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UPPER EOCENE FORAMINIFERA OF THE
SOUTHEASTERN UNITED STATES

BY
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CONTENTS

	Page		Page
Abstract.....	1	Heterohelicidae.....	33
Introduction.....	1	Buliminidae.....	34
Lituolidae.....	6	Ellipsoidinidae.....	42
Textulariidae.....	7	Rotaliidae.....	42
Verneulinidae.....	9	Cassidulinidae.....	49
Valvulinidae.....	10	Chilostomellidae.....	49
Miliolidae.....	11	Hantkeninidae.....	49
Ophthalmidiidae.....	15	Globorotaliidae.....	50
Lagenidae.....	15	Anomalinidae.....	50
Polymorphinidae.....	23	Planorbulinidae.....	54
Nonionidae.....	30	Rupertiidae.....	55
Camerinidae.....	32	Index.....	85

ILLUSTRATIONS

	Page		Page
PLATE 1. Lituolidae and Textulariidae.....	62	PLATE 13. Hantkeninidae and Buliminidae.....	74
2. Textulariidae, Verneulinidae, Valvulinidae, and Miliolidae.....	63	14-15. Buliminidae.....	75-76
3. Miliolidae.....	64	16. Buliminidae, Ellipsoidinidae, and Rotaliidae.....	77
4. Miliolidae, Ophthalmidiidae, and Lagenidae.....	65	17-19. Rotaliidae.....	78-80
5-8. Lagenidae.....	66-69	20. Rotaliidae, Cassidulinidae, and Chilostomel- lidae.....	81
9. Lagenidae and Polymorphinidae.....	70	21. Globorotaliidae and Anomalinidae.....	82
10. Polymorphinidae.....	71	22. Anomalinidae.....	83
11. Nonionidae.....	72	23. Anomalinidae, Planorbulinidae, and Ruper- tiidae.....	84
12. Nonionidae and Heterohelicidae.....	73		

INSERTS

	Page		Page
Distribution of Eocene Foraminifera in Florida.....	60	Distribution of Eocene Foraminifera in Alabama.....	60
Distribution of species of Foraminifera in Georgia.....	60		

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By JOSEPH A. CUSHMAN

ABSTRACT

This paper describes the Foraminifera (except the Orbitoidae) of upper Eocene (Jackson) age from the States between North Carolina and Texas. About 203 species or varieties, including 47 new species, are described, and most of them are figured. Faunas of both shallow and deep water facies are recognized. As a whole, the shallow-water faunas are more closely related to the Recent shallow-water faunas of the Indo-Pacific region than to the Recent West Indian faunas, but the deeper-water species are most closely related to the Recent species of the Gulf of Mexico and the West Indies. The Cooper marl of South Carolina contains many species not found in the Gulf States.

INTRODUCTION

The upper Eocene (Jackson formation) is represented in the Atlantic and Gulf Coastal Plain of the United States by a varying series of sediments. Some of these evidently represent very shallow water and conditions not unlike those which prevail today in the warm waters of southern Florida and the West Indies. Other sediments represent much deeper and somewhat cooler water. The fauna of the Jackson is therefore a varied one, as it covers a wide range of ecologic conditions. There is also a great range in the condition of preservation of the Foraminifera; many of those in the limestones are very difficult to determine, although they are in many places fairly common. On the other hand, numerous specimens from the finer clays, deposited in deeper water, are beautifully preserved in their minute details and are fully as satisfactory for study as living material.

There are very many undescribed species, and the Jackson as a whole has a fauna which is unlike most of those already described from the upper Eocene of other regions. As a whole the shallow-water faunas are most closely like the present-day faunas of shallow water in the Indo-Pacific, rather than the living West Indian fauna. The deeper-water group, however, is much more closely allied with forms still living in the present Gulf of Mexico and West Indian region. The shallow-water group has therefore migrated from this general region during the time interval since the Jackson, whereas the deeper-water representatives have remained.

The fauna of the Jackson includes many species which are identical with or very closely related to species in the Oligocene of the Gulf Coastal Plain.

Many of those which are not identical represent ancestral forms from which undoubtedly the Oligocene species were derived. There are, however, a great many species in the Jackson which apparently did not persist into the Oligocene. A few species are identical with or closely allied to species known from the Claiborne group.

Some of the larger Miliolidae, such as those from Jackson, Miss., seem to be closely allied to similar forms found in the Eocene of the Paris Basin. As a whole, however, this group is poorly preserved, although specimens are fairly common.

The fauna of the Jackson is economically important, as in the western portion of the area (Louisiana and Texas) it is often used in the correlation of sediments and in the determination of the age of surface outcrops and of well drillings. The Jackson is also brought up toward the surface about some of the coastal salt domes. For the general worker on the group it has been thought advantageous to describe and illustrate the fauna rather than to attempt any detailed discussion of vertical ranges of the particular species. With adequate definitions and illustrations it will be possible for the economic worker to plot for himself the vertical ranges in any particular area for which he has detailed information.

Some of the forms that are very common in the Jackson, such as *Hantkenina*, are widely distributed in the areas about the Gulf of Mexico and Caribbean regions and serve as excellent index fossils for this particular period.

The species of the Cooper marl of South Carolina show perhaps less definite correlation with some of the other formations of this region than the species occurring in formations that crop out along the Gulf Coastal Plain. Although many species are common to the two areas, the Cooper marl presents many species not found at all, so far as present collections show, in the Gulf Coastal Plain.

In the systematic descriptions the various genera and species are arranged according to the latest ideas in regard to the classification of the Foraminifera. This may make some difficulties in comparisons between this paper and those on the Oligocene Foraminifera (Professional Papers 129 and 133), but where the

species are identical the older name will be found in the synonymy in the present paper.

There are two groups of the so-called larger Foraminifera. A report on one group has already been published.¹ Descriptions of these species with additions will be found in their proper place in this paper, but the illustrations are not repeated. The other group, the Orbitoididae, includes several genera, especially *Lepidocyclina* and *Discocyclina*. As this group is now receiving a great deal of special attention, no attempt has been made to include members of this family in the present paper. Most of the species of this group occurring in the upper Eocene of the Coastal Plain region are described and illustrated in an earlier paper.²

Most of the species described in the present paper are illustrated on the accompanying plates. Plates 1 to 6 are reproduced from photographs, and the other plates from drawings by Miss Margaret S. Moore.

A list of the stations from which material has been studied, with the names of the collectors, is given below. The data in somewhat abbreviated form are also given under each species.

NORTH CAROLINA

Castle Hayne marl

5611. Wilmington, New Honover County.

8165. Erroneously assigned to Trent marl (lower Miocene). Label reads: "Trent fm. From marl pits 2 miles north from creek near Maple Cypress, Craven County, farm of J. H. Stokes. J. A. Cushman, 1918."

8171. At bridge across New River on road to Jacksonville, 4 miles from Richlands, Onslow County. J. A. Cushman, 1918.

SOUTH CAROLINA

Cooper marl

5531. Navy yard, Charleston. Sloan's locality 444. Earle Sloan.

6319. Ingleside marl pit, Ingleside, Berkeley County. T. W. Vaughan and Earle Sloan.

6321. Mill Creek, Baldock, Allendale County, formerly Barnwell County. T. W. Vaughan.

11857. Pit on US Highway 17, 1 mile south of Moncks Corner, Berkeley County. C. W. Cooke, 1928.

11861. Steep bluff on west side of Biggin Creek, three-fourths mile below the coastal highway, Berkeley County. C. W. Cooke, 1928.

11862. Dump heap from Charleston aqueduct tunnel, about 1 mile west of Givhans, Dorchester County. C. W. Cooke, 1928.

11863. At end of fill at west side of Santee Canal on US Highway 17, three-fourths mile west of old Biggin Church, Berkeley County. C. W. Cooke, 1928.

— Baldock. C. W. Cooke (C-48-16).

3595. Barnwell County.

— Ashley marl works, Dorchester County.

¹ Cushman, J. A., American species of *Operculina* and *Heterostegina* and their faunal relations: U.S. Geol. Survey Prof. Paper 128, pp. 125-146, 1921.

² Cushman, J. A., The American species of *Orthophragmina* and *Lepidocyclina*: U.S. Geol. Survey Prof. Paper 125, pp. 39-108, 1921.

GEORGIA

Ocala limestone

3387. Red Bluff, Flint River, 7 miles above Bainbridge, Decatur County. T. W. Vaughan.

3390. Below Plant System railroad wharf, Bainbridge, Decatur County. T. W. Vaughan, 1900.

3617. Just above railroad bridge on Muckafoonee Creek, near Albany, Dougherty County. T. W. Vaughan, 1902.

3626. Well $4\frac{1}{2}$ miles southwest of Philema, Lee County, 30 feet down. T. W. Vaughan, 1902.

3760. Georgia Southern & Florida Railway, half a mile south of Tivola, Houston County. S. W. McCallie, 1903.

3966. 2 miles south of Perry, Houston County. S. W. McCallie.

6110. Steamboat landing, Bainbridge, Decatur County.

6160. Flint River, 4 miles below Bainbridge, Decatur County. L. W. Stephenson.

6161. Flint River, Bainbridge, Decatur County. L. W. Stephenson.

6171. Flint River, Bainbridge, Decatur County. L. W. Stephenson.

7097. East bank of Flint River at bend three-fourths mile northeast of Atlantic Coast Line railroad station at Bainbridge. C. W. Cooke and W. C. Mansfield.

7098. Red Bluff, west bank of Flint River 7 miles above Bainbridge, Decatur County. C. W. Cooke.

7099. East bank of Flint River about half a mile above Red Bluff, Decatur County. C. W. Cooke.

7108. Flint River at Seaboard Air Line Railway bridge, Sumter County. C. W. Cooke and J. E. Brantly.

7115. East bank of Flint River at bend to west 6 miles below Burke Ferry and about 6 miles above Georgia Southwestern & Gulf Railway bridge near Warwick, Worth County.

7116. Flint River, Lee County, about $1\frac{3}{4}$ miles above Georgia Southwestern & Gulf Railway bridge, at base of bluff. C. W. Cooke.

7117. Flint River, Lee County, about $1\frac{3}{4}$ miles above Georgia Southwestern & Gulf Railway bridge, upper beds. C. W. Cooke.

7119. East bank of Flint River, Worth County, near Dougherty County line, about 16 miles above Albany. C. W. Cooke.

7120. West bank of Flint River half a mile below Georgia Northern Railway bridge at Albany, Dougherty County. C. W. Cooke.

7123. East bank of Flint River $9\frac{1}{2}$ miles below Albany, Dougherty County, $4\frac{1}{2}$ miles below Blue Spring. C. W. Cooke.

7126. Flint River, Mitchell County, at Dry Bread Shoals, $8\frac{1}{2}$ or 9 miles below Newton, Baker County, from dumps blasted from the channels. C. W. Cooke.

7127. A quarter of a mile below Norman's Ferry, Flint River, Mitchell County. C. W. Cooke and J. E. Brantly.

7130. East bank of Flint River $1\frac{1}{2}$ miles below Red Bluff, Decatur County. C. W. Cooke.

7189. Rich Hill, Crawford County. C. W. Cooke.

7235. East bank Flint River near northeast corner of Dougherty County. C. W. Cooke.

7237. Quarry half a mile east of Huguenen Ferry, Crisp County. C. W. Cooke and J. E. Brantly.

7689. Quarry on Perry-Fitzgerald road 1 mile south of Tivola, Houston County. C. W. Cooke.

7704. Chalk Hill, 3 miles west of Tartersville, Twiggs County. C. W. Cooke and H. K. Shearer.

7719. Old Spring Mill, Spring Mill Branch, 5 miles north of Millen, Jenkins County. C. W. Cooke and H. K. Shearer.

Barnwell formation

7755. Stevens pottery, Central of Georgia Railway, Baldwin County. C. W. Cooke.

FLORIDA

Probably all Ocala limestone

322. Newmansville, Alachua County. L. C. Johnson.
 329. Deep wells at Padlock, Suwannee County. L. C. Johnson.
 365. Johnsons Sink, Levy County. L. C. Johnson.
 380. Vicinity of Gainesville and Arredondo, Alachua County. L. C. Johnson.
 3174. Edgar kaolin works, Edgar, Putnam County, at depth of 130 feet.
 3629. Ocala limestone, Alachua County. T. W. Vaughan.
 3636. Spring Hill schoolhouse, 6 miles north of Alachua, Alachua County. T. W. Vaughan.
 3684. Pemberton Ferry (now Croom), Hernando County. Jos. Willcox (?).
 3685. Martin, Marion County. W. H. Dall.
 3686. Said to have come from Martin. Jos. Willcox (?).
 4965. Half a mile southwest of Fort White, Columbia County. G. C. Matson.
 4974. 6 miles southwest of Chipley, Washington County, near Duncan (near 1/48). G. C. Matson.
 5030. Ocala, Marion County. G. C. Matson.
 6754 (C-67-13). East bank of Choctawhatchee River at Alabama-Florida State line (Geneva County, Ala.-Holmes County, Fla.). C. W. Cooke.
 6768. Wagon bridge over Chipola River east of Marianna, lowest bed of Ocala limestone exposed. C. W. Cooke (supplementary collection by C. W. Cooke and Stuart Mossom).
 6799. Alachua Sink, near Gainesville, Alachua County. T. W. Vaughan and C. W. Cooke.
 6804. Ocala, Marion County, quarry 1, Florida Lime Co. C. W. Cooke.
 6805. Oakhurst quarry, 2 miles southeast of Ocala, Marion County, quarry 2, Florida Lime Co. C. W. Cooke.
 6807. Quarry at Zuber, 6½ miles north of Ocala, Marion County, quarry 3, Florida Lime Co. C. W. Cooke.
 6808. Quarry at Martin, on Atlantic Coast Line Railroad, 9 miles north of Ocala. C. W. Cooke and H. Gunter.
 6810. Cummer Lumber Co.'s pit 10, 1 mile northwest of Newberry, Alachua County. C. W. Cooke.
 6812. Cummer Lumber Co.'s pit 6, 1¼ miles south of Newberry, Alachua County. C. W. Cooke.
 6814. Quarry 1½ miles northwest of Newberry, Alachua County. C. W. Cooke.
 6815. Clark, on Atlantic Coast Line Railroad, 5 miles south of High Springs, Alachua County. C. W. Cooke.
 6817. Fort White, Columbia County. C. W. Cooke.
 6823. East bank of Suwannee River, Suwannee County, near Ellaville; no. 2 of section. C. W. Cooke.
 7191. Marianna, Jackson County, bed 3 of section at cavern. C. W. Cooke and W. C. Mansfield.
 7194. Marianna, bed 4 of section at cavern. C. W. Cooke and W. C. Mansfield.
 7337. Left bank of Suwannee River above bridge of Florida Railway, Suwannee County. C. W. Cooke.
 7338. Suwannee River at Dowling Springs, Suwannee County. C. W. Cooke.
 7341. Left bank of Suwannee River at Branford, Suwannee County. C. W. Cooke.
 7345. Suwannee River 2¼ miles above Branford, Suwannee County. C. W. Cooke.

7348. Suwannee River about 1½ miles above Troy Springs and 9 miles above Branford, Suwannee County. C. W. Cooke.

7349. Suwannee River about half a mile below Fort McComb, Suwannee County. C. W. Cooke.

7355. 3 miles northwest of Levyville, Levy County. C. W. Cooke.

7360. 3½ miles south of Floral City, Citrus County. C. W. Cooke.

7364. 1½ miles west of Croom, Hernando County. C. W. Cooke.

7365. Pineola, 5 miles south of Floral City, Citrus County. C. W. Cooke.

7366. Old French phosphate mine east of Anthony, Marion County. C. W. Cooke.

7367. Willow Sink, about 2 miles west of Chiefland, Levy County. C. W. Cooke.

7378. 1¼ miles southwest of Inverness, Citrus County. C. W. Cooke.

1/19. Near Blue Springs, Jackson County, 6 miles northwest of Marianna. C. W. Cooke and Julia Gardner.

1/48. Duncan, 7 miles southwest of Chipley, Washington County. C. W. Cooke and Julia Gardner.

ALABAMA

Ocala limestone

5567. Roadside up from Claiborne Ferry, Monroe County, bed 8. T. W. Vaughan.

6707. Oven Bluff, Tombigbee River, Clarke County. C. W. Cooke.

6719. Three-quarters of a mile north of Drewry, Monroe County, upper part of cut on Louisville & Nashville Railroad. C. W. Cooke.

6720. Three-quarters of a mile north of Drewry, Monroe County, lower part of cut on Louisville & Nashville Railroad. C. W. Cooke.

6722. Three-quarters of a mile northwest of Monroeville, Monroe County. C. W. Cooke.

6724. Road leading up from Claiborne Ferry, Monroe County, bed 5 of section, just above "*Scutella* bed." C. W. Cooke.

6725. Road leading up from Claiborne Ferry, Monroe County, bed 7 of section. C. W. Cooke.

6726. Road leading up from Claiborne Ferry, Monroe County, bed 8 of section. C. W. Cooke.

6727. Road leading up from Claiborne Ferry, Monroe County, bed 10 of section. C. W. Cooke.

6730. Roadside 2½ miles west of Monroeville, Monroe County, west of Double Branches. C. W. Cooke.

6738. Sepulga River 6½ miles northeast of Brooklyn, Conecuh County, on J. B. Robinson's land, sec. 13 (?), T. 4 N., R. 13 E., top of bed 3. C. W. Cooke.

6739. 4 miles northeast of Brooklyn, Conecuh County, mouth of Robinsons Mill Creek, bed 2, east branch of Sepulga River. C. W. Cooke.

6740. 4 miles northeast of Brooklyn, Conecuh County, mouth of Robinsons Mill Creek, bed 3. C. W. Cooke.

6741. East bank of Sepulga River 3½ miles northeast of Brooklyn, Conecuh County, bed 4. C. W. Cooke.

6742. Powell's Landing, Sepulga River, Covington County, sec. 35, T. 4 N., R. 13 E., beds 1 and 2. C. W. Cooke.

6746. East bank of Sepulga River opposite Ward's sawmill, sec. 8, T. 3 N., R. 13 E., Conecuh County, bed 2. C. W. Cooke.

6747. Steamboat Point, on west side of Sepulga River, Escambia County, near middle of sec. 20, T. 3 N., R. 13 E. C. W. Cooke.

6754. East bank of Choctawhatchee River at Alabama-Florida State line, Geneva County, Ala., and Holmes County, Fla. C. W. Cooke.

6755. West bank of Choctawhatchee River a quarter of a mile above Alabama-Florida State line. C. W. Cooke.

6756. Choctawhatchee River $3\frac{1}{2}$ miles below Geneva, Geneva County. C. W. Cooke.

7159. Near middle of E $\frac{1}{2}$ sec. 35, T. 8 N., R. 3 E., Clarke County, 4 miles southeast of Whatley, "Zeuglodon beds", No. 2 of section. C. W. Cooke.

7161. 5 miles southeast of Whatley, Clarke County, east of Jones Field Branch, sec. 35, T. 8 N., R. 3 E. C. W. Cooke.

1/7. 1 mile east of Beck, Covington County, NE $\frac{1}{4}$ sec. 6, T. 3 N., R. 15 E. C. W. Cooke and Julia Gardner.

1/8. Conecuh River at Beck, Covington County. C. W. Cooke and Julia Gardner.

1/21. SE $\frac{1}{4}$ sec. 22, T. 1 N., R. 18 E., Covington County. C. W. Cooke and Julia Gardner.

1/23. About 8 feet above "Scutella bed" on road to Claiborne Ferry, Monroe County. C. W. Cooke.

1/25. South bank of Conecuh River at sharp bend 1 mile east of Harts Bridge, SW $\frac{1}{4}$ sec. 28, T. 3 N., R. 14 E., Covington County. C. W. Cooke and Julia Gardner.

1/26. Bottom bed at Drewry, Monroe County. C. W. Cooke.

1/33. $7\frac{1}{2}$ miles northwest of Geneva, Geneva County, 1.2 miles north of Lytle. C. W. Cooke and Julia Gardner.

1/38. $3\frac{1}{4}$ miles north of Grove Hill, Clarke County. C. W. Cooke and Julia Gardner.

1/39. West bank of Pea River at Geneva, Geneva County, 100 yards above mouth of river. C. W. Cooke and Julia Gardner.

1/43. $1\frac{1}{2}$ miles southwest of Perdue Hill, Monroe County, sec. 7, T. 6 N., R. 6 E. C. W. Cooke and Julia Gardner.

Jackson formation

2637. "Zeuglodon beds", Jackson formation (middle zone), Dr. Brown's field, near Cocoa post office, Choctaw County (echinoderm horizon). Schuchert and Burns, 1894.

7203. About $3\frac{1}{2}$ miles southeast of Cullomburg, Washington County, bed 4. C. W. Cooke and W. C. Mansfield.

7220. Half a mile southeast of Melvin, Choctaw County, bed 3 (top of formation). C. W. Cooke.

7227. Keyzers Hill, a quarter of a mile west of Water Valley, Choctaw County, on road to Melvin. W. C. Mansfield.

MISSISSIPPI

Jackson formation

6457. Chickasawhay River, a quarter of a mile below Mobile & Ohio Railway bridge, $1\frac{1}{2}$ miles south of Shubuta, Wayne County. C. W. Cooke.

6463. Jackson, hill above pumping station. C. W. Cooke.

6646. Bluff on Chickasawhay River at Hays Chapel, Wayne County, a quarter to half a mile above railroad bridge, $1\frac{1}{2}$ miles south of Shubuta, near base of bluff. C. W. Cooke.

TEXAS

Jackson group

6143. Near Tordilla Mountain, Karnes County. A. Deussen.

6148. Bluff on Atascosa Creek near old Whitsett ranch house, Atascosa County. A. Deussen.

6217. $4\frac{1}{2}$ miles south of Smiley, Gonzales County. A. Deussen.

— Upper Eocene near Cheapside, Gonzales County.

— Haynes well 1, near Burkeville, Newton County.

— Stovall Creek east of Diboll, Angelina County. (Is this same as "upper Eocene of Texas from 4 miles east of Diboll, Angelina County"?)

— Tarkiln Creek, half a mile above Neches River, Trinity County.

— Three-quarters of a mile below Robinson's Ferry, Sabine River, Sabine County.

— Bridge Creek $1\frac{1}{2}$ miles above Angelina River, San Augustine County.

— Upper Eocene north of Whitsett, Live Oak County. (About same location as 6148 but on other side of county line.)

— Warren well 4, depth 4,250 feet, Texas Exploration Co., Hockley, Harris County.

— Upper Eocene of Ohio and Red River well 2, Tyler County, depth 330 feet.

— Same, depth 400 feet.

— Same, depth 537 feet.

— Same, depth 890 feet.

— Same, depth 1,056 feet.

— Same, depth 2,330 feet.

Since the completion of the manuscript for this paper several works have appeared with descriptions and figures of upper Eocene Foraminifera from the same general region. In order to give the reader the references so that descriptions and figures of these other species may be available, a list is here given of those species not included in the present paper. These species are noted below with references to publications containing the descriptions and to the State from which they have been described.

Angulogerina danvillensis Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 56, pl. 12, fig. 2, 1932. Upper Eocene, Louisiana.

Anomalina barrowi Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 7, p. 57, pl. 7, figs. 10a-c, 1931.

Upper Eocene, Texas.—Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 4, figs. 5a-c, 1933.

Anomalina danvillensis Howe and Wallace, op. cit., p. 76, pl. 14, figs. 2a, b. Upper Eocene, Louisiana.

Anomalina jacksonensis (Cushman and Applin) var. *umbosa* Cushman and Ellisor, op. cit., p. 58, pl. 7, figs. 11a-c. Upper Eocene, Texas.—Ellisor, op. cit., pl. 5, figs. 1a-c, 1933.

Bolivina danvillensis Howe and Wallace, op. cit., p. 56, pl. 11, figs. 8a, b. Upper Eocene, Louisiana.

Bolivina gracilis Cushman and Applin var. *danvillensis* Howe and Wallace, op. cit., p. 57, pl. 11, fig. 7. Upper Eocene, Louisiana.

Bolivina mexicana Cushman var. *horizontalis* Cushman. Howe and Wallace, op. cit., p. 58, pl. 11, fig. 10. Upper Eocene, Louisiana.

Bolivina ouachitaensis Howe and Wallace, op. cit., p. 59, pl. 11, figs. 9a, b. Upper Eocene, Louisiana.

Bulimina pyrula D'Orbigny. Howe and Wallace, op. cit., p. 60, pl. 11, fig. 6. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 3, fig. 2.

Buliminella basistriata Cushman and Jarvis var. *nuda* Howe and Wallace, op. cit., p. 60, pl. 11, fig. 4. Upper Eocene, Louisiana.

Buliminella elegantissima (D'Orbigny). Howe and Wallace, op. cit., p. 61, pl. 11, fig. 3. Upper Eocene, Louisiana.

Cancris danvillensis Howe and Wallace, op. cit., p. 67, pl. 13, figs. 4, 5. Upper Eocene, Louisiana.

- Cuspidulinoidea braziliensis* (Cushman). Howe and Wallace, op. cit., p. 72, pl. 10, figs. 6a, b. Upper Eocene, Louisiana.
- Chilostomella cylindroides* Reuss. Howe and Wallace, op. cit., p. 72, pl. 14, figs. 1a, b. Upper Eocene, Louisiana.
- Chilostomelloides oviformis* (Sherborn and Chapman). Howe and Wallace, op. cit., p. 73, pl. 15, fig. 5. Upper Eocene, Louisiana.
- Cibicides danvillensis* Howe and Wallace, op. cit., p. 77, pl. 14, figs. 5a-c. Upper Eocene, Louisiana.
- Cibicides ouachitaensis* Howe and Wallace, op. cit., p. 78, pl. 14, figs. 6a-c. Upper Eocene, Louisiana.
- Darbyella danvillensis* Howe and Wallace, op. cit., p. 24, pl. 4, figs. 1, 2. Upper Eocene, Louisiana.
- Dentalina communis* D'Orbigny. Howe and Wallace, op. cit., pl. 6, fig. 8. Upper Eocene, Louisiana.
- Dentalina communis* D'Orbigny var. *emaciata* Reuss. Howe and Wallace, op. cit., p. 25, pl. 7, fig. 7. Upper Eocene, Louisiana.
- Dentalina filiformis* (D'Orbigny). Howe and Wallace, op. cit., p. 25, pl. 6, figs. 2a, b. Upper Eocene, Louisiana.
- Dentalina mexicana* (Cushman) var. *danvillensis* Howe and Wallace, op. cit., p. 26, pl. 6, fig. 4. Upper Eocene, Louisiana.
- Dentalina* sp. *a* Howe and Wallace, op. cit., p. 26, pl. 6, fig. 1. Upper Eocene, Louisiana.
- Dentalina* sp. *b* Howe and Wallace, op. cit., p. 26, pl. 7, fig. 4. Upper Eocene, Louisiana.
- Dentalina* sp. *c* Howe and Wallace, op. cit., p. 27, pl. 6, fig. 3. Upper Eocene, Louisiana.
- Discorbis farishi* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 8, p. 43, pl. 6, figs. 6a-c, 1932. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 7, figs. 6a-c.
- Dimorphina danvillensis* Howe and Wallace, op. cit., p. 44, pl. 8, figs. 1a, b. Upper Eocene, Louisiana.
- Dyocibicides danvillensis* Howe and Wallace, op. cit., p. 78, pl. 15, figs. 1, 2. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 6, fig. 3.
- Ellipsonodosaria?* sp. Howe and Wallace, op. cit., p. 67, pl. 11, fig. 9. Upper Eocene, Louisiana.
- Elphidium eocenicum* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 7, p. 53, pl. 7, figs. 6a, b, 1931. Upper Eocene, Texas.—Ellisor, op. cit., pl. 2, figs. 13a, b.
- Elphidium* sp. Howe and Wallace, op. cit., p. 50, pl. 9, fig. 6. Upper Eocene, Louisiana.
- Epistomina elegans* (D'Orbigny). Howe and Wallace, op. cit., p. 68, pl. 13, fig. 2. Upper Eocene, Louisiana.
- Epontides ouachitaensis* Howe and Wallace, op. cit., p. 69, pl. 13, figs. 8a-c. Upper Eocene, Louisiana.
- Glandulina dimorpha* (Bornemann). Howe and Wallace, op. cit., p. 44, pl. 8, fig. 7. Upper Eocene, Louisiana.
- Glandulina laevigata* D'Orbigny. Howe and Wallace, op. cit., p. 45, pl. 8, figs. 5, 6. Upper Eocene, Louisiana.
- Globigerina bulloides* D'Orbigny. Howe and Wallace, op. cit., p. 73, pl. 10, fig. 10. Upper Eocene, Louisiana.
- Globigerina danvillensis* Howe and Wallace, op. cit., p. 74, pl. 10, figs. 9a, b. Upper Eocene, Louisiana.
- Globigerina ouachitaensis* Howe and Wallace, op. cit., p. 74, pl. 10, figs. 7a, b. Upper Eocene, Louisiana.
- Globigerina* sp. *a* Howe and Wallace, op. cit., p. 75, pl. 10, figs. 8a, b. Upper Eocene, Louisiana.
- Globigerina* sp. *b* Howe and Wallace, op. cit., p. 75, pl. 10, fig. 5. Upper Eocene, Louisiana.
- Globulina ampulla* (Jones). Howe and Wallace, op. cit., p. 45, pl. 8, fig. 9. Upper Eocene, Louisiana.
- Gümbelina* sp. Howe and Wallace, op. cit., p. 53, pl. 9, fig. 8. Upper Eocene, Louisiana.
- Guttulina austriaca* D'Orbigny. Howe and Wallace, op. cit., p. 47, pl. 8, fig. 3. Upper Eocene, Louisiana.
- Guttulina* sp. Howe and Wallace, op. cit., p. 49, pl. 7, fig. 6. Upper Eocene, Louisiana.
- Gyroldina danvillensis* Howe and Wallace, op. cit., p. 69, pl. 13, figs. 3a-c. Upper Eocene, Louisiana.
- Hantkenina brevispina* Cushman. Howe and Wallace, op. cit., p. 54, pl. 10, fig. 4. Upper Eocene, Louisiana.
- Hantkenina longispina* Cushman. Howe and Wallace, op. cit., p. 55, pl. 10, fig. 2. Upper Eocene, Louisiana.
- Hantkenina mccordi* Howe and Wallace, op. cit., p. 55, pl. 10, figs. 1a, b. Upper Eocene, Louisiana.
- Hopkinsina danvillensis* Howe and Wallace, op. cit., p. 62, pl. 12, figs. 1a-c. Upper Eocene, Louisiana.
- Lagena globosa* (Montagu). Howe and Wallace, op. cit., p. 27, pl. 6, figs. 15, 16. Upper Eocene, Louisiana.
- Lagena hispida* Reuss. Howe and Wallace, op. cit., p. 28, pl. 6, fig. 13. Upper Eocene, Louisiana.
- Lagena ouachitaensis* Howe and Wallace, op. cit., p. 29, pl. 6, fig. 9. Upper Eocene, Louisiana.
- Lagena pleniluna* Howe and Wallace, op. cit., p. 29, pl. 6, fig. 5. Upper Eocene, Louisiana.
- Lagena striata* (D'Orbigny) var. *strumosa* Reuss. Howe and Wallace, op. cit., p. 30, pl. 6, fig. 11. Upper Eocene, Louisiana.
- Lagena* sp. *a* Howe and Wallace, op. cit., p. 30, pl. 6, fig. 12. Upper Eocene, Louisiana.
- Lagena* sp. *b* Howe and Wallace, op. cit., p. 30, pl. 6, fig. 10. Upper Eocene, Louisiana.
- Lagena* sp. *c* Howe and Wallace, op. cit., p. 31, pl. 6, fig. 6. Upper Eocene, Louisiana.
- Lagena* sp. *d* Howe and Wallace, op. cit., p. 31, pl. 6, fig. 7. Upper Eocene, Louisiana.
- Lenticulina* sp. Howe and Wallace, op. cit., p. 32, pl. 7, figs. 2a, b. Upper Eocene, Louisiana.
- Marginalina triangularis* D'Orbigny var. *danvillensis* Howe and Wallace, op. cit., p. 34, pl. 5, figs. 6a, b. Upper Eocene, Louisiana.
- Marginalina* sp. *a* Howe and Wallace, op. cit., p. 34, pl. 7, fig. 3. Upper Eocene, Louisiana.
- Marginalina* sp. *b* Howe and Wallace, op. cit., p. 35, pl. 3, fig. 5. Upper Eocene, Louisiana.
- Marginalina?* sp. *c* Howe and Wallace, op. cit., p. 35, pl. 3, fig. 6. Upper Eocene, Louisiana.
- Massilina humblei* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 8, p. 40, pl. 6, figs. 1a-c, 1932. Upper Eocene, Texas.—Ellisor, op. cit., pl. 6, figs. 8a-c.
- Massilina pratti* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 7, p. 53, pl. 7, figs. 4a-c, 1931. Upper Eocene, Texas.—Howe and Wallace, op. cit., p. 21, pl. 2, fig. 5.—Ellisor, op. cit., pl. 1, figs. 10a-c.
- Nodosaria longiscata* D'Orbigny. Howe and Wallace, op. cit., p. 35, pl. 7, fig. 8. Upper Eocene, Louisiana.
- Nonion applini* Howe and Wallace, op. cit., p. 51, pl. 9, figs. 4a, b. Upper Eocene, Louisiana.
- Nonion danvillensis* Howe and Wallace, op. cit., p. 51, pl. 9, fig. 3. Upper Eocene, Louisiana.
- Nonion hantkeni* (Cushman and Applin) var. *fayettei* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 8, p. 41, pl. 6, figs. 3a, b, 1932. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 7, figs. 9a, b.
- Nonion laevis* (D'Orbigny) var. *marginatum* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 7, p. 52, pl. 7, figs. 5a, b, 1931. Upper Eocene, Texas.—Ellisor, op. cit., pl. 2, figs. 8a, b.
- Nonion scaphum* (Fichtel and Moll) var. *inflatum* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 8, p. 41, pl. 6, figs. 2a, b, 1932. Upper Eocene, Louisiana.—Ellisor, op. cit., No. 11, pl. 7, figs. 7a, b.

- Nonion* sp. Howe and Wallace, op. cit., p. 52, pl. 9, figs. 1a, b. Upper Eocene, Louisiana.
- Nonionella danvillensis* Howe and Wallace, op. cit., p. 52, pl. 9, figs. 5a-c. Upper Eocene, Louisiana.
- Nonionella turgida* (Williamson). Howe and Wallace, op. cit., p. 53, pl. 9, figs. 2a-c. Upper Eocene, Louisiana.
- Planularia catahoulaensis* Howe and Wallace, op. cit., p. 36, pl. 3, figs. 3, 4. Upper Eocene, Louisiana.
- Planularia danvillensis* Howe and Wallace, op. cit., p. 36, pl. 3, fig. 1. Upper Eocene, Louisiana.
- Planularia ouachitaensis* Howe and Wallace, op. cit., p. 37, pl. 3, fig. 7. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 6, fig. 9.
- Pulvinulinella danvillensis* Howe and Wallace, op. cit., p. 71, pl. 13, figs. 7a-c. Upper Eocene, Louisiana.
- Pyrgo inornata* (D'Orbigny) var. *danvillensis* Howe and Wallace, op. cit., p. 21, pl. 2, figs. 1a, b. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 7, fig. 13, 1933.
- Quinqueloculina danvillensis* Howe and Wallace, op. cit., p. 22, pl. 2, figs. 2a-c. Upper Eocene, Louisiana.
- Quinqueloculina seminula* (Linné): Howe and Wallace, op. cit., p. 22, pl. 2, fig. 3. Upper Eocene, Louisiana.
- Robulus clericii* (Fornasini). Howe and Wallace, op. cit., p. 38, pl. 15, fig. 3. Upper Eocene, Louisiana.
- Robulus cultratus* Montfort. Howe and Wallace, op. cit., p. 38, pl. 7, fig. 1. Upper Eocene, Louisiana.
- Robulus? danvillensis* Howe and Wallace, op. cit., p. 39, pl. 5, fig. 7. Upper Eocene, Louisiana.
- Robulus mayi* Cushman and Parker. Howe and Wallace, op. cit., p. 40, pl. 2, fig. 7. Upper Eocene, Louisiana.
- Saracenaria danvillensis* Howe and Wallace, op. cit., p. 41, pl. 4, figs. 3a-c. Upper Eocene, Louisiana.
- Saracenaria moresiana* Howe and Wallace, op. cit., p. 42, pl. 2, figs. 8a-c. Upper Eocene, Louisiana.
- Sigmomorphina semitecta* (Reuss). Howe and Wallace, op. cit., p. 50, pl. 8, figs. 4a-c. Upper Eocene, Louisiana.
- Siphonina carttoni* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 8, p. 42, pl. 6, figs. 5a-c, 1932. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 6, figs. 1a-c.
- Siphonina danvillensis* Howe and Wallace, op. cit., p. 70, pl. 13, figs. 1a, b. Upper Eocene, Louisiana.
- Textularia broussardi* Howe and Wallace, op. cit., p. 18, pl. 1, figs. 3a, b. Upper Eocene, Louisiana.
- Textularia danvillensis* Howe and Wallace, op. cit., p. 18, pl. 1, figs. 2, 4. Upper Eocene, Louisiana.
- Textularia mississippiensis* Cushman var. *rhomboidea* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 7, p. 51, pl. 7, figs. 1a, b, 1931. Upper Eocene, Texas.—Ellisor, op. cit., pl. 1, figs. 2a, b.
- Textularia ouachitaensis* Howe and Wallace, op. cit., p. 20, pl. 1, figs. 1a, b. Upper Eocene, Louisiana.
- Triloculina rotunda* D'Orbigny var. Howe and Wallace, op. cit., p. 23, pl. 2, figs. 4a, b. Upper Eocene, Louisiana.—Ellisor, op. cit., pl. 7, fig. 14, 1933.
- Trochammina teasi* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 7, p. 52, pl. 7, figs. 3a-c, 1931. Upper Eocene, Texas.—Ellisor, op. cit., pl. 1, figs. 9a-c.
- Tubulogenerina eocenica* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 8, p. 42, pl. 6, figs. 4a, b, 1932. Upper Eocene, Texas.—Ellisor, op. cit., pl. 6, figs. 4a, b.
- Uvigerina danvillensis* Howe and Wallace, op. cit., p. 62, pl. 12, fig. 5. Upper Eocene, Louisiana.
- Uvigerina farinosa* Hantken. Howe and Wallace, op. cit., p. 63, pl. 12, fig. 4. Upper Eocene, Louisiana.

- Valvulineria texana* Cushman and Ellisor, Contr. Cushman Lab. Foram. Research, vol. 7, p. 56, pl. 7, figs. 9a-c, 1931. Upper Eocene, Texas.—Howe and Wallace, op. cit., p. 70, pl. 13, figs. 6a, b.—Ellisor, op. cit., pl. 4, figs. 1a-c.
- Ventilabrella* sp. Howe and Wallace, op. cit., p. 54, pl. 9, fig. 7. Upper Eocene, Louisiana.
- Virgulina danvillensis* Howe and Wallace, op. cit., p. 65, pl. 11 figs 2a, b. Upper Eocene, Louisiana.

SYSTEMATIC DESCRIPTIONS

Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

Haplophragmoides dibollensis Cushman and Applin

Plate 1, figures 1a, b

- Haplophragmoides dibollensis* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 163, pl. 6, figs. 1a, b, 1926.

Test planispiral, much compressed, completely involute, slightly depressed at the umbilical region on both sides, periphery rounded, in the later portions subacute; chambers rather indistinct, 8 or 9 in the last-formed coil; sutures indistinct, not depressed; apertural face convex; wall arenaceous but smoothly finished. Diameter 0.60 mm.

Originally described from the upper Eocene of Ohio and Red River well 2, Tyler County, Tex., at a depth of 1,056 feet. This species has later been found in several other wells of Texas that reached the upper Eocene. It has not been noted in outcrop material from the eastern Gulf Coastal Plain.

Genus AMMOBACULITES Cushman, 1910

Ammobaculites hockleyensis Cushman and Applin

Plate 1, figures 2a, b

- Ammobaculites* cf. *A. foliaceus* Brady. Dumble, Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 443, 1924.
- Ammobaculites hockleyensis* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 163, pl. 6, figs. 2a, b, 1926.
- Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 7, fig. 11, 1933.

Test nearly twice as long as broad, very much compressed, involute, early portion close coiled, later 1 or 2 chambers tending to become uncoiled, periphery rounded; chambers rather indistinct; sutures indistinct; wall coarsely arenaceous, of angular black sand grains. Length 1.00 mm; breadth 0.65 mm; thickness 0.10 mm.

The type of this species came from a sample from Ohio and Red River well 2, Tyler County, Tex., at a depth of 400 feet. The species has occurred in several well sections from the Texas upper Eocene but is not recorded from the eastern Gulf Coastal Plain.

Family TEXTULARIIDAE

Genus TEXTULARIA DeFrance, 1824

Textularia mississippiensis Cushman

Plate 1, figures 3, 4

Textularia mississippiensis Cushman, U.S. Geol. Survey Prof. Paper 129, pp. 90, 125, pl. 14, fig. 4, 1922; Prof. Paper 133, p. 17, 1923.

Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 166, pl. 6, figs. 10, 11, 1926.

Cushman and Thomas, Jour. Paleontology, vol. 3, p. 177, pl. 23, figs. 1a, b, 1929.

Cushman, Contr. Cushman Lab. Foram. Research, vol. 5, p. 79, pl. 12, fig. 5, 1929.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 19, pl. 1, figs. 7a, b, 1932.

Test elongate, fairly broad, thickest in the middle, thence thinning toward the periphery, in end view biconvex, central portion curved; chambers low and broad, especially in the early stages, becoming somewhat higher in the adult; sutures covered by a coarsely arenaceous layer, meeting at the center and at the periphery, having the central portion of each chamber uncovered; periphery irregular, not definitely or regularly spinose, chamber walls smooth and finely perforate. Length 0.40–0.75 mm.

This species is known from the upper Eocene of Texas, where it is widely distributed in both outcrop and well samples, and is common in the Alazan of Mexico, with a few records from the region east of Texas.

Textularia mississippiensis, which is found in most of the formations of the Vicksburg group (Oligocene) of the Gulf Coastal Plain of the United States, occurs at a very few of the U.S.G.S. stations in the upper Eocene.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.; 6472, 6473, Yazoo City, Miss.; three-fourths mile below Robinson's Ferry, on Sabine River, Sabine County, Tex.; 4 miles east of Diboll, Angelina County, Tex.; Bridge Creek, 1½ miles above Angelina River, San Augustine County, Tex.

Textularia mississippiensis Cushman var. *alabamensis* Cushman

Plate 1, figures 5, 6

Textularia mississippiensis Cushman var. *alabamensis* Cushman, U.S. Geol. Survey Prof. Paper 133, p. 17, pl. 1, fig. 4, 1923.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 1, fig. 6, 1933.

Variety differing from the typical species in the more elongate form, somewhat thicker test, especially in the center, the less well-defined peripheral carina, and the sutures excavated instead of being covered by an arenaceous layer.

This variety is especially characteristic of the Marianna limestone of the Vicksburg group (Oligocene). It is very much more abundant than the typi-

cal form in the upper Eocene of the Coastal Plain of the United States.

Cooper marl: 6319, Ingleside, S.C.; 6321, Baldock, S.C.

Ocala limestone: 7108, Flint River at Seaboard Air Line Ry. bridge, Sumter County, Ga.; 7237, half a mile east of Huguenen Ferry, Crisp County, Ga.; 6805, Oakhurst quarry, Ocala, Fla.; 7194, Marianna, Fla.; 6706, Oven Bluff, Tombigbee River, Ala.; 6719, three-fourths mile north of Drewry, Ala.; 6722, three-fourths mile northwest of Monroeville, Ala.; 6724, 6725, 6726, Claiborne, Ala.; 6730, Double Branches Creek, Ala.; 6746, Ward's sawmill, Sepulga River, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/8, Beck, Ala.; 1/21, Covington County, Ala.; 1/26, Drewry, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 7227, Water Valley, Ala.; 6463, Jackson, Miss.

Textularia ocalana Cushman

Plate 1, figures 7a, b

Textularia ocalana Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 30, pl. 4, figs. 3a, b, 1926.

Test very much compressed, sides nearly flat, apical end bluntly pointed, apertural end broadly rounded, periphery even, subacute; chambers few, low, and broad, not inflated; sutures very slightly depressed, rather indistinct; wall finely arenaceous, smoothly finished. Maximum length 0.70 mm.

This peculiar-shaped species is very rare, occurring only in the typical Ocala limestone at a few stations. Its very broad form, with the sides very much compressed and but very slightly convex, distinguishes it from any other of the Vicksburg or Jackson species. It probably occurs at more stations, but the finer material of this phase of the Ocala is often not well preserved.

Ocala limestone: 6807, Zuber, Fla.; 6808, Martin, Fla.; 6812, 1¼ miles south of Newberry, Fla., the type locality.

Textularia recta Cushman

Plate 1, figures 8, 9

Textularia recta Cushman, U.S. Geol. Survey Prof. Paper 133, p. 17, pl. 1, fig. 2, 1923.

Test elongate, slightly compressed, early portion rapidly increasing in diameter, later portion in the adult with the sides parallel for a large part of the test; chambers numerous; sutures distinct; wall thick, covered with agglutinated calcareous grains but when worn showing a coarsely perforated undertest; apertural end obliquely truncate; aperture in a deep depression at the base of the last-formed chamber. Maximum length of specimens 1.25 mm.

Specimens similar to *Textularia recta*, which was described from the Red Bluff clay of the Vicksburg group, occur in the upper Eocene at the following U.S.G.S. stations:

Ocala limestone: 6725, 6726, Claiborne, Ala.; 6754, Choctawhatchee River at State line, Ala.-Fla.; 6756, Choctaw-

hatchee River 3½ miles below Geneva, Ala.; 1/8, Beck, Ala.; 1/39, Pea River at Geneva, Ala.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Textularia subhauerii Cushman

Plate 1, figure 10

Textularia subhauerii Cushman, U.S. Geol. Survey Prof. Paper 129, pp. 89, 126, pl. 14, figs. 2a, b, 1922; Prof. Paper 133, p. 16, 1923.

Test large, stout, elongate, early portion rapidly increasing in width with each newly added chamber, later adult portion with the sides nearly parallel, slightly lobulate; periphery rounded, but the median portion nearly flat; chambers 18 to 20, increasing in height as added, those of the later portion nearly as high as broad; sutures usually rather indistinct; wall coarsely arenaceous, aperture at the base of the inner margin of the chamber. Maximum length 2.00 mm.

Specimens very similar to this species, which was described from the Oligocene Byram marl, were found in the upper Eocene at the following U.S.G.S. stations:

Cooper marl: 6319, Ingleside, S.C.; 6321, Baldock, S.C.

Ocala limestone: 7108, Flint River at Seaboard Air Line Railway bridge, Sumter County, Ga.; 7189, Rich Hill, Ga.; 7704, 3 miles west of Taversville, Ga.; 6768, Marianna, Fla.; 6738, 6½ miles north of Brooklyn, Ala.; 6740, mouth of Robinsons Mill Creek, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.; 6754, Choctawhatchee River at State line, Ala.-Fla.; 1/7, 1 mile east of Beck, Ala.; 1/8, Beck, Ala.; 1/25, 1 mile east of Harts Bridge, Ala.; 1/48, Duncan, Fla.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.

Textularia adalta Cushman

Plate 1, figures 11, 12

Textularia adalta Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 29, pl. 4, figs. 2a, b, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 6, fig. 2, 1933.

Test elongate, slender, early portion tapering and compressed, adult portion thicker and with the sides nearly parallel, periphery subacute except in the last few chambers, which are rounded; chambers numerous, the last 5 or 6 making up half the test, earlier ones indistinct, low and broad, later ones more inflated, higher; sutures distinct, especially in the later portion, where they are somewhat depressed, usually oblique; wall finely arenaceous, only slightly roughened; aperture a high, arched opening in the central part of the base of the apertural face. Maximum length 2.00 mm.

Ocala limestone: 6741, 3½ miles northeast of Brooklyn, Ala., type and only locality (abundant).

Textularia dibollensis Cushman and Applin

Plate 1, figures 13-16

Textularia dibollensis Dumble (nomen nudum), Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 443, 1924.

Textularia dibollensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 165, pl. 6, figs. 12-14, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 1, fig. 4, 1933.

Test small, short, and broad, moderately compressed, margin subacute, initial end rounded; apertural end broadly truncate; chambers few, rather indistinct, rapidly increasing in breadth as added, becoming high in the adult, with the sides nearly parallel, the last four usually making up at least half of the test; sutures indistinct, not depressed, at right angles to the peripheral margin; wall finely arenaceous; aperture an arched opening, low and broad, at the inner margin of the last-formed chamber, the apertural face of the chamber evenly rounded. Maximum length 0.80 mm, usually much shorter; breadth 0.30 mm.

This is a well-characterized small species not easily confused with any other of the Coastal Plain Oligocene or upper Eocene species. It was originally described from the upper Eocene outcropping 4 miles east of Diboll, Angelina County, Tex. It is known from the upper Eocene of samples from several wells in the eastern part of the Gulf Coastal Plain of Texas.

Ocala limestone: 3629, Alachua County, Fla.; 6724, Claiborne, Ala.; 6754, Choctawhatchee River at State line, Ala.-Fla.; 6756, Choctawhatchee River 3½ miles below Geneva, Ala.; 1/8, Beck, Ala.; 1/39, Pea River at Geneva, Ala.

Textularia dibollensis Cushman and Applin var. *humblei* Cushman and Applin

Plate 1, figures 17a, b

Textularia dibollensis var. *humblei* Dumble (nomen nudum), Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 443, 1924.

Textularia dibollensis Cushman and Applin var. *humblei* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 165, pl. 6, fig. 9, 1926.

Variety differing from the typical in the larger size, more elongate form, more tapering, the greatest width being near the apertural end; the sutures much more distinct and depressed, and the periphery somewhat more acute. Length 1.60 mm; breadth 1.00 mm.

This variety was described from Haynes well 1, near Burkeville, Newton County, Tex., at a depth of 3,175 to 3,270 feet.

Textularia distortio Cushman and Applin

Plate 1, figures 18, 19

Textularia hockleyensis var. *distortio* Dumble (nomen nudum), Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 443, 1924.

Textularia distortio Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 164, pl. 6, figs. 7, 8, 1926.

Test irregular in shape, variously distorted, much compressed, thickest in the central portion, periphery thin but rounded; chambers numerous, low, and broad; sutures very distinctly excavated, especially toward the median portion of each chamber; wall arenaceous, somewhat roughened; aperture curved in end view, the aperture making a very strong crescent. Length 1.00 mm or slightly more.

This peculiar-formed species was described from samples from Ohio and Red River well 2, Tyler County, Tex., at a depth of 890 feet.

Textularia hockleyensis Cushman and Applin

Plate 1, figures 20, 21

Textularia hockleyensis Dumble (nomen nudum), Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 443, 1924.

Textularia hockleyensis Cushman and Applin. Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 164, pl. 6, figs. 3-6, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 1, fig. 7, 1933.

Textularia hockleyensis Cushman and Applin var.? Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 19, pl. 1, figs. 5a, b, 1932.

Test comparatively large, tapering, compressed, the central portion thickest, thence with a depressed area between the center and the periphery, periphery thin but rounded; chambers numerous, distinct; sutures distinct and toward the central portion often somewhat limbate, strongly curved, especially toward the periphery; wall arenaceous but smoothly finished, in end view rhomboid; the aperture much curved, low. Length up to 3.00 mm; breadth up to 1.25 mm.

Type specimens came from Bridge Creek, 1½ miles above Angelina River, San Augustine County, Tex. Outside of the Texas region the only specimens seen are those noted below.

Barnwell formation: 7755, Stevens Pottery, Ga.

There are probably several other species of *Textularia* in the upper Eocene of the Coastal Plain. In the Ocala limestone specimens are frequently found, but the nature of the friable material is such that the surface characters are not well preserved. If the same fauna can be found in a less friable and better-preserved condition, these species can be worked out in specific details.

Genus *VULVULINA* D'Orbigny, 1826

Vulvulina advena Cushman

Plate 2, figures 1a, b

Vulvulina advena Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 32, pl. 4, figs. 9a, b, 1926; vol. 8, p. 84, pl. 10, fig. 14, 1932.

Cole, Bull. Am. Paleontology, vol. 14, no. 53, p. 206 (6), pl. 1, fig. 24; pl. 3, fig. 17, 1928.

Test small, thin, much compressed, periphery acute but not keeled, early chambers alternating, later ones (as many as 5) uniserial; chambers rather high, gently sloping; sutures of the biserial portion flush with the surface, the whole early portion smooth, in the later portion the sutures slightly depressed; wall smoothly finished, each angle of the chambers with a short, spinose projection, even those of the uniserial portion; aperture elongate, terminal. Maximum length 1.25 mm.

This is a very distinct species, having a very white test, smooth and shining, the material being very fine in texture with much cement.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala., the type locality.

Ocala limestone: 1/43, 1½ miles southwest of Perdue Hill, Ala.

Family VERNEUILINIDAE

Genus *VERNEUILINA* D'Orbigny, 1840

Verneuilina propinqua H. B. Brady

Plate 2, figures 3a, b

Verneuilina propinqua H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 387, pl. 47, figs. 8-12 (not 13, 14), 1884.

Goës, K. svensk. vet. akad. Handl., vol. 25, no. 9, p. 33, pl. 7, figs. 264-266, 1895.

Flint, U.S. Nat. Mus. Rept. for 1897, p. 285, pl. 31, fig. 2, 1899.

Cushman, U.S. Nat. Mus. Bull. 104, pt. 3, p. 56, pl. 9, figs. 10, 11, 1922.

Test free, pyramidal, triserial, the apical end bluntly rounded; chambers well inflated but closely set; wall arenaceous, the surface nearly smooth; aperture elongate, at the base of the inner margin of the chamber. Length 1.20 mm; breadth 0.75 mm.

Cooper marl: 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

The one Cretaceous record for this species is unaccompanied by a figure, and the range is therefore given as from Eocene to Recent.

Genus *GAUDRYINA* D'Orbigny, 1839.

Gaudryina jacksonensis Cushman

Plate 2, figures 4-6

Gaudryina jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 33, pl. 5, figs. 1a, b, 1926.

Test large, elongate, irregularly triangular in section, the angles subacute, triserial portion short, biserial portion triangular, angles subacute, almost carinate; chambers distinct, very slightly inflated; sutures distinct, slightly depressed; wall composed of fine sand grains with a large amount of cement, surface smoothly finished; aperture semicircular, in a reentrant at the base of the apertural face of the last-formed chamber. Maximum length 2.00 mm.

This is a striking species of the deeper-water sediments of the upper Eocene. It is apparently the direct ancestral form of the recent species *G. atlantica* (Bailey), which is very abundant off the eastern coast of the United States.

It is a dominant species in the *Albatross* dredgings at depths ranging from 67 to 210 fathoms. The recent species has carried the development further in the loss of the angles in the last-formed chambers, the greater sharpness of the angles of earlier chambers, and the reduction of the early triserial stage. *G. atlantica* is also a larger species.

Gaudryina jacksonensis also occurs in the Alazan shale of Mexico.

Cooper marl: 6319, Ingleside, S.C., the type locality.

Ocala limestone: 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 7220, half a mile southeast of Melvin, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Gaudryina gardnerae Cushman

Plate 2, figures 7a, b

Gaudryina gardnerae Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 33, pl. 5, figs. 2a, b, 1926.

Test elongate, early portion triserial and forming a distinctly triangular test in section, the angles somewhat rounded, sides flattened or very slightly convex, later portion biserial, with straight, nearly parallel sides, somewhat polygonal in section; chambers rather indistinct, especially in the earlier portion, in the later portion more distinct and the sutures somewhat depressed; wall rather coarsely arenaceous; aperture rounded, deep, at the inner border of the last-formed chamber. Length 0.85 mm.

This resembles *G. triangularis* Cushman in some respects, and the Oligocene specimens referred to that species may belong here.

Ocala limestone: 6785, three-fourths mile south of Herlong, Fla.; 1/43, 1½ miles southwest of Perdue Hill, Ala., the type locality.

Gaudryina subquadrata Cushman

Plate 2, figures 8a-c

Gaudryina subquadrata Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 2, pl. 1, figs. 1a-c, 1933.

Test elongate, slender, the biserial portion compressed, concave at the broader faces, margins rounded, truncate, early triserial portion greatly reduced; chambers of the biserial portion distinct, 7 or 8 pairs; sutures strongly oblique, slightly depressed; wall arenaceous, exterior somewhat roughened; aperture at the base of the last-formed chamber at the inner edge, small. Length 1.00 mm; breadth 0.30 mm; thickness 0.20 mm.

Holotype (no. 371526, U.S.N.M.) from Cooper marl, station 11861, Berkeley County, S.C.

This is a very elongate, tapering species, the triserial portion being greatly reduced. The broader faces are very distinctly concave.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Genus PSEUDOCALVULINA Cushman, 1934

Pseudoclavulina sp.?

Plate 2, figures 10a, b

Clavulina nodosaria D'Orbigny var. *novangliae* Cushman, U.S. Nat. Mus. Bull. 104, pt. 3, p. 82, pl. 15, figs. 3-5, 1922.

Test elongate, slender, slightly tapering, the early triserial portion much reduced, three-sided, the angles rounded, later portion circular in transverse section, increasing in size as the chambers are added; chambers very few in the triserial portion, 5 to 8 in the uniserial portion, more or less indistinct except the last-formed ones, slightly inflated; sutures indistinct except near the apertural end, where they are depressed; wall arenaceous, slightly roughened; aperture single, circular, terminal, often with a slight neck; color light gray. Length of figured specimen 0.90 mm; diameter 0.30 mm.

The specimens seem to belong to *Pseudoclavulina* but are not numerous enough to warrant a specific name.

Cooper marl: 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Family VALVULINIDAE

Genus VALVULINA D'Orbigny, 1826

Valvulina ocalana Cushman

Plate 2, figures 11, 12

Valvulina ocalana Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 34, pl. 5, figs. 4 a, b, 1926.

Test elongate, early portion triangular in section, the chambers closely set, later and larger portion loosely coiled; chambers numerous, those of the early triserial portion indistinct, later portion with the chambers inflated and very distinct; sutures indistinct in the early portion, depressed and distinct in the later portion; wall arenaceous but smoothly finished when the specimens are well preserved; aperture rounded, in a deep reentrant of the apertural face, with an inward-projecting toothlike plate above the opening. Maximum length 1.50 mm.

Valvulina ocalana is a very characteristic species of the shallow-water phase of the upper Eocene of warm waters as developed in the Ocala limestone of Florida. Such deposits are not usually very well preserved as to their smaller fossils, but *V. ocalana* is a well-char-

acterized species, recognizable even when the preservation would make impossible the specific identification of many other species. It is related to such species as *Valvulina triangularis* D'Orbigny, of the Eocene of the Paris Basin.

Valvulina ocalana is the direct ancestral form of a species now very abundant in shallow, warm waters of coral-reef conditions in the general West Indian region, where it occurs in very shallow water of reefs of southern Florida, the Bahamas, Jamaica, etc. The Recent species *V. ovidoriana* D'Orbigny is a shorter, stouter form but with the same characteristic apertural features.

Ocala limestone: 3629, Alachua County, Fla.; 6790, Alachua, Fla.; 6805, Oakhurst quarry, Ocala, Fla., the type locality; 6807, Zuber, Fla.; 6808, Martin, Fla.; 7345, Suwannee River 2¼ miles above Branford, Fla.; 6823, Ellaville, Fla.; 7360, 3½ miles south of Floral City, Fla.; 7364, 1½ miles west of Croom, Fla.; 7366, Anthony, Fla.

Genus **TEXTULARIELLA** Cushman, 1927

Textulariella barrettii (Jones and Parker)

Plate 2, figures 2a, b

Textularia barrettii Jones and Parker, British Assoc. Rept. Newcastle meeting, pp. 50, 105, 1860; Soc. malacol. Belgique Annales, vol. 11, p. 99, woodcut, 1876.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 367, pl. 44, figs. 6-8, 1884.

Woodward, New York Micr. Soc. Jour., 1885, p. 149.

Flint, U.S. Nat. Mus. Rept. for 1897, p. 285, pl. 30, fig. 2, 1899.

Cushman, Carnegie Inst. Washington Pub. 291, p. 31, pl. 6, figs. 5-7, 1919; U.S. Nat. Mus. Bull. 104, pt. 3, p. 20, pl. 3, figs. 3-6, 1922.

Textulariella barrettii Cushman, Contr. Cushman Lab. Foram. Research, vol. 3, p. 24, pl. 5, fig. 3, 1927; Special Pub. 1, p. 115, pl. 11, figs. 6-8; pl. 13, fig. 3, 1928.

Textularia conica Goës (not D'Orbigny), Harvard Coll. Mus. Comp. Zoology Bull., vol. 29, p. 43, 1896.

Test tapering, about twice as long as broad, very slightly compressed, broadest near the apertural end, the apical end bluntly pointed, later portion of the test often with nearly straight sides; chambers distinct, numerous, labyrinthic; sutures very clearly marked, not depressed; wall finely arenaceous with an abundance of cement, very smoothly finished; aperture a narrow slit at the base of the inner margin of the last-formed chamber, the sides of the chamber slightly projecting beyond it on each side, sometimes subdivided into one or more openings. Length of figured specimen 0.75 mm; diameter 0.65 mm.

The figured specimen is evidently not an adult. The species is known from the Miocene of Jamaica and is a common one in the West Indian region and off the southeastern coast of the United States in 100 fathoms or more. It is interesting to see that this species has persisted in this region since the upper Eocene with but little change.

Cooper marl: 11861, steep bluff on west side of Biggen Creek, Berkeley County, S.C.

Genus **LIEBUSELLA** Cushman, 1933

Liebusella byramensis (Cushman) var. *turgida* (Cushman)

Plate 2, figure 9

Clavulina byramensis Cushman var. *turgida* Cushman, U.S. Geol. Survey Prof. Paper 133, p. 22, pl. 2, figs. 4, 5, 1923.

Test elongate, subcylindrical, early portion triserial, forming but a small portion of the test, later ones uniserial, both portions rounded in section; sutures usually indistinct or very slightly depressed; wall coarsely arenaceous but smoothly finished; aperture terminal, rounded, in well-preserved specimens with a slightly projecting, tapering neck. Maximum length 3.00 mm.

This variety becomes common in the lower portions of the Oligocene, occurring in the Glendon limestone, the typical Marianna limestone, and abundantly in the Red Bluff clay. It is somewhat larger and stouter than the typical form of the Byram marl. This form is related to *Liebusella cylindrica*, described from the Eocene of Europe by Hantken, and *L. coccinea* (Gümbel). *Liebusella byramensis* is probably the direct ancestor of *L. flintiana* Cushman, now living off the southeastern coast of the United States, the depths where it is common ranging from 68 to 210 fathoms.

Liebusella byramensis var. *turgida* is characteristic of the deeper-water deposits of the upper Eocene of the Coastal Plain of the United States:

Cooper marl: 6319, Ingleside, S.C.

Ocala limestone: 7194, Marianna, Fla.; 1/21, Covington County, Ala.; 1/26, Drewry, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Family **MILIOLIDAE**

Genus **QUINQUELOCULINA** D'Orbigny, 1826

Quinqueloculina laevigata D'Orbigny

Plate 2, figures 13-15

Quinqueloculina laevigata D'Orbigny, Annales sci. nat., vol. 7, p. 301, no. 6, 1826; in Barker-Webb and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, Foraminifères, p. 143, pl. 3, figs. 31-33, 1839.

Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 173, pl. 18 (26), figs. 14, 15, 1882.

Test nearly twice as long as broad, slightly compressed, periphery rounded; chambers distinct, somewhat inflated, of nearly uniform diameter, the ends only slightly extended, apertural end slightly exserted; sutures distinct, slightly depressed; wall smooth; aperture nearly circular, terminal, with a simple tooth but usually without a lip. Length 0.35 mm; breadth 0.20 mm; thickness 0.12 mm.

Jackson formation: 6463, Jackson, Miss.

Quinqueloculina longirostra D'Orbigny

Plate 2, figures 16a-c

Quinqueloculina longirostra D'Orbigny, Annales sci. nat., vol. 7, p. 303, no. 46, 1826; Foraminifères fossiles du bassin tertiaire de Vienne, p. 291, pl. 18, figs. 25-27, 1846.

Test nearly twice as long as broad, compressed, periphery subacute; chambers distinct, not inflated, gradually compressed to the subacute, almost keeled periphery, sides on the inner part convex, thence becoming slightly concave toward the periphery, each extending well beyond the previous ones at both ends, apertural end exserted so that the aperture is terminal; sutures distinct, slightly depressed; wall smooth; aperture circular, terminal, with a slight lip and a small, simple tooth. Length 0.90 mm; breadth 0.45 mm; thickness 0.25 mm.

Jackson formation: 6463, Jackson, Miss.

Quinqueloculina anguina Terquem

Plate 2, figures 18, 19

Quinqueloculina anguina Terquem, Soc. géol. France Mém., sér. 3, vol. 1, p. 78, pl. 9 (14), figs. 20a-c, 1878; vol. 2, p. 180, pl. 19 (27), figs. 20a-c, 1882.

Test about 2½ times as long as broad, compressed, periphery broadly rounded; chambers distinct, inflated, at the base somewhat enlarged and extending well beyond the previous chamber, at the apertural end narrowed and extended into a short cylindrical neck; sutures distinct, much depressed; wall smooth; aperture circular, terminal with a distinct lip and a small, narrow, simple tooth. Length 0.35 mm; breadth 0.15 mm; thickness 0.08 mm.

Our specimens agree very closely with specimens from the Eocene of the Paris Basin.

Jackson formation: 6463, Jackson, Miss.

Quinqueloculina hauerina D'Orbigny?

Plate 2, figures 17a-c

There are some specimens of a small quinqueloculine form which resemble somewhat the species described by D'Orbigny from the Miocene of the Vienna Basin. They are figured here for reference until larger series of well-preserved specimens are available for study.

Jackson formation: 6463, Jackson, Miss.

Quinqueloculina sp.?

Plate 4, figures 5, 6

Quinqueloculina sp.? Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 184, pl. 10, figs. 20, 21, 1926.

Although not enough material is available for specific determination, these specimens from the upper

Eocene of Stovall Creek east of Diboll, Angelina County, Tex., are figured, that the record of this form may be available.

Quinqueloculina sp.?

Plate 4, figures 7, 8

Quinqueloculina sp.? Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 184, pl. 10, figs. 22, 23, 1926.

This species seems to be distinct from the preceding, especially in its apertural characters, the aperture being much smaller and the test itself comparatively broader. Without more material, it seems unwise to give this a specific name.

The specimens came from Stovall Creek east of Diboll, Angelina County, Tex.

Quinqueloculina sp.?

Plate 4, figures 9, 10

Quinqueloculina sp.? Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 184, pl. 10, fig. 24, 1926.

The peculiar form here figured occurs with the two preceding species on Stovall Creek east of Diboll, Angelina County, Tex. Much more material is needed before a specific determination can be made.

Genus MILIOLA Lamarck, 1801

By elimination of other species placed by Lamarck under this genus, the type of *Miliola* becomes *Miliola saxorum* Lamarck. The original figures given by Lamarck are crude and leave much to the imagination as to the exact character of the type. The model of D'Orbigny, no. 33, made in 1826, gives a very clear idea of what was probably Lamarck's species. It is the large common species of the Calcaire grossier of the Paris Basin. The aperture is cribrate, and this generic name *Miliola* may therefore be used for *M. saxorum* and its allies without disturbing the later *Quinqueloculina* of D'Orbigny.

Miliola saxorum Lamarck

Plate 3, figures 1-3

Miliola (Miliolites) saxorum Lamarck, Annales du Muséum, vol. 5, p. 352, no. 5, 1804; vol. 9, pl. 17, figs. 2a, b, 1807. Defrance, Dictionnaire des sciences naturelles, vol. 31, p. 69, 1824; Atlas de conchyliologie, pl. 15, fig. 1. *Quinqueloculina saxorum* D'Orbigny, Annales sci. nat., vol. 7, p. 301, no. 1, pl. 16, figs. 10-14, 1826.

Test large, elongate, fusiform, quinqueloculine; chambers very numerous, distinct, the periphery flattened; sutures distinct; wall nearly smooth, marked by very numerous small circular pits arranged in oblique rows across the chambers; aperture at the end of a

very short neck, cribrate, made up of a large number of pores. Length 2.50 mm; diameter 0.60 mm.

In the Paris Basin Eocene there are at least two large species with very different types of ornamentation, as in the Jackson. As no indication is given in the original figures or description as to the surface except that it is not indicated and therefore probably not prominent, this form may be taken as the typical.

Terquem⁵ figures a specimen with the punctae arranged in longitudinal lines. In the largest specimens from the Paris Basin the ornamentation is similar to that in the American specimens, very fine punctae arranged nearly at right angles to the axis of the chamber. In both localities specimens with longitudinal lines of punctae are found similar to Terquem's figures.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Miliola jacksonensis Cushman

Plate 3, figures 4-6

Miliola jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 2, pl. 1, figs. 2, 3, 1933.

Test elongate, elliptical or fusiform, large, quinqueloculine; chambers numerous, distinct, the periphery angled; sutures distinct; wall ornamented with numerous oblique longitudinal costae with a single row, occasionally a double one, of coarse round pits between each two costae; aperture at the end of a very short neck cribrate in the adult, in the young with a large number of fine teeth projecting in from the edge. Length 2.00 mm; diameter 0.55 mm.

Holotype (no. 371527, U.S.N.M.) from Jackson formation, Jackson, Miss.

The species occurs in some numbers at Jackson, Miss., in the upper Eocene. It differs from *M. saxorum* in the shape of the chambers and the character of the ornamentation. In some respects it resembles the *Quinqueloculina parisiensis* of D'Orbigny, as figured by Terquem, but Fornasini's tracings of D'Orbigny's original plates show only the longitudinal costae with no sign of punctae.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

?Ocala limestone: 6725, Claiborne, Ala.

The specimens from Claiborne are internal casts of large size which may be this species.

Genus **MASSILINA** Schlumberger, 1893

Massilina decorata Cushman

Plate 3, figures 14-16

Massilina decorata Cushman, U.S. Geol. Survey Prof. Paper 129, p. 143, pl. 34, fig. 7, 1922; Prof. Paper 133, p. 55, 1923.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 20, pl. 2, fig. 6, 1932.

⁵ Soc. géol. France Mém., sér. 3, vol. 2, pl. 19, figs. 22a, b, 1882.

Test much flattened, elliptical or oval, slightly longer than broad, basal and apertural ends projecting, the apertural end narrowing to a small cylindrical neck, nearly in the longitudinal axis of the test; sutures rather indistinct; surface dull white; periphery rounded, the wall ornamented by very fine pits, giving a finely granular, matte appearance to the test. Maximum length 1.00 mm.

This species was described from the lower members of the Oligocene, being especially abundant in the Red Bluff clay. It occurs in considerable numbers in the upper part of the Jackson.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Massilina cookei Cushman, n. sp.

Plate 3, figure 17

Test in the early stages quinqueloculine, later with the chambers in one plane and much compressed; periphery acute and slightly carinate; chambers of the early portion less flattened, those of the adult very much flattened, widest near the inner margin, which stands above the remainder of the surface; ends projecting, especially the apertural end, which has a short cylindrical neck; surface very finely costate; nearly parallel with the curvature of the chamber but more distinct and somewhat obliquely twisted toward the apertural end. Length 1.00 mm; breadth 0.55 mm.

Holotype (no. 371528, U.S.N.M.) from upper Eocene, Jackson, Miss.

Jackson formation: 6463, Jackson, Miss. (fairly common).

Massilina jacksonensis Cushman

Plate 3, figures 7-10

Massilina jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 2, pl. 1, fig. 4, 1933.

Test broadly oval or elliptical, much compressed, periphery subacute, apertural end slightly projecting; early chambers quinqueloculine, later ones in a single plane and *Spiroloculina*-like; sutures distinct, slightly depressed; wall beautifully ornamented by a series of punctae, nearly circular, arranged in longitudinal curved rows parallel to the sutures and also in somewhat definite curved diagonal lines across the chamber; apertural end with a short neck but without a distinct lip. Length 1.40 mm; breadth 1.00 mm; thickness 0.20 mm.

Holotype (no. 371529, U.S.N.M.) from Jackson formation, station 6463, Jackson, Miss., where it is common.

The early stages are occasionally found represented by young individuals and strongly resemble *Quinqueloculina*. They remotely resemble some of the forms referred by authors to *Q. prisca* D'Orbigny, but they are sharply angled, and the numerous specimens show

that they are only the young stages of the larger *Massilina*.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

***Massilina jacksonensis* Cushman var. *punctatocostata*
Cushman**

Plate 3, figures 11-13

Massilina jacksonensis Cushman var. *punctatocostata* Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 3, pl. 1, figs. 5, 6, 1933.

Variety differing from the typical form in the ornamentation of the wall of the test, which has a series of longitudinal curved costae between the rows of punctae, those near the periphery more strongly developed than those nearer the inner portion of the chamber; the neck is more strongly developed than in the typical.

Holotype (no. 371530, U.S.N.M.) from upper Eocene at Jackson, Miss., where it occurs somewhat more abundantly than the typical form.

Jackson formation: 6463, Jackson, Miss.

***Massilina* sp.?**

Plate 4, figures 11-13

Massilina sp.? Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 185, pl. 10, figs. 25-27, 1926.

This is a fairly large species with the periphery of the chambers keeled in the adult. The apertural end has a definite projecting cylindrical neck and distinct lip.

These specimens came from a depth of 400 feet in Ohio and Red River well 2, Tyler County, Tex.

Genus SPIROLOCULINA D'Orbigny, 1826

***Spiroloculina grateloupi* D'Orbigny**

Plate 3, figures 18-21

Spiroloculina grateloupi D'Orbigny, Annales sci. nat., vol. 7, p. 298, 1826.

Terquem, Soc. géol. France Mém., sér. 3, vol. 1, p. 52, pl. 5, figs. 5, 6, 1878; vol. 2, p. 155, pl. 16, figs. 6a, b, 1882.

Weisner, Archiv Protistenkunde, vol. 25, p. 203, 1912.

Cushman, U.S. Nat. Mus. Bull. 71, pt. 6, p. 31, pl. 4, figs. 4, 5, 1917; U.S. Geol. Survey Prof. Paper 129, p. 101, pl. 25, fig. 2, 1922; Prof. Paper 133, p. 50, 1923.

Spiroloculina excavata H. B. Brady (not D'Orbigny), Challenger Rept., Zoology, vol. 9, p. 151, pl. 9, figs. 5, 6, 1884.

Test with the length greater than the breadth, the periphery flattened or convex, the angles somewhat carinate, flat faces of the test much excavated; wall smooth, matte; apertural end produced with a cylindrical neck. Specimens not exceeding 0.75 mm.

All the specimens of both the Vicksburg and the Jackson are smaller than Recent specimens referred to this species. In most other respects they are similar. Terquem figures specimens from the upper Eocene of the Paris Basin that are similar to some of the specimens from the Jackson.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.; 6457, 1½ miles south of Shubuta, Miss.

***Spiroloculina* sp.?**

Plate 4, figures 1a-c

There are some very small specimens, one of which is here figured, which belong to this genus. Owing to their scarcity and rather poor state of preservation, it has seemed unwise to give them a specific name.

Jackson formation: 6463, Jackson, Miss.

Genus ARTICULINA D'Orbigny, 1826

***Articulina terquemi* Cushman**

Plate 4, figures 2, 3

Articulina terquemi Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 3, pl. 1, figs. 7a-c, 1933.

Test small, somewhat larger than broad, compressed; periphery broadly rounded; chambers indistinct except the last two, nearly involute, inflated, ornamented by numerous rounded longitudinal costae, in general parallel to the periphery, often somewhat uneven, apertural end with a distinct lip; sutures indistinct; wall matte; aperture circular, with a very distinct, slightly flaring lip without a definite tooth. Length 0.25 mm; breadth 0.13 mm; thickness 0.07 mm.

Holotype (no. 371531, U.S.N.M.) from Jackson formation, Miss.

This species somewhat resembles one of the figures given by Terquem⁶ as *Articulina gibbosula* D'Orbigny, from the Eocene of the Paris Basin. It is not the same as D'Orbigny's species of the Miocene of the Vienna Basin, and Terquem's figure 25 is much more like D'Orbigny's species. On the same plate, figure 24, referred by Terquem to *Articulina nitida* D'Orbigny, is somewhat similar but not identical with our form. A figure given by Sowerby⁷ as "*Triloculina striata* Brown" also somewhat resembles our specimens, but the costae are not the same, and the species is probably a *Massilina*. Our species is somewhat similar to *Articulina byramensis* Cushman, but that species has a very distinctive shape as well as a very different ornamentation.

Jackson formation: 6463, Jackson, Miss.

⁶ Soc. géol. France Mém., sér. 3, vol. 2, pl. 15 (23), fig. 26, 1882.
⁷ Sowerby, G.B., Foraminifera from the Colne tidal river, pl. figs. 5, 6, 1856.

Genus *TRILOCULINA* D'Orbigny, 1826*Triloculina* sp.?

Plate 4, figures 4a-c

The figured form is evidently a *Triloculina*, but a large enough series for specific determination is not available. The chambers are highly angled, and the aperture is circular and terminal, with a distinctly bifid tooth.

Jackson formation: 6463, Jackson, Miss.

Family OPTHALMIDIIDAE

Genus *CORNUSPIRA* Schultze, 1854*Cornuspira olygogyra* Hantken

Plate 4, figure 14

Cornuspira olygogyra Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 16, pl. 1, fig. 10, 1875 (1876); K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 20, pl. 1, fig. 10, 1875 (1881).

Liebus, Geol. Reichsanstalt, Jahrb., vol. 56, p. 360, 1906.

Test close-coiled, much compressed, sides flattened, periphery truncate; chamber rectangular in section, in end view the apertural end higher than broad, the sides in the last-formed chamber very slightly concave, sutural line distinct and the basal edge of the chamber slightly thickened; wall smooth, glossy. Diameter 0.60 mm.

There is but a single microspheric specimen in the collection from the Jackson formation at Jackson, Miss., but this is very typical in the shape of the test, the slightly concave sides, and the raised ridge at the base of the chamber as in Hantken's figure. His specimen was evidently megalospheric. Our specimen is probably not a full-grown one. Hantken's record is from the *Clavulina szaboi* beds of Hungary, and that of Liebus from the upper Eocene of Biarritz.

Jackson formation: 6463, Jackson, Miss.

Family LAGENIDAE

Genus *ROBULUS* Montfort, 1808*Robulus gutticostatus* (Gümbel)

Plate 5, figures 1, 2

Robulina gutticostata Gümbel, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 643, pl. 1, fig. 74, 1868 (1870). Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 48, pl. 6, fig. 10, 1875 (1876); K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 57, pl. 6, fig. 10, 1875 (1881).

Test close-coiled, periphery acute, keeled, compressed; chambers distinct but not inflated, 9 to 11 chambers in the last-formed coil in the adult; sutures distinct, ornamented, limbate, a raised costa on the exterior broken into a row of rounded, beadlike protuberances, especially toward the umbilicus, the beads

increasing in size, with the largest nearest the umbilicus; sutures very slightly curved; wall between the sutures smooth; aperture peripheral, radiate, slightly projecting. Diameter up to 1.50 mm.

The type figure of Gümbel shows but 7 chambers in the last-formed whorl; Hantken's figure shows 8. Most of the American specimens have 9, or 1 or 2 more in adult specimens. Gümbel's types are from the Eocene of Bavaria, and Hantken's from the upper Eocene of Hungary.

Ocala limestone: 7159, 4 miles southeast of Whatley, Ala.; 1/26, Drewry, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/48, Duncan, Fla.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Robulus gutticostatus (Gümbel) var. *cocoaensis* (Cushman)

Plate 5, figures 3, 4

Cristellaria gutticostata (Gümbel) var. *cocoaensis* Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 67, pl. 10, fig. 11, 1925.

Variety with usually a larger number of chambers in each whorl than in the typical form; sutures with very distinct beading, the beads growing larger toward the inner end of the sutures, and the umbonal region occupied by a series of large bosses, last-formed suture in adults often unornamented and slightly depressed.

Jackson formation: 2637, Cocoa, Ala., type station (fairly abundant); also in the Jackson of well samples in Louisiana.

Robulus gutticostatus (Gümbel) var. *yazooensis* Cushman

Plate 5, figure 5

Robulus gutticostatus (Gümbel) var. *yazooensis* Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 4, pl. 1, fig. 8, 1933.

Variety differing from the typical form in having a very few beads on the proximal end of the chambers, the distal portion unornamented and depressed, in the adult with the last few sutures entirely without ornamentation and depressed throughout, the keel wanting, and the periphery of each chamber nearly straight, each slightly projecting beyond its immediate predecessor at the angle. Diameter 0.75 mm.

Holotype (no. 371532, U.S.N.M.) from Jackson formation at station 7220, half a mile southeast of Melvin, Ala.

Robulus alato-limbatus (Gümbel)

Plate 6, figures 2a, b

Robulina alato-limbata Gümbel, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 641, pl. 2, figs. 70a, b, 1868 (1870).

Robulus alato-limbata (Gümbel) Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 37, pl. 3, figs. 2a, b, 1932.

Cristellaria alato-limbata (Gümbel) Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 171, pl. 8, fig. 8, 1926.

Test close-coiled, last-formed coil composed of few chambers, usually 7 in number, the central region with a large umbo not greatly projecting above the general surface but distinct, periphery with a narrow keel; chambers distinct, not inflated; sutures distinct, not depressed, strongly curved; aperture radiate; wall smooth. Diameter 0.65 mm.

This species is already recorded from the upper Eocene of Texas from Ohio and Red River well 2, at a depth of 400 feet, Tyler County. Gümbel described the species from the upper Eocene of central Europe.

Cooper marl: 5531, Cooper River, S.C.

Ocala limestone: 1/38, 3¼ miles north of Grove Hill, Ala.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.

***Robulus articulatus* (Reuss) var. *texanus* (Cushman and Applin)**

Plate 4, figures 16, 17

Cristellaria articulata Reuss var. *texana* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 170, pl. 8, figs. 1, 2, 1926.

Robulus articulatus (Reuss) var. *texanus* Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 3, 1933.

Lenticulina articulata (Reuss) var. *texana* Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 31, pl. 5, figs. 1, 2, 1932.

This variety is of large size, in the young with the chambers close-coiled, but in the adult with the central portion becoming visible, owing to the shortening of the chambers, which fail to cover the preceding whorl entirely, periphery with a distinct, rounded keel, in the adult with as many as 10 to 12 chambers. Diameter 1.60 mm or less.

This variety is related to the typical form, as it occurs in the Tertiary of Europe. "Type specimens of the variety are from Warren well 4, 4,250 feet, Texas Exploration Co., Hockley, Harris County, Tex." Jackson formation.

Cooper marl: 5531, Cooper River, Charleston, S.C.; 6319, Ingleside, S.C.

***Robulus limbosus* (Reuss)**

Plate 6, figure 5

Robulina limbosa Reuss, Akad. Wiss. Wien Sitzungsber., vol. 48, pt. 1, p. 55, pl. 6, figs. 69a, b, 1863 (1864).

Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 48, pl. 6, fig. 11, 1875 (1876); K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 57, pl. 6, fig. 11, 1875 (1881).

Robulus limbosus Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, figs. 1a, b, 1933.

Test close-coiled, umbonate, periphery with a broad, very thin, platelike transparent keel; chambers distinct, 9 or 10 in the last-formed coil; sutures distinct, curved, slightly limbate, of clear material, ending at

the umbo in a transparent mass of clear shell material; wall smooth; apertural face slightly concave, aperture on the peripheral angle, radiate. Maximum diameter 1.50 mm.

The Coastal Plain specimens are very close indeed to the figures of *R. limbosus*, especially that of Hantken.

Ocala limestone: 1/38, 3¼ miles north of Grove Hill, Ala.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6473, Yazoo City, Miss.

***Robulus limbosus* (Reuss) var. *hockleyensis* (Cushman and Applin)**

Plate 4, figures 15a, b; plate 6, figures 3a, b

Cristellaria limbosa (Reuss) var. *hockleyensis* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 171, pl. 8, figs. 3, 4, 1926.

Robulus limbosus (Reuss) var. *hockleyensis* Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 1, figs. 11a, b, 1933.

Test differing from the typical form in the fewer chambers and the broader form in apertural view, the keel perhaps not so broad and thin, and the central umbo not so strongly developed. Diameter 0.75 mm.

Type specimens from Bridge Creek, 1½ miles above Angelina River, San Augustine County, Tex.

This is evidently related to *Robulus limbosus*, which is known from the upper Eocene of central Europe.

Specimens probably the same as the Texas variety occur in the upper Eocene of the Coastal Plain at numerous stations. The material is not always well preserved, and accurate identification is difficult.

Castle Hayne marl: 5611, Wilmington, N.C.

Cooper marl: Ashley marl works, Dorchester County, S.C.; 6319, Ingleside, S.C.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.

***Robulus propinquus* (Hantken)**

Plate 6, figures 1a, b

Cristellaria propinqua Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 45, pl. 5, fig. 4, 1875 (1876); K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 52, pl. 5, fig. 4, 1876 (1881).

Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 172, pl. 8, fig. 9, 1926.

Robulus propinquus Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 7, figs. 12a, b, 1933.

Test with the early portion close-coiled, later tending to become uncoiled, the periphery subacute, later chambers increasing in width; chambers few, 6 or 7 in the last-formed coil, distinct but not inflated; sutures distinct, curved, not depressed; wall smooth; apertural face somewhat tapering toward the aperture, which is radiate and slightly projecting. Diameter 0.60 mm.

The only upper Eocene specimens from the Coastal Plain region are from the Ohio and Red River well 2, Tyler County, Tex., at a depth of 1,056 feet.

These specimens are very similar to those figured and described by Hantken from the upper Eocene of central Europe.

***Robulus arcuato-striatus* (Hantken) var. *carolinianus* Cushman**

Plate 6, figures 6a, b

Robulus arcuato-striatus (Hantken) var. *carolinianus* Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 4, pl. 1, figs. 9a, b, 1933.

Test close-coiled throughout, strongly umbonate, periphery keeled with a fairly wide thin carina; chambers very distinct, 8 or 9 in the last-formed coil, of uniform shape and increasing very slightly in size as added; sutures distinct, strongly limbate, slightly raised, very strongly curved, ending in the middle in a clear umbo; wall smooth except for the slightly raised sutures; aperture slightly protruding, at the peripheral angle, radiate, apertural face slightly concave, the sides thickened. Diameter 1.30 mm.

Holotype of variety (no. 371548, U.S.N.M.) from Ocala limestone, station 1/38, 3¼ miles north of Grove Hill, Ala.

Cooper marl: 6319, Ingleside, S.C.; 5531, Cooper River, S.C. Ocala limestone: 1/21, Covington County, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.

Genus **LENTICULINA** Lamarck, 1804

***Lenticulina convergens* (Bornemann)**

Plate 6, figures 4a, b

Cristellaria convergens Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 327, pl. 13, figs. 16, 17, 1855.

Test compressed, ovate, close-coiled, thickest in the umbonal region but without a distinct umbo; chambers fairly distinct, the later ones increasing somewhat in height; sutures fairly distinct, not depressed; apertural face strongly convex, aperture at the peripheral angle, radiate, slightly produced. Diameter 1.00 mm.

Bornemann originally described this species from the Oligocene of central Europe, and many fossil and Recent specimens have been assigned to this name.

This species has been recorded as far back as the Triassic, but the earlier records lack further confirmation.

Ocala limestone: 7097, Bainbridge, Ga.; 7719, Spring Mill Branch, Jenkins County, Ga.

Genus **SARACENARIA** Defrance, 1824

***Saracenaria arcuata* (D'Orbigny) var. *hantkeni* Cushman**

Plate 5, figures 6, 7

Cristellaria arcuata Hantken (not D'Orbigny), Magy. kir. földt. int. Évkönyve, vol. 4, p. 45, pl. 5, figs. 5a-c, 6, 1875 (1876); K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 53, pl. 5, figs. 5a-c, 6, 1875 (1881).

Saracenaria arcuata (D'Orbigny) var. *hantkeni* Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 4, pl. 1, figs. 11, 12, 1933.

Test longer than broad, periphery subacute, apertural face truncate, test triangular in transverse section, early portion somewhat close-coiled in the first few chambers, soon becoming uncoiled; chambers comparatively few, usually only 7 or 8, distinct but not inflated, angles subacute, almost keeled in the last-formed chambers; sutures distinct, very slightly if at all depressed; wall smooth and polished; aperture peripheral, radiate, slightly projecting. Maximum length 1.30 mm; breadth of final chamber 0.50 mm.

Holotype of variety (no. 371533, U.S.N.M.) from Cooper marl, station 6319, Ingleside, S.C.

This is very similar to if not identical with the variety figured by Hantken from the Eocene of Hungary and referred to *Cristellaria arcuata* D'Orbigny. It is usually much more acute than the Oligocene species of the Vienna Basin, and the apertural face is much more flattened. The Eocene variety is also straighter, the uncoiled portion being much less strongly curved on both faces, but especially in the inner concave margin.

Cooper marl: 5531, Cooper River, S.C.; 6319, Ingleside, S.C.; 11861, Steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Genus **PLANULARIA** Defrance, 1824

***Planularia truncana* (Gümbel)**

Plate 6, figures 7a, b

Cristellaria truncana Gümbel, K. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 639, pl. 1, figs. 68a, b, 1868 (1870).

Test much compressed, periphery slightly keeled; the earliest chambers thicker than the others, forming a distinct umbo; chambers numerous, early ones short, making a close-coiled test, later ones increasing rapidly in length but not actually uncoiling, the inner margin extending back to the previous coil; sutures distinct, somewhat limbate; wall smooth; aperture at the peripheral angle. Maximum length 1.50 mm.

The specimens from the upper Eocene of the Coastal Plain are apparently identical with that described by Gümbel from the upper Eocene of the Bavarian Alps.

Castle Hayne marl: 5611, Wilmington, N.C.

Cooper marl: Baldock, S.C.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.; 6768, Marianna, Fla.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles south-east of Cullomburg, Ala.

Planularia cooperensis Cushman

Plate 6, figures 8a, b

Planularia cooperensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 5, pl. 1, figs. 10 a, b, 1933.

Test large, strongly compressed, periphery rounded, not keeled, 15 or more chambers in the final coil, of nearly uniform shape, increasing gradually in size as added; sutures fairly distinct, very slightly limbate, slightly curved, later ones very slightly depressed, earlier ones flush with the surface; wall smooth, matte. Length 4.00 mm; breadth 3.00 mm; thickness 0.60 mm.

Holotype (no. 371534, U.S.N.M.) from Cooper marl, station 11863, highway 17, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.

This is a fine large species of the general form usually assigned to *Cristellaria cassis* (Fichtel and Moll), which is, however, a very different species. The Eocene species has no keel, and the wall is entirely smooth.

Cooper marl: 11861, Steep Bluff, on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.

Genus MARGINULINA D'Orbigny, 1826***Marginulina karreriana* Cushman, n. sp.**

Plate 7, figures 1, 2

Marginulina abbreviata Karrer (not Neugeboren, 1851), Akad. Wiss. Wien Sitzungsber., vol. 44, pt. 1, p. 445, pl. 1, fig. 7, 1861 (1862).

Test elongate, somewhat compressed, periphery rounded, earliest chambers coiled, later ones uncoiled but with the sutures oblique, last-formed chambers much inflated; sutures of the earlier portion very slightly if at all depressed, later ones distinctly depressed; wall smooth; aperture at the dorsal margin radiate, somewhat produced. Length 0.90 mm; breadth 0.45 mm; thickness 0.20 mm.

Holotype (no. 371535, U.S.N.M.) from Cooper marl, station 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Specimens from the Cooper marl are like the figures given by Karrer, but these are not the same as the early species of Neugeboren under the same name.

Cooper marl: 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

***Marginulina subrecta* Franke**

Plate 7, figures 3a, b

Marginulina subrecta Franke, Danmarks geol. Undersøgelse, 2. Raekke, Nr. 46, p. 19, pl. 1, fig. 28, 1927.

Test elongate, subcylindrical, not compressed, circular in transverse section, earliest chambers showing

traces of coiling, later ones in a rectilinear series, slightly inflated; sutures distinct, later ones slightly compressed; wall smooth; aperture in the adult becoming terminal, central, slightly exserted, radiate. Length 0.90 mm; diameter 0.35 mm.

Cooper marl: 11861, Steep bluff on west side of Biggin Creek, Berkeley County, S.C.

***Marginulina jacksonensis* (Cushman and Applin)**

Plate 7, figures 5a, b

Cristellaria jacksonensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 172, pl. 8, fig. 10, 1926.

Test much elongate, the greatest width being at the base, where there are a few close-coiled chambers, later portion consisting of 3 to 5 uniserial chambers, much inflated, especially toward the apertural end, early portion with the periphery acute, consisting of 4 or 5 chambers in the coil, the later uncoiled chamber progressively increasing in thickness so that the last-formed chamber is often circular in transverse section; sutures distinct, those of the later portion depressed; wall smooth; aperture radiate, terminal. Maximum length nearly 1.00 mm; breadth at the base 0.20 mm.

Type specimens were obtained from the Jackson group in Ohio and Red River well 2, Tyler County, Tex., at a depth of 1,056 feet. It occurs also in the Alazan clays of Mexico.

***Marginulina cocoaensis* Cushman**

Plate 7, figures 6, 7

Marginulina cocoaensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 67, pl. 10, figs. 9, 10, 1925.
Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 33, pl. 7, fig. 5, 1932.
Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 6, fig. 6, 1933.

Test elongate, compressed, initial end composed of a few partly coiled chambers much compressed, later and major portion composed of more rounded chambers, 6 to 10 in number in adult specimens; sutures fairly distinct, of clear shell material; ornamentation consisting of 9 or 11 lamellate costae running from the initial end to the base of the last-formed chamber in adults, the last chamber being usually smooth in completely developed specimens, two of the costae forming keels on the compressed portion of the test; aperture at the peripheral side of the apertural face, radiate, at the end of a distinct projection. Maximum length 1.60 mm; breadth 0.25 mm.

Marginulina cocoaensis is a very well characterized species with its strongly lamellate costae, compressed early portion, the smooth last chamber, and the peculiar apertural characters.

Jackson formation: 2637, Cocoa, Ala., type locality; 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Cooper marl: 6321, Baldock, S.C.

Ocala limestone: 7345, Suwannee River, 2¼ miles above Branford, Fla.; 7719, Spring Mill Branch, Jenkins County, Ga.; 1/38, 3¼ miles north of Grove Hill, Ala.

Marginulina cooperi Cushman

Plate 7, figures 4a, b

Marginulina cooperi Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 5, pl. 1, fig. 13, 1933.

Test of medium size, the earlier chambers close-coiled, later ones becoming uncoiled, periphery broadly rounded, without a keel but with 2 or 3 short, stout spines at the curve of the test, 1 to a chamber; chambers distinct, about 6 in a volution in the earlier part, not inflated, entirely involute, in the later uncoiled part with more inflated chambers; sutures very distinct, not depressed, slightly limbate; aperture peripheral throughout, rather large, radiate. Length 1.50 mm.

Holotype (no. 371536, U.S.N.M.) from Cooper marl, Cooper River, S.C.

This is a very distinct species in the American Eocene. It perhaps most closely resembles *M. hauerina* (D'Orbigny) and *M. alazanensis* (Cushman) but is distinct in many of its characters.

Cooper marl: 5531, Cooper River, Charleston County, S.C.

Marginulina fragaria (Gümbel) var. *texasensis* (Cushman and Applin)

Plate 7, figures 8-10

Cristellaria fragaria Gümbel var. *texasensis* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 171, pl. 8, figs. 5-7, 1926.

Lenticulina fragaria (Gümbel) var. *texasensis* Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 32, pl. 5, figs. 3-5, 1932.

Marginulina fragaria (Gümbel) var. *texasensis* Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 4, 1933.

Test differing from the typical form in the more elongate character of the test, the more coarsely beaded ornamentation, and the more deeply excavated sutures, the periphery often decidedly lobulate. Maximum length 1.25 mm; breadth 0.50 mm; thickness 0.25 mm.

A specimen from the Jackson formation at Cocoa, Ala., station 2637, is very close to if not identical with the Texas variety. The type specimens are from Haynes well 1, near Burkeville, Newton County, Tex., at a depth of 3,175 to 3,270 feet.

Marginulina cooperensis Cushman

Plate 7, figures 11, 12

Marginulina cooperensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 8, pl. 1, figs. 14, 15, 1933.

Test elongate, tapering, the early portion much compressed, later portion circular in transverse section; chambers distinct, earlier ones forming part of a coil; last 3 or 4 subglobular; sutures somewhat hidden by the ornamentation, which is composed of longitudinal costae, numerous, about 15 to 18 on the visible half of the last chamber, becoming somewhat produced at the proximal margin of each chamber; aperture terminal with a definite cylindrical neck and thickened lip. Length 1.40 mm; maximum breadth 0.35 mm.

Holotype (no. 371537, U.S.N.M.) from station 5531, Cooper marl, Cooper River, Charleston County, S.C.

This has not been noted at any of the other stations from which material was examined.

Genus *DENTALINA* D'Orbigny, 1826

Dentalina cocoaensis (Cushman)

Plate 8, figures 1, 2

Nodosaria sp. Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 170, pl. 7, fig. 17, 1926.

Nodosaria cocoaensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 66, pl. 10, figs. 5, 6, 1925; Jour. Paleontology, vol. 1, p. 153, pl. 24, fig. 1, 1927.

Dentalina cocoaensis Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 5, 1933.

Test elongate, very slender, slightly curved, gradually tapering from the acute or spinose initial end, early portions with the sides straight, toward the apertural end with the chambers slightly inflated; chambers in the adult 11 to 14, in the very early portion only slightly longer than broad, becoming as much as 2½ to 3 times as long as broad in the last-formed ones; sutures very distinct, of clear shell material but not depressed; wall very smooth, slightly glossy in well-preserved specimens, apertural end produced. Maximum length, 2.25 mm; maximum breadth, 0.20 mm.

This species is allied to *Nodosaria filiformis* D'Orbigny and other species. It is very close to Hantken's figure of *Dentalina consobrina* D'Orbigny, from the Eocene of the *Clavulina szaboi* beds of Hungary, but the early portion is different. It is close to the Recent material figured by Flint from off the coast of the United States under the name *Nodosaria filiformis* D'Orbigny. The initial end is ornamented by a single stout, short spine, the sutures are of clear shell material and broad, only the later chambers show any swelling, and the form is very constant. The best-preserved specimens have 12, 13, or 14 chambers, and the number is very constant. The species occurs in the upper Eocene of Texas, in the Ohio and Red River well 2, Tyler County, at a depth of 537 feet, and in the Alazan clays of Mexico.

Jackson formation: 2637, Cocoa, Ala., the type locality; 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Cooper marl: 5531, Cooper River, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.

Ocala limestone: 7159, 4 miles southeast of Whatley, Ala.; 7719, Spring Mill Branch, Jenkins County, Ga.; 1/8, Beck, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Dentalina cooperensis Cushman

Plate 8, figures 3, 4

Dentalina cooperensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 8, pl. 1, fig. 17, 1933.

Test elongate, slightly compressed, very slightly tapering, gently curved, periphery only slightly sinuate, apical end pointed or with a single small spine; chambers few, usually about 10 in the adult specimen, often indistinct; sutures fairly distinct, oblique; wall smooth, matte; aperture at the periphery of the chamber slightly projecting. Length 2.00–2.50 mm; breadth 0.30 mm.

Holotype (no. 371538, U.S.N.M.) from Cooper marl, Cooper River, Charleston County, S.C.

This species is allied to some of the forms referred to *Nodosaria communis* D'Orbigny, but in the upper Eocene of the Coastal Plain it seems to be distinct. The margins are nearly entire, only slightly sinuous; occasionally, near the apertural end, the sutures are distinctly oblique, and the number of chambers is usually not more than 10.

Cooper marl: 5531, Cooper River, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Ocala limestone: 6768, Marianna, Fla.; 7159, 4 miles southeast of Whatley, Ala.; 7719, Spring Mill Branch, Jenkins County, Ga.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.

Dentalina hantkeni Cushman

Plate 8, figures 5, 6

Dentalina hantkeni Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 9, pl. 1, figs. 18, 19, 1933.

Dentalina budensis Hantken, Magy. kir. földt. Évkönyve, vol. 4, p. 28, pl. 3, fig. 12, 1875 (1876). [Not *Nodosaria budensis* Hantken.]

Test elongate, arcuate, somewhat compressed, composed of a few chambers, initial end rounded; chambers distinct, increasing in length as added, outer curve sinuate, inner curve nearly uniform; sutures fairly distinct, somewhat oblique; aperture near the inner curve with a slightly produced neck. Length 1.25 mm; greatest diameter 0.15 mm.

Holotype (no. 371539, U.S.N.M.) from Ocala limestone, station 6741, 3½ miles northeast of Brooklyn, Ala.

Hantken's figure and description of *Dentalina budensis* are identical with this species from the upper Eocene. Hantken's specimens were from the Eocene of Hungary.

Ocala limestone: 6740, mouth of Robinsons Mill Creek, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.

Dentalina jacksonensis (Cushman and Applin)

Plate 8, figures 7–9

Nodosaria jacksonensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 170, pl. 7, figs. 14–16, 1926.

Cushman, Jour. Paleontology, vol. 1, p. 153, pl. 24, fig. 3, 1927.

Cole, Bull. Am. Paleontology, vol. 14, no. 53, p. 203, pl. 3, fig. 12, 1928.

Test elongate, tapering, gently curved, initial end rounded, ornamented with one to several spines, sides lobulate throughout, more strongly so in later growth; chambers subglobular, fairly numerous, usually 10 in well-developed specimens, inflated, length and breadth about equal except the last 1 or 2 in the adult, which are slightly longer than broad; sutures distinct, somewhat depressed, of clear shell material, surface smooth, glossy to dull; aperture with a cylindrical neck, the aperture itself not well preserved. Maximum length 2.50 mm; maximum breadth 0.35 mm.

In its character of a broadly rounded initial end, with occasionally a group of spines, and in the apertural neck, this species resembles *Nodosaria abyssorum* H. B. Brady. The Eocene species has more chambers, is more slender, and is always curved. Specimens are very constant in their characters. There is some resemblance to *N. insecta* Schwager, but our species is curved, much more tapering, and has more chambers. The types were from the upper Eocene of Texas, from Haynes well 1, Newton County. The species is also common in the Alazan clays of Mexico.

Cooper marl: 5531, Cooper River, S.C.; 6321, Baldock, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.; 1/38, 3½ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Dentalina halkyardi Cushman

Plate 8, figure 10

Dentalina halkyardi Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 9, pl. 1, fig. 20, 1933.

Nodosaria (Dentalina) spinulosa Halkyard (not Montagu), Manchester Lit. Philos. Soc. Mem. and Proc., vol. 62, p. 79, 1919.

Test elongate, tapering, initial end rounded, composed of a few chambers, 7 in the type specimen, globular, the earlier ones more overlapping than the later ones; sutures distinct and depressed; wall ornamented in the earliest chambers by longitudinal costae, about 7 or 8 visible on each side of the chambers, the proximal end of each costa somewhat projecting, in

the next-formed chambers the costae are broken into short bits, which become spinose at the proximal end, and in the last-formed chambers the ornamentation consists of a series of fine, almost hispid spines in longitudinal lines; apertural end with a cylindrical neck with a thickened lip, the neck with annular corrugations and the outer border with a series of teeth. Length 1.40 mm or more; breadth of last-formed chamber 0.30–0.40 mm.

From the description given by Halkyard in the reference above, this is the same as his material from the upper Eocene Blue marl of Côte des Basques, Biarritz. His description is as follows: "The earlier chambers of the shells are invariably ornamented with longitudinal costae, which later are interrupted or broken up into short lengths, and later still into spines or prickles pointing backward. The prickles first make their appearance on the basal portion of each segment."

Cooper marl: 5531, Cooper River, S.C.; 6319, Ingleside, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.

Dentalina cf. *D. adolphina* D'Orbigny

Plate 8, figures 11, 12

There are a very few incomplete specimens from the Cooper marl, station 11857, pit on U.S. Highway 17, about 1 mile south of Moncks Corner, Berkeley County, S.C., which may be referred to this species. Figures of two of these specimens are given.

Dentalina cf. *D. vertebralis* (Batsch)

Plate 8, figures 13, 14

Specimens similar to the figures given here are common in the Cooper marl of South Carolina. They are in some respects close to the species described and figured by Batsch. A more slender form is also figured here. It is very rare but occurs with the other form. It has less pronounced chambers.

Cooper marl: 11861, Steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.

Dentalina sp.?

Plate 8, figures 15, 16

In the Cooper marl of South Carolina there is a large species which may be referred to *Dentalina*. The initial end has a short terminal spine, and the chambers are well separated and rounded. Although fragments occur at several stations, there are no complete specimens to give the full adult characters of the species.

Cooper marl: 11861, Steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west

of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus *NODOSARIA* Lamarck, 1812

Nodosaria latejugata Gümbel

Nodosaria latejugata Gümbel, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 619, pl. 1, fig. 32, 1868 (1870).

Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 21, pl. 2, figs. 6a–d, 1875 (1876).

Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 66, pl. 10, fig. 7, 1925.

Nodosaria budensis Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 23, pl. 2, fig. 10; pl. 16, fig. 4, 1875 (1876).

Test elongate, subcylindrical, initial end with a single spine; chambers distinct, slightly inflated; sutures distinct, of clear shell material, slightly depressed; surface ornamented with a few very prominent longitudinal costae, averaging about 10, continuous from initial to apertural ends, except occasionally the final chamber smooth; apertural end slightly prolonged; aperture radiate. Maximum length of American specimens 8.00 mm; breadth 0.50 mm.

Gümbel originally described this species from the upper Eocene of Bavaria, and Hantken figures it from the upper Eocene of Hungary. Our upper Eocene specimens are very similar, except that the microspheric form occurs as well. The species belongs to the general *Nodosaria raphanus* group, which occurs as many species from the Cretaceous to the present seas. A very large species belonging to this group is now living in the Philippine region. *Nodosaria bacilloides* Hantken is probably the same species.

Castle Hayne marl: 5611, Wilmington, N.C.

Cooper marl: 5531, Cooper River, S.C.; 6319, Ingleside, S.C.

Ocala limestone: 7097, Bainbridge, Ga.; 7719, Spring Mill Branch, Jenkins County, Ga.; 6768, Marianna, Fla.; 7378, 1¼ miles southwest of Inverness, Fla.; 6722, three-fourths mile northwest of Monroeville, Ala.; 1/7, 1 mile east of Beck, Ala.; 1/21, Covington County, Ala.; 1/26, Drewry, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.; 7159, 4 miles southeast of Whatley, Ala.

Jackson formation: 2637, Cocoa, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 7203, 3½ miles southeast of Cullomburg, Ala.

The only Cretaceous record for this species probably should be assigned to *Nodosaria affinis* Reuss.

Nodosaria latejugata Gümbel var. *carolinensis* Cushman

Plate 5, figures 10–13

Nodosaria latejugata Gümbel var. *carolinensis* Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 5, pl. 1, fig. 16, 1933.

Variety differing from the typical form in having the chambers more distinct and more inflated, the costae similar, but double the number in the typical, and the whole test larger.

Holotype of variety (no. 371540, U.S.N.M.) from Cooper marl, Cooper River, Charleston County, S.C.

In the Carolina material this variety seems to be more characteristic than the typical form.

Cooper marl: 5531, Cooper River, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.

Ocala limestone: 1/38, 3¼ miles north of Grove Hill, Ala.

Nodosaria cookei Cushman

Plate 9, figure 1

Nodosaria cookei Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 9, pl. 1, fig. 21, 1933.

Test small, composed of few chambers, well separated from one another; chambers very distinct, slightly longer than wide, circular in diameter; sutures indistinct; wall covered by very fine hispid spines, both on the body of the chambers and on the connections; aperture at the end of an elongate cylindrical neck. Length 0.75 mm; diameter 0.25 mm.

Holotype (no. 371541, U.S.N.M.) from Ocala limestone, station 1/21, Covington County, Ala.

This seems to be identical with a species figured without name by Von Schlicht,⁸ and apparently not named by Reuss.

The newly added chamber is set onto the neck of the preceding one near the apertural end, and a long, narrow connection is thus left between adjacent chambers. The surface ornamentation is very delicate. The species resembles somewhat *N. conspurcata* Reuss, but it has a finer ornamentation, and the chambers are more remote.

Ocala limestone: 1/21, Covington County, Ala.

Nodosaria ewaldi Reuss?

Plate 9, figure 2

There are fragments showing two chambers each from two stations, which from their very cylindrical character and peculiar lack of incurving at the ends of the chambers, much resemble the figures of Reuss' *N. ewaldi*.⁹ They strongly resemble the figures given by Von Schlicht¹⁰ and referred by Reuss to *N. ewaldi*.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Nodosaria fissicostata (Gümbel)

Plate 5, figures 8, 9

Dentalina fissicostata Gümbel, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 626, pl. 1, fig. 46, 1868 (1870).

⁸ Von Schlicht, E., Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 6, fig. 28, 1870.

⁹ Deutsch. geol. Gesell. Zeitschr., vol. 3, pl. 3, fig. 2, 1851.

¹⁰ Von Schlicht, E., op. cit., pl. 7, figs. 8, 9.

Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 37, pl. 3, fig. 19, 1875 (1876); K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 37, pl. 3, fig. 19, 1875 (1881).

Nodosaria fissicostata Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 66, pl. 10, fig. 8, 1925.

Chapman and Parr, Linnean Soc. London Jour., Zoology, vol. 36, p. 384, pl. 19, fig. 45, 1926.

Cushman, Jour. Paleontology, vol. 1, p. 154, pl. 24, figs. 10, 11, 1927.

Test large, slightly curved, especially in the earlier portion, slightly tapering, initial end rounded; chambers fairly numerous, about as long as broad, earlier ones somewhat hidden by the ornamentation, later ones somewhat inflated and distinct; sutures between the later chambers slightly depressed and distinct, earlier ones indistinct; surface ornamented with numerous fine longitudinal costae, continuous over the length of the test except for a slight anastomosing or interpolation of new costae as the diameter of the test increases, about 20 to 25 costae in the last-formed chamber of adult specimens; aperture radiate, at the end of a conical projection. Maximum length, 6.00 mm; maximum breadth, 0.60 mm.

Gümbel described this species originally from the Eocene of Bavaria, and Hantken records it from the Eocene of central Europe and Italy, with numerous localities. Hantken gives as measurements 3–6 mm for the length and 0.60–1.00 mm for the diameter of the last-formed chamber. It is an easily broken species, complete specimens being rare in the collections. Specimens occur in the Alazan clay of Mexico.

Cooper marl: 3595, Barnwell County, S.C.; 5531, Cooper River, S.C.; 6321, Baldock, S.C.

Ocala limestone: 6768, Marianna, Fla.; 7719, Spring Mill Branch, Jenkins County, Ga.; 1/7, 1 mile east of Beck, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.

Genus *LAGENA* Walker and Jacob, 1798

Lagena laevis (Montagu)?

Plate 9, figures 3, 4

"*Serpula (Lagena) laevis ovalis*" Walker and Boys, Testacea minuta, p. 3, pl. 1, fig. 9, 1784.

Vermiculum laeve Montagu, Testacea Britannica, p. 524, 1803.

Lagena laevis Williamson, Annals and Mag. Nat. Hist., 2d ser., vol. 1, p. 12, pl. 1, figs. 1, 2, 1848.

The specimen here figured is referred to the above species provisionally. The ornamentation if ever present has been eroded, and more specimens are necessary to place it more definitely. The specimen is from station 3595, the Cooper marl of Barnwell County, S.C. An additional specimen from the Cooper marl, station 11857, Berkeley County, S.C., also figured, seems to show traces of the typical costae at the base.

Cooper marl: 3595, Barnwell County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Lagena acuticosta Reuss

Plate 9, figures 5, 6

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

There are single specimens which may be referred to this species, at least until further material is obtained.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.

Cooper marl: 11861, Steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Lagena costata (Williamson)

Plate 9, figures 7, 8

Entosolenia costata Williamson, Recent Foraminifera of Great Britain, p. 9, pl. 1, fig. 18, 1858.

Lagena costata Reuss, Akad. Wiss. Wien Sitzungsber., vol. 46, pt. 1, p. 329, pl. 4, fig. 54, 1862 (1863).

The costate specimens figured may be referred to *L. costata*.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.

Cooper marl: 11861, Steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

The only record for this species from the Cretaceous is without a figure.

Lagena orbignyana (Seguenza) var. *semiconcentrica* Cushman

Plate 9, figure 9

Lagena orbignyana (Seguenza) var. *semiconcentrica* Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 10, pl. 1, fig. 22, 1933.

This variety differs from var. *concentrica* Sidebottom in having the central part of the faces of the test without ornamentation. There are numerous concentric ridges at the sides, but they are slightly interrupted at the base and are wanting in the center. Length 0.45 mm.

Holotype (no. 371542, U.S.N.M.) from Castle Hayne marl, station 5611, Wilmington, N.C.

Castle Hayne marl: 5611, Wilmington, N.C.

Lagena hexagona (Williamson)

Plate 9, figure 10

The single specimen figured here may be referred to Williamson's species.

Cooper marl: 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.

Lagena sp.?

Plate 9, figure 11

The figured specimen shows a form with several basal spines, that occurs in the Cooper marl of South Carolina, but the single specimen is not enough to place the species with certainty.

Cooper marl: 5531, Charleston, S.C.

Family POLYMORPHINIDAE

Genus GUTTULINA D'Orbigny, 1826

Guttulina problema D'Orbigny

Plate 9, figure 12

Guttulina problema D'Orbigny, Annales sci. nat., vol. 7, p. 266, no. 14, 1826.

Cushman and Schenck, California Univ. Dept. Geol. Sci. Bull., vol. 17, p. 310, pl. 43, figs. 9-11, 1928.

Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 19, pl. 2, figs. 1-6; pl. 3, figs. 1a-c, 1930.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 49, pl. 7, fig. 9, 1932.

Polymorphina problema D'Orbigny, Modèles, no. 61, 1826.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 568, pl. 72, fig. 20; pl. 73, fig. 1, 1884.

Jones, Foraminifera of the Crag, pt. 3, p. 267, pl. 1, fig. 64; pl. 5, fig. 23; pl. 6, figs. 12a, b, 1896.

Burrows and Holland, Geol. Assoc. Proc., vol. 15, p. 46, pl. 2, fig. 17, 1897.

Weller, New Jersey Geol. Survey, Paleontology, vol. 4, p. 253, pl. 3, figs. 27, 28, 1907.

Cushman, U.S. Nat. Mus. Bull. 100, vol. 4, p. 264, pl. 54, figs. 3, 4, 1921; U.S. Geol. Survey Prof. Paper 133, p. 33, pl. 5, fig. 6, 1923.

Chapman, New Zealand Geol. Survey Pal. Bull. 11, p. 68, pl. 5, figs. 10-12, 1926.

Polymorphina (*Guttulina*) *problema* Andreae, Geol. Special-Karte Elsass-Lothringen Abh., vol. 2, pt. 3, p. 118, pl. 9, figs. 21a-c, 1884.

Polymorphina problema var. *Hosius*, Naturhist. Ver. preuss. Rheinlande Verh., vol. 50, p. 103, pl. 2, figs. 2a-c (not figs. 3-5), 1893.

Guttulina communis D'Orbigny, Annales sci. nat., vol. 7, p. 266, no. 15, pl. 12, figs. 1-4, Modèles, no. 62, 1826.

Reuss, in Geinitz, Grundriss der Versteinerungskunde, p. 669, pl. 24, fig. 82, 1845-46.

Polymorphina communis Roemer, Neues Jahrb., 1838, p. 385, pl. 3, fig. 29.

H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 224, pl. 39, figs. 10a, b, 1869.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 568, pl. 72, fig. 19, 1884.

Flint, U.S. Nat. Mus. Rept. for 1897, p. 319, pl. 67, fig. 6 (part), 1899.

Bagg, U.S. Geol. Survey Bull. 88, p. 60, pl. 6, fig. 2, 1898.

Fornasini, Accad. sci. Ist. Bologna Mem., ser. 5, vol. 8, p. 33, fig. 37, 1900.

Weller, New Jersey Geol. Survey, Paleontology, vol. 4, p. 248, pl. 3, fig. 18, 1907.

Bagg, U.S. Geol. Survey Bull. 513, p. 68, pl. 21, figs. 7a, b, 13-15, 1912.

Cushman, U.S. Nat. Mus. Bull. 71, pt. 3, p. 87, pl. 37, fig. 7, 1913.

- Polymorphina lactea* Walker and Jacob var. *communis* Williamson, Recent Foraminifera of Great Britain, p. 72, pl. 6, figs. 153-155, 1858.
- Polymorphina (Guttulina) lata* Egger, Neues Jahrb., 1857, p. 288, pl. 13, figs. 22-24.
- Guttulina cretacea* Alth, Haidinger's Naturwiss. Abh., vol. 3, p. 262, pl. 13, fig. 14, 1850.
Reuss, Haidinger's Naturwiss. Abh., vol. 4, p. 28, pl. 4, fig. 10, 1851.
- Polymorphina cretacea* Egger, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 21, pt. 1, p. 127, pl. 17, figs. 12, 13, 1899.
- Globulina irregularis* Terquem, Soc. géol. France Mém., sér. 3, vol. 1, p. 44, pl. 4 (9), figs. 13, 14, 1878.
- Polymorphina lactea* Sidebottom, Manchester Lit. Philos. Soc. Mem. and Proc., vol. 5, no. 9, p. 9, pl. 2, fig. 11, 1907.
Franke, Geol. palaeont. Inst. Univ. Greifswald Abh., vol. 6, p. 77, pl. 6, fig. 18, 1925; Danmarks geol. Undersøgelse, 2. Raekke, Nr. 46, p. 34, pl. 3, fig. 13, 1927.
- Globulina gibba* var. *glomula* Fornasini, Accad. sci. Ist. Bologna Mem., ser. 5, vol. 9, p. 68, fig. 20 (in text), 1902.

Test broadly fusiform, acute at the apertural end, more or less rounded at the initial end in the megaspheric form, rather rounded at the base in the microspheric form; chambers elongated, more or less inflated, arranged in a clockwise, quinqueloculine series, each succeeding chamber slightly removed from the base; sutures depressed, very distinct; wall rather thick, smooth; aperture radiate. Length 0.50-1.25 mm; breadth 0.40-1.25 mm; thickness 0.28-0.70 mm.

For further notes in regard to this species, see Cushman and Ozawa in the paper cited above.

Cooper marl: 5531, Charleston, S.C.

Jackson formation: Tarkiln Creek, half a mile above Neches River, Trinity County, Tex.

Guttulina irregularis (D'Orbigny)

Plate 9, figures 13-16

- Globulina irregularis* D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 226, pl. 13, figs. 9, 10, 1846.
Cushman and Thomas, Jour. Paleontology, vol. 3, p. 177, pl. 23, figs. 2a-c, 1929.
- Guttulina irregularis* Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 25, pl. 3, figs. 4, 5; pl. 7, figs. 1, 2, 1930.
Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 48, pl. 8, fig. 8, 1932.
- Guttulina dilatata* Reuss, K. Akad. Wiss. Wien Denkschr., vol. 1, p. 378, pl. 48, fig. 11, 1850.
- Guttulina problema* D'Orbigny (not D'Orbigny, 1826), Foraminifères fossiles du bassin tertiaire de Vienne, p. 224, pl. 12, figs. 26-28, 1846.
Reuss, in Geinitz, Grundriss der Versteinerungskunde, p. 669, pl. 24, fig. 83, 1845-46.
- Globulina guttula* Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 82, pl. 6, fig. 46, 1851.
- Guttulina semiplana* Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 82, pl. 6, fig. 48, 1851.
- Guttulina centrata* Terquem, Soc. géol. France Mém., sér. 3, vol. 1, p. 46, pl. 4 (9), figs. 25a-26, 1878.
- Polymorphina byramensis* Cushman, U.S. Geol. Survey Prof. Paper 129, p. 94, pl. 17, figs. 2a, b, 1922; Prof. Paper 133, p. 31, pl. 5, figs. 1-5, 1923.

Guttulina byramensis Cushman and Schenck, California Univ. Dept. Geol. Sci. Bull., vol. 17, p. 309, pl. 43, figs. 6-8, 1928.

Test oval to subdeltoidal, equilaterally triangular with rounded sides and angles, except the acute apertural end; chambers more or less angular, elongated, arranged in a clockwise, quinqueloculine series, each succeeding chamber except the last one or two chambers in full-grown specimens coming down to the base; sutures depressed, distinct; wall smooth but in full-grown specimens often having the last small chamber with spines or covered with fistulose tubes; aperture radiate. Length 0.45-1.40 mm; breadth 0.30-1.20 mm; thickness 0.20-0.75 mm.

This is a common species in both the lower Oligocene and the Eocene of the Gulf Coastal Plain of the United States. It is one of the most common species of the whole family and is very widely distributed in many parts of the world.

Castle Hayne marl: 5611, Wilmington, N.C.

Ocala limestone: 7098, Red Bluff, Flint River, Ga.; 7189, Rich Hill, Ga.; 7719, Spring Mill Branch, Jenkins County, Ga.; 6768, Marianna, Fla.; 6799, Alachua Sink, Gainesville, Fla.; 1/19, near Blue Springs, Jackson County, Fla.; 6706, Oven Bluff, Tombigbee River, Ala.; 6722, three-fourths mile northwest of Monroeville, Ala.; 6739, 6740, mouth of Robinsons Mill Creek, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 1/21, Covington County, Ala.; 1/25, 1 mile east of Harts Bridge, Ala.; 1/26, Drewry, Ala.; 1/39, Pea River at Geneva, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6463, pumping station, Jackson, Miss.; 6472, Yazoo City, Miss.

Guttulina spicaeformis (Roemer)

Plate 9, figure 17; plate 10, figures 9, 10

- Polymorphina spicaeformis* Roemer, Neues Jahrb., 1838, p. 386, pl. 3, fig. 31.
- Guttulina spicaeformis* Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 31, pl. 5, figs. 1, 2, 1930.
Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 7, fig. 3, 1933.
- Polymorphina austriaca* D'Orbigny var. *io* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 174, pl. 9, figs. 6, 7, 1926.
- Guttulina planicii* D'Orbigny, Voyage dans l'Amérique méridionale, vol. 5, pt. 5, Foraminifères, p. 60, pl. 1, fig. 5, 1839.
- Polymorphina uviformis* Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 289, pl. 11, fig. 5, 1855.

Test fusiform, initial end rounded, apertural end acute, margin slightly lobulate; chambers clavate, but little embracing, arranged in a contraclockwise, quinqueloculine series, each succeeding chamber removed from the base; sutures depressed, distinct; wall smooth; aperture radiate. Length 0.35-0.75 mm; breadth 0.20-0.35 mm; thickness 0.12-0.25 mm.

This is a common species in the upper Eocene of the Coastal Plain region of the United States but is not as abundant as the preceding species.

Castle Hayne marl: 5611, Wilmington, N.C.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 6321, Baldock, S.C.

Ocala limestone: 6768, Marianna, Fla.; 6730, Double Branches Creek, Ala.; 6738, 6½ miles north of Brooklyn, Ala.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.; 6463, pumping station, Jackson, Miss.; 6471, Garlands Creek, Miss.; 6646, Hays Chapel, Wayne County, Miss.; 4787, three-fourths mile below Robinsons Ferry, Sabine County, Tex.; on Stoval Creek, east of Diboll, and in oil-well drillings, Tex.

Genus **GLOBULINA** D'Orbigny, 1826

Globulina gibba D'Orbigny

Plate 9, figure 18

- Globulina gibba* D'Orbigny, Annales sci. nat., vol. 7, p. 266, no. 10, Modèles, no. 63, 1826; Foraminifères fossiles du bassin tertiaire de Vienne, p. 227, pl. 13, figs. 13, 14, 1846. Terquem, Essai sur le classement des animaux de Dunkerque, p. 38, pl. 5, fig. 15, 1875; Soc. géol. France Mém., sér. 3, vol. 1, p. 43, pl. 4 (9), figs. 1-5, 1878; vol. 2, p. 130, pl. 13 (21), figs. 22-27, 1882.
- Jones and Chapman, Linnean Soc. London Jour., Zoology, vol. 25, pp. 509, 515, figs. 6, 7, 40 (in text), 1896.
- Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 60, pl. 16, figs. 1-4, 1930.
- Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 46, pl. 8, figs. 11a, b, 1932.
- Polymorphina (Globulina) gibba* Egger, Neues Jahrb., 1857, p. 289, pl. 13, figs. 1-4.
- Andreae, Geol. Special-Karte Elsass-Lothringen Abh., vol. 2, pt. 3, pp. 117, 141, pl. 9, figs. 10-12, 13a, b, 1884.
- Polymorphina gibba* H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 216, pl. 39, figs. 2a, b, 1870.
- Reuss, Akad. Wiss. Wien Sitzungsber., vol. 62, pt. 1, p. 485, 1870.
- Von Schlicht, Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 27, figs. 1-6, 16-18; pl. 26, figs. 31-34, 1870.
- H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 561, pl. 71, figs. 12a, b, 1884.
- Sherborn and Chapman, Roy. Micr. Soc. Jour., ser. 2, vol. 6, p. 755, pl. 16, fig. 5, 1836.
- Goës, K. svensk. vet. akad. Handl., vol. 25, no. 9, p. 55, pl. 9, figs. 520-526, 1894.
- Jones, Foraminifera of the Crag, pt. 3, p. 253, pl. 1, figs. 49-51, 1896.
- Jones and Chapman, Linnean Soc. London Jour., Zoology, vol. 25, pp. 513, 514, figs. 31-33 (in text), 1896.
- Bagg, Maryland Geol. Survey, Eocene, p. 248, pl. 63, fig. 12, 1901; Miocene, p. 477, pl. 133, fig. 4, 1904.
- Weller, New Jersey Geol. Survey, Paleontology, vol. 4, p. 250, pl. 3, fig. 21, 1907.
- Sidebottom, Manchester Lit. Philos. Soc. Mem. and Proc., no. 9, vol. 51, p. 10, pl. 2, figs. 15-17, 1907.
- Paalzow, Offenbacher Ver. Naturkunde Ber., 1912, p. 67, p. 1, fig. 10.
- Cushman, U.S. Geol. Survey Bull. 676, pp. 10, 52, pl. 2, fig. 4; pl. 11, fig. 5, 1918; Prof. Paper 129, pp. 93, 94; pl. 17, fig. 3; pl. 18, figs. 3a, b, 1922.
- Plummer, Texas Univ. Bull. 2644, p. 122, pl. 6, figs. 8a, b, 1927.
- Stadnichenko, Jour. Paleontology, vol. 1, p. 230, pl. 38, figs. 20-22, 1928.

Guttulina (Globulina) gibba Cushman, Soc. sci. Seine-et-Oise Bull., sér. 2, vol. 9, p. 50, pl. 1, figs. 4a-c, 5a, b, 1928 (separate, p. 4, pl. 1, figs. 4a-c, 5a, b).

Globulina globosa Reuss (not Münster), in Geinitz, Grundriss der Versteinerungskunde, p. 669, pl. 24, fig. 85, 1845-46; Akad. Wiss. Wien Sitzungsber., vol. 44, pt. 1, p. 318, pl. 3, fig. 3, 1861 (1862).

Globulina tubulosa D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 228, pl. 13, figs. 15, 16, 1846.

Polymorphina (Globulina) gibba D'Orbigny var. *ovoides* Egger, Neues Jahrb., 1857, p. 289, pl. 13, figs. 5-7.

Polymorphina (Globulina) gibba D'Orbigny var. *subgibba* Egger, Neues Jahrb., 1857, p. 289, pl. 13, figs. 8-10.

Polymorphina (Globulina) gibba D'Orbigny var. *pirula* Egger, Neues Jahrb., 1857, p. 290, pl. 13, figs. 11, 12.

Globulina amplexens Bornemann (not Reuss), Deutsch. geol. Gesell. Zeitschr., vol. 12, p. 160, pl. 6, figs. 12a-c, 1860.

Polymorphina gibba (D'Orbigny) var. *orbicularis* Karrer, Akad. Wiss. Wien Sitzungsber., vol. 58, Abt. 1, p. 174, pl. 4, fig. 8, 1868.

Globulina subgibba Gümbel, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 645, pl. 2, fig. 79, 1870.

Globulina ovalis Terquem, Essai sur le classement des animaux de Dunkerque, p. 77, pl. 10, fig. 2, 1876.

Globulina oviformis Terquem, Soc. géol. France Mém., sér. 3, vol. 1, p. 44, pl. 4 (9), figs. 9-12, 1878.

Globulina transversa Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 129, pl. 13 (21), figs. 17-21, 1882.

Guttulina ponderosa Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 135, pl. 14 (22), figs. 1a, b, 1882.

Guttulina gravis Terquem and Terquem (not Terquem, 1878), Soc. zool. France Bull., vol. 11, p. 334, pl. 11, fig. 21, 1886.

Polymorphina inflata Terquem and Terquem (not Terquem, 1878), Soc. zool. France Bull., vol. 11, p. 335, pl. 11, fig. 23, 1886.

Polymorphina lactea (Walker and Jacob) var. *diffusa* Cushman, U.S. Nat. Mus. Bull. 71, pt. 3, p. 84, pl. 41, fig. 8, 1913.

Test globular to subglobular, transverse section almost circular; chambers few, inflated, rounded, arranged in a nearly triserial series; sutures not depressed, generally clear; wall smooth, translucent, often with fistulose tubes, especially at apertural end; aperture radiate. Length 0.45-1.10 mm; breadth 0.40-0.90 mm; thickness 0.40-0.90 mm.

This is a very common species widely distributed in the Coastal Plain, especially in the lower Oligocene and the Eocene.

Cooper marl: 6319, Ingleside, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.; 6321, Baldock, S.C.

Ocala limestone: 7097, Bainbridge, Ga.; 7189, Rich Hill, Ga.; 7719, Spring Mill Branch, Ga.; 6768, Marianna, Fla.; 6804, Ocala, Fla.; 7364, 1½ miles west of Croom, Fla.; 1/19, near Blue Springs, Jackson County, Fla.; 1/8, Beck, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 6730, Double Branches Creek, Ala.; 6740, mouth of Robinsons Mill Creek, Ala.; 6742, Powells Landing, Sepulga River, Ala.

Jackson formation: 6463, Jackson, Miss., near pumping station; 6471, Garlands Creek, Miss.

Globulina gibba D'Orbigny var. globosa (Von Münster)

Plate 9, figure 21

- Polymorphina globosa* Von Münster, in Roemer, Neues Jahrb., 1838, p. 386, pl. 3, fig. 33.
 Reuss, Versteinerungen der böhmischen Kreideformation, p. 40, pl. 13, fig. 82, 1845.
 Egger, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 21, pt. 1, p. 129, pl. 17, fig. 26, 1899.
- Globulina gibba* D'Orbigny var. *globosa* Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 64, pl. 17, figs. 8, 9, 1930.
 Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 46, pl. 8, fig. 10, 1932.
- Polymorphina acuta* Roemer, Neues Jahrb., 1838, p. 386, pl. 3, fig. 36.
- Globulina acuta* Reuss, Akad. Wiss. Wien Sitzungsber., vol. 18, p. 245, pl. 6, fig. 62, 1855 (1856).
- Globulina aequalis* D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 227, pl. 13, figs. 11, 12, 1846.
- Polymorphina equalis* Cushman, U.S. Geol. Survey Prof. Paper 129, p. 132, pl. 31, fig. 3, 1922; U.S. Nat. Mus. Bull. 104, pt. 4, p. 149, pl. 40, fig. 3, 1923.
- Polymorphina gibba* var. *aequalis* H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 216, pl. 39, figs. 2c, d, 1870.
- Globulina turbinata* Terquem, Soc. géol. France Mém., sér. 3, vol. 1, p. 43, pl. 4 (9), figs. 6-8, 1898.

Test subglobular to broadly oval, rather convex on one side in the microspheric form, more or less equally compressed in the megalospheric form, slightly produced at the apertural end; chambers more or less compressed, generally as many as 7 in the microspheric, 4 in the megalospheric form, the later chambers more embracing on one side, arranged in an almost triserial series, each succeeding chamber more or less above the base; sutures not depressed, distinct; wall smooth, thick, often with fistulose tubes; aperture radiate. Length 0.65-0.90 mm; breadth 0.40-0.65 mm; thickness 0.20-0.35 mm.

This is a compressed modification of *Globulina gibba*, and there is a certain range of variation in its test.

This variety seems to be rare in the Eocene, so far as the material examined is concerned.

Castle Hayne marl: 5611, Wilmington, N.C.

Cooper marl: Ashley marl works, Dorchester County, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Ocala limestone: 7189, Rich Hill, Ga.

Globulina gibba D'Orbigny var. tuberculata D'Orbigny

Plate 9, figures 19, 20

- Globulina tuberculata* D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 230, pl. 13, figs. 21, 22, 1846.
 Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 132, pl. 13 (21), figs. 33, 34, 1882.
- Globulina gibba* D'Orbigny var. *tuberculata* Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 68, pl. 17, figs. 6, 7, 1930.

Polymorphina (Globulina) tuberculata Egger, Neues Jahrb., 1857, p. 292, pl. 14, figs. 7, 8.

Polymorphina tuberculata H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 242, pl. 41, figs. 35a-d, 1870.

Jones, Foraminifera of the Crag, pt. 3, p. 273, pl. 5, fig. 29, 1896.

Cushman, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 603, pl. 20, fig. 5, 1926.

Globulina spinosa D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 230, pl. 13, figs. 23, 24, 1846.

Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 132, pl. 13 (21), fig. 35, 1882.

Polymorphina (Globulina) spinosa Egger, Neues Jahrb., 1857, p. 292, pl. 14, figs. 9, 10.

Polymorphina spinosa H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 243, pl. 42, figs. 36a, b, 1870.

Balkwill and Wright, Roy. Irish Acad. Sci. Trans., vol. 28, p. 347, pl. 12, fig. 27, 1885.

Cushman, U.S. Geol. Survey Prof. Paper 129, p. 133, pl. 31, fig. 5, 1922; U.S. Nat. Mus. Bull. 104, pt. 4, p. 157, pl. 41, figs. 1, 13, 1923.

Globulina asperula Gümbel, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 646, pl. 2, figs. 81a, b, 1870.

Polymorphina frondiformis Searles Wood var. *brevis* Jones, Foraminifera of the Crag, pt. 3, p. 271, pl. 7, fig. 20, 1896.

Variety ornamented with strong spines of unequal size and irregularly spaced. Length with spines 0.70-0.90 mm; breadth 0.60-0.80 mm; thickness 0.50-0.70 mm.

Rare specimens occur in the Jackson, which may be referred to this variety. The spines are variable.

Cooper marl: 6319, Ingleside, S.C.

Ocala limestone: 1/21, Covington County, Ala.

Globulina inaequalis Reuss

Plate 9, figure 22

Globulina inaequalis Reuss, K. Akad. Wiss. Wien Denkschr., vol. 1, p. 377, pl. 48, fig. 9, 1850.

Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 73, pl. 18, figs. 2-4, 1930.

Globulina discreta Reuss, K. Akad. Wiss. Wien Denkschr., vol. 1, p. 378, pl. 48, fig. 10, 1850.

Globulina amplexens Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 81, pl. 6, fig. 44, 1851.

Globulina inflata Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 81, pl. 6, fig. 45, 1851.

Globulina amygdaloides Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 82, pl. 6, fig. 47, 1851.

Polymorphina amygdaloides Reuss (not Reuss, 1851), Akad. Wiss. Wien Sitzungsber., vol. 62, pt. 1, p. 486, 1870.

Von Schlicht, Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 27, figs. 7-9, 10-12, 1870.

Guttulina diluta Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 12, p. 160, pl. 6, fig. 11a-c, 1860.

Polymorphina pauperata Terquem (part), Soc. géol. France Mém., sér. 3, vol. 1, p. 38, pl. 3 (8), figs. 12, 13 (not figs. 11, 14-19), 1878.

Globulina translucida D'Orbigny, Annales sci. nat., vol. 7, p. 267, no. 25, 1826.

Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 131, pl. 13 (21), fig. 31a, b, 1882.

Polymorphina translucida Fornasini, Accad. sci. Ist. Bologna Mem., ser. 5, vol. 10, p. 52, fig. 51, 1902.

Test ovate, more or less compressed, broadly rounded at the base, tapering toward the apex; chambers few, inflated, much overlapping, arranged in a nearly tri-serial series; sutures very slightly if at all depressed, distinct; wall smooth, translucent; aperture radiate. Length 0.50–0.85 mm; breadth 0.45–0.85 mm; thickness 0.25–0.50 mm.

This species is not common in the Eocene of the Coastal Plain area and also occurs rarely in the lower Oligocene and in the Miocene.

Cooper marl: 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Jackson formation: 4787, three-fourths mile below Robinsons Ferry, Sabine River, Sabine County, Tex.

Globulina minuta (Roemer)

Plate 9, figure 23

Polymorphina minuta Roemer, Neues Jahrb., 1838, p. 386, pl. 3, fig. 35.

Reuss, Akad. Wiss. Wien Sitzungsber., vol. 62, pt. 1, p. 486, 1870.

Von Schlicht, Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 27, figs. 13–15; pl. 25, figs. 51–56, 1870.

Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 344, pl. 17, fig. 3, 1855.

Globulina minuta Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 83, pl. 20, figs. 3, 4, 1930.

Polymorphina (*Guttulina*) aff. *P. minima* Andreae, Geol. Special-Karte Elsass-Lothringen Abh., vol. 2, pt. 3, p. 118, pl. 9, fig. 16, 1884.

Polymorphina similis Reuss, Akad. Wiss. Wien Sitzungsber., vol. 18, p. 249, pl. 7, fig. 79, 1855 (1856).

Polymorphina sororia Reuss, Akad. Wiss. Wien Sitzungsber., vol. 48, pt. 1, p. 57, pl. 7, figs. 72 (?), 73, 74, 1863; Acad. roy. sci. Belgique Bull., sér. 2, vol. 15, p. 151, pl. 2, fig. 25 (not figs. 26–29), 1863.

Polymorphina gracilis Reuss, Akad. Wiss. Wien Sitzungsber., vol. 62, pt. 1, p. 486, 1870.

Von Schlicht, Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 31, figs. 34–37, 42, 45–49; pl. 32, figs. 5–16, 27, 28, 1870.

Polymorphina acuta Reuss, Akad. Wiss. Wien Sitzungsber., vol. 62, pt. 1, p. 486, 1870.

Von Schlicht, Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 27, figs. 19–21; pl. 29, figs. 15, 16, 43–46, 1870.

Polymorphina lactea Burrows, Sherborn, and Bailey (not Walker and Jacob), Roy. Micr. Soc. Jour., 1890, p. 561, pl. 11, figs. 9, 10.

Egger, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 18, p. 308, pl. 9, figs. 8, 14, 15, 1893.

Mills, Hull Sci. and Field Nat. Club Trans., vol. 1, p. 149, pl. 11, fig. 33, 1900.

Polymorphina lactea elongate variety, Weller, New Jersey Geol. Survey, Paleontology, vol. 4, p. 251, pl. 3, figs. 24–25, 1907.

Test fusiform, pointed at both ends, circular to elliptical in section; chambers few, elongate, each some distance from the base; sutures distinct, not depressed; wall smooth; aperture radiate, pointed. Length 0.50–0.70 mm; breadth 0.20–0.35 mm; thickness 0.20–0.35 mm.

Ocala limestone: 6738, 6½ miles north of Brooklyn, Ala.

Globulina münsteri (Reuss)

Plate 9, figure 25

Polymorphina münsteri Reuss, Akad. Wiss. Wien Sitzungsber., vol. 18, p. 249, pl. 8, fig. 80, 1855 (1856).

Globulina münsteri Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 85, pl. 22, figs. 3a–c, 1930.

Polymorphina ovulum Reuss, Akad. Wiss. Wien Sitzungsber., vol. 18, p. 250, pl. 8, fig. 83, 1855 (1856).

Polymorphina amygdaloides Reuss (not Reuss, 1851), Akad. Wiss. Wien Sitzungsber., vol. 18, p. 250, pl. 8, fig. 84, 1855 (1856).

Burrows and Holland, Geol. Assoc. Proc., vol. 15, p. 46, pl. 2, fig. 18, 1897.

Polymorphina communis D'Orbigny var. *etrusca* Fornasini, Accad. sci. Ist. Bologna Mem., ser. 5, vol. 9, p. 70, fig. 23 (in text), 1900–1902.

Polymorphina obtusa D'Orbigny, Annales sci. nat., vol. 7, p. 265, no. 1, 1828.

Fornasini, Soc. geol. italiana Boll., vol. 19, p. 146, fig. 4 (in text), 1900.

Polymorphina gibba Burrows, Sherborn, and Bailey, Roy. Micr. Soc. Jour., 1890, p. 561, pl. 11, fig. 13.

Specimens occur at several stations in the Coastal Plain region, but the species is not at all common.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.; 6730, Double Branches Creek, Ala.; 6741, 3½ miles north-east of Brooklyn, Ala.; 1/7, 1 mile east of Beck, Ala.

Globulina rotundata (Bornemann)

Plate 9, figures 24a–c

Guttulina rotundata Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 346, pl. 18, fig. 3, 1855.

Globulina rotundata Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 86, pl. 21, figs. 3, 4, 1930.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 47, pl. 15, fig. 4, 1932.

Polymorphina rotundata H. B. Brady, Parker, and Jones, Linnæan Soc. London Trans., vol. 27, p. 234, pl. 49, figs. 19a–e, woodcuts k, l, m, 1870.

H. B. Brady, Annals and Mag. Nat. Hist., 5th ser., vol. 1, p. 435, pl. 20, figs. 6a, b, 1878.

Sidebottom, Manchester Lit. Philos. Soc. Mem. and Proc., vol. 151, no. 9, p. 11, pl. 2, fig. 18, 1907.

Guttulina fracta Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 344, pl. 17, fig. 4, 1855.

Guttulina incurva Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 345, pl. 17, fig. 6, 1855.

Guttulina globosa Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 346, pl. 18, fig. 1, 1855.

Guttulina obtusa Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 346, pl. 18, fig. 2, 1855.

Guttulina turgida Reuss, Akad. Wiss. Wien Sitzungsber., vol. 18, p. 246, pl. 6, fig. 66, 1855 (1856).

Polymorphina turgida Reuss, Akad. Wiss. Wien Sitzungsber., vol. 62, pt. 1, p. 487, 1870.

Von Schlicht, Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 28, figs. 6–10; pl. 29, figs. 1–5, 1870.

Globulina subalpina Gümbel, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10, p. 646, pl. 2, figs. 80a, b, 1870.

Polymorphina subcruciata Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 140, pl. 14 (22), figs. 26, 27, 1882.

Test ellipsoidal or ovoid to cylindrical, rounded at the base, slightly produced at the apertural end; chambers rounded, almost as long as broad, arranged

in a nearly triserial series, each succeeding chamber removed much farther from the base, rarely becoming almost uniserial in the last chamber; sutures but little depressed, generally distinct; wall smooth, thick, often with fistulose tubes; aperture radiate. Length, 0.45–0.90 mm; breadth, 0.30–0.60 mm; thickness, 0.25–0.55 mm.

Cooper marl: 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus *SIGMOMORPHINA* Cushman and Ozawa, 1928

Sigmomorphina jacksonensis (Cushman)

Plate 10, figures 1–4

Polymorphina jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 36, pl. 5, figs. 5a, b, 1926.

Sigmomorphina jacksonensis Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 123, pl. 32, figs. 2a, b, 1930. Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 49, pl. 8, fig. 2, 1932.

Polymorphina compressa Nuttall (not D'Orbigny), Geol. Soc. London Quart. Jour., vol. 84, p. 93, pl. 6, figs. 18, 19, 1928.

Test broad and compressed, periphery broadly rounded, apertural and narrowed to a slightly produced aperture; chambers elongate, slightly inflated, embracing, arranged in a contraclockwise sigmoid series, each succeeding chamber removed farther from the base; sutures very slightly depressed, distinct, almost straight; wall thick, smooth; aperture radiate. Maximum length 1.10 mm; breadth 0.65 mm; thickness 0.25 mm.

While this species and the following variety are characteristic of the Jackson Eocene of the Gulf Coastal Plain of the United States, it also occurs in the Claiborne group and in the Eocene of Trinidad.

Cooper marl: 6321, Baldock, S.C.

Ocala limestone: 1/19, near Blue Springs, Jackson County, Fla., the type locality; 1/7, 1 mile east of Beck, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles south-east of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.

Sigmomorphina jacksonensis (Cushman) var. *costifera*
Cushman and Ozawa

Plate 10, figures 5, 6

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

Sigmomorphina jacksonensis (Cushman) var. *costifera* Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 123, pl. 32, figs. 3 a, b, 1930.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 7, fig. 1, 1933.

Variety differing from the typical form in the ornamentation of the test, which has several rounded longitudinal costae on the basal portion, sometimes covering a large part of the surface. As a rule the variety and

the typical form do not occur together, although both occur at Jackson, Miss., and at a station 1 mile east of Beck, Covington County, Ala. Maximum length 1.20 mm; breadth 0.50 mm; thickness 0.13 mm.

Cooper marl: 5531, Barnwell County, S.C.

Ocala limestone: 7189, Rich Hill, Ga.; 6730, Double Branches Creek, Ala.; 6740, mouth of Robinsons Mill Creek, Ala.; 1/7, 1 mile east of Beck, Ala., type locality.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.; 6472, Yazoo City, Miss.

Sigmomorphina regularis (Von Münster)

The only American records for this species seem to be from the Cooper marl of South Carolina. The other records are mostly from the German Oligocene. Figures and synonymy of this species are given by Cushman and Ozawa.¹¹

Cooper marl: 5531, Charleston, S.C.; 11857, 1 mile south of Moncks Corner, S.C.

Sigmomorphina vauhani Cushman and Ozawa

Plate 10, figures 7a–c

Sigmomorphina vauhani Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 137, pl. 38, figs. 2a–c, 1930.

Test almost rhombic with three rounded angles and acute apertural angle, compressed, and more or less twisted, margin of the lower half wavy; chamber compressed, elongated, arranged in a clockwise sigmoid series, each succeeding chamber farther removed from the base; sutures slightly depressed, distinct; wall smooth; aperture radiate. Length of holotype 0.80 mm; breadth 0.62 mm; thickness 0.30 mm.

Cooper marl: 6319, Ingleside, S.C., type locality; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Sigmomorphina semitecta (Reuss) var. *terquemiana*
(Fornasini)

Polymorphina amygdaloides Reuss var. *terquemiana* Fornasini, Accad. sci. Ist. Bologna Mem., ser. 5, vol. 9, p. 72, fig. 25 (in text), 1902.

Sigmomorphina semitecta (Reuss) var. *terquemiana* Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 129, pl. 33, figs. 4, 5; pl. 34, figs. 2, 3; pl. 35, fig. 1, 1930.

Polymorphina amygdaloides Terquem (not Reuss, 1851), Soc. géol. France Mém., sér. 3, vol. 2, p. 141, pl. 14 (22), figs. 30, 31, 1882.

Polymorphina pauperata Terquem (part), Soc. géol. France Mém., sér. 3, vol. 1, p. 38, pl. 3 (8), figs. 11a, b (not figs. 12–19), 1878.

Globulina varians Terquem, Soc. géol. France Mém., sér. 3, vol. 2, p. 128, pl. 13 (21), figs. 9–16, 1882.

This variety occurs in the Jackson Eocene of the Gulf Coastal Plain but only rarely. Other records are mostly from the European Tertiary.

Ocala limestone: 7189, Rich Hill, Ga.; 6741, 3½ miles north-east of Brooklyn, Ala.

¹¹ U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 126, pl. 33, figs. 1a, b, 1930.

Genus **PSEUDOPOLYMORPHINA** Cushman and Ozawa, 1928

Pseudopolymorphina dumblei (Cushman and Applin)

Plate 10, figures 14, 15

Polymorphina compressa D'Orbigny var. *dumblei* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 173, pl. 9, figs. 4, 5, 1926.

Pseudopolymorphina dumblei Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 97, pl. 25, figs. 1a, b, 1930. Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 7, fig. 2, 1933.

Test compressed, elongated, obtuse at the base, more or less acute at the apertural end; chambers slightly longer than wide, more or less compressed, much embracing, arranged at first in a nearly triserial series, becoming biserial later; sutures but little depressed, distinct; wall smooth; aperture radiate. Length 0.70–1.10 mm; breadth 0.35–0.40 mm; thickness 0.16–0.20 mm.

This seems to be a definite species originally described from the Jackson of Bridge Creek, 1½ miles above the Angelina River, San Augustine County, Tex., but since found rather widely distributed in the upper Eocene of the Gulf Coastal Plain and in Mexico.

Ocala limestone: 7189, Rich Hill, Ga.; 7719, Spring Mill Branch, Jenkins County, Ga.; 6742, Powells Landing, Sepulga River, Ala.; 1/8, Beck, Ala.

Pseudopolymorphina decora (Reuss)

Plate 10, figures 11, 12

Polymorphina decora Reuss, Acad. roy. sci. Belgique Bull., sér. 2, vol. 15, p. 152, pl. 3, fig. 41, 1863.

Pseudopolymorphina decora Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 96, pl. 24, figs. 6–8, 1930.

Polymorphina texana Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 173, pl. 9, figs. 1, 2, 1926.

Test elongated, more or less compressed, periphery rounded, sides nearly parallel; chambers somewhat longer than wide, slightly embracing, alternating, arranged in a nearly biserial series from the start; sutures not depressed, distinct; wall smooth; aperture radiate. Length 0.75–1.10 mm; breadth 0.32–0.36 mm; thickness 0.15–0.18 mm.

This species occurs in the upper Eocene of Texas, and the specimens figured came from the Jackson group on Tarkiln Creek, half a mile above the Neches River, Trinity County, Tex.

Genus **POLYMORPHINA** D'Orbigny, 1826

Polymorphina advena Cushman

Plate 10, figure 8

Polymorphina advena Cushman, U.S. Geol. Survey Prof. Paper 129, p. 132, pl. 31, fig. 4, 1922; Contr. Cushman Lab. Foram. Research, vol. 5, p. 41, pl. 7, fig. 5, 1929.

Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 118, pl. 30, figs. 10a, b, 1930.

Test much compressed, broadly ovate; chambers numerous, elongate, alternating, much the broadest near the apertural end; sutures slightly depressed, very oblique; surface ornamented with numerous fine longitudinal costae, often obscure, except the last-formed one or two chambers, which are smooth, at least at the apertural end; aperture radiate. Length 0.40–0.65 mm; breadth 0.22–0.30 mm; thickness 0.05–0.06 mm.

This is a characteristic species of the lower Oligocene of the Gulf Coastal Plain of the United States but occurs also in the upper Eocene of the same region.

Cooper marl: 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Ocala limestone: 7189, Rich Hill, Ga.; 7237, half a mile east of Huguenen Ferry, Crisp County, Ga.; 6720, three-fourths mile north of Drewry, Ala.; 6725, Claiborne, Ala.; 6730, Double Branches Creek, Ala.

Jackson formation: 6463, Jackson, Miss.

Genus **SIGMOIDELLA** Cushman and Ozawa, 1928

Sigmoidella plummerae Cushman and Ozawa

Plate 10, figures 13a, b

Sigmoidella plummerae Cushman and Ozawa, U.S. Nat. Mus. Proc., vol. 77, art. 6, p. 142, pl. 39, figs. 3a, b, 1930.

Test compressed, ovate, broadly rounded at the base, acute toward the aperture, periphery angular; chambers elongated, more or less compressed, arranged in a contraclockwise sigmoid series, each succeeding chamber embracing the earlier one, but often the last chamber not extending down to the initial end; sutures not depressed, usually distinct; wall rather thin, smooth; aperture radiate. Length of the holotype 0.70 mm; breadth 0.35 mm; thickness 0.22 mm.

The types are from the Eocene Cook Mountain formation of Texas, but there are also records from the Cooper marl of South Carolina.

Cooper marl: 5531, Cooper River, S.C.; 6319, Ingleside, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus **GLANDULINA** D'Orbigny, 1826

Glandulina laevigata D'Orbigny var. *ovata* Cushman and Applin

Plate 10, figures 16, 17

Nodosaria (*Glandulina*) *laevigata* D'Orbigny var. *ovata* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 169, pl. 7, figs. 12, 13, 1926.

Glandulina laevigata D'Orbigny var. *ovata* Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 6, 1933.

Test ovate, longer than broad, circular in transverse section, widest toward the apertural end; chambers overlapping, few, indistinct, earlier ones irregularly biserial, especially in the microspheric form, later ones uniserial; sutures indistinct; wall smooth, matte; aperture radiate, slightly projecting. Average length 0.60 mm; breadth 0.40 mm.

This somewhat shorter and broader variety of the typical form occurs in the Jackson of Texas, and the types were collected 4 miles east of Diboll, Angelina County.

Family NONIONIDAE

Genus NONION Montfort, 1808

Nonion advenum (Cushman)

Plate 11, figures 1-4

Nonionina advena Cushman, U.S. Geol. Survey Prof. Paper 129, p. 139, pl. 32, fig. 8, 1922; Prof. Paper 133, p. 50, 1923. Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 181, pl. 10, figs. 16, 17, 1926.

Test small, circular, in side view biconvex; periphery rounded, 9 to 11 chambers in the last-formed coil, inflated; sutures curved, slightly sigmoid, the inner portion excavated and broadened; umbilical region at each side of the test occupied by a large projecting knob of clear shell material; aperture at the base of the last-formed chamber. Maximum length 0.75 mm.

This species was originally described from the Mint Spring marl member of the Marianna limestone (lower Oligocene), from Vicksburg and Boice, Miss. It occurs in the upper Eocene of Texas near Cheapside, Gonzales County. The species also occurs in the lower Oligocene and upper Eocene of the Atlantic Coastal Plain of Mexico. It is allied to some of the species described by Terquem from the Eocene of the Paris Basin.

Cooper marl: 6321, Baldock, S.C.

Ocala limestone: 7189, Rich Hill, Ga.; 7704, 3 miles west of Tannersville, Ga.; 6804, Ocala, Fla.; 6805, Oakhurst quarry, Ocala, Fla.; 6807, Zuber, Fla.; 6808, Martin, Fla.; 7366, Anthony, Fla.; 6719, three-fourths mile north of Drewry, Ala.; 6725, 6727, Claiborne, Ala.; 6730, Double Branches Creek, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.; 6742, Powells Landing, Sepulga River, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 7161, 5 miles southeast of Whatley, Ala.

Jackson formation: 7227, Water Valley, Ala.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Barnwell formation: 7755, Stevens pottery, Ga.

Nonion inexcavatum (Cushman and Applin)

Plate 11, figures 5-8

Nonionina advena Cushman var. *inexcavata* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 182, pl. 10, figs. 18, 19, 1926.

Nonion inexcavatum Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 7, 1933.

Nonion inexcavatum (Cushman and Applin) var. Ellisor, op. cit., pl. 7, figs. 10a, b.

Test of medium size, circular in side view, biconvex, periphery subacute, 12 to 15 chambers in the last-formed coil in adults, distinct, slightly inflated; sutures very slightly curved, very slightly if at all depressed; umbilical region at each side of the test occupied by a slightly projecting knob of clear shell material, with the area toward the aperture from this knob covered with a pustulose ornamentation, especially marked in adults; aperture at the base of the last-formed chamber. Maximum breadth 0.85 mm.

This was originally described as a variety of *Nonion advenum* (Cushman), but a study of the more numerous specimens of the present series seems to show that it is specifically different. In adults there are traces in the last two or three chambers of retral processes, making the relation to *Elphidium* very marked.

The type specimens are from the upper Eocene of Texas, 4 miles east of Diboll, Angelina County.

Cooper marl: 6321, Baldock, S.C.

Ocala limestone: 1/8, Beck, Ala.

Jackson formation: 6463, Jackson, Miss.; 7227, Water Valley, Ala.

Nonion chapapotense Cole

Plate 11, figures 9-13

Nonion chapapotensis Cole, Bull. Am. Paleontology, vol. 14, no. 53, p. 210 (10), pl. 1, figs. 18, 19, 1928.

Test close-coiled planispirally, the umbilical area on each side very slightly open, but filled with a central boss, about which is a narrow, depressed, grooved area, the outer edge of which is slightly thickened, periphery rounded; chambers distinct, numerous, usually about 10 in the adult coil, of uniform shape, gradually increasing in size as added; sutures distinct, somewhat limbate, slightly curved, fusing at the inner end into the thickened ridge at the outside edge of the grooved area about the umbilical boss; wall of the chamber smooth, conspicuously perforate; aperture along the base of the apertural face in the median line. Diameter 0.40 mm; thickness 0.20 mm.

This species was described by Cole from the Eocene Chapapote formation of Mexico. In the Eocene material of the present paper it shows considerable variation, with many intermediate stages between the forms with an open umbilicus and those with a large boss.

Ocala limestone: 3966, 2 miles south of Perry, Ga.; 6726, Claiborne, Ala.; 6738, 6½ miles north of Brooklyn, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/8, Beck, Ala.

Jackson formation: 6472, 6473, Yazoo City, Miss.

Nonion micrum Cole

Plate 11, figures 14, 15

Nonion micrus Cole, Bull. Am. Paleontology, vol. 14, no. 51, p. 22, pl. 5, fig. 12, 1927; vol. 14, no. 53, p. 211 (11), 1928.

Weinzierl and Applin, Jour. Paleontology, vol. 3, p. 400, pl. 43, figs. 6a-c, 1929.

Test small, compressed, bilaterally symmetrical, periphery subacute; chambers distinct, somewhat involute, rapidly increasing in size as added, about 6 making up the adult coil, sutures distinct, depressed, slightly curved; wall smooth, finely perforate; aperture median, at the base of the apertural face of the chamber, with a slight lip. Diameter 0.25–0.32 mm; thickness 0.10–0.13 mm.

This species has been recorded from the Claiborne Eocene of Mexico and Texas. It seems to occur in the Jackson but is evidently very rare.

Jackson formation: 6646, Hays Chapel, Wayne County, Miss.

Nonion whitsettense (Cushman and Applin)

Plate 11, figures 16–18

Nonionina whitsettensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 183, pl. 10, figs. 4–6, 1926.

Nonion whitsettensis Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 14, 1933.

Test much compressed, sides nearly parallel, the periphery broadly rounded; chambers long, narrow, distinct, usually 9 in the adult coil; sutures very strongly curved, especially in the later portion, slightly depressed; wall smooth; aperture a very narrow, elongate slit at the base of the apertural face. Maximum diameter 0.50 mm; thickness 0.10–0.12 mm.

The type specimens of this species came from the Whitsett beds (Frio clay) of the Jackson of Texas, from Ohio and Red River well 2, Tyler County, at a depth of 330 feet, where it is very common and holds its characters very closely. There seem to be occasionally traces of what may be retral processes, but they are not definite. The species has not been found in the collections from the more easterly portion of the Gulf Coastal Plain.

Genus **NONIONELLA** Cushman, 1926

Nonionella hantkeni (Cushman and Applin)

Plate 12, figures 1, 2

Nonionina hantkeni Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 182, pl. 10, figs. 10, 11, 1926.

Nonionella hantkeni Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 9, 1933.

Pullenia elongata Hantken, Magy. kir. földt. int. Évkönyve, p. 50, pl. 10, fig. 10, 1875 (1876); K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 59, pl. 10, fig. 10, 1875 (1881).

Test somewhat longer than broad, consisting of numerous chambers, as many as 12 in the last-formed coil, periphery broadly rounded, the umbilical region slightly exposed, showing the inner ends of the earlier chambers; sutures distinct, very slightly and evenly curved; wall smooth; aperture arched in the base of the apertural face of the last-formed chamber. Maximum length, 0.60 mm.

Type specimen from Ohio and Red River well 2, Tyler County, Tex., at a depth of 2,330 feet.

In the regions east of Texas this species is apparently replaced by the following variety.

Nonionella hantkeni (Cushman and Applin) var. spissa
Cushman

Plate 12, figures 6a–c

Nonionella hantkeni (Cushman and Applin) var. *spissa* Cushman, Contr. Cushman Lab. Foram. Research, vol. 7, p. 58, pl. 7, figs. 13a–c, 1931.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, figs. 10, 12, 1933.

Variety differing from the typical form in the much thicker test and the usually smaller number of chambers. Some of the broader specimens are close to the typical in outline, but there is a very considerable amount of variation in any large series of specimens. The typical form occurs in the Eocene of Texas, but the material from regions to the east seems all to belong to the variety.

Holotype (no. 371677, U.S.N.M.) from Cooper marl, station 11863, Berkeley County, S.C.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Ocala limestone: 6754, Choctawhatchee River at State line, Ala.-Fla.; 6755, Choctawhatchee River above State line, Ala.; 6720, three-fourths mile north of Drewry, Ala.; 6724, 6725, 6726, 6727, Claiborne, Ala.; 6730, Double Branches Creek, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.; 6742, Powells Landing, Sepulga River, Ala.; 1/7, 1 mile east of Beck, Ala.; 1/8, Beck, Ala.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Nonionella jacksonensis Cushman

Plate 12, figures 3, 4

Nonionella jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 10, pl. 1, figs. 23a–c, 1933.

Test longer than broad, periphery rounded, ventral side involute and the chambers extending over the umbilical region, dorsal side with the chambers ending at the umbilical region; chambers distinct, about 8 in the final whorl, becoming increasingly elongate in the adult, the inner end of the final chamber extending across the umbilical area nearly to the periphery on the ventral side, inflated; sutures distinct, slightly if at all depressed; wall smooth, finely perforate; aperture peripheral at the base of the apertural face, low. Length 0.35 mm; breadth 0.20 mm; thickness 0.10 mm.

Holotype (no. 371678, U.S.N.M.) from Ocala limestone, station 6726, Claiborne, Ala.

This species resembles some of the forms often assigned to *Nonionella turgida* (Williamson), but the

general shape is different, and the chambers of our species are broader and usually fewer.

Cooper marl: 5531, Charleston, S.C.

Ocala limestone: 5567, 6726, 6727, Claiborne, Ala.; 6738, 6½ miles north of Brooklyn, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.

Genus **ELPHIDIUM** Montfort, 1808

Elphidium texanum (Cushman and Applin)

Plate 12, figures 5a-c

Polystomella texana Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 184, pl. 10, figs. 7-9, 1926.

Test nearly circular in outline, the periphery broadly rounded, slightly umbonate; chambers distinct, usually 11 in the adult coil, of nearly uniform size; sutures distinct, slightly depressed, strongly curved, retral processes only slightly developed; wall smooth; aperture a low arched slit at the base of the ventral face of the last-formed chamber. Diameter 0.45 mm; thickness 0.20 mm.

The type specimens of this species came from the Jackson Eocene from Ohio and Red River well 2, Tyler County, Tex., at a depth of 537 feet.

The retral processes are not highly developed, and young specimens are difficult to distinguish from *Nonion*. It has not been recorded from the area east of Texas. Specimens were collected by Alexander Deussen in outcrop material of the Jackson group in a bluff on Atascosa Creek near the old Whitsett ranch house in Atascosa County, Tex., U.S.G.S. station 6148.

Family **CAMERINIDAE**

Genus **ASSILINA** D'Orbigny, 1826

Assilina floridensis (Heilprin)

Nummulites floridensis Heilprin, Acad. Nat. Sci. Philadelphia Proc. for 1884, pp. 321, 322, text fig., 1885.

Operculina floridensis Cushman, U.S. Geol. Survey Prof. Paper 128, p. 130, pl. 20, fig. 12, 1921.

Test planispiral, much compressed, composed of 3 or 4 coils, gradually increasing in breadth; chambers very numerous, 30 or more in the last-formed coil of the adult, the length about five times the height, somewhat irregular in size, each chamber very gradually increasing in size toward the greatest height, which is near the periphery; sutures slightly curved at first but gradually increasing in convexity in the adult; the height of the coil not increasing, and in the specimens there is actually a decrease, indicating senescence toward the end of the development. Maximum diameter 8.00 mm.

This species probably belongs in the genus *Assilina* of D'Orbigny. The outer whorls are not involute; otherwise it is close to *Camerina*.

Ocala limestone: 3636, Spring Hill schoolhouse, 6 miles north of Alachua, Fla.; 3634, Pemberton Ferry (now Croom), Hernando County, Fla., the type locality; 3686(?), Martin, Fla.

Genus **OPERCULINA** D'Orbigny, 1826

Operculina cookei Cushman

Operculina cookei Cushman, U.S. Geol. Survey Prof. Paper 128, p. 127, pl. 18, figs. 1, 2, 1921.

Test planispiral, much compressed, composed of 2½ to 3 coils rapidly increasing in breadth; chambers very numerous, 28 to 32 in the last-formed coil, fairly constant in size and shape, in the adult the length of the chamber 10 to 12 times the height, each chamber gradually widening toward the center or slightly beyond the center; sutures starting in a slightly tangential curve that rapidly increases in convexity toward the periphery, near which it bends back at a sharp angle, joining the peripheral margin of the test; surface of the test in the umbonal region with numerous rounded bosses irregularly placed, the sutures in the last-formed coil ornamented by raised ridges, in the earlier part broken into separate knobs and bosses, toward the later part fused into continuous, raised ridges; surface of the chambers between the sutures somewhat concave, smooth, translucent. Length of adult specimens as much as 10.00 mm.

Ocala limestone: 7116, Flint River near Oakfield, Ga., the type locality; 3626(?), 4½ miles southwest of Philema, Ga.

Jackson formation: 6458, Moodys Branch, Jackson, Miss.

Operculina ocalana Cushman

Operculina ocalana Cushman, U.S. Geol. Survey Prof. Paper 128, p. 129, pl. 19, figs. 4, 5, 1921.

Test planispiral, much compressed, composed of 2 to 3 coils, the last with 16 to 18 chambers; sutures raised, confluent in the center, somewhat rounded, the area between concave and smooth; chambers 3 to 4 times as long as wide; central area of the test umbonate; periphery somewhat raised by a thickening in which the raised sutures terminate. Maximum length 6.00 mm.

Ocala limestone: 3626, 4½ miles southwest of Philema, Ga.; 3760, half a mile south of Tivola, Ga.; 3387, Red Bluff, Flint River, Ga.; 3390, 7097, Bainbridge, Ga.; 7123, Flint River, 4½ miles below Blue Spring, Ga.; 7126, Flint River, 8½ to 9 miles below Newton, Ga.; 7127, a quarter of a mile below Normans Ferry, Flint River, Ga.; 4965, half a mile southwest of Fort White, Fla.; 6785, three-fourths of a mile south of Herlong, Fla.; 7337, Suwannee River above Florida Railway, Fla.; 7348, Suwannee River 1½ miles above Troy Springs, Fla.; 7349, Suwannee River half a mile below Fort McComb, Fla.; 6747, Steamboat Point, Sepulga River, Ala., the type locality.

Operculina vaughani Cushman

Operculina vaughani Cushman, U.S. Geol. Survey Prof. Paper 128, p. 128, pl. 19, figs. 6, 7, 1921.

Test planispiral, much compressed, composed of about 3 coils rapidly increasing in breadth; chambers numerous, 20 to 22 in the last-formed coil, fairly constant in size and shape, in the adult the length of the chamber 5 to 6 times the height, each chamber grad-

ually increasing in height from the proximal end to the maximum height near the distal end; sutures usually starting from the proximal end in a nearly straight radial line and keeping so for about one-third the length, then gently rounded backward toward the periphery, near which the rate of curvature is abruptly increased. Length of adult specimens 7.00–8.00 mm.

Ocala limestone: 3617, Muckafonee Creek, Albany, Ga.; 7115, Flint River near Warwick, Ga.; 7117, Flint River, Lee County, Ga.; 7119, Flint River 16 miles above Albany, Ga.; 7120, Flint River at Albany, Ga.; 7237, half a mile east of Huguenen Ferry, Crisp County, Ga.

Operculina mariannensis Vaughan

Operculina mariannensis Vaughan, Florida Geol. Survey 19th Ann. Rept., p. 158, pl. 1, figs. 1–4, 1923.

Vaughan gives the following description:

Test small, compressed, thin. Diameter from outer edge of aperture through the center 2.00 mm; diameter at right angle to preceding 1.70 mm; thickness through the center about 0.30 mm, but only about half as thick outside the central area.

The number of chambers in the last coil is 11 or 12. The chamber walls are marked externally by costae and rather coarse granules, as shown in the figures. At the center there is a knob which is larger than the costal granulations, its diameter ranging between 0.10 and 0.20 mm.

There are almost 4 coils in a specimen 2.00 mm in diameter. The chamber walls curve rather uniformly and bend backward near the periphery.

Operculina mariannensis is closely related to *O. ocalana* Cushman, with which it is associated and from which it is distinguished by its more delicate test and its smaller number of chambers. The number of chambers in even small specimens of *O. ocalana* is between 16 and 18, whereas in *O. mariannensis* the number is between 11 and 13. The costae corresponding to the chamber walls in *O. ocalana* are usually sinuous and not regularly curved as in *O. mariannensis*, and their sides slope. The intercostal areas in *O. mariannensis* are flatter and more sharply bounded. The center of the test of *O. ocalana* is more conical than in *O. mariannensis*.

Vaughan described this species from "Chipola River below wagon bridge east of Marianna, Fla., lowest bed of Ocala limestone exposed" at that locality; collected by C. Wythe Cooke and D. S. Mossom (U.S.G.S. station 6768).

Genus *OPERCULINELLA* Yabe, 1918

Operculinella willcoxi (Heilprin)

Nummulites willcoxi Heilprin, Acad. Nat. Sci. Philadelphia Proc. for 1882, p. 191, text figs. 1, 2, 1882; idem for 1884, pp. 321, 322, text figs. 1, 2, 1885.

Operculina willcoxi Cushman, U.S. Geol. Survey Prof. Paper 128, p. 129, pl. 20, figs. 9–11, 1921.

Test planispiral, nearly involute, especially in the young, compressed, about 5 coils in the adult, 35 to 45 chambers in the last-formed coil; sutures raised, irregularly curved, somewhat wavy near the middle, central part of the test umbonate. Diameter about 8.00 mm.

Ocala limestone: 322, Newmansville, Fla.; 329, Padlock, Fla.; 4965, half a mile southwest of Fort White, Fla.; 6790, Alachua,

Fla.; 6804, Ocala, Fla.; 6805, Oakhurst quarry, Ocala, Fla.; 6808, Martin, Fla.; 6817, Fort White, Fla.; 7337, Suwannee River above Florida Railway, Fla.

Genus *HETEROSTEGINA* D'Orbigny, 1826

Heterostegina ocalana Cushman

Heterostegina ocalana Cushman, U.S. Geol. Survey Prof. Paper 128, p. 130, pl. 21, figs. 15–18, 1921.

Test broadly complanate, central portion thickest, biconvex, rapidly thinning to the periphery, which is rounded; central portion with irregularly radial costae fusing near the base of the convex portion with the raised ribs of the sutures; in well-preserved specimens the lines between the chambers often marked by raised ribs, giving that portion of the test a reticulate appearance. Maximum length 8.00 mm.

Ocala limestone: 322, Newmansville, Fla.; 365, Johnsons Sink, Levy County, Fla.; 380, near Gainesville, Fla.; 3174, Edgar, Fla.; 3685, Martin, Fla.; 5030, Ocala, Fla.; 6785, three-fourths of a mile south of Herlong's, Fla.; 6787, 2 miles north of High Springs, Fla.; 6789, Alachua, Fla.; 6804, Ocala, Fla.; 6805, Oakhurst quarry, Ocala, Fla.; 6808, Martin, Fla.; 6810, 1 mile northwest of Newberry, Fla.; 6812, 1¼ miles south of Newberry, Fla., the type locality; 6814, 1½ miles northwest of Newberry, Fla.; 6817, Fort White, Fla.; 7338, Dowling Springs, Fla.; 7341, Branford, Fla.; 7365, Pineola, Fla.; 7367, Willow Sink, Fla.; 7098, Red Bluff, Flint River, Ga.

Heterostegina ocalana Cushman var. *glabra* Cushman

Heterostegina ocalana Cushman var. *glabra* Cushman, U.S. Geol. Survey Prof. Paper 128, p. 131, pl. 21, fig. 19, 1921.

Variety differing from the typical form mainly in the smoother surface of the test.

Ocala limestone: 7345, Suwannee River 2½ miles above Branford, Fla.; 7348, Suwannee River 1½ miles above Troy Springs, Fla., the type locality; 7349, Suwannee River half a mile below Fort McComb, Fla.

Family HETEROHELICIDAE

Genus *SPIROPLECTOIDES* Cushman, 1927

Spiroplectoides curta Cushman

Plate 12, figures 7a, b

Spiroplectoides curta Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 11, pl. 1, figs. 24a, b, 1933.

Test minute, about three times as long as broad, only slightly compressed in the later biserial portion, early planispiral portion much compressed, sides of the test nearly parallel; chambers distinct, slightly inflated, usually four pairs in the biserial portion, periphery in the later chambers broadly rounded; sutures distinct, very slightly if at all depressed, nearly at right angles to the periphery; wall distinctly perforate, otherwise smooth; aperture narrow on the terminal face, median. Length 0.25 mm; breadth 0.10 mm; thickness 0.06 mm.

Holotype (no. 371543, U.S.N.M.) from Cooper marl, station 11857, Berkeley County, S.C., where the species is common. It was not found in any of the other samples examined.

This is a very short, stout species of this genus and evidently has a restricted range. The planispiral early portion consists of about a single complete coil, and the chambers show best when the specimen is wet.

Cooper marl: 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus *PLECTOFRONDICULARIA* Liebus, 1903

Plectofrondicularia cf. *P. vaughani* Cushman

Plate 12, figures 8, 9

There are but two specimens of smooth, broad *Plectofrondicularia* in all the Eocene material examined. These are both from the Cooper marl. One of these shows the early chambers fairly well when wet and seems to show that both probably belong to this species, described from the Alazan clays of Mexico.

Cooper marl: 5531, Charleston, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Plectofrondicularia trinitatensis Cushman and Jarvis

Plate 12, figure 10

Plectofrondicularia trinitatensis Cushman and Jarvis, Contr. Cushman Lab. Foram. Research, vol. 5, p. 11, pl. 2, fig. 16, 1929.

Test elongate, sides nearly parallel except at the initial end, which is slightly tapering, initial end subacute; chambers in the earliest portion biserial, quickly becoming uniserial in all the later development, numerous, increasing in height as added, early ones with the sutures sloping to the sides and the chambers much broader than high, in the adult the sutures more nearly transverse and the chambers becoming higher than broad; sutures slightly depressed, distinct; wall ornamented by several distinct, low, sharp costae, continuous from the initial to the apertural end, one at each periphery with 4 or 6 on each side of the test and occasionally another in the median line; aperture elliptical. Maximum length 1.00 mm or slightly more; breadth 0.18 mm; thickness 0.08 mm.

This species was originally described from the Eocene Mount Moriah beds of the Vistabella quarry, Trinidad.

The specimens from the Cooper marl have been compared with the holotype and seem to be identical.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Plectofrondicularia cookei Cushman

Plate 12, figures 11, 12

Plectofrondicularia cookei Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 11, pl. 1, fig. 26, 1933.

Test elongate, tapering, much compressed, slightly keeled, early chambers biserial, later ones uniserial; chambers distinct, especially the later ones, earlier ones somewhat obscured by the ornamentation of the wall,

the uniserial ones extending back farther and farther at the sides as added; sutures of the later portion distinct and slightly depressed, somewhat limbate throughout; wall of the earlier one-third or one-half ornamented by very distinct, sharp longitudinal costae, as many as 15 in some specimens, later portion of the test smooth; aperture elliptical, terminal. Maximum length 2.00 mm; diameter 0.15–0.25 mm.

Holotype (no. 371679, U.S.N.M.) from Cooper marl, Cooper River, S.C.

This species resembles some of those described by Reuss and by Karrer from the Miocene and Oligocene of Europe and the Philippines, but it differs from all of them. It is abundant at several stations in the Cooper marl but was not found in the other Jackson material examined. The biserial chambers can be observed only when the specimen is wet or mounted in balsam or other transparent media. Some specimens are much wider than those shown in the figures.

Cooper marl: 5531, Charleston, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths of a mile west of Old Biggin Church, Berkeley County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus *NODOGENERINA* Cushman, 1927

Nodogenerina cooperensis Cushman

Plate 12, figure 13

Nodogenerina cooperensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 11, pl. 1, fig. 27, 1933.

Test small, slender, tapering, final chamber usually the largest but occasionally reduced somewhat in size, uniserial throughout, or the initial end showing traces of a triserial arrangement; chambers distinct, subglobular or slightly pyriform, the greatest diameter slightly below the middle; sutures distinct, much depressed; wall very finely spinose; aperture terminal, circular, with a very short neck and distinct but narrow lip. Length 0.75 mm; diameter 0.13 mm.

Holotype (no. 371680, U.S.N.M.) from Cooper marl, 1 mile south of Moncks Corner, Berkeley County, S.C., where it is abundant. This is a small but distinctive species with its finely spinose surface. The basal portion of the chamber is not cut under as distinctly as in some of the other species of the genus, and the neck is very short.

Cooper marl: 6319, Ingleside, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Family *BULIMINIDAE*

Genus *BULIMINELLA* Cushman, 1911

Buliminella alabamensis Cushman

Plate 13, figures 6a, b

Buliminella alabamensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 32, pl. 4, figs. 8a, b, 1926.

Test small, obovate, broadest in front view slightly above the middle, initial end pointed, apertural end

broadly rounded, somewhat obliquely truncated, whole test of $1\frac{1}{2}$ to 2 coils; chambers fairly distinct, not inflated; sutures distinct but not depressed; apertural face with a very large open area somewhat broadening toward the base, which reaches to at least the middle of the test; wall very thin and transparent. Length 0.22 mm.

This species differs from others of the genus in the peculiar large open area on the apertural side of the test, broadening toward the base, which reaches to or below the middle line of the test. The apical end is acute. It is very distinct from the species recorded from the lower Oligocene.

Jackson formation: 7227, Water Valley, Choctaw County, Ala., type locality.

Genus **BULIMINA** D'Orbigny, 1826

Bulimina jacksonensis Cushman

Plate 13, figures 7-9

Bulimina jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, pt. 1, p. 6, pl. 1, figs. 6, 7, 1925.

Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 168, pl. 7, figs. 8a, b, 1926.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 59, pl. 11, fig. 5, 1932.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 7, fig. 5, 1933.

Test elongate, tapering, the initial end acute, broadly rounded at the apertural end and in adults somewhat contracted; chambers numerous, fairly distinct; sutures not depressed; surface ornamented by very prominent longitudinal costae, usually 6 to 8, platelike, much raised above the general surface, continuous from the apical end to the base of the last-formed chamber in adults; the outer margin in well-preserved specimens serrate; aperture elongate, comma-shaped. Maximum length 1.40 mm.

This species is evidently the ancestor of the species of the Red Bluff clay, *B. sculptilis* Cushman. The Jackson species is larger, the platelike costae higher, the sutures not depressed, and the costae in well-preserved specimens decidedly serrate as each new portion is added in growth. It occurs also in the Alazan clays of Mexico and the upper Eocene of Texas.

Both species belong to the group represented in the Eocene of Europe by *B. truncana* Gümbel, which has the costae more numerous and less prominent than in the American species. Related to these is *B. buchiana* D'Orbigny, known from the later Tertiary and in the present oceans. In this species the sculpture is still further reduced, but it is evidently a derivative from ancestral forms such as *B. jacksonensis*, *B. sculptilis*, and *B. truncana*.

B. jacksonensis is found in that part of the upper Eocene Jackson formation characterized by the "Zeuglodon bed" of station 2637, Cocoa, Ala., which

is representative of offshore conditions. Similar conditions are indicated in the Texan and Mexican material.

Cooper marl: Ashley marl works, Dorchester County, S.C.

Ocala limestone: 7378, $1\frac{1}{4}$ miles southwest of Inverness, Fla.; 7159, 4 miles southeast of Whatley, Ala.; 1/38, $3\frac{1}{4}$ miles north of Grove Hill, Ala.; 1/43, $1\frac{1}{2}$ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, $3\frac{1}{2}$ miles southeast of Cullomburg, Ala.; 6457, $1\frac{1}{2}$ miles south of Shubuta, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Bulimina jacksonensis Cushman var. **cuneata** Cushman

Plate 13, figures 10, 11

Bulimina jacksonensis Cushman var. *cuneata* Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 35, 1926.

Variety differing from the typical in the larger number of costae (10 to 12), the more tapering form, and especially the very serrate character of the edge of the costae. Length 1.00 mm.

This variety, which is distinct from the typical form, has been found at only two stations but occurs abundantly at the Alabama station.

Cooper marl: 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Jackson formation: 7220, half a mile southeast of Melvin, Ala., type locality.

Bulimina cooperensis Cushman

Plate 13, figures 12-14

Bulimina cooperensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 12, pl. 1, figs. 32a, b, 1933.

Test elongate, tapering, $2\frac{1}{2}$ to 3 times as long as wide, greatest breadth toward the apertural end; chambers distinct, inflated, considerably overlapping; sutures deep, distinct; wall of the basal half of the chambers with platelike costae ending in sharp points, the initial end of the test often with a spine; aperture elongate with a slightly depressed border. Length 0.40-0.50 mm; breadth 0.18-0.20 mm.

Holotype (no. 371684, U.S.N.M.) from Cooper marl, station 11857, Berkeley County, S.C.

This belongs in the general group of *Bulimina inflata* but is quite different from the typical form of that species in the Pliocene of Italy. It was common at the type station but not found at any other in the material examined.

Cooper marl: 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Bulimina ovata D'Orbigny

Plate 13, figures 15, 16

Bulimina ovata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 185, pl. 11, figs. 13, 14, 1846.

Test narrowly ovate in front view, circular or nearly so in end view, the apex broadly rounded; chambers

elongate, distinct, slightly inflated; sutures distinct, slightly depressed; wall smooth; aperture narrow, with a platelike tooth visible in well-preserved specimens. Length 0.35–0.50 mm; breadth 0.15–0.18 mm.

The specimens from the Cooper marl are very close indeed to those figured by D'Orbigny from the Vienna Basin.

Possibly the specimen figured from the Eocene Ohio and Red River well 2, Tyler County, Texas, at a depth of 1,056 feet,¹² may belong here.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Genus *VIRGULINA* D'Orbigny, 1826

Virgulina dibollensis Cushman and Applin

Plate 14, figures 1–3

Virgulina dibollensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 168, pl. 7, figs. 7a–c, 1926.

Howe, Jour. Paleontology, vol. 2, p. 175, 1928.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 66, pl. 11, fig. 1, 1932.

Test much compressed, very slender, tapering, about $4\frac{1}{2}$ times as long as broad, the whole test twisted through about 180°, initial end rounded, greatest breadth at about three-quarters of the length from the initial end; periphery rounded; chambers distinct, 15 or more, early ones spiral, later ones biserial, the last three chambers making up half the test; sutures oblique, distinct, slightly depressed; wall thin, punctate, the punctae in longitudinal rows; aperture elongate, elliptical. Length, 0.60 mm; maximum breadth, 0.12–0.15 mm.

This is a much slenderer species than *V. schreibersiana* Czjzek, from the Vienna Basin. It has many more chambers, and the ornamentation of punctae arranged in linear series is distinctive.

The type specimens were from Haynes well 1, near Burkeville, Newton County, Tex., at a depth of 3,175 to 3,270 feet.

Ocala limestone: 6722, three-fourths mile northwest of Monroeville, Ala.; 6730, Double Branches Creek, Ala.; 6741, $3\frac{1}{2}$ miles northeast of Brooklyn, Ala.

Virgulina recta Cushman

Plate 14, figures 4a, b

Virgulina recta Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 12, pl. 1, figs. 31a, b, 1933.

Virgulina sp.?, Cushman, U.S. Geol. Survey Prof. Paper 129, p. 92, pl. 16, figs. 2, 3, 1922.

Test elongate, not much compressed, tapering at the initial end, sides for the remainder of the test nearly parallel, apertural end broadly truncate; chambers distinct, high, 6 biserial ones making up the larger part of the test; sutures distinct, slightly de-

pressed, nearly at right angles to the periphery; wall smooth; aperture rather broad and large for the genus. Length 0.55 mm; breadth 0.15 mm; thickness 0.08 mm.

Holotype (no. 371544, U.S.N.M.) from Cooper marl, station 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

This is the same as the species figured without name from the Byram marl of Mississippi. It resembles somewhat *Virgulina mexicana* Cole, from the Guayabal formation of Mexico, but specimens of that species examined show a smaller, much more delicate and more compressed form.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus *BOLIVINA* D'Orbigny, 1839

Bolivina attenuata Cushman

Plate 14, figure 5

Bolivina attenuata Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 30, pl. 4, fig. 4, 1926.

Test very strongly compressed, broad, rapidly increasing in width with newly added chambers, in the type specimen about as broad as long; central portion slightly thickened; chambers comparatively few, distinct, elongate, curved backward strongly, the inner end of each with a slight backward-pointing projection; sutures very distinct, limbate, the periphery of the chamber with a slight keel continuous with the suture; earliest chambers with a reticulate ornamentation, later ones smooth. Length 0.40 mm.

This species has a very broad test, much broader than any of the others of the upper Eocene except perhaps *Bolivina frondea* Cushman, which it resembles in no other particular. The early ornamentation is suggestive of *B. caelata* Cushman, and the later portion with its peculiar backward-projecting inner portion of the chamber is somewhat like *B. jacksonensis* Cushman.

Ocala limestone: 1/43, $1\frac{1}{2}$ miles southwest of Perdue Hill, Ala., the type locality.

Bolivina caelata Cushman var.

At two stations in the deeper-water deposits of the upper Eocene there are numerous specimens of a form of *Bolivina caelata* Cushman which more closely resemble var. *byramensis* than the typical form of the species.

All these forms are related to *Bolivina reticulata* Hantken, from the Eocene of Europe, but have a more carinate, thinner test. A similar form occurs in the Alazan clays of Mexico.

Ocala limestone: 1/38, $3\frac{1}{4}$ miles north of Grove Hill, Ala.; 1/43, $1\frac{1}{2}$ miles southwest of Perdue Hill, Ala.

¹² Cushman, J. A., and Applin, E. R., Am. Assoc. Petroleum Geologists Bull., vol. 10, pl. 7, figs. 10, 11, 1926.

***Bolivina gardnerae* Cushman**

Plate 14, figures 6, 7

Bolivina cf. *B. punctata* Cushman, U.S. Geol. Survey Prof. Paper 133, p. 19, pl. 2, fig. 1, 1923.

Bolivina gardnerae Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 31, pl. 4, figs. 7a, b, 1926.

Test elongate, compressed, slightly tapering from the rounded initial end, periphery rounded, test broadly oval in transverse section, sides nearly parallel; chambers numerous, slightly inflated, distinct; sutures distinct, depressed; wall coarsely perforate, without a definite arrangement of the perforations; aperture elongate. Maximum length 0.46 mm.

Bolivina gardnerae occurs also in the lower Vicksburg. It is more compressed, shorter, and broader than *B. gracilis*, described next, and the perforations have no definite arrangement.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga., the type locality; 6742, Powells Landing, Sepulga River, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.

***Bolivina gracilis* Cushman and Applin**

Plate 14, figures 8-10

Bolivina gracilis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 167, pl. 7, figs. 1, 2, 1926.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 57, 1932.

Test small, slender, slightly curved, very little compressed, composed of numerous chambers, distinct, slightly inflated; sutures distinct, oblique, slightly depressed; wall coarsely perforate, the perforations often falling into a linear arrangement lengthwise of the test; aperture comma-shaped, with a slight trace of a lip. Maximum length 0.45 mm.

Bolivina gracilis is one of the group of elongate punctate or perforate species represented by *B. punctata* D'Orbigny. Its nearly circular transverse section distinguishes it from *B. gardnerae*, described above. It was originally described from the upper Eocene, 4 miles east of Diboll, Angelina County, Tex.

Ocala limestone: 6722, three-fourths of a mile northwest of Monroeville, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.

Jackson formation: 7227, Water Valley, Ala.; 6472, 6473, Yazoo City, Miss.

***Bolivina jacksonensis* Cushman and Applin**

Plate 14, figures 11-13

Bolivina sp.? Cushman, U.S. Geol. Survey Prof. Paper 133, p. 19, pl. 3, fig. 2, 1923.

Bolivina jacksonensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 167, pl. 7, figs. 3, 4, 1926.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 59, pl. 11, fig. 11, 1932.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, fig. 3, 1933.

Test much compressed, thickest along the median line, periphery slightly keeled or with the keel want-

ing; chambers numerous, distinct, both the median and peripheral portions extending backward; sutures distinct, slightly depressed; wall thin, translucent, smooth, very finely punctate; aperture elongate. Maximum length 0.50 mm.

This is the species figured in the first reference given above. The specimen was from the Red Bluff clay, the lowest formation of the Oligocene of Mississippi and Alabama. The species is common at numerous stations in the upper Eocene of the Coastal Plain of the United States and Mexico. It is related to *Bolivina mississippiensis* Cushman, of the Oligocene Byram marl. The type specimens are from Haynes well 1, near Burkeville, Newton County, Tex., at a depth of 3,175 to 3,270 feet.

Cooper Marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 6321, Baldock, S.C.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.; 6725, 6726, 6727, Claiborne, Ala.; 6730, Double Branches Creek, Ala.; 6740, mouth of Robinsons Mill Creek, Ala.; 1/3, Beck, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 7227, Water Valley, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

***Bolivina jacksonensis* Cushman and Applin var. *striatella* Cushman and Applin**

Plate 14, figures 14-18

Bolivina jacksonensis Cushman and Applin var. *striatella* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 167, pl. 7, figs. 5, 6, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, fig. 4, 1933.

Variety differing from the typical form in having the early portion with a number of very fine longitudinal costae, without a definite carina; sutures in the median portion limbate.

This variety is known from the upper Eocene of the Coastal Plain of the United States and Mexico. The type specimens were found 4 miles east of Diboll, Angelina County, Tex.

Cooper Marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Creek, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.; 6321, Baldock, S.C.

Ocala limestone: 6742, Powells Landing, Sepulga River, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.; 6646, Hays Chapel, Wayne County, Miss.

***Bolivina spiralis* Cushman**

Plate 15, figures 1, 2

Bolivina spiralis Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 31, pl. 4, figs. 6a, b, 1926.

Test small, only slightly compressed, spirally twisted, periphery rounded; chambers numerous, dis-

tinct, last 5 chambers making up half of the test; sutures strongly depressed, distinct; wall in the earlier chambers roughened and slightly spinose, later ones coarsely punctate. Length 0.50 mm.

This species in some respects resembles the Recent Indo-Pacific *B. tortuosa* H. B. Brady but is much less compressed and has a roughened exterior, almost spinose in the young.

Cooper marl: 6319, Ingleside, S.C., the type locality; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus *LOXOSTOMUM* Ehrenberg, 1854

Loxostomum dalli (Cushman)

Plate 15, figure 3

Bifarina dalli Cushman, Contr. Cushman Lab. For. Research, vol. 2, p. 31, pl. 4, figs. 5a, b, 1926.

Test slightly compressed, elongate, slightly tapering from the rounded initial end, apertural end truncate; chambers few, distinct, inflated, especially toward the apertural end; sutures distinct, compressed; wall ornamented with numerous fine but sharp costae on the earlier two-thirds, the last-formed chambers smooth, finely punctate; aperture becoming terminal in the adult, elliptical or elongate oval. Maximum length 0.55 mm.

This is a beautifully ornamented species occurring at only two stations. The later chambers place the species in the genus *Loxostomum*, having the aperture terminal and the chamber occupying the entire width of the test.

Jackson formation: 7220, half a mile southeast of Melvin, Ala., the type locality.

Ocala limestone: 1/38, 3¼ miles north of Grove Hill, Ala.

Genus *REUSSSELLA* Galloway, 1933

Reussella eocena (Cushman)

Plate 15, figures 4, 5

Reussia eocena Cushman, Contr. Cushman Lab. For. Research, vol. 9, p. 13, pl. 1, fig. 25, 1933.

Test short and broad, pyramidal, three-sided, widest above the middle, triangular in transverse section, the sides in the adult deeply concave, in the young stages nearly flat; angles in the young sharp, in the adult becoming thick and rounded; surface smooth; aperture at the inner border of the last-formed chamber. Maximum length 0.80 mm.

Holotype (no. 371545, U.S.N.M.) from Ocala limestone, station 7365, Pineola, Fla.

This species differs from the two common Vicksburg species, *Reussella rectimargo* (Cushman) and *R. spinulosa* (Reuss) var. *glabrata* (Cushman), in the short, broad form and especially the much deeper concavity of the sides and the rounded angles. It seems to be most abundant in the shallower-water phase, such as is represented by the Ocala limestone.

In its very early stages the sides are flat and suggest *Reussella spinulosa* (Reuss); later it assumes the form of var. *glabrata* (Cushman) but in its adult characters becomes very broad, with deeply concave sides. The early stages might easily be confused with the other forms mentioned, but the adult is distinctive.

Cooper marl: 6321, Baldock, S.C.

Ocala limestone: 7097, Bainbridge, Ga.; 7098, Red Bluff, Flint River, Ga.; 7099, half a mile above Red Bluff, Ga.; 7127, a quarter of a mile below Normans Ferry, Flint River, Ga.; 7130, Flint River, 1½ miles below Red Bluff, Ga.; 7189, Rich Hill, Ga.; 3629, Alachua County, Fla.; 6768, Marianna, Fla.; 6785, three-fourths mile south of Herlong's, Fla.; 6790, Alachua, Fla.; 6799, Alachua Sink, Gainesville, Fla.; 6804, Ocala, Fla.; 6805, Oakhurst quarry, Ocala, Fla.; 6807, Zuber, Fla.; 6808, Martin, Fla.; 6812, 1¼ miles south of Newberry, Fla.; 7194, Marianna, Fla.; 7338, Dowling Springs, Fla.; 7345, Suwannee River 2¼ miles above Branford, Fla.; 7348, Suwannee River 1½ miles above Troy Springs, Fla.; 7349, Suwannee River half a mile below Fort McComb, Fla.; 7355, 3 miles northwest of Levyville, Fla.; 7364, 1½ miles west of Croom, Fla.; 7365, Pineola, Fla.; 7366, Anthony, Fla.; 7378, 1¼ miles southwest of Inverness, Fla.; 1/48, Duncan, Fla.; 6719, three-fourths mile north of Drewry, Ala.; 6722, three-fourths mile northwest of Monroeville, Ala.; 6725, Claiborne, Ala.; 6730, Double Branches Creek, Ala.; 6738, 6½ miles north of Brooklyn, Ala.; 6740, mouth of Robinsons Mill Creek, Ala.; 6746, Ward's sawmill, Sepulga River, Ala.; 6754, Choctawhatchee River at State line, Ala.-Fla.; 6755, Choctawhatchee River above State line, Ala.; 6756, Choctawhatchee River 3½ miles below Geneva, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/8, Beck, Covington County, Ala.; 1/21, Covington County, Ala.; 1/25, 1 mile east of Harts Bridge, Ala.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Reussella rectimargo (Cushman)

Verneuilina rectimargo Cushman, U.S. Geol. Survey Prof. Paper 129, p. 127, pl. 29, figs. 4, 5, 1922; Prof. Paper 133, p. 21, 1923.

Test elongate, triangular in cross section, early portion tapering, adult portion with the sides nearly parallel and straight; chambers numerous, arranged triserially; sutures not depressed, often slightly limbate; sides of the test flattened or very slightly concave; peripheral angles rounded; apertures slightly elongate at the base of the inner margin of the last-formed chamber; wall finely punctate. Length 1.00 mm or less.

With the one exception noted below, *Reussella rectimargo* has been found only in the Vicksburg Oligocene. It is related to *R. sculptilis* and *R. eocena*, described in this paper.

Ocala limestone: 1/7, 1 mile east of Beck, Ala.

Reussella sculptilis (Cushman)

Plate 15, figures 6, 7

Verneuilina sculptilis Cushman, Contr. Cushman Lab. For. Research, vol. 2, p. 34, pl. 5, fig. 3, 1926.

Test somewhat longer than broad, pyramidal, three-sided, widest at about two-thirds its length, triangular

in transverse section, sides flattened or even slightly convex, apical-end tapering, in well-preserved specimens ending in a short point, angles of the test acute; wall sculptured, the sutural lines strongly raised, the central line of each side of the test marked by a strongly raised costa; aperture on the inner border of the last-formed chamber. Maximum length 0.50 mm.

This is a beautifully sculptured species. The apical end is prolonged into a short spine.

Ocala limestone: 1/39, Pea River at Geneva, Ala.

Genus *UVIGERINA* D'Orbigny, 1826

Uvigerina alata Cushman and Applin

Plate 15, figures 8-10

Uvigerina alata Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 176, pl. 8, figs. 11-13, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, figs. 11, 12, 1933.

Test elongate, about twice as long as broad; chambers distinct and inflated; sutures distinct, depressed; wall ornamented with a few very prominent, thin, high, platelike costae, usually extending posteriorly beyond the limits of the chambers; apertural end of the last-formed chamber truncate, with a very short, cylindrical neck somewhat set down into a depression in the chamber wall. Maximum length 0.75 mm; breadth 0.30-0.35 mm.

Type specimens from Jackson group in Ohio and Red River well 2, Tyler County, Tex., at a depth of 1,056 feet.

Uvigerina cocoaensis Cushman

Plate 15, figures 11-13

Uvigerina cocoaensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 68, pl. 10, fig. 12, 1925.

Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 174, pl. 8, fig. 15, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, fig. 13, 1933.

Test of medium size for the genus, elongate, fusiform, greatest width slightly above the middle, periphery very slightly lobulate; chambers rather few, inflated, evenly rounded; sutures slightly depressed; wall ornamented with coarse longitudinal costae, not usually confluent with those of the chambers above or below, becoming lower and less conspicuous in later chambers, the last-formed chamber in the adult usually smooth, about 12 to 16 costae in the complete circumference in the widest region; wall finely punctate; apertural end with a short cylindrical neck and phialine lip. Maximum length 0.80 mm; width 0.30-0.35 mm.

This species is nearest to *U. jacksonensis*, of the lower Eocene, but is somewhat smaller, more slender, and has fewer costae. It is especially characteristic of the Jackson horizon and occurs in the upper Eocene of Texas, in the Ohio and Red River well 2, Tyler

County, at a depth of 1,056 feet, and in the Alazan clays of Mexico. The type specimen is from Cocoa, Ala.

Ocala limestone: 6720, three-fourths mile north of Drewry, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Uvigerina cookei Cushman, n. sp.

Plate 15, figures 14-16

Test of large size for the genus, elongated, sub-cylindrical, slightly fusiform, greatest width above the middle, periphery slightly lobulate; chambers numerous, inflated, evenly rounded; sutures slightly depressed; wall ornamented with sharp, low, longitudinal costae, in part confluent with those above and below, usually reduced on the last-formed chamber, about 24 to 30 costae in the complete circumference in the widest region; wall finely punctate; apertural end with a very short cylindrical neck and wide phialine lip. Maximum length 1.20 mm; width 0.35-0.40 mm.

Holotype (no. 371546, U.S.N.M.) from Ocala limestone, station 1/38, 3¼ miles north of Grove Hill, Ala.

This species is the largest of those of the upper Eocene; the costae are very numerous but not highly developed, and the neck is very short and stout for the size of the test. It is related to such species as *U. tenuistriata* Reuss and may be the ancestral form of the living *U. peregrina* var. *bradyana* Cushman of our eastern coast.

Castle Hayne marl: 5611, Wilmington, N.C.

Cooper marl: 6319, Ingleside, S.C.; Ashley marl works, Dorchester County, S.C.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.; 7237, half a mile east of Huguenen Ferry, Crisp County, Ga.; 6706, Oven Bluff, Tombigbee River, Ala.; 6720, three-fourths of a mile north of Drewry, Ala.; 1/21, Covington County, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.

Uvigerina dumblei Cushman and Applin

Plate 15, figure 17

Uvigerina dumblei Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 177, pl. 8, fig. 19, 1926.

Test large, periphery rounded, the sides nearly parallel for most of its length, nearly twice as long as broad; chambers distinct; sutures slightly depressed; wall ornamented by very numerous fine longitudinal costae, often 10 to 12 to a single chamber, extending backward, making the sutures crenulate; the apertural end with a slightly projecting cylindrical neck. Maximum length 1.00 mm.

Type specimens from Haynes well 1, near Burkeville, Newton County, Tex., at a depth of 3,175 to 3,270 feet.

Uvigerina gardnerae Cushman

Plate 15, figures 18, 19

Uvigerina gardnerae Cushman, in Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 175, pl. 8, figs. 16, 17, 1926.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 63, pl. 12, fig. 6, 1932.

Test of medium size for the genus, much elongated, slender, early portion fusiform, later portion with the chambers somewhat loosely arranged, periphery somewhat lobulate; chambers numerous, inflated, especially the later ones, earlier ones with the basal end of the chambers tending to overhang the preceding ones; wall ornamented with longitudinal costae in the earlier portion, the costae not confluent with those of chambers above or below, costae later tending to break up into lines of spines, and the later portion of the test in adults generally hispid, over 20 costae in the complete circumference before breaking into spines; apertural end with a slightly tapering sub-cylindrical neck and slight phialine lip. Maximum length 0.80 mm; width 0.25 mm.

This species can hardly be confused with any other of the upper Eocene species of the Coastal Plain. Its characters of ornamentation and the slender form distinguish it from all but *U. ocalana*, which can be identified by the very small size and the triangular shape of the later chambers.

Uvigerina gardnerae is related to and probably the ancestral form of the living *U. auberiana* D'Orbigny.

Besides the following records for the eastern and Gulf Coastal Plain, *U. gardnerae* occurs in the upper Eocene of Texas and in the Alazan clays of Mexico. The type specimens are from Ohio and Red River well 2, Tyler County, Tex., at a depth of 1,056 feet.

Cooper marl: Ashley marl works, Dorchester County, S.C.
Ocala limestone: 7378, 1¼ miles southwest of Inverness, Fla.; 6706, Oven Bluff, Tombigbee River, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 1/26, Drewry, Ala.; 1/38, ¾ miles north of Grove Hill, Ala.

Jackson formation: 7203, ¾ miles southeast of Cullomburg, Ala.; 7227, Water Valley, Ala.; 6457, ½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Uvigerina gardnerae Cushman var. *texana* Cushman and Applin

Plate 15, figure 20

Uvigerina gardnerae Cushman var. *texana* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 175, pl. 8, fig. 18, 1926.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 64, pl. 12, figs. 3, 9, 1932.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, fig. 15, 1933.

Variety differing from the typical form in being much more elongate; the later portion is somewhat less in diameter than the earlier part. Length 0.60 mm; breadth 0.20 mm.

This variety occurs in the upper Eocene of Texas but has not been recognized from the eastern portion of the Coastal Plain. The type specimens came from a depth of 1,056 feet in Ohio and Red River well 2, Tyler County, Tex.

Uvigerina glabrans Cushman

Plate 15, figure 21

Uvigerina glabrans Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 13, pl. 1, fig. 28, 1933.

Test of medium size for the genus, elongated, sub-cylindrical, or slightly fusiform, greatest width usually below the middle, periphery only slightly lobulate; chambers comparatively few, inflated, evenly rounded; sutures very slightly depressed; wall smooth, or with faint traces of costae near the initial end, finely perforate; apertural end truncate, with a short delicate cylindrical neck and phialine lip, the neck often broken. Maximum length, 0.75 mm; width, 0.30–0.35 mm.

Holotype (no. 371686, U.S.N.M.) from Jackson formation, station 7203, ¾ miles southeast of Cullomburg, Ala.

This is the only smooth species of the Coastal Plain upper Eocene. It is related to *U. cocoaensis* and is usually found associated with that species but in fewer numbers. It is also related to certain of the living species of the western Atlantic, usually referred to *U. canariensis* D'Orbigny.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.

Ocala limestone: 7159, 4 miles southeast of Whatley, Ala.; 1/26, Drewry, Ala.; 1/38, ¾ miles north of Grove Hill, Ala.; 1/43, ½ miles southwest of Perdue Hill, Ala.

Jackson formation: 7203, ¾ miles southeast of Cullomburg, Ala.

Uvigerina jacksonensis Cushman

Plate 16, figures 1–3

Uvigerina jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 67, pl. 10, fig. 13, 1925.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 65, pl. 12, figs. 7, 8, 1932.

Test large for the genus, stout, broadly fusiform, greatest width at about the middle, periphery slightly lobulate; chambers rather few, inflated; sutures somewhat depressed, basal part of chamber not conspicuously overhanging, evenly curved; wall ornamented with coarse longitudinal costae, in the early portion usually limited to the individual chamber, in the adult portion usually becoming confluent with

those of the adjacent chambers above and below, outer edge of the costae entire; about 18 to 22 costae in the complete circumference in the widest region; wall rather coarsely punctate; apertural end with a tendency in the last-formed chamber to lose or reduce the costae, with a cylindrical neck of medium length and phialine lip. Maximum length 0.90 mm; width 0.45 mm.

Uvigerina jacksonensis is a larger, stouter species than *U. yazooensis*. The costae, although nearly as numerous, seem to be much fewer on account of the larger size of the test. It seems to be characteristic of the middle part of the upper Eocene represented by the "Zeuglodon bed" of the Jackson formation, U.S.G.S. station 2637. It is not found in any numbers in the eastern material representing the shallower phase of the Ocala limestone, being replaced there by *Angulogerina ocalana*, which is closely related to *Angulogerina occidentalis* Cushman, a species of shallow, warm waters of the Tortugas region and elsewhere, which also occurs in the Miocene of Florida. *Uvigerina jacksonensis* occurs also in the Alazan clays of Mexico.

Cooper marl: 6319, Ingleside, S. C.; Ashley marl works, Dorchester County, S.C.

Ocala limestone: 7719, Spring Mill Branch, Jenkins County, Ga.; 6730, Double Branches Creek, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 1/26, Drewry, Ala.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Uvigerina topilensis Cushman

Plate 16, figure 4

Uvigerina topilensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 5, pl. 1, figs. 5a, b, 1925.

Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 176, pl. 8, fig. 14, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, fig. 14, 1933.

Test generally fusiform, broadest in the middle, initial and apertural ends both rounded; chambers irregularly spiral, inflated; sutures distinct, depressed; wall ornamented with a very few costae, progressively decreasing in height toward the apertural end of the test and usually continuous from one chamber to another, the last-formed chamber usually smooth; wall finely punctate, the costae on the earliest portion sometimes projecting backward into plate-like processes; aperture with a very narrow cylindrical neck. Length 0.70 mm; breadth 0.30 mm.

This species, described from the upper Eocene clays of Mexico, occurs in the upper Eocene of Texas at a depth of 1,056 feet in Ohio and Red River well 2, Tyler County.

Uvigerina yazooensis Cushman

Plate 16, figures 5, 6

Uvigerina yazooensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 13, pl. 1, fig. 29, 1933.

Test small, elongate, fusiform, greatest width toward the apertural end, periphery strongly lobulate; chambers numerous, inflated; sutures strongly depressed, the basal portion of the chamber overhanging the preceding ones; wall ornamented with sharp, longitudinal costae, limited to the individual chamber, those preceding the succeeding chambers not usually in the same line, the outer edge of the costae often serrate, about 22 to 26 costae in the complete circumference in the widest region; wall rather coarsely punctate; apertural end with a short, narrow cylindrical neck and phialine lip. Maximum length 0.70 mm; width 0.28 mm.

Holotype (no. 371549, U.S.N.M.) from Jackson formation, station 7220, half a mile southeast of Melvin, Ala.

This species is distinct from the others of the upper Eocene of the Coastal Plain in the sharp costae, limited to the individual chambers, the very deeply indented sutural regions making a very lobulate periphery. There is apparently no tendency for the costae to become obsolete in the last-formed chambers.

Uvigerina yazooensis is apparently the direct ancestral form of some of the species now living in the eastern Atlantic, especially *U. peregrina* Cushman. This Recent species has occurred below the 100-fathom mark only twice in a large number of stations from which it is recorded.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths of a mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Jackson formation: 7220, half a mile southeast of Melvin, Ala.; 6472, Yazoo City, Miss.; 6463, Jackson, Miss.

Genus *ANGULOGERINA* Cushman, 1927

Angulogerina ocalana Cushman

Plate 16, figures 7, 8

Angulogerina ocalana Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 14, pl. 1, fig. 30, 1933.

Test small for the genus, elongate, fusiform, periphery very slightly lobulate, somewhat triangular in section, the angles rounded, especially in the early portion; wall ornamented with numerous very fine, slightly raised costae, the outer edge broken into a finely serrate line; apertural end with the chambers somewhat loosely arranged, the costae less prominent or nearly wanting, the chambers more definitely triangular, angles sharper; apertural end extended into

a short neck with a slight lip. Maximum length 0.35 mm; width 0.15 mm.

Holotype (no. 371550, U.S.N.M.) from upper Eocene at station 7719, Spring Hill Branch, Jenkins County, Ga.

This is probably the ancestral form of *A. byramensis* Cushman, so abundant in the Byram marl of the lower Oligocene, and these are again ancestral forms of the Miocene and living *A. occidentalis* Cushman of the shallow water of the Florida region.

A. ocalana occurs in the lower part of the upper Eocene close to the "Scutella bed" in the western part of the area, which probably represents shallower conditions than the succeeding members. It is also found in the Ocala limestone or its equivalent in the shallower phase of the eastern part of the area. In the Alazan clays of Mexico it occurs very sparingly.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Ocala limestone: 7237, half a mile east of Huguenen Ferry, Crisp County, Ga.; 7719, Spring Mill Branch, Jenkins County, Ga.; 7378, 1¼ miles southwest of Inverness, Fla.; 6724, Claiborne, Ala.; 6740, mouth of Robinson Mill Creek, Ala.; 6756, Choctawhatchee River 3½ miles below Geneva, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/33, 7½ miles northwest of Geneva, Ala.; 1/39, Pea River at Geneva, Ala.; 1/48, Duncan, Fla.

Jackson formation: 6471, Garlands Creek, Miss.

***Angulogerina cooperensis* Cushman, n. sp.**

Plate 16, figures 9a, b

Test small, slender, initial end tapering to a sharp point, triangular in section throughout, periphery slightly keeled at the three angles; chambers distinct in the later part but not inflated or loosely arranged, strongly angled; sutures distinct, very slightly if at all depressed; wall ornamented with longitudinal costae, usually broken at the sutures, last chambers often becoming somewhat smooth; aperture with a short neck and a distinct lip. Length 0.40–0.45 mm; breadth 0.18–0.20 mm.

Holotype (no. 371551, U.S.N.M.) from Cooper marl, station 11863, three-fourths of a mile west of Old Biggin Church, Berkeley County, S.C.

This is distinct from *Angulogerina ocalana* in the angular test throughout, *A. ocalana* having very rounded, inflated chambers in the early series. In *A. ocalana* the last chambers are very loosely arranged in the adult; in *A. cooperensis* they are fairly compact throughout. The costae of *A. ocalana* are finer and more numerous.

Cooper marl: 11863, three-fourths of a mile west of Old Biggin Church, Berkeley County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus **TRIFARINA** Cushman, 1923

***Trifarina bradyi* Cushman var. *advena* Cushman**

Plate 16, figures 10a, b

Trifarina bradyi Cushman var. *advena* Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, pt. 4, p. 87, 1926.

Variety differing from the typical form in being slightly smaller and stouter; the sides especially being much less concave, and the carinae of the sides much less prominent, the surface rougher and the wall thicker. Length 0.30 mm.

This variety is most nearly allied to *T. bradyi* from the Pacific Ocean.

This is apparently the first record of the typical form of the genus from the Eocene. It is a small, rather easily overlooked form, but has occurred at several stations in the upper Eocene.

Ocala limestone: 6790, Alachua, Fla.; 6739, 6740, mouth of Robinsons Mill Creek, Ala.; 1/33, 7½ miles northwest of Geneva, Ala.

Jackson formation: 6463, Jackson, Miss., type locality.

Family **ELLIFSOIDINIDAE**

Genus **PLEUROSOTOMELLA** Reuss, 1860

***Pleurostomella jacksonensis* Cushman and Applin**

Plate 16, figures 11a–c

Pleurostomella jacksonensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 168, pl. 7, figs. 9a–c, 1926.

Test elongate, tapering, broadest at about the middle of the last-formed chamber, circular in transverse section; chambers comparatively few, alternating, distinct; sutures slightly depressed; wall marked by series of depressions in longitudinal lines; aperture of the usual type in this genus. Length 0.50 mm.

The only record of this species is from the upper Eocene of the Coastal Plain of Texas. The specimens are from a depth of 3,175 to 3,270 feet in Haynes well 1, near Burkeville, Newton County.

Family **ROTALIIDAE**

Genus **SPIRILLINA** Ehrenberg, 1841

***Spirillina vivipara* Ehrenberg**

Plate 16, figure 12

Spirillina vivipara Ehrenberg, Akad. Wiss. Berlin Abh., 1841, p. 442, pl. 3, fig. 41.

Moebius, Beiträge zur Meeresfauna der Insel Mauritius, p. 88, pl. 8, figs. 1, 2, 1880.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 630, pl. 85, figs. 1–5, 1884.

Flint, U.S. Nat. Mus. Rept. for 1897, p. 326, pl. 71, fig. 4, 1899.

Millett, Roy. Micr. Soc. Jour., 1903, p. 693.

Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, p. 32, pl. 2, fig. 7, 1906.

Cushman, U.S. Nat. Mus. Bull. 71, pt. 5, p. 3, pl. 1, figs. 1, 2, fig. 1 (in text), 1915.

Test planispiral, composed of a few coils not divided into chambers, coils flattened and somewhat broader in the later portion, both sides somewhat flattened, the periphery rounded; wall conspicuously perforate. Diameter of single specimen 0.30 mm.

There is a single specimen from U.S.G.S. station 6725, Ocala limestone, Claiborne, Ala., which probably can best be referred to this species, although the coils are not as much flattened as in the Recent specimens, nor are the perforations as large.

There are specimens of *Spirillina* also from stations 6726, Claiborne, Ala., and 1/8, Beck, Ala., Ocala limestone, but they are not sufficiently well preserved to warrant specific determination.

Genus *DISCORBIS* Lamarck, 1804

Discorbis globulo-spinosa Cushman

Plate 16, figures 14a-c

Discorbis globulo-spinosa Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 14, pl. 2, figs. 1a-c, 1933.

Test small, ventral side flat, dorsal side strongly convex, composed of several whorls, last-formed one with 5 chambers, ventral peripheral angle sharp and somewhat keeled; chambers of the early whorls somewhat indistinct, later ones more so, narrow and high, and inner portion on the dorsal side produced into a distinct, raised ridge, which often becomes spinose in the central portion; sutures fairly distinct, slightly depressed and very oblique on the dorsal side, on the ventral side nearly radial; wall coarsely perforate both on the dorsal and ventral sides, ventral side smooth; aperture a curved, arched opening on the ventral side of the test, extending in a curve toward the umbilical area. Diameter 0.30 mm; thickness 0.20-0.25 mm.

Holotype (no. 371553, U.S.N.M.) from upper Eocene, Jackson, Miss.

Castle Hayne marl: 5611, Wilmington, N.C.

Ocala limestone: 6725, Claiborne, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/23, Claiborne, Ala.

Jackson formation: 7227, Water Valley, Ala.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

This species is related to those of the Indo-Pacific region, more especially to some of those described from the late Tertiary of Australia.

Discorbis hemisphaerica Cushman

Plate 16, figures 13a-c

Discorbis hemisphaerica Cushman, Contr. Cushman Lab. Foram. Research, vol. 7, p. 59, pl. 7, figs. 14a-c, 1931.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, figs. 17, 18, 1933.

Test small, hemispherical, the ventral side flattened, dorsal side strongly convex, composed of several whorls, last-formed one with 4 chambers, ventral peripheral portions rounded; chambers of the early

whorls somewhat covered by a secondary clear growth, later chambers more distinct, somewhat narrowed, smooth; sutures distinct, oblique, slightly depressed, on the ventral side radial; wall coarsely and conspicuously perforate, less distinctly so on the ventral side, which is peculiar, as the last-formed whorl of chambers only partly covers the earlier ones; aperture a curved arched opening on the ventral side of the test from near the periphery, well back from the umbilical region, developing a slight raised lip and apertural face. Diameter 0.35 mm; thickness 0.20-0.30 mm.

Holotype (no. 371552, U.S.N.M.) from upper Eocene, station 6463, Jackson, Miss.

Ocala limestone: 7161, 5 miles southeast of Whatley, Ala.; 1/7, 1 mile east of Beck, Ala.; 1/8, Beck, Ala.

Jackson formation: 7227, Water Valley, Ala.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

The ventral side of the test is very peculiar in the slight overlapping of the last-formed whorl, leaving the earlier chambers exposed in the umbilical region.

Discorbis subaraucana Cushman

Plate 18, figures 1a-c

Discorbis subaraucana Cushman, Carnegie Inst. Washington Pub. 311, p. 41, pl. 7, figs. 1, 2, 1922.

Test unequally biconvex, dorsal side somewhat convex, ventral side very slightly convex, flattened, or even somewhat concave, umbilicate, periphery rounded, entire except the last part, which may be very slightly lobulate; chambers about 6 in the adult whorl, rapidly increasing in size as added, very slightly inflated; sutures oblique, curved, earlier ones strongly limbate; wall smooth, finely but conspicuously perforate; aperture at the umbilical end of the chamber, with a slight overhanging lip. Diameter 0.50-0.60 mm; thickness 0.15-0.20 mm.

This species was described from off the southern coast of Florida. The types are very close indeed to the specimen figured here, and they seem specifically identical.

Jackson formation: 7220, half a mile southeast of Melvin, Ala.

Ocala limestone: 7704, 3 miles west of Tarversville, Ga.; 6742, Powells Landing, Sepulga River, Ala.; 1/38, 3/4 miles north of Grove Hill, Ala.

Discorbis bulla Cushman

Plate 17, figures 6a-c

Discorbis bulla Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 16, pl. 2, figs. 6a-c, 1933.

Test much compressed except at the umbo, which is distinctly elevated, ventral side convex but umbilicate, periphery acute; chambers few, much elongate, narrow, strongly curved, three completing a whorl, the last-formed one making up more than half the periphery; sutures distinct, very strongly curved on

the dorsal side, somewhat limbate, ventrally slightly depressed, curved; wall on the dorsal side smooth, ventrally with traces of radial markings; aperture opening into the umbilical area. Diameter 0.50-0.60 mm; height 0.15-0.18 mm.

Holotype (no. 371554, U.S.N.M.) from U.S.G.S. station 1/39, Ocala limestone, Pea River at Geneva, Ala.

This is a peculiar-shaped species with a very prominent umbo, convex ventral side, and very long curved chambers. It belongs in the group usually assigned to *Discorbis orbicularis* (Terquem).

Ocala limestone: 1/39, Pea River, Geneva, Ala.; 6727, Claiborne, Ala.

Discorbis ocalana Cushman

Plate 16, figures 15a-c

Discorbis ocalana Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 15, pl. 2, figs. 5a-c, 1933.

Test biconvex, dorsal side slightly more convex than the ventral, which is slightly umbilicate, periphery rounded; chambers usually 5 in the adult whorl, those of the last whorl distinct, earlier ones obscure, gradually increasing in size as added, slightly inflated; sutures gently curved dorsally, ventrally nearly radial, slightly depressed on both sides; wall thick, smooth; aperture ventral, toward the umbilicus. Diameter 0.60 mm; height 0.20 mm.

Holotype (no. 371555, U.S.N.M.) from Ocala limestone, station 6768, Marianna, Fla.

This is a thick-walled species which occurs in the Ocala limestone but differs from numerous other species of this formation in not being usually well preserved.

Ocala limestone: 6768, Marianna, Fla.

Discorbis assulata Cushman

Plate 17, figures 1, 2

Discorbis assulata Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 15, pl. 2, figs. 2a-c, 1933.

Test very much compressed, planoconvex, ventral side flat or concave, dorsal side very slightly convex, periphery subacute, slightly keeled; chambers usually 6 in the final whorl, of uniform shape but increasing rather rapidly in size as added; sutures distinct, limbate, about evenly curved on the dorsal and ventral sides, the later one or two on the ventral side with a liplike projection; wall smooth, finely perforate; aperture ventral toward the umbilicus beneath a slight overhanging lip. Diameter 0.50 mm; height 0.10 mm.

Holotype (no. 371556, U.S.N.M.) from U.S.G.S. station 3966, Ocala limestone, 2 miles south of Perry, Ga.

This is a very thin scalelike species with distinctly limbate sutures, which are evenly curved on the two sides.

Ocala limestone: 3966, 2 miles south of Perry, Ga.; 6727, Claiborne, Ala.; 1/8, Beck, Ala.

Discorbis alabamensis Cushman

Plate 17, figures 3a-c

Discorbis alabamensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 16, pl. 2, figs. 3a-c, 1933.

Test small, unequally biconvex, ventral side slightly convex, dorsal side more strongly so, periphery rounded; chambers distinct, usually about 6 in the final whorl, slightly inflated, of uniform shape, increasing very slightly in size as added, on the ventral side with the inner end of the chambers lobed; sutures distinct, slightly depressed, gently curved; wall smooth; aperture near the umbilicus, with a slight overhanging lip. Diameter 0.25 mm; height 0.06 mm.

Holotype (no. 371557, U.S.N.M.) from station 1/8, Ocala limestone, Beck, Ala.

This is a very small but distinctive species, especially when seen from the ventral side.

Ocala limestone: 1/8, Beck, Ala.

Discorbis alveata Cushman

Plate 17, figures 4a-c

Discorbis alveata Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 16, pl. 2, figs. 4a-c, 1933.

Test planoconvex, dorsal side raised in a low spire, ventral side nearly flat, periphery acute and slightly keeled; chambers distinct, about 5 in the adult whorl, of uniform shape, increasing gradually in size as added, the ventral side with the inner portion broken up into a series of channels radiating from the umbilicus; sutures distinct, slightly limbate on the dorsal side, strongly curved, flush with the surface, on the ventral side nearly radial, slightly curved and distinctly depressed; wall smooth except for the channeling of the umbilical area on the ventral side; aperture narrow, at the umbilical end of the chamber. Diameter 0.35 mm; height 0.12 mm.

Holotype (no. 371558, U.S.N.M.) from U.S.G.S. station 6471, Jackson formation, Garlands Creek, Miss.

This is a small, distinctive species of few chambers, one of the main characteristics being the channeling of the ventral side. It is common at the type locality.

Jackson formation: 6471, Garlands Creek, Miss.

Genus VALVULINERIA Cushman, 1926

Valvulineria jacksonensis Cushman

Plate 18, figures 2a-c

Valvulineria jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 18, pl. 2, figs. 9a-c, 1933.

Test biconvex, compressed, dorsal side with a very low spire, ventrally convex toward the periphery, but depressed at the umbilicus, which is somewhat finely

papillate, periphery rounded; chambers distinct, about 8 in the adult whorl, of uniform shape, gradually increasing in size as added, not inflated; sutures distinct, on the dorsal side gently curved, limbate, not depressed, ventrally nearly straight, oblique, very slightly depressed; wall smooth; aperture ventral beneath the umbilicate lobe of the last-formed chamber. Length 0.50 mm; breadth 0.40 mm; thickness 0.18 mm.

Holotype (no. 371559, U.S.N.M.) from Ocala limestone, U.S.G.S. station 6741, 3½ miles northeast of Brooklyn, Ala.

This is a characteristic species, probably occurring at more stations than here recorded, but the preservation of the material does not always allow certain determination.

Ocala limestone: 7189, Rich Hill, Ga.; 6741, 3½ miles northeast of Brooklyn, Ala.

Genus **LAMARCKINA** Berthelin, 1881

Lamarckina ocalana Cushman

Plate 17, figures 5a-c

Lamarckina ocalana Cushman, Contr. Cushman Lab. Foram. Research, vol. 2, p. 11, pl. 1, figs. 4a-c, 1926.

Test subcircular, periphery slightly lobulate, thin, slightly biconvex, periphery very thin, slightly keeled, composed of about 1½ coils, 7 chambers in the last-formed coil; dorsal side smooth and very finely perforate, the sutures barely depressed, not limbate; ventral side flattened or slightly convex, umbilicate, smooth and highly polished, sutures barely depressed; aperture large with a broadly rounded projecting lip: Diameter about 1.00 mm; thickness 0.35 mm.

This is the largest of the species of the genus and may be distinguished by its smooth, unornamented dorsal surface, tendency to become keeled, and compressed form.

Ocala limestone: 1/19, near Blue Springs, Jackson County, Fla.

Lamarckina jacksonensis Cushman

Plate 20, figures 14a-c

Lamarckina jacksonensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 20, pl. 2, figs. 10a-c, 1933.

Test about equally biconvex, periphery acute, slightly keeled; chambers about 5 in the adult whorl, rapidly increasing in size as added, ventrally somewhat inflated; sutures on the dorsal side slightly curved, very oblique, limbate and raised, on the ventral side curved, either flush with the surface or slightly depressed; walls smooth except for the raised sutures on the dorsal side, on the ventral side smooth and polished; aperture a large opening in a deep re-entrant of the ventral side. Length 0.45-0.50 mm; breadth 0.35-0.40 mm; thickness 0.15 mm.

Holotype (no. 371571, U.S.N.M.) from U.S.G.S. station 1/39, Ocala limestone, Geneva, Ala.

This species is most closely related in the shape of its chambers to *Lamarckina ocalana* Cushman but differs from that species in the much more oblique sutures, fewer chambers, and less convex form.

Ocala limestone: 1/39, west bank of Pea River at Geneva, Ala.

Genus **GYROIDINA** D'Orbigny, 1826

Gyroidina soldanii D'Orbigny var. *octocamerata* Cushman and G. D. Hanna

Plate 18, figures 4a-c

Gyroidina soldanii D'Orbigny var. *octocamerata* Cushman and G. D. Hanna, California Acad. Sci. Proc., ser. 4, vol. 16, p. 223, pl. 14, figs. 16-18, 1927.

Cole, Bull. Am. Paleontology, vol. 14, no. 51, p. 29, pl. 2, figs. 22-24, 1927.

Cushman and Schenck, California Univ. Dept. Geol. Sci. Bull., vol. 17, p. 312, pl. 44, figs. 3-5, 1928.

Weinzierl and Applin, Jour. Paleontology, vol. 3, no. 4, p. 406, 1929.

Cushman and Thomas, Jour. Paleontology, vol. 4, p. 40, pl. 4, figs. 2, 3, 1930.

Test small, dorsal side flattened, ventral side much convex, composed of about 3 coils, the last-formed one consisting of 8 chambers, periphery broadly rounded, ventral side with the umbilical region strongly depressed; chambers distinct; sutures distinct, slightly depressed, on the dorsal side somewhat oblique, on the ventral side radial; wall finely perforate, smooth and polished; aperture elongate, arched, from the periphery at least halfway to the umbilicus along the ventral border of the last-formed chamber, with a very slightly developed lip. Length 0.50 mm; breadth 0.45 mm; thickness 0.35 mm. The 8 chambers and small size are characteristic of all the specimens, and there seems to be very little variation.

The type specimen is from U.S.G.S. station 1/39, Ocala limestone, Geneva, Ala.

Castle Hayne marl: 5611, Wilmington, N.C.; 8171, Richlands, N.C.

Ocala limestone: 1/21, southeastern Covington County, Ala.; 1/39, Pea River at Geneva, Ala.

This variety occurs also in the Claiborne group, as well as in the equivalent Eocene of Mexico and California.

Gyroidina orbicularis D'Orbigny var. *planata* Cushman, n. var.

Plate 18, figures 3a-c

Test planoconvex, the dorsal side very flat, the ventral very strongly convex; periphery forming a blunt angle, the last-formed coil either at the same level as the previous ones or falling slightly below, occasionally rising very slightly above, ventrally distinctly

umbilicate; chambers fairly distinct on the dorsal side, especially those of the last-formed coil, which has 10 or 11 chambers; in peripheral view with the periphery broadly rounded, the dorsal angle blunt, the ventral side strongly curved, sometimes projecting slightly to form a slight angle; sutures on the dorsal side oblique, only those of the last-formed coil distinct; on the ventral side radial and depressed; wall smooth and polished; aperture extending from the peripheral angle nearly to the umbilicus, low, without a lip. Diameter 0.50 mm; thickness 0.30–0.35 mm.

Holotype (no. 371560, U.S.N.M.) from Cooper marl, Ingleside, S.C.

Cooper marl: 6319, Ingleside, S.C. (common); 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths of a mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus *ROTALIA* Lamarck, 1804

Rotalia sp.?

Plate 19, figures 11a–c

A fairly large sized species of *Rotalia* occurs commonly in the Ocala limestone. The dorsal side has a high conical form; the ventral side is flattened. Although this species is common, it is not well preserved, and it has not been deemed advisable to make a specific determination.

Ocala limestone: 6812, 1¼ miles south of Newberry, Alachua County, Fla.

Genus *EPONIDES* Montfort, 1808

Eponides jacksonensis (Cushman and Applin)

Plate 19, figures 4–8

Pulvinulina jacksonensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 181, pl. 9, figs. 24, 25, 1926.

Test with a fairly high spire, the periphery not keeled but only slightly rounded, the dorsal side much more convex than the ventral; chambers numerous, 6 or 7 in the last-formed coil; sutures distinct but on the dorsal side very oblique, on the ventral side only slightly curved and somewhat depressed; wall smooth; aperture on the ventral side, forming a distinct angle in the border of the test and extending to the umbilicus. Diameter 1.00 mm.

The types of this species are from the upper Eocene 4 miles east of Diboll, Angelina County, Tex. It also occurs in Texas on Tarkiln Creek, half a mile above the Neches River, Trinity County, and in well samples. The species is widely distributed in the upper Eocene of the Coastal Plain of the United

States eastward from Texas and in the Alazan clays of Mexico.

Eponides jacksonensis is related to *E. byramensis* Cushman, from the lower Oligocene of the Coastal Plain, but has more whorls and fewer chambers, as well as being of smaller size on the average. It is also related to *E. mexicana* Cushman, which has more chambers and is a much more highly ornamented form of larger size. All these species are related to *E. haidingeri* D'Orbigny, from the Tertiary of Europe, but are all distinct.

Cooper marl: 5531, Charleston, S.C.; 6321, Baldock, S.C.

Ocala limestone: 7189, Rich Hill, Ga.; 7237, half a mile east of Huguenen Ferry, Ga.; 7719, Spring Mill Branch, Jenkins County, Ga.; 4974, Duncan, Fla.; 6768, Marianna, Fla.; 6790, Alachua, Fla.; 6805, Oakhurst quarry, Ocala, Fla.; 6807, Zuber, Fla.; 6808, Martin, Fla.; 6815, Clark, Fla.; 7194, Marianna, Fla.; 6720, three-quarters mile north of Drewry, Ala.; 6738, 6½ miles north of Brooklyn, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/7, 1 mile east of Beck, Ala.; 1/39, Pea River at Geneva, Geneva County, Ala.; 1/48, Duncan, Fla.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Some specimens from the Cooper marl of South Carolina that are referred to this species have a very low spire and a subacute periphery and may be found worthy of varietal distinction with further collecting. They came from the following U.S.G.S. stations:

Cooper marl: 11863, three-quarters mile west of Old Biggin Church, Berkeley County, S.C.; 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Eponides carolinensis Cushman, n. sp.

Plate 17, figures 7a–c

Test comparatively large, biconvex, umbonate, periphery with a rounded thickened margin; chambers numerous, about 12 in the last-formed coil in the adult, the last few more distinct than the earlier ones; sutures indistinct except in the last portion, strongly curved on the dorsal side, slightly so on the ventral, sometimes limbate and fusing with the thickened peripheral margin; wall distinctly perforate, thickened with an outer heavy wall showing little structure but when broken away revealing the distinct perforations and the sutures below; chambers in the thickened specimens ending in a ring of thickened beadlike projections about the umbilical area, which is also filled to form a distinct cross; aperture an elongate opening on the ventral side at the inner margin of the last-formed chamber, sometimes with a slightly thickened lip and occasionally with secondary rounded apertures in the apertural face. Diameter 1.85 mm; thickness 1.15 mm.

Holotype (no. 371562, U.S.N.M.) from the upper Eocene Castle Hayne marl, station 5611, Wilmington, N.C., where the species is common.

It is the largest of the upper Eocene forms of the Coastal Plain area and is peculiar in the thickened outer layers, which largely conceal the structures of the test.

Castle Hayne marl: 5611, Wilmington, N.C.

Eponides cocoaensis Cushman

Plate 19, figures 1, 2

Eponides cocoaensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 4, p. 73, pl. 10, figs. 2a-c, 1928.

Test planoconvex, dorsal side flattened or very slightly umbonate, ventral side very strongly convex; chambers few, usually four in the last-formed coil, the last one large and occupying nearly half the surface on the ventral side; periphery subacute or even with a blunt keel; sutures distinct and depressed, on the ventral side nearly radiate, on the dorsal curved; wall in well-preserved specimens rather distinctly perforate, although the perforations are not coarse, and occasionally with small spines or papillae scattered over the surface; aperture elongate, semielliptical, at about the middle of the inner margin of the chamber on the ventral side. Diameter 0.50 mm; thickness 0.45 mm.

The type specimens are from the Jackson formation at station 2637, Cocoa, Ala.

Ocala limestone: 7191, Marianna, Fla.; 7159, 4 miles southeast of Whatley, Ala.

Jackson formation: 2637, Cocoa, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Cooper marl: 6321, Baldock, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Eponides budensis (Hantken) var. *planata* Cushman, n. var.

Plate 18, figures 6a-c

Test planoconvex, dorsal side moderately convex, ventral side flat or even slightly concave, periphery acute, slightly keeled; chambers 5 or 6 in the final whorl, of uniform shape, gradually increasing in size as added, not inflated; sutures on the dorsal side flush with the surface, strongly oblique, ventrally curved, and slightly depressed; wall smooth; aperture on the ventral side midway between the umbilicus and periphery. Diameter 0.45-0.50 mm; thickness 0.12-0.15 mm.

Holotype (no. 371563, U.S.N.M.) from Castle Hayne marl, station 5611, Wilmington, N.C.

This variety in many respects resembles Hantken's species, but that is biconvex, whereas our form is very decidedly planoconvex or even slightly concave on the ventral side.

Castle Hayne marl: 5611, Wilmington, N.C.

Eponides ocalana Cushman

Plate 18, figures 5a-c

Eponides ocalana Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 17, pl. 2, figs. 7a-c, 1933.

Test comparatively large, strongly planoconvex, periphery rounded, dorsal side flat, ventral side very convex; chambers 5 or 6 in the last-formed coil, distinct; sutures on the dorsal side curved, limbate, raised above the surface and often connecting with a raised ridge about the periphery, on the ventral side slightly depressed, very slightly curved, ending in the rather large umbilical cavity; wall thick, matte; aperture a short semielliptical opening near the umbilical end of the ventral margin of the chamber. Length 1.00-1.25 mm; breadth 0.75-0.85 mm; thickness 0.50-0.60 mm.

Holotype (no. 371561, U.S.N.M.) from Ocala limestone at U.S.G.S. station 1/21, Covington County, Ala. This rather large, heavy-walled species seems to occur only in the Ocala limestone.

Ocala limestone: 7194, Marianna, Fla.; 1/48, Duncan, Fla.; 1/21, Covington County, Ala.; 1/25, 1 mile east of Harts Bridge, Ala.; 1/26, Drewry, Ala.

Eponides pygmaea (Hantken)

Plate 19, figures 9a-c

There are rare specimens from the upper Eocene Jackson group north of Whitsett, Live Oak County, Tex., one of which is here figured and which may be referred to the above-named species of Hantken. These have already been noted elsewhere.¹³ They have not occurred in the material from the eastern part of the region.

Eponides minima Cushman

Plate 19, figures 3a-c

Eponides minima Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 17, pl. 2, figs. 8a-c, 1933.

Test small, trochoid, spire low, periphery bluntly keeled, lobulate; chambers typically 6 or 7 in the adult whorl, of uniform shape, gradually increasing in size as added; sutures on the dorsal side obliquely curved, slightly limbate, flush with the surface, on ventral side slightly curved, slightly depressed; wall smooth dorsally, on the ventral side with papillae somewhat obscuring the sutures over the umbilical portion; aperture ventral, between the periphery and the umbilical area. Diameter 0.28-0.30 mm; height 0.12 mm.

Holotype (no. 371564, U.S.N.M.) from Cooper marl, station 11863, Berkeley County, S.C.

¹³ Cushman, J. A., and Applin, E. R., Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 179, pl. 9, fig. 14, 1926.

This is a very small species, probably nearest to the Recent *Eponides exigua* (H. B. Brady) but differing from that species in the sutures of the dorsal side, which in Brady's species are strongly limbate, especially the spiral suture, and on the ventral side, which is smooth in Brady's species but in ours is very markedly papillate.

Cooper marl: 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.

Eponides umbonata (Reuss)

Plate 19, figures 10a-c

Rotalina umbonata Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 75, pl. 5, fig. 35, 1851.

Eponides umbonata Cole, Bull. Am. Paleontology, vol. 14, p. 15, pl. 2, fig. 6, 1928.

Cushman, Contr. Cushman Lab. Foram. Research, vol. 5, p. 98, pl. 14, figs. 8a-c, 1929.

Rotalia umbonata Galloway and Morrey, Bull. Am. Paleontology, vol. 15, no. 55, p. 26, pl. 4, figs. 1a-c, 1929.

Rotalia ecuadorensis Galloway and Morrey, idem, p. 26, pl. 3, figs. 13a-c.

Test trochoid, biconvex, periphery acute; chambers usually 5 or 6 in the adult whorl, of uniform shape, slightly increasing in size as added, not inflated; sutures on the dorsal side straight and at right angles to the periphery, slightly limbate, flush with the surface, on the ventral side typically with a sigmoid curve most pronounced near the inner end; wall smooth; aperture elongate, on the ventral side between the periphery and the umbilical area. Diameter about 0.50 mm.

This species, which has a general range from Oligocene to Recent, has occurred in the Eocene collections at but one locality.

Cooper marl: 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.

Genus *CANCERIS* Montfort, 1808

Canceris brongniartii (D'Orbigny)

Plate 20, figures 1a-c

Rotalia brongniartii D'Orbigny, Annales sci. nat., vol. 7, p. 273, Modèles, no. 27, 1826.

Rotalina brongniartii Reuss, in Geinitz, Grundriss der Versteinerungskunde, p. 673, pl. 24, fig. 55, 1845-46.

D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 158, pl. 8, figs. 22-24, 1846.

Test biconvex, periphery subacute, longer than broad; chambers increasing rapidly in size and length as added in the adult whorl, all visible from the dorsal side, from the ventral side only those of the final whorl, the last-formed chamber making a large proportion of the surface; wall smooth, the last-formed chamber with an oval thinner area toward the base on the ventral side; aperture narrow, beneath the in-

ner end of the chamber on the ventral side. Length 0.85 mm; breadth 0.60 mm; thickness 0.30 mm.

Specimens of this species are rare in the Eocene collections examined. They seem very close to D'Orbigny's species.

Castle Hayne marl: 5611, Wilmington, N.C.; 8165, near Maple Cypress, Craven County, N.C.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.

Genus *SIPHONINA* Reuss, 1849

Siphonina jacksonensis Cushman and Applin

Plate 20, figures 2-8

Siphonina jacksonensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 180, pl. 9, figs. 20-23, 1926.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 3, fig. 21, 1933.

Test much compressed, chambers slightly projecting at the posterior angle, at the periphery, keeled, 5 chambers in the last-formed coil, fairly distinct; sutures very slightly limbate on the dorsal side, spiral suture not prominent; wall ornamented by very numerous small spinose processes, in some specimens distinctly developed so that the periphery of the test is itself spinose, central portion strongly reticulate; aperture elongate, with a slightly projecting neck and lip. Diameter 0.50 mm.

The type specimens of this species came from the upper Eocene 4 miles east of Diboll, Angelina County, Tex. It has proved to be abundant at the type locality of the Jackson formation at Jackson, Miss., and is characteristic of the upper Eocene of the general Gulf Coastal Plain region. It also occurs in the Alazan clays of Mexico and in Trinidad.

The distinctive characters are the very much compressed form and the peculiar spinose and reticulate ornamentation of the surface.

Castle Hayne marl: 5611, Wilmington, N.C.

Ocala limestone: 7235, Flint River near northeast corner of Dougherty County, Ga.; 7237, half a mile east of Huguenen Ferry, Ga.; 6768, Marianna, Fla.; 6785, three-fourths mile south of Herlong, Fla.; 6789, 6790, Alachua, Fla.; 6799, Alachua Sink, Gainesville, Fla.; 6804, Ocala, Fla.; 6805, Oakhurst quarry, Ocala, Fla.; 7348, Suwannee River 1½ miles above Troy Springs, Fla.; 7360, 3½ miles south of Floral City, Fla.; 6755, Choctawhatchee River above State line, Ala.; 5567, Claiborne, Ala.; 6706, Oven Bluff, Tombigbee River, Ala.; 6720, three-fourths mile north of Drewry, Ala.; 6722, three-fourths mile northwest of Monroeville, Ala.; 6725, 6726, 6727, Claiborne, Ala.; 6730, Double Branches Creek, Ala.; 6738, 6½ miles north of Brooklyn, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.; 6742, Powells Landing, Sepulga River, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 1/7, 1 mile east of Beck, Ala.; 1/8, Beck, Ala.; 1/33, 7½ miles northwest of Geneva, Ala.; 1/39, Pea River at Geneva, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.; 7220, half a mile southeast of Melvin, Ala.; 7227, Water Valley, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.; 6473, Yazoo City, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Siphonina advena Cushman var. *eocenica* Cushman and Applin

Plate 20, figures 9-11

Siphonina advena Cushman var. *eocenica* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 180, pl. 9, figs. 16-19, 1926.

Test differing from the typical form of the species, which was described from the lower Oligocene, in the less prominent spiral suture on the dorsal side and the more entire periphery, the chambers not showing as definitely as in the typical form. Diameter 0.40 mm.

The type specimens of this variety came from Tarkiln Creek half a mile above the Neches River, Trinity County, Tex. It is very rare in the eastern portion of the Coastal Plain.

Cooper marl: 3595, Barnwell County, S.C.

Family CASSIDULINIDAE

Genus CASSIDULINA D'Orbigny, 1826

Cassidulina globosa Hantken

Plate 20, figures 12a, b

Cassidulina globosa Hantken, Magy. kir. földt. int. Évkönyve, vol. 4, p. 54, pl. 16, fig. 2, 1875 (1876).

Liebus, Neues Jahrb., 1901, p. 125; Geol. Reichsanstalt Jahrb., vol. 56, p. 357, figs. 5a-c (in text), 1906.

Martinotti, Soc. italiana sci. nat. Atti, vol. 62, p. 328, 1923. Cushman, Contr. Cushman Lab. Foram. Research, vol. 1, p. 56, pl. 9, figs. 25, 26, 1925.

Cole, Bull. Am. Paleontology, vol. 14, no. 51, p. 32, 1927.

Cushman, Jour. Paleontology, vol. 1, p. 167, pl. 26, fig. 13, 1927.

Cole, Bull. Am. Paleontology, vol. 14, no. 63, p. 216 (16), 1928.

Test small, subglobose, periphery broadly rounded, about 5 pairs of chambers making up the adult whorl, only a very small triangular point of the chambers of the reverse side showing at the periphery; sutures slightly and evenly curved, distinct but not depressed; wall smooth; aperture small, narrow. Length 0.25-0.30 mm; breadth 0.20-0.25 mm; thickness 0.12-0.15 mm.

This species, described by Hantken from Hungary, is found in the upper Eocene both of Europe and America. It is one of the smallest species of the genus but is common in the Cooper marl. There is a con-

siderable amount of variation in the rotundity of the test.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Family CHILOSTOMELIDAE

Genus SPHAEROIDINA D'Orbigny, 1826

Sphaeroidina austriaca D'Orbigny

Plate 20, figures 13a, b

Sphaeroidina austriaca D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 284, pl. 20, figs. 19-21, 1846.

Test globose, on the dorsal side several chambers visible, on the ventral side only 3 chambers visible, one occupying at least half the ventral surface, periphery broadly rounded; sutures distinct, depressed; wall smooth; aperture small, at the inner margin of the last-formed chamber on the ventral side. Diameter 0.45-0.50 mm.

Species of *Sphaeroidina* are rare in the Eocene but become increasingly more common in the later Tertiary. Specimens are fairly common in the Cooper marl of South Carolina but were not found elsewhere in the collections examined. They are of the typical form seen in the Miocene of the Vienna Basin and elsewhere in the Tertiary of Europe, with the chambers less completely involute than in *S. bulloides* D'Orbigny, and more chambers visible on the dorsal side.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.

Family HANTKENINIDAE

Genus HANTKENINA Cushman, 1924

Hantkenina alabamensis Cushman

Plate 13, figures 1-5

Hantkenina alabamensis Cushman, U.S. Nat. Mus. Proc., vol. 66, art. 3, p. 3, pl. 1, figs. 1-6, pl. 2, fig. 5, 1924; Contr. Cushman Lab. Foram. Research, vol. 1, p. 7, pl. 1, fig. 11; p. 68, 1925.

Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 177, pl. 10, fig. 3, 1926.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 54, pl. 10, fig. 3, 1932.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 6, fig. 5, 1933.

Test planispiral, compressed, adult coil with 5 or 6 chambers, periphery very slightly if at all lobulate; wall very finely punctate, smooth, granular near the aperture, each chamber with a hollow, slender, acicular spine at the periphery, pointing somewhat anteriorly; aperture tripartite, with an elongate projection along

each side at the base of the apertural face, and the third, median, extending peripherally from the base of the apertural face. Diameter without spines 0.45 mm; with spines 0.75 mm.

I described this species from the sand in the Jackson formation at U.S.G.S. station 2637, Cocoa, Ala. It is abundant at this station and is characteristic of this horizon of the upper Jackson.

Ocala limestone: 6722, three-fourths mile northwest of Monroeville, Ala.; 6746, Ward's sawmill, Sepulga River, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 7719, Spring Mill Branch, Jenkins County, Ga.; 1/38, 3¼ miles north of Grove Hill, Ala.; 1/43, 1½ miles southwest of Perdue Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6473, Yazoo City, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Hantkenina alabamensis also occurs in well samples in Texas and is known from the Alazan clays of Mexico.

Related species, *Hantkenina brevispina* Cushman, *H. longispina* Cushman, and *H. mexicana* Cushman, occur in the Eocene of Mexico. *H. mexicana* var. *aragonensis* Nuttall, *H. alabamensis* var. *primitiva* Cushman and Jarvis, and *H. lehneri* Cushman and Jarvis occur in the Eocene of Trinidad. *H. kochi* (Hantken) is known from Europe.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

Globorotalia cocoaensis Cushman

Plate 21, figures 1-3

Globorotalia cocoaensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 4, p. 75, pl. 10, figs. 3a-c, 1928.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 75, pl. 14, fig. 4, 1932.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 4, figs. 6a, b, 1933.

Test small, with a low, rounded spire, ventral side strongly convex, periphery rounded; chambers very distinct, 4 usually making up the last-formed whorl, inflated, earlier ones more globular than the later ones; sutures very distinct on the dorsal side, oblique and curved, on ventral side nearly straight, radiate, deeper, depressed, wall in the early chambers rough and almost spinose, in the last ones nearly smooth, calcareous, perforate; aperture about midway between the umbilicus and periphery, an elongate, arched opening. Diameter 0.35 mm; height 0.25 mm.

This species is closely related to *Globorotalia canariensis* (D'Orbigny) and *G. crassa* (D'Orbigny), but it greatly differs from these in the relative shape of the test and the form of the individual chambers. It is very abundant at the type locality, Cocoa, Ala., but occurs at a few other stations.

Cooper marl: 6321, Baldock, S.C.

Ocala limestone: 7191, Marianna, Fla.; 7159, 4 miles southeast of Whatley, Ala.

Jackson formation: 2637, Cocoa, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Family ANOMALINIDAE

Genus ANOMALINA D'Orbigny, 1826

Anomalina bilateralis Cushman

Plate 21, figures 4, 5

Anomalina bilateralis Cushman, U.S. Geol. Survey Prof. Paper 129, pp. 97, 137, pl. 21, figs. 1, 2, 1922; Prof. Paper 133, p. 42, 1923.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 4, fig. 7, 1933.

Test of about 4 coils, bilateral or nearly so, composed of numerous chambers, 10 or more in the last-formed whorl, umbilical region on both sides with a knob of clear shell material, more pronounced on the dorsal side; chambers smooth but coarsely punctate, more coarsely so on the ventral side; sutures broad and somewhat limbate with clear shell material; aperture a narrow curved opening at the base of the final chamber. Maximum diameter 1.00 mm.

This species, which is widely distributed throughout the various members of the Vicksburg group of the lower Oligocene, also occurs in the upper Eocene, but in much less numbers. The type of this species is from the lower Oligocene of the United States.

Ocala limestone: 6706, Oven Bluff, Tombigbee River, Ala.; 6719, three-fourths mile north of Drewry, Ala.; 6725, Claiborne, Ala.; 7159, 4 miles southeast of Whatley, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/21, Covington County, Ala.; 1/26, Drewry, Ala.; 3966, 2 miles south of Perry, Ga.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.; 6473, Yazoo City, Miss.; 6646, Hays Chapel, Wayne County, Miss.

Anomalina granosa (Hantken) var. *dibollensis* Cushman and Applin

Plate 21, figures 6, 7

Anomalina granosa (Hantken) var. *dibollensis* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 179, pl. 9, fig. 15, 1926.

Test nearly bilaterally symmetrical, umbilicate on both sides, periphery rounded; chambers about 10 in the final coil, of nearly uniform size and shape, increasing slowly in size as added; sutures slightly curved, depressed; wall smooth but distinctly perforate; aperture at the base of the periphery of the chamber. Diameter 0.40 mm; thickness 0.10 mm.

The type specimens of this variety were collected 4 miles east of Diboll, Angelina County, Tex.

Jackson formation: 6457, 1½ miles south of Shubuta, Miss.

Anomalina affinis (Hantken)

Plate 21, figures 11, 12

Pulvinulina affinis Hantken, K. ungar. geol. Anstalt Mitt. Jahrb., vol. 4, p. 78, pl. 10, figs. 6a, b, 1875.

Anomalina affinis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 180, pl. 10, figs. 1, 2, 1926.

Test nearly planispiral in the adult, the dorsal side slightly evolute, periphery in the earlier portion subacute, later rounded; chambers about 12 in the final coil, of nearly uniform size and shape, increasing slightly in size as added; sutures curved, slightly depressed; wall smooth, finely but distinctly perforate; aperture peripheral at the base of the chamber. Maximum diameter 0.90 mm; thickness 0.25 mm.

The specimens came from the Jackson Eocene 4 miles east of Diboll, Angelina County, Tex.

The chambers are more numerous and more elongate than those of *A. granosa* var. *dibollensis*.

Anomalina cocoaensis Cushman

Plate 21, figures 13a-c

Anomalina cocoaensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 4, p. 75, pl. 10, figs. 4a-c, 1928.

Test planoconvex, ventral side broadly convex, dorsal side flattened or even somewhat concave; the ventral side with a series of irregular-shaped bosses in a cluster in the umbilical region; the dorsal side with a low spire appearing almost as a low smooth boss, the adjacent area depressed and then rising to the raised, rounded border, periphery broadly rounded; chambers 10 to 12 in the last-formed coil, fairly distinct; sutures on the dorsal side limbate and slightly raised, oblique and curved, sutures on the ventral side limbate, not raised or depressed, broadest near the inner end, nearly radial; wall calcareous, coarsely perforate, especially on the ventral side; aperture peripheral, small, arched, with a slight lip. Diameter 0.50 mm; height 0.20 mm.

The types of this species are from the Jackson formation at Cocoa, Ala., where it is abundant. It occurs in typical form at other stations, and the characters are remarkably constant.

Ocala limestone: 1/38, 3¼ miles north of Grove Hill, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles south-east of Cullomburg, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Anomalina jacksonensis (Cushman and Applin)

Plate 21, figures 8a-c

Discorbis jacksonensis Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 178, pl. 9, figs. 8, 9, 1926.

Anomalina jacksonensis Ellis, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 4, figs. 10a, b, 1933.

Test small, planoconvex, the ventral side flattened, dorsal side only slightly convex, with a distinct, clear

umbonal mass, occupying the central region, periphery subacute; chambers numerous, 10 or more in the last-formed coil, elongate, distinct; sutures distinct, very slightly depressed and somewhat limbate, on the dorsal side nearly straight until toward the outer half, where they become strongly recurved; on the ventral side sutures much depressed, especially toward the umbilicus, which becomes somewhat open in well-developed specimens; wall smooth, finely punctate. Length 0.50 mm; breadth 0.40 mm.

The type specimens of this species came from the Jackson of Bridge Creek, 1½ miles above the Angelina River, San Augustine County, Tex. It occurs in numerous well sections of Texas.

Anomalina jacksonensis is represented also by several varieties.

Cooper marl: 3595, Barnwell County, S.C.

Ocala limestone: 6720, three-fourths mile north of Drewry, Ala.; 6722, three-fourths mile northwest of Monroeville, Ala.; 6724, 6726, Claiborne, Ala.; 6738, 6½ miles north of Brooklyn, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.; 6754, Choctawhatchee River at State line, Ala.-Fla.; 7159, 4 miles south-east of Whatley, Ala.; 1/8, Beck, Ala.

Jackson formation: 7227, Water Valley, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Anomalina jacksonensis (Cushman and Applin) var. dibollensis (Cushman and Applin)

Plate 21, figure 9

Discorbis jacksonensis Cushman and Applin var. *dibollensis* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 178, pl. 9, fig. 10, 1926.

Variety differing from the typical form in being slightly more rounded and having fewer chambers; chambers shorter and wider; sutures more evenly curved and on the dorsal side slightly less developed, an umbonate thickening over the central region; wall finely punctate, smooth. Maximum length 0.50 mm; breadth 0.35 mm.

Type specimens from the upper Eocene 4 miles east of Diboll, Angelina County, Tex.

Cooper marl: 5531, Charleston, S.C.; 6321, Baldock, S.C.

Ocala limestone: 5567, Claiborne, Ala.; 6730, Double Branches Creek, Ala.; 6742, Powells Landing, Sepulga River, Ala.; 7161, 5 miles southeast of Whatley, Ala.; 1/39, Pea River at Geneva, Ala.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Anomalina jacksonensis (Cushman and Applin) var. texana (Cushman and Applin)

Plate 21, figure 10

Discorbina jacksonensis Cushman and Applin var. *texana* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 178, pl. 9, fig. 11, 1926.

Howe and Wallace, Louisiana Dept. Conservation Geol. Bull. 2, p. 77, pl. 14, figs. 3a-c, 1932.

Ellis, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 4, fig. 8, 1933.

Variety differing from the typical form in the slightly larger size and the more open coil, resulting in shorter, broader chambers. Length 0.60 mm; breadth 0.40 mm.

The type specimens came from the Jackson of Ohio and Red River well 2, Tyler County, Tex., at a depth of 400 feet. The variety has not been noted except at this locality.

Genus **PLANULINA** D'Orbigny, 1826

Planulina cocoaensis Cushman

Plate 22, figures 7a-c

Planulina cocoaensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 4, p. 76, pl. 10, figs. 1a-c, 1928.

Test much compressed, periphery acute and slightly keeled, central region of the ventral side occupied by a distinct, smooth, rounded boss, on the dorsal side the very low spire with numerous small rounded protuberances; chambers usually 10 to 12 in the last-formed whorl, distinct, the last-formed ones slightly inflated, especially on the ventral side; sutures very distinct, somewhat limbate on both sides, very slightly if at all depressed, curved on both sides; wall calcareous, coarsely perforate; aperture in the adult extending over onto the dorsal side of the test, elongate, narrow. Length 0.50 mm; breadth 0.40 mm; thickness 0.15 mm.

This species is very abundant at Cocoa, Ala., the type locality. It is a very finely marked species and is usually very well preserved.

Ocala limestone: 1/38, 3½ miles north of Grove Hill, Ala.; 7159, 4 miles southeast of Whatley, Ala.

Jackson formation: 2637, Cocoa, Ala.; 7203, 3½ miles southeast of Cullomburg, Ala.; 7220, half a mile southeast of Melvin, Ala.; 6457, 1½ miles south of Shubuta, Miss.

Planulina cocoaensis Cushman var. **cooperensis** Cushman

Plate 22, figures 8a-c

Planulina cocoaensis Cushman var. *cooperensis* Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 20, pl. 2, figs. 12a-c, 1933.

Variety differing from the typical form in the somewhat larger size, smaller number of chambers, typically 8, and a much smoother, less ornamented surface. Maximum diameter 1.50 mm.

Holotype (no. 371565, U.S.N.M.) from Cooper marl of station 11861, Berkeley County, S.C.

This variety so far as known seems to be characteristic of the Cooper marl and has not been found elsewhere in the material examined.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Genus **CIBICIDES** Montfort, 1808

Cibicides lobatulus (Walker and Jacob)

Plate 22, figures 4-6

Nautilus lobatula Walker and Jacob, Adam's Essays on the microscope, Kanmacher's ed., p. 642, pl. 14, fig. 36, 1798.

Cibicides lobatulus Cushman, Jour. Paleontology, vol. 1, p. 170, pl. 27, figs. 12, 13, 1927.

Hanna and Church, Jour. Paleontology, vol. 1, p. 201, 1928.

Truncatulina lobatula (Walker and Jacob) D'Orbigny, in Barker-Webb and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, Foraminifères, p. 134, pl. 2, figs. 22-24, 1839; Foraminifères fossiles du bassin tertiaire de Vienne, p. 168, pl. 9, figs. 18-23, 1846.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 660, pl. 92, fig. 10; pl. 93, fig. 1, 1884.

Cushman, U.S. Geol. Survey Bull. 676, p. 16, pl. 1, fig. 10; p. 60, pl. 17, figs. 1-3, 1918; Carnegie Inst. Washington Pub. 291, p. 41, 1919; U.S. Geol. Survey Prof. Paper 129, pp. 96, 135, pl. 20, figs. 1-3, 1923; Prof. Paper 133, p. 40, 1923.

Test planoconvex, flattened on the ventral face, moderately convex dorsally or nearly flat, sometimes slightly concave, peripheral margin rounded; chambers numerous, 7 or 8 in the last-formed whorl; sutures depressed, especially on the dorsal face; wall smooth, conspicuously punctate.

The specimens referred to this species were apparently attached in their growth, as is the species today. The dorsal face in some specimens is concave, apparently to conform to the surface of attachment. For this reason the dorsal face varies considerably in general shape. The species is common in the various members of the earlier Tertiary.

This is one of the species to which many forms have been referred, but it is questionable whether the records from older formations than the Eocene should be included under this name.

Cooper marl: 6319, Ingleside, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.; 6321, Baldock, S.C.

Castle Hayne marl: 8171, Richlands, N.C.

Ocala limestone: 3966, 2 miles south of Perry, Ga.; 7097, Bainbridge, Ga.; 7689, 1 mile south of Tivola, Ga.; 7719, Spring Mill Branch, Jenkins County, Ga.; 6722, three-fourths mile northwest of Monroeville, Ala.; 1/7, 1 mile east of Beck, Ala.; 1/21, Covington County, Ala.; 1/26, Drewry, Ala.; 1/39, Pea River at Geneva, Ala.

Barnwell formation: 7755, Stevens Pottery, Ga.

Jackson formation: 7227, Water Valley, Ala.

Cibicides pseudoungerianus (Cushman)

Plate 23, figures 1a-c

Truncatulina ungeriana H. B. Brady, *Challenger* Rept., Zoology, vol. 9, pl. 94, figs. 9a-c, 1884 [not *Rotulina ungeriana* D'Orbigny].

Cushman, U.S. Nat. Mus. Bull. 103, p. 69, pl. 24, fig. 1, 1918.

Truncatulina pseudoungeriana Cushman, U.S. Geol. Survey Prof. Paper 129, pp. 97, 136, pl. 20, fig. 9, 1922; Prof. Paper 133, p. 40, 1923.

Cibicides pseudoungerianus Cole and Gillespie, Bull. Am. Paleontology, vol. 15, no. 57b, p. 15, pl. 3, figs. 10, 11, 1930. Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 5, figs. 3, 4, 1933.

Test almost equally biconvex, periphery subacute; chambers 9 to 11 in the last-formed whorl, those of the earlier whorls not visible on either the ventral or the dorsal side, being hidden on the dorsal side by the roughness of the surface and on the ventral side by the involute character of the chambers; periphery lobulate; sutures distinct in the last whorl on the dorsal side, on the ventral even more so; umbilical region filled by clear shell material nearly flush with the chambers, last few chambers on the dorsal side slightly above the surface on the inner margin; surface on the dorsal side coarsely punctate, below smooth and finely perforate; aperture peripheral. Diameter 1.00 mm or less.

This species occurs in the upper members of the Tertiary and seems to show relatively little variation.

Castle Hayne marl: 5611, Wilmington, N.C.

Cooper marl: 5531, Charleston, S.C.; 6319, Ingleside, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Ocala limestone: 7237, half a mile east of Huguenen Ferry, Ga.; 6706, Oven Bluff, Tombigbee River, Ala.; 7191, Marianna, Fla.; 1/21, Covington County, Ala.; 1/26, Drewry, Ala.; 1/39, Pea River at Geneva, Ala.; 6725, Claiborne, Ala.; 6726, Claiborne, Ala.; 6727, Claiborne, Ala.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Cibicides americanus (Cushman) var. *antiquus* (Cushman and Applin)

Plate 22, figures 1, 2

Truncatulina americana Cushman var. *antiqua* Cushman and Applin, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 179, pl. 9, figs. 12, 13, 1926.

Variety differing from the typical form in the more limbate, much more curved sutures and fewer chambers. Length 0.40 mm; breadth 0.28 mm.

Type specimens came from the upper Eocene 4 miles east of Diboll, Angelina County, Tex.

This variety possibly should have specific standing and is closely related to *Cibicides yazooensis* Cushman.

Cooper marl: 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Ocala limestone: 5567, Claiborne, Ala.; 6741, 3½ miles northeast of Brooklyn, Ala.; 6738, 6½ miles north of Brooklyn, Ala.

Jackson formation: 7203, 3½ miles southeast of Cullomburg, Ala.; 7220, half a mile southeast of Melvin, Ala.; 7227, Water Valley, Ala.; 6457, 1½ miles south of Shubuta, Miss.; 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Cibicides yazooensis Cushman

Plate 23, figures 2a-c

Cibicides yazooensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 7, p. 59, pl. 7, figs. 12a-c, 1931.

Ellisor, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 5, figs. 2, 5, 1933.

Test slightly longer than broad, compressed, periphery angled, slightly lobulate, ventral side convex, dorsal side flattened or slightly convex, nearly involute on both sides; chambers distinct, usually 8 in the last-formed coil; sutures distinct, curved, very strongly limbate and somewhat raised, increasing in thickness toward the inner end; wall distinctly but finely perforate, with a clouding of the surface except at the sutures, which are clear and transparent; aperture a curved, somewhat arched opening near the periphery on the ventral side. Length 0.60 mm; breadth 0.50 mm; thickness 0.25 mm.

Holotype (no. 371566, U.S.N.M.) from Jackson formation, station 6473, Yazoo City, Miss.

This species is related to *Cibicides americanus* (Cushman) var. *antiquus* (Cushman and Applin), but the sutures are much more limbate, the chambers are broader, and the whole test is heavier and coarser.

Ocala limestone: 1/38, 3¼ miles north of Grove Hill, Ala.
Jackson formation: 6472, 6473, Yazoo City, Miss.

Cibicides cooperensis Cushman

Plate 23, figures 3a-c

Cibicides cooperensis Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 20, pl. 2, figs. 11a-c, 1933.

Test coiled, nearly planispiral in the adult, unequally biconvex, dorsal side slightly convex, deeply umbilicate, both sides almost completely involute, periphery rounded, more broadly so in the later portion, very slightly lobulate; chambers distinct, 7 or 8 in the final whorl, increasing rapidly in size as added, on the dorsal side with a slight lip along the umbilical end; sutures distinct, somewhat limbate, later ones slightly depressed, earlier ones flush with the surface, gently curved; wall smooth, finely but distinctly perforate; aperture extending from the periphery over onto the dorsal side, somewhat covered by the liplike projection from the umbilical end of the chamber. Length 0.80 mm; breadth 0.65 mm; thickness 0.25-0.30 mm.

Holotype (no. 371568, U.S.N.M.) from Cooper marl, station 11857, Berkeley County, S.C. This is a very abundant and distinctive species in the Cooper marl.

Cooper marl: 11861, steep bluff on west side of Biggin Creek, Berkeley County, S.C.; 11863, three-fourths mile west of Old Biggin Church, Berkeley County, S.C.; 11862, 1 mile west of Givhans, Dorchester County, S.C.; 11857, 1 mile south of Moncks Corner, Berkeley County, S.C.

Cibicides mississippiensis (Cushman)

Plate 22, figures 3a-c

Anomalina mississippiensis Cushman, U.S. Geol. Survey Prof. Paper 129, pp. 98, 137, pl. 21, figs. 6-8, 1922; Prof. Paper 133, p. 43, 1923.

Cibicides mississippiensis Ellis, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 5, figs. 6, 7, 1933.

Test small, planoconvex, of about $2\frac{1}{2}$ coils, periphery slightly lobulate, bluntly rounded, dorsal side very much flattened, even slightly concave, ventral side very convex; chambers comparatively few, 6 to 8 in the last-formed coil; sutures curved, on the dorsal side broad and limbate, even with the surface of clear shell material, on the ventral side narrower and depressed; the last-formed 2 or 3 chambers on the inner margin on the dorsal side slightly above the general surface; wall thin and translucent, especially on the dorsal side, smooth, on the ventral side finely punctate and not so clear; aperture a curved opening at the inner margin at the periphery, extending to the dorsal side. Length 0.25-0.35 mm; breadth 0.20-0.30 mm.

This small but very definite species occurs in all the divisions of the lower Oligocene of the eastern Gulf Coastal Plain. In the upper Eocene of the same region it is not abundant as to numbers but is widely distributed. At least one related species may be distinguished which is more abundant than this.

Castle Hayne marl: 5611, Wilmington, N.C.; 8165, near Maple Cypress, Craven County, N.C.

Cooper marl: 6321, Baldock, S.C.

Ocala limestone: 7097, Bainbridge, Ga.; 7108, Flint River at Seaboard Air Line Ry. bridge, Sumter County, Ga.; 7237, half a mile east of Huguenen Ferry, Ga.; 6768, Marianna, Fla.; 6785, three-fourths mile south of Herlong, Fla.; 6790, Alachua, Fla.; 7191, Marianna, Fla.; 6720, three-fourths mile north of Drewry, Ala.; 6722, three-fourths mile northwest of Monroeville, Ala.; 6738, $6\frac{1}{2}$ miles north of Brooklyn, Ala.; 6741, $3\frac{1}{2}$ miles northeast of Brooklyn, Ala.; 7159, 4 miles southeast of Whatley, Ala.

Jackson formation: 2637, Cocoa, Ala.; 6463, Jackson, Miss.; 6457, $1\frac{1}{2}$ miles south of Shubuta, Miss.

Cibicides mississippiensis (Cushman) var. *ocalanus* Cushman, n. var.

Test planoconvex, of about $2\frac{1}{2}$ coils, periphery entire, sharply angled, dorsal side very much flattened, even slightly concave, ventral side very convex, especially the central portion, near the periphery thinning rapidly; chambers 10 to 12 in the last-formed coil; sutures strongly curved, on the dorsal side somewhat limbate, not depressed, on the ventral side narrow and depressed, the last-formed chambers on the inner margin on the dorsal side very slightly above the general surface; wall smooth; aperture a curved opening at the inner margin at the periphery. Maximum diameter 0.40 mm.

Holotype (no. 371567, U.S.N.M.) from Ocala limestone, station 6815, Alachua County, Fla.

This variety is close to *Cibicides mississippiensis* (Cushman) but may be distinguished by the larger number of chambers, the broader form, and the peculiar reversed curve of the ventral side, concave near the periphery, then strongly convex.

The variety *ocalanus* seems to be possibly the ancestral form of *C. mississippiensis*, occurring in the upper Eocene in much greater numbers, and replaced by *C. mississippiensis* in the lower Oligocene.

Ocala limestone: 3966, 2 miles south of Perry, Ga.; 6768, Marianna, Fla.; 6785, three-fourths mile south of Herlong, Fla.; 6789, 6790, Alachua, Fla.; 6799, Alachua Sink, Gainesville, Fla.; 6804, Ocala, Fla.; 6805, Oakhurst quarry, Ocala, Fla.; 6807, Zuber, Fla.; 6808, Martin, Fla.; 6812, $1\frac{1}{4}$ miles south of Newberry, Fla.; 6815, Clark, Fla.; 7191, Marianna, Fla.; 7345, Suwannee River $2\frac{1}{4}$ miles above Branford, Fla.; 7366, Anthony, Fla.; 7348, Suwannee River $1\frac{1}{2}$ miles above Troy Springs, Fla.; 7360, $3\frac{1}{2}$ miles south of Floral City, Fla.; 6754, Choctawhatchee River at State line, Ala.-Fla.; 6755, Choctawhatchee River above State line, Ala.; 6724, Claiborne, Ala.; 1/8, Beck, Ala.; 1/39, Pea River at Geneva, Ala.

Cooper marl: 3595, Barnwell County, S.C.

Family PLANORBULINIDAE

Genus GYPSINA Carter, 1877

Gypsina globula (Reuss)

Plate 23, figures 4, 5

Cerriopora globulus Reuss, Haidinger's Naturwiss. Abh., vol. 2, p. 23, pl. 5, fig. 7, 1847.

Test globular, usually spherical, consisting of numerous chambers in irregular concentric layers, surface pustulose, as all the chambers are not added at the same time, the last-formed chambers protruding beyond earlier-formed ones; wall coarsely perforate, between adjacent chambers somewhat thickened but not raised. Maximum diameter 2.00 mm.

This species was described by Reuss from the middle Tertiary of central Europe. It has been recorded from numerous Tertiary formations and from Recent seas. The Recent species is, however, distinct from this early Tertiary one in the details of its structure. The very large form from the Bowden marl of Jamaica has already been distinguished by Brady as var. *pilaris*.

From the material examined the species seems to be most common in the Ocala limestone phase of the upper Eocene. The Recent species are usually common in shallow water of the Tropics.

Ocala limestone: 7097, Bainbridge, Ga.; 6790, Alachua, Fla.; 7338, Dowling Springs, Fla.; 7360, $3\frac{1}{2}$ miles south of Floral City, Fla.; 7364, $1\frac{1}{2}$ miles west of Croom, Fla.; 7365, Pineola, Fla.; 7366, Anthony, Fla.; 7161, 5 miles southeast of Whatley, Ala.

Jackson formation: 6463, Jackson, Miss.; 6471, Garlands Creek, Miss.

Family RUPERTIIDAE

Genus RUPERTIA Wallich, 1877

Rupertia floridana Cushman

Plate 23, figures 6, 7

Rupertia? floridana Cushman, Contr. Cushman Lab. Foram. Research, vol. 9, p. 21, pl. 2, figs. 13, 14, 1933.

Test attached, elongate, chambers in a loose spiral in a column, gradually increasing in diameter toward the upper, apertural end; chambers fairly distinct, slightly inflated; sutures fairly distinct, slightly depressed; wall smooth, calcareous, perforate; aperture multiple, in a slight depression of the outer end of the test. Height 2.00 mm; diameter 1.00 mm.

Holotype (no. 371569, U.S.N.M.) from Ocala limestone of Alachua, Fla.

This has many of the characters of *Rupertia*, but further specimens are needed so that sections may be made for comparison with some of the other Eocene forms of somewhat similar structure.

Ocala limestone: 6790, Alachua, Fla.

Genus CARPENTERIA Gray, 1859

Carpenteria monticularis Carter

Plate 23, figure 9

Carpenteria monticularis Carter, Annals and Mag. Nat. Hist., ser. 4, vol. 19, p. 211, pl. 13, figs. 9-12, 1877.H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 677, pl. 99, figs. 1-5, 1884.

Egger, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 18, p. 439, pl. 21, fig. 12, 1893.

Chapman, Linnean Soc. London Jour., Zoology, vol. 28, p. 14, pl. 2, fig. 5; pl. 4, figs. 5, 6, 1899.

Millett, Roy. Micr. Soc. Jour., 1904, p. 496.

Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 713, 1915.

Cushman, U.S. Nat. Mus. Bull. 71, pt. 5, p. 48, pl. 20, figs. 3a-c, 1915; Bull. 100, vol. 4, p. 362, 1921.

Test attached, in the early stages resembling *Cibicides*, usually with about 4 chambers in a coil, in the

adult spreading, the chambers compressed but rising toward the center and ending in a necklike protuberance, at the open end of which is the aperture; wall smooth, very finely perforate. Diameter of Eocene specimens 3.00-4.00 mm.

The records for this species are almost entirely from Recent material of the general Indo-Pacific region. Brady recorded it from off the Falkland Islands and off Bermuda, although these records may possibly be based on the young of another species.

It is surprising to find this species in the upper Eocene of America, but several specimens confirm its presence. It is attached to valves of *Pecten* and to *Lepidocyclina ocalana* Cushman. There is little to distinguish it from the Recent Indo-Pacific species.

Castle Hayne marl: 5611, Wilmington, N.C.

Carpenteria carolinensis Cushman, n. sp.

Plate 23, figure 8

Test attached, somewhat spreading, but the whole much more compact and higher than in *C. monticularis*; chambers somewhat fused, the sutures indistinct, aperture central; wall smooth and somewhat polished, with a few large, deep, circular, porelike depressions. Diameter 2.00 mm.

Holotype (no. 371570, U.S.N.M.) from Castle Hayne marl, station 5611, Wilmington, N.C.

This species differs from the other species of the same locality in the punctations of the surface and the more compact higher form. It is unlike any described species. It was attached to a species of brachiopod.

Castle Hayne marl: 5611, Wilmington, N.C.

Fragments of other attached forms make it apparent that under the warm, shallow-water conditions, of the Ocala especially, there were probably others of the large attached Foraminifera present. A careful search of the surface of Mollusca and *Lepidocyclina* will undoubtedly reveal additional species.

Distribution of species of Foraminifera in Texas

	4787. Below Robinson's Ferry, Sabine County	Bridge Creek, San Augustine County	Stovall Creek, 4 miles east of Diboll, Angelina County	Tarkiln Creek, Trinity County	Ohio and Red River well 2, Tyler County	Warren well 4, Harris County	Near Cheapside, Gonzales County	6148. Old Whitsett ranch, Atascosa Creek, Atascosa County	North of Whitsett, Live Oak County	Other upper Eocene localities	Known stratigraphic range	
											Earliest	Latest
Haplophragmoides dibollensis Cushman and Applin.					×					×	Eocene	Eocene.
Ammobaculites hockleyensis Cushman and Applin.					×					×	do	Do.
Textularia mississippiensis Cushman and Applin.										×	do	Miocene.
dibollensis Cushman and Applin.			×							×	do	Eocene.
dibollensis Cushman and Applin var. humblei Cushman and Applin.											do	Do.
distortio Cushman and Applin.					×						do	Do.
hockleyensis Cushman and Applin.		×									do	Do.
Quinqueloculina sp.? Cushman and Applin.			×								do	Do.
sp.? Cushman and Applin.			×								do	Do.
sp.? Cushman and Applin.			×								do	Do.
Massilina sp.? Cushman and Applin.					×						do	Do.
Robulus alato-limbatus (Gümbel).					×						do	Do.
articulatus (Reuss) var. texanus (Cushman and Applin).						×					do	Do.
limbosus (Reuss) var. hockleyensis (Cushman and Applin).		×									do	Do.
propinquus (Hantken).					×						do	Oligocene.
Marginulina jacksonensis Cushman and Applin.					×						do	Eocene.
fragaria (Gümbel) var. texasensis (Cushman and Applin.)											do	Do.
Dentalina cocoaensis (Cushman).					×						do	Do.
jacksonensis (Cushman and Applin).											do	Do.
Guttulina problema D'Orbigny spicaeformis (Roemer)	×		×	×						×	Cretaceous.	Recent.
Globulina inaequalis Reuss	×										Eocene	Do.
Pseudomorphina dumblei (Cushman and Applin).		×									do	Miocene.
decora (Reuss)				×							do	Do.
Glandulina laevigata D'Orbigny var. ovata Cushman and Applin.			×								do	Eocene.
Nonion advenum (Cushman) inexcavatum (Cushman and Applin).			×								do	Oligocene.
whitsettense (Cushman and Applin).					×						do	Eocene.
Nonionella hantkeni (Cushman and Applin).					×						do	Oligocene.
Elphidium texanum (Cushman and Applin).					×			×			do	Eocene.
Hantkenina alabamensis Cushman.										×	do	Do.
Bulimina jacksonensis Cushman ovata D'Orbigny					×					×	do	Do.
Virgulina dibollensis Cushman and Applin.											Cretaceous.	Recent.
Bolivina gracilis Cushman and Applin.			×								Eocene	Eocene.
jacksonensis Cushman and Applin.											do	Do.
jacksonensis Cushman and Applin var. striatella Cushman.			×								do	Do.

Distribution of species of Foraminifera in Texas—Continued

	4787. Below Robinson's Ferry, Sabine County	Bridge Creek, San Augustine County	Stovall Creek, 4 miles east of Diboll, Angelina County	Tarklin Creek, Trinity County	Ohio and Red River well 2, Tyler County	Warren well 4, Harris County	Near Cheapside, Gonzales County	6148. Old Whitsett ranch, Atascosa Creek, Atascosa County	North of Whitsett, Live Oak County	Other upper Eocene localities	Known stratigraphic range	
											Earliest	Latest
<i>Uvigerina alata</i> Cushman and Applin.					×						Eocene	Eocene.
<i>cocoaensis</i> Cushman					×						do	Do.
<i>dumblei</i> Cushman and Applin.											do	Do.
<i>gardnerae</i> Cushman and Applin.					×						do	Do.
<i>gardnerae</i> Cushman and Applin var. <i>texana</i> Cushman and Applin.					×						do	Do.
<i>topilensis</i> Cushman					×						do	Do.
<i>Pleurostomella jacksonensis</i> Cushman and Applin.											do	Do.
<i>Eponides jacksonensis</i> Cushman and Applin.			×	×						×	do	Do.
<i>pygmaea</i> (Hantken)									×		do	Recent. Eocene.
<i>Siphonina jacksonensis</i> Cushman and Applin.			×								do	Do.
<i>advena</i> Cushman var. <i>ecenica</i> Cushman and Applin.				×							do	Do.
<i>Anomalina granosa</i> (Hantken) var. <i>dibollensis</i> Cushman and Applin.			×								do	Do.
<i>affinis</i> (Hantken)			×								do	Oligocene. Eocene.
<i>jacksonensis</i> (Cushman and Applin).		×								×	do	Do.
<i>jacksonensis</i> Cushman and Applin var. <i>dibollensis</i> (Cushman and Applin).			×								do	Do.
<i>jacksonensis</i> (Cushman and Applin) var. <i>texana</i> (Cushman and Applin).					×						do	Do.
<i>Cibicides americanus</i> (Cushman) var. <i>antiquus</i> (Cushman and Applin).			×								do	Do.

Distribution of Eocene Foraminifera in North Carolina

	8165	8171	5611	Known stratigraphic range	
				Earliest	Latest
<i>Robulus limbosus</i> (Reuss) var. <i>hockleyensis</i> (Cushman and Applin)			×	Eocene	Eocene.
<i>Planularia truncana</i> (Gümbel)			×	do	Do.
<i>Nodosaria latejugata</i> Gümbel			×	do	Oligocene.
<i>Lagena orbignyana</i> (Seguenza) var. <i>semiconcentrica</i> Cushman			×	do	Eocene.
<i>Guttulina irregularis</i> (D'Orbigny)			×	do	Recent.
<i>spicaeformis</i> (Roemer)			×	do	Do.
<i>Globulina gibba</i> D'Orbigny var. <i>globosa</i> (Von Münster)			×	do	Do.
<i>Uvigerina cookei</i> Cushman, n. sp.			×	do	Eocene.
<i>Discorbis globulo-spinosa</i> Cushman			×	do	Do.
<i>Gyroidina soldanii</i> D'Orbigny var. <i>octocamerata</i> Cushman and G. D. Hanna.		×	×	do	Oligocene.
<i>Eponides carolinensis</i> Cushman, n. sp.			×	do	Eocene.
<i>budensis</i> (Hantken) var. <i>planata</i> Cushman, n. var.			×	do	Do.
<i>Cancris brongniarti</i> (D'Orbigny)	×		×	do	Miocene.
<i>Siphonina jacksonensis</i> Cushman and Applin			×	do	Eocene.
<i>Cibicides lobatulus</i> (Walker and Jacob) D'Orbigny		×	×	do	Recent.
<i>pseudoungerianus</i> (Cushman)			×	do	Do.
<i>mississippiensis</i> (Cushman)	×		×	do	Oligocene.
<i>Carpenteria monticularis</i> Carter			×	do	Recent.
<i>carolinensis</i> Cushman			×	do	Eocene.

Distribution of species of Foraminifera in Mississippi

	6472	6473	Jackson		6457	6471	6646	Known stratigraphic range	
			6463	6458				Earliest	Latest
Textularia mississippiensis Cushman	×	×			×			Eocene	Miocene.
mississippiensis Cushman var. alabamensis Cushman			×					do	Oligocene.
recta Cushman			×			×		do	Eocene.
subhauerii Cushman					×			do	Oligocene.
Gaudryina jacksonensis Cushman					×			do	Eocene.
Liebusella byramensis (Cushman) var. turgida (Cushman)					×			do	Oligocene.
Quinqueloculina laevigata D'Orbigny			×					do	Recent.
longirostra D'Orbigny			×					do	Do.
anguina Terquem			×					do	Do.
hauerina? D'Orbigny			×					do	Do.
Miliola saxorum Lamarck			×			×		do	Eocene.
jacksonensis Cushman			×			×		do	Do.
Massilina decorata Cushman			×			×		do	Oligocene.
cookei Cushman, n. sp.			×					do	Eocene.
jacksonensis Cushman			×			×		do	Do.
jacksonensis Cushman var. punctato-costata Cushman			×					do	Do.
Spiroloculina grateloupi D'Orbigny			×		×	×		do	Recent.
sp.?			×					do	Eocene.
Articulina terquemi Cushman			×					do	Do.
Triloculina sp.?			×					do	Do.
Cornuspira olygogyra Hantken			×					do	Oligocene.
Robulus gutticostatus (Gümbel)					×			do	Eocene.
alato-limbatus (Gümbel)					×			do	Do.
limbosus (Reuss)		×			×			do	Oligocene.
arcuato-striatus (Hantken) var. carolinianus Cushman					×			do	Eocene.
Saracenaria arcuata (D'Orbigny) var. hantkeni Cushman					×			do	Do.
Marginulina cocoaensis Cushman					×			do	Do.
Dentalina cocoaensis (Cushman)					×			do	Do.
cooperensis Cushman					×			do	Do.
jacksonensis (Cushman and Applin)					×			do	Do.
Nodosaria latejugata Gümbel					×			do	Oligocene.
ewaldi Reuss (?)					×			do	Pliocene.
Guttulina irregularis (D'Orbigny)	×		×		×			Cretaceous	Recent.
spicaeformis (Roemer)			×		×	×	×	Eocene	Do.
Globulina gibba D'Orbigny			×		×	×		do	Do.
Sigmomorphina jacksonensis (Cushman)			×		×	×		do	Do.
jacksonensis (Cushman) var. costifera (Cushman)	×		×		×	×		do	Do.
Polymorphina advena Cushman			×		×			do	Oligocene.
Nonion advenum (Cushman)			×		×			do	Do.
inexcavatum (Cushman and Applin)			×					do	Eocene.
chapotense Cole	×	×						do	Do.
micrum Cole							×	do	Do.
Nonionella hantkeni (Cushman and Applin) var. spissa Cushman			×			×		do	Do.
Operculina cookei Cushman				×				do	Do.
Hantkenina alabamensis Cushman		×			×		×	do	Do.
Bulimina jacksonensis Cushman					×		×	do	Do.
Bolivina gracilis Cushman and Applin	×	×			×	×		do	Do.
jacksonensis Cushman and Applin			×		×	×		do	Do.
jacksonensis Cushman and Applin var. striatella Cushman			×		×	×	×	do	Do.
Reussella eocena (Cushman)			×			×		do	Do.
Uvigerina cocoaensis Cushman					×		×	do	Do.
gardnerae Cushman			×		×		×	do	Do.
jacksonensis Cushman					×		×	do	Do.
yazooensis Cushman	×	×						do	Do.
Angulogerina ocalana Cushman						×		do	Do.
Trifarina bradyi Cushman var. advena Cushman			×					do	Do.
Discorbis globulo-spinosa Cushman			×			×		do	Do.
hemisphaerica Cushman			×			×		do	Do.
alveata Cushman						×		do	Do.
Eponides jacksonensis (Cushman and Applin)			×		×	×		do	Do.
cocoaensis Cushman					×			do	Do.
Cancris brongniartii (D'Orbigny)					×	×		do	Do.
Siphonina jacksonensis Cushman and Applin		×	×		×	×	×	do	Do.
Globorotalia cocoaensis Cushman			×		×			do	Do.

Distribution of species of Foraminifera in Mississippi—Continued

	6472	6473	Jackson				Known stratigraphic range		
			6463	6458	6457	6471	6646	Earliest	Latest
Anomalina bilateralis Cushman		×			×			Eocene	Oligocene.
granosa (Hantken) var. dibollensis Cushman and Applin.			×		×			do.	Eocene.
cocoaensis Cushman					×			do.	Do.
jacksonensis (Cushman and Applin)					×			do.	Do.
jacksonensis (Cushman and Applin) var. dibollensis (Cushman and Applin)			×			×		do.	Do.
Planulina cocoaensis Cushman					×			do.	Do.
Cibicides pseudoungerianus (Cushman)			×			×		do.	Recent.
americanus (Cushman) var. antiquus (Cushman and Applin)				×	×	×		do.	Eocene.
yazooensis Cushman	×	×						do.	Do.
mississippiensis (Cushman)			×		×			do.	Oligocene.
Gypsina globula (Reuss)			×			×		do.	Recent.

Distribution of Eocene Foraminifera in South Carolina

	3595	Bal-dock	6321	11862	Ashley marl works, Dorchester County	11857	11861	11863	6319	5531	Known stratigraphic range	
											Earliest	Latest
Textularia mississippiensis Cushman var. alabamensis Cushman			×						×		Eocene	Oligocene.
subhauerii Cushman			×						×		do.	Do.
barrettii (Jones and Parker)							×				do.	Recent.
Verneuilina propinqua H. B. Brady						×					do.	Do.
Gaudryina jacksonensis Cushman									×		do.	Eocene.
subquadrata Cushman									×		do.	Do.
Liebusella byramensis (Cushman) var. turgida (Cushman)									×		do.	Oligocene.
Pseudoclavulina sp.?						×					do.	Recent.
Robulus alato-limbatus Gumbel										×	do.	Eocene.
articulatus (Reuss) var. texanus Cushman									×	×	do.	Do.
limbosus (Reuss) var. hockleyensis (Cushman and Applin)				×					×		do.	Do.
arcuato-striatus (Hantken) var. carolinianus Cushman									×		do.	Do.
Saraceneria arcuata D'Orbigny var. hantkeni Cushman				×		×	×	×	×	×	do.	Do.
Planularia truncana (Gumbel)		×									do.	Do.
cooperensis Cushman							×	×			do.	Do.
Marginulina karreriana Cushman, n.sp.				×		×		×			do.	Do.
subrecta Franke								×			do.	Do.
cocoaensis Cushman			×								do.	Do.
cooperi Cushman										×	do.	Do.
cooperensis Cushman										×	do.	Do.
Dentalina cocoaensis (Cushman)				×						×	do.	Do.
cooperensis Cushman										×	do.	Do.
jacksonensis (Cushman and Applin)			×							×	do.	Do.
halkyardi Cushman				×						×	do.	Do.
cf. D. adolphina D'Orbigny						×					Cretaceous?	Miocene.
cf. D. vertebralis (Batsch)				×		×	×				Eocene	Recent.
sp.?				×		×	×				do.	Do.
Nodosaria latejugata Gumbel									×	×	do.	Oligocene.
latejugata Gumbel var. carolinensis Cushman				×		×	×			×	do.	Eocene.
ewaldi Reuss?											Cretaceous	Pliocene.
fissicostata (Cushman)	×		×							×	Eocene	Do.
Lagena laevis (Montagu)?	×					×					do.	Recent.
acuticosta Reuss				×		×	×				Cretaceous	Do.
costata (Williamson)				×		×	×				Eocene	Do.
hexagona (Williamson)								×			do.	Do.
sp.?										×	do.	Eocene.
Guttulina problema D'Orbigny										×	Cretaceous	Recent.
spicaeformis (Roemer)			×				×				Eocene	Do.
Globulina gibba D'Orbigny			×	×		×	×	×			do.	Do.
gibba D'Orbigny var. globosa (Von Münster)					×		×				do.	Do.
gibba D'Orbigny var. tuberculata D'Orbigny									×		do.	Pliocene.
inaequalis Reuss						×					do.	Recent.
rotundata (Bornemann)				×		×					do.	Do.

Distribution of Eocene Foraminifera in South Carolina—Continued

	3595	Bal- dock	6321	11862	Ashley marl works, Dor- chester County	11857	11861	11863	6319	5531	Known stratigraphic range	
											Earliest	Latest
<i>Sigmomorphina jacksonensis</i> (Cushman)			×								Eocene	Eocene.
<i>jacksonensis</i> (Cushman), var. <i>costifera</i> (Cushman).	×										do.	Do.
<i>regularis</i> (Von Münster)						×			×	?	do.	Oligocene.
<i>vaughani</i> Cushman and Ozawa						×			×		do.	Eocene.
<i>Polymorphina advena</i> Cushman						×		×			do.	Oligocene.
<i>Sigmoidella plummerae</i> Cushman and Ozawa				×			×	×	×	×	do.	Eocene.
<i>Nonion advenum</i> (Cushman)			×								do.	Oligocene.
<i>inexcavatum</i> (Cushman and Applin)			×								do.	Eocene.
<i>Nonionella hantkeni</i> (Cushman and Applin)				×		×	×	×			do.	Do.
var. <i>spissa</i> Cushman.											do.	Do.
<i>jacksonensis</i> Cushman											do.	Do.
<i>Spiroplectoides curta</i> Cushman						×					do.	Do.
<i>Plectofrondicularia</i> cf. <i>P. vaughani</i> (Cushman)						×	×			×	do.	Miocene.
<i>trinitatensis</i> Cushman and Jarvis						×	×				do.	Eocene.
<i>cookei</i> Cushman						×	×	×		×	do.	Do.
<i>Nodogenerina cooperensis</i> Cushman						×				×	do.	Do.
<i>Bulimina jacksonensis</i> Cushman					×						do.	Do.
<i>jacksonensis</i> Cushman var. <i>cuneata</i> Cushman.						×					do.	Do.
<i>cooperensis</i> Cushman						×					do.	Do.
<i>ovata</i> D'Orbigny							×				Cretaceous	Recent.
<i>Virgulina recta</i> Cushman				×		×	×	×			Eocene	Eocene.
<i>Bolivina jacksonensis</i> Cushman and Applin			×			×	×				do.	Do.
<i>jacksonensis</i> Cushman and Applin var. <i>striatella</i> (Cushman and Applin).			×	×		×	×	×			do.	Do.
<i>spiralis</i> Cushman				×		×			×		do.	Do.
<i>Reussella cocena</i> (Cushman)			×								do.	Do.
<i>Uvigerina cookei</i> Cushman, n. sp.					×				×		do.	Do.
<i>gardnerae</i> Cushman					×						do.	Do.
<i>glabrans</i> Cushman				×			×				do.	Do.
<i>jacksonensis</i> Cushman					×				×		do.	Do.
<i>yazooensis</i> Cushman				×		×	×	×			do.	Do.
<i>Angulogerina ocalana</i> Cushman				×		×	×	×			do.	Do.
<i>cooperensis</i> Cushman, n. sp.						×	×	×			do.	Do.
<i>Gyroidina orbicularis</i> D'Orbigny var. <i>planata</i> Cushman, n. var.				×		×	×	×	×		do.	Do.
<i>Eponides jacksonensis</i> (Cushman and Applin)			×							×	do.	Do.
<i>jacksonensis</i> (Cushman and Applin) var.?						×	×	×			do.	Do.
<i>cocoaensis</i> Cushman			×			×	×	×			do.	Do.
<i>minima</i> Cushman				×			×	×			do.	Do.
<i>umbonata</i> (Reuss)							×	×			do.	Recent.
<i>Cancris brongniartii</i> (D'Orbigny)							×	×			do.	Miocene.
<i>Siphonina jacksonensis</i> Cushman and Applin				×		×	×	×			do.	Eocene.
<i>advena</i> Cushman var. <i>eocenica</i> Cushman and Applin.	×										do.	Do.
<i>Cassidulina globosa</i> Hantken				×		×	×	×			do.	Oligocene.
<i>Sphaeroidina austriaca</i> D'Orbigny				×		×	×	×			do.	Miocene.
<i>Globorotalia cocoaensis</i> Cushman			×								do.	Eocene.
<i>Anomalina jacksonensis</i> (Cushman and Applin)	×										do.	Do.
<i>jacksonensis</i> (Cushman and Applin) var. <i>dibollensis</i> (Cushman and Applin).			×							×	do.	Do.
<i>Planulina cocoaensis</i> Cushman var. <i>cooperensis</i> Cushman.				×		×	×	×			do.	Do.
<i>Cibicides lobatulus</i> (Walker and Jacob)			×			×		×	×		do.	Recent.
<i>pseudoungerianus</i> (Cushman)				×		×		×	×	×	do.	Do.
<i>americanus</i> (Cushman) var. <i>antiquus</i> (Cushman and Applin).				×		×		×			do.	Eocene.
<i>cooperensis</i> Cushman				×		×	×	×			do.	Do.
<i>mississippiensis</i> (Cushman)			×								do.	Oligocene.
<i>mississippiensis</i> (Cushman) var. <i>ocalanus</i> Cushman, n. var.											do.	Eocene.

Distribution of species of Foraminifera in Georgia

	Barnwell formation	Ocala limestone																							Known stratigraphic range					
		7755	7719	7704	7189	3966	3760	7689	7237	7108	7115	7119	3626	7116	7117	7235	3617	7120	7123	7126	7127	7099	3387	7098	7130	3390	7097	Earliest	Latest	
Textularia subbauerii Cushman				X	X				X																				Eocene	Oligocene.
hockleyensis Cushman and Applin	X																											do	Eocene.	
mississippiensis Cushman var. alabamensis Cushman								X	X																			do	Oligocene.	
Lenticulina convergens (Bornemann)		X																									X	Cretaceous	Do.	
Saracenaria arcuata (D'Orbigny) var. hantkeni Cushman		X																										do	Eocene.	
Planularia truncana (Gümbel)		X																										do	Do.	
Marginula cocoaensis Cushman		X																										do	Do.	
Dentalina cocoaensis (Cushman)		X																										do	Do.	
cooperensis Cushman		X																										do	Do.	
jacksonensis (Cushman and Applin)		X																									X	do	Do.	
Nodosaria latejugata Gümbel		X																										do	Oligocene.	
ewaldi Reuss?		X																										Cretaceous	Pliocene.	
fissicostata (Gümbel)		X																										do	Do.	
Lagena acuticosta Reuss		X																										Cretaceous	Recent.	
costata (Williamson)		X																										Eocene	Do.	
Guttulina irregularis (D'Orbigny)		X			X																							do	Do.	
Globulina gibba D'Orbigny		X			X																						X	do	Do.	
gibba D'Orbigny var. globosa (Von Münster)		X			X																							do	Do.	
münsteri (Reuss)		X			X																							do	Do.	
Sigmomorphina jacksonensis (Cushman) var. costifera (Cushman)					X																							do	Miocene.	
semitecta (Reuss) var. terquemiana (Fornasini)					X																							do	Eocene.	
Pseudopolymorphina dumblei (Cushman and Applin)		X			X																							do	Recent.	
Polymorphina advena Cushman					X			X																				do	Miocene.	
Nonion advenum (Cushman)	X		X		X																							do	Oligocene.	
chapapotense Cole					X																							do	Do.	
Operculina cookei Cushman					X																							do	Eocene.	
ocalana Cushman						X						X	X															do	Do.	
vaughani Cushman								X		X	X	X	X															do	Do.	
Heterostegina ocalana Cushman								X		X	X	X	X															do	Do.	
Hantkenina alabamensis Cushman		X																										do	Do.	
Bolivina gardnerae Cushman		X																										do	Do.	
jacksonensis Cushman and Applin		X																										do	Do.	
Reussella eocena (Cushman)		X			X																							do	Do.	
Uvigerina cookei Cushman, n.sp.		X			X				X												X	X		X	X			do	Do.	
jacksonensis Cushman		X			X																							do	Do.	
Angulogerina ocalana Cushman		X			X				X																			do	Do.	
Discorbis subarucana Cushman			X																									do	Do.	
assulata Cushman					X																							Oligocene	Recent.	
Valvulinera jacksonensis Cushman					X																							do	Eocene.	
Eponides jacksonensis (Cushman and Applin)		X			X				X																			do	Do.	
Siphonina jacksonensis Cushman and Applin		X			X				X																			do	Do.	
Anomalina bilateralis Cushman					X																							do	Oligocene.	
Cibicides lobatulus (Walker and Jacob)	X	X			X			X																				do	Recent.	
pseudoungerianus (Cushman)					X				X																			do	Do.	
mississippiensis (Cushman)					X				X	X																		do	Oligocene.	
mississippiensis (Cushman) var. ocalanus Cushman, n. var.					X																							do	Eocene.	
Gypsina globula (Reuss)																											X	do	Recent.	

PLATES

PLATE 1

Haplophragmoides dibollensis Cushman and Applin (p. 6)

FIGURE 1. Holotype. a, Side view; b, apertural view, $\times 28$. From well sample, Tyler County, Tex.

Ammobaculites hockleyensis Cushman and Applin (p. 6)

FIGURE 2. Holotype. a, Side view; b, apertural view, $\times 35$. From well sample, Tyler County, Tex.

Textularia mississippiensis Cushman (p. 7)

FIGURE 3. Side view, $\times 50$. From well sample, Tyler County, Tex.

FIGURE 4. Side view, $\times 50$. U.S.G.S. station 6473.

Textularia mississippiensis Cushman var. alabamensis Cushman (p. 7)

FIGURE 5. Side view, $\times 50$. U.S.G.S. station 7227.

FIGURE 6. Side view, $\times 35$. U.S.G.S. station 6321.

Textularia ocalana Cushman (p. 7)

FIGURE 7. Holotype. a, Side view; b, apertural view, $\times 50$. U.S.G.S. station 6812.

Textularia recta Cushman (p. 7)

FIGURE 8. Side view, $\times 50$. U.S.G.S. station 6726.

FIGURE 9. Side view, $\times 50$. U.S.G.S. station 1/8.

Textularia subhauerii Cushman (p. 8)

FIGURE 10. Side view, $\times 45$. U.S.G.S. station 1/38.

Textularia adalta Cushman (p. 8)

FIGURE 11. a, Front view; b, apertural view, $\times 30$. U.S.G.S. station 6741.

FIGURE 12. Front view, $\times 30$. U.S.G.S. station 6741.

Textularia dibollensis Cushman and Applin (p. 8)

FIGURE 13. Front view, $\times 50$. 4 miles east of Diboll, Angelina County, Tex.

FIGURE 14. Front view, $\times 50$. U.S.G.S. station 1/8.

FIGURE 15. Front view, $\times 50$. U.S.G.S. station 1/8.

FIGURE 16. Front view, $\times 50$. East of Diboll, Angelina County, Tex.

Textularia dibollensis Cushman and Applin var. humblei Cushman and Applin (p. 8)

FIGURE 17. a, Front view; b, apertural view, $\times 50$. From well sample, Newton County, Tex.

Textularia distortio Cushman and Applin (p. 8)

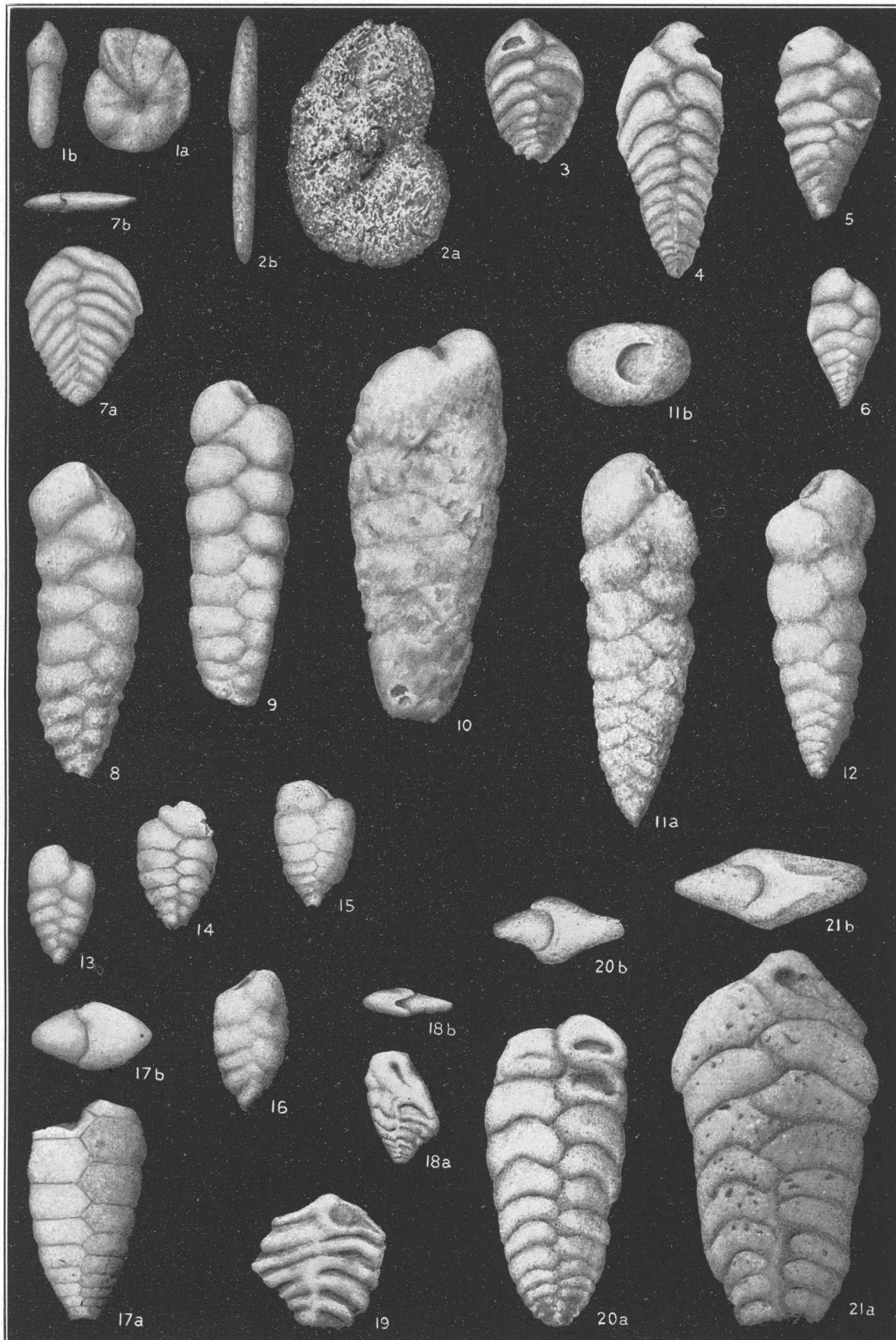
FIGURE 18. a, Front view; b, apertural view, $\times 35$. From well sample, Tyler County, Tex.

FIGURE 19. Front view, $\times 50$. Alazan clay, Mexico.

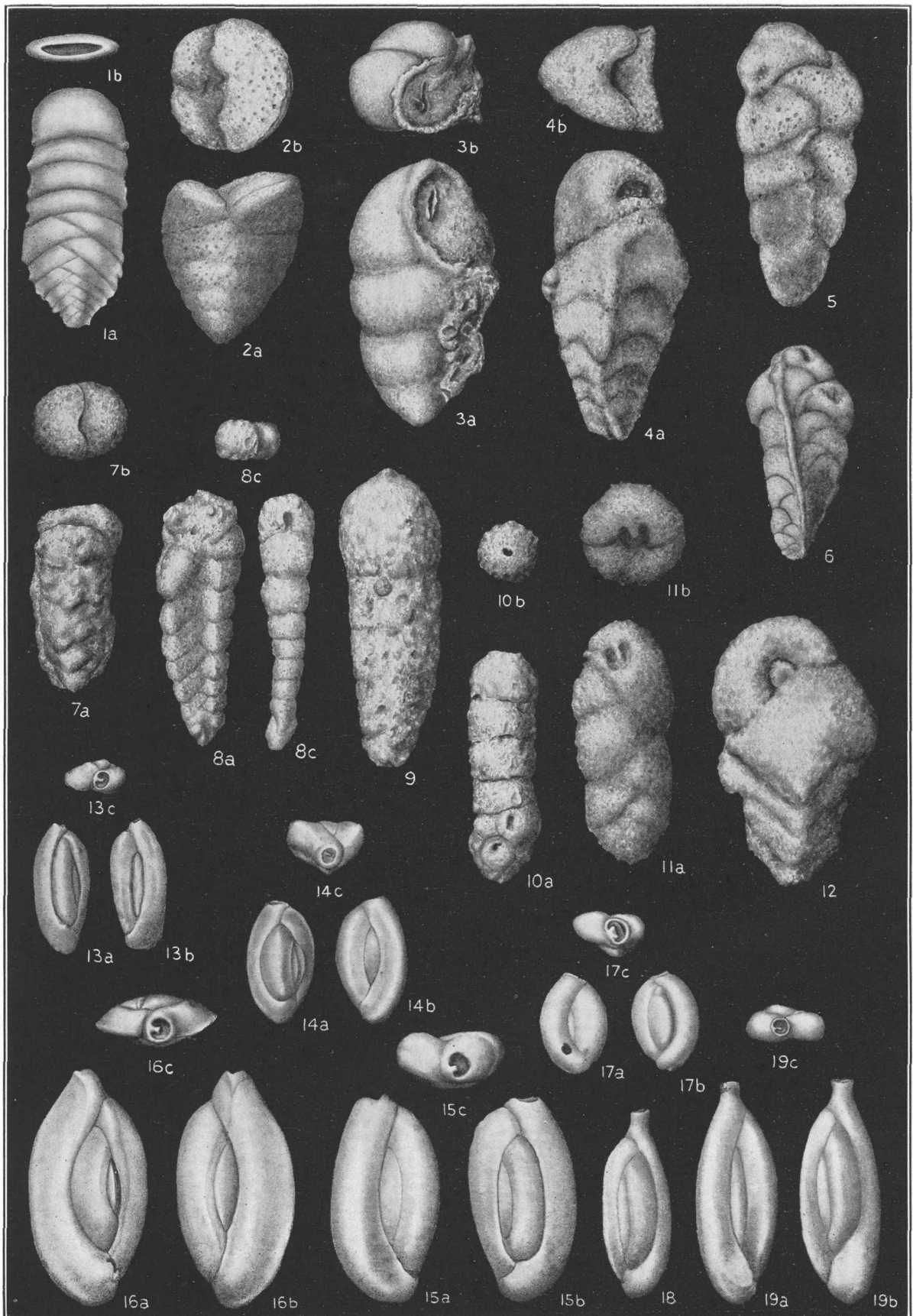
Textularia hockleyensis Cushman and Applin (p. 9)

FIGURE 20. a, Side view; b, apertural view, $\times 35$. Bridge Creek, San Augustine County, Tex.

FIGURE 21. a, Side view; b, apertural view, $\times 35$. Bridge Creek, San Augustine County, Tex.



LITUOLIDAE AND TEXTULARIIDAE.



TEXTULARIIDAE, VERNEUILINIDAE, VALVULINIDAE, AND MILIOLIDAE.

PLATE 2

Vulvulina advena Cushman (p. 9)

FIGURE 1. a, Side view; b, apertural view, $\times 65$. U.S.G.S. station 7203.

Textulariella barrettii (Jones and Parker) (p. 11)

FIGURE 2. a, Side view; b, apertural view, $\times 60$. U.S.G.S. station 289.

Verneuilina propinqua H. B. Brady (p. 9)

FIGURE 3. a, Side view; b, apertural view, $\times 50$. U.S.G.S. station 292.

Gaudryina jacksonensis Cushman (p. 9)

FIGURE 4. a, Side view; b, apertural view, $\times 50$. U.S.G.S. station 6319.

FIGURE 5. Side view, $\times 50$. U.S.G.S. station 6319.

FIGURE 6. Side view, $\times 50$. Alazan clay, Mexico.

Gaudryina gardnerae Cushman (p. 10)

FIGURE 7. a, Side view; b, apertural view, $\times 65$. U.S.G.S. station 1/43.

Gaudryina subquadrata Cushman (p. 10)

FIGURE 8. a, Front view; b, side view; c, apertural view, $\times 70$. U.S.G.S. station 289.

Liebusella byramensis (Cushman) var. *turgida* (Cushman) (p. 11)

FIGURE 9. Side view, $\times 35$. U.S.G.S. station 6319.

Pseudoclavulina sp.? (p. 10)

FIGURE 10. a, Side view; b, apertural view, $\times 60$. U.S.G.S. station 292.

Valvulina ocalana Cushman (p. 10)

FIGURE 11. a, Side view; b, apertural view, $\times 65$. U.S.G.S. station 6805.

FIGURE 12. Side view, larger, more angled form, $\times 65$. U.S.G.S. station 6805.

Quinqueloculina laevigata D'Orbigny (p. 11)

FIGURE 13. a, b, Opposite sides; c, apertural view, $\times 70$. Jackson, Miss.

FIGURE 14. a, b, Opposite sides; c, apertural view, $\times 70$. Showing variations. Jackson, Miss.

FIGURE 15. a, b, Opposite sides; c, apertural view, $\times 70$. Jackson, Miss.

Quinqueloculina longirostra D'Orbigny (p. 12)

FIGURE 16. a, b, Opposite sides; c, apertural view, $\times 70$. Jackson, Miss.

Quinqueloculina hauerina D'Orbigny? (p. 12)

FIGURE 17. a, b, Opposite sides; c, apertural view, $\times 70$. Jackson, Miss.

Quinqueloculina anguina Terquem (p. 12)

FIGURE 18. Side view, $\times 70$. Jackson, Miss.

FIGURE 19. a, b, Opposite sides; c, apertural view, $\times 70$. Jackson, Miss.

PLATE 3

Miliola saxorum Lamarck (p. 12)

- FIGURE 1. Side view, $\times 35$. Jackson, Miss.
FIGURE 2. Side view, $\times 35$. Jackson, Miss.
FIGURE 3. Side view, $\times 35$. Showing the eroded form very common at Jackson, Miss.

Miliola jacksonensis Cushman (p. 13)

- FIGURE 4. Holotype, side view, $\times 35$. Jackson, Miss.
FIGURE 5. Side view, $\times 35$. Jackson, Miss.
FIGURE 6. Side view, $\times 35$. Jackson, Miss.

Massilina jacksonensis Cushman (p. 13)

- FIGURE 7. Holotype. Side view, $\times 35$. Jackson, Miss.
FIGURE 8. Side view, $\times 35$. Jackson, Miss.
FIGURE 9. Side view, early stages of microspheric form, $\times 35$. Jackson, Miss.
FIGURE 10. Side view, early stages of microspheric form, $\times 35$. Jackson, Miss.

Massilina jacksonensis Cushman var. *punctatocostata* Cushman (p. 14)

- FIGURE 11. Holotype. Side view, $\times 35$. Jackson, Miss.
FIGURE 12. Side view, early stages of microspheric form, $\times 35$. Jackson, Miss.
FIGURE 13. Side view, $\times 35$. Jackson, Miss.

Massilina decorata Cushman (p. 13)

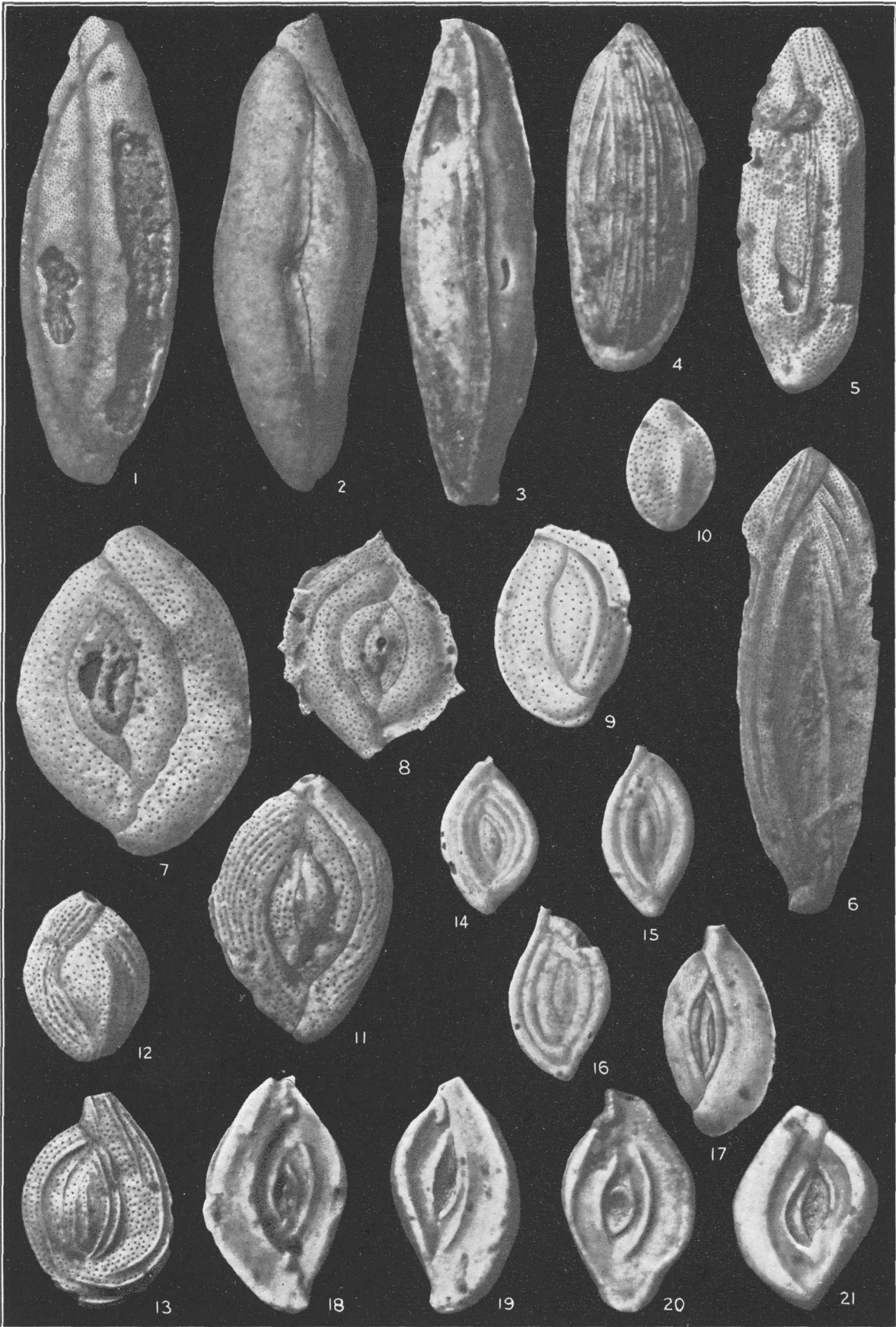
- FIGURE 14. Side view, $\times 35$. U.S.G.S. station 6457.
FIGURE 15. Side view, $\times 35$. U.S.G.S. station 6457.
FIGURE 16. Side view, $\times 35$. U.S.G.S. station 6457.

Massilina cookei Cushman, n. sp. (p. 13)

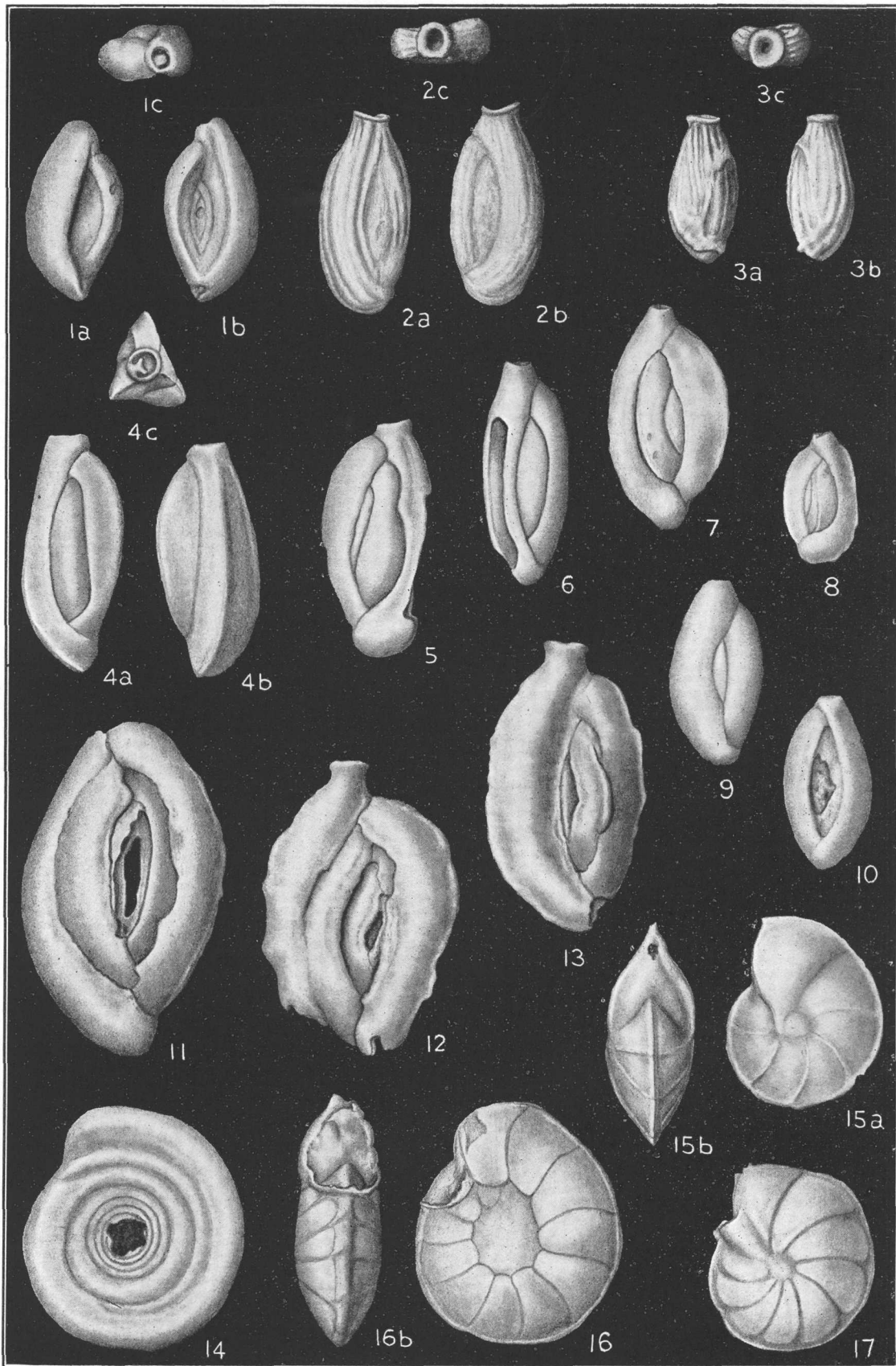
- FIGURE 17. Side view, $\times 35$. Jackson, Miss.

Spiroloculina grateloupi D'Orbigny (p. 14)

- FIGURE 18. Side view, $\times 35$. Jackson, Miss.
FIGURE 19. Side view, $\times 35$. Jackson, Miss.
FIGURE 20. Side view, $\times 35$. Jackson, Miss.
FIGURE 21. Side view, $\times 35$. Jackson, Miss.



MILIOLIDAE.



MILIOLIDAE, OPHTHALMIDIIDAE, AND LAGENIDAE.

PLATE 4

Spiroloculina sp.? (p. 14)

FIGURE 1. a, b, Opposite sides; c, apertural view, $\times 120$. Jackson, Miss.

Articulina terquemi Cushman (p. 14)

FIGURE 2. Holotype. a, b, Opposite sides; c, apertural view, $\times 75$. Jackson, Miss.

FIGURE 3. a, b, Opposite sides; c, apertural view, $\times 75$. Jackson, Miss.

Triloculina sp.? (p. 15)

FIGURE 4. a, b, Opposite sides; c, apertural view, $\times 70$. Jackson, Miss.

Quinqueloculina sp.? (p. 12)

FIGURE 5. Side view, $\times 35$. Stovall Creek, east of Diboll, Angelina County, Tex.

FIGURE 6. Side view, $\times 35$. Stovall Creek, east of Diboll, Angelina County, Tex.

Quinqueloculina sp.? (p. 12)

FIGURE 7. Side view, $\times 35$. Stovall Creek, east of Diboll, Angelina County, Tex.

FIGURE 8. Side view, $\times 35$. Stovall Creek, east of Diboll, Angelina County, Tex.

Quinqueloculina sp.? (p. 12)

FIGURE 9. Side view, $\times 35$. Stovall Creek, east of Diboll, Angelina County, Tex.

FIGURE 10. Side view, $\times 35$. Stovall Creek, east of Diboll, Angelina County, Tex.

Massilina sp.? (p. 14)

FIGURE 11. Side view, $\times 35$. Well sample, Tyler County, Tex.

FIGURE 12. Side view, $\times 35$. Well sample, Tyler County, Tex.

FIGURE 13. Side view, $\times 35$. Well sample, Tyler County, Tex.

Cornuspira olygogyra Hantken (p. 15)

FIGURE 14. Side view, $\times 70$. Jackson, Miss.

Robulus limbosus (Reuss) var. *hockleyensis* (Cushman and Applin) (p. 16)

FIGURE 15. a, Side view; b, peripheral view, $\times 35$. Bridge Creek, San Augustine County, Tex.

Robulus articulatus (Reuss) var. *texanus* (Cushman and Applin) (p. 16)

FIGURE 16. Adult. a, Side view; b, peripheral view, $\times 17$. Well sample, Harris County, Tex.

FIGURE 17. Young. Side view, $\times 35$. Well sample, Harris County, Tex.

PLATE 5

***Robulus gutticostatus* (Gümbel) (p. 15)**

FIGURE 1. Side view, $\times 40$. U.S.G.S. station 1/38.

FIGURE 2. Side view, $\times 40$. U.S.G.S. station 1/38.

***Robulus gutticostatus* (Gümbel) var. *cocoaensis* (Cushman) (p. 15)**

FIGURE 3. Side view, $\times 40$. Cocoa, Ala.

FIGURE 4. Side view, $\times 40$. Cocoa, Ala.

***Robulus gutticostatus* (Gümbel) var. *yazooensis* Cushman (p. 15)**

FIGURE 5. Side view, $\times 40$. U.S.G.S. station 7220.

***Saracenaria arcuata* (D'Orbigny) var. *hantkeni* Cushman (p. 17)**

FIGURE 6. Holotype. Side view, $\times 50$. U.S.G.S. station 6319.

FIGURE 7. Side view, $\times 50$. U.S.G.S. station 6319.

***Nodosaria fissicostata* (Gümbel) (p. 22)**

FIGURE 8. Side view, $\times 50$. U.S.G.S. station 1/43.

FIGURE 9. Side view, $\times 50$. U.S.G.S. station 1/7.

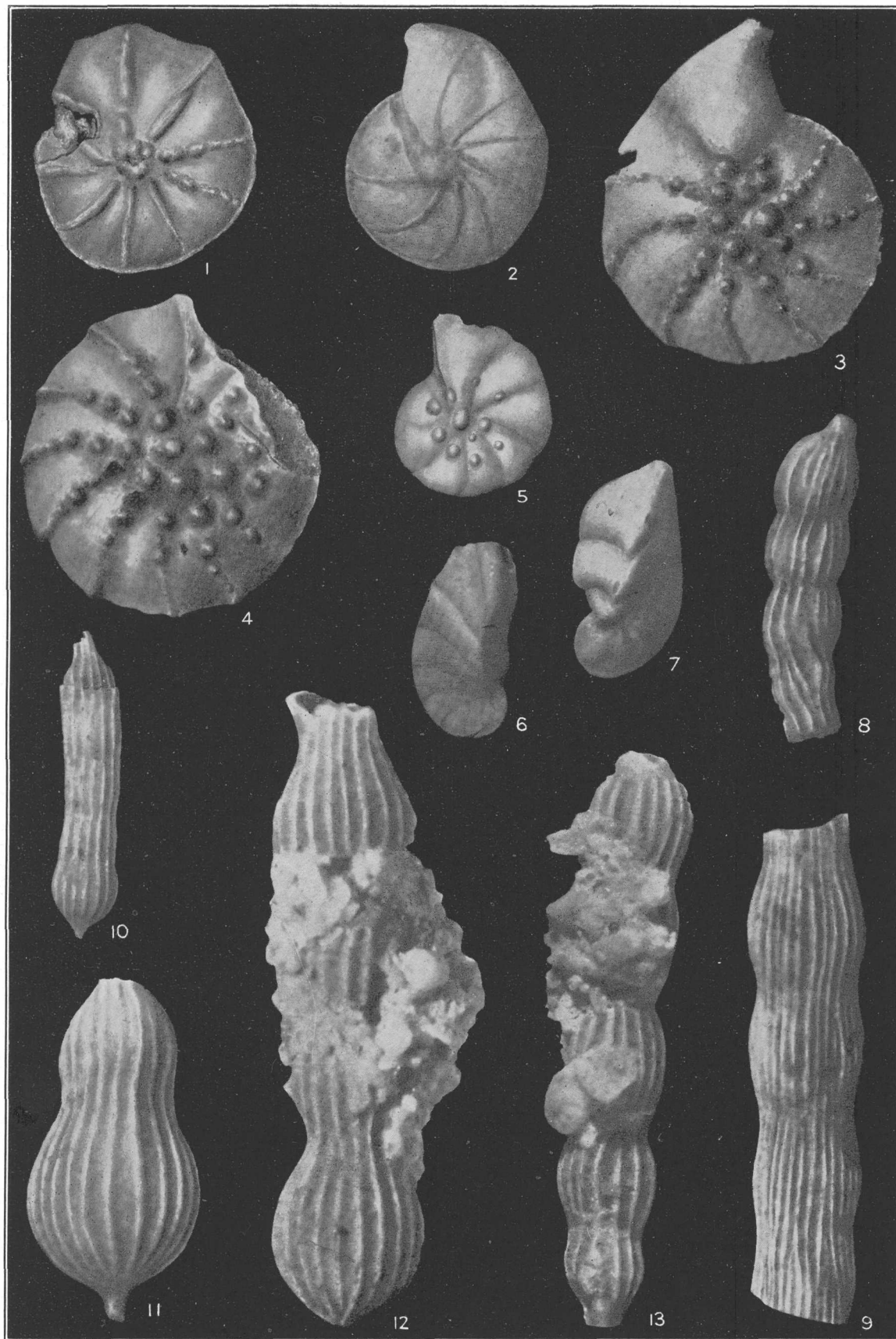
***Nodosaria latejugata* Gümbel var. *carolinensis* Cushman (p. 21)**

FIGURE 10. Holotype. Side view, $\times 35$. U.S.G.S. station 7203.

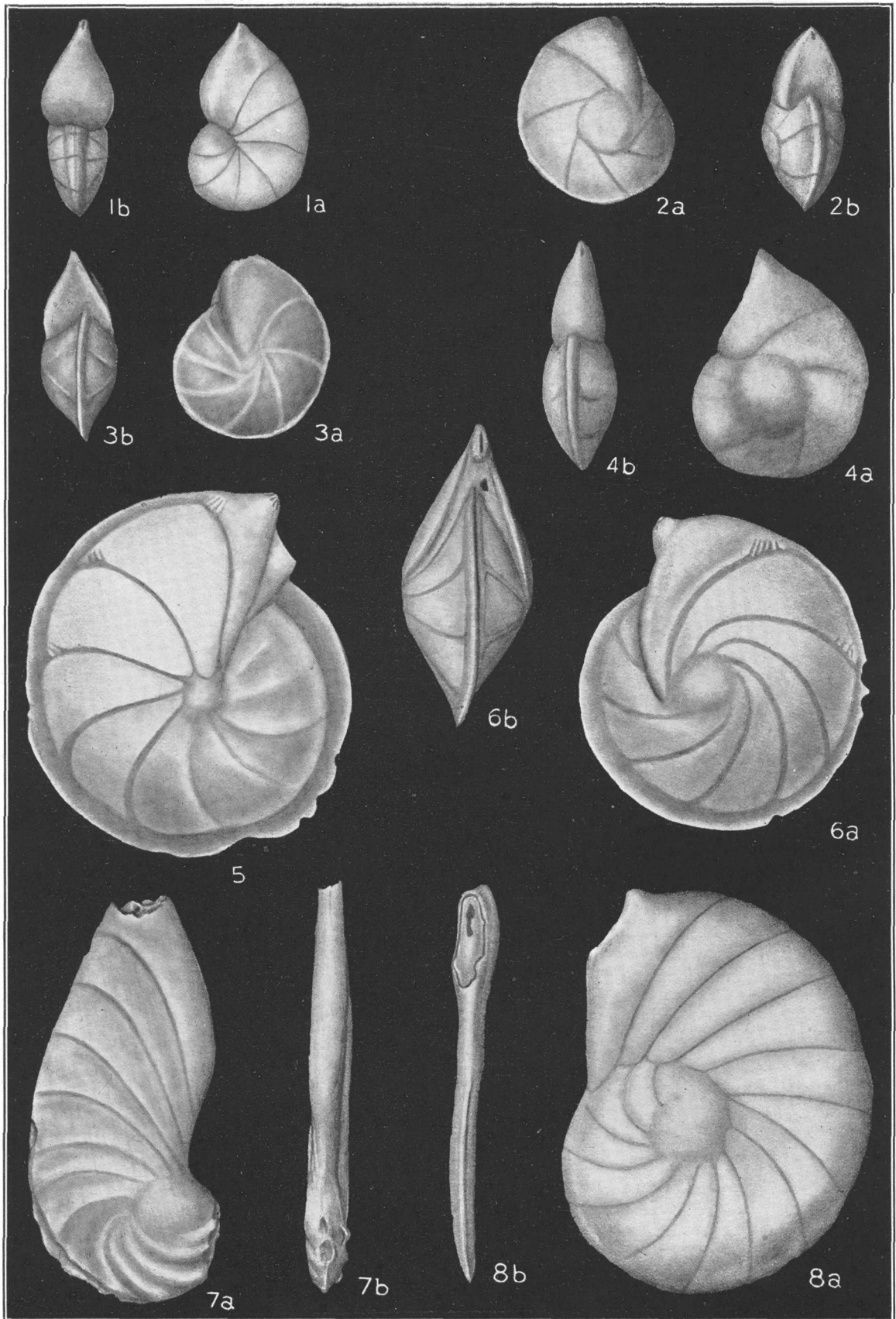
FIGURE 11. Side view, $\times 35$. Cooper River, S.C.

FIGURE 12. Side view, $\times 35$. U.S.G.S. station 7203.

FIGURE 13. Side view, $\times 35$. Cooper River, S.C.



LAGENIDAE.



LAGENIDAE.

PLATE 6

Robulus propinquus (Hantken) (p. 16)

FIGURE 1. a, Side view; b, peripheral view, $\times 35$. Well sample, Tyler County, Tex.

Robulus alato-limbatus (Gümbel) (p. 15)

FIGURE 2. a, Side view; b, peripheral view, $\times 35$. Well sample, Tyler County, Tex.

Robulus limbosus (Reuss) var. hockleyensis (Cushman and Applin) (p. 16)

FIGURE 3. a, Side view; b, peripheral view, $\times 35$. Bridge Creek, San Augustine County, Tex.

Lenticulina convergens (Bornemann) (p. 17)

FIGURE 4. a, Side view; b, peripheral view, $\times 35$. U.S.G.S. station 7719.

Robulus limbosus (Reuss) (p. 16)

FIGURE 5. Side view, $\times 30$. U.S.G.S. station 1/38.

Robulus arcuato-striatus (Hantken) var. carolinianus Cushman (p. 17)

FIGURE 6. a, Side view; b, peripheral view, $\times 30$. U.S.G.S. station 1/38.

Planularia truncana (Gümbel) (p. 17)

FIGURE 7. a, Side view; b, peripheral view, $\times 40$. U.S.G.S. station 7203.

Planularia cooperensis Cushman (p. 18)

FIGURE 8. a, Side view; b, peripheral view, $\times 15$. U.S.G.S. station 11863.

PLATE 7

Marginulina karreriana Cushman, n. sp. (p. 18)

FIGURE 1. Holotype. a, Side view; b, peripheral view, $\times 40$. U.S.G.S. station 11857.

FIGURE 2. a, Side view; b, peripheral view, $\times 40$. U.S.G.S. station 11862.

Marginulina subrecta Franke (p. 18)

FIGURE 3. a, Side view; b, peripheral view, $\times 40$. U.S.G.S. station 11861.

Marginulina cooperi Cushman (p. 19)

FIGURE 4. a, Side view; b, peripheral view, $\times 40$. Cooper River, S.C.

Marginulina jacksonensis (Cushman and Applin) (p. 18)

FIGURE 5. a, Side view; b, peripheral view, $\times 35$. Well sample, Tyler County, Tex.

Marginulina cocoaensis Cushman (p. 18)

FIGURE 6. Side view, $\times 50$. Megalospheric form. Cocoa, Ala.

FIGURE 7. Side view, $\times 50$. Paratype. Microspheric form. Cocoa, Ala.

Marginulina fragaria (Gümbel) var. texasensis (Cushman and Applin) (p. 19)

FIGURE 8. a, Side view; b, peripheral view, $\times 35$. Well sample, Newton County, Tex.

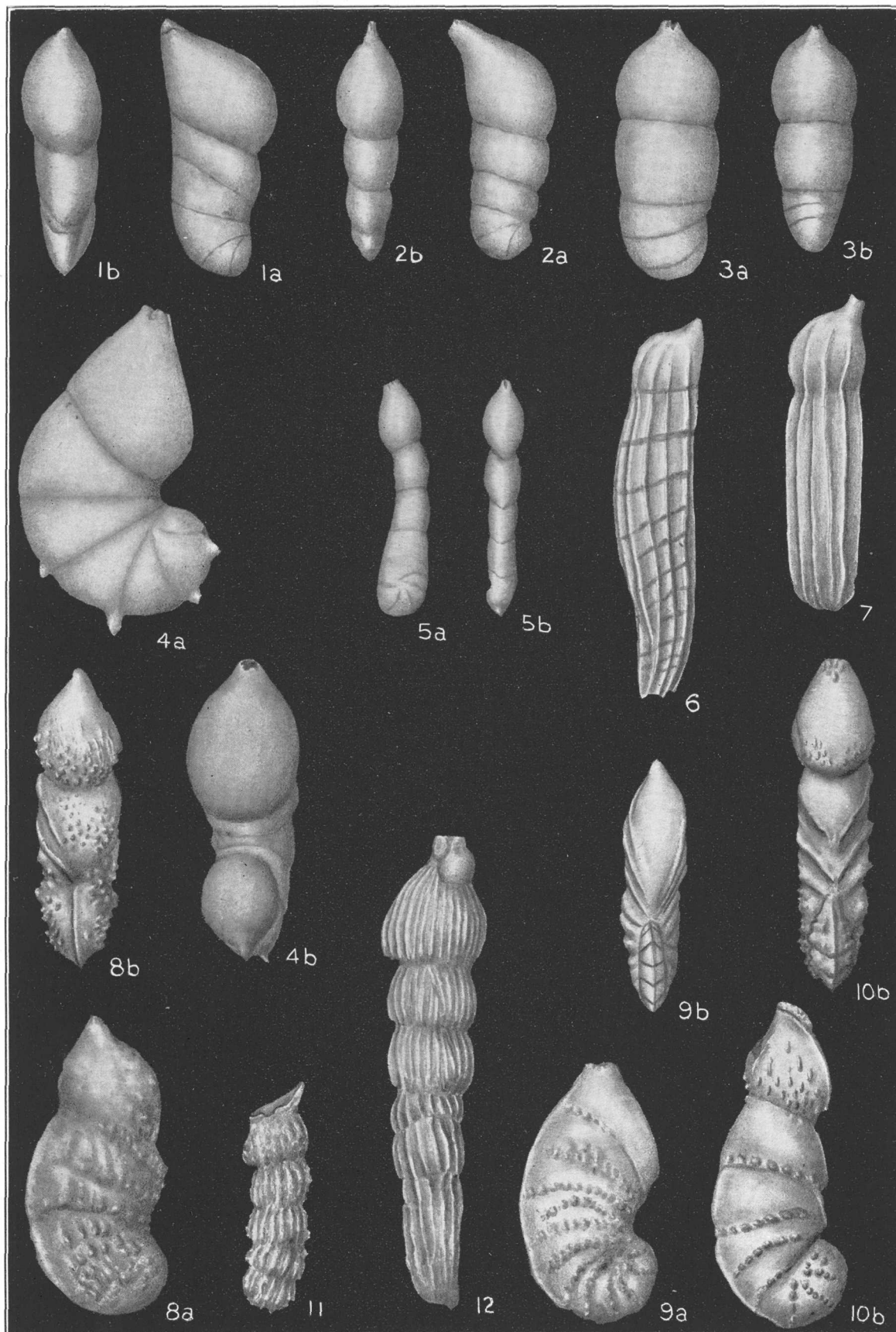
FIGURE 9. a, Side view; b, peripheral view, $\times 35$. Well sample, Newton County, Tex.

FIGURE 10. a, Side view; b, peripheral view, $\times 35$. Well sample, Newton County, Tex.

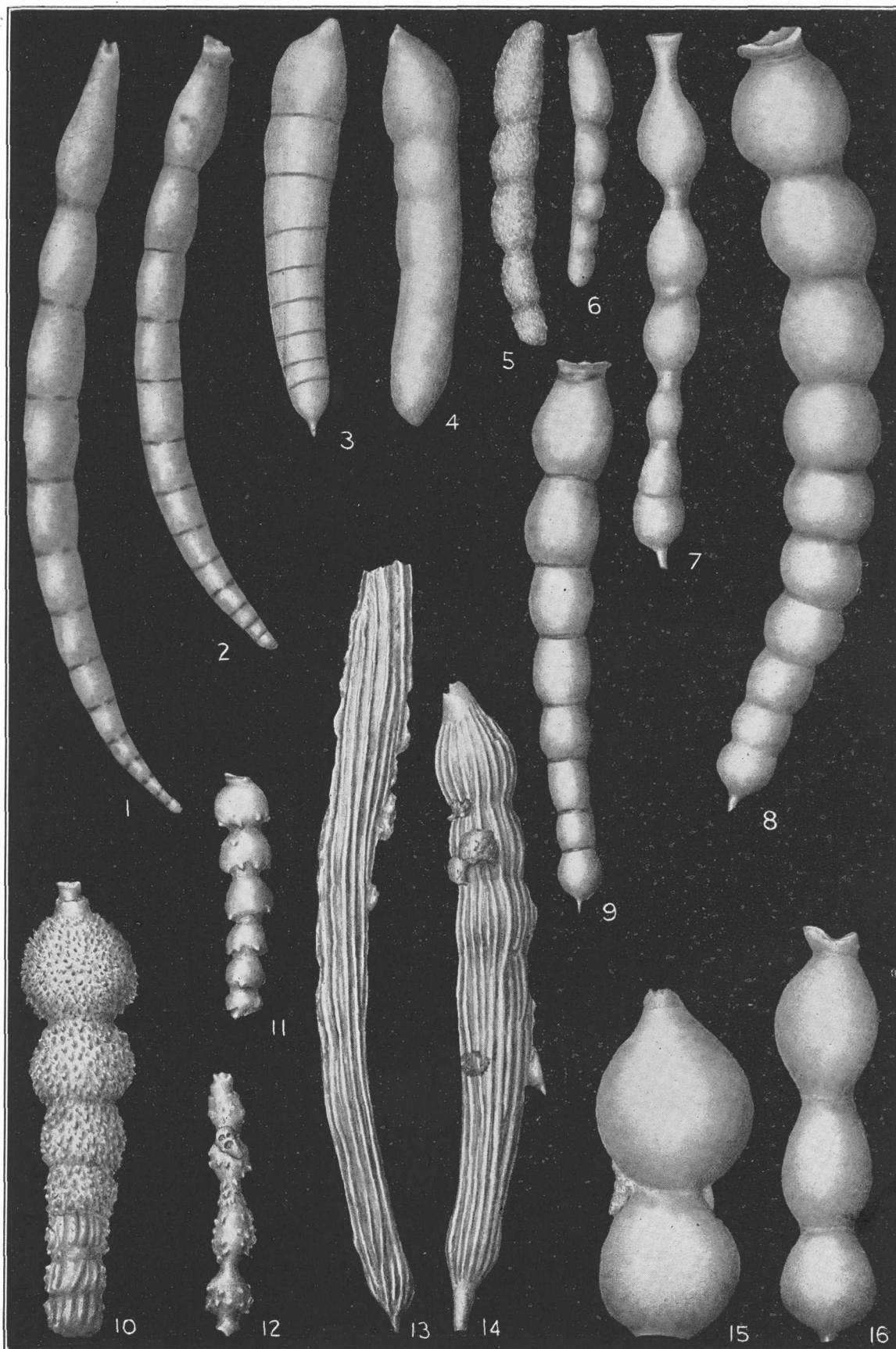
Marginulina cooperensis Cushman (p. 19)

FIGURE 11. Holotype. Microspheric form. $\times 50$. Cooper River, S.C.

FIGURE 12. Paratype. Megalospheric form. $\times 50$. Cooper River, S.C.



LAGENIDAE.



LAGENIDAE.

PLATE 8

Dentalina cocoaensis (Cushman) (p. 19)

FIGURE 1. Side view, $\times 65$. Cocoa, Ala.

FIGURE 2. Side view, $\times 65$. U.S.G.S. station 7203.

Dentalina cooperensis Cushman (p. 20)

FIGURE 3. Side view, $\times 65$. Cocoa, Ala.

FIGURE 4. Holotype. Side view, $\times 65$. Cooper River, S.C.

Dentalina hantkeni Cushman (p. 20)

FIGURE 5. Side view, $\times 65$. U.S.G.S. station 6740.

FIGURE 6. Holotype. Side view, $\times 65$. U.S.G.S. station 6741.

Dentalina jacksonensis (Cushman and Applin) (p. 20)

FIGURE 7. Side view, $\times 65$. Alazan clay, Mexico.

FIGURE 8. Side view, $\times 65$. Cocoa, Ala.

FIGURE 9. Side view, $\times 65$. Alazan clay, Mexico.

Dentalina halkyardi Cushman (p. 20)

FIGURE 10. Side view, $\times 65$. Cooper River, S.C.

Dentalina cf. D. adolphina D'Orbigny (p. 21)

FIGURE 11. Side view, $\times 50$. U.S.G.S. station 11857.

FIGURE 12. Side view, $\times 50$. U.S.G.S. station 11857.

Dentalina cf. D. vertebralis (Batsch) (p. 21)

FIGURE 13. Side view, $\times 35$. U.S.G.S. station 11861.

FIGURE 14. Side view, $\times 35$. U.S.G.S. station 11862.

Dentalina sp.? (p. 21)

FIGURE 15. Side view, $\times 35$. U.S.G.S. station 11861.

FIGURE 16. Side view, $\times 35$. U.S.G.S. station 11862.

PLATE 9

Nodosaria cookei Cushman (p. 22)

FIGURE 1. Side view, $\times 65$. U.S.G.S. station 1/21.

Nodosaria ewaldi Reuss? (p. 22)

FIGURE 2. Side view, $\times 65$. U.S.G.S. station 2457.

Lagena laevis (Montagu)? (p. 22)

FIGURE 3. Side view, $\times 90$. U.S.G.S. station 11857.

FIGURE 4. Side view, $\times 65$. Barnwell County, S.C.

Lagena acuticosta Reuss (p. 23)

FIGURE 5. Side view, $\times 90$. U.S.G.S. station 11857.

FIGURE 6. Side view, $\times 65$. U.S.G.S. station 7719.

Lagena costata (Williamson) (p. 23)

FIGURE 7. Side view, $\times 90$. U.S.G.S. station 11857.

FIGURE 8. Side view, $\times 90$. U.S.G.S. station 11857.

Lagena orbignyana (Seguenza) var. *semiconcentrica* Cushman (p. 23)

FIGURE 9. Side view, $\times 65$. U.S.G.S. station 5611.

Lagena hexagona (Williamson) (p. 23)

FIGURE 10. Side view, $\times 90$. U.S.G.S. station 11863.

Lagena sp.? (p. 23)

FIGURE 11. Side view, $\times 90$. U.S.G.S. station 11861.

Guttulina problema D'Orbigny (p. 23)

FIGURE 12. Side view, $\times 65$. U.S.G.S. station 6321.

Guttulina irregularis (D'Orbigny) (p. 24)

FIGURE 13. Side view, $\times 65$. Alazan clay, Mexico.

FIGURE 14. Side view, $\times 65$. U.S.G.S. station 1/21.

FIGURE 15. Side view, $\times 65$. Cocoa, Ala.

FIGURE 16. Side view, $\times 65$. U.S.G.S. station 1/21.

Guttulina spicaeformis (Roemer) (p. 24)

FIGURE 17. Side view, $\times 65$. U.S.G.S. station 6319.

Globulina gibba D'Orbigny (p. 25)

FIGURE 18. Side view, $\times 65$. U.S.G.S. station 6463.

Globulina gibba D'Orbigny var. *tuberculata* D'Orbigny (p. 26)

FIGURE 19. Side view, $\times 65$. U.S.G.S. station 1/21.

FIGURE 20. Side view, $\times 65$. U.S.G.S. station 6319.

Globulina gibba D'Orbigny var. *globosa* (Von Münster) (p. 26)

FIGURE 21. Side view, $\times 65$. U.S.G.S. station 7364.

Globulina inaequalis Reuss (p. 26)

FIGURE 22. Side view, $\times 90$. Well sample, Tyler County, Tex.

Globulina minuta (Roemer) (p. 27)

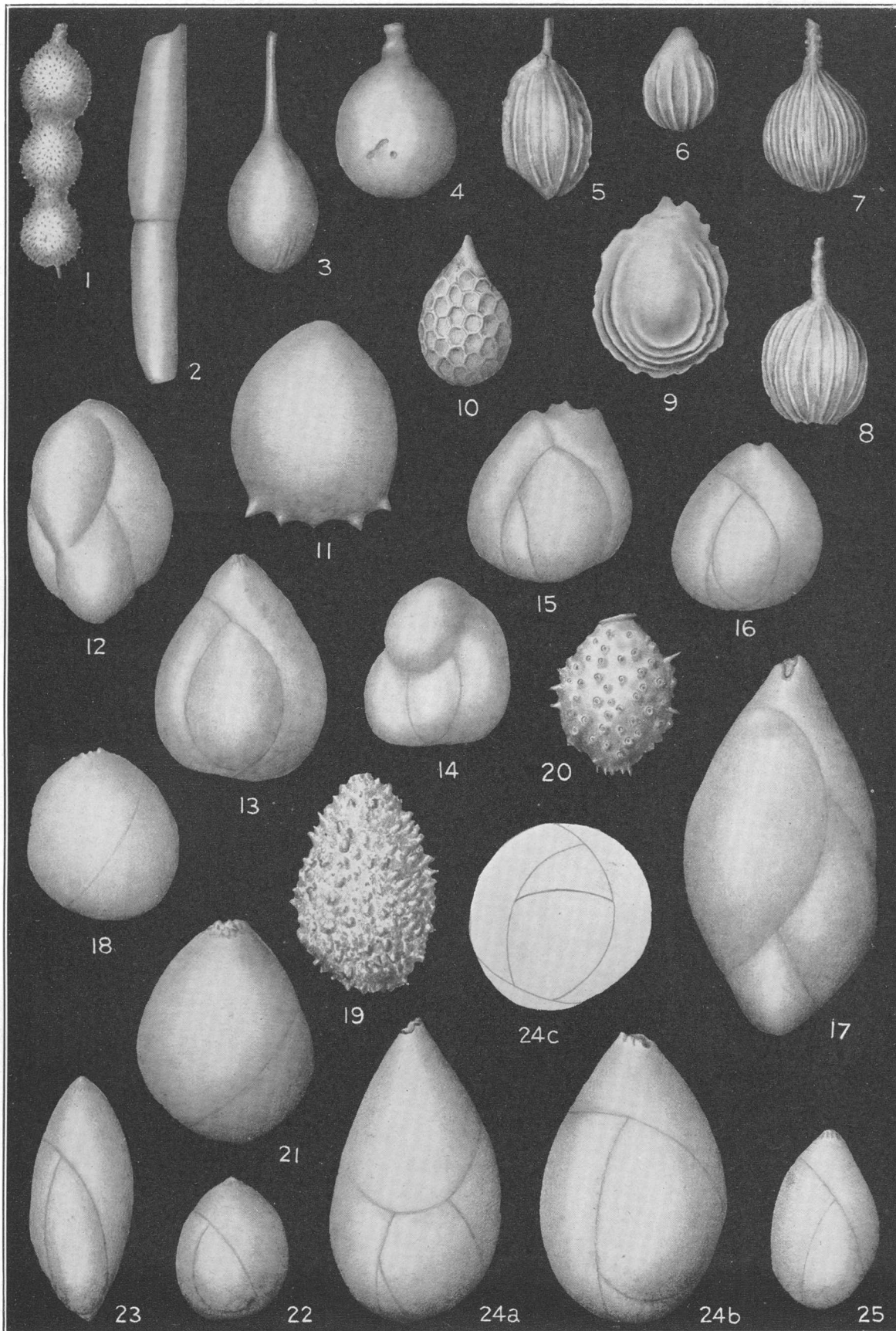
FIGURE 23. Side view, $\times 90$. U.S.G.S. station 6738.

Globulina rotundata (Bornemann) (p. 27)

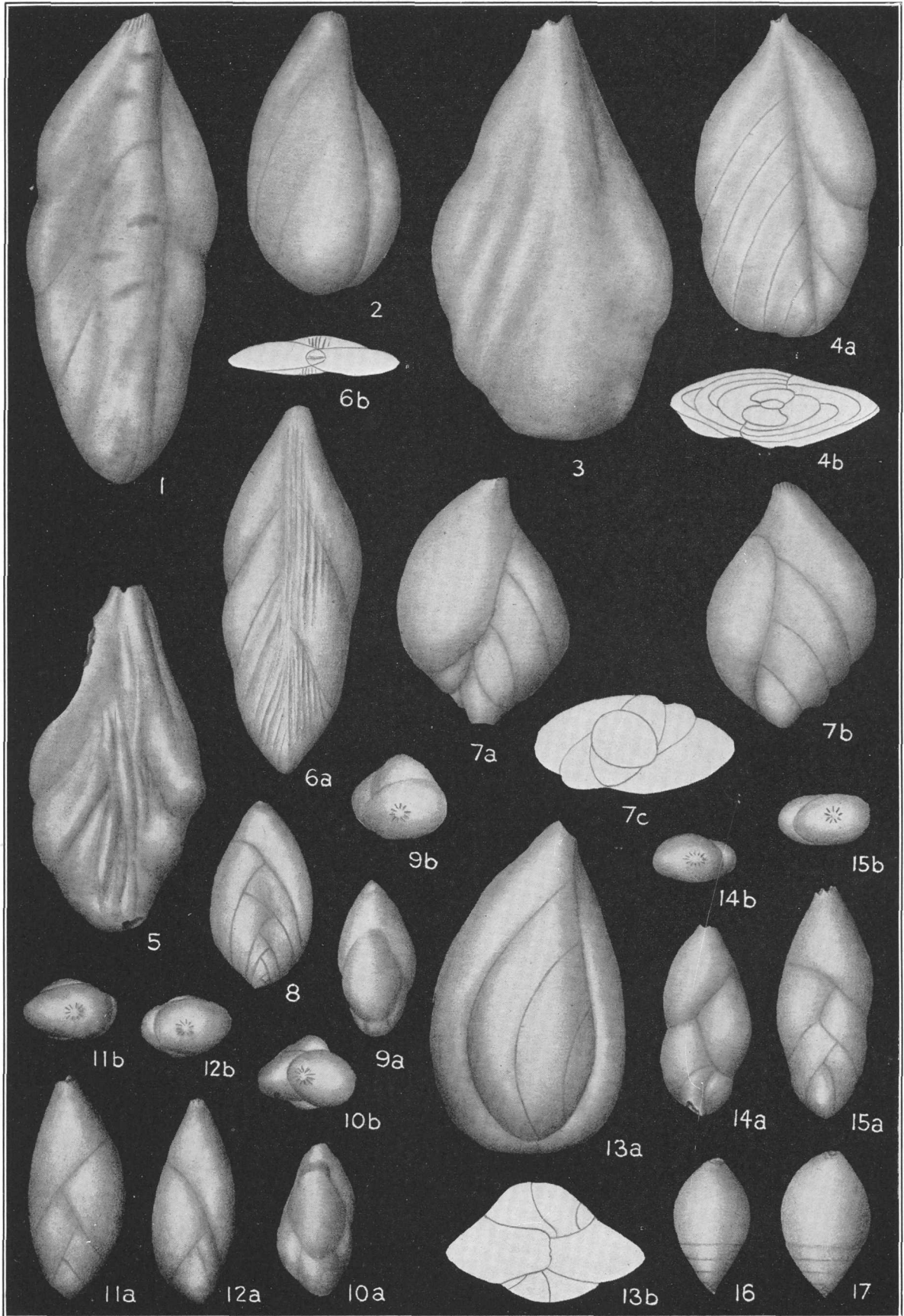
FIGURE 24. a, b, Opposite sides; c, basal view, $\times 35$. Specimen from Hermsdorf, Germany.

Globulina münsteri (Reuss) (p. 27)

FIGURE 25. Side view, $\times 90$. U.S.G.S. station 7719.



LAGENIDAE AND POLYMORPHINIDAE



POLYMORPHINIDAE.

PLATE 10

***Sigmomorphina jacksonensis* (Cushman) (p. 28)**

FIGURE 1. Side view, $\times 65$. Jackson, Miss.

FIGURE 2. Side view, $\times 65$. U.S.G.S. station 1/19.

FIGURE 3. Side view, $\times 65$. U.S.G.S. station 1/19.

FIGURE 4. a, Side view; b, basal view, $\times 65$. Blue Springs, Jackson County, Fla.

***Sigmomorphina jacksonensis* (Cushman) var. *costifera* (Cushman) (p. 28)**

FIGURE 5. Side view, $\times 65$. U.S.G.S. station 1/7.

FIGURE 6. a, Side view; b, apertural view, $\times 65$. Barnwell County, S.C.

***Sigmomorphina vauhani* Cushman and Ozawa (p. 28)**

FIGURE 7. a, b, Opposite sides; c, basal view, $\times 35$. Cooper River, S.C.

***Polymorphina advena* Cushman (p. 29)**

FIGURE 8. Side view, $\times 90$. U.S.G.S. station 11857.

***Guttulina spicaeformis* (Roemer) (p. 24)**

FIGURE 9. a, Side view; b, apertural view, $\times 35$. Well sample, Newton County, Tex.

FIGURE 10. a, Side view; b, apertural view, $\times 35$. Well sample, Newton County, Tex.

***Pseudopolymorphina decora* (Reuss) (p. 29)**

FIGURE 11. a, Side view; b, apertural view, $\times 35$. Tarkiln Creek, Trinity County, Tex.

FIGURE 12. a, Side view; b, apertural view, $\times 35$. Tarkiln Creek, Trinity County, Tex.

***Sigmoidella plummerae* Cushman and Ozawa (p. 29)**

FIGURE 13. a, Side view; b, basal view, $\times 60$. Specimen from Cook Mountain formation, Tex.

***Pseudopolymorphina dumblei* (Cushman and Applin) (p. 29)**

FIGURE 14. a, Side view; b, apertural view, $\times 35$. Bridge Creek, San Augustine County, Tex.

FIGURE 15. a, Side view; b, apertural view, $\times 35$. Bridge Creek, San Augustine County, Tex.

***Glandulina laevigata* D'Orbigny var. *ovata* Cushman and Applin (p. 29)**

FIGURE 16. Side view, $\times 35$. 4 miles east of Diboll, Angelina County, Tex.

FIGURE 17. Side view, $\times 35$. 4 miles east of Diboll, Angelina County, Tex.

PLATE 11

Nonion advenum (Cushman) (p. 30)

- FIGURE 1. a, Side view; b, apertural view, $\times 35$. U.S.G.S. station 6321.
FIGURE 2. a, Side view; b, apertural view, $\times 35$. U.S.G.S. station 6321.
FIGURE 3. a, Side view; b, apertural view, $\times 35$. Cheapside, Gonzales County, Tex.
FIGURE 4. Side view, $\times 35$. Cheapside, Gonzales County, Tex.

Nonion inexcavatum (Cushman and Applin) (p. 30)

- FIGURE 5. a, Side view; b, apertural view, $\times 60$. U.S.G.S. station 6321.
FIGURE 6. a, Side view; b, apertural view, $\times 60$. U.S.G.S. station 6321.
FIGURE 7. Side view, $\times 60$. East of Diboll, Angelina County, Tex.
FIGURE 8. a, Side view; b, apertural view, $\times 60$. East of Diboll, Angelina County, Tex.

Nonion chapapotense Cole (p. 30)

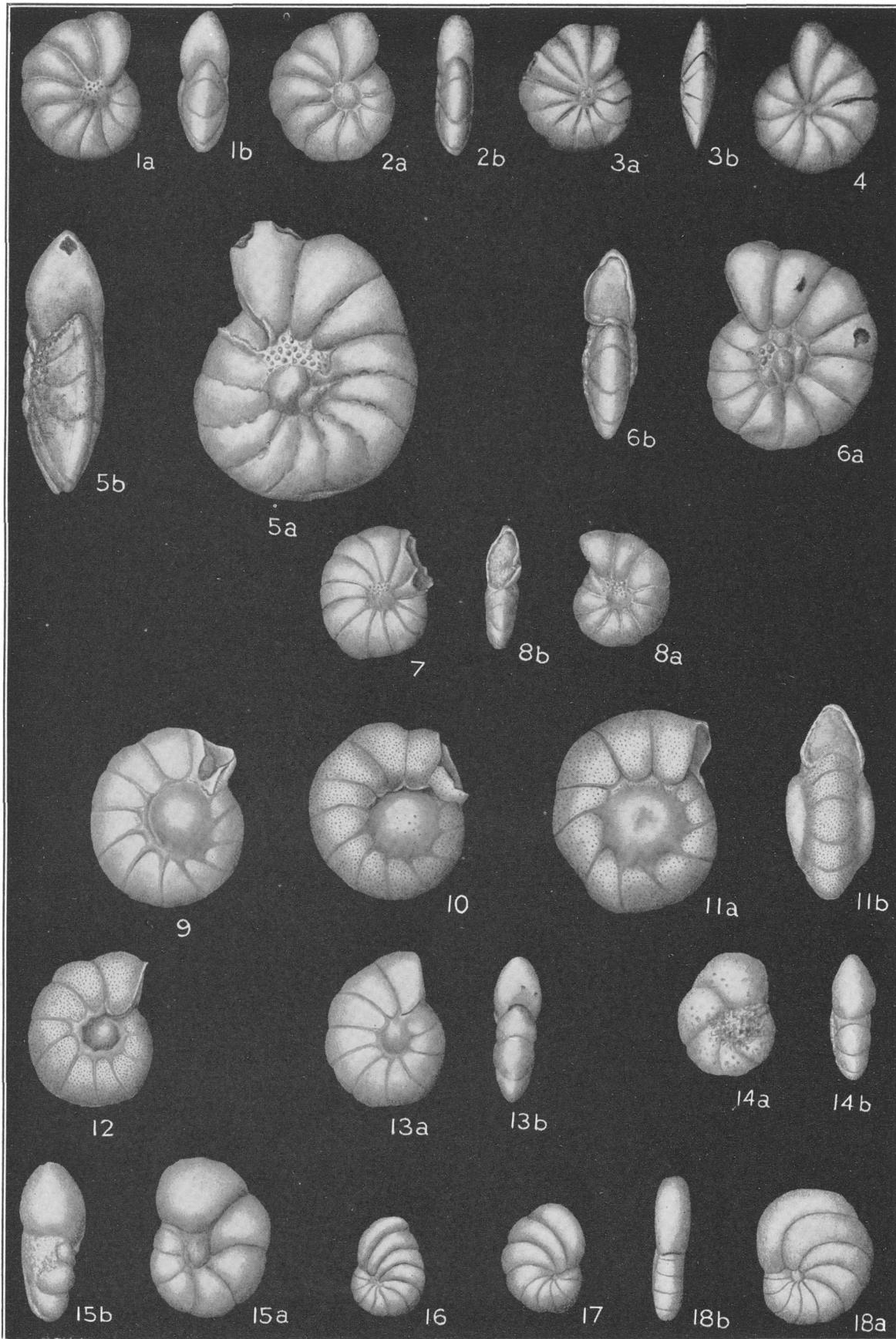
- FIGURE 9. Side view, $\times 90$. U.S.G.S. station 6472.
FIGURE 10. Side view, $\times 90$. U.S.G.S. station 6472.
FIGURE 11. a, Side view; b, apertural view, $\times 90$. U.S.G.S. station 6472.
FIGURE 12. Side view, $\times 90$. U.S.G.S. station 6473.
FIGURE 13. a, Side view; b, apertural view, $\times 90$. U.S.G.S. station 6473.

Nonion micrum Cole (p. 30)

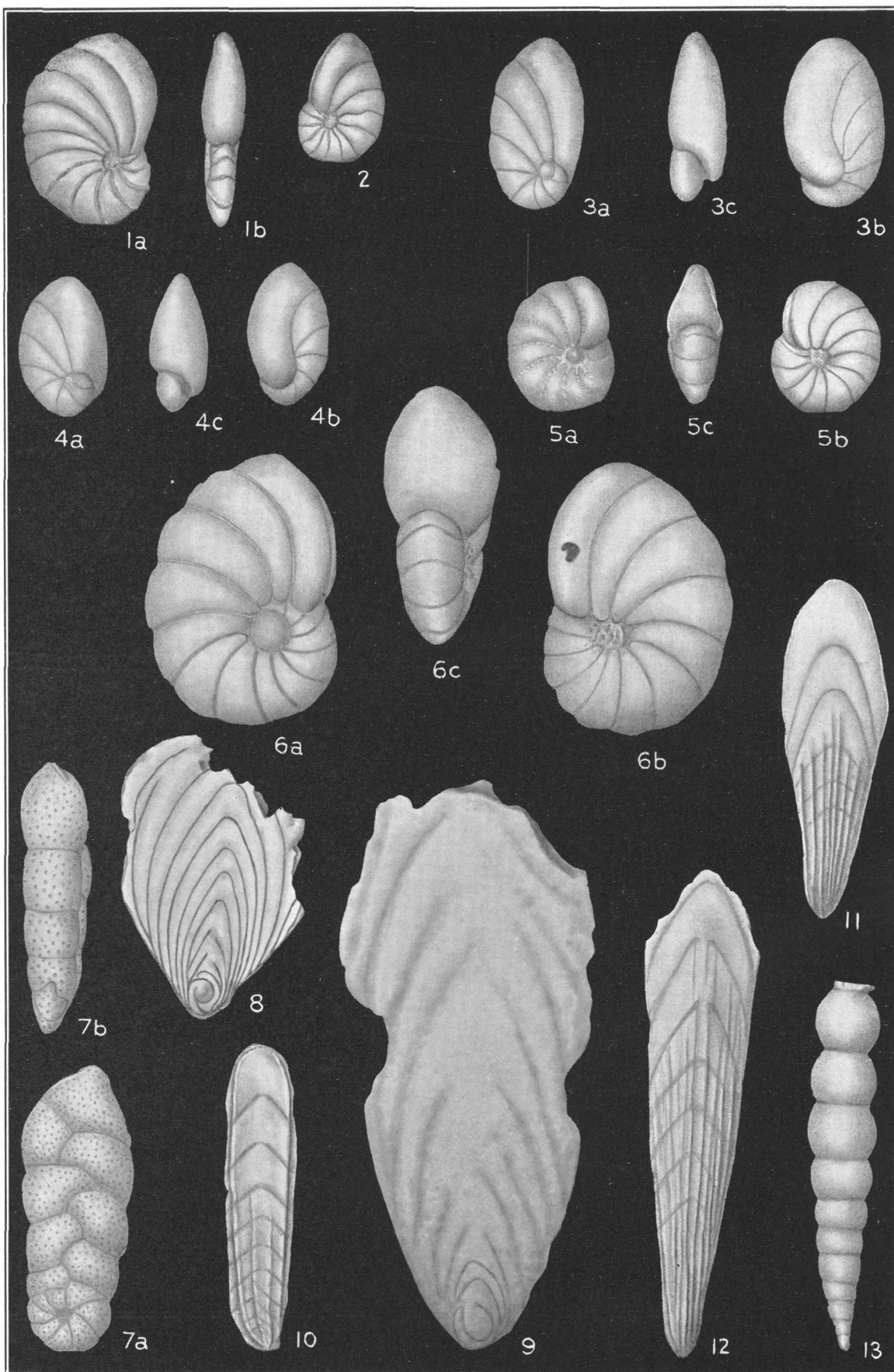
- FIGURE 14. a, Side view; b, apertural view, $\times 90$. U.S.G.S. station 6646.
FIGURE 15. a, Side view; b, apertural view, $\times 90$. U.S.G.S. station 6646.

Nonion whitsettense (Cushman and Applin) (p. 31)

- FIGURE 16. Side view, $\times 35$. Well sample, Tyler County, Tex.
FIGURE 17. Side view, $\times 35$. Well sample, Tyler County, Tex.
FIGURE 18. a, Side view; b, apertural view, $\times 35$. Well sample, Tyler County, Tex.



NONIONIDAE.



NONIONIDAE AND HETEROHELICIDAE.

PLATE 12

Nonionella hantkeni (Cushman and Applin) (p. 31)

FIGURE 1. a, Side view; b, peripheral view, $\times 35$. Well sample, Tyler County, Tex.

FIGURE 2. Side view, $\times 35$. Well sample, Tyler County, Tex.

Nonionella jacksonensis Cushman (p. 31)

FIGURE 3. a, Dorsal view; b, ventral view; c, apertural view, $\times 90$. U.S.G.S. station 11861.

FIGURE 4. Holotype. a, Dorsal view; b, ventral view; c, apertural view, $\times 90$. U.S.G.S. station 6726.

Elphidium texanum (Cushman and Applin) (p. 32)

FIGURE 5. a, b, Opposite sides; c, apertural view, $\times 35$. Well sample, Tyler County, Tex.

Nonionella hantkeni (Cushman and Applin) var. *spissa* Cushman (p. 31)

FIGURE 6. a, Dorsal view; b, ventral view; c, apertural view, $\times 70$. U.S.G.S. station 11863.

Spiroplectoides curta Cushman (p. 33)

FIGURE 7. a, Side view; b, peripheral view, $\times 200$. U.S.G.S. station 11857.

Plectofrondicularia cf. *P. vaughani* Cushman (p. 34)

FIGURE 8. Side view, $\times 50$. U.S.G.S. station 11861.

FIGURE 9. Side view, $\times 50$. Cooper River, S.C.

Plectofrondicularia trinitatensis Cushman and Jarvis (p. 34)

FIGURE 10. Side view, $\times 90$. U.S.G.S. station 11857.

Plectofrondicularia cookei Cushman (p. 34)

FIGURE 11. Side view, $\times 65$. U.S.G.S. station 6319.

FIGURE 12. Holotype. Side view, $\times 65$. Cooper River, S.C.

Nodogenerina cooperensis Cushman (p. 34)

FIGURE 13. Side view, $\times 90$. U.S.G.S. station 11857.

PLATE 13

Hantkenina alabamensis Cushman (p. 49)

- FIGURE 1. a, Side view; b, apertural view, $\times 50$. Cocoa, Ala.
FIGURE 2. a, Side view; b, apertural view, $\times 50$. Cocoa, Ala.
FIGURE 3. Side view, $\times 50$. Cocoa, Ala.
FIGURE 4. Side view, $\times 50$. Cocoa, Ala.
FIGURE 5. Side view, $\times 35$. Sabine River, Sabine County, Tex.

Buliminella alabamensis Cushman (p. 34)

- FIGURE 6. a, b, Opposite sides, $\times 100$. U.S.G.S. station 7227.

Bulimina jacksonensis Cushman (p. 35)

- FIGURE 7. a, Side view; b, apertural view, $\times 50$. Well sample, Newton County, Tex.
FIGURE 8. a, Side view; b, apertural view, $\times 65$. Cocoa, Ala.
FIGURE 9. a, Side view; b, apertural view, $\times 65$. Cocoa, Ala.

Bulimina jacksonensis Cushman var. cuneata Cushman (p. 35)

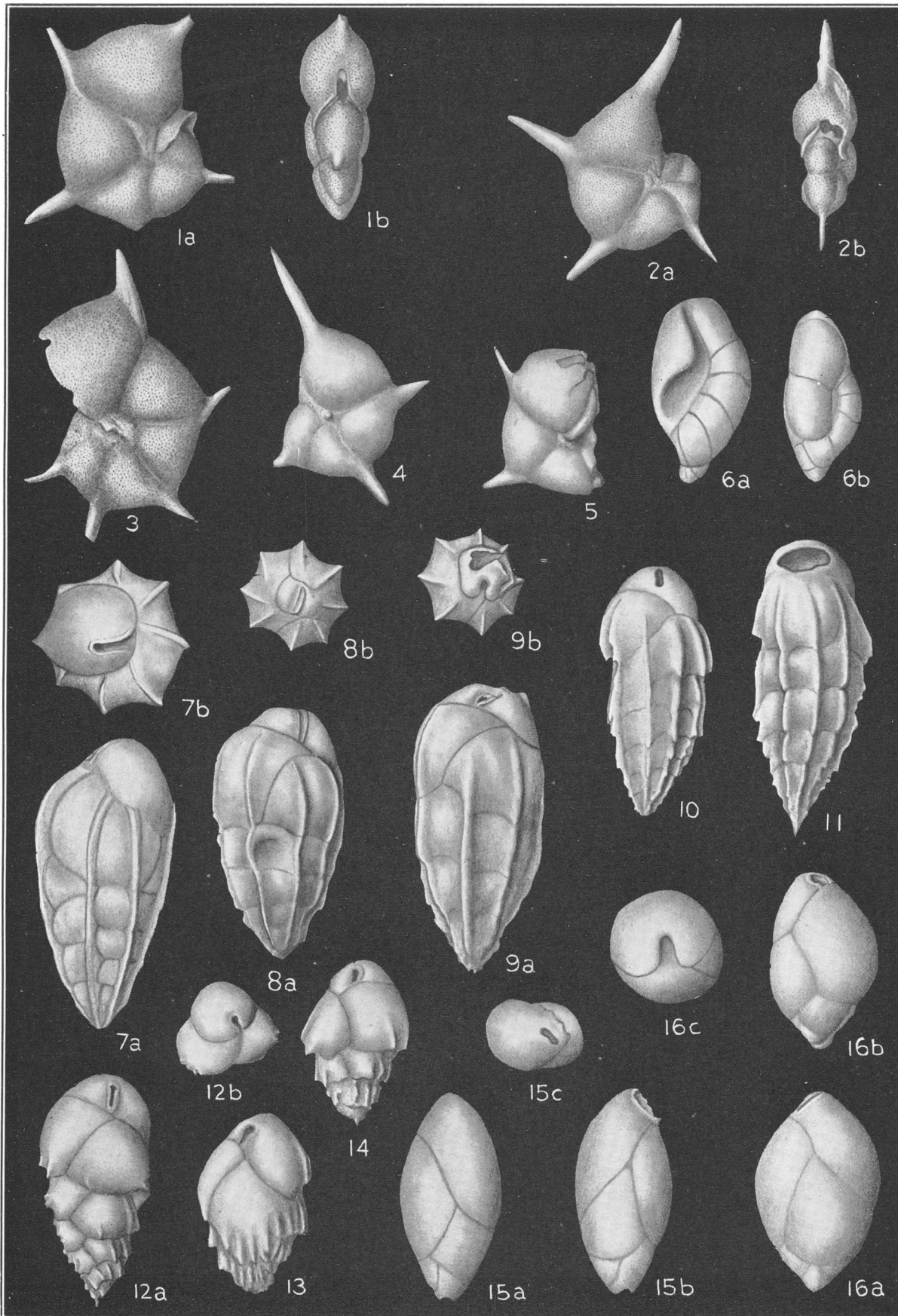
- FIGURE 10. Side view, $\times 65$. U.S.G.S. station 7220.
FIGURE 11. Side view, $\times 65$. U.S.G.S. station 7220.

Bulimina cooperensis Cushman (p. 35)

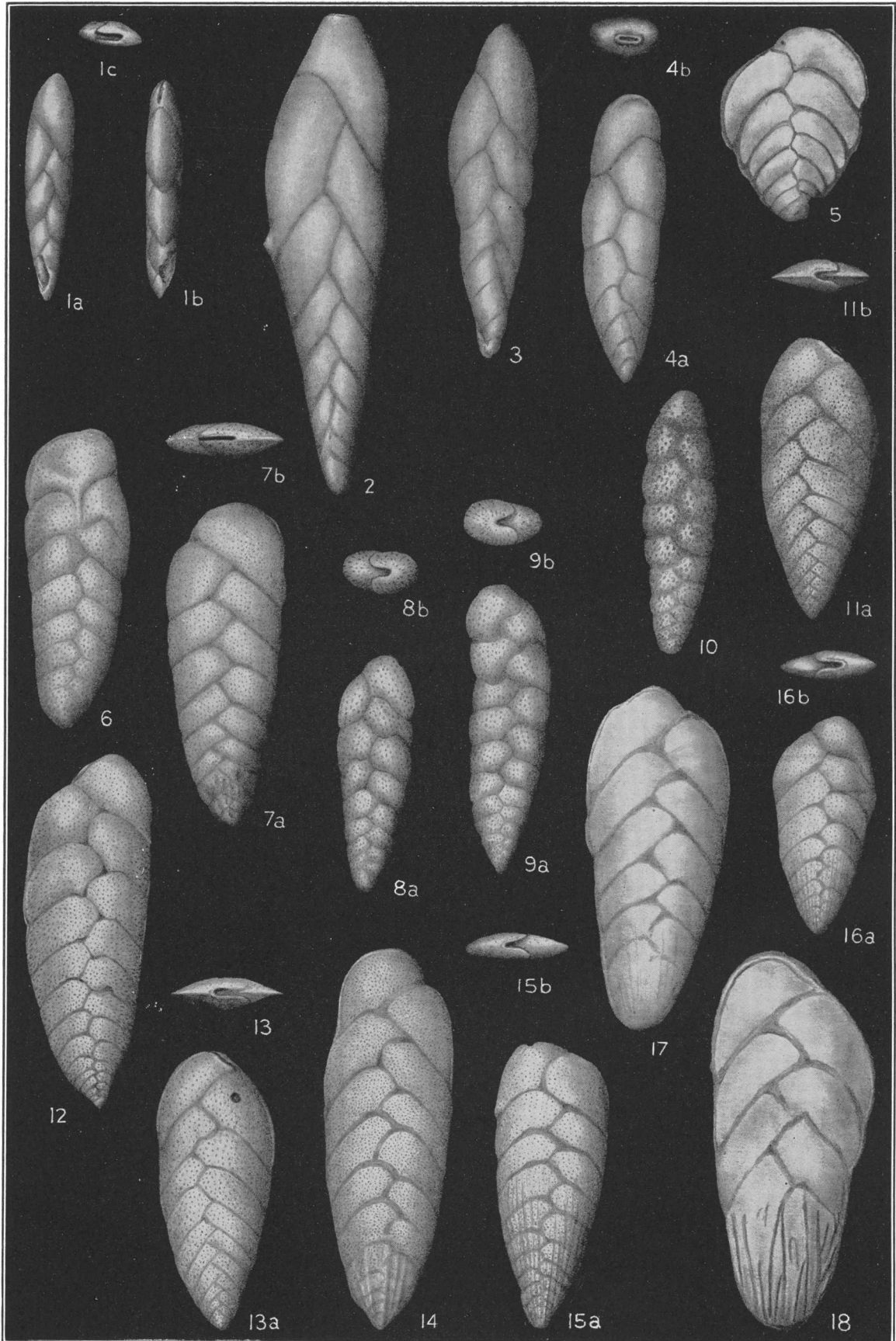
- FIGURE 12. Holotype: a, Side view; b, apertural view, $\times 90$. U.S.G.S. station 11857.
FIGURE 13. Side view, $\times 90$. U.S.G.S. station 11857.
FIGURE 14. Side view, $\times 90$. U.S.G.S. station 11857.

Bulimina ovata D'Orbigny (p. 35)

- FIGURE 15. a, b, Opposite sides; c, apertural view, $\times 90$. Well sample, Tyler County, Tex.
FIGURE 16. a, b, Opposite sides; c, apertural view, $\times 50$. U.S.G.S. station 11861.



HANTKENINIDAE AND BULIMINIDAE.



BULIMINIDAE.

PLATE 14

Virgulina dibollensis Cushman and Applin (p. 36)

- FIGURE 1. a, b, Opposite sides; c, apertural view, $\times 50$. Well sample, Newton County, Tex.
FIGURE 2. Side view, $\times 100$. U.S.G.S. station 6741.
FIGURE 3. Side view, $\times 100$. U.S.G.S. station 6730.

Virgulina recta Cushman (p. 36)

- FIGURE 4. a, Front view; b, apertural view, $\times 90$. U.S.G.S. station 11857.

Bolivina attenuata Cushman (p. 36)

- FIGURE 5. Side view, $\times 65$. U.S.G.S. station 1/43.

Bolivina gardnerae Cushman (p. 37)

- FIGURE 6. Side view, $\times 65$. U.S.G.S. station 7719.
FIGURE 7. a, Side view; b, apertural view, $\times 65$. U.S.G.S. station 7719.

Bolivina gracilis Cushman and Applin (p. 37)

- FIGURE 8. a, Side view; b, apertural view, $\times 50$. East of Diboll, Angelina County, Tex.
FIGURE 9. a, Side view; b, apertural view, $\times 50$. East of Diboll, Angelina County, Tex.
FIGURE 10. Side view, $\times 50$. U.S.G.S. station 6473.

Bolivina jacksonensis Cushman and Applin (p. 37)

- FIGURE 11. a, Side view; b, apertural view, $\times 50$. Well sample, Newton County, Tex.
FIGURE 12. Side view, $\times 65$. U.S.G.S. station 7227.
FIGURE 13. a, Side view; b, apertural view, $\times 50$. Well sample, Newton County, Tex.

Bolivina jacksonensis Cushman and Applin var. striatella Cushman and Applin (p. 37)

- FIGURE 14. Side view, $\times 65$. U.S.G.S. station 6463.
FIGURE 15. a, Side view; b, apertural view, $\times 50$. East of Diboll, Angelina County, Tex.
FIGURE 16. a, Side view; b, apertural view, $\times 50$. East of Diboll, Angelina County, Tex.
FIGURE 17. Side view, $\times 65$. U.S.G.S. station 7159.
FIGURE 18. Side view, $\times 65$. U.S.G.S. station 6457.

PLATE 15

Bolivina spiralis Cushman (p. 37)

FIGURE 1. Side view, $\times 65$. U.S.G.S. station 6319.

FIGURE 2. Side view, $\times 90$. U.S.G.S. station 11857.

Loxostomum dalli (Cushman) (p. 38)

FIGURE 3. Side view, $\times 65$. U.S.G.S. station 7220.

Reussella cocena (Cushman) (p. 38)

FIGURE 4. Holotype. Side view. U.S.G.S. station 7365.

FIGURE 5. Side view, $\times 65$. U.S.G.S. station 7365.

Reussella sculptilis (Cushman) (p. 38)

FIGURE 6. Side view, $\times 65$. U.S.G.S. station 1/39.

FIGURE 7. Side view, $\times 65$. U.S.G.S. station 1/39.

Uvigerina alata Cushman and Applin (p. 39)

FIGURE 8. Side view, $\times 50$. Well sample, Tyler County, Tex.

FIGURE 9. Side view, $\times 50$. Well sample, Tyler County, Tex.

FIGURE 10. Side view, $\times 50$. Well sample, Tyler County, Tex.

Uvigerina cocoaensis Cushman (p. 39)

FIGURE 11. Side view, $\times 65$. Cocoa, Ala.

FIGURE 12. Side view, $\times 65$. Cocoa, Ala.

FIGURE 13. Side view, $\times 65$. Alazan clay, Mexico.

Uvigerina cookei Cushman, n. sp. (p. 39)

FIGURE 14. Holotype. Side view, $\times 65$. U.S.G.S. station 1/38.

FIGURE 15. Side view, $\times 65$. U.S.G.S. station 6319.

FIGURE 16. Side view, $\times 65$. U.S.G.S. station 6319.

Uvigerina dumblei Cushman and Applin (p. 39)

FIGURE 17. Side view, $\times 35$. Well sample, Newton County, Tex.

Uvigerina gardnerae Cushman (p. 40)

FIGURE 18. Side view, $\times 35$. Well sample, Tyler County, Tex.

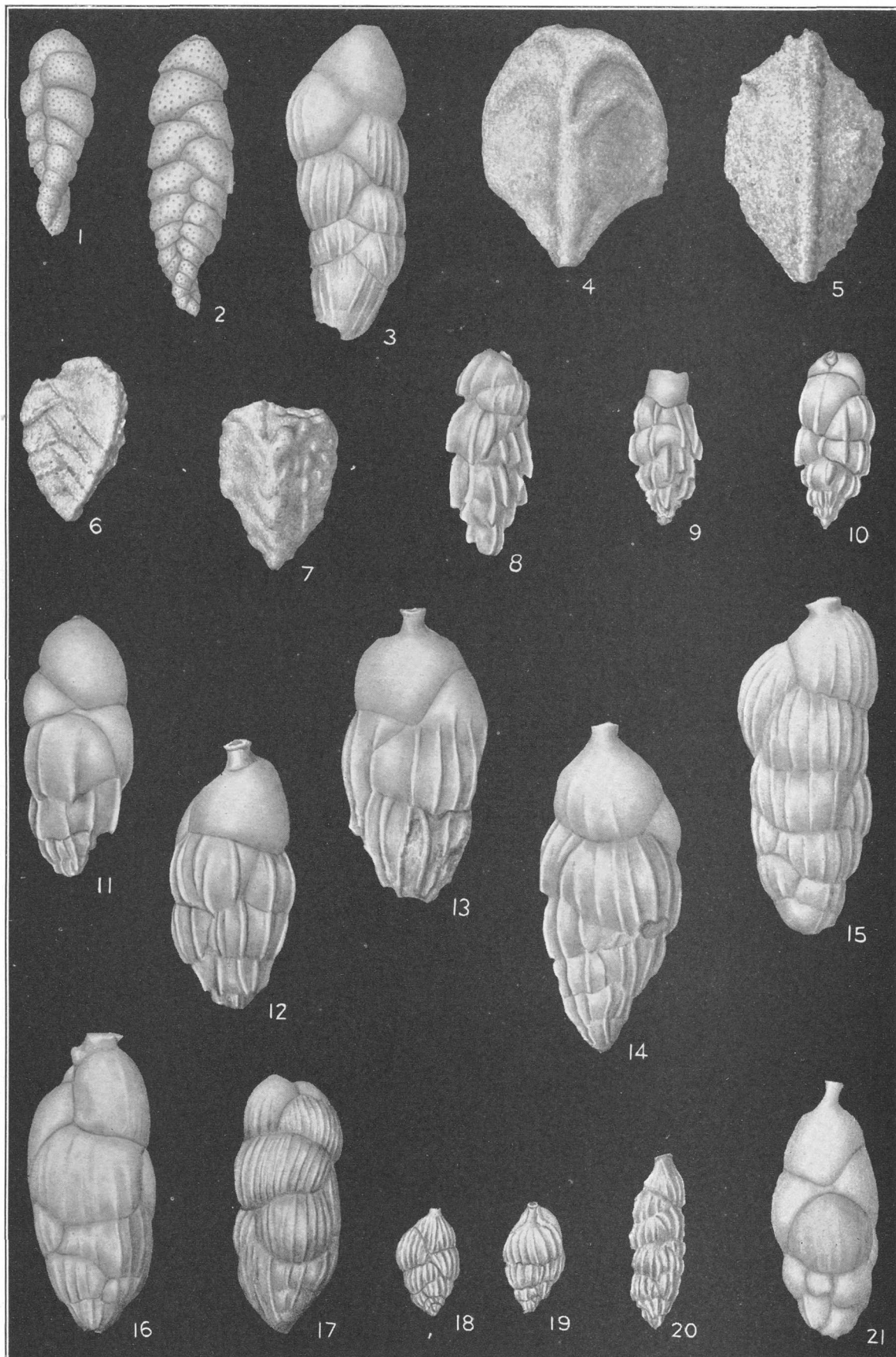
FIGURE 19. Side view, $\times 35$. Well sample, Tyler County, Tex.

Uvigerina gardnerae Cushman var. *texana* Cushman and Applin (p. 40)

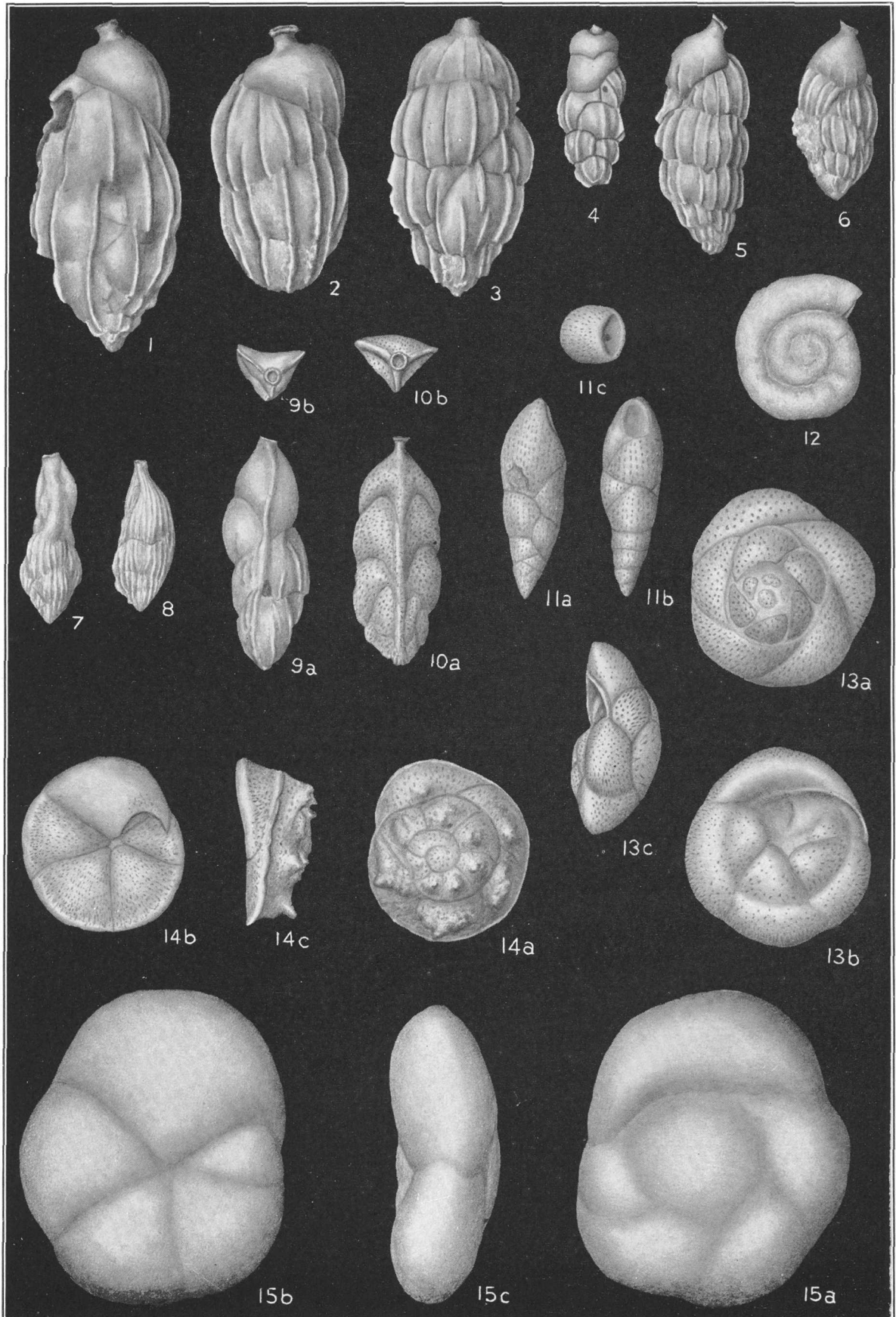
FIGURE 20. Side view, $\times 35$. Well sample, Tyler County, Tex.

Uvigerina glabrans Cushman (p. 40)

FIGURE 21. Side view, $\times 65$. U.S.G.S. station 7203.



BULIMINIDAE.



BULIMINIDAE, ELLIPSOIDINIDAE, AND ROTALIIDAE.

PLATE 16

Uvigerina jacksonensis Cushman (p. 40)

- FIGURE 1. Side view, $\times 65$. Alazan clay, Mexico.
FIGURE 2. Side view, $\times 65$. U.S.G.S. station 7203.
FIGURE 3. Side view, $\times 65$. Cocoa, Ala.

Uvigerina topilensis Cushman (p. 41)

- FIGURE 4. Side view, $\times 35$. Well sample, Tyler County, Tex.

Uvigerina yazooensis Cushman (p. 41)

- FIGURE 5. Holotype. Side view, $\times 65$. U.S.G.S. station 7220.
FIGURE 6. Side view, $\times 65$. U.S.G.S. station 6472.

Angulogerina ocalana Cushman (p. 41)

- FIGURE 7. Holotype. Side view, $\times 65$. U.S.G.S. station 7719.
FIGURE 8. Side view, $\times 65$. U.S.G.S. station 7719.

Angulogerina cooperensis Cushman, n. sp. (p. 42)

- FIGURE 9. a, Side view; b, apertural view, $\times 90$. U.S.G.S. station 11863.

Trifarina bradyi Cushman var. advena Cushman (p. 42)

- FIGURE 10. a, Side view; b, apertural view, $\times 100$. Jackson Miss.

Pleurostomella jacksonensis Cushman and Applin (p. 42)

- FIGURE 11. a, Side view; b, front view; c, end view, $\times 50$. Well sample, Newton County, Tex.

Spirillina vivipara Ehrenberg (p. 42)

- FIGURE 12. Side view, $\times 90$. U.S.G.S. station 6725.

Discorbis hemisphaerica Cushman (p. 43)

- FIGURE 13. a, Dorsal view; b, ventral view; c, peripheral view, $\times 120$. Jackson, Miss.

Discorbis globulo-spinosa Cushman (p. 43)

- FIGURE 14. a, Dorsal view; b, ventral view; c, peripheral view, $\times 120$. Jackson, Miss.

Discorbis ocalana Cushman (p. 44)

- FIGURE 15. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 6768.

PLATE 17

Discorbis assulata Cushman (p. 44)

FIGURE 1. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 6727.

FIGURE 2. Holotype. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 3966.

Discorbis alabamensis Cushman (p. 44)

FIGURE 3. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 1/8.

Discorbis alveata Cushman (p. 44)

FIGURE 4. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 6471.

Lamareckina ocalana Cushman (p. 45)

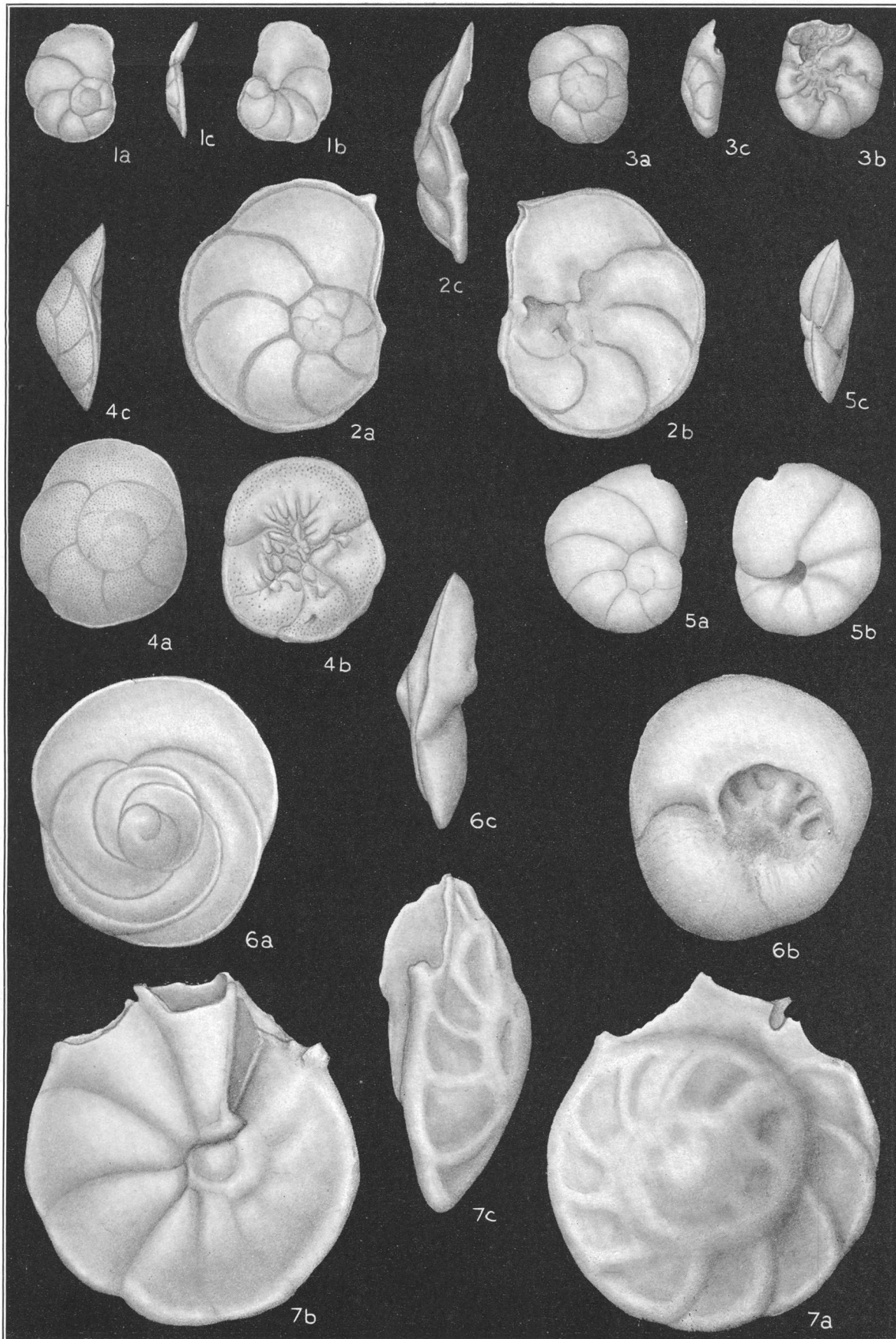
FIGURE 5. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 1/19.

Discorbis bulla Cushman (p. 43)

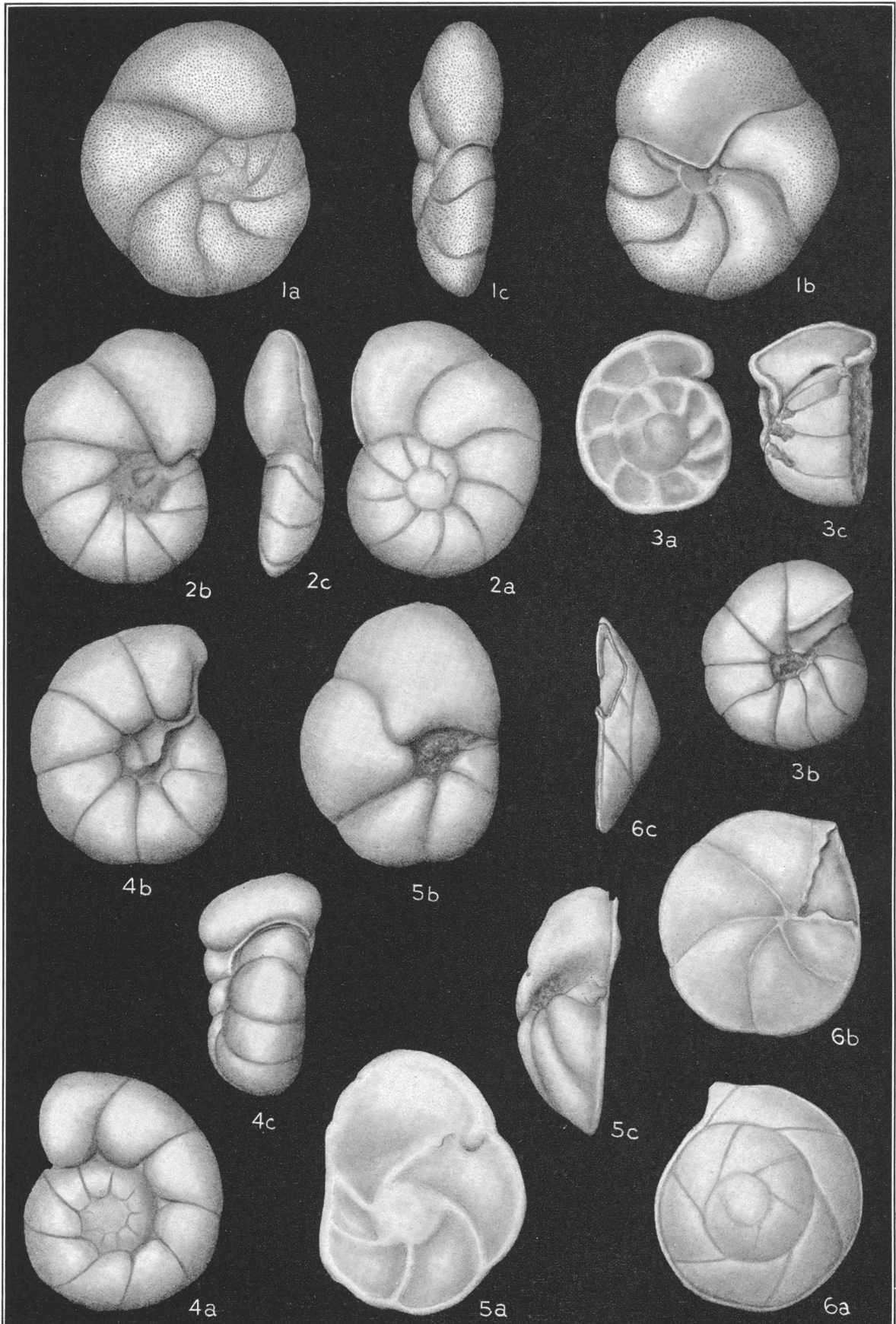
FIGURE 6. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 1/39.

Eponides carolinensis Cushman, n. sp. (p. 46)

FIGURE 7. a, Dorsal view; b, ventral view; c, peripheral view, $\times 40$. U.S.G.S. station 5611.



ROTALLIDAE



ROTALIIDAE.

PLATE 18

Discorbis subaraucana Cushman (p. 43)

FIGURE 1. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 7220.

Valvulineria jacksonensis Cushman (p. 44)

FIGURE 2. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 6741.

Gyroidina orbicularis D'Orbigny var. *planata* Cushman, n. var. (p. 45)

FIGURE 3. a, Dorsal view; b, ventral view; c, peripheral view, $\times 65$. Three figures of different specimens. U.S.G.S. station 6319.

Gyroidina soldanii D'Orbigny var. *octocamerata* Cushman and G. D. Hanna (p. 45)

FIGURE 4. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 8572.

Eponides ocalana Cushman (p. 47)

FIGURE 5. a, Dorsal view; b, ventral view; c, peripheral view, $\times 50$. U.S.G.S. station 1/21.

Eponides budensis (Hantken) var. *planata* Cushman, n. var. (p. 47)

FIGURE 6. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 5611.

PLATE 19

***Eponides cocoaensis* Cushman (p. 47)**

FIGURE 1. a, Dorsal view; b, ventral view; c, peripheral view, $\times 65$. U.S.G.S. station 6457.

FIGURE 2. a, Dorsal view; b, ventral view; c, peripheral view, $\times 65$. U.S.G.S. station 6457.

***Eponides minima* Cushman (p. 47)**

FIGURE 3. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 11863.

***Eponides jacksonensis* (Cushman and Applin) (p. 46)**

FIGURE 4. Dorsal view, $\times 35$. East of Diboll, Angelina County, Tex.

FIGURE 5. Ventral view, $\times 65$. U.S.G.S. station 1/7.

FIGURE 6. Ventral view, $\times 40$. U.S.G.S. station 1/38.

FIGURE 7. Peripheral view, $\times 50$. U.S.G.S. station 1/7.

FIGURE 8. Ventral view, $\times 35$. East of Diboll, Angelina County, Tex.

***Eponides pygmaea* (Hantken) (p. 47)**

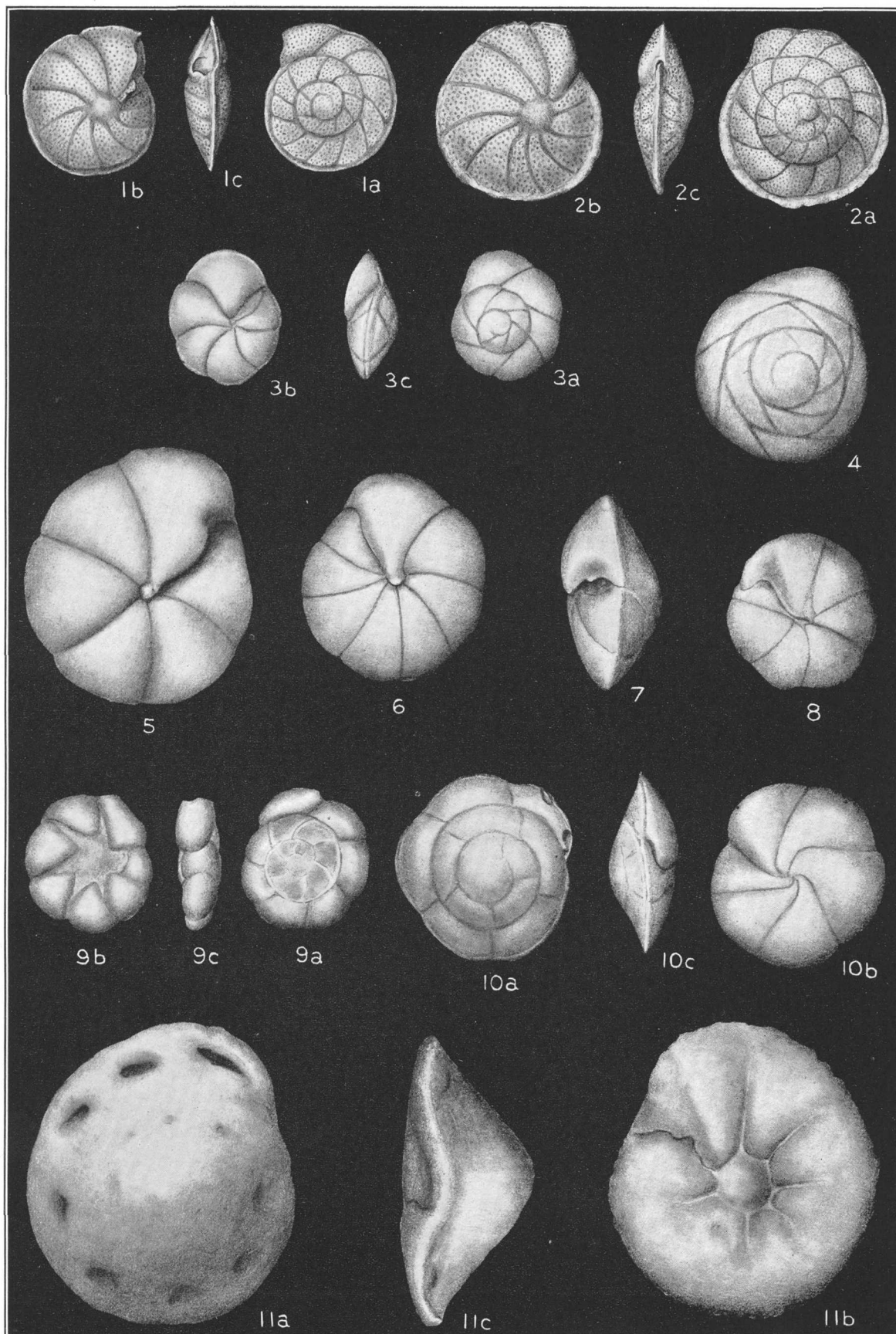
FIGURE 9. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. North of Whitsett, Live Oak County, Tex.

***Eponides umbonata* (Reuss) (p. 48)**

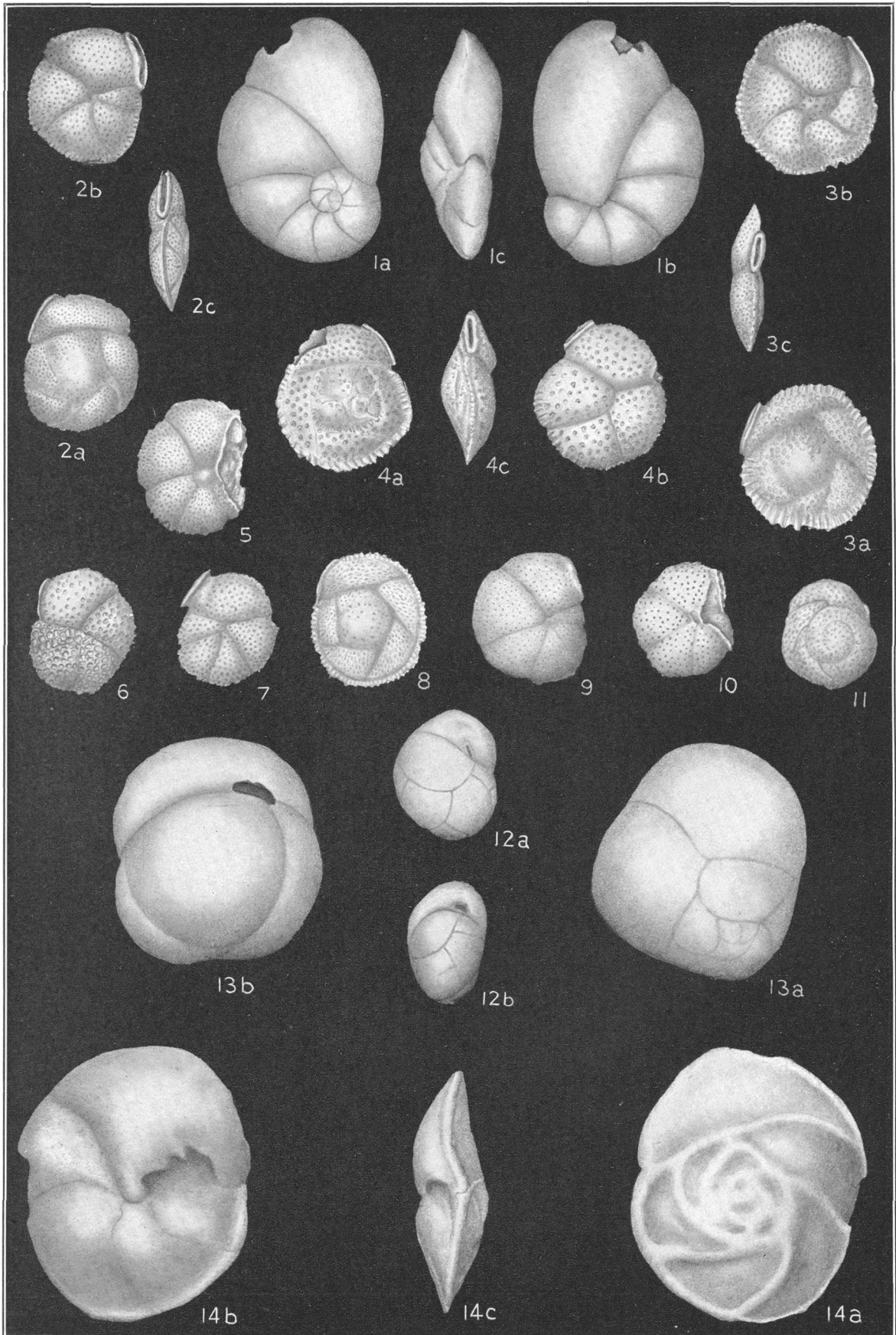
FIGURE 10. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 11863.

***Rotalia* sp.? (p. 46)**

FIGURE 11. a, Dorsal view; b, ventral view; c, peripheral view, $\times 70$. U.S.G.S. station 6812.



ROTALIIDAE.



ROTAIIDAE, CASSIDULINIDAE, AND CHILOSTOMELLIDAE.

PLATE 20

Canceris brongniartii (D'Orbigny) (p. 48)

FIGURE 1. a, Dorsal view; b, ventral view; c, peripheral view, $\times 50$. U.S.G.S. station 11861.

Siphonina jacksonensis Cushman and Applin (p. 48)

FIGURE 2. a, Dorsal view; b, ventral view; c, peripheral view, $\times 65$. U.S.G.S. station 1/7.

FIGURE 3. a, Dorsal view; b, ventral view; c, peripheral view, $\times 65$. U.S.G.S. station 6457.

FIGURE 4. a, Dorsal view; b, ventral view; c, peripheral view, $\times 65$. U.S.G.S. station 6473.

FIGURE 5. Ventral view, $\times 65$. U.S.G.S. station 1/7.

FIGURE 6. Ventral view, $\times 35$. East of Diboll, Angelina County, Tex.

FIGURE 7. Ventral view, $\times 35$. East of Diboll, Angelina County, Tex.

FIGURE 8. Dorsal view, $\times 35$. East of Diboll, Angelina County, Tex.

Siphonina advena Cushman var. eocenica Cushman and Applin (p. 49)

FIGURE 9. Ventral view, $\times 35$. Tarkiln Creek, Trinity County, Tex.

FIGURE 10. Ventral view, $\times 35$. Tarkiln Creek, Trinity County, Tex.

FIGURE 11. Dorsal view, $\times 35$. Tarkiln Creek, Trinity County, Tex.

Cassidulina globosa Hantken (p. 49)

FIGURE 12. a, Side view; b, peripheral view, $\times 90$. U.S.G.S. station 11857.

Sphaeroidina austriaca D'Orbigny (p. 49)

FIGURE 13. a, Dorsal view; b, ventral view, $\times 90$. U.S.G.S. station 11863.

Lamarckina jacksonensis Cushman (p. 45)

FIGURE 14. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 1/39.

PLATE 21

***Globorotalia cocoaensis* Cushman (p. 50)**

FIGURE 1. a, Dorsal view; b, ventral view; c, peripheral view, $\times 45$. Cocoa, Ala.

FIGURE 2. Ventral view, $\times 45$. U.S.G.S. station 6457.

FIGURE 3. a, Dorsal view; b, ventral view; c, peripheral view, $\times 45$. Cocoa, Ala.

***Anomalina bilateralis* Cushman (p. 50)**

FIGURE 4. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 6725.

FIGURE 5. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. Jackson, Miss.

***Anomalina granosa* (Hantken) var. *dibollensis* Cushman and Applin (p. 50)**

FIGURE 6. Ventral view, $\times 35$. East of Diboll, Angelina County, Tex.

FIGURE 7. a, Dorsal view; b, ventral view; c, peripheral view, $\times 35$. East of Diboll, Angelina County, Tex.

***Anomalina jacksonensis* (Cushman and Applin) (p. 51)**

FIGURE 8. a, Dorsal view; b, ventral view; c, peripheral view, $\times 35$. Bridge Creek, San Augustine County, Tex.

***Anomalina jacksonensis* (Cushman and Applin) var. *dibollensis* (Cushman and Applin) (p. 51)**

FIGURE 9. Dorsal view, $\times 35$. East of Diboll, Angelina County, Tex.

***Anomalina jacksonensis* (Cushman and Applin) var. *texana* (Cushman and Applin) (p. 51)**

FIGURE 10. Dorsal view, $\times 35$. Well sample, Tyler County, Tex.

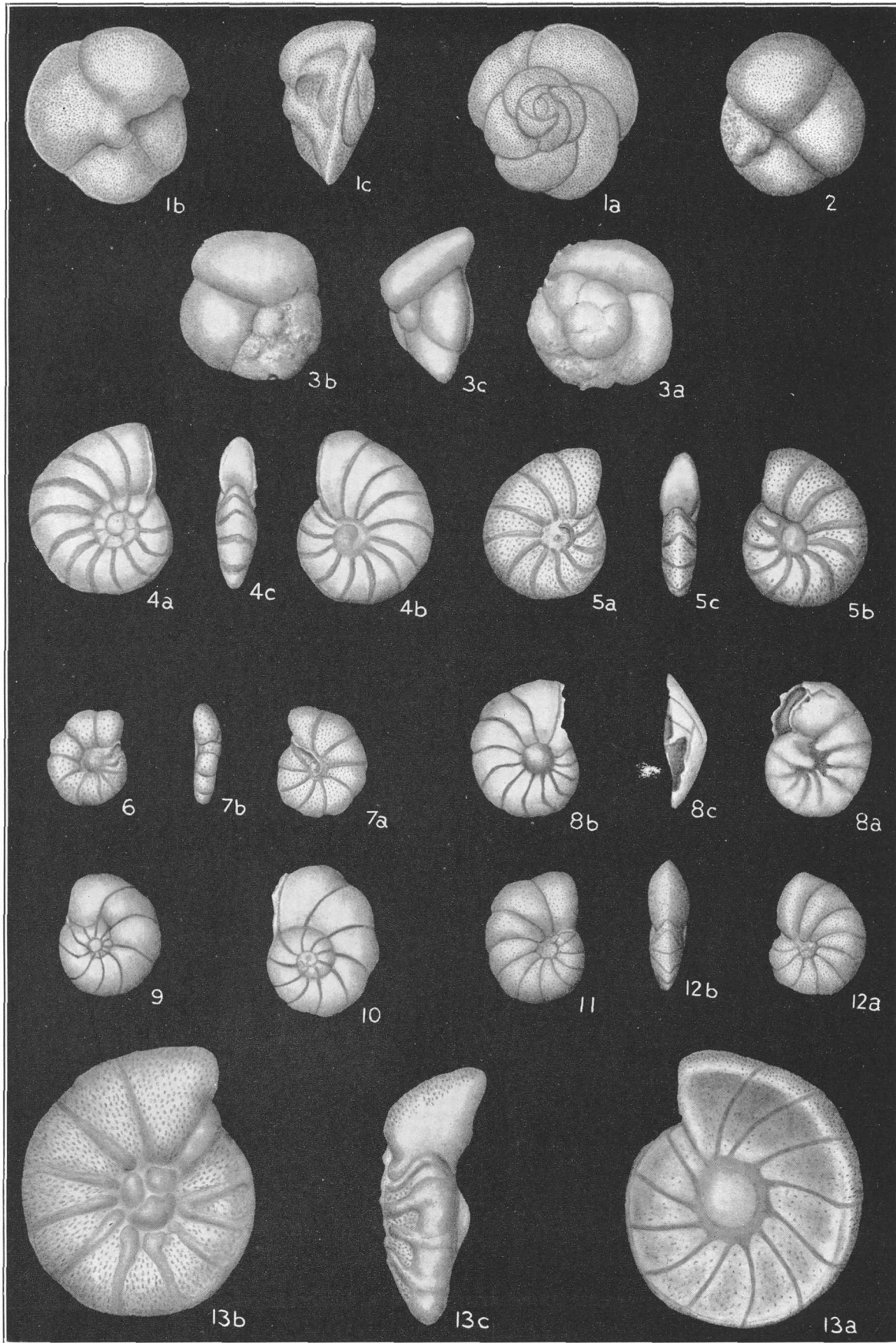
***Anomalina affinis* (Hantken) (p. 51)**

FIGURE 11. Dorsal view, $\times 35$. East of Diboll, Angelina County, Tex.

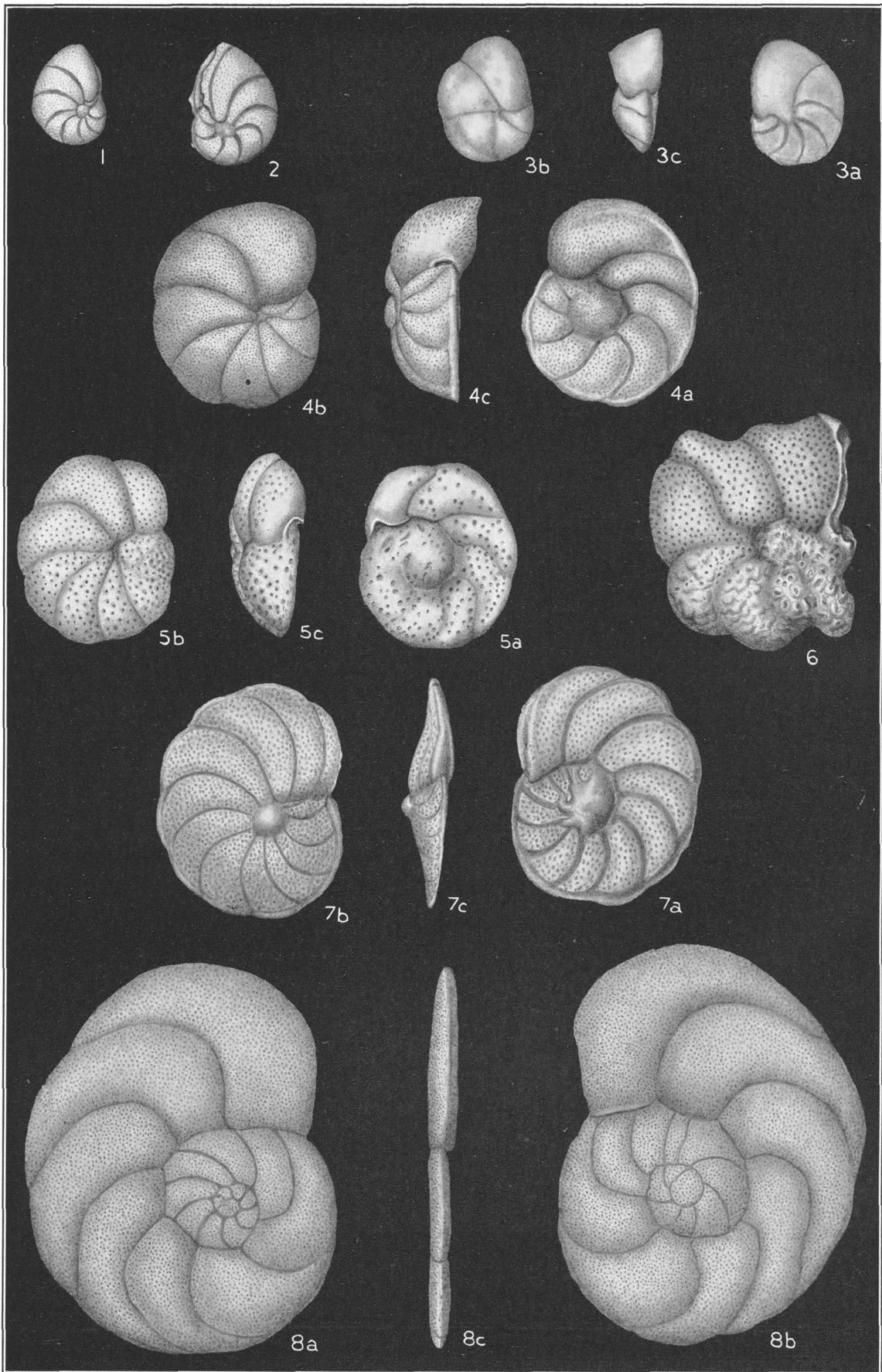
FIGURE 12. Ventral view, $\times 35$. East of Diboll, Angelina County, Tex.

***Anomalina cocoaensis* Cushman (p. 51)**

FIGURE 13. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. Cocoa, Ala.



GLOBOROTALIIDAE AND ANOMALINIDAE.



ANOMALINIDAE.

PLATE 22

***Cibicides americanus* (Cushman) var. *antiquus* (Cushman and Applin) (p. 53).**

FIGURE 1. Ventral view, $\times 35$. East of Diboll, Angelina County, Tex.

FIGURE 2. Dorsal view, $\times 35$. East of Diboll, Angelina County, Tex.

***Cibicides mississippiensis* (Cushman) (p. 54)**

FIGURE 3. a, Dorsal view; b, ventral view; c, peripheral view, $\times 45$. U.S.G.S. station 6321.

***Cibicides lobatulus* (Walker and Jacob) (p. 52)**

FIGURE 4. a, Dorsal view; b, ventral view; c, peripheral view, $\times 45$. U.S.G.S. station 6319.

FIGURE 5. a, Dorsal view; b, ventral view; c, peripheral view, $\times 45$. U.S.G.S. station 7755.

FIGURE 6. Ventral view, $\times 45$. U.S.G.S. station 7755.

***Planulina cocoaensis* Cushman (p. 52)**

FIGURE 7. a, Dorsal view; b, ventral view; c, peripheral view, $\times 45$. Cocoa, Ala.

***Planulina cocoaensis* Cushman var. *cooperensis* Cushman (p. 52)**

FIGURE 8. a, Dorsal view; b, ventral view; c, peripheral view, $\times 50$. U.S.G.S. station 11861.

PLATE 23

Cibicides pseudoungerianus (Cushman) (p. 52)

FIGURE 1. a, Dorsal view; b, ventral view; c, peripheral view, $\times 65$. U.S.G.S. station 6319.

Cibicides yazooensis Cushman (p. 53)

FIGURE 2. a, Dorsal view; b, ventral view; c, peripheral view, $\times 90$. U.S.G.S. station 6473.

Cibicides cooperensis Cushman (p. 53)

FIGURE 3. a, Dorsal view; b, ventral view; c, peripheral view, $\times 70$. U.S.G.S. station 11857.

Gypsina globula (Reuss) (p. 54)

FIGURE 4. $\times 30$. U.S.G.S. station 6810.

FIGURE 5. $\times 30$. U.S.G.S. station 6810.

Rupertia floridana Cushman (p. 55)

FIGURE 6. Holotype. Side view, $\times 18$. U.S.G.S. station 6790.

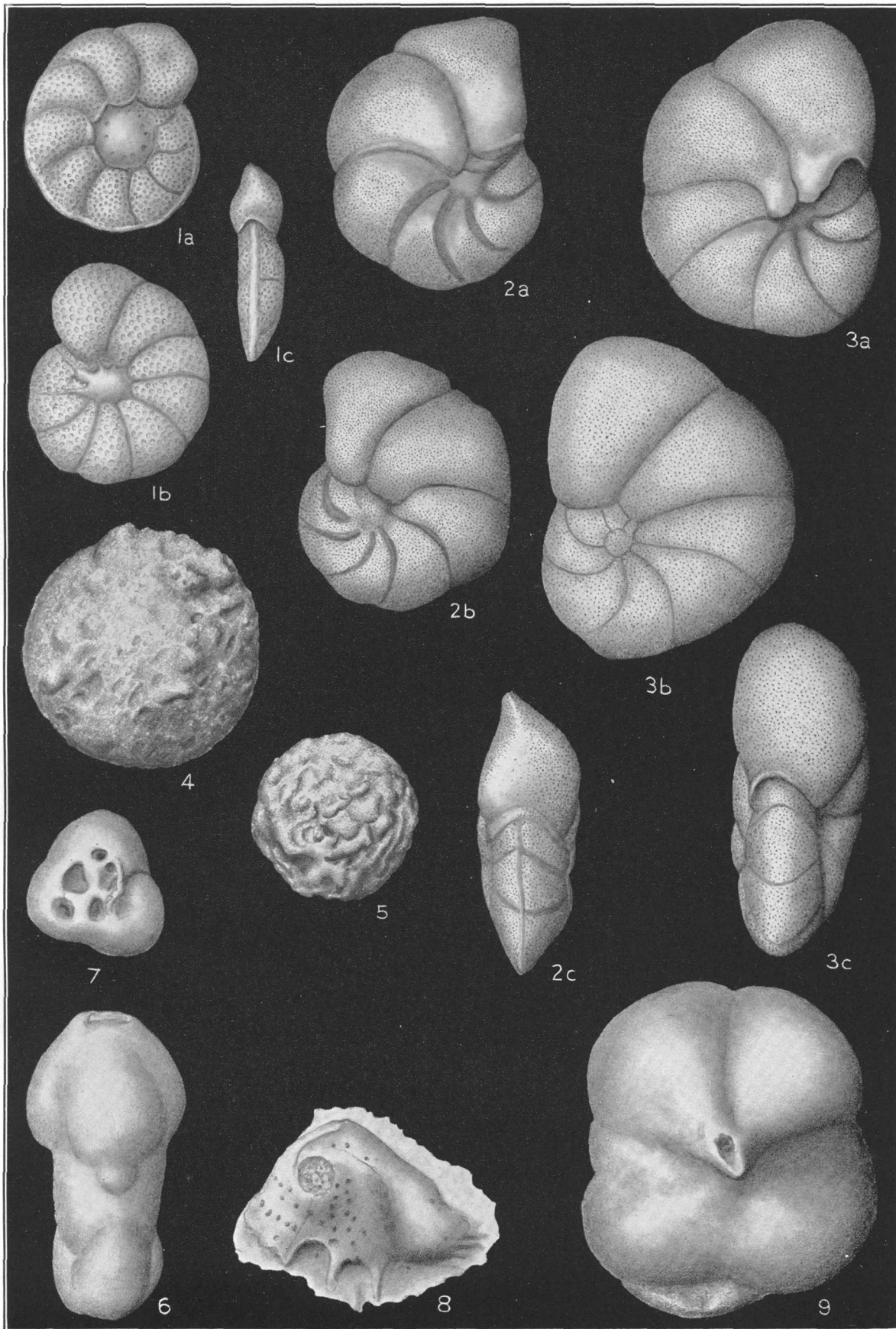
FIGURE 7. Apertural view, $\times 18$. U.S.G.S. station 6790.

Carpenteria carolinensis Cushman, n. sp. (p. 55)

FIGURE 8. Viewed from above, $\times 18$. U.S.G.S. station 5611.

Carpenteria monticularis Carter (p. 55)

FIGURE 9. Viewed from above, $\times 18$. U.S.G.S. station 5611.



ANOMALINIDAE, PLANORBULINIDAE, AND RUPERTIIDAE.

INDEX

	Page		Page
Alabama, species of Foraminifera found in, table showing	60	Ceriopora globulus Reuss	54
stations from which material has been collected in	3-4	Chilostomella cylindroides Reuss	5
Ammobaculites hockleyensis Cushman and Applin	6, pl. 1	Chilostomellidae	49, pl. 20
cf. A. foliaceus Brady	6	Chilostomelloides oviformis (Sherborn and Chapman)	5
Angulogerina byramensis Cushman	42	Cibicides americanus (Cushman) var. antiquus (Cushman and Applin)	53, pl. 22
cooperensis Cushman, n. sp.	42, pl. 16	cooperensis Cushman	53, pl. 23
danvillensis Howe and Wallace	4	danvillensis Howe and Wallace	5
ocalana Cushman	41-42, pl. 16	lobatulus (Walker and Jacob)	52, pl. 22
occidentalis Cushman	41, 42	mississippiensis (Cushman)	54, pl. 22
Anomallina affinis (Hantken)	51, pl. 21	var. ocalanus Cushman, n. var.	54
barrowi Cushman and Ellisor	4	ouachitaensis Howe and Wallace	5
bilateralis Cushman	50, pl. 21	pseudoungerianus (Cushman)	52-53, pl. 23
cocoensis Cushman	51, pl. 21	yazoensis Cushman	53, pl. 23
danvillensis Howe and Wallace	4	Clavulina nodosaria D'Orbigny var. novangliae Cushman	10
granosa (Hantken) var. dibollensis Cushman and Applin	50, pl. 21	szaboi	19
Jacksonensis (Cushman and Applin)	51, pl. 21	Cooper marl, collections from, list of stations	2
var. dibollensis (Cushman and Applin)	51, pl. 21	faunal relationships of	1
var. limbosa Cushman and Ellisor	4	Cornuspira oligogyra Hantken	15, pl. 4
var. texana (Cushman and Applin)	51-52, pl. 21	Cristellaria alato-limbata (Gümbel) Cushman and Applin	16
mississippiensis Cushman	54	arcuata Hantken	17
Anomallinidae	50-54, pls. 21-23	arcuata D'Orbigny	17
Articulina byramensis Cushman	14	articulata Reuss var. texana Cushman and Applin	16
gibbosula D'Orbigny	14	cassisi (Fichtel and Moll)	18
nitida D'Orbigny	14	convergens Bornemann	17
terquemii Cushman	14, pl. 4	gutticostata (Gümbel) var. cocoensis (Cushman)	15
Assilina floridensis (Heilprin)	32	Jacksonensis Cushman and Applin	18
Barnwell formation, collections from, list of stations	3	limbosa (Reuss) var. hockleyensis Cushman and Applin	16
Bifarina dalli Cushman	38	propinqua Hantken	16
Bolivina attenuata Cushman	36, pl. 14	truncana Gümbel	17
caelata Cushman var. byramensis	36	Darbyella danvillensis Howe and Wallace	5
caelata Cushman var. danvillensis Howe and Wallace	4	Dentalina budensis Hantken	20
gardnerae Cushman	37, pl. 14	cocoensis (Cushman)	19-20, pl. 8
gracilis Cushman and Applin	37, pl. 14	communis D'Orbigny	5
var. danvillensis Howe and Wallace	4	var. emaciata Reuss	5
Jacksonensis Cushman and Applin	37, pl. 14	consobrina D'Orbigny	19
var. striatella Cushman and Applin	37, pl. 14	cooperensis Cushman	20, pl. 8
mexicana Cushman var. horizontalis Cushman	4	filiformis (D'Orbigny)	5
mississippiensis Cushman	37	halkyardi Cushman	20-21, pl. 8
ouachitaensis Howe and Wallace	4	hantkeni Cushman	20, pl. 8
punctata D'Orbigny	37	Jacksonensis (Cushman and Applin)	20, pl. 8
reticulata Hantken	36	mexicana (Cushman) var. danvillensis Howe and Wallace	5
spiralis Cushman	37-38, pl. 15	cf. D. adolphina D'Orbigny	21, pl. 8
tortuosa H. B. Brady	38	cf. D. vertebralis (Batsch)	21, pl. 8
cf. B. punctata Cushman	37	sp., Howe and Wallace	5
Bullimina buchiana D'Orbigny	35	sp?	21, pl. 8
cooperensis Cushman	35, pl. 13	Dimorphina danvillensis Howe and Wallace	5
inflata	35	Discorbina jacksonensis Cushman and Applin var. texana Cushman and Applin	51
Jacksonensis Cushman	35, pl. 13	Discorbis alabamensis Cushman	44, pl. 17
var. cuneata Cushman	35, pl. 13	alveata Cushman	44, pl. 17
ovata D'Orbigny	35-36, pl. 13	assulata Cushman	44, pl. 17
pyrula D'Orbigny	4	bullata Cushman	43-44, pl. 17
sculptilis Cushman	35	farishi Cushman and Ellisor	5
truncana Gümbel	35	globulo-spinosa Cushman	43, pl. 16
Bulliminella alabamensis Cushman	34-35, pl. 13	hemisphaerica Cushman	43, pl. 16
basistrata Cushman and Jarvis var. nuda Howe and Wallace	4	Jacksonensis Cushman and Applin	51
var. elegantissima (D'Orbigny)	4	var. dibollensis Cushman and Applin	51
Bulliminidae	34-42, pls. 13-16	ocalana Cushman	44, pl. 16
Camerinidae	32-33	orbicularis (Terquem)	44
Cancris bronngartii (D'Orbigny)	48, pl. 20	subarucana Cushman	43, pl. 18
danvillensis Howe and Wallace	4	Distribution of species, tables showing	56-60
Carpenteria carolinensis Cushman, n. sp.	55, pl. 23	Dyocibicides danvillensis Howe and Wallace	5
monticularis Carter	55, pl. 23	Ellipsoidinidae	42, pl. 16
Cassidulina globosa Hantken	49, pl. 20	Ellipsinodosaria? sp.	5
Cassidulinidae	49, pl. 20	Elphidium cocenicum Cushman and Ellisor	5
Cassidulinoides braziliensis (Cushman)	5	texanum (Cushman and Applin)	32, pl. 12
Castle Hayne marl, collections from, list of stations	2	sp.	5
		Entosolenia costata Williamson	23

	Page		Page
Epistomina elegans (D'Orbigny)-----	5	Guttulina planicii D'Orbigny-----	24
Eponides budensis (Hantken) var. planata Cushman, n. var.-----	47, pl. 18	ponderosa Terquem-----	25
byramensis Cushman-----	46	problema D'Orbigny-----	23-24, pl. 9
carolinensis Cushman, n. sp.-----	46-47, pl. 17	rotundata Bornemann-----	27
cocoaensis Cushman-----	47, pl. 19	semiplana Reuss-----	24
exigua (H. B. Brady)-----	48	spicaeformis (Roemer)-----	24-25, pls. 9-10
haidingeri D'Orbigny-----	46	turgida Reuss-----	27
jacksonensis (Cushman and Applin)-----	46, pl. 19	sp.-----	5
mexicana Cushman-----	46	(Globulina) gibba Cushman-----	25
minima Cushman-----	47-48, pl. 19	Gypsina globula (Reuss)-----	54, pl. 23
ocalana Cushman-----	47, pl. 18	Gyroidina danvillensis Howe and Wallace-----	5
ouachitaensis Howe and Wallace-----	5	orbicularis D'Orbigny var. planata Cushman, n. var.-----	45-46, pl. 18
pygmaea (Hantken)-----	47, pl. 19	soldanii D'Orbigny var. octocamerata Cushman and G. D. Hanna-----	45, pl. 18
umbonata (Reuss)-----	48, pl. 19		
Florida, species of Foraminifera found in, table showing-----	60	Hantkenina alabamensis Cushman-----	49-50, pl. 13
stations from which material has been collected in-----	3	alabamensis Cushman var. primitiva Cushman and Jarvis-----	50
Foraminifera, Oligocene, publications on-----	1	brevispina Cushman-----	50
upper Eocene, list of species described in other publica- tions-----	4-6	kochi (Hantken)-----	50
		lehneri Cushman and Jarvis-----	50
Gaudryina gardnerae Cushman-----	10, pl. 2	longispina Cushman-----	5, 50
jacksonensis Cushman-----	9-10, pl. 2	mccordi Howe and Wallace-----	5
subquadrata Cushman-----	10, pl. 2	mexicana Cushman-----	50
triangularis Cushman-----	10	var. aragonensis Nuttall-----	50
Georgia, species of Foraminifera found in, table showing-----	60	Hantkeninidae-----	49-50, pl. 13
stations from which material has been collected in-----	2-3	Haplophragmoides dibollensis Cushman and Applin-----	6, pl. 1
Glandulina dimorpha (Bornemann)-----	5	Heterohelicidae-----	33-34, pl. 12
laevigata D'Orbigny-----	5	Heterostegina ocalana Cushman-----	33
var. ovata Cushman and Applin-----	29-30, pl. 10	ocalana Cushman var. glabra Cushman-----	33
Globigerina bulloides D'Orbigny-----	5	Hopkinsina danvillensis Howe and Wallace-----	5
danvillensis Howe and Wallace-----	5		
ouachitaensis Howe and Wallace-----	5	Jackson formation, collections from, list of stations-----	4
sp.-----	5	faunal characteristics of-----	1
Globorotalia canariensis (D'Orbigny)-----	50		
cocoaensis Cushman-----	50, pl. 21	Lagena acuticosta Reuss-----	23, pl. 9
crassa D'Orbigny-----	50	costata (Williamson)-----	23, pl. 9
Globorotaliidae-----	50, pl. 21	globosa (Montague)-----	5
Globulina acuta Reuss-----	26	hexagona (Williamson)-----	23, pl. 9
aequalis D'Orbigny-----	26	hispidula Reuss-----	5
amplectens Bornemann-----	25	laevis (Montagu) ?-----	22, pl. 9
amplectens Reuss-----	26	orbignyana (Seguenza) var. concentrica Sidebottom-----	23
amygdaloides Reuss-----	26	var. semiconcentrica Cushman-----	23, pl. 9
asperula Gumbel-----	26	ouachitaensis Howe and Wallace-----	5
discreta Reuss-----	26	pleniluna Howe and Wallace-----	5
gibba D'Orbigny-----	25, pl. 9	striata (D'Orbigny) var. strumosa Reuss-----	5
var. globosa (Von Münster)-----	26, pl. 9	sp., Howe and Wallace-----	5
var. glomula Fornasini-----	24	sp. ?-----	23, pl. 9
var. tuberculata D'Orbigny-----	26, pl. 9	Lagenidae-----	15-23, pls. 4-9
globosa Reuss-----	25	Lamarckina jacksonensis Cushman-----	45, pl. 20
guttula Reuss-----	24	ocalana Cushman-----	45, pl. 17
inaequalis Reuss-----	26-27, pl. 9	Lenticulina articulata (Reuss) var. texana Howe and Wallace-----	16
inflata Reuss-----	26	convergens (Bornemann)-----	17, pl. 6
irregularis D'Orbigny-----	24	fragaria (Gumbel) var. texasensis Howe and Wallace-----	19
irregularis Terquem-----	24	sp.-----	5
minuta (Roemer)-----	27, pl. 9	Lepidocyclus ocalana Cushman-----	55
munsteri (Reuss)-----	27, pl. 9	Liebusella byramensis (Cushman) var. turgida (Cushman)-----	11, pl. 2
ovalis Terquem-----	25	cylindrica Hantken-----	11
oviformis Terquem-----	25	cocaena (Gumbel)-----	11
rotundata (Bornemann)-----	27-28, pl. 9	flintiana Cushman-----	11
spinosa D'Orbigny-----	26	Lituolidae-----	6, pl. 1
subalpina Gumbel-----	27	Loxostomum dalli (Cushman)-----	38, pl. 15
subgibba Gumbel-----	25		
translucida D'Orbigny-----	26	Marginulina abbreviata Karrer-----	18
transversa Terquem-----	25	alazanensis (Cushman)-----	19
tuberculata O'Orbigny-----	26	cocoaensis Cushman-----	18-19, pl. 7
tubulosa D'Orbigny-----	25	cooperensis Cushman-----	19, pl. 7
turbinata Terquem-----	26	cooperi Cushman-----	19, pl. 7
varians Terquem-----	28	fragaria Gumbel var. texasensis Cushman and Applin-----	19, pl. 7
Gumbelina sp.-----	5	hauerina (D'Orbigny)-----	19
Guttulina austriaca D'Orbigny-----	5	jacksonensis (Cushman and Applin)-----	18, pl. 7
byramensis Cushman and Schenck-----	24	karreriana Cushman, n. sp.-----	18, pl. 7
centrata Terquem-----	24	subrecta Franke-----	18, pl. 7
communis D'Orbigny-----	23	triangularis D'Orbigny var. danvillensis Howe and Wallace-----	5
cretacea Alth-----	24	sp.-----	5
dilatata Reuss-----	24	Marginulina? sp.-----	5
diluta Bornemann-----	26	Massilina cooki Cushman, n. sp.-----	13, pl. 3
fracta Bornemann-----	27	decorata Cushman-----	13, pl. 3
globosa Bornemann-----	27	humblei Cushman and Ellisor-----	5
gravida Terquem and Terquem-----	25	jacksonensis Cushman-----	13-14, pl. 3
incurva Bornemann-----	27	var. punctatocostata Cushman-----	14, pl. 3
irregularis D'Orbigny-----	24, pl. 9	pratti Cushman and Ellisor-----	5
obtusa Bornemann-----	27	sp. ?-----	14, pl. 4

	Page		Page
<i>Millola jacksonensis</i> Cushman	13, pl. 3	<i>Polymorphina advena</i> Cushman	29, pl. 10
<i>saxorum</i> Lamarck	12-13, pl. 3	<i>amygdaloides</i> Reuss (1856)	27
(<i>Milolites</i>) <i>saxorum</i> Lamarck	12	<i>amygdaloides</i> Reuss (1870)	26
		var. <i>terquemiana</i> Fornasini	28
		<i>amygdaloides</i> Terquem	28
		<i>austriaca</i> D'Orbigny var. <i>io</i> Cushman and Applin	24
		<i>byramensis</i> Cushman	24
		<i>communis</i> D'Orbigny var. <i>etrusca</i> Fornasini	27
		<i>communis</i> Roemer	23
		<i>compressa</i> D'Orbigny var. <i>dumblei</i> Cushman and Applin	29
		<i>compressa</i> Nuttall	28
		<i>cretacea</i> Egger	24
		<i>decora</i> Reuss	29
		<i>equalis</i> Cushman	26
		<i>frondiformis</i> Searles Wood var. <i>brevis</i> Jones	26
		<i>gibba</i> H. B. Brady, Parker, and Jones	25
		var. <i>aequalis</i> H. B. Brady, Parker, and Jones	26
		<i>gibba</i> Burrows, Sherborn, and Bailey	27
		<i>gibba</i> (D'Orbigny) var. <i>orbicularis</i> Karrer	25
		<i>globosa</i> Von Münster	26
		<i>gracilis</i> Reuss	27
		<i>inflata</i> Terquem and Terquem	25
		<i>jacksonensis</i> Cushman	28
		var. <i>costifera</i> Cushman	28
		<i>lactea</i> Burrows, Sherborn, and Bailey	27
		<i>lactea</i> Sidebottom	24
		<i>lactea</i> Walker and Jacob var. <i>communis</i> Williamson	24
		var. <i>diffusa</i> Cushman	25
		<i>lactea</i> elongate variety, Weller	27
		<i>minuta</i> Roemer	27
		<i>münsteri</i> Reuss	27
		<i>obtusa</i> D'Orbigny	27
		<i>ovulum</i> Reuss	27
		<i>pauperata</i> Terquem	26, 28
		<i>problema</i> D'Orbigny	23
		var. <i>Hosius</i>	23
		<i>rotundata</i> H. B. Brady, Parker, and Jones	27
		<i>similis</i> Reuss	27
		<i>sororia</i> Reuss	27
		<i>spicaeformis</i> Roemer	24
		<i>spinosa</i> H. B. Brady, Parker, and Jones	26
		<i>subcruciata</i> Terquem	27
		<i>texana</i> Cushman and Applin	29
		<i>translucida</i> Fornasini	26
		<i>tuberculata</i> H. B. Brady, Parker, and Jones	26
		<i>turgida</i> Reuss	27
		<i>uviformis</i> Reuss	24
		(<i>Globulina</i>) <i>gibba</i> D'Orbigny var. <i>ovoidea</i> Egger	25
		var. <i>pirula</i> Egger	25
		var. <i>subgibba</i> Egger	25
		(<i>Globulina</i>) <i>gibba</i> Egger	25
		(<i>Globulina</i>) <i>spinosa</i> Egger	26
		(<i>Globulina</i>) <i>tuberculata</i> Egger	26
		(<i>Guttulina</i>) <i>lata</i> Egger	24
		(<i>Guttulina</i>) <i>problema</i> Andreae	23
		(<i>Guttulina</i>) aff. <i>P. minima</i> Andreae	27
			27
		<i>Polymorphinidae</i>	23-30, pls. 9-10
		<i>Polystomella texana</i> Cushman and Applin	32
		<i>Pseudoclavulina</i> sp.?	10, pl. 2
		<i>Pseudopolymorphina decora</i> (Reuss)	29, pl. 10
		<i>dumblei</i> (Cushman and Applin)	29, pl. 10
		<i>Pullenia elongata</i> Hantken	31
		<i>Pulvinulina affinis</i> Hantken	51
		<i>jacksonensis</i> Cushman and Applin	46
		<i>Pulvinulinella danvillensis</i> Howe and Wallace	6
		<i>Pyrgo inornata</i> (D'Orbigny) var. <i>danvillensis</i> Howe and Wallace	6
			6
		<i>Quinqueloculina anguina</i> Terquem	12, pl. 2
		<i>danvillensis</i> Howe and Wallace	6
		<i>hauerina</i> D'Orbigny?	12, pt. 2
		<i>laevigata</i> D'Orbigny	11, pl. 2
		<i>longirostra</i> D'Orbigny	12, pl. 2
		<i>saxorum</i> D'Orbigny	12
		<i>seminula</i> (Linné)	6
		sp.?	12, pl. 4
		<i>Reussella cocena</i> (Cushman)	38, pl. 15
		<i>rectimargo</i> (Cushman)	38
		<i>sculptilis</i> (Cushman)	38, pl. 15
		<i>spinulosa</i> (Reuss)	38
		var. <i>glabrata</i> (Cushman)	38
		<i>Reussia cocena</i> Cushman	38
			38

	Page		Page
<i>Robulina alato-limbata</i> Gumbel	15	<i>Textularia dibollensis</i> Cushman and Applin	8, pl. 1
<i>gutticostata</i> Gumbel	15	<i>var. humblei</i> Cushman and Applin	8, pl. 1
<i>limbosa</i> Reuss	16	<i>distortio</i> Cushman and Applin	8-9, pl. 1
<i>Robulus alato-limbatus</i> (Gumbel)	15-16, pl. 6	<i>hockleyensis</i> Cushman and Applin	9, pl. 1
<i>arcuato-striatus</i> (Hantken) <i>var. carolinianus</i> Cushman	17, pl. 6	<i>mississippiensis</i> Cushman	7, pl. 1
<i>articulatus</i> (Reuss) <i>var. texanus</i> (Cushman and Applin)	16, pl. 4	<i>var. alabamensis</i> Cushman	7, pl. 1
<i>clericii</i> (Fornasini)	6	<i>var. rhomboidea</i> Cushman and Ellisor	6
<i>cultratus</i> Montfort	6	<i>ocalana</i> Cushman	7, pl. 1
<i>gutticostatus</i> (Gumbel)	15, pl. 5	<i>ouachitaensis</i> Howe and Wallace	6
<i>var. cecconensis</i> (Cushman)	15, pl. 5	<i>recta</i> Cushman	7-8, pl. 1
<i>var. yazoensis</i> Cushman	15, pl. 5	<i>subhaueri</i> Cushman	8, pl. 1
<i>limbosus</i> (Reuss)	16, pl. 6	<i>Textulariella barrettii</i> (Jones and Parker)	11, pl. 2
<i>var. hockleyensis</i> (Cushman and Applin)	16, pl. 4	<i>Textulariidae</i>	7-9, pls. 1-2
<i>mayi</i> Cushman and Parker	6	<i>Trifarina bradyi</i> Cushman <i>var. advena</i> Cushman	42, pl. 16
<i>propinquus</i> (Hantken)	16-17, pl. 6	<i>Triloculina rotunda</i> D'Orbigny <i>var.</i>	6
<i>Robulus?</i> <i>danvillensis</i> Howe and Wallace	6	<i>sp.?</i>	15, pl. 4
<i>Rotalia brongniartii</i> D'Orbigny	48	“ <i>Triloculina striata</i> Brown”	14
<i>ecuadorensis</i> Galloway and Morrey	48	<i>Trochammina teasi</i> Cushman and Ellisor	6
<i>umbonata</i> Galloway and Morrey	48	<i>Truncatulina americana</i> Cushman <i>var. antiqua</i> Cushman and Applin	53
<i>sp.?</i>	46, pl. 19	<i>lobatula</i> (Walker and Jacob) D'Orbigny	52
<i>Rotaliidae</i>	42-49, pls. 16-20	<i>pseudoungeriana</i> Cushman	52
<i>Rotalina brongniartii</i> Reuss	48	<i>ungeriana</i> H. B. Brady	52
<i>umbonata</i> Reuss	48	<i>Tubulogenerina eocenica</i> Cushman and Ellisor	6
<i>Rupertia floridana</i> Cushman	55, pl. 23		
<i>Rupertidae</i>	55, pl. 23	<i>Uvigerina alata</i> Cushman and Applin	39, pl. 15
<i>Saracenaria arcuata</i> (D'Orbigny) <i>var. hantkeni</i> Cushman	17, pl. 5	<i>auberiana</i> D'Orbigny	40
<i>danvillensis</i> Howe and Wallace	6	<i>canariensis</i> D'Orbigny	40
<i>moresiana</i> Howe and Wallace	6	<i>cocoaensis</i> Cushman	39, 40, pl. 15
“ <i>Scutella</i> bed”	42	<i>cookei</i> Cushman, <i>n. sp.</i>	39, pl. 15
“ <i>Serpula</i> (<i>Lagena</i>) <i>laevis ovalis</i> ” Walker and Boys	22	<i>danvillensis</i> Howe and Wallace	6
<i>Sigmoidella plummerae</i> Cushman and Ozawa	29, pl. 10	<i>dumlei</i> Cushman and Applin	39-40, pl. 15
<i>Sigmomorphina jacksonensis</i> (Cushman)	28, pl. 10	<i>farinosa</i> Hantken	6
<i>Jacksonensis</i> (Cushman) <i>var. costifera</i> Cushman and Ozawa	28, pl. 10	<i>gardnerae</i> Cushman	40, pl. 15
<i>regularis</i> (Von Münster)	28	<i>var. texana</i> Cushman and Applin	40, pl. 15
<i>semitecta</i> (Reuss)	6	<i>glabrans</i> Cushman	40, pl. 15
<i>var. terquemiana</i> (Fornasini)	28	<i>jacksonensis</i> Cushman	39, 40-41, pl. 16
<i>vaughani</i> Cushman and Ozawa	28, pl. 10	<i>ocalana</i>	40
<i>Siphonina advena</i> Cushman <i>var. eocenica</i> Cushman and Applin	49, pl. 20	<i>peregrina var. bradyana</i> Cushman	39, 41
<i>carltoni</i> Cushman and Ellisor	6	<i>tenuistriata</i> Reuss	39
<i>danvillensis</i> Howe and Wallace	6	<i>topilensis</i> Cushman	41, pl. 16
<i>Jacksonensis</i> Cushman and Applin	48-49, pl. 20	<i>yazoensis</i> Cushman	41, pl. 16
South Carolina, species of Foraminifera found in, table showing	59-60		
stations from which material has been collected in	2	<i>Valvulina ocalana</i> Cushman	10-11, pl. 2
<i>Sphaeroidina austriaca</i> D'Orbigny	49, pl. 20	<i>Valvulinera jacksonensis</i> Cushman	44, pl. 18
<i>Spirillina vivipara</i> Ehrenberg	42-43, pl. 16	<i>texana</i> Cushman and Ellisor	6
<i>Spiroloculina excavata</i> H. B. Brady	14	<i>Valvulinidae</i>	10-11, pl. 2
<i>grateloupi</i> D'Orbigny	14, pl. 3	<i>Ventilabrella</i> <i>sp.</i>	6
<i>sp.?</i>	14, pl. 4	<i>Vermiculum laeve</i> Montagu	22
<i>Spiroplectoides curta</i> Cushman	33-34, pl. 12	<i>Verneuilina propinqua</i> H. B. Brady	9, pl. 2
Stations from which material has been collected, list of	2-4	<i>rectimargo</i> Cushman	38
tables showing	56-60	<i>sculptilis</i> Cushman	38
Texas, species of Foraminifera found in, table showing	56-57	<i>Verneuilinidae</i>	9-10, pl. 2
stations from which material has been collected in	4	<i>Virgulina danvillensis</i> Howe and Wallace	6
<i>Textularia adalta</i> Cushman	8, pl. 1	<i>dibollensis</i> Cushman and Applin	36, pl. 14
<i>barrettii</i> Jones and Parker	11	<i>mexicana</i> Cole	36
<i>broussardi</i> Howe and Wallace	6	<i>recta</i> Cushman	36, pl. 14
<i>conica</i> Goës	11	<i>schreibersiana</i> Czjzek	36
<i>danvillensis</i> Howe and Wallace	6	<i>Valvulina advena</i> Cushman	9, pl. 2
		“ <i>Zeuglodon</i> bed”	35, 41