

CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

218. AMERICAN UPPER CRETACEOUS FORAMINIFERA
OF THE FAMILY ANOMALINIDAE*

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A number of the Cretaceous species of the Anomalinidae have proved to be good index fossils for stratigraphic use. As the types in some species have not been adequately illustrated, a number of holotypes have been redrawn for our plates. Thanks are due to the Director of the U. S. Geological Survey for the use of the figures pending publication of a large paper on the Foraminifera of the American Upper Cretaceous.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA NELSONI W. Berry (Pl. 5, figs. 1, 2)

Anomalina nelsoni W. BERRY, in Berry and Kelley, Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 14, pl. 2, figs. 19-21.

Anomalina involuta CUSHMAN (part) (not REUSS), Tenn. Div. Geol., Bull. 41, 1931, p. 60, pl. 12, figs. 1 a-c.

"Test nautiloid, dorsal side nearly flat to slightly concave, ventral side convex; periphery broadly rounded, lobate; chambers numerous, seven to eight in the last-formed coil, inflated, gradually increasing in size; sutures distinct, depressed; wall punctate; umbilical cavity usually filled with shell material; aperture an arched slit with a slight lip above it at the base of the last chamber. Diameter 0.52 mm."

The type is from the Ripley, from Dave Week's place on Coon Creek, 3½ miles S. of Enville, 7½ miles N. of Adamsville and

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$\frac{1}{8}$ mile E. of main Hendersonville-Adamsville road, McNairy County, Tenn. The holotype specimen has been redrawn for our plate.

This has proved to be one of the most common species of the genus in our Cretaceous material, ranging from the top of the Navarro down through the upper part of the Taylor marl.

ANOMALINA BENTONENSIS Morrow (Pl. 5, fig. 3)

Anomalina bentonensis MORROW, Journ. Pal., vol. 8, 1934, p. 201, pl. 30, figs. 4 a, b.

"Test small, nearly symmetrical, slightly involute, periphery broadly rounded, earlier whorls partly exposed on both sides at the center; chambers inflated, increasing rather rapidly in size as added, quite uniform in shape, numbering seven to nine in last whorl; sutures strongly impressed, usually curving backward as they pass over the periphery; wall conspicuously perforate; aperture peripheral, passing onto the dorsal side. Diameter of holotype 0.4 mm., thickness 0.2 mm.

"This species differs from any known to the writer by being more nearly planispiral and bilaterally symmetrical and in having a broad and evenly rounded periphery.

"This species has been found only in the Greenhorn formation where it is common locally."

The types are from the Hartland shale member of the Greenhorn formation, Sec. 31, T. 21 S., R. 22 W., Hodgeman County, Kansas. The holotype is redrawn on our plate.

ANOMALINA AMMONOIDES (Reuss) (Pl. 5, figs. 4, 5)

Rosalina ammonoides REUSS, Geog. Skizzen Böhmen, vol. 2, pt. 1, 1844, p. 214; Verstein. böhm Kreide., pt. 1, 1845, p. 36, pl. 8, fig. 33; pl. 13, fig. 66.

A study of specimens named by Reuss shows that most of the references to it by later authors are not correct. On our plate is a drawing of one of the specimens selected by Reuss and in the Reuss collection of the Museum of Comparative Zoölogy, Harvard University. This species occurs in typical form in our collections from the lower part of the Taylor marl and Austin chalk. Figures of a typical specimen from the Annona chalk are also given.

The stratigraphic range is similar both in the European and American Cretaceous.

ANOMALINA PSEUDOPAPILLOSA Carsey (Pl. 5, fig. 6)

Anomalina pseudopapillosa CARSEY, Univ. Texas Bull. 2612, 1926, p. 47, pl. 1, figs. 6 a, b.—PLUMMER, l. c., Bull. 3101, 1931, p. 200, pl. 14, fig. 13.

Test nearly equally biconvex, nearly involute on both sides, the early coils showing slightly on the dorsal, periphery rounded but contracted somewhat; chambers numerous, usually 15 to 18 in the adult whorl, slightly inflated, of uniform shape, increasing very gradually in size as added; sutures distinct, strongly limbate and somewhat raised above the general surface; wall distinctly and coarsely perforate, the surface often granular in appearance, the umbilical region with small raised bosses; aperture near the periphery, with a slight lip. Diameter 0.35-0.50 mm.; thickness 0.12-0.20 mm.

The types of this species are from the Navarro of Texas. The species is a small one but often very abundant in the Navarro, ranging from the Nacatoch sand upward to the Midway contact.

ANOMALINA CLEMENTIANA (d'Orbigny) (Pl. 5, figs. 7, 8)

Rosalina clementiana D'ORBIGNY, Mém. Soc. géol. France, sér. 1, vol. 4, 1840, p. 37, pl. 3, figs. 23-25.

Anomalina clementiana FRANKE, Abhandl. Geol. Pal., Inst., Univ. Greifswald., vol. 6, 1925, p. 85, pl. 7, figs. 12 a-c; Abhandl. Preuss. geol. Landes., n. ser., vol. 111, 1928, p. 179, pl. 16, figs. 9 a-c.—CUSHMAN, Tenn. Div. Geol., Bull. 41, 1931, p. 61, pl. 13, figs. 1 a-c; Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 46, pl. 6, figs. 10 a-c.

Test somewhat tending toward planispiral in the adult, trochoid in the young, variable, compressed, periphery rounded; chambers distinct, 7 to 9 in the last-formed whorl; sutures on the dorsal side curved, limbate and strongly raised except in the last few chambers of the adult which are smooth, and the sutures often slightly depressed, on the ventral side nearly radial, depressed, the ends of the chambers raised between the sutures; wall smooth except for the ornamentation already noted in the earlier portions; aperture peripheral and extending onto the dorsal side. Diameter 0.30-0.40 mm.; thickness 0.10-0.15 mm.

Specimens similar to typical European ones have been found in our material, particularly from the upper part of the Taylor marl, and it occurs in Upper Cretaceous collections of similar age from Antigua.

ANOMALINA SEMICOMPLANATA Cushman (Pl. 5, fig. 9)

Anomalina complanata CUSHMAN (not REUSS), Tenn. Div. Geol. Bull. 41, 1931, p. 60, pl. 11, figs. 7 a-c.—SANDIDGE, Amer. Midl. Nat., vol.

13, 1932, p. 368, pl. 31, figs. 30, 31.

Anomalina semicomplanata CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 14, 1938, p. 68, pl. 12, fig. 1.

Test planispiral, at least in the adult, much compressed, periphery subacute, earlier coils exposed on both sides at the center; chambers numerous, increasing very slowly in size as added, of nearly uniform shape, the later ones tending to become slightly inflated; sutures distinct, little if at all depressed, slightly limbate; wall smooth but conspicuously perforate, with a slight thickening in the central region at each side; aperture peripheral, extending slightly onto the dorsal side, with a slight lip. Diameter 0.50-0.65 mm.; thickness 0.15-0.18 mm.

The types are from the Ripley formation, 11½ miles W. of Sardis on Sardis-Henderson road, Henderson County, Tenn.

A study of topotypes of *A. complanata* Reuss shows that it is a very different species from our American one. *A. semicomplanata* differs in having a subacute instead of a very acute periphery, and in being much more umbonate.

In our material the species seems to be largely limited to the upper part of the Taylor marl and the Neylandville marl of the lower Navarro.

ANOMALINA TENNESSEENSIS W. BERRY (Pl. 5, fig. 11)

Anomalina tennesseensis W. BERRY (in BERRY and KELLEY), Proc. U. S.

Nat. Mus., vol. 76, Art. 19, 1929, p. 13, pl. 2, figs. 13-15.

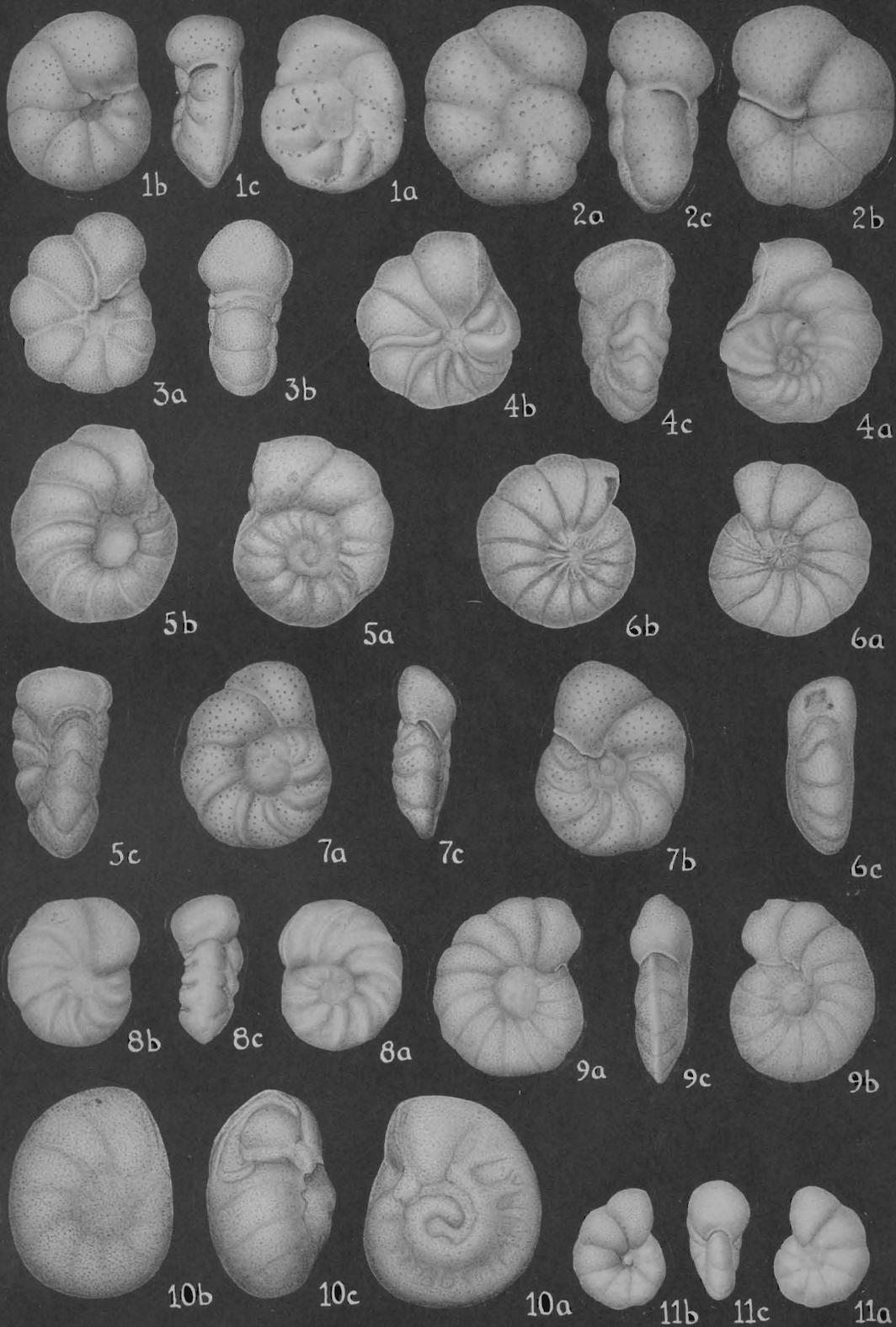
"Test small, nautiloid, slightly compressed laterally, composed of numerous chambers all clearly visible from the dorsal side,

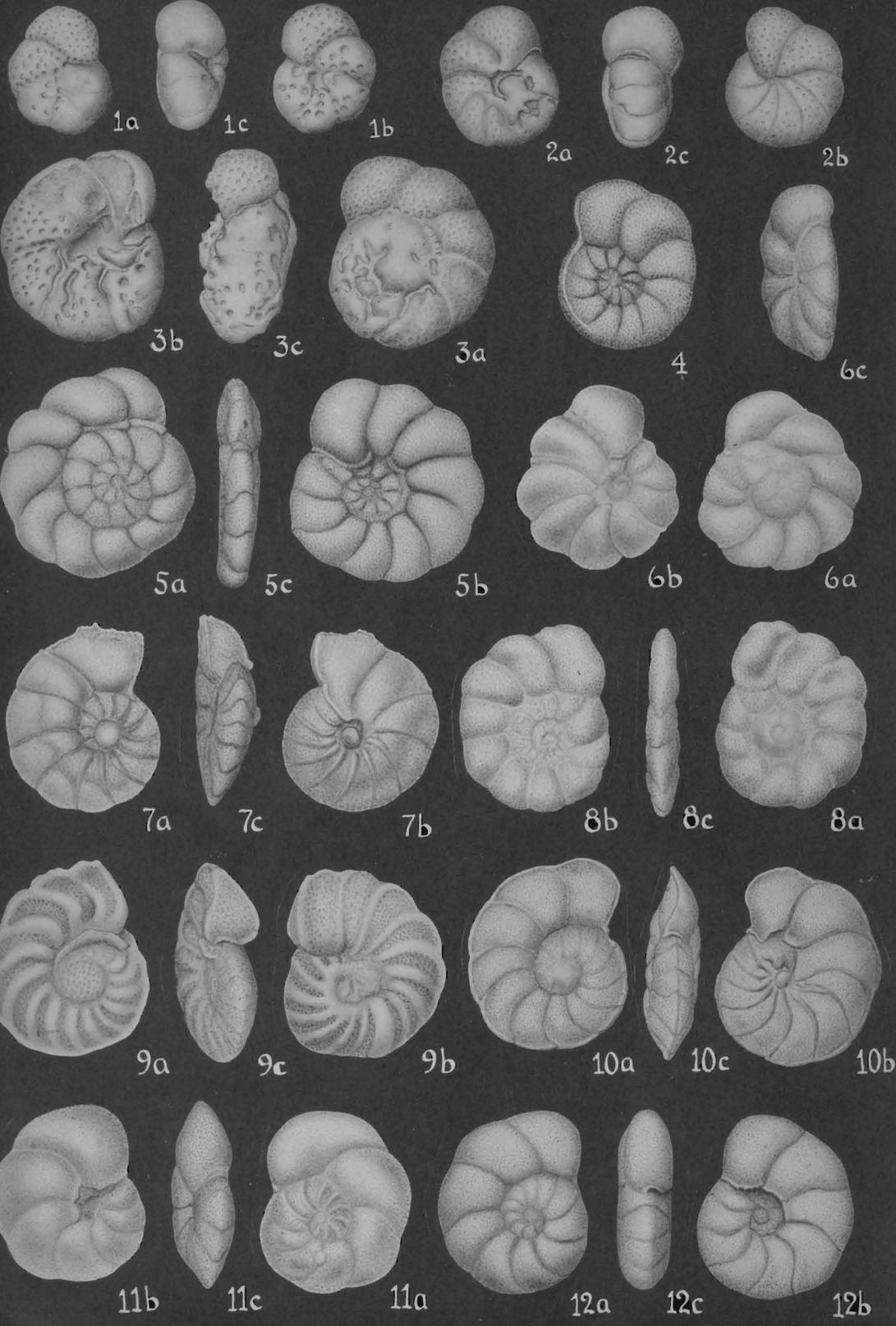
EXPLANATION OF PLATE 5

(for plate 5 see facing p. 46)

Unless otherwise noted: a, dorsal view; b, ventral view; c, peripheral view.

Figs. 1, 2. *Anomalina nelsoni* W. Berry. 1, × 55. Holotype redrawn. Ripley formation, McNairy Co., Tenn. 2, × 90. Selma chalk (middle part), Hardin Co., Tenn. 3. *Anomalina bentonensis* Morrow. × 68. Holotype redrawn. Hartland shale member of Greenhorn limestone, Hodgeman Co., Kans. a, dorsal view; b, peripheral view. 4, 5. *Anomalina ammonoides* (Reuss). 4, × 45. Autotype. Planermergel, Bohemia. 5, × 55. Annona chalk, Red River Co., Tex. 6. *Anomalina pseudopapillosa* Carsey. × 68. Corsicana marl, Navarro Co., Tex. 7, 8. *Anomalina clementiana* (d'Orbigny). 7, × 90. Ripley formation, McNairy Co., Tenn. 8, × 45. White chalk, Antigua, B. W. I. 9. *Anomalina semicomplanata* Cushman. × 60. Ripley formation, Henderson Co., Tenn. 10. *Anomalina velascoensis* Cushman. × 58. Holotype redrawn. Velasco shale, Tamalte Arroyo, Hacienda El Limon, Mexico. 11. *Anomalina tennesseensis* W. Berry. × 55. Holotype redrawn. Ripley formation, McNairy Co., Tenn.





only those of the last-formed coil visible on the ventral side; ventral side umbilicate; about 7 to 8 chambers in last coil, usually about two coils; sutures slightly depressed, more or less distinct; wall thin, coarsely perforate; aperture a narrow curved slit at base of final chamber. Diameter, 0.32 mm.

"This small species is fairly common in the Ripley. It can be compared to *A. clementina* d'Orbigny in general appearance, but while *A. clementina* has slightly raised ridges on the sutures, *A. tennesseensis* has none. In size the two species are nearly alike, *A. clementina* being only slightly larger."—(W. Berry, 1929.)

The types are from the Ripley, from Dave Week's place on Coon Creek, 3½ miles S. of Enville, 7½ miles N. of Adamsville, and ⅛ mile E. of main Hendersonville-Adamsville road, McNairy County, Tenn.

The only specimens in our material are from Selma chalk of upper Taylor age, 10½ miles S. of Corinth, Alcorn County, Miss. Our figures are redrawn from the holotype.

The species is very distinct from *A. clementina*.

ANOMALINA RUBIGINOSA Cushman (Pl. 6, figs. 1-3)

Anomalina rubiginosa CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 607, pl. 21, figs. 6 a-c.—CUSHMAN and JARVIS, Proc. U. S. Nat. Mus., vol. 80, Art. 14, 1932, p. 52, pl. 16, figs. 3-5.

Planulina rubiginosa WHITE, Journ. Pal., vol. 2, 1928, p. 303, pl. 41, figs. 6 a-c.

Test close coiled, the dorsal side slightly convex, ventral side somewhat concave, periphery broadly rounded, 9 or 10 chambers in the last-formed coil, rather indistinct, as are also the sutures, more distinct in the last few chambers, dorsal side with the wall

EXPLANATION OF PLATE 6

a, dorsal view; b, ventral view; c, peripheral view.

FIGS. 1-3. *Anomalina rubiginosa* Cushman. × 38. (After Cushman and Jarvis.) Cretaceous, Trinidad. 4, 5. *Planulina eaglefordensis* (Moreman). × 60. Eagle Ford shale, Dallas Co., Tex. 6. *Planulina austinana* Cushman. × 55. Holotype. Lower Austin chalk, Dallas Co., Tex. 7. *Planulina texana* Cushman. × 48. Holotype. Lower Taylor marl, Fannin Co., Tex. 8. *Planulina kansasensis* Morrow. × 55. Holotype redrawn. Fort Hays limestone member of Niobrara formation, Ellis Co., Kans. 9. *Planulina spissocostata* Cushman. × 60. Holotype. Upper Taylor marl, Navarro Co., Tex. 10. *Planulina taylorensis* (Carsey). × 30. Saratoga chalk, Howard Co., Ark. 11. *Planulina correcta* (Carsey). × 68. Corsicana marl, Travis Co., Tex. 12. *Planulina nacatochensis* Cushman. × 68. Holotype. Nacatoch sand, White Co., Ark.

very coarsely punctate, ventral side, especially in the earlier portion, with very large depressed areas of an irregular form, giving a peculiar appearance to that portion of the test; aperture along the ventral margin of the last-formed chamber. Diameter 0.50-0.80 mm.; height 0.30-0.40 mm.

This is a common and well marked species in the Velasco shale of Mexico, and occurs in typical form in Trinidad. Some of the young stages are also shown here. So far as our material from both areas shows, the species does not become sufficiently evolute to warrant placing it in the genus *Planulina*.

The specimens referred to this species from the Saratoga chalk (Cushman, Journ. Pal., vol. 5, 1931, p. 314, pl. 36, figs. 9 a-c) and from the Annona chalk (idem, vol. 6, 1932, p. 344) belong elsewhere.

ANOMALINA VELASCOENSIS Cushman (Pl. 5, fig. 10)

Anomalina velascoensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 1, 1925, p. 21, pl. 3, figs. 3 a-c; Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 607, pl. 21, figs. 7 a-c; Journ. Pal., vol. 1, 1927, p. 170, pl. 28, figs. 14 a, b.

Test plano-convex, the dorsal side nearly flat, ventral side very broadly rounded, periphery broadly rounded; chambers fairly distinct, 8 or 9 in the last-formed coil; on the dorsal side there is a depressed area coinciding with the line of coiling, the central portion raised in a spiral, later chambers with a slightly depressed area over each chamber, the sutures being somewhat limbate and raised; on the ventral side sutures limbate but not raised above the general surface, curved, in the edge view the thickenings of the dorsal side often stand up slightly above the general surface; wall generally smooth and finely punctate. Length about 0.50 mm.; breadth 0.45 mm.; thickness 0.35 mm.

This is a widely distributed species throughout most of the Velasco formation, and may be distinguished by the very different characters of the dorsal and ventral surfaces, the peculiar spiral thickening of the dorsal side being especially marked.

Genus PLANULINA d'Orbigny, 1826

PLANULINA EAGLEFORDENSIS (Moreman) (Pl. 6, figs. 4, 5)

Anomalina eaglefordensis MOREMAN, Journ. Pal., vol. 1, 1927, p. 99, pl. 16, figs. 9 a, b.—VANDERPOOL, l. c., vol. 4, 1930, p. 255 (list).

Test trochoid, very much compressed, partially evolute, periphery rounded, somewhat lobulate; chambers distinct, slight-

ly inflated, usually 10 to 12 in the adult whorl, of uniform shape, increasing very gradually in size as added; sutures distinct, curved, more strongly so on the dorsal side, somewhat depressed, earlier ones limbate; wall distinctly perforate; aperture a low opening at the base of the last-formed chamber, with a slight overhanging lip. Diameter 0.50-0.70 mm.; thickness 0.10-0.12 mm.

The types of this species are from Eagle Ford shales, 2 miles N. of Hebron, Texas. The species has occurred in our material at a number of localities, but seems to be an index fossil for the Eagle Ford.

PLANULINA AUSTINANA Cushman (Pl. 6, fig. 6)

Planulina austinana CUSHMAN, Contr. Cushman Lab. Foramin. Res., vol. 14, 1938, p. 68, pl. 12, fig. 2.

Test very much compressed, partially evolute on both sides, particularly so on the dorsal side which is very slightly umbonate, ventral side slightly umbilicate, periphery subacute, lobulate; chambers distinct, somewhat inflated, of uniform shape, increasing very gradually in size as added, 8 to 10 in the adult whorl; sutures distinct, only slightly curved on the dorsal side, ventrally nearly radial, slightly depressed; wall smooth, finely but conspicuously perforate; aperture, a low opening at the base of the last-formed chamber at the periphery, and extending over along the dorsal side. Diameter 0.50-0.55 mm.; thickness 0.18-0.22 mm.

The types are from lower part of Austin chalk, road cut, S. side U. S. highway 80, 2 feet above sidewalk, opposite Catholic School, 3.8 miles W. of Union Station, Dallas, Dallas County, Texas.

The species seems to be limited to the Austin chalk.

Planulina austinana differs from *P. taylorensis* (Carsey) in its smaller size, more lobulate periphery, more depressed sutures, and lack of a peripheral keel.

PLANULINA TEXANA Cushman (Pl. 6, fig. 7)

Planulina texana CUSHMAN, Contr. Cushman Lab. Foramin. Res., vol. 14, 1938, p. 69, pl. 12, fig. 3.

Test much compressed, dorsal side usually flattened but with a central boss, partially evolute, ventral side somewhat less evolute, more convex, periphery subacute, not keeled; chambers distinct, especially those of the last-formed whorl, of uniform shape, in-

creasing rather rapidly in size as added, little if at all inflated; sutures distinct in the last whorl, strongly limbate, slightly raised, thickened toward the inner end, gently curved; wall finely but distinctly perforate, generally smooth except in the center where there is usually a raised spiral ridge on the ventral side; aperture a narrow slit with a slightly overhanging lip. Diameter 0.55-0.65 mm.; thickness 0.18-0.22 mm.

The types of this species are from lower part of the Taylor marl, N. fork of Sulphur Creek, 2.3 miles SE. of Gober, Fannin County, Texas.

This species differs from *Planulina taylorensis* (Carsey), of which it may be the ancestral form, in the smaller size, less keeled and less lobulated periphery, sutures more ornamented and the apertural lip less well developed. *P. texana* is characteristic of the Austin chalk and lower part of the Taylor marl.

PLANULINA KANSASENSIS Morrow (Pl. 6, fig. 8)

Planulina kansasensis MORROW, Journ. Pal., vol. 8, 1934, p. 201, pl. 30, figs. 2 a, b, 12 a-c, 15 a-c.—LOETTERLE, Bull. 12, Nebraska Geol. Surv., 1937, p. 49, pl. 8, figs. 2 a-c.

“Test much compressed, dorsal and ventral sides nearly flat, slightly trochoid and involute; periphery rounded, chambers numerous, eight to ten in final whorl, all chambers exposed on the dorsal side, partially covered on the ventral side; sutures distinct between the later chambers, slightly depressed, curved outward and backward; central area on both sides covered by a calcareous deposit varying in thickness from a film to a thick rounded plug, which may be transparent showing the covered chambers; wall smooth, perforate; aperture obscure, extending along the base of the last chamber onto the ventral side. Diameter up to 0.52 mm., thickness 0.12 mm.”

The types of this species are from basal Niobrara chalk, Fort Hays limestone member, SE $\frac{1}{4}$ sec. 12, T. 12 S., R. 17 W., Ellis County, Kans. The holotype is redrawn on our plate. Loetterle records the species as abundant in the Fort Hays member of the Niobrara of Nebraska, Kansas, and South Dakota, and less typical in the Smoky Hill member in the same three states. In our material, the species occurs most commonly in the lower part of the Austin chalk with specimens at single localities in the Brownstown and upper Austin.

PLANULINA SPISSOCOSTATA Cushman (Pl. 6, fig. 9)

Planulina spissocostata CUSHMAN, Contr. Cushman Lab. Foram. Res.,
vol. 14, 1938, p. 69, pl. 12, fig. 4.

Test trochoid, generally plano-convex, dorsal side flattened or even concave in the center, ventral side slightly convex, but often somewhat umbilicate in the center, periphery subacute, somewhat evolute on the dorsal side, mostly involute on the ventral side; chambers of the last whorl distinct, those of the earlier whorls obscure, usually 14 to 16 in the final whorl, not inflated, the outer margin strongly raised and thickened on both sides, but more strongly so on the dorsal side, of rather uniform shape, and increasing very gradually in size as added; sutures of the last whorl distinct, others obscure, strongly curved; wall distinctly perforate, smooth except for the thickened margins of the chambers which form rounded, raised ridges; aperture a low opening at the inner margin of the last-formed chamber. Diameter 0.40-0.45 mm.; thickness 0.17-0.20 mm.

The types of this species are from the upper part of the Taylor marl, 2.6 miles E. of Barry, on road to Corsicana, Navarro County, Texas.

This species is close to *Anomalina clementiana* (d'Orbigny), but differs in having the raised portions more prominent, a greater number of chambers, and more acute periphery.

It occurs in our material in the Neylandville marl in the lower part of the Navarro group and in the Taylor marl.

PLANULINA TAYLORENSIS (Carsey) (Pl. 6, fig. 10)

Anomalina taylorensis CARSEY, Univ. Texas Bull. 2612, 1926, p. 47, pl. 6, figs. 1 a, b.

Planulina taylorensis CUSHMAN, Tenn. Div. Geol., Bull. 41, 1931, p. 62, pl. 12, figs. 5 a-c; Journ. Pal., vol. 5, 1931, p. 314, pl. 36, figs. 6 a-c; vol. 6, 1932, p. 345.—LOETTERLE, Bull. 12, Nebraska Geol. Surv., 1937, p. 63, pl. 11, figs. 4 a-c.

Test large, nearly planispiral, much compressed, later whorls becoming partially evolute, periphery acute and slightly keeled; chambers very distinct, numerous, 9 or more in the adult whorls, of nearly uniform shape and very gradually increasing in size as added, centers at each side slightly umbonate; sutures very distinct, curved, slightly depressed in the adult, in the young slightly limbate and raised on the ventral side; wall mostly smooth, finely but conspicuously perforate; aperture peripheral and extending onto the dorsal side nearly to the center, with a

distinct lip. Diameter up to 1.50 mm. or more; thickness 0.10-0.15 mm.

This is a large and conspicuous species, particularly abundant and widespread in the general upper Taylor and in the Neylandville marl in the lower part of the Navarro group. It is recorded by Loetterle from the Pierre shale of South Dakota and Nebraska.

PLANULINA CORRECTA (Carsey) (Pl. 6, fig. 11)

Discorbis correcta CARSEY, Univ. Texas Bull. 2612, 1926, p. 45, pl. 3, fig. 5.—PLUMMER, l. c., Bull. 3101, 1931, p. 188, pl. 14, figs. 1-4.

Test much compressed, one side more flattened than the other, periphery slightly rounded, lobulate; chambers distinct, very slightly inflated, typically 5 to 9 in the adult whorl, earlier ones low and broad, later ones becoming rapidly much higher and increasing greatly in size in the latest portion; sutures distinct, earlier ones strongly limbate and slightly raised, later ones not limbate and slightly depressed, curved; wall smooth, finely but distinctly perforate; aperture a low elongate slit with a slight lip. Diameter 0.40-0.50 mm.; height 0.08-0.10 mm.

The types of this species are from the Navarro, Corsicana marl, right bank of Onion Creek, just east of bridge known as Jones Crossing on Austin-Bastrop highway, Travis County, Texas.

This is a very variable species, the microspheric and megalospheric forms often showing considerable differences, the former continuing the low chambers almost throughout, while in the megalospheric form the chambers become much larger in the adult. The species is widely distributed in the Navarro of Texas and its equivalents eastward. Its vertical range in our material seems to be limited to that part of the Navarro above the Nacatoch sand.

PLANULINA NACATOCHENSIS Cushman (Pl. 6, fig. 12)

Planulina nacatochensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 14, 1938, p. 50, pl. 8, fig. 9.

Test much compressed, nearly planispiral in the adult, periphery rounded, evolute throughout, at least in the megalospheric form; chambers distinct, averaging 9 in the adult whorl, increasing very gradually in size as added, somewhat more overlapping on the dorsal side, very little inflated; sutures distinct, slightly limbate, on the ventral side evenly curved, on the dorsal

side somewhat sigmoid; wall smooth, finely perforate; aperture extending from the periphery over onto the dorsal side with a slight, overhanging lip. Diameter 0.40-0.50 mm.; thickness 0.10-0.12 mm.

The types are from the Nacatoch sand, Cyrus Heller's marl bed, Beebe, White County, Ark.

This species differs from *P. taylorensis* (Carsey) Cushman in the smaller size, rounded periphery, more evolute form and lack of a central umbo.

PLANULINA GREENHORNENSIS (Morrow) (Pl. 7, fig. 1)

Globorotalia greenhornensis MORROW, Journ. Pal., vol. 8, 1934, p. 199, pl. 31, figs. 1 a-c.

"Test trochoid, biconvex, dorsal side distinctly convex, ventral side strongly convex; periphery slightly scalloped, chambers numerous, eight or nine in final whorl, dorsal side flattened, bordered by a thickened, slightly elevated margin which curves forward from the edge of the preceding chamber to the spiral suture, chambers seen from the ventral side inflated, extended in the direction of the axis of coiling producing a deep, steep-sided umbilical area; sutures on the ventral side strongly depressed, curving gently backward; periphery acute, wall finely perforate; aperture umbilical at base of last chamber. Diameter 0.66 mm., thickness 0.22 mm.

"The characters of *G. greenhornensis* are distinctive and quite constant, making it very easy to distinguish from other species with which it is associated.

"This species is very abundant locally and apparently restricted to the Greenhorn formation."

The type is redrawn on our plate. It seems to belong to *Planulina*. No specimens referable to this have been noted in our material.

Genus CIBICIDES Montfort, 1808

CIBICIDES STEPHENSONI Cushman (Pl. 7, fig. 2)

Cibicides stephensoni CUSHMAN, Contr. Cushman Lab. Foramin. Res., vol. 14, 1938, p. 70, pl. 12, fig. 5.

Test trochoid, much compressed, dorsal side flattened or even slightly concave except for the slightly raised umbo, ventral side somewhat convex also with a central umbo surrounded by a deep groove, periphery subacute; chambers of the last whorl distinct, slightly inflated, 10 to 12 in adult whorl, of rather uniform shape,

increasing gradually in size as added; sutures on the dorsal side somewhat limbate, sometimes slightly raised, curved, ventrally slightly depressed; wall smooth, finely but distinctly perforate; aperture a low opening at the base of the last-formed chamber, with a slight lip. Diameter 0.55-0.65 mm.; thickness 0.27-0.30 mm.

The types of this species are from the Selma chalk of Pecan Gap chalk age, upper end of bluff on Tombigbee River at Demopolis, Ala.

This differs from *Cibicides harperi* (Sandidge) in the smaller size, the costae more definitely raised, and the periphery less sharp.

It occurs most commonly in the upper part of the Taylor marl, especially common in the Pecan Gap chalk member, and ranging upward to the Neylandville marl and Saratoga chalk in the lower part of the Navarro group.

CIBICIDES HARPERI (Sandidge) (Pl. 7, figs. 3-6)

Anomalina harperi SANDIDGE, Amer. Midl. Nat., vol. 13, 1932, p. 316, pl. 29, figs. 1, 2.

Cibicides ripleyensis SANDIDGE (?) (not *Truncatulina ripleyensis* W. BERRY), Amer. Midl. Nat., vol. 13, 1932, p. 199, pl. 19, figs. 17-19.

"Test almost equally biconvex, the ventral side somewhat conical, the dorsal side slightly flattened at the center; periphery subacute, smooth in early stages, later becoming lobate; chambers numerous, 9 in the last coil, increasing in size very gradually, early chambers concealed on the dorsal side by a spiral of clear shell material occupying the umbilical area, chambers involute on the ventral side, a small umbo at the center of the coil; sutures slightly limbate on the dorsal side, smooth on the ventral side, curving slightly from the center of both faces to the periphery; wall coarsely punctate; aperture an arched opening at the base of the chambers on the periphery of the penultimate coil, extending a short distance onto the dorsal side under the margin of the chambers. Diameter of the holotype, 0.6 mm."

The types are from the Ripley formation, low bluff where Eoguechitto Creek joins the Alabama River, Alabama. In our material, the species occurs in the Ripley and in the upper part of the Navarro in the Kemp clay, Corsicana marl and in the equivalent Prairie Bluff chalk.

CIBICIDES COONENSIS (W. Berry) (Pl. 7, figs. 6-8)

Anomalina coonensis W. BERRY (in BERRY and KELLEY), Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 14, pl. 2, figs. 22-24.

Anomalina pseudopapillosa CUSHMAN (not CARSEY), Tenn. Div. Geol., Bull. 41, 1931, p. 61, pl. 12, figs. 4 a-c.

"Test involute, somewhat compressed, nearly equally biconvex, peripheral margin subcarinate; chambers numerous, usually 12 in the last formed coil, very slightly curving; sutures limbate, slightly raised, comma-shaped, slightly elevated at the edge of the umbilical area; wall punctate; aperture an arched slit at the base of the last chamber, extending toward the umbilicus. Diameter 0.55 mm."

The types are from the Ripley, from Dave Week's place on Coon Creek, 3½ miles S. of Enville, 7½ miles N. of Adamsville, and ⅛ mile E. of main Hendersonville-Adamsville road, McNairy County, Tenn. The holotype is redrawn on our plate.

In our material, the species occurs mainly in the upper part of the Taylor marl with specimens also in the Navarro.

From a study of the holotypes, it is probable that "*Truncatulina wadei* W. Berry" (in Berry and Kelley, Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 12, pl. 3, figs. 13-15) and "*Anomalina wadei* W. Berry" (l. c., p. 14, pl. 3, figs. 20-22) should be placed within the range of *Cibicides coonensis*. The holotypes of these are redrawn on our plate.

CIBICIDES BEAUMONTIANUS (d'Orbigny) (Pl. 7, fig. 9)

Truncatulina beaumontiana D'ORBIGNY, Mém. Soc. géol. France, sér. 1, vol. 4, 1840, p. 35, pl. 3, figs. 17-19.

Cibicides beaumontiana BROTZEN, Sver. geol. under., ser. C, No. 396, 1936, p. 188.

Cibicides involuta CUSHMAN (not REUSS), Journ. Pal., vol. 5, 1931, p. 315, pl. 36, figs. 10 a-c; l. c., vol. 6, 1932, p. 345.

Test trochoid, plano-convex, dorsal side flattened or slightly concave, evolute, ventral side strongly convex, involute, periphery acute, slightly lobulate; chambers distinct, usually 7 or 8 in the adult whorl, slightly inflated on the ventral side, increasing rather rapidly in size as added; sutures distinct, earlier ones slightly limbate, strongly curved, slightly depressed ventrally in the later portion; wall smooth, or slightly thickened above the sutures in the center of the dorsal side; aperture a low opening extending from the periphery well over onto the dorsal side at the base of the last-formed chamber. Diameter 0.75-1.00 mm.; thickness 0.50 mm.

The types are from the Upper Cretaceous, White chalk of Meudon, near Paris. It occurs fairly widely distributed in the upper Senonian of Europe. In our material it ranges from the Saratoga chalk down to the Annona chalk.

CIBICIDES CONSTRICTUS (Hagenow) (Pl. 7, fig. 10)

Rotalia constricta HAGENOW, Neues Jahrb., 1842, p. 571.—REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, 1861 (1862), p. 329, pl. 6, fig. 7.

Cibicides constricta CUSHMAN, Journ. Pal., vol. 5, 1931, p. 315, pl. 36, figs. 7 a-c.

Specimens similar to the one figured on our plate have been referred to the above species. They are common in the Saratoga chalk, but have not been noted elsewhere in our collections.

CIBICIDES BERRYI Cushman (Pl. 7, fig. 11)

Truncatulina coonensis W. BERRY (in BERRY and KELLEY), Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 12, pl. 3, figs. 1-3.

Cibicides berryi CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 14, 1938, p. 71, pl. 12, fig. 6.

"Test free, biconvex, dorsal side less convex than ventral, peripheral margin slightly rounded and slightly subcarinate; chambers numerous, 9 to 10 in the last coil, involute on ventral side, sutures depressed, slightly distinct, wall punctate; aperture an arched opening at the base of the last formed chamber with a slit extending under the dorsal margin of the chambers. Diameter, 0.35 mm."

The types are from the Ripley, from Dave Week's place on Coon Creek, 3½ miles S. of Enville, 7½ miles N. of Adamsville and ¼ mile E. of main Hendersonville-Adamsville road, McNairy County, Tennessee. The holotype is redrawn on our plate.

I have not found material in our collections.

219. SOME NOTES ON THE GENUS *CANDORBULINA*

By J. A. CUSHMAN and A. L. DORSEY

The genus *Candorbulina* was erected by Dr. Jedlitschka in 1933. It has not been referred to since in the literature so far as we have observed. It is of interest therefore to record the occurrence of the genus in America, and to note some of its re-

relationships to other genera of the Globigerinidae.

Genus CANDORBULINA Jedlitschka, 1933

Genoholotype, *Candorbulina universa* Jedlitschka, 1933

Candorbulina JEDLITSCHKA, Verhandl. Naturforschenden Vereins in Brünn, Jahrg. 65, 1934 (1933), p. 20.

Test similar to *Orbulina*, but with the apertures consisting of one or more rings of small openings coinciding with the edge of contact of the earlier attached *Globigerina*-like chambers with the adult spherical one.

Jedlitschka described the single species, *Candorbulina universa*, from the Miocene of Czechoslovakia, and gave numerous figures of the exterior showing the pores, and of interiors with the early attached globigerine chambers. In our material, we have found very similar specimens, some of which are figured on our plate. The early stages while definitely globigerine, suggest that there may be dorsal secondary apertures which would indicate that *Candorbulina* was derived from *Globigerinoides* instead of from *Globigerina*. Jedlitschka figures a young stage with two openings, which strongly suggest *Globigerinoides*.

If such be the case, it would not be a very great step to the circular group of pores characteristic of *Candorbulina*. The globular chamber in *Candorbulina* does not usually entirely cover the earlier ones, as it does in *Orbulina*, and instead of being truly spherical the final chamber usually has an area which slightly projects above the general outline of the spherical chamber, and represents the area of the earlier chambers. In some specimens, this projection is very marked. The early chambers are shown in Plate 8, figure 7.

In the same paper in which he figures the specimens of *Candorbulina*, Jedlitschka figures and names certain bilobed tests as *Candeina biloba*. Such specimens apparently differ from *Candorbulina* according to his figures in not developing a complete, spherical chamber, but having a ring of pores about the line of contact of the chambers, a structure which in reality does not differ from that of *Candorbulina*. We have noted these "bilobed" tests (Pl. 8, fig. 8) occurring with *Candorbulina* in the Miocene of Austria, Egypt, and Florida. The surface details in both forms seem identical, and it is strongly suggested that they are but forms of one species. Although not showing well in the figure, the original specimen of figure 8 shows the early stages

at the surface just as they occur in *Candorbulina* in the same sample.

In figure 9 is shown a specimen in which two globular chambers have been added on opposite sides. Although difficult to make out, some of our specimens do show the line of pores along the line of attachment of the globular chamber and the preceding one. All the evidence seems to point to the fact that these forms all represent a single species which, in its adult form or possible senescence, adds one or more globular chambers at the sides which only partially enclose the earlier ones. If this be correct, the "*Candeina*" species figured by Jedlitschka would be included in the range of variation of *Candorbulina universa*.

So far as we have seen from the material at our disposal, *Candorbulina* has occurred only in the Miocene. Being a pelagic form, it would naturally have had a wide distribution. Our material shows specimens from the Miocene of Czechoslovakia, Hungary, Austria, Egypt, and in America from the Eastern Coastal plain regions of the United States from Maryland and Florida, and in Panama and Venezuela. We have not found the genus earlier in the upper Oligocene material available, nor in the Pliocene or Recent. It would seem therefore that *Candorbulina* originated from *Globigerinoides* in the Miocene, and gave rise to *Orbulina*, but itself becoming extinct. If this be the case, *Candorbulina* should make a good index fossil for the Miocene.

220. TWO NEW SPECIES OF FORAMINIFERA FROM THE OLIGOCENE, LINCOLN FORMATION, OF WASHINGTON

By J. A. CUSHMAN and D. L. FRIZZELL

Pending the publication of a paper on the fauna of the Lincoln formation, descriptions of two new species are given here with figures, so that they may be available to workers on this group.

EPONIDES KLEINPELLI Cushman and Frizzell, n. sp. (Pl. 8, fig. 11)

Test comparatively large for the genus, trochoid, biconvex, in peripheral view the ventral side flattened in the umbilical region

and the dorsal side somewhat umbonate, periphery with a blunt keel; chambers distinct, of uniform shape, very gradually increasing in size as added, averaging about 15 in the last-formed whorl in the adult; sutures distinct, on the dorsal side nearly tangential, very slightly curved, limbate, on the ventral side depressed, nearly radial, slightly curved; wall distinctly perforate, the dorsal side smooth, the early chambers showing through the added thickness of shell material, ventrally with a cluster of irregular, raised bosses over the umbilical region; aperture on the ventral side a low, arched opening with a distinct lip. Diameter up to 1.35 mm.; height 0.70 mm.

Holotype (Cushman Coll. No. 35750) from the Oligocene, Lat. 46° 45' N., Long. 123° W., Lewis Co., Washington, in the S. W. $\frac{1}{4}$ of Sect. 27, T. 15 N., R. 3 W.; cuts along the O. W. R. R. & N. Co. R. R., $\frac{1}{4}$ mile N. of town of Galvin (formerly Lincoln Creek), Washington.

This is a large, well characterized species. It differs from *Eponides guayabalensis* Cole in its larger size, greater number of chambers, and the cluster of bosses in the umbilical region instead of a thickened ring.

CASSIDULINA GALVINENSIS Cushman and Frizzell, n. sp. (Pl. 8, fig. 10)

Test compressed, nearly circular in side view, periphery subacute, slightly keeled, slightly lobulate; chambers distinct, very slightly if at all inflated, four pairs making up the last-formed coil, on the ventral side of the basal edge of the chamber somewhat concave where it meets the previous one, and each added nearly at right angles to it; sutures distinct, slightly if at all depressed, very slightly limbate; wall thin, finely perforate, polished; aperture an elongate, elliptical opening, its axis parallel to the periphery. Diameter 0.45 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 35752) from the Oligocene, Lat. 46° 45' N., Long. 123° W., Lewis Co., Washington, in the S. W. $\frac{1}{4}$ of Sect. 27, T. 15 N., R. 3 W.; cuts along the O. W. R. R. & N. Co. R. R., $\frac{1}{4}$ mile N. of town of Galvin (formerly Lincoln Creek), Washington.

This species resembles *Cassidulina cushmani* R. E. and K. C. Stewart, but differs in the shape of the chambers, which, in our species, are shorter and more nearly at right angles to each other, the wider aperture and less definite keel.

221. NEW SPECIES OF BULIMINA

By J. A. CUSHMAN and F. L. PARKER

The following species and varieties of *Bulimina* are apparently new:

BULIMINA KICKAPOOENSIS Cole, var. **PINGUA** Cushman and Parker, n. var.
(Pl. 8, figs. 13, 14)

Variety differing from the typical in being shorter and broader, and in having more inflated chambers and more depressed sutures. Length 0.50-0.67 mm.; diameter 0.30-0.35 mm.

Holotype of variety (Cushman Coll. No. 35789) from the Upper Cretaceous, Corsicana marl, Mexia highway at forks of Wortham rd., 2.8 miles east southeast of Cooleedge, Limestone Co., Texas.

The variety is found only in the upper part of the Upper Cretaceous of the Gulf Coast region in the Kemp clay, Corsicana marl, and upper Navarro of Texas, the Arkadelphia marl of Arkansas, and the Prairie Bluff chalk of Mississippi.

The form is easily differentiated from the typical by the greater breadth of the test in proportion to the length, as well as the greater inflation of the chambers.

BULIMINA ASPERA Cushman and Parker, n. sp. (Pl. 18, figs. 18, 19)

Bulimina pupoides CARSEY (not D'ORBIGNY), Univ. Texas Bull. 2612, 1926, p. 29, pl. 4, fig. 3.—PLUMMER, l. c., Bull. 3101, 1931, p. 180, pl. 9, fig. 15.—? SANDIDGE, Journ. Pal., vol. 6, 1932, p. 280, pl. 43, fig. 1.

Bulimina obtusa CUSHMAN and CHURCH (not D'ORBIGNY), Proc. Calif. Acad. Sci., ser. 4, vol. 18, 1929, p. 513, pl. 39, figs. 17-19.—CUSHMAN, Tenn. Geol. Survey Bull. 41, 1931, p. 47, pl. 7, figs. 17, 18; Journ. Pal., vol. 5, 1931, p. 309, pl. 35, figs. 15 a, b.

Bulimina subornata SANDIDGE (not H. B. BRADY), l. c., vol. 6, 1932, p. 280, pl. 43, fig. 2.

? *Bulimina elongata* SANDIDGE (not D'ORBIGNY), l. c., vol. 6, 1932, p. 281, pl. 43, fig. 3.

Bulimina quadrata CUSHMAN and PARKER (part) (not PLUMMER), Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 100, pl. 15, figs. 12, 15, 16 (not figs. 13, 14).

Bulimina kickapoensis COLE (part), Fla. Dept. Conservation, Geol. Bull. 16, 1938, p. 45.

Test of medium size, two or more times as long as broad, slightly tapering, consisting of 4 to 5 whorls, initial end bluntly pointed, sometimes with 1 or 2 short, basal spines; chambers joined at an angle of about 90° or less, slightly inflated; sutures distinct,

slightly depressed; wall of initial part of the test somewhat roughened, perforate, with the perforations often arranged in regular lines; aperture elongate, at apex of test, with a small, plate-like tooth. Length (specimens at type locality) 0.38-0.50 mm.; diameter 0.16-0.26 mm.

Holotype (Cushman Coll. No. 35786) from the Upper Cretaceous, upper Taylor formation, 6.15 miles from Kaufman on the road to Crandall, Kaufman Co., Texas.

The species is very widespread in the Upper Cretaceous, Taylor and Navarro, throughout the Gulf Coast region. The upper Navarro specimens do not have the small basal spines, seen in the lower forms.

The species differs from *Bulimina pupoides* d'Orbigny in the angled character of the chambers, in the much slighter inflation of the chambers, and in the shape of the test which is less tapering, and has a more blunt initial end. It differs from *B. hickapooensis* Cole in the smaller size and the greater inflation of the chambers, in the roughened early portion of the test, and in the usual presence of one or two short, basal spines.

BULIMINA PECTINATA Cushman and Parker, n. sp. (Pl. 8, fig. 20)

Test of medium size, triangular in transverse section, somewhat twisted on its axis, broadest part near the apertural end, initial end bluntly pointed, consisting of about six whorls; chambers made somewhat indistinct by the ornamentation except in the central part of the sides of the test; sutures indistinct except at the sides, flush with the surface, somewhat darker in color than the rest of the test; wall ornamented along the edges of the chambers by a bluntly toothed border which gives a somewhat fringed appearance to the test, finely perforate; aperture loop-shaped, at the apex of the test. Length (adult specimens) 0.32-0.38 mm.; diameter 0.18-0.20 mm.

Holotype (Cushman Coll. No. 32761) from the Upper Cretaceous, upper Taylor marl, road cut, east bank, near crest of hill, 14.4 miles south of Paris, 0.9 mile north of Lake City, Delta Co., Texas.

The species is known only from the type locality. It is somewhat similar in shape to *Bulimina rudita* Cushman and Parker, but tapers less rapidly, and is easily differentiated by the fringe-like ornamentation.

BULIMINA MARSSONI Cushman and Parker, new name (Pl. 8, fig. 17)

Tritaxia minuta MARSSON, Mitth. nat. Ver. Neu-Vorpommern u. Rügen, Jahrb. 10, 1878, p. 162, pl. 4, figs. 31 a-d.

Bulimina minuta CUSHMAN, Special Publ. No. 7, Cushman Lab. Foram. Res., 1937, p. 29.

Test small, triangular in transverse section, consisting of five whorls, rapidly tapering; chambers indistinct, adjacent series meeting in zigzag line on the somewhat concave sides; sutures slightly depressed, dark in color; wall coarsely perforate, smooth; aperture loop-shaped, at apex of test. Length (figured specimen) 0.28 mm.; diameter 0.12 mm.

The types of Marsson's species are from the Upper Cretaceous, Senonian, of Rügen. A topotype is figured here. The species has not been recorded elsewhere.

The name "*Bulimina minuta*" was used by Hantken in 1883, and for that reason a new name is given to the form. The specimens used for study were compared with Marsson's type in Vienna in 1932 by the senior author. The species resembles *Bulimina rudita* Cushman and Parker, but is smaller, more regular in character, has a smooth wall, and less depressed sutures.

BULIMINA ECCENTRICA Cushman and Parker, n. sp. (Pl. 8, fig. 12)

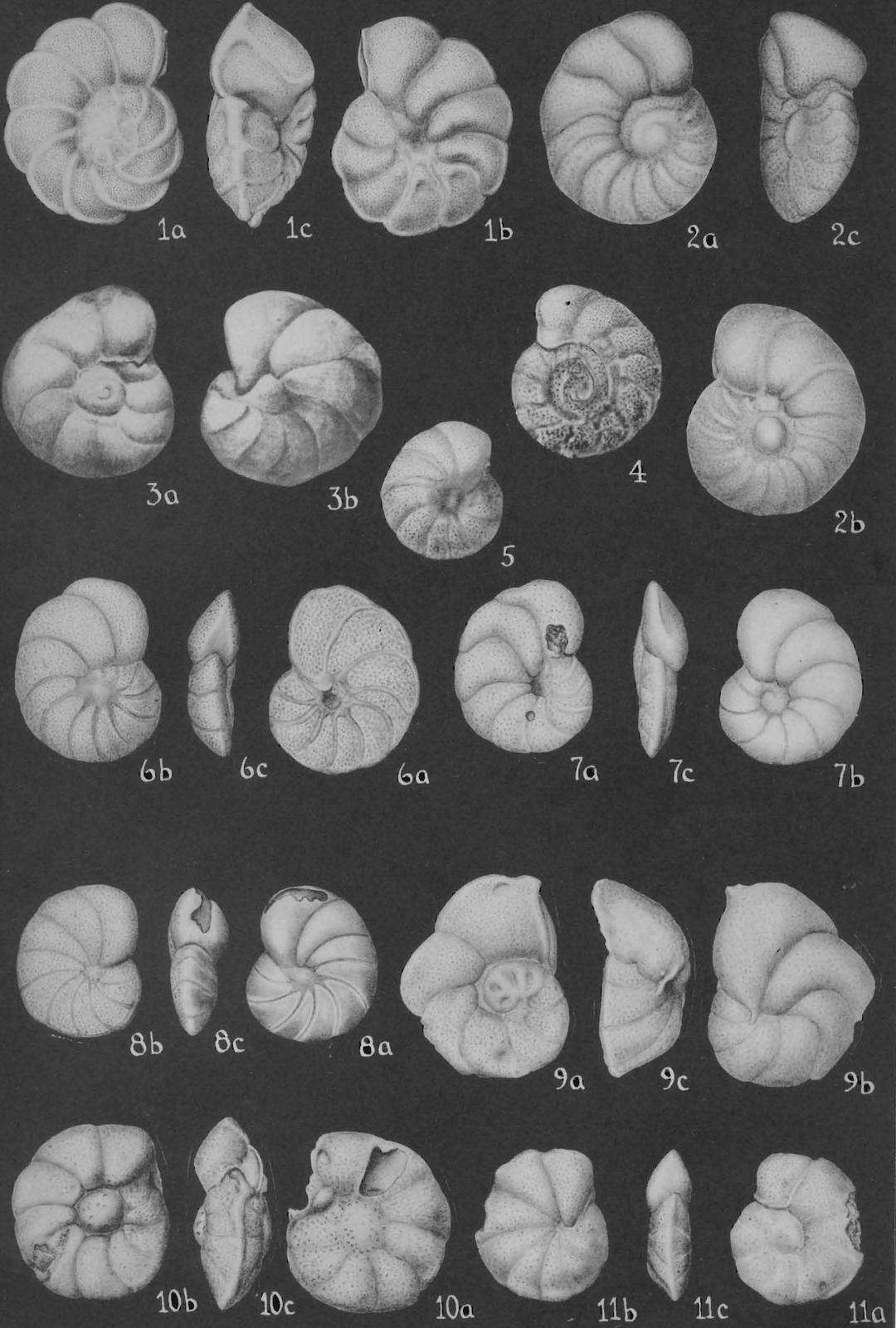
Test of medium size, slightly less than twice as long as broad, tapering, with the widest portion at the middle of the last-formed whorl, initial end bluntly rounded, consisting of four whorls, the last whorl comprising at least two-thirds of the test; chambers distinct, those of early whorls not inflated, last whorl very much

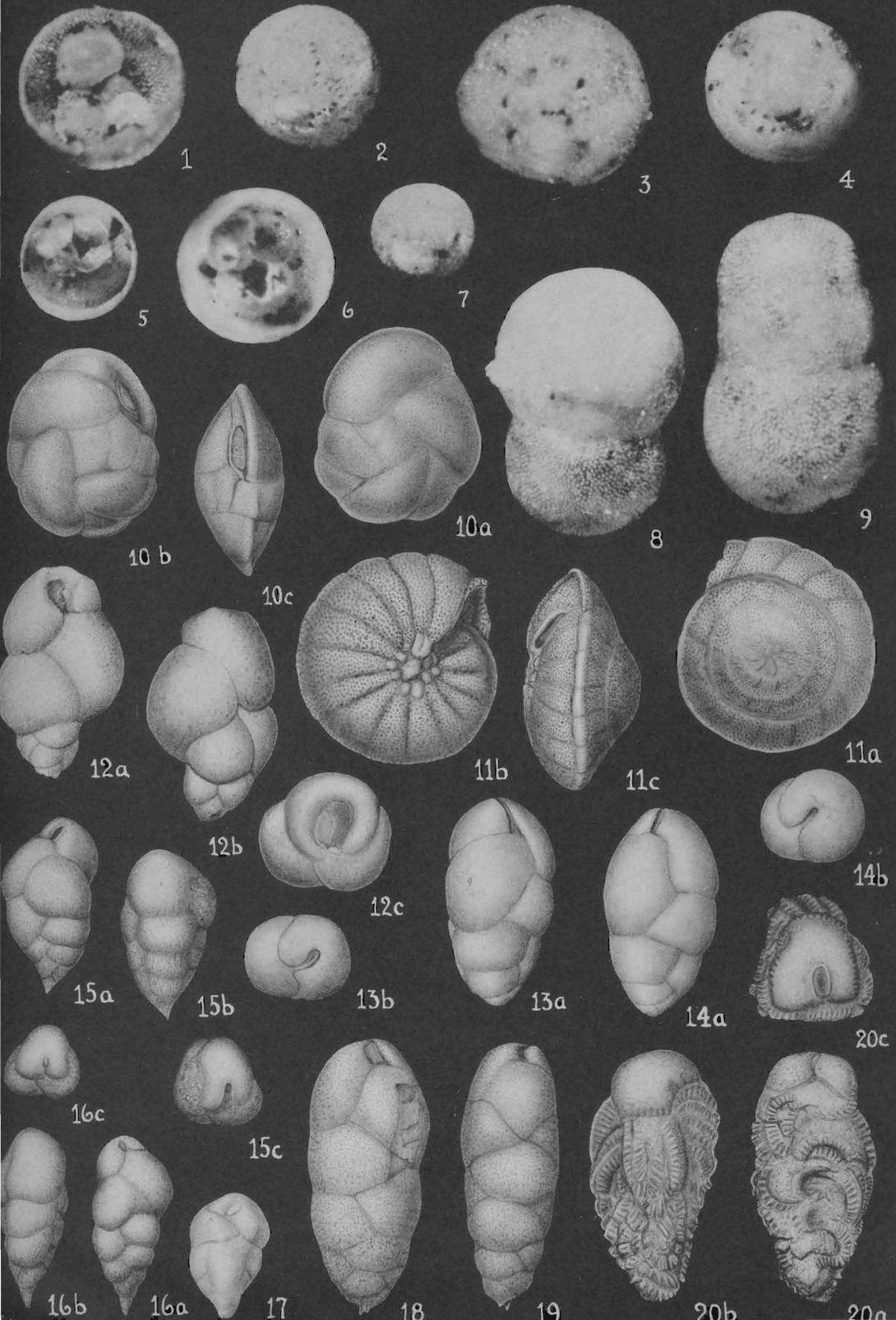
EXPLANATION OF PLATE 7

(for plate 7 see facing p. 30).

a, dorsal view; b, ventral view; c, peripheral view.

FIG. 1. *Planulina greenhornensis* (Morrow). × 55. Holotype redrawn. Hartland shale member of Greenhorn limestone, Hodgeman Co., Kans. 2. *Cibicides stephensoni* Cushman. × 55. Holotype. Selma chalk of Pecan Gap chalk age, Marengo Co., Ala. 3-5. *Cibicides harperi* (Sandidge). 3, × 58. (After Sandidge.) Ripley formation, Alabama River, Ala. 4, 5, × 38. Kemp clay, Navarro Co., Tex. 4, dorsal view; 5, ventral view. 6-8. *Cibicides coonensis* (W. Berry). × 55. 6, Holotype redrawn. Ripley formation, McNairy Co., Tenn. 7, Holotype of "*Anomalina wadei* W. Berry" redrawn. Same locality. 8, Holotype of "*Truncatulina wadei* W. Berry" redrawn. Same locality. 9. *Cibicides beaumontianus* (d'Orbigny). × 38. Saratoga chalk, Howard Co., Ark. 10. *Cibicides constrictus* (Hagenow). × 30. Saratoga chalk, Howard Co., Ark. 11. *Cibicides berryi* Cushman. × 68. Holotype of "*Truncatulina coonensis* W. Berry" redrawn. Ripley formation, McNairy Co., Tenn.





inflated so that the sudden increase in diameter between the early whorls and the last is very marked; sutures distinct, those of last whorl depressed; wall smooth, rather coarsely perforate; aperture large, broadly loop-shaped. Length (of holotype) 0.65 mm.; diameter 0.25 mm.

Holotype (Cushman Coll. No. 35784) from the Eocene, Calcaire grossier inférieur, St. Félicé, Département of Oise, France.

This species occurs at many localities in the Paris Basin Eocene. While the initial portion of the test somewhat resembles that of *Bulimina elongata* d'Orbigny, the very greatly inflated last whorl easily distinguishes this species.

BULIMINA VERSA Cushman and Parker, n. sp. (Pl. 8, figs. 15, 16)

Test small, triangular in transverse section, with rounded angles and slightly concave sides, somewhat twisted about the vertical axis, with a well developed basal spine; chambers distinct, somewhat inflated; sutures distinct, depressed; wall of first half of test very finely costate, latter half coarsely perforate, almost punctate in appearance; aperture small, loop-shaped, at apex of test. Length 0.25-0.30 mm.; diameter 0.12-0.15 mm.

Holotype (Cushman Coll. No. 35792) from the Eocene, Montian, Les Moulineaux, Département of Seine, France.

This species was found only in material from the type locality. It differs from *Bulimina semicostata* Nuttall in being very much

EXPLANATION OF PLATE 8

FIGS. 1-9. *Candorbulina universa* Jedlitschka. 1, 5, 6, Showing early globigerine chambers. 2-4, 7, Exteriors with rings of small apertures and early globigerine chambers showing from exterior. 8, "Bilobate adult." 9, "Trilobate adult." 1, 8, 9, Miocene, near head of Vaughan Creek, Sec. 27, T. 2 N., R. 19 W., Walton Co., Fla. 5, 7, Miocene, Bell Farm, Sec. 29, T. 2 N., R. 19 W., Walton Co., Fla. 4, 6, Miocene, 1 mile S. of Plum Point, Calvert Co., Md. 2, 3, Miocene, N. of Scientists Cliffs, ½ mile S. of mouth of Parker Creek, Calvert Co., Md. 1-4, 7, × 45. 5, 6, 8, 9, × 60. 10. *Cassidulina galvinensis* Cushman and Frizzell, n. sp. × 60. a, dorsal view; b, ventral view; c, peripheral view. 11. *Eponides kleinPELLI* Cushman and Frizzell, n. sp. × 33. a, dorsal view; b, ventral view; c, peripheral view. 12. *Bulimina eccentrica* Cushman and Parker, n. sp. × 45. a, front view; b, rear view; c, apertural view. 13, 14. *Bulimina kickapooensis* Cole, var. *pingua* Cushman and Parker, n. var. × 45. 13, Holotype. 14, Paratype. 15, 16. *Bulimina versa* Cushman and Parker, n. sp. × 80. 15, Holotype. 16, Paratype. a, a, front views; b, b, rear views; c, c, apertural views. 17. *Bulimina marssoni* Cushman and Parker, new name. × 55. 18, 19. *Bulimina aspera* Cushman and Parker, n. sp. × 80. 18, Holotype. 19, Paratype. 20. *Bulimina pectinata* Cushman and Parker, n. sp. × 120. a, front view; b, rear view; c, apertural view.

smaller, triangular in transverse section, much more finely costate, and in having a basal spine. It bears no close resemblance to any known species.

BULIMINA GIBBA Fornasini

- Bulimina gibba* FORNASINI, Mem. Sci. Istit. Bologna, ser. 5, vol. 9, 1901, p. 10, pl. 0, figs. 32, 34.
- Bulimina fusiformis* WILLIAMSON, var. *baccata* FORNASINI, l. c., p. 10, pl. 0, figs. 2, 5, 30.
- Bulimina elongata* D'ORBIGNY, var. *ariminensis* FORNASINI (not D'ORBIGNY), l. c., p. 9, pl. 0, figs. 8, 11.
- Bulimina fusiformis* FORNASINI (not WILLIAMSON), l. c., p. 10, pl. 0, figs. 1, 3, 4, 16, 18, 21, 23, 27, 36, 40 (not 6, 9, 41).
- Bulimina elegans* H. B. BRADY (not D'ORBIGNY), Rep. Voy. Challenger, Zool., vol. 9, 1884, p. 398, pl. 50, figs: 1-4.
- Bulimina baccata* CUSHMAN and PARKER (not YOKOYAMA), Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 14, pl. 3, figs. 1-6.

In the last issue of these "Contributions" in a discussion of Recent species of *Bulimina*, the name "*Bulimina baccata* Fornasini" was recognized for a species recorded from Rimini, Italy. We have since discovered that this name is preoccupied by *Bulimina baccata* Yokoyama in 1890, and so the name "*B. gibba* Fornasini," which was placed in the synonymy under this form, must be used.

RECENT LITERATURE ON THE FORAMINIFERA

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

- Scheffen, W.** Studi Micro-paleontologici dei Terreni Argillo-marnosi Terziari della Sicilia centro-meridionale. (Appendix to Appunti sulla geologica della Sicilia centro-meridionale by R. B. Behrmann.)—Rome, 1938, 4 pp., 2 pls.—A few species figured, mostly identified to genus only.
- Dunbar, Carl O.** Permian Fusulines from Central America.—Journ. Pal., vol. 13, No. 3, May, 1939, pp. 344-348, pls. 35, 36.—Two species, *Parafusulina guatemalaensis*, n. sp. and *P. sapperi* (Staff) described and figured.
- Permian Fusulines from Sonora.—Bull. Geol. Soc. Amer., vol. 50, 1939, pp. 1745-1760, 4 pls.—Eight species figured, three new: *Parafusulina imlayi*, *P. skinneri*, and *P. sonoraensis*.

- Eaton, J. E. Geology and Oil Possibilities of Caliente Range, Cuyama Valley and Carrizo Plain, California.—Calif. Journ. Mines and Geology, Rep't XXXV of State Mineralogist, July, 1939, pp. 255-274, 5 text figs., map.—Mentions various foraminiferal zones.
- Silvestri, Alfredo. Illustrazione di specie caratteristica del Cretaceo superiore.—Boll. Soc. Geol. Ital., vol. LVIII, 1939, pp. 225-234, pl. XII.—A new genus and species described from the Upper Cretaceous of Italy, *Fascispira Colomi*.
- Nummulitidi delle Alpi Apuane attribuite al Triassico.—L. c., 1939, pp. 293-298, pl. XV.—A new name given, *Nummulites Canavarii*, n. sp., and a partial section figured.
- Macfadyen, W. A. On *Ophthalmidium*, and Two New Names for Recent Foraminifera of the Family *Ophthalmidiidae*.—Journ. Roy. Micr. Soc., ser. III, vol. LIX, pt. 3, Sept., 1939, pp. 162-169, 3 text figs.—*Nodophthalmidium* a new generic name for *Nodobacularia*, and a new species *Ophthalmidium balkwilli*.
- Yabe, Hisakatsu and Kiyosi Asano. Contribution to the Palaeontology of the Tertiary Formations of West Java. Part 1. Minute Foraminifera from the Neogene of West Java.—Tohoku Imp. Univ., Sci. Rep'ts, ser. 2 (Geol.), vol. 19, 1937, pp. 87-126 (1-40), pls. XVII-XIX (I-III).—Over a hundred species and varieties noted, mostly figured; 14 n. sp., 1 n. var.
- Asano, Kiyosi. Japanese Fossil Nodosariidae, with Notes on the Frondiculariidae.—L. c., 1937, pp. 179-220 (1-42), pls. XXIV-XXXI (I-VIII).—Numerous species and varieties, many new, and a new genus, *Parafrondicularia*.
- Deussen, Alexander and Kenneth Dale Owen. Correlation of Surface and Subsurface Formations in Two Typical Sections of the Gulf Coast of Texas.—Bull. Amer. Assoc. Petr. Geol., vol. 23, No. 11, November, 1939, pp. 1603-1634, maps, and charts.—Mention foraminifera of various formations.
- Pratje, Otto. Sediments of South Atlantic Ocean.—L. c., November, 1939, pp. 1666-1672, 1 text fig.—Mentions foraminifera.
- Mohr, C. L. Subsurface Cross Section of Permian from Texas to Nebraska.—L. c., November, 1939, pp. 1694-1711, 3 text figs.—Lists a few foraminifera.
- Perez Farfante, Isabel. Nuevos Foraminíferos de Cuba.—Mem. Soc. Cubana Hist. Nat., vol. 13, No. 5, 1939, pp. 317-320, pl. 45.—Describes two new species and a new variety from the Gulf of Batabanó, Cuba: *Dentostomina bermudiana* Carman, var. *trilongidens*, n. var.; *D. aguayoi*, n. sp.; *D. bermudezi*, n. sp.
- Garrett, J. B. Some middle Tertiary smaller Foraminifera from subsurface beds of Jefferson County, Texas.—Journ. Pal., vol. 13, No. 6, November, 1939, pp. 575-579, pls. 65, 66.—The following species and varieties described as new: *Textularia mornhinvegi*, n. sp.; *Vulvulina ignava*, n. sp.; *Robulus chambersi*, n. sp.; *R. lucerta*, n. sp.; *Lenticulina jeffersonensis*, n. sp.; *Bifarina vicksburgensis* (Cushman), var. *monsouri*, n. var.; *Uvigerina howei*, n. sp.; *U. israelskyi*, n. sp.; *Siphogenerina fredsmithi*, n. sp.; *Discorbis gravelli*, n. sp.; *D. nomada*, n. sp.;

Gyroidina vicksburgensis (Cushman), var. *hannaï* Garrett; *Eponides allisorae*, n. sp.; *Cibicides jeffersonensis*, n. sp.; *C. moreyi*, n. sp.

Use of the name *Marginulina mexicana*.—L. c., November, 1939, p. 622.

Merchant, Frank E. and Raymond P. Keroher. Some fusulinids from the Missouri Series of Kansas.—L. c., November, 1939, pp. 594-614, pl. 69.—Several species of *Triticites* described and measured in detail, the following new: *T. tenuis*, n. sp.; *T. plicatulus*, n. sp.; *T. secalinus* (Say), var. *primarius*, n. var.

Caudri, Bramine. Lepidocyclusen von Java.—Verhandl. Geol. Mijn. Gen. Ned. Kol., Geol. ser., Deel XII, 1939, pp. 135-257, pls. I-X, text figs.—An exhaustive work on the group from this area; 27 species and varieties included, 4 new.

Van der Weijden, W. J. M. Het Genus *Discocyclina* in Europa. Een Monografie naar Aanleiding van een Heronderzoek van het Tertiair-profiel van Biarritz.—Leiden, Feb. 29, 1940, pp. 1-116, pls. I-XII, text figs. and charts.—Many species described and figured, one new: *Discocyclina augustae*, n. sp.

Cushman, Joseph A. Foraminifera, Their Classification and Economic Use. Third Edition, Revised and Enlarged, with an Illustrated Key to the Genera.—Harvard University Press, Cambridge, Mass., 1940, pp. i-viii, 1-535, 79 pls., text figs.—Nearly 500 genera are recognized, described, and illustrated; 60 pages of Bibliography. Fusulinidae by Dr. Carl O. Dunbar. Orbitoididae, Discocyclinidae and Miogypsinidae by Drs. T. Wayland Vaughan and W. Storrs Cole.

Vaughan, Thomas Wayland. Ecology of Modern Marine Organisms with Reference to Paleogeography.—Bull. Geol. Soc. Amer., vol. 51, March, 1940, pp. 433-468, 8 text figs.—Discusses various groups of foraminifera from their ecology.

Tappan, Helen. Foraminifera from the Grayson formation of Northern Texas.—Journ. Pal., vol. 14, No. 2, March, 1940, pp. 93-126, pls. 14-19.—Ninety species are described, with a new genus, 32 new species and a new variety as follows: *Lagenammina pyriformis*, n. sp.; *Reophax deckeri*, n. sp.; *R. minuta*, n. sp.; *Ammobaculites cuyleri*, n. sp.; *A. testacea*, n. sp.; *A. variabilis*, n. sp.; *Spiroplectammina ammovitrea*, n. sp.; *Gaudryina cushmani*, n. sp.; *Massilina planoconvexa*, n. sp.; *Placopsilina longa*, n. sp.; *Nodosaria bifurcata*, n. sp.; *N. chapmani*, n. sp.; *Pseudoglandulina scotti*, n. sp.; *Saracenaria cushmani*, n. sp.; *Lingulina lamellata*, n. sp.; *L. serrata*, n. sp.; *Vaginulina complanata* (Reuss), var. *perstriata*, n. var.; *Lagena leptata*, n. sp.; *L. striatifera*, n. sp.; *Paleopolymorphina ozawai*, n. sp.; *Pseudopolymorphina roanokensis*, n. sp.; *Pyrulina longa*, n. sp.; *Gümbelina washitensis*, n. sp.; *G. harrisi*, n. sp.; *Gümbelitrella*, n. gen.; *G. graysonensis*, n. sp.; *Bulimina nanmina*, n. sp.; *Neobulimina minima*, n. sp.; *Bifarina tenuilissa*, n. sp.; *Dentalinopsis subquadrata*, n. sp.; *Gyroidina loetterlei*, n. sp.; *Globigerina graysonensis*, n. sp.; *G. planispira*, n. sp.; *Schackoia primitiva*, n. sp.; *Anomalina plummerae*, n. sp.