTALINA sp(?) (Pl. 7, fig. 17)

There are fragments only of a very elongate, slightly curved species in which the chambers themselves, at least in the adult, are 3 or 4 times as long as broad, and the wall ornamented with nu-

EXPLANATION OF PLATE 7

- FIGS. 1 *a, b.* *Spiroplectammina wilcoxensis* Cushman and Ponton, n. sp. $\times 60$. *a*, front view; *b*, apertural view.
- FIGS. 2 *a, b.* *Robulus isidis* (Schwager). $\times 30$. *a*, side view; *b*, peripheral view.
- FIGS. 3 *a, b.* *Robulus wilcoxensis* Cushman and Ponton, n. sp. $\times 30$. *a*, side view; *b*, peripheral view.
- FIGS. 4, 5. *Marginulina pachygaster* Gümbel. $\times 36$. Fig. 4 *a*, side view; *b*, peripheral view of young. Fig. 5, Adult.
- FIGS. 6 *a, b.* *Marginulina dubia* (?) Neugeboren. $\times 35$. *a*, side view; *b*, peripheral view.
- FIGS. 7 *a, b.* *Marginulina subbullata* Hantken. $\times 35$. *a*, side view; *b*, peripheral view.
- FIGS. 8 *a, b.* *Marginulina eximia* Neugeboren. $\times 50$. *a*, side view; *b*, peripheral view.
- FIGS. 9 *a, b.* *Saracenaria wilcoxensis* Cushman and Ponton, n. sp. $\times 50$. *a*, side view; *b*, peripheral view.
- FIGS. 10, 11. *Dentalina jacksonensis* (Cushman and Applin). $\times 35$. Fig. 10, Adult specimen with only slightly depressed sutures. Fig. 11, Young specimen with strongly depressed sutures.
- FIGS. 12, 13. *Dentalina communis* (?) d'Orbigny. $\times 35$. Fig. 12, Microspheric form. Fig. 13, Megalospheric form.
- FIGS. 14 *a, b.* *Lingulina wilcoxensis* Cushman and Ponton, n. sp. $\times 22$. *a*, front view; *b*, apertural view.
- FIGS. 15, 16. *Nodosaria latejugata* Gümbel, var. $\times 40$.
- FIG. 17. *Dentalina* sp(?). $\times 40$.
- FIGS. 18 *a, b.* *Lagena mucronulata* Reuss. $\times 60$. *a*, front view; *b*, apertural view.
- FIGS. 19 *a, b.* *Triplasia wilcoxensis* Cushman and Ponton, n. sp. $\times 35$. *a*, front view; *b*, apertural view.
- FIGS. 20 *a, b.* *Lagena acuticosta* Reuss. $\times 60$. *a*, front view; *b*, apertural view.
- FIGS. 21 *a, b.* *Lagena costata* (Williamson). $\times 60$. *a*, front view; *b*, apertural view.
- FIGS. 22 *a, b.* *Lagena* sp(?). $\times 60$. *a*, front view; *b*, apertural view.
- FIGS. 23 *a, b.* *Lagena clavata* (d'Orbigny). $\times 60$. *a*, front view; *b*, apertural view.
- FIGS. 24 *a, b.* *Lagena orbignyana* (Seguenza), var. $\times 60$. *a*, front view; *b*, apertural view.

Figures drawn by Margaret S. Moore



merous, sharp, longitudinal costae continuous from one chamber to another. No complete specimens of this species were found, and so it cannot be assigned to a definite specific name, but is recorded here for reference for future workers on the Wilcox formation.

LINGULINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 7, figs. 14 a, b)

Test very large, somewhat compressed, the periphery bluntly angled, greatest thickness in the middle, sides nearly parallel in the adult portion, rapidly tapering at the base, apertural end broadly rounded; chambers distinct, the earliest ones showing traces of coiling, later ones in a rectilinear series, as many as 6 or 7 chambers making up the adult portion, of rather uniform shape and size, slightly overlapping; sutures distinct, the later ones slightly depressed and with a tendency in the central portion to curve back toward the base, thence toward the sides curving outward and becoming oblique, downward again toward the periphery at either side; wall smooth, thick, opaque; aperture a very elongate, narrow slit, terminal. Length up to 3.60 mm.; breadth up to 1.25 mm.; thickness up to 0.70 mm.

Holotype (Cushman Coll. No. 16195) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is a very large species which seems to be rather widely distributed in the Wilcox Eocene of this particular region, as it has been found in other stations in very similar form. The peculiar curving of the sutures and the very large size with straight sides should distinguish it from other species of the Eocene.

NODOSARIA LATEJUGATA Gümbel, var. (Pl. 7, figs. 15, 16)

Rather rare specimens of the form figured occur in this collection of Wilcox material. The heavy costae running across the sutures from chamber to chamber and the strongly developed basal spine indicate the close relationship of this form to the above species so well developed in the Upper Eocene of the general Coastal Plain region of the United States. These few Wilcox specimens, however, seem to be less strongly developed and smaller than the Jackson form of the species.

TRIPLASIA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 7, figs. 19 a, b)

Test elongate, slightly fusiform, triangular in transverse section, the sides bluntly rounded, peripheral angle slightly lobulate; chambers distinct, of rather uniform shape, slightly increasing in

size as added, but with the adult chambers of nearly uniform size, the sides of this portion of the test nearly parallel; sutures distinct, depressed, strongly curved toward the apertural end in the middle of each face; wall smooth, polished; aperture terminal, radiate. Length 0.80-0.85 mm.; diameter 0.25 mm.

Holotype (Cushman Coll. No. 16197) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is one of the characteristic species of this collection of Wilcox foraminifera. It may be referred to Reuss' genus *Triplasia* which was afterward renamed by him *Rhabdogonium* because he later found specimens which had more than three sides. The species should be one of the index fossils for this part of the Eocene. It is apparently uniserial throughout, and belongs with the Lagenidae.

LAGENA MUCRONULATA Reuss (Pl. 7, figs. 18 a, b)

Lagena mucronulata REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 329, pl. 4, fig. 52.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 25, pl. 8, fig. 4.

Test fusiform, the initial end tapering into a short spinose projection, the apertural end with a short neck ending in a somewhat expanded portion at the outer end; wall ornamented with a few coarse costae extending from just below the neck to the initial end. Length 0.40 mm.; diameter 0.15 mm.

This form is rare in the Wilcox material examined, but seems to be referable to this species of Reuss.

LAGENA ACUTICOSTA Reuss (Pl. 7, figs. 20 a, b)

Lagena acuticosta REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, 1861 (1862), p. 305, pl. 1, fig. 4.

There are many references from Recent to Cretaceous for this species which is a short, broad form, circular in transverse section with a few very distinct, raised, longitudinal costae running from the fused ring just below the aperture to the base of the test. The Wilcox specimens are small, about 0.25 mm. in length, and 0.18 mm. in diameter.

LAGENA COSTATA (Williamson) (Pl. 7, figs. 21 a, b)

Entosolenia costata WILLIAMSON, Rec. Foram. Gt. Britain, 1858, p. 9, pl. 1, fig. 18.

There are a number of specimens in the collection which may be referred to this species of Williamson, in which there is a globu-

lar body to the test with a distinct cylindrical neck, often with a transverse raised ring, and the main portion of the test with numerous, fine, longitudinal costae.

Such forms have a wide distribution in Recent and Tertiary collections. Our specimens are small with a length of 0.30 mm. and breadth of 0.20 mm.

LAGENA CLAVATA (d'Orbigny) (Pl. 7, figs. 23 a, b)

Oolina clavata D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 24, pl. 1, fig. 2.

Lagena clavata MACKIE, Recreative Science, vol. 1, 1859, p. 48, fig. 13 (in text).

Our specimens referred to this species have the general form usually referred to under this name, a somewhat elongate body with an elongate cylindrical neck and distinct lip at the outer end; wall smooth and the basal end with or without a slight projection. It is known in both Recent and Tertiary collections, and is somewhat variable in form. Our Wilcox specimens have a length up to 0.40 mm. and diameter of 0.22-0.25 mm. The species is somewhat variable in the shape of the main body of the test ranging from gently globular to somewhat elliptical in side view.

LAGENA ORBIGNYANA (Seguenza), var. (Pl. 7, figs. 24 a, b)

The figured specimen shows a form found in this Wilcox material which has a compressed form, the main body of the chamber convex at the two sides, and with a distinct peripheral keel at either side, after which is a depression and another keel developed at either side of the main peripheral one. The convex faces of the test are smooth. Length up to 0.35 mm.; breadth 0.22 mm.; thickness 0.10-0.12 mm.

LAGENA sp(?) (Pl. 7, figs. 22 a, b)

The figures show the characters of a small, rather rare form found in the Wilcox collections. The test is smooth, tapering at either end, and circular in transverse section. The length is up to 0.30 mm., and diameter 0.15-0.18 mm.

GUTTULINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 1, 2)

Test elongate, fusiform, composed of comparatively few chambers, distinctly inflated, elongate, usually 2 or 3 times as long as wide, each chamber added in the adult only reaching to about $\frac{1}{2}$ or $\frac{2}{3}$ of the way to the base of the preceding chamber; sutures dis-

tinct, depressed; wall smooth, finely perforate; aperture radiate, terminal. Length 0.60-0.75 mm.; diameter 0.20-0.25 mm.

Holotype (Cushman Coll. No. 16204) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

In the specimens from this locality the characters of the test are held rather closely. This should be a good species for marking this part of the Eocene.

GUTTULINA PROBLEMA d'Orbigny (Pl. 8, figs. 3, 4)

Guttulina problema d'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 266, No. 14. (For further references to this species, see Cushman and Ozawa, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 19.)

In this Wilcox material there are both fistulose specimens and the normal form, both of which are figured on our plate. According to the records this is a very widely ranging species.

PSEUDOPOLYMORPHINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 5, 6)

Test somewhat compressed, only slightly longer than broad, periphery broadly rounded, apertural end slightly produced, early chambers irregularly spiral, later ones becoming biserial; chambers distinct, slightly inflated; sutures distinct, very slightly if at all depressed in the early stages, slightly so in the adult; wall thick, opaque, ornamented with definite, short, slightly raised, somewhat elongate papillae arranged generally lengthwise of the test but irregularly placed; aperture fairly large, radiate, terminal, slightly projecting. Length 0.60-0.75 mm.; breadth 0.55-0.60 mm.; thickness 0.30-0.35 mm.

Holotype (Cushman Coll. No. 16208) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is one of the most characteristic and distinctive species of this Wilcox collection, and should make an excellent index fossil for this portion of the Eocene section.

SIGMOMORPHINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 7 a-c)

Test elongate, in the type specimen about twice as long as broad, much compressed, periphery rounded; chambers in the early portion in an elongate spiral, later ones becoming somewhat sigmoid, successive chambers in the adult being removed rapidly from the base, inflated; sutures distinct, later ones slightly depressed, earlier ones flush with the surface; wall smooth, finely perforate; aperture comparatively large, terminal, radiate. Length 0.90 mm.; breadth 0.45 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 16210) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is less common in this collection than is the preceding species, but in specimens examined keeps its characters closely.

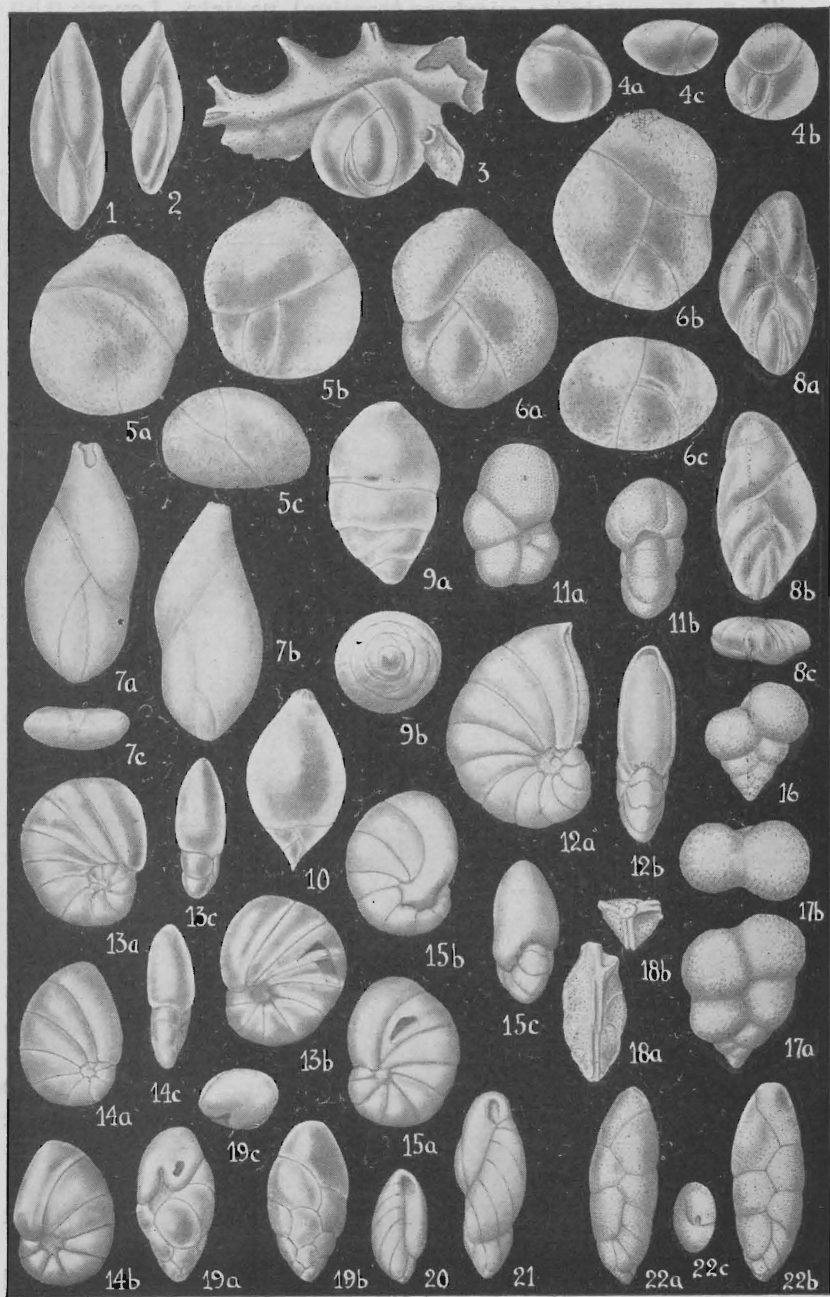
SIGMOMORPHINA ALABAMENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 8 a-c)

Test much compressed, in side view irregularly rhomboid, broadest in the middle, periphery rounded; chambers distinct, slightly inflated, earlier ones in an irregular spiral, later becoming irregularly sigmoid; sutures distinct, slightly depressed; wall

EXPLANATION OF PLATE 8

- FIGS. 1, 2. *Guttulina wilcoxensis* Cushman and Ponton, n. sp. $\times 40$. Fig. 1, Holotype.
- FIGS. 3, 4. *Guttulina problema* d'Orbigny. Fig. 3, $\times 50$. Fistulose specimen. Fig. 4, $\times 40$. *a, b*, opposite sides; *c*, basal view.
- FIGS. 5, 6. *Pseudopolymorphina wilcoxensis* Cushman and Ponton, n. sp. $\times 40$. *a, a, b, b*, opposite sides; *c, c*, basal views. Fig. 6, Holotype.
- FIGS. 7 a-c. *Sigmomorphina wilcoxensis* Cushman and Ponton, n. sp. $\times 35$. *a, b*, opposite sides; *c*, basal view.
- FIGS. 8 a-c. *Sigmomorphina alabamensis* Cushman and Ponton, n. sp. $\times 50$. *a, b*, opposite sides; *c*, basal view.
- FIGS. 9 a, b. *Glandulina abbreviata* Neugeboren. $\times 60$. *a*, side view; *b*, basal view.
- FIG. 10. *Glandulina laevigata* d'Orbigny. $\times 60$.
- FIGS. 11 a, b. *Nonion wilcoxensis* Cushman and Ponton, n. sp. $\times 80$. *a*, side view; *b*, apertural view.
- FIGS. 12 a, b. *Nonionella wilcoxensis* Cushman and Ponton, n. sp. $\times 60$. *a*, side view; *b*, apertural view.
- FIGS. 13, 14. *Nonionella insecta* (Schwager). $\times 80$. *a, a, b, b*, opposite sides; *c, c*, apertural views.
- FIGS. 15 a-c. *Nonionella alabamensis* Cushman and Ponton, n. sp. $\times 40$. *a, b*, opposite sides; *c*, apertural view.
- FIGS. 16, 17. *Gumbelina wilcoxensis* Cushman and Ponton, n. sp. $\times 50$. Fig. 17, Holotype. *a*, front view; *b*, apertural view.
- FIGS. 18 a, b. *Pseudouwigerina wilcoxensis* Cushman and Ponton, n. sp. $\times 60$. *a*, side view; *b*, apertural view.
- FIGS. 19 a-c. *Robertina wilcoxensis* Cushman and Ponton, n. sp. $\times 60$. *a, b*, opposite sides; *c*, apertural view.
- FIGS. 20, 21. *Buliminella cf. elegantissima* (d'Orbigny). $\times 60$.
- FIGS. 22 a-c. *Virgulina wilcoxensis* Cushman and Ponton, n. sp. $\times 60$. *a, b*, opposite sides; *c*, apertural view.

Figures drawn by Margaret S. Moore



smooth, finely perforate; aperture terminal, radiate. Length 0.50 mm.; breadth 0.30 mm.; thickness 0.12 mm.

Holotype (Cushman Coll. No. 16211) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This species has the chambers peculiarly arranged especially in the adult where there is a tendency for the chambers not only to become irregularly biserial and sigmoid, but for them to overlap very irregularly, giving a very unusual arrangement for this group.

GLANDULINA ABBREVIATA Neugeboren (Pl. 8, figs. 9 a, b)

Glandulina abbreviata NEUGEBOREN, Verh. Mitth. siebenbürg. Ver. Nat., Jahrb. 1, 1850, p. 48, pl. 1, figs. 1 a, b.

Nodosaria (Glandulina) abbreviata SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., ser. 2, vol. 6, 1886, p. 745, pl. 14, figs. 20 a, b.

The short, rather broad form figured has the early stages biserially arranged, and is here referred to Neugeboren's species which Sherborn and Chapman have recorded also from the Eocene London clay of England. The whole test is thick and the apertural end broadly rounded.

GLANDULINA LAEVIGATA d'Orbigny (Pl. 8, fig. 10)

Nodosaria (Glandulina) laevigata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 252, No. 1, pl. 10, figs. 1-3.

The figured specimen seems rather typical of this species with its pointed initial end and tapering apertural end, the last-formed chamber strongly overlapping and making up a large proportion of the surface of the test.

NONION WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 11 a, b)

Test small, bilaterally symmetrical, deeply umbilicate on both sides, periphery broadly rounded; chambers distinct, inflated, few, 5 or 6 in the last-formed coil; sutures distinct, depressed, straight; wall smooth, distinctly perforate; aperture an elongate curved opening at the base of the last-formed chamber in the median line. Length 0.25 mm.; breadth 0.18 mm.; thickness 0.12-0.15 mm.

Holotype (Cushman Coll. No. 16214) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is a small, rather distinctive species most nearly related to *Nonion micrum* Cole from the later Eocene.

NONIONELLA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 12 a, b)

Test very much compressed, periphery rounded, somewhat unequal on the two sides; chambers distinct, 10-12 in the last-formed coil, increasing regularly in size and length as added, slightly inflated; sutures distinct, strongly curved, very slightly if at all depressed except at the inner end; wall smooth, very finely perforate; aperture an elongate slit at the base of the apertural face in the median line. Length 0.45 mm.; breadth 0.30 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 16215) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This species is distinctly umbilicate on one side, showing the early coils and the spiral suture, on the other side the early coils covered. There is a tendency for the wall to be slightly papillate at the base of the chambers.

NONIONELLA INSECTA (Schwager) (Pl. 8, figs. 13, 14)

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

This is apparently one of the species described by Schwager from the Middle Eocene of northern Africa. The young stage shown in figure 14 and the adult in figure 13 correspond very closely with figures given by Schwager. The peculiar form of the adult with the very oblique chambers is characteristic. Our specimens are all small. Maximum length 0.25 mm.; breadth 0.20 mm.; thickness 0.08 mm.

NONIONELLA ALABAMENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 15 a-c)

Test slightly longer than broad, periphery rounded, the last-formed chamber covering the umbilical area on one side, the opposite side showing the earlier coils; chambers distinct, slightly inflated, 8-10 in the last-formed coil, the last-formed chamber covering the umbilicus and often showing a stellate form, increasing gradually in size and length as added; sutures distinct, slightly depressed, often somewhat limbate, particularly on the side with the open umbilicus; wall smooth, finely perforate; aperture extending from the periphery under the stellate projection of the last-formed chamber. Length 0.50 mm.; breadth 0.35 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 16217) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This species resembles somewhat forms found in the Late Tertiary of the Pacific coast, but the sutures are usually distinctly limbate in the young stages at least, and the form in the peripheral view is broader.

GUMBELINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 16, 17)

Test biserial, periphery broadly rounded; chambers distinct, much inflated, increasing very rapidly in the adult so that the last four chambers make up a very considerable amount of the entire test; sutures distinct, depressed; wall distinctly papillate throughout; aperture a low opening at the base of the last-formed chamber in the median line. Length 0.45 mm.; breadth 0.35 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 16218) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This species is a distinctive one in the great expansion of the last few chambers and the peculiar papillate surface. It brings the range of this genus well into the Eocene.

PSEUDOUVIGERINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 18 a, b)

Test small, elongate, about twice as long as broad, sides in the adult nearly parallel, triangular in transverse section, the angles with two distinct ribs, and a deep channel between; chambers fairly distinct, not inflated, in the adult triserial; sutures fairly distinct, strongly curved, not depressed; wall coarsely perforate; aperture in the adult terminal with a short neck and slight lip. Length 0.30 mm.; diameter 0.15 mm.

Holotype (Cushman Coll. No. 16220) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This minute species brings the range of this genus, like the preceding, well into the Eocene.

ROBERTINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 19 a-c)

Test elongate, about twice as long as broad, fusiform, greatest breadth slightly above the middle; chambers in an elongate spiral, those in each whorl alternating, very slightly inflated; sutures distinct, not depressed; wall smooth, finely perforate; aperture on the ventral side formed by an elongate narrow opening deeply entering the apertural face. Length 0.35 mm.; breadth 0.18 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 16221) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This species brings the record for this genus back into the Eocene. It somewhat resembles the genotype, *Robertina arctica* d'Orbigny, but the chambers are not nearly as inflated, and the whole test is more compact.

BULIMINELLA cf. ELEGANTISSIMA (d'Orbigny) (Pl. 8, figs. 20, 21)

There are a few specimens, two of which are here figured, which in their general characters seem similar to d'Orbigny's species which is now known from the Recent and Later Tertiary collections. More material is necessary to establish the specific identity of this form.

VIRGULINA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 8, figs. 22, a-c)

Test elongate, fusiform, somewhat compressed, about $2\frac{1}{2}$ times as long as broad, early portion irregularly spiral, adult irregularly biserial, periphery rounded; chambers distinct, very slightly inflated; sutures distinct, very slightly depressed; wall smooth, distinctly perforate; aperture a broad, comma-shaped opening at the base of the apertural face in the median line. Length 0.50 mm.; breadth 0.15 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 16223) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is a distinctive species with its irregularly arranged chambers due to the somewhat spirally twisted adult. The characters are constant.

BULIMINA OVATA d'Orbigny (Pl. 9, figs. 1, 2)

Bulimina ovata D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 185, pl. 11, figs. 13, 14.

The figures show microspheric and megalospheric forms which seem to be very closely allied to, if not identical with, this species of d'Orbigny described from the Miocene of the Vienna Basin and widely recorded elsewhere. Length 0.40-0.60 mm.; diameter 0.22-0.25 mm.

LOXOSTOMUM WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 9, figs. 3 a, b)

Test elongate, slender, the sides nearly parallel, periphery rounded; chambers numerous, twelve or more pairs in the adult, very slightly inflated in the later portion, of uniform size and shape, the last few becoming somewhat higher than the earlier

ones, and in the adult tending to become uniserial; sutures distinct, the later ones slightly depressed, straight, sloping strongly backward, forming an angle of about 30° with the horizontal; wall smooth, very finely perforate; aperture in the adult becoming terminal, elliptical. Length 0.40 mm.; breadth 0.10 mm.; thickness 0.05 mm.

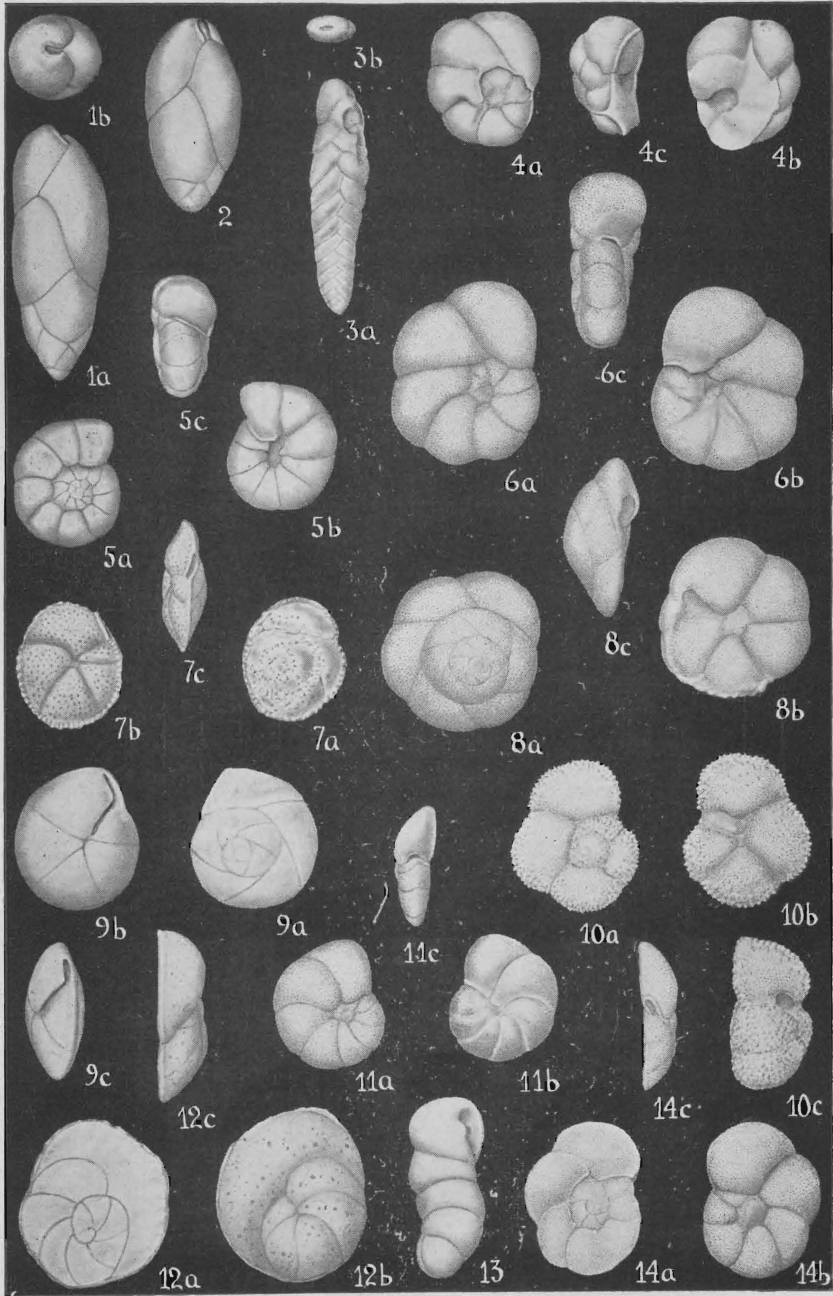
Holotype (Cushman Coll. No. 16225) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is a very elongate, slender form apparently characteristic of this portion of the Eocene. No other species of the genus was found with it.

EXPLANATION OF PLATE 9

- FIGS. 1, 2. *Bulimina ovata* d'Orbigny. $\times 60$. Fig. 1, Microspheric form. *a*, front view; *b*, apertural view. Fig. 2, Megalospheric form.
- FIGS. 3 *a, b*. *Loxostomum wilcoxensis* Cushman and Ponton, n. sp. $\times 80$. *a*, front view; *b*, apertural view.
- FIGS. 4 *a-c*. *Lamarckina wilcoxensis* Cushman. $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 5 *a-c*. *Valvulineria scrobiculata* (Schwager). $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 6 *a-c*. *Valvulineria wilcoxensis* Cushman and Ponton, n. sp. $\times 35$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 7 *a-c*. *Siphonina wilcoxensis* Cushman. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 8 *a-c*. *Epomides lotus* (Schwager). $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 9 *a-c*. *Pulvinulinella exigua* (H. B. Brady), var. *obtusa* (Burrows and Holland). $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 10 *a-c*. *Globorotalia wilcoxensis* Cushman and Ponton, n. sp. $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 11 *a-c*. *Anomalina umbonifera* (Schwager). $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 12, 13 (?). *Cibicides semiplectus* (Schwager). $\times 40$. Fig. 12 *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 14 *a-c*. *Cibicides praecursorius* (Schwager). $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

Figures drawn by Margaret S. Moore



LAMARCKINA WILCOXENSIS Cushman (Pl. 9, figs. 4 a-c)

Lamarckina wilcoxensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 1, 1926, p. 9, pl. 1, figs. 3 a-c.

This species was originally described from the Wilcox formation from Woods Bluff, Tombigbee River, Ala. The specimens figured from this new locality are identical with the types. This is evidently a well characterized species of the Wilcox. Length 0.40 mm.; breadth 0.40 mm.; thickness 0.25 mm.

VALVULINERIA SCROBICULATA (Schwager) (Pl. 9, figs. 5 a-c)

Anomalina scrobiculata SCHWAGER, Palaeontographica, vol. 30, 1888, Pal. Theil, p. 129, pl. 29 (6), figs. 18 a-d.

Our specimens seem to be identical with that described in the above reference by Schwager from the Middle Eocene of northern Africa. The test is smooth with 8-10 chambers in the adult whorl, ventral side umbilicate, and the chambers with a distinct lip-like projection over the umbilical area. Length 0.45 mm.; breadth 0.35 mm.; thickness 0.20 mm.

VALVULINERIA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 9, figs. 6 a-c)

Test nearly circular in side view, periphery slightly lobulate, nearly bilaterally symmetrical, umbilical region slightly depressed on the ventral side; chambers very distinct, 6 or 7 in the last-formed whorl, inflated; sutures distinct, slightly curved, strongly limbate on the ventral side, less so on the dorsal side in the early stages, sutures of the later portion depressed, not limbate; wall smooth, distinctly perforate; aperture a low opening, running from the median line onto the ventral side beneath the somewhat flattened lip of the ventral margin of the chamber. Diameter 0.75 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 16228) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This is one of the species which is somewhat similar to later derivatives in the Eocene and Later Tertiary, but probably will be found to be a characteristic of the Wilcox.

SIPHONINA WILCOXENSIS Cushman (Pl. 9, figs. 7 a-c)

Siphonina wilcoxensis CUSHMAN, Proc. U. S. Nat. Mus., vol. 72, Art. 20, 1927, p. 3, pl. 2, figs. 1-3.

This species described in the above reference and figured here from this new locality has been found in various formations of

the Wilcox in Alabama and Mississippi. Diameter 0.30 mm.; thickness 0.12 mm.

EPONIDES LOTUS (Schwager) (Pl. 9, figs. 8 a-c)

Pulvinulina lota SCHWAGER, Palaeontographica, vol. 30, 1883, Pl. Theil, p. 132, pl. 28 (5), figs. 9 a-d.

This species seems to be identical with Schwager's species from the Middle Eocene of northern Africa. It is evidently an ancestral form of species of similar character occurring in the various portions of the Later Tertiary. The figures give the general characters of the species: the aperture large, on the ventral side, toward the periphery, ending in a broad expansion. Diameter 0.55 mm.; height 0.25 mm.

PULVINULINELLA EXIGUA (H. B. Brady), var. **OBTUSA** (Burrows and Holland)

(Pl. 9, figs. 9 a-c)

Pulvinulina exigua H. B. BRADY, var. *obtusæ* 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, figs. 2 a-c.

This variety described originally from the London clay and recorded by Mrs. Plummer from the Midway of Texas seems to be identical with the form here figured from the Wilcox. Diameter 0.45 mm.; thickness 0.20 mm.

GLOBOROTALIA WILCOXENSIS Cushman and Ponton, n. sp. (Pl. 9, figs. 10 a-c)

Test plano-convex, dorsal side flat, ventral side strongly convex, slightly umbilicate, periphery subacute in the later portion, rounded in the earlier stages; chambers distinct, four making up the last-formed whorl in the adult, of uniform shape, increasing regularly in size as added; sutures distinct, very slightly curved, nearly radial, slightly depressed; wall distinctly perforate with the early portion strongly papillate or with short spines, in the later chambers largely confined to the peripheral angle; aperture a semicircular opening toward the umbilical end of the ventral side of the last-formed chamber. Length 0.50 mm.; breadth 0.40 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 16232) from Eocene of Wilcox age from RR. cut, 1 m. N. of Ozark, Ala.

This species rather strongly resembles one described by Schwager from the Middle Eocene of northern Africa, but is not as strongly convex as his species, and is apparently more coarsely spinose.

ANOMALINA UMBONIFERA (Schwager) (Pl. 9, figs. 11 a-c)

Discorbina umbonifera SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 126, pl. 27 (4), figs. 14 a-d.

Our species from the Wilcox are very similar indeed to those described by Schwager from the Middle Eocene of northern Africa. The test is nearly bilateral, and the aperture is in the median line; 7 or 8 chambers make up the last-formed whorl, the sutures slightly curved and somewhat limbate but not raised, wall finely but distinctly perforate. Diameter 0.40 mm.; thickness 0.15 mm.

CIBICIDES SEMIPLECTUS (Schwager) (Pl. 9, figs. 12 a-c, 13[?])

Pulvinulina semiplecta SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 130, pl. 27 (4), figs. 16 a-d.

One of the distinctive and fairly common species in this collection is that figured and here referred to Schwager's species. The dorsal side is flat and the ventral convex, the last-formed chamber greatly enlarged and spreading backward on both sides of the test. This was evidently an attached form. With it are found certain peculiar, somewhat uncoiled, elongate specimens, such as those figured in Plate 9, figure 13, which in some of their characters seem to be related to this form. It is figured here for reference.

CIBICIDES PRAECURSORIUS (Schwager) (Pl. 9, figs. 14 a-c)

Discorbina praecursoria SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 125, pl. 27 (4), figs. 12 a-d, 13 a-d; pl. 29 (6), figs. 16 a-d.

This is a small, thin walled, distinctly perforate species with the dorsal side flat or slightly concave and the ventral side slightly convex, six chambers making up the last-formed whorl; sutures distinct, curved and slightly limbate; the aperture running from the peripheral margin over onto the dorsal side beneath the somewhat extended lip of the last-formed chamber. Length 0.50 mm.; breadth 0.40 mm.; thickness 0.12 mm.

RECENT LITERATURE ON THE FORAMINIFERA

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

Bakx, L. A. J.

De Genera Fasciolites en Neoalveolina in het Indo-Pacifische Gebied.

(Verhandl. Geol.-Mijn. Gen. Ned. Kolonien. Geol. Ser., Deel IX, 1932, pp. 205-266, pls. 1-4, text figures.) *Gravenhage.*

Describes and figures the species in much detail, one new.

Gorter, Nettie E. and I. M. van der Vlerk.

Larger Foraminifera from Central Falcon (Venezuela).

(Leidsche Geol. Med., Deel IV, Afl. 2, 1932, pp. 94-122, pls. 11-17.) *Leiden.*

Describe and figure 14 species, 5 new.

Yabe, H. and S. Hanzawa.

Feestbundel K. Martin. Deel I. De Palaeontologie en Stratigraphie van Nederlandsch Oost-Indië. Hoofdstuk I. Onze Palaeontologische Kennis van Nederlandsch Oost-Indië in 1930. 1. Palaeozoic and Mesozoic Foraminifera.

(Leidsche Geologische Mededeelingen, Deel V, Nov. 24, 1931, pp. 23-34.) *Leiden.*

Give list of species, table of distribution and bibliography for the region.

Liebus, A.

Fossilium Catalogus, I: Animalia. Editus a W. Quenstedt. Pars 49: A. Liebus. Bibliographia foraminiferum recentium et fossilium II. (1911-1930.)

(W. Junk, Berlin, July 22, 1931, pp. 1-36.) *Berlin.*

A bibliography of foraminiferal works from 1911-1930.

Woodring, W. P.

Age of the Orbitoid-Bearing Eocene Limestone and *Turritella variata* Zone of the Western Santa Ynez Range, California.

(Trans. San Diego Soc. Nat. Hist., vol. 6, No. 25, 1931, pp. 371-388.) *San Diego.*

Notes a few orbitoid foraminifera.

Berry, Willard.

Distribution of the Fusulinidae.

(Pan-Amer. Geol., vol. 56, 1931, pp. 181-187, 1 map.)

Des Moines.

General notes with map of distribution.

Silvestri, Alfredo.

Particolari aspetti lito-paleontologici del Miocene ed Oligocene della Sicilia Occidentale.

(Boll. Soc. Geol. Ital., vol. 50, fasc. 2, 1931, pp. 117-125, pl. 8.)

Rome.

Figures sections of orbitoids, &c. None new.

Storm, Hugo.

Zur Stratigraphischen Stellung der Oberturon- und Emschermergel in der Umgebung von Leitmeritz.

(Firgenwald 4 Jahrgang, 1931, pp. 3-29, 1 plate.)

Reichenberg.

Lists various foraminifera, 1 new.

Hodson, Floyd and Helen K.

Some Venezuelan Mollusks.

(Bull. Amer. Pal., vol. 16, No. 59, Oct. 1, 1931, pp. 1-94, pls. 1-24.)

Ithaca.

This is of interest to students of foraminifera, as on pp. 5 and 6 are now given Holotype localities for foraminifera described in Bull. Amer. Pal., vol. 12, No. 47, 1926.

Hofker, J.

De Foraminiferen in den Omtrek van Amsterdam.

(Mededeelingen van de Zuiderzee-Commissie, 1931, pp. 61-66.)

Amsterdam.

Notes on the occurrence of several species.

Hofker, J.

Une analyse du foraminifere fossile *Orthophragmina advena*, Cushman.

(Ann. Prot., vol. 3, fasc. 4, March, 1932, pp. 209-215, pl. 20.)

Paris.

Notes and measurements of this form are given.