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SOME PLIOCENE AND MIOCENE FORAMINIFERA OF THE COASTAL PLAIN OF THE UNITED STATES

PAPERS BY

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CONTENTS.

ILLUSTRATIONS.

PLIOCENE FORAMINIFERA OF THE COASTAL PLAIN OF THE UNITED STATES.

By JOSEPH AUGUSTINE CUSHMAN.

The collection of Pliocene Foraminifera discussed in this report was obtained through the United States Geological Survey and the Florida Geological Survey. The material represents five localities in three States—Walkers Bluff, Cape Fear River, N. C. (several species); Cronly, 16 miles west of Wilmington, N. C. (several species); Waccamaw River, S. C. (a large number of species); Shell Creek, De Soto County, Fla. (very few species); and Caloosahatchee River, Fla. (the largest number of species). Most of the species are fairly well preserved and some of them occur in considerable numbers, but others are represented by a single specimen.

Two geologic formations are represented by the five localities: The Waccamaw formation [1] by Walkers Bluff and Cronly, N. C., and Waccamaw River, S. C.; the Caloosahatchee marl [2] by Caloosahatchee River and Shell Creek, Fla.

A comparison of the faunas shows marked differences in the conditions under which the two formations were deposited. Although the lots of material from the Waccamaw formation are not so rich as those from the Caloosahatchee marl, they nevertheless contain enough species clearly to show that the Waccamaw was laid down under conditions very dissimilar to those of the Caloosahatchee at its type locality. Very few typically southern species occur outside of the Caloosahatchee marl on Caloosahatchee River. Nearly all the species in all the material are identical with those found at the present time along our Atlantic coast, but those from the Waccamaw formation of North and South Carolina and also some of those from Shell Creek, Fla., are much more similar to the material now found north of Cape Hatteras, while the Caloosahatchee River material represents a typically tropical shoal-water fauna such as may be found

[1] For description see Miller, B. L., The Tertiary formations: North Carolina Geol. and Econ. Survey, vol. 3, pp. 250, 258, 1912. Clark, W. B., U. S. Geol. Survey Prof. Paper 71, pp. 748, 749, 1912.

[2] For description see Matson, G. C., and Clapp, F. G., A preliminary report on the geology of Florida: Florida Geol. Survey Second Ann. Rept., pp. 123–128, 1909. Vaughan, T. W., U. S. Geol. Survey Prof. Paper 71, pp. 810, 811, 1912. Matson, G. C., Geology and ground waters of Florida: U. S. Geol. Survey Water-Supply Paper 319, pp. 134–138, 1913.

about southern Florida and in shallow water about the West Indies. Such genera as *Orbitolites*, *Orbiculina*, *Peneroplis*, and *Quinqueloculina* form a large part of the foraminiferal fauna in the present coral-reef area in southern Florida and the West Indies. These genera form a large portion of the foraminiferal fauna of the Caloosahatchee marl from Caloosahatchee River, but they occur not at all or only very sparingly in the other lots of material, as will be seen by reference to the table of occurrence (p. 7).

The Miliolidae are typical of warm shallow water and therefore indicate that the Caloosahatchee material was formed under such conditions. The more northern assemblage of forms found in the other lots indicate in a similar way that the material was deposited in cooler water. It is interesting that in certain genera, such as *Discorbis*, the species represented in the northern lots of material are replaced in the Caloosahatchee marl by similar species having a much more southern distribution.

Not all the specimens in the Pliocene material can be referred to described species, and a few of them are here described as new. Others differ somewhat from species described, but they are assigned to those species and the differences noted. Many of the species, especially of the Caloosahatchee marl, seem to be close to or identical with the species described by D'Orbigny in his work on the fauna of the shore sands of Cuba.

In none of the lots do the Foraminifera form a considerable portion of the material. They are comparatively few and inconspicuous. None of the deposits are in any sense foraminiferal marls, although in some of the Caloosahatchee material *Orbiculina* and *Orbitolites* are easily distinguished.

The following table shows the occurrence of the species obtained at the five localities. The text sets forth something of their geographic and geologic distribution and gives enough synonymy so that original figures can be consulted if desired. The figures on the accompanying plates are all original and were made from specimens obtained at the localities here discussed.

Distribution of Pliocene Coastal Plain Foraminifera.

[The species marked "(M)" occur also in the Miocene.]

	Waccamaw formation.			Caloosahatchee marl.	
	Walkers Bluff, N. C.	Cronly, N. C.	Waccamaw River, S. C.	Shell Creek, Fla.	Caloosahatchee River, Fla.
Textularia gramen (M)		×	×		
Bolivina karreriana				×	
Verneuilina glabrata		×			
Cassidulina laevigata		×			
Lagena semistriata				×	
Marginulina sp		×			
Cristellaria gibba			×		
Uvigerina tenuistriata (M)		×			
angulosa			×		
Polymorphina gibba				×	
Orbulina universa			×		
Globigerina bulloides (M)			×		
Discorbis globularis		×	×	×	
orbicularis (M)					×
subrugosa					×
vilardeboana (M)					×
Anomalina ammonoides (M)	×	×	×		
grosserugosa (M)			×		
sp					×
Truncatulina lobatula (M)	×	×			
boueana			×		
ungeriana				×	
Pulvinulina concamerata		×	×		
Rotalia beccarii (M)		×	×	×	
beccarii var. ornata					×
Nonionina depressula (M)		×		×	
Polystomella striatopunctata (M)		×	×	×	×
fimbriatula			×	×	×
craticulata var			×		
Amphistegina lessonii (M)		×			×
Spiroloculina excavata					×
antillarum					×
reticulosa					×
glabrata					×
Quinqueloculina seminulum (M)		×	×	×	
agglutinans					×
venusta (M)					×
auberiana (M)				×	×
bidentata					×
poeyana					×
sp		×			
Triloculina linnaeana					×
Biloculina laevis					×
Vertebralina cassis					×
Hauerina ornatissima					×
Peneroplis pertusus					×
pertusus var. discoideus					×
Orbiculina adunca					×
Orbitolites marginalis					×

Family TEXTULARIIDAE.

Genus TEXTULARIA Defrance, 1824.

Textularia gramen D'Orbigny.

Plate I, figure 1; Plate II, figure 1.

Textularia gramen D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 248, pl. 15, figs. 4, 6, 1846.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 365, pl. 43, figs. 9, 10, 1884.
Flint, U. S. Nat. Mus. Rept. for 1897, p. 284, pl. 29, fig. 5, 1899.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 8, figs. 6–8, 1911.

Test short, nearly as broad as long, cuneate, rapidly increasing in breadth from the early chambers; chambers comparatively few, lateral borders angled, sutures more or less indistinct; wall arenaceous; aperture elongate, at the base of the inner border of the chamber.

Specimens of this species were found in the Waccamaw formation, at Cronly, N. C., and on Waccamaw River, S. C. The specimens from these two localities differ somewhat in texture and other minor characters. They both evidently belong to the same species. The specimens from North Carolina are smoother and have higher chambers than those from South Carolina.

This species is a common one in the Tertiary deposits and also in the present ocean. It is widely distributed.

Genus BOLIVINA D'Orbigny, 1839.

Bolivina karreriana Brady.

Plate II, figure 5.

Bolivina karreriana Brady, Quart. Jour. Micr. Sci., vol. 21, p. 58, 1881; *Challenger* Rept., Zoology, vol. 9, p. 424, pl. 53, figs. 19–21, 1884.
Egger, K.-bayer Akad. Wiss. München, Cl. II, Abh., vol. 18, p. 299, pl. 8, figs. 38, 39, 1893.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 40, fig. 65 *a*, *b*, 1911.

Test elongate, compressed, cylindrical, apical end broadly rounded; chambers several, inflated, sutures somewhat depressed but not breaking up the costae of the ornamentation; wall calcareous, ornamented by numerous longitudinal raised costae running the whole length of the test, occasionally branching or uniting; aperture broadly elliptical and bordered by a raised lip; color white.

This species was found in considerable numbers in the Caloosahatchee marl on Shell Creek, Fla. The specimens differ somewhat from the typical *B. karreriana* but on the whole undoubtedly represent this species. None of the specimens had a spinose apical end, all being broadly rounded. The species has been described by Brady from recent material in the Pacific and southern Atlantic. Its occurrence in the Pliocene of Florida is an unexpected extension of its range.

Genus VERNEUILINA D'Orbigny, 1840.

Verneuilina glabrata Cushman, n. sp.

Plate I, figure 2.

Test elongate, three-sided, triangular in transverse section, sides flattened, or one slightly concave, the initial end acute, test broadest in the middle, tapering again toward the apertural end; wall usually rather smooth or slightly granular, edges of the chamber at the aperture thickened; the aperture a curved slit at the base of the inner chamber.

Type specimen, U.S.N.M. No. 325308.

This species was found in the Waccamaw formation at Cronly, N. C. It somewhat resembles *V. spinulosa* Reuss but differs in the tapering form and in the nonspinose character of the test.

Genus CASSIDULINA D'Orbigny, 1826.

Cassidulina laevigata D'Orbigny.

Plate I, figure 5.

Cassidulina laevigata D'Orbigny, Annales sci. nat., vol. 7, p. 282, pl. 15, figs. 4, 5, 1826; Modèles, No. 41, 1826.
Williamson, Recent Foraminifera of Great Britain, p. 68, pl. 6, figs. 141, 142, 1858.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 428, pl. 54, figs. 1–3, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 96, fig. 150 *a*, *b*, 1911.

Test nearly circular in outline, in side view lenticular, nearly biconvex with an angled periphery or somewhat carinate; chambers numerous, long and narrow, curved, alternating; sutures distinct but not depressed; wall calcareous, smooth; aperture an elongate slit close to the end, nearly parallel to the margin of the test; color white.

This species was found in the Waccamaw formation at Cronly, N. C. It is typical in every way. The species has been found in the Tertiary of Europe and is widely distributed in the present oceans. It may be considered a cool-water form, although it occurs in the Mediterranean.

Family LAGENIDAE.

Genus LAGENA Walker and Boys, 1784.

Lagena semistriata Williamson.

Plate II, figure 3.

Lagena striata var. *semistriata* Williamson, Annals and Mag. Nat. Hist., 2d ser., vol. 1, p. 14, pl. 1, figs. 9, 10, 1848.
Lagena semistriata Jones, Parker, and Brady, Monograph of the Foraminifera of the Crag, p. 34, pl. 4, fig. 6, 1866.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 465, pl. 57, figs. 14, 16, 17, 1884.

Test flask-shaped, smooth except for the apical end, which has numerous short radiating raised costae extending about a quarter

of the length of the test; neck elongated; aperture with a phialine lip; test rounded in cross section.

A single specimen of this species occurred in the Caloosahatchee marl on Shell Creek, Fla.

Genus MARGINULINA D'Orbigny, 1826.

Marginulina sp.?

Plate I, figure 4.

A single specimen figured in outline was found in the Waccamaw formation at Cronly, N. C. It is a very young specimen and is not sufficiently developed to determine specifically.

Genus CRISTELLARIA Lamarck, 1816.

Cristellaria gibba D'Orbigny.

Plate II, figure 6.

Cristellaria gibba D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 63, pl. 7, figs. 20, 21, 1839.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 546, pl. 69, figs. 8, 9, 1884.
Flint, U. S. Nat. Mus. Rept. for 1897, p. 317, pl. 64, fig. 1, 1899.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 69, pl. 35, fig. 1, 1913.

Test elongate oval, biconvex, peripheral margin subacute; wall smooth; sutures slightly if at all depressed; chambers comparatively few.

A single worn specimen was found in the Waccamaw formation on Waccamaw River, S. C. Although the exterior is largely eroded the form of the test is that of this species. The species is widely distributed both geographically and geologically, and its occurrence is therefore not at all characteristic.

Genus UVIGERINA D'Orbigny, 1826.

Uvigerina tenuistriata Reuss.

Plate I, figure 3.

Uvigerina tenuistriata Reuss, K. Akad. Wiss. Wien Sitzungsber., vol. 52, p. 485, 1870.
Von Schlicht, Die Foraminiferen des Septarienthones von Pietzpuhl, pl. 22, figs. 34–36, 1870.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 574, pl. 74, figs. 4–7, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 95, pl. 42, fig. 4, 1913.

Test elongate, cylindrical, somewhat tapering toward the apical end, composed of numerous inflated chambers with distinct, depressed sutures, the early chambers with fine longitudinal costae, later ones often smooth; aperture with a short tubular neck; wall with a phialine lip.

This species occurred in the Waccamaw formation at Cronly, N. C. The specimen figured is shorter than is typical but otherwise seems to belong to this species. Reuss described this species from specimens obtained in the Tertiary of Europe, and it is rather widely distributed in the present oceans.

Uvigerina angulosa Williamson.

Plate II, figure 2.

Uvigerina angulosa Williamson, Recent Foraminifera of Great Britain, p. 67, pl. 5, fig. 140, 1858.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 576, pl. 74, figs. 15–18, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 320, pl. 68, fig. 3, 1899.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 98, pl. 44, fig. 4, 1913.

Test elongate, tapering toward either end; chambers numerous, usually three in each whorl, laterally compressed, making a triangular test in end view; wall costate longitudinally; sutures depressed; apical end of test often slightly spinose; aperture with a short tubular neck.

This species occurred in the Waccamaw formation on Waccamaw River, S. C. It is typical except that the costae are rather more numerous than is usual in recent specimens. It occurs in the later Tertiary of Europe and is rather widely distributed in the present oceans. It is not a typical tropical foraminifer but is more characteristic of temperate waters.

Genus POLYMORPHINA D'Orbigny, 1826.

Polymorphina gibba (D'Orbigny) Brady, Parker, and Jones.

Plate II, figure 4.

Globulina gibba D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 227, pl. 13, figs. 13, 14, 1846.
Polymorphina gibba (D'Orbigny) Brady, Parker, and Jones (part), Linnaean Soc. London Trans., vol. 27, p. 216, pl. 39, figs. 2*a–d*, 1870.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 561, pl. 71, figs. 12*a*, *b*, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 85, pl. 41, fig. 4, 1913.

Test oval, both in end and in side views, inflated; visible chambers few; sutures distinct but not depressed or only slightly so; wall smooth; apertural end somewhat drawn out; aperture radiate.

A single specimen of this species occurred in the Caloosahatchee marl on Shell Creek, Fla. It seems typical and very similar to the specimens figured by Brady. It occurs in the Tertiary of Europe and perhaps in earlier beds and is rather widely distributed in the present oceans.

Family GLOBIGERINIDAE.

Genus ORBULINA D'Orbigny, 1839.

Orbulina universa D'Orbigny.

Plate III, figure 3.

Orbulina universa D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 3, pl. 1, fig. 1, 1839; in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, p. 122, pl. 1, fig. 1, 1839.

Williamson, Recent Foraminifera of Great Britain, p. 2, pl. 1, fig. 4, 1858.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 608, pl. 78; pl. 81, figs. 8–26; pl. 82, figs. 1–3, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 322, pl. 69, fig. 1, 1899.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 4, p. 14, pl. 6; pl. 7; pl. 11, fig. 3, 1914.

Test from the exterior consisting of a single nearly spherical chamber but often inclosing several *Globigerina*-like chambers within, surface reticulate, perforate, with a single large circular aperture.

In the Waccamaw formation on Waccamaw River, S. C., a single specimen occurred which seems to be this species, although the surface is not clearly characteristic. This species is recorded from the Lias to the present, but the specimens from the earlier formations are not all well preserved. It is very widely distributed in the present oceans.

Genus GLOBIGERINA D'Orbigny, 1826.

Globigerina bulloides D'Orbigny.

Plate III, figure 2.

Globigerina bulloides D'Orbigny, Annales sci. nat., vol. 7, p. 277, No. 1, 1826; Modèles, Nos. 17, 76; Voyage dans l'Amérique méridionale, Foraminifères, p. 37, 1839; in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, pt. 2, p. 132, pl. 2, figs. 1–3, 28, 1839.

Williamson, Recent Foraminifera of Great Britain, p. 56, pl. 5, figs. 116–118, 1858.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 593, pl. 77; pl. 79, figs. 3–7, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 321, pl. 69, fig. 2, 1899.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 4, p. 5, pl. 2, figs. 7–9; pl. 9, 1914.

Test subglobose, spiral, made up of a few inflated chambers, all visible from the dorsal side, three to four visible from the ventral side; sutures deep, surface reticulate.

A few specimens from the Waccamaw formation on Waccamaw River, S. C., apparently belong to this species, which is widely distributed geographically and geologically.

Family ROTALIIDAE.

Genus DISCORBIS Lamarck, 1804.

Discorbis globularis (D'Orbigny) Cushman.

Plate I, figure 9.

Rosalina globularis D'Orbigny, Annales sci. nat., vol. 7, p. 271, pl. 13, figs. 1–4, 1826.
Discorbis globularis (D'Orbigny) Cushman, U. S. Nat. Mus. Bull. 71, pt. 5, p. 11, pl. 9, fig. 4; fig. 9 in text, 1915.
Discorbina globularis (D'Orbigny) Carpenter, Parker, and Jones, Introduction to the study of the Foraminifera, p. 204, pl. 3, fig. 1, 1862.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 643, pl. 86, figs. 8, 13, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 327, pl. 72, fig. 2, 1899.
Bagg, U. S. Geol. Survey Bull. 513, p. 81, pl. 24, fig. 15, 1912.

Test plano-convex, dorsal side convex, rounded, ventral side usually flattened or somewhat concave, peripheral margin rounded on the ventral side with radiating lines on the border; chambers few, usually five in the last-formed whorl; sutures slightly depressed, much more so on the ventral side, where the chambers end at the center in angular projections; umbilicate.

This species was found in the Waccamaw formation at Cronly, N. C., and on Waccamaw River, S. C., and in the Caloosahatchee marl on Shell Creek, Fla. All the specimens from these localities were typical, showing especially the milled edge on the ventral border. This species occurs in the Tertiary of Europe and in the present oceans mainly in temperate and subtropical waters, being much less common in the Tropics.

Discorbis orbicularis (Terquem) Berthelin.

Plate III, figure 4.

Rosalina orbicularis Terquem, Essai sur le classement des animaux qui vivent sur la plage et dans les environs de Dunkerque, p. 75, pl. 9, fig. 4*a*, *b*, 1876.
Discorbis orbicularis (Terquem) Berthelin, Foraminifères recueillis dans la baie de Bourgneuf et à Pornichet, p. 39, No. 63, 1878.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 647, pl. 88, figs. 4–8, 1884.

Test convex dorsally, concave ventrally; chambers few, ranging from two to four in the last-formed whorl; peripheral border acute, sometimes carinate; sutures well marked by fine lines, occasionally limbate; chambers ventrally elongate, from three to five visible; wall punctate.

This species occurred in the Caloosahatchee marl on Caloosahatchee River, Fla. It is known from the Miocene and Pliocene of southern Europe. In the present oceans it occurs most abundantly as a coral-reef species of the Tropics, especially in shallow water. This is interesting, as this species occurs in the Caloosahatchee, which has typically a tropical reef-coral fauna, so far as the Foraminifera show, and it does not occur in material from the other three localities here described, which have a more northern assemblage of forms.

Discorbis subrugosa Cushman, n. sp.

Plate V, figure 4.

Test composed of numerous chambers, six or seven in the final whorl, inflated; sutures deeply depressed; dorsally somewhat umbonate, ventrally somewhat flattened, depressed at the umbilicus; chambers extending in to the center of the test; ventral margin broadly rounded, surface smooth.

Type specimen, U. S. N. M. No. 325309.

This species was found in the material of the Caloosahatchee marl on Caloosahatchee River, Fla. In form and general shape it much resembles *Discorbina rugosa* D'Orbigny, but it is not so rugose as that species and the chambers on the ventral side extend to the center.

Discorbis vilardeboana (D'Orbigny) Cushman.

Plate III, figure 1.

Rosalina vilardeboana D'Orbigny, Voyage dans l'Amérique méridionale, Foraminifères, p. 44, pl. 6, figs. 13–15, 1839.

Discorbis vilardeboana (D'Orbigny) Cushman, U. S. Nat. Mus. Bull. 71, pt. 5, p. 14, pl. 9, fig. 2; fig. 14 in text, 1915.

Discorbina vilardeboana (D'Orbigny) Parker and Jones, London Geol. Soc. Quart. Jour., vol. 28, p. 115, 1872.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 645, pl. 86, figs. 9–12; pl. 88, fig. 2, 1884.

Bagg, U. S. Nat. Mus. Proc., vol. 34, p. 157, 1908.

Test plano-convex, rounded dorsally, flattened or slightly concave ventrally, peripheral margin rounded; chambers five to seven in the last-formed whorl, on the ventral side the last-formed chamber large, often forming one-third of the ventral surface; sutures distinct, slightly depressed, especially on the ventral side; umbilicate.

A single specimen of this species was found in the Caloosahatchee marl on Caloosahatchee River, Fla., and seems to be typical in every way. This species is known in the Tertiary of Europe and is widely distributed in the present oceans.

Genus ANOMALINA D'Orbigny, 1826.

Anomalina ammonoides (Reuss) Brady.

Plate I, figure 11; Plate IV, figure 2.

Rosalina ammonoides Reuss, Geognostiche Skizze aus Böhmen, Band 2, p. 214, 1844.
Anomalina ammonoides (Reuss) Brady, *Challenger* Rept., Zoology, vol. 9, p. 672, pl. 94, figs. 2, 3, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 335, pl. 78, fig. 4, 1899.
Bagg, U. S. Geol. Survey Bull. 513, p. 85, pl. 26, figs. 7–10, 1912.
Planorbulina ammonoides (Reuss) Jones, Geologist [London], vol. 6, p. 294, pl. 15, figs. 7, 8, 1863.
Discorbina ammonoides (Reuss) Reuss, K. Akad. Wiss. Wien Sitzungsber., vol. 52, p. 456, No. 5, 1865.
Rotalia ammonoides (Reuss) Gümbel, K.-bayer. Akad. Wiss. Sitzungsber., 1870, p. 283.

Test biconvex, composed of three or four whorls; chambers numerous, ten or more in each whorl, slightly concave at the umbilici, chambers somewhat inflated; sutures depressed, distinct; peripheral margin rounded; wall coarsely perforate, especially on the ventral side.

Specimens were found in the Waccamaw formation at Cronly, N. C., and on Waccamaw River, S. C. As a fossil this species, to judge from the records, has a wide range, and it is also widely distributed in the present oceans.

Anomalina grosserugosa (Gümbel) Brady.

Plate IV, figure 1.

Truncatulina grosserugosa Gümbel, K.-bayer. Akad. Wiss. Abh., vol. 10, p. 660, pl. 2, fig. 104, 1868.
Anomalina grosserugosa (Gümbel) Brady, *Challenger* Rept., Zoology, vol. 9, p. 673, pl. 94, figs. 4, 5, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 335, pl. 78, fig. 5, 1899.
Bagg, U. S. Geol. Survey Bull. 513, p. 85, pl. 26, figs. 1–6, 1912.

Test nautiloid, dorsally somewhat concave, ventrally somewhat convex; chambers numerous, all visible from the dorsal side, but only those of the last-formed whorl visible from the ventral side, chambers inflated, six to eight in the last-formed whorl; sutures depressed; periphery broadly rounded; wall coarsely perforate, more so on the ventral side.

A few specimens evidently belonging to this species were found in the Waccamaw formation on Waccamaw River, S. C. It is found as a fossil in the Tertiary of Europe and is rather widely distributed in the cooler waters of the present oceans.

Genus TRUNCATULINA D'Orbigny, 1826.

Truncatulina lobatula (Walker and Jacob) D'Orbigny.

Plate I, figure 10.

Nautilus lobatulus Walker and Jacob, Adam's Essays on the microscope, Kanmacher's ed., p. 642, pl. 14, fig. 36, 1798.

Truncatulina lobatula (Walker and Jacob) D'Orbigny, in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, p. 134, pl. 2, figs. 22–24, 1839.

Brady, *Challenger* Rept., Zoology, vol. 9; p. 660, pl. 92, fig. 10; pl. 93, figs. 1, 4, 5; pl. 95, figs. 4, 5, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 333, pl. 76, fig. 4, 1899.

Bagg, Bull. U. S. Geol. Survey Bull. 513, p. 82, pl. 24, figs. 9–14, 1912.

Serpula lobatula (Walker and Jacob), Montagu, Testacea Britannica, p. 515, 1803; Suppl., p. 160, 1808.

Test plano-convex, flattened on the ventral face, moderately convex dorsally, peripheral margin rounded; chambers numerous, seven or eight in the last-formed whorl; sutures depressed, especially on the dorsal face; wall smooth, punctate.

This species was found in the Waccamaw formation at Cronly, N. C. From the records it is widely distributed both geographically and geologically. On our Atlantic coast, however, it is one of the most common species, especially in the northern portion, therefore it would be expected in the North Carolina material rather than in that obtained farther south.

Truncatulina boueana D'Orbigny.

Truncatulina boueana D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 169, pl. 9, figs. 24–26, 1846.

Test plano-convex, dorsally flattened, ventrally convex, nine or ten chambers in the last-formed whorl, all chambers visible from the dorsal side, only the last-formed whorl visible from the ventral side; sutures distinct but only slightly depressed; peripheral margin acute, not lobulated, or only slightly so; wall coarsely perforate.

This species was found in the Waccamaw formation on Waccamaw River, S. C. It is more regularly built than *T. lobatula* and the peripheral border is more regular. It is described from specimens found in the Tertiary of Europe.

Truncatulina ungeriana (D'Orbigny) Reuss.

Plate IV, figure 5.

Rotalina ungeriana D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 157, pl. 8, figs. 16–18, 1846.

Truncatulina ungeriana (D'Orbigny) Reuss, K. Akad. Wiss. Wien Denkschr., vol. 25, p. 161, 1865.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 664, pl. 94, figs. 9*a–d*, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 333, pl. 77, fig. 2, 1899.

Bagg, U. S. Geol. Survey Bull. 513, p. 83, pl. 25, figs. 1–3, 1912.

Planorbulina ungeriana (D'Orbigny) Brady, Linnaean Soc. London Trans., vol. 24, p. 469, pl. 48, fig. 12, 1864.

Test unequally biconvex, peripheral margin subacute, somewhat carinate; chambers numerous, ten to twelve in the last-formed whorl; sutures distinct, somewhat depressed; wall somewhat coarsely punctate dorsally.

One rather poor, broken specimen of this species was found in the Caloosahatchee marl on Shell Creek, Fla. The species occurs in the later Tertiary of Europe and is fairly common in the cooler waters of the present oceans.

Genus PULVINULINA Parker and Jones, 1862.

Pulvinulina concamerata (Montagu) Brady.

Plate IV, figure 4.

Serpula concamerata Montagu, Testacea Britannica Suppl., p. 160, 1808.

Pulvinulina repanda var. *concamerata* (Montagu) Brady, *Challenger* Rept., Zoology, vol. 9, p. 685, pl. 104, figs. 19*a–c*, 1884.

Rotalina concamerata (Montagu) Williamson, Recent Foraminifera of Great Britain, p. 52, pl. 4, fig. 102, 1858.

Test biconvex, more convex dorsally than ventrally; chambers numerous, seven or more in the last-formed whorl, umbilicate below; peripheral margin subacute, carinate; sutures on the dorsal side raised, conspicuously limbate, ventrally depressed, surface smooth.

This species was found in the Waccamaw formation at Cronly, N. C., and on Waccamaw River, S. C. It is found in the present ocean in comparatively shallow water in temperate regions, especially of the north Atlantic. Therefore it is an added indication of the cool-water conditions under which the Pliocene materials of North and South Carolina were laid down. It was not found in the Pliocene material from Florida.

Genus ROTALIA Lamarck, 1804.

Rotalia beccarii (Linnaeus) D'Orbigny.

Plate V, figure 1; Plate VI, figure 1.

Nautilus beccarii Linnaeus, Systema naturae, 12th ed., p. 1162, 1767; Gmelin's 13th ed., p. 3370, No. 4, 1788.

Rotalia (Turbinulina) beccarii (Linnaeus) D'Orbigny, Annales sci. nat., vol. 7, p. 275, No. 40, 1826; Modèles, No. 74, 1826.

Rotalia beccarii (Linnaeus) Parker and Jones, Philos. Trans., vol. 155, p. 388, pl. 16, figs. 29, 30, 1865.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 704, pl. 107, figs. 2, 3, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 331, pl. 75, fig. 2, 1899.

Test biconvex; chambers numerous, the last-formed whorl containing eight to twelve; periphery rounded; sutures limbate above, much depressed ventrally, umbilical region often filled with a rounded mass of material surrounded by a depressed area running to the sutures; wall smooth.

This species was found in the Waccamaw formation at Cronly, N. C., and on Waccamaw River, S. C., and in the Caloosahatchee marl on Shell Creek, Fla. The material from all these localities is typical. As a fossil it occurs from the Miocene to the Pliocene. It is common in shallow water, especially in the temperate seas, therefore its occurrence at these three localities is what might be expected. It is represented in the Caloosahatchee marl by another form, described below.

Rotalia beccarii (Linnaeus) D'Orbigny var. ornata Cushman, n. var.

Plate VIII, figure 7.

Test biconvex, periphery broadly rounded; chambers numerous, last-formed coil consisting of ten or more chambers; sutures marked with a raised ornamentation of clear shell material, both dorsally and ventrally.

Type specimen, U. S. N. M. No. 325310.

This variety is not uncommon in the Caloosahatchee marl on Caloosahatchee River, Fla. It is apparently a tropical modification of the species.

Family NUMMULINIDAE.

Genus NONIONINA D'Orbigny, 1826.

Nonionina depressula (Walker and Jacob) Parker and Jones.

Plate I, figure 6.

Nautilus depressulus Walker and Jacob, in Adam's Essays on the microscope, Kanmacher's ed., p. 641, pl. 14, fig. 33, 1798.

Nonionina depressula (Walker and Jacob) Parker and Jones, Annals and Mag. Nat. Hist., 3d ser., vol. 4, pp. 339, 341, 1859.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 725, pl. 109, figs. 6, 7, 1884.

Bagg, U. S. Geol. Survey Bull. 513, p. 88, pl. 26, figs. 16*a–c;* pl. 28, figs. 7, 8, 1912.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 4, p. 23, pl. 17, fig. 3, 1914.

Test nearly circular in side view, last-formed whorl consisting of ten or more chambers, only those of the last-formed whorls visible; periphery broadly rounded, slightly lobulated; sutures very slightly depressed, broader toward the umbilical region, which is filled with clear shell material.

This species is found in the Waccamaw formation at Cronly, N. C., and in the Caloosahatchee marl on Shell Creek, Fla. The species is known from the Tertiary of Europe and is found at present especially in shallow water of the cooler oceans but is less abundant in the Tropics.

Genus POLYSTOMELLA Lamarck, 1822.

Polystomella striatopunctata (Fichtel and Moll) Parker and Jones.

Plate VIII, figure 4.

Nautilus striatopunctata Fichtel and Moll, Testacea microscopica, p. 61, pl. 9, figs. *a–c*, 1803.

Polystomella striatopunctata (Fichtel and Moll) Parker and Jones, Annals and Mag. Nat. Hist., 3d ser., vol. 5, p. 103, No. 6, 1860.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 733, pl. 109, figs. 22, 23, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 337, pl. 80, fig. 2, 1899.

Bagg, U. S. Geol. Survey Bull. 513, p. 92, pl. 27, figs. 10–12, 1912.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 4, p. 31, pl. 18, fig. 2, 1914.

Test nautiloid, composed of several coils, the last-formed one with about ten chambers, periphery broadly rounded, depressed at the umbilicus; chambers inflated, sutures depressed, septal lines with regular bridging; aperture a nearly semicircular, narrow opening.

This species occurs in both the Waccamaw and Caloosahatchee formations at all four of the localities described in this paper. It is a rather common species throughout the Tertiary and is very widely distributed in the present ocean, especially in shallow water.

Polystomella fimbriatula Cushman, n. sp.

Plate VIII, figure 5.

Test nautiloid, subcircular in side view, the sides nearly parallel, in apertural view, about three times as long as wide, central raised ring standing out distinctly, peripheral margin angular, carinate; last-formed coil with about twelve chambers, the bridging greater than the intervening space; umbilicate, the umbilicus surrounded by a raised ridge, which is fimbriate; aperture a narrow curved slit.

Type specimen, U. S. N. M. No. 325311.

This species was found to be especially common in the Caloosahatchee marl on Caloosahatchee River, Fla., but occurs also in the Caloosahatchee marl on Shell Creek, Fla., and in the Waccamaw formation on Waccamaw River, S. C.

Polystomella craticulata (Fichtel and Moll) D'Orbigny var.

Plate VIII, figure 6.

This variety is not typical *P. craticulata*, differing especially in the number of chambers in the last-formed coil and in the narrower and less numerous bridgings and also in the less tumid character of the whole test.

This variety was found in the Waccamaw formation on Waccamaw River, S. C.

Genus AMPHISTEGINA D'Orbigny, 1826.

Amphistegina lessonii D'Orbigny.

Plate IV, figure 3.

Amphistegina lessonii D'Orbigny, Annales sci. nat., vol. 7, p. 304, No. 3, pl. 17, figs. 1–4, 1826; Modèles, No. 98, 1826.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 740, pl. 111, figs. 1–7, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 338, pl. 82, fig. 4, 1899.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 4, p. 35, pl. 19, fig. 2, 1914.

Test lenticular, slightly more convex on one side than on the other; surface smooth except near the aperture, where it is often somewhat granular, composed of numerous chambers, whorls embracing; sutures angled, simple on the dorsal side, ventrally divided usually into two lobes; aperture simple.

This species is known from the Tertiary of most parts of the world. In the present oceans it is common in tropical and subtropical waters. It was found in the Waccamaw formation at Cronly, N. C. (a few specimens only) and is common in the Caloosahatchee marl on Caloosahatchee River, Fla.

Family MILIOLIDAE.

Genus SPIROLOCULINA D'Orbigny, 1826.

Spiroloculina excavata D'Orbigny.

Plate VI, figure 6.

Spiroloculina excavata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 271, pl. 16, figs. 19–21, 1846.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 151, pl. 9, figs. 5, 6, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 296, pl. 41, fig. 5, 1899.

Test elongate, excavated at the center, broadest near the periphery, about twice as long as wide; chambers numerous, limbate at the margins; apertural end extended in a tubular neck having a phialine lip; the aperture often with a bifid tooth; surface more or less granular.

This species was found only in the Caloosahatchee marl on Caloosahatchee River, Fla. As a fossil it is known from the Tertiary of Europe, and in the present ocean it is characteristic of warmer seas and usually shallow water. It is fairly common in the shallow water on the shore of the West Indies and Florida.

Spiroloculina antillarum D'Orbigny.

Plate VIII, figure 2.

Spiroloculina antillarum D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 166, pl. 9, figs. 3, 4, 1839.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 155, pl. 10, fig. 21, 1884.

Test elongate, twice as long as broad; chambers subtriangular; peripheral margin broadly rounded, ornamented by numerous longitudinal costae; apertural and extended. The costae are distinct and continue from one end to the other of the chambers without any trace of branching or anastomosing.

Specimens which seem referable to this species were found in the Caloosahatchee marl on Caloosahatchee River, Fla. D'Orbigny described the species from specimens obtained in the shore sands of Cuba, and Brady records it from Brazil in the *Challenger* material.

Spiroloculina reticulosa Cushman, n. sp.

Plate VI, figure 4.

Test large, elliptical, compressed, planospiral, composed of several chambers, somewhat rounded with a bluntly angled periphery; wall ornamented with a reticulation of raised ridges which anastomose freely; apertural end somewhat extended; aperture rounded, with a slightly bifid tooth.

Type specimen, U. S. N. M. No. 325312.

This species was found in the Caloosahatchee marl on Caloosahatchee River, Fla.

Spiroloculina glabrata Cushman, n. sp.

Plate VI, figure 3.

Test small, broadly elliptical, subcircular, very much compressed, planospiral; chambers rather broad; wall entirely smooth; sutures slightly depressed, indistinct except in the later portion.

Type specimen, U. S. N. M. No. 325313.

Specimens of this species were found in Caloosahatchee marl on Caloosahatchee River, Fla. It is a small, very flat, smooth species. In the figure the raised portions are bits of the matrix that adhered to the surface of the test.

Genus QUINQUELOCULINA D'Orbigny, 1826.

Quinqueloculina seminulum (Linnaeus) D'Orbigny.

Plate I, figure 8.

Serpula seminulum Linnaeus, Systema naturae, 12th ed., p. 1264, No. 791, 1767.
Quinqueloculina seminulum (Linnaeus) D'Orbigny, Annales sci. nat., vol. 7, p. 303, No. 44, 1826.
Jones, Parker, and Brady, Foraminifera of the Crag, p. 9, pl. 3, figs. 35, 36, 1866.
Milolina seminulum (Linnæus) Williamson, Recent Foraminifera of Great Britain, p. 85, pl. 7, figs. 183–185, 1858.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 157, pl. 5, fig. 6, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 297, pl. 43, fig. 2, 1899.
Bagg, U. S. Geol. Survey Bull. 513, p. 30, pl. 4, fig. 9, 1912.

Test oval, elongate, one and one-half times as long as wide; chambers comparatively few; peripheral margin broadly rounded; apertural end with a neck; aperture with a single tooth; wall smooth.

This species occurred in three of the four stations from which material was available in the Waccamaw formation at Cronly, N. C.; on Waccamaw River, S. C., and in the Caloosahatchee marl on Shell Creek, Fla. As a fossil this species occurs throughout the Tertiary of Europe, and it seems to be one of the most common species in the present oceans, especially in shallow water along the Atlantic coast.

Quinqueloculina agglutinans D'Orbigny.

Plate VII, figure 6.

Quinqueloculina agglutinans D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 195, pl. 12, figs. 11–13, 1839.
Miliolina agglutinans (D'Orbigny) Brady, *Challenger* Rept., Zoology, vol. 9, p. 180, pl. 8, figs. 6, 7, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 301, pl. 47, fig. 2, 1899.

Test oval, subtriangular in end view, periphery rounded; wall composed of sand grains, rough; apertural end occasionally somewhat extended; aperture with a bifid tooth.

In the material on which the present paper is based this species occurred only in the Caloosahatchee marl on Caloosahatchee River,

Fla. This specimen is here figured. It does not seem to be widely known as a fossil except in the later Tertiary. In the present oceans it is widely distributed and is characteristic of shallow water, especially among the coral sands of tropical shores.

Quinqueloculina venusta Karrer.

Plate VIII, figure 3.

Quinqueloculina venusta Karrer, K. Akad. Wiss. Wien Sitzungsber. vol. 57, p. 147, pl. 2, fig. 6, 1868.

Miliolina venusta (Karrer) Brady, *Challenger* Rept., Zoology, vol. 9, p. 162, pl. 5, figs. 5, 7, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 298, pl. 44, fig. 2, 1899.

Bagg, U. S. Geol. Survey Bull. 513, p. 32, pl. 6, fig. 2, 1912.

Test much elongate, two and a half times as long as broad, apertural end narrow, other end broadly rounded; wall smooth; sutures distinct, somewhat depressed; apertural end somewhat extended, truncate; aperture circular, with a bifid tooth.

This species occurs in the Caloosahatchee marl on Caloosahatchee River, Fla. The specimen does not seem to be typical of this species as figured by several authors, though it has the characteristic truncate apertural end and the angular chambers.

Quinqueloculina auberiana D'Orbigny.

Plate V, figure 3.

Quinqueloculina auberiana D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 167, pl. 12, figs. 1–3, 1839.

Miliolina auberiana (D'Orbigny) Brady, *Challenger* Rept., Zoology, vol. 9, p. 162, pl. 5, figs. 8, 9, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 298, pl. 43, fig. 6, 1899.

Bagg, U. S. Geol. Survey Bull. 513, p. 26, pl. 4, fig. 2; pl. 6, fig. 6, 1912.

Test oval, subtriangular in end view, chambers smooth, sharply angled, apertural end slightly extended; aperture circular with a bifid tooth; wall smooth.

This species was found in the Caloosahatchee marl, both on Shell Creek and on Caloosahatchee River, Fla. It was described by D'Orbigny from specimens found in shell sand on the coast of Cuba.

Quinqueloculina bidentata D'Orbigny.

Plate VII, figure 5.

Quinqueloculina bidentata D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 197, pl. 12, figs. 18–20, 1839.

Test elongate, twice as long as broad, subtriangular in end view; chambers distinct, angled; peripheral border broadly rounded; sutures distinct, depressed; apertural end slightly extended; other end broadly rounded; aperture circular, typically with a bidentate tooth; surface granular, rugose.

This species was found in some numbers in the Caloosahatchee marl on Caloosahatchee River, Fla. It is described by D'Orbigny from specimens collected in shore sands, Cuba.

Quinqueloculina poeyana D'Orbigny.

Plate VI, figure 2.

Quinqueloculina poeyana D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 191, pl. 11, figs. 25–27, 1839.

Test elongate, two and a half times as long as broad; chambers rounded, distinct, surface ornamented with numerous raised costae, running the entire length of the test; apertural end not extended; aperture with a single tooth.

This species occurs in the Caloosahatchee marl on Caloosahatchee River, Fla. It was described by D'Orbigny from specimens obtained in the shore sands of Cuba.

Quinqueloculina sp.?

Plate I, figure 7.

A single specimen of *Quinqueloculina* from the Waccamaw formation at Cronly, N. C., has somewhat the shape of *Q. seminulum*, which also was found there, but has indications of faint striae on the surface. It is somewhat worn and its identity is questionable.

Genus TRILOCULINA D'Orbigny, 1826.

Triloculina linnaeana D'Orbigny.

Plate VII, figure 1.

Triloculina linnaeana D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 153, pl. 9, figs. 11–13, 1839.

Miliolina linnaeana (D'Orbigny) Brady, *Challenger* Rept., Zoology, vol. 9, p. 174, pl. 6, figs. 15–20, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 300, pl. 46, fig. 3(?), 1899.

Bagg, U. S. Geol. Survey Bull. 513, p. 28, pl. 3, figs. 8, 9, 1912.

Test elongate, oval, subtriangular in end view; three chambers visible from the exterior, angled; surface ornamentation consisting of numerous longitudinal costae, usually anastomosing; apertural end slightly extended; aperture elliptical, with a definite lip and a slightly bifid tooth.

Specimens of this species were found in the Caloosahatchee marl on Caloosahatchee River, Fla. The species was described from specimens found in the shore sands of Cuba and is a characteristic recent foraminifer in shallow water about tropical coral islands.

There seems to be much confusion in regard to this species. The original figures of D'Orbigny show a typical triloculine test with distinct longitudinal raised costae, the apertural end extended, chambers

rounded in apertural view. Some of the recent figures of specimens under this name show a very few coarse ridges with flattened chambers very unlike those of the form figured by D'Orbigny. The specimen here figured in end view is more angled than the typical figure of D'Orbigny and has more numerous costae.. In this respect it is more like *T. bicornis* Walker and Jacob.

Genus BILOCULINA D'Orbigny, 1826.

Biloculina laevis (Defrance) D'Orbigny.

Plate VII, figures 3, 4.

Pyrgo laevis Defrance, Dictionnaire des sciences naturelles, vol. 32, p. 273; atlas, pl. 88, fig. 2, 1824.

Biloculina laevis (Defrance) D'Orbigny, Annales sci. nat., vol. 7, p. 298, No. 8, 1826. Brady, *Challenger* Rept., Zoology, vol. 9, p. 146, pl. 2, fig. 14, 1884.

Test oval in front view, nearly circular in end view, smooth, bicarinate; apertural end somewhat extended, aperture elongate laterally, tooth broad, base often somewhat roughened.

This species was found in Caloosahatchee marl from Caloosahatchee River, Fla. It occurs as a fossil in the Tertiary of Europe.

Genus VERTEBRALINA D'Orbigny, 1826.

Vertebralina cassis D'Orbigny.

Vertebralina cassis D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminiferès, p. 51, pl. 7, figs. 14, 15, 1839.

Vertebralina conico-articulata Goës, in part [not Batsch], K. svenska Vet.-Akad. Handl., vol. 19, No. 4, p. 121, pl. 9, figs. 311–316[?], 1882.

Test compressed, planospiral, subtriangular; wall ornamented by longitudinal raised costae, with a wide peripheral keel; aperture an elongate slit with a definite raised border; later chambers becoming uniserial.

D'Orbigny described this species from specimens obtained in the shore sands of Cuba, and Goës has figured specimens from the Caribbean Sea that are somewhat similar to those here described. These specimens, which were found in the Caloosahatchee marl on Caloosahatchee River, Fla., seem to be identical with that described by D'Orbigny. Many of the early chambers are nearly smooth, like those figured by Goës.

Genus HAUERINA D'Orbigny, 1848.

Hauerina ornatissima (Karrer) Brady(?).

Plate VI, figure 5.

Quinqueloculina ornatissima Karrer, K. Akad. Wiss. Wien Sitzungsber. vol. 58, p. 151, pl. 3, fig. 2, 1868.

Hauerina ornatissima (Karrer) Brady, *Challenger* Rept., Zoology, vol. 9, p. 192, pl. 7, figs. 15–22, 1884.

Test oval, compressed, early portion quinqueloculine, later planospiral, peripheral margin subacute, surface of later chambers with transverse crenulations, last-formed chamber smooth; aperture consisting of a series of sievelike pores.

A single specimen of this species was obtained from the Caloosahatchee marl of Caloosahatchee River, Fla. The specimen is not characteristic and lacks certain of the features of typical recent specimens of the species.

Hauerina ornatissima is typically a coral-reef species.

Genus PENEROPLIS Montfort, 1808.

Peneroplis pertusus (Forskål) Jones, Parker, and Brady.

Plate VIII, figure 1.

Nautilus pertusus Forskål, Descriptiones animalium, p. 125, No. 65, 1775.

Peneroplis pertusus (Forskål) Jones, Parker, and Brady, Foraminifera of the Crag, p. 19, 1865.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 204, pl. 13, figs. 12–25, 1884.

Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 304, pl. 48, fig. 4, 1899.

Test flattened, loosely coiled, planospiral, consisting of about three coils; chambers numerous, rapidly increasing in length, much varied in the relative amount of their overlapping, chambers distinct; sutures somewhat depressed, chambers simple, aperture composed of a number of pores.

The only material in which this occurred was the Caloosahatchee marl from Caloosahatchee River, Fla. As a fossil it is apparently limited to Tertiary beds. In the present oceans it is widely distributed and is one of the commonest species, especially in the shallow water about tropical shores.

Peneroplis pertusus (Forskål) var. discoideus Flint.

Peneroplis pertusus (Forskål) var. *discoideus* Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 304, pl. 49, fig. 1, 1899.

Test similar to the type but the chambers early becoming annular, forming a circular, disklike test similar to *Orbitolites simplex* but with no trace of divisions in the chambers.

Flint's description of this variety was based on specimens from Key West Harbor, Fla., in shallow water. It was found as a fossil in the Caloosahatchee marl of Caloosahatchee River, Fla.

Genus ORBICULINA Lamarck, 1816.

Orbiculina adunca (Fichtel and Moll) Lamarck.

Plate VII, figure 2.

Nautilus aduncus Fichtel and Moll, Testacea microscopica, p. 115, pl. 23, 1803.
Orbiculina adunca (Fichtel and Moll) Lamarck, Tableau encyclopédique et méthodique, pl. 468, fig. 2, 1816.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 209, pl. 14, figs. 1–13, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 304, pl. 50, fig. 1, 1899.

Test flattened, planospiral, coiled; chambers numerous, increasing in length until in the later-formed portion they become annular; sutures distinct; chambers divided into chamberlets; aperture consisting of numerous pores; surface smooth.

This species occurred in some numbers in the Caloosahatchee marl of Caloosahatchee River, Fla. As a fossil it is known from the Tertiary, especially the later portion, and it is very common in the present oceans, being characteristic of shallow water, especially in tropical regions. In the West Indies and along the Florida coast this is probably the most abundant foraminifer of the coral-reef tracts.

Genus ORBITOLITES Lamarck, 1801.

Orbitolites marginalis (Lamarck) Carpenter.

Orbitolites marginalis Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 2, p. 196, No. 1, 1816.
Orbitolites marginalis (Lamarck) Carpenter, Philos. Trans., 1856, p. 192, pl. 9, figs. 1–4.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 214, pl. 15, figs. 1–5, 1884.
Flint, U. S. Nat. Mus. Ann. Rept. for 1897, p. 304, pl. 50, fig. 2; pl. 51, fig. 1, 1899.
Orbiculina (*Orbitolites*) *complanata*, Williamson, London Micr. Soc. Trans., 1st ser., vol. 3, p. 115, pl. 17, fig. 8; pl. 18, figs. 9, 10, 1851.

Test complanate, much flattened; chambers very numerous, early ones spirally arranged, later becoming elongate and finally annular, the later ones regularly divided into chamberlets; sutures distinct; aperture a single row of circular pores along the peripheral margin; wall smooth, translucent.

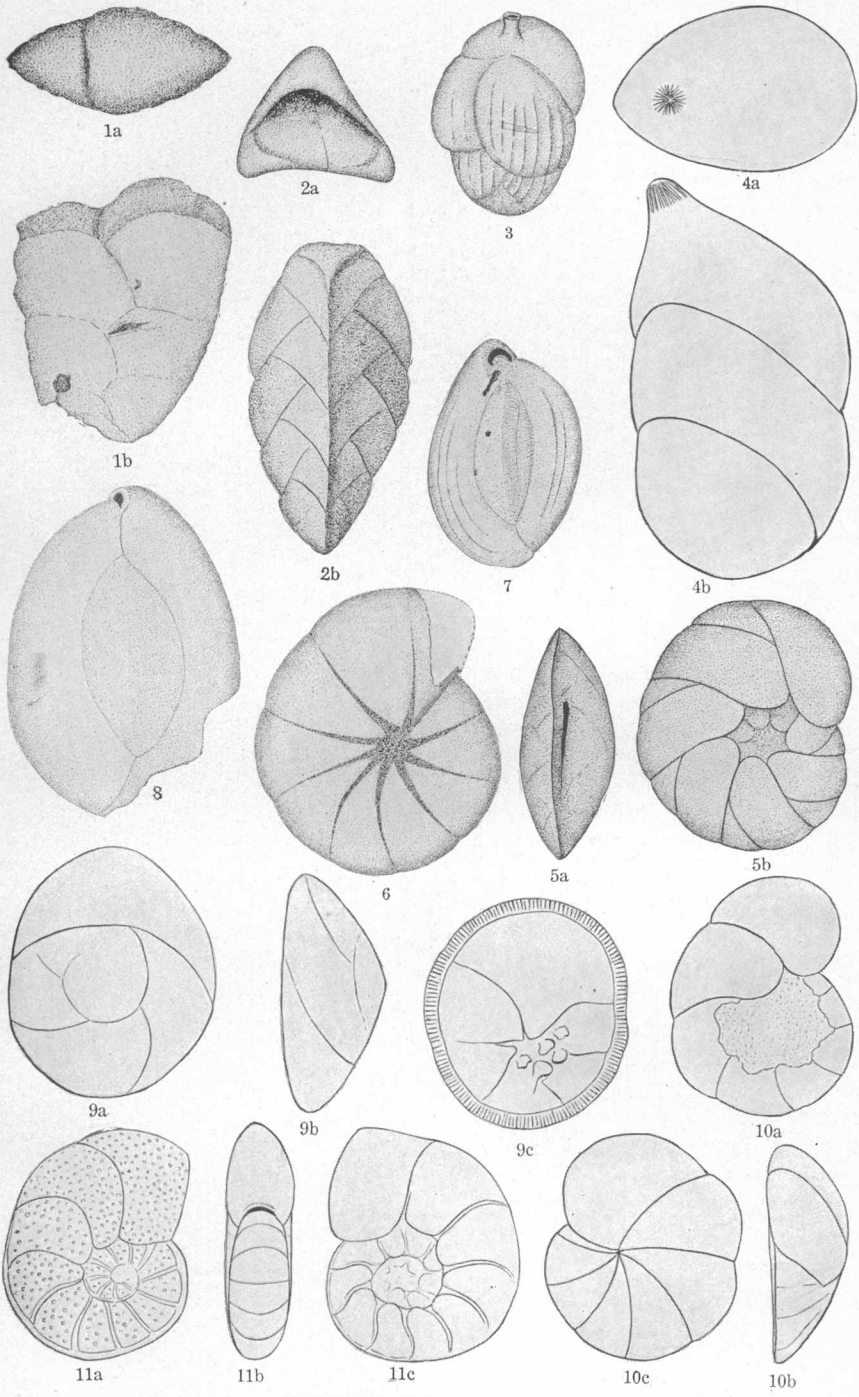
This species occurs in the Caloosahatchee marl of Caloosahatchee River, Fla. The species seems to be almost entirely a recent one. It is characteristic of the calcareous sands of warm, shallow waters.

PLATES I-VIII.

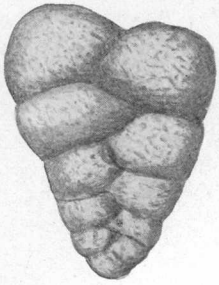
PLATE I.

FIGURE 1. *Textularia gramen* D'Orbigny, × 60. *a*, Apertural view; *b*, front view.
2. *Verneuilina glabrata* Cushman, n. sp., × 60. *a*, Apertural view; *b*, front view.
3. *Uvigerina tenuistriata* Reuss, × 60.
4. *Marginulina* sp.?, × 60. *a*, Apertural view; *b*, front view.
5. *Cassidulina laevigata* D'Orbigny, × 60. *a*, Apertural view; *b*, front view.
6. *Nonionina depressula* (Walker and Jacob) Parker and Jones, × 60.
7. *Quinqueloculina* sp., × 60.
8. *Quinqueloculina seminulum* (Linnaeus) D'Orbigny, × 60.
9. *Discorbis globularis* (D'Orbigny) Cushman, × 60. *a*, Dorsal view; *b*, side view; *c*, ventral view.
10. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny, × 60. *a*, Dorsal view; *b*, side view; *c*, ventral view.
11. *Anomalina ammonoides* (Reuss) Brady, × 60. *a*, Ventral view; *b*, side view; *c*, dorsal view.

All specimens from Cronly, N. C.



PLIOCENE FORAMINIFERA.



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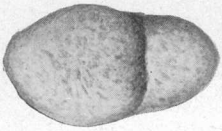
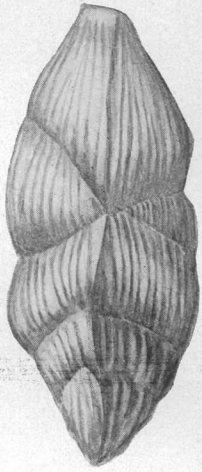


1b

5b



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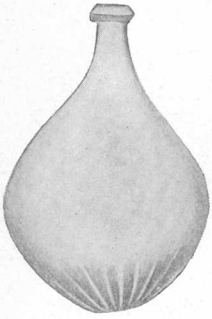

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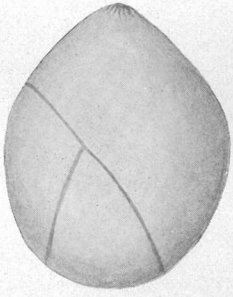
5a



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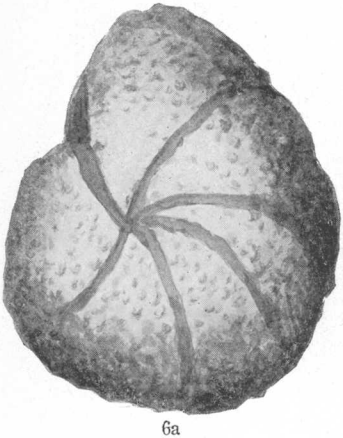


6a

6b

PLIOCENE FORAMINIFERA.

PLATE II.

FIGURE 1. *Textularia gramen* D'Orbigny, × 60. *a*, Apertural view; *b*, front view. Waccamaw River, S. C.

2. *Uvigerina angulosa* Williamson, × 60. Waccamaw River, S. C.

3. *Lagena semistriata* Williamson, × 120. Shell Creek, Fla.

4. *Polymorphina gibba* (D'Orbigny) Brady, Parker, and Jones, × 120. Shell Creek, Fla.

5. *Bolivina karreriana* Brady, × 120. *a*, Front view; *b*, apertural view. Shell Creek, Fla.

6. *Cristellaria gibba* D'Orbigny, × 35. *a*, Front view; *b*, apertural view. Waccamaw River, S. C.

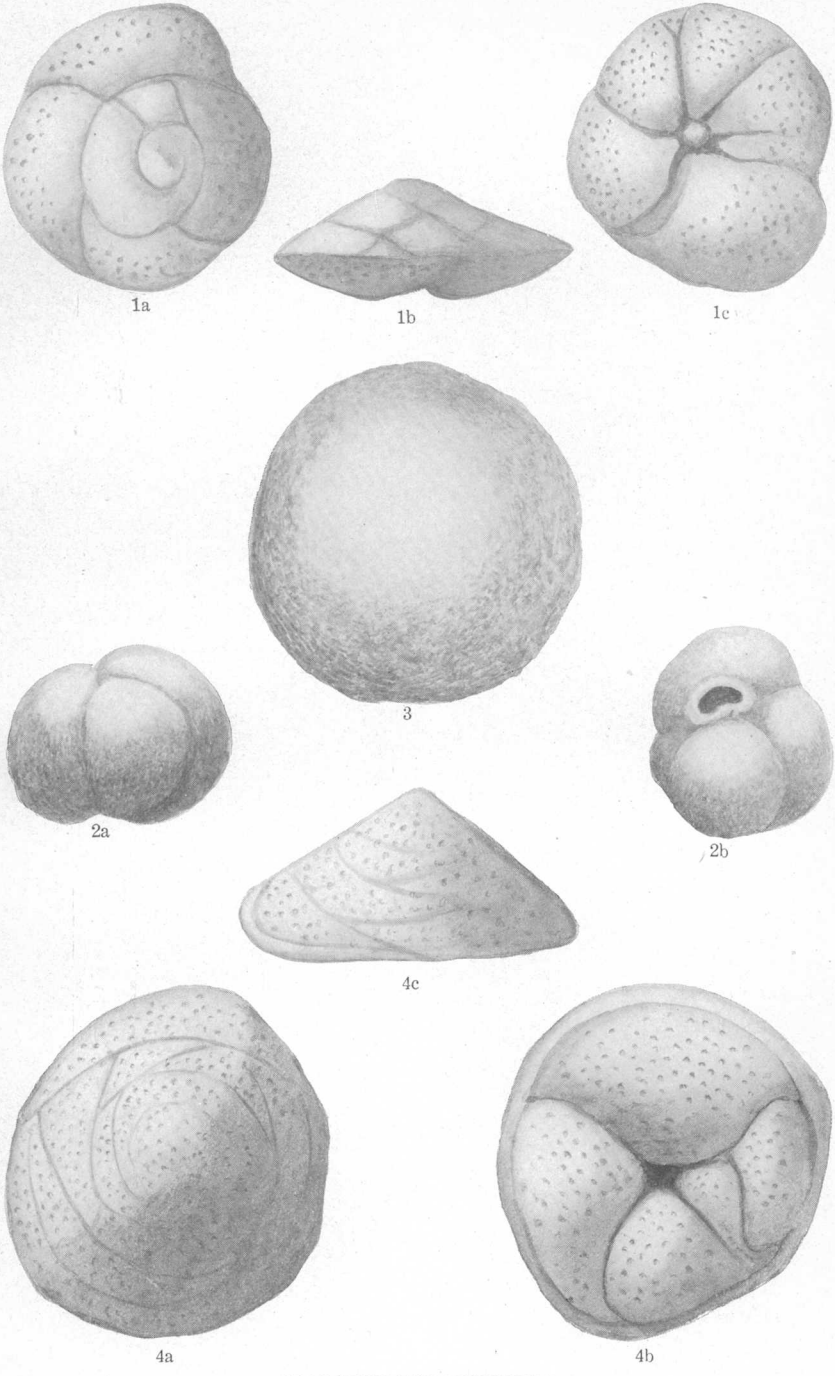
PLATE III.

FIGURE 1. *Discorbis vilardeboana* (D'Orbigny) Cushman. *a*, Dorsal view; *b*, side view; *c*, ventral view. Caloosahatchee River, Fla.

2. *Globigerina bulloides* D'Orbigny, × 60. *a*, Side view; *b*, apertural view. Waccamaw River, S. C.

3. *Orbulina universa* D'Orbigny, × 60. Waccamaw River, S. C.

4. *Discorbis orbicularis* (Terquem) Berthelin, × 120. *a*, Dorsal view; *b*, ventral view; *c*, side view. Caloosahatchee River, Fla.



1a 1b 1c

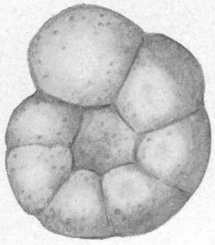
3

2a 2b

4c

4a 4b

PLIOCENE FORAMINIFERA.



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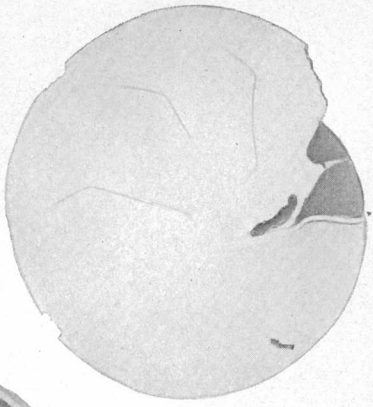

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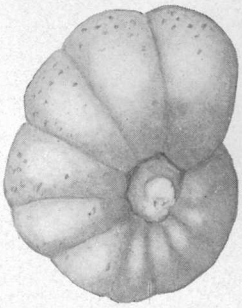

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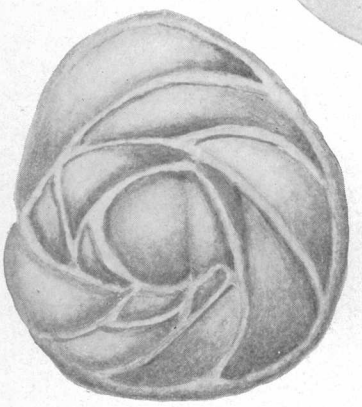

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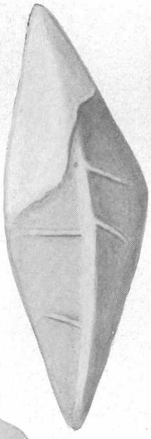

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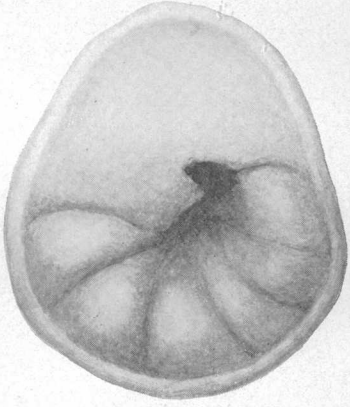

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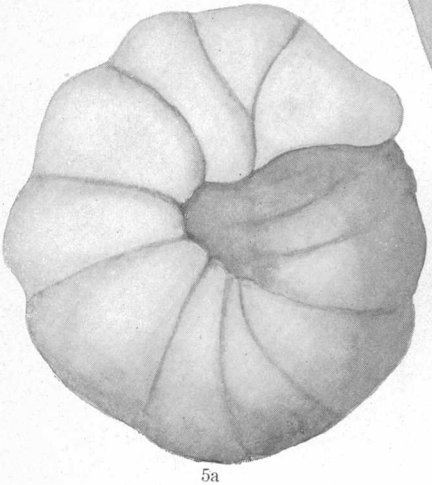

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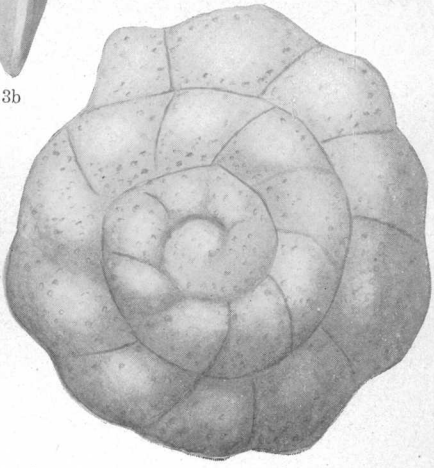

5b

PLIOCENE FORAMINIFERA.

PLATE IV.

FIGURE 1. *Anomalina grosserugosa* (Gümbel) Brady, × 60. Waccamaw River, S. C.
2. *Anomalina ammonoides* (Reuss) Brady, × 60. Waccamaw River, S. C.
3. *Amphistegina lessonii* D'Orbigny, × 35. *a*, Front view; *b*, side view. Cronly, N. C.
4. *Pulvinulina concamerata* (Montagu) Brady, × 60. *a*, Dorsal view; *b*, ventral view. Waccamaw River, S. C.
5. *Truncatulina ungeriana* (D'Orbigny) Reuss, × 120. *a*, Ventral view; *b*. dorsal view. Shell Creek, Fla.

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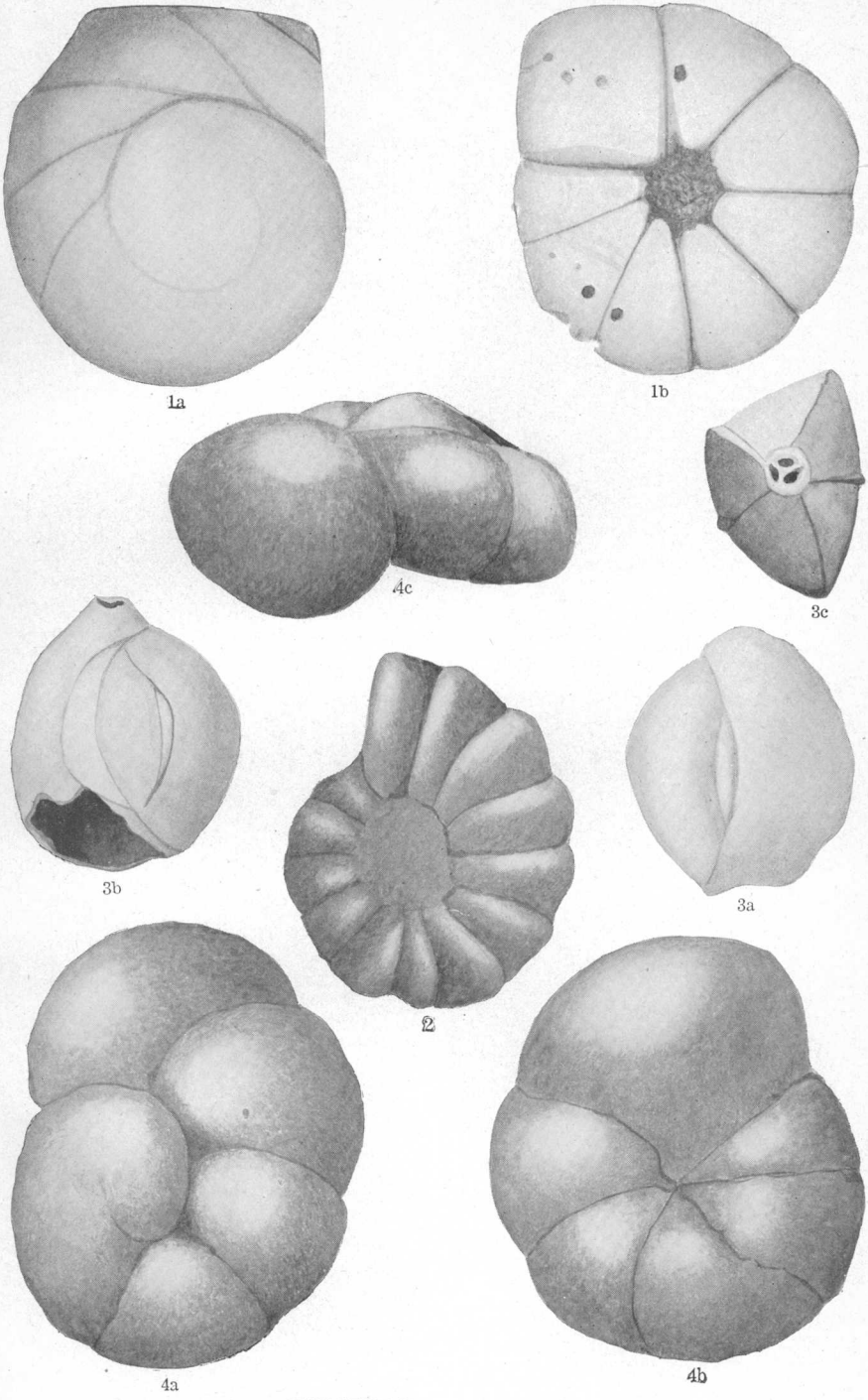
PLATE V.

FIGURE 1. *Rotalia beccarii* (Linnaeus) D'Orbigny, × 60. *a*, Dorsal view; *b*, ventral view. Cronly, N. C.

2. *Anomalina* sp.?, × 60. Caloosahatchee River, Fla.

3. *Quinqueloculina auberiana* D'Orbigny, × 120. *a* and *b*, Side views; *c*, apertural view. Shell Creek, Fla.

4. *Discorbis subrugosa* Cushman, n. sp., × 120. *a*, Dorsal view; *b*, ventral view; *c*, side view. Caloosahatchee River, Fla.



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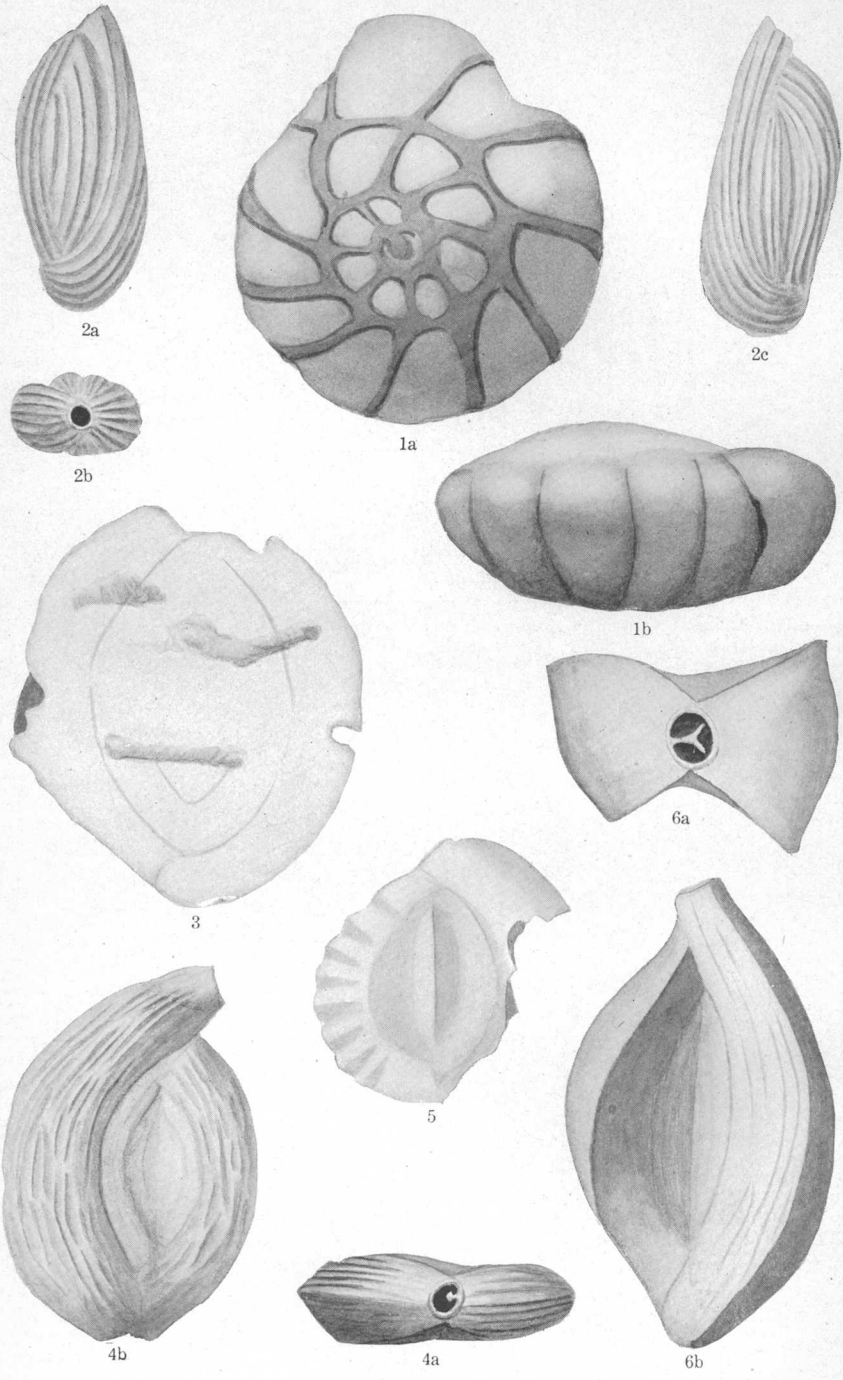


PLIOCENE FORAMINIFERA.

PLATE VI.

FIGURE 1. *Rotalia beccarii* (Linnaeus) D'Orbigny, × 60. *a*, Dorsal view; *b*, side view. Waccamaw River, S. C.

2. *Quinqueloculina poeyana* D'Orbigny, × 60. *a* and *c*, Side views; *b*, apertural view. Caloosahatchee River, Fla.

3. *Spiroloculina glabrata* Cushman, n. sp., × 120. Caloosahatchee River, Fla.

4. *Spiroloculina reticulosa* Cushman, n. sp., × 35. *a*, Apertural view; *b*, front view. Caloosahatchee River, Fla.

5. *Hauerina ornatissima* (Karrer) Brady?, × 60. Caloosahatchee River, Fla.

6. *Spiroloculina excavata* D'Orbigny, × 60. *a*, Apertural view; *b*, front view. Caloosahatchee River, Fla.

PLATE VII.

FIGURE 1. *Triloculina linnaeana* D'Orbigny, × 30. *a* and *b*, Side views; *c*, apertural view.

2. *Orbiculina adunca* (Fichtel and Moll) Lamarck, × 30.

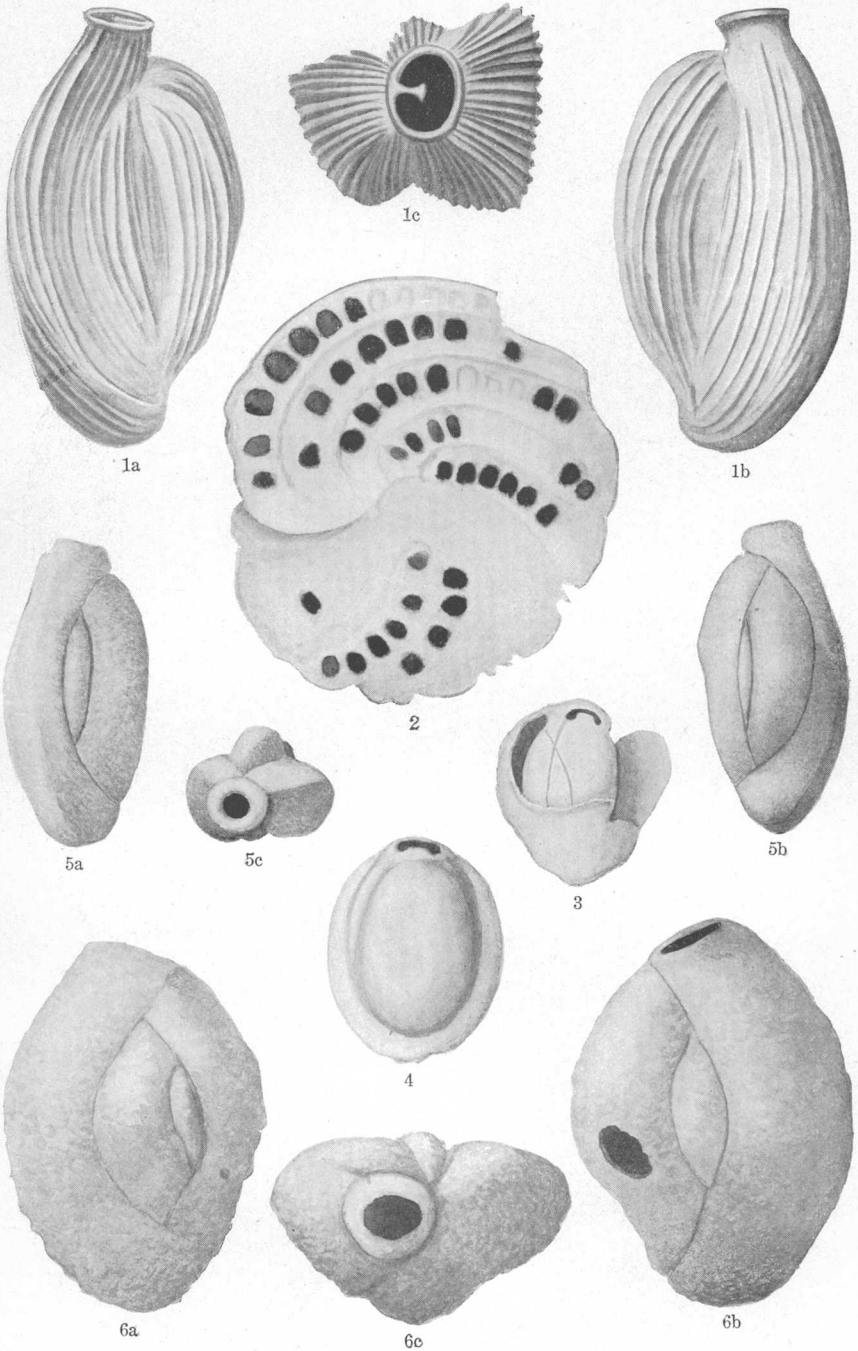
3. *Biloculina laevis* (Defrance) D'Orbigny, × 60. Specimen broken, showing the triloculine young stage within.

4. *Biloculina laevis* (Defrance) D'Orbigny, × 60.

5. *Quinqueloculina bidentata* D'Orbigny, × 60. *a* and *b*, Side views; *c*, apertural view.

6. *Quinqueloculina agglutinans* D'Orbigny, × 30. *a* and *b*, Side views; *c*, apertural view.

All specimens from Caloosahatchee River, Fla.



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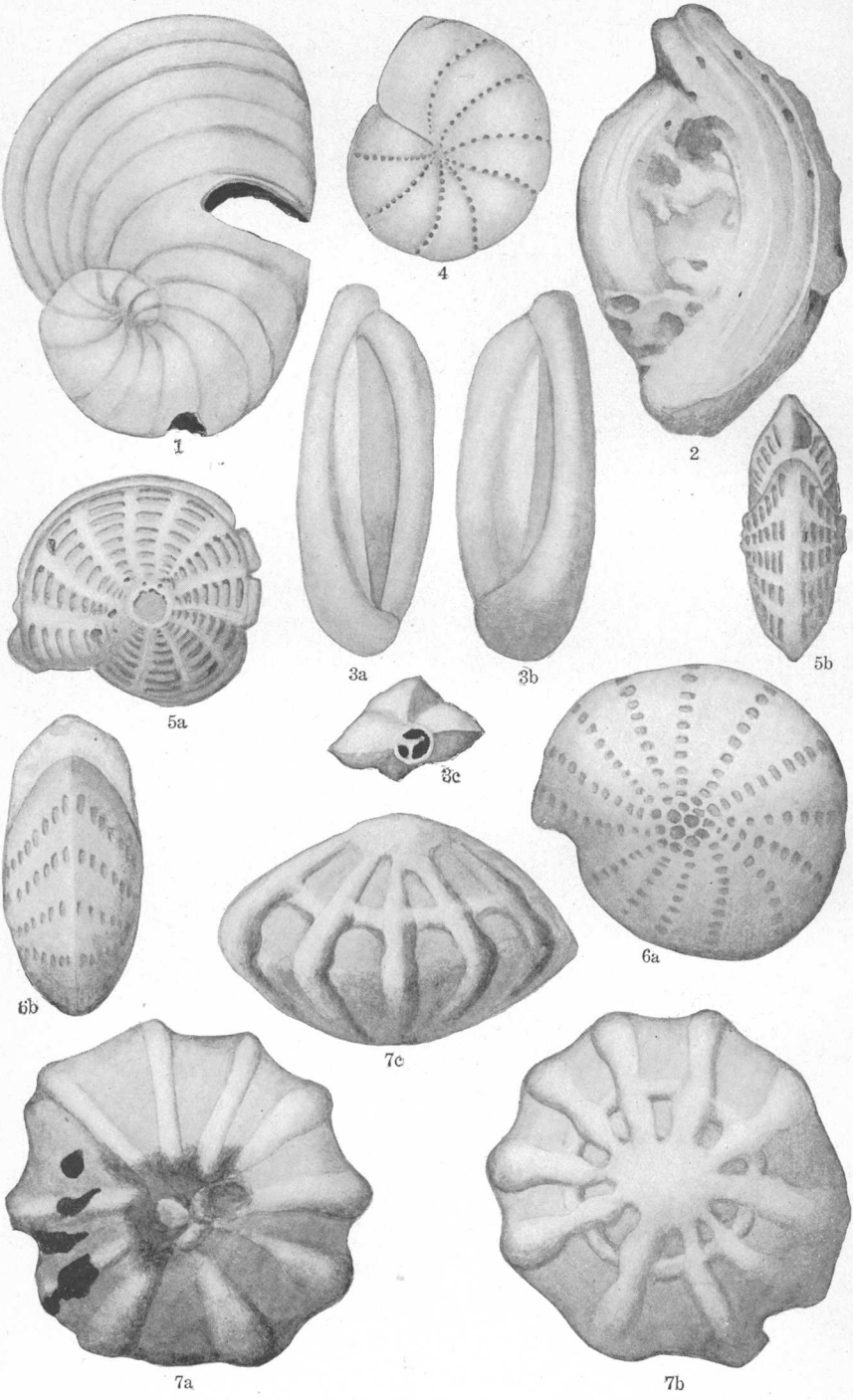


PLIOCENE FORAMINIFERA

PLATE VIII.

FIGURE 1. *Peneroplis pertusus* (Forskål) Jones, Parker, and Brady, × 60. Caloosahatchee River, Fla.

2. *Spiroloculina antillarum* D'Orbigny, × 30. Caloosahatchee River, Fla.

3. *Quinqueloculina venusta* Karrer, × 60. *a* and *b*, Side views; *c*, end view. Caloosahatchee River, Fla.

4. *Polystomella striatopunctata* (Fichtel and Moll) Parker and Jones, × 60. Shell Creek, Fla.

5. *Polystomella fimbriatula* Cushman, n. sp., × 60. *a*, Side view; *b*, apertural view. Caloosahatchee River, Fla.

6. *Polystomella craticulata* (Fichtel and Moll) D'Orbigny var., × 60. *a*, Side view; *b*, apertural view. Waccamaw River, S. C.

7. *Rotalia beccarii* (Linnaeus) D'Orbigny var. *ornata* Cushman, n. var., × 30. *a*, Ventral view: *b*, dorsal view; *c*, side view. Caloosahatchee River, Fla.

SOME MIOCENE FORAMINIFERA OF THE COASTAL PLAIN OF THE UNITED STATES.

By JOSEPH AUGUSTINE CUSHMAN.

In the following report the species of Foraminifera found in the later Miocene of the Coastal Plain of the eastern United States are described or recorded. An attempt has been made to include all records of the Foraminifera reported from the Atlantic and Gulf Coastal Plain from Alabama to New Jersey.

The greater part of the previous work on the Miocene Foraminifera has been done by Dr. Rufus M. Bagg and is especially exhaustive with reference to the Maryland region. I have undertaken to go over the Maryland material on which Dr. Bagg worked and find that I do not agree with some of his determinations. For the most part, however, this report has been intended to add information in regard to the Miocene Foraminifera of the region farther south by a study of collections from Virginia, North Carolina, South Carolina, and Florida.

The geologic formations represented by the collections on which this report is based are as follows:

Choctawhatchee marl,[1] Coes Mill, Jackson Bluff, and Red Bay, Fla.

Duplin marl,[2] Muldrows Mill, Mayesville, and Darlington, S. C.; Wilmington and Natural Well, N. C.

Yorktown formation,[3] Suffolk and Yorktown, Va.

Calvert formation,[4] Chesapeake Beach and Plum Point, Md.

Choptank formation,[5] Jones Wharf, Governor Run, Peach Blossom Creek, Md.

St. Marys formation,[6] Crisfield, St. Marys River, Cove Point, Md.

Kirkwood formation,[7] Mullica Hill, N. J.

[1] Matson, G. C., and Clapp, F. G., Florida Geol. Survey Second Ann. Rept., pp. 114–122, 1910. Vaughan, T. W., U. S. Geol. Survey Prof. Paper 71, pp. 806–809, 1912. Matson, G. C., U. S. Geol. Survey Water-Supply Paper 319, pp. 127–133, 1913.

[2] Miller, B. L., North Carolina Geol. and Econ. Survey, vol. 3, pp. 236–249, 1913. Clark, W. B., U. S. Geol. Survey Prof. Paper 71, pp. 748, 749, 1912. Vaughan, T. W., idem, pp. 806–808.

[3] Clark, W. B., and Miller, B. L., Virginia Geol. Survey Bull. 4, pp. 158–175, 1912. Clark, W. B., U. S. Geol. Survey Prof. Paper 71, pp. 747–749, 1912.

[4] Shattuck, G. B., Maryland Geol. Survey, Miocene, pp. lxix–lxxvii, 1904. Clark, W. B., and Miller, B. L., Virginia Geol. Survey Bull. 4, pp. 126–140, 1912. Clark, W. B., U. S. Geol. Survey Prof. Paper 71, pp. 746–749, 1912.

[5] Shattuck, G. B., Maryland Geol. Survey, Miocene, pp. lxxviii–lxxxii, 1904. Clark, W. B., and Miller, B. L., Virginia Geol. Survey Bull. 4, pp. 140–141, 1912. Clark, W. B., U. S. Geol. Survey Prof. Paper 71, pp. 746, 747, 749, 1912.

[6] Shattuck, G. B., Maryland Geol. Survey, Miocene, pp. lxxxii–xcii, 1904. Clark, W. B., and Miller, B. L., Virginia Geol. Survey Bull. 4, pp. 141–158, 1912. Clark, W. B., U. S. Geol. Survey Prof. Paper 71, pp. 746–749, 1912.

[7] Knapp, G. N., New Jersey Geol. Survey Ann. Rept. for 1903, p. 82, 1904. Kümmel, H. B., New Jersey Geol. Survey Bull. 4, p. 14, 1911.

Besides the localities mentioned, there are several whose geologic relations are not known with precision. The uncertainty is indicated both in the captions of the table showing distribution and in the text.

The Miocene Foraminifera are not susceptible of so definite a division into faunas as the Pliocene Foraminifera, and yet by an inspection of the table of distribution it will be seen that in the Choctawhatchee marl of Florida and in the Duplin marl of South Carolina were developed faunas that were distinct in many ways from those of Maryland and Virginia.

The material includes many species that differ essentially from the living allied species, and many of the fossil species have been described here as new. The new species are especially numerous in the fauna of the Florida and South Carolina regions, which seems to differ more from the recent fauna than that of Virginia and Maryland.

For the most part the Miocene sediments consist of sands and marls, none of which can be said to be rich in Foraminifera so far as the percentage of bulk is concerned. Some of the material is notably foraminiferal, but in such material the individuals of certain species are usually numerous and those of others comparatively rare. No such masses of Foraminifera occur as are found in certain Oligocene and Eocene strata of the same general region.

The species of the Maryland and Virginia region are either identical with or allied to species now occurring in comparatively shallow water in the same general region. On the other hand, except in the material from Jackson Bluff, Ochlockonee River, Fla., there is almost no appreciable development of the Miliolidae, which form so dominant a constituent of comparatively shallow water of the region at the present time. Even at Jackson Bluff there are but a few species and apparently no representatives of *Orbiculina, Orbitolites, Peneroplis,* and similar genera which are characteristic of warm southern waters and which in the Pliocene of this region are common.

The localities that have afforded most numerous additions from the Miocene are grouped according to geologic formations as follows:

Choctawhatchee marl: Coes Mill, Liberty County, Fla.; Jackson Bluff, Ochlockonee River, 25 miles southwest of Tallahassee, Fla.; 1 mile south of Red Bay, Walton County, Fla.

Duplin marl: Muldrows Mills, S. C.; Mayesville, S. C.; Wilmington, N. C.

Yorktown formation: Near Suffolk, Va.

I am indebted to Mr. T. W. Vaughan for many suggestions in regard to material and localities and for help in obtaining collections from many sources; to Dr. E. H. Sellards, of the Florida Geological Survey, for additional material from that State; and to Profs. E. W. Berry and W. B. Clark for the loan of the material from Johns Hopkins University.

The following papers contain information concerning Miocene Foraminifera of this region:

BAGG, R. M., The Tertiary and Pleistocene Foraminifera of the middle Atlantic slope: Bull. Am. Paleontology, vol. 2, No. 10, pp. 1–54 (295–348), pls. 131–133, 1898.

BAGG, R. M., Maryland Geol. Survey, Miocene, pp. 460–483, pls. 131–133, 1904.

WOODWARD, A., Note on foraminiferal fauna of the Miocene beds at Petersburg, Va., with list of species found: New York Micr. Soc. Jour., vol. 3, pp. 16–17, 1887.

WOODWARD, A., in Smith, E. A., Johnson, L. C., and Langdon, D. W., jr., Geology of the Coastal Plain of Alabama, p. 93, Alabama Geol. Survey, 1894.

Distribution of Miocene Coastal Plain Foraminifera.

	Choctaw-hatchee marl (?).	Choctaw-hatchee marl.			Duplin marl.						York-town formation.		Horizon not positively known.				Calvert formation.			Choptank formation.				St. Marys formation (?).	St. Marys formation.		Kirk-wood formation.
	Mobile artesian well.	Coes Mills.	Jackson Bluff.	1 mile south of Red Bay.	Muldrows Mills.	Mayesville.	Darlington.	Locality uncertain.	Wilmington.	Natural well.	Suffolk.	Yorktown.	James River.	Lancaster County.	Norfolk well.	Locality uncertain.	Chesapeake Beach.	Plum Point.	Near Centerville.	Jones Wharf.	Governor Run.	Peach Blossom Creek.	Pawpaw Point.	Crisfield well.[1]	St. Marys River.	Cove Point.	Mullica Hill.
	Ala.	Fla.			S. C.				N. C.		Va.						Md.										N. J.
Saccammina glabra																×											
Cyclammina placenta																											×
Textularia gramen			×	×				×				×	×	×						×	×						
agglutinans											×						×	×		×	×						
abbreviata												×	×								×						
articulata																	×	×									
subangulata													×								×						
carinata																	×			×							
sagittula												×	×				×	×		×							
virginiana														×													
sp				×																							
Bolivina marginata				×																							
aenariensis var. multicosta				×																							
beyrichi var. alata																	×										
floridana				×																							
punctata										×																	
Bulimina buchiana															×												
Nodosaria communis				×																							
Cristellaria americana				×	×																						
americana var. spinosa				×																							
floridana				×																							
catenulata				×																							
cultrata															×									×			
wetherellii																								×			
Polymorphina gibba						×											×										
lactea				×														×		×							×
compressa													×		×		×	×		×	×						
compressa var. striata																				×	×						
elegantissima																	×										

regina						×											×										
Uvigerina canariensis											×													×			
tenuistriata				×											×									×			
pygmaea															×									×			
Siphogenerina spinosa																				×							
lamellata				×																							
Globigerina bulloides				×			×				×	×	×		×		×	×		×		×					
cretacea			×														×										
dubia					×																						
sacculifera			×																								
apertura											×																
sp.											×																
Spirillina orbicularis						×						×															
Discorbis vilardeboana						×					×																
bertheloti				×				×			×																
rosacea	×										×																
orbicularis							×													×							
turrita											×																
Planorbulina mediterranensis																	×			×							
Anomalina ammonoides									×																		
grosserugosa																	×					×					
sp.						×																					
Truncatulina lobatula		×	×	×	×	×	×				×	×	×		×			×		×	×	×	×				
lobatula var. ornata		×									×																
refulgens		×																									
variolata			×																								
subloba											×																
rostrata						×																					
floridana				×																							
wuellerstorfi			×			×																					
americana		×	×			×			×		×			×						×							
haidingerii															×												
basiloba								×																			
concentrica				×																							
variabilis												×						×		×	×	×	×				
Pulvinulina menardii														×													
repanda			×																								
sagra				×							×																
sp.			×																								
Rotalia beccarii	×	×	×			×	×		×											×						×	
reticulata									×																		
broeckhiana																						×	×				
soldanii	×													×													
orbicularis														×													
Nonionina depressula	×										×	×															
scapha			×			×					×	×	×		×		×	×		×							
boueana				×											×												
extensa						×																					
umbilicatula																			×								
Polystomella striatopunctata		×				×										×				×							
crispa		×	×						×																		
subnodosa											×																

Distribution of Miocene Coastal Plain Foraminifera—Continued.

	Choctawhatchee marl (?).	Choctawhatchee marl.			Duplin marl.						York-town formation.		Horizon not positively known.				Calvert formation.			Choptank formation.				St. Marys formation (?).	St. Marys formation.		Kirkwood formation.
	Mobile artesian well	Coes Mills.	Jackson Bluff.	1 mile south of Red Bay.	Muldrows Mills.	Mayesville.	Darlington.	Locality uncertain.	Wilmington.	Natural well.	Suffolk.	Yorktown.	James River.	Lancaster County.	Norfolk well.	Locality uncertain.	Chesapeake Beach.	Plum Point.	Near Centerville.	Jones Wharf.	Governor Run.	Peach Blossom Creek.	Pawpaw Point.	Crisfield well.[1]	St. Marys River.	Cove Point.	Mullica Hill.
	Ala.	Fla.			S. C.				N. C.		Va.						Md.										N. J.
Amphistegina lessonii			×	×	×	×	×			×						×											
Quinqueloculina seminulum	×				×						×	×	×	×						×	×				×		
auberiana														×													
venusta			×																								
subdecorata																×											
Triloculina oblonga																×											
schreiberiana			×																								
asperula		×																									
Biloculina bulloides			×																								
Spiroloculina limbata			×																								
planulata												×															
grata																	×										
tenuis																						×					

Family ASTRORHIZIDAE.

Genus SACCAMMINA Carpenter, 1869.

Saccammina glabra Cushman, n. sp.

Plate IX, figure 1.

Test composed of a single spherical chamber, wall comparatively thin, composed of fine agglutinated particles with a brown cement, surface smooth; aperture a circular opening with no definite apertural neck; color, brownish. Diameter, 0.50 millimeter.

Type specimen (U. S. N. M. No. 325314) from the Miocene of Virginia; locality, uncertain; collected by Tuomey.

This species, which has a definite arenaceous test, although composed of very fine fragments, a single chamber, and a single aperture, seems to belong to the genus *Saccammina* and is certainly very different from the recent *S. sphaerica.*

Family LITUOLIDAE.

Cyclammina placenta (Reuss) Bagg.

Nonionina placenta Reuss, Deutsche geol. Gesell. Zeitschr., 1851, p. 72, pl. 5, fig. 33.
Cyclammina placenta (Reuss) Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 18 (312), 1898.
Haplophragmium placenta (Reuss) Andreae, Beitrag zur Kentniss des Elsässer Tertiärs, Theil 2, p. 105, pl. 7, fig. 6, 1884.

Test large, discoidal, compressed, of a snow-white color, consisting of numerous irregular chambers, about fifteen in the final convolution, peripheral margin somewhat lobulated, septal lines distinct, slightly depressed, irregularly curved; peripheral margin rounded; septal plane rather large, ovoidal. Diameter, 3.10 millimeters.—Bagg.

This species is recorded in the Kirkwood formation near Mullica Hill, N. J.

Family TEXTULARIIDAE.

Genus TEXTULARIA Defrance, 1824.

Textularia gramen D'Orbigny.

Plate IX, figures 2–5.

[For description see paper on Pliocene Foraminifera, p. 8.]

Specimens of this species were found in the Choctawhatchee marl 1 mile south of Red Bay and at Jackson Bluff, Fla., also in the Miocene of South Carolina (precise locality not known) and in the St. Marys formation (?) in Lancaster County, Va. Bagg records this species from the Choptank formation of Governors Run and Jones Wharf, Md.

Textularia agglutinans D'Orbigny.

Plate IX, figure 6.

Textularia agglutinans D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 136, pl. 1, figs. 17, 18, 32–34, 1839.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 363, pl. 43, figs. 1, 2, 1884.

Test elongate, tapering, more or less oval or rounded in end view, chambers high, rotund, sutures deeply depressed; wall composed of coarse agglutinated sand grains; aperture at the base of the inner margin of the chamber. Length, 1.50 millimeters or more.

Material containing this species was collected in the Yorktown formation in Suffolk, Va. Bagg records the species from the Choptank formation at Jones Wharf and 1 mile north of Governors Run, Md. Specimens from these stations are not typical but are much more like *T. sagittula*. Bagg records it also from the Calvert formation of Plum Point and Chesapeake Beach, Md. This species is a common and widely distributed fossil throughout the Tertiary.

Textularia abbreviata D'Orbigny.

Textularia abbreviata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 249, pl. 15, figs. 9–12 (7–12), 1846.
Brady, Parker, and Jones, London Zool. Soc. Trans., vol. 12, p. 219, pl. 42, figs. 4, 5, 1888.
Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 18, 1898; Maryland Geol. Survey, Miocene, p. 470, pl. 132, fig. 4, 1904.

Bagg records this species in the Choptank formation of Governors Run, Md. His material, which I have examined, is at best very poor and does not correspond to recent specimens of this species as I have seen it.

Textularia articulata D'Orbigny.

Textularia articulata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 250, pl. 15, figs. 16–18, 1846.
Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 19, 1898; Maryland Geol. Survey, Miocene, p. 471, pl. 132, figs. 6, 7, 1904.

Test rather broad and laterally compressed; tapering only slightly toward the posterior end, which is somewhat rounded; peripheral margin sharp, provided with a marginal keel encircling the sides of the entire shell; chambers numerous, about ten in each series, separated by nearly straight, depressed septal lines. Aperture a small median opening along the inner margin of the final segment. This species is closely related to *T. carinata* but differs in not possessing the marginal spines and irregularity and the sutures and is not quite so limbate. Some of the specimens assume irregular shapes and are more or less bent or deformed.—Bagg.

Bagg records this species from the Calvert formation of Plum Point and Chesapeake Beach, Md. I have seen no other Miocene material of this species. Bagg, however, also records it from James River, Va.

Textularia carinata D'Orbigny.

Textularia carinata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 247, pl. 14, figs. 32–34, 1846.

Bagg, Maryland Geol. Survey, Miocene, p. 472, pl. 132, fig. 10, 1904.

Test arenaceous, rather stoutly built and somewhat compressed but tapering rather narrowly at the posterior end so that it is almost acuminate. The lateral margins are strongly carinate as in *T. articulata*, from which it is with difficulty distinguished, and it may well be doubted if it is wise to separate these two as D'Orbigny has done. It has somewhat strongly marginal extensions however, and these extensions are more broken and the sutures are less depressed. It is closely allied to *T. marginata* but differs from it in the flanged sides.—Bagg.

Bagg records this species in the Choptank formation at Jones Wharf and in the Calvert formation at Chesapeake Beach, Md. I have seen the specimen from Chesapeake Beach, but it is too poor to give any idea of the species.

Textularia sagittula Defrance.

Textularia sagittula Defrance, Dictionnaire des sciences naturelles, vol. 32, p. 177, 1824; Atlas, Conchyliologie, pl. 13, fig. 5, 1828.

Bagg, Maryland Geol. Survey, Miocene, p. 472, pl. 132, figs. 11, 12, 1904.

Test elongated, strongly compressed, with sharp-angled peripheral margins; chambers numerous, closely set, separated by short, straight septal lines visible exteriorly but not depressed. The aperture linear, terminal.—Bagg.

Bagg records this species from the Choptank formation at Jones Wharf and the Calvert formation at Plum Point and Chesapeake Beach, Md. I have seen the specimens from Jones Wharf, which seem to agree well with this species. That from Plum Point, however, seems to be a species of *Bolivina*. That from Chesapeake Beach I have not seen. Bagg also records the species from James River and Yorktown, Va.

Textularia subangulata D'Orbigny.

Textularia subangulata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 274, pl. 15, figs. 1–3, 1846.

Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 20, 1898; Maryland Geol. Survey, Miocene, p. 473, pl. 132, fig. 13, 1904.

Test consisting of a relatively small number of chambers, which increase very rapidly from the posterior toward the anterior end; peripheral margins sharp-angled. The sides of the shell are laterally compressed and parallel, only the extremities forming the sharp periphery. The posterior end is acuminate, anterior broad, obtusely rounded; ultimate chambers much elevated and larger than any other segment. The aperture is a median arched slit set on the inner margin of the final segment.—Bagg.

Bagg records this species from the Choptank formation of Governor Run, Md. The specimen which I have examined is a rather poor one and does not show the characters well.

Textularia sp.?

Plate IX, figure 7.

The figured specimen is from the Choctawhatchee marl, 1 mile south of Red Bay, Fla. It is a smooth species, but the sutures are indistinct and it can not be definitely determined. The early portion is somewhat angled, suggesting *Gaudryina*.

Textularia virginiana Cushman, n. sp.

Plate X, figure 3.

Test subtriangular in front view, very abruptly tapering from the initial end, somewhat twisted, the elongate portion compressed; chambers numerous, the later ones high, with the posterior angle projecting, forming an irregular serrate peripheral margin; sutures indistinct, as in the later portion; wall composed of coarsely agglutinated material with a large proportion of cement; aperture rather large, at the base of the inner margin of the last-formed chamber. Length, 1.30 millimeters.

Type specimen (U. S. N. M. No. 325315) and others were taken from sand included in the valves of *Balanus proteus* from the Miocene of Virginia (no definite locality given).

This is a very peculiar-shaped species in its subtriangular form, serrate margin, and peculiar surface material, as well as in the twisted character of the early portion.

Genus BOLIVINA D'Orbigny, 1839.

Bolivina marginata Cushman, n. sp.

Plate X, figure 1.

Test much elongated, very much compressed, composed of numerous chambers, tapering gradually from the initial end, sutures distinct, early chambers long and narrow, later ones much higher in proportion, the very earliest chambers showing a portion of a coil; periphery of the test with a distinct keel, running from the initial end nearly to the apertural end, where it becomes obsolescent; wall smooth. Length, 2 millimeters.

Type specimen (U. S. N. M. No. 325316) from the Choctawhatchee marl, 1 mile south of Red Bay, Fla.

Bolivina aenariensis (Costa) Brady var. multicostata Cushman, n. var.

Plate X, figure 2.

Test composed of numerous chambers, initial end tapering gradually toward the apertural end, early chambers elongate, later ones much higher, periphery of the test with a definite narrow keel along its entire border, continuing over the sutures, which are distinct and deep; surface ornamentation consisting of numerous raised costae

running nearly the entire length of the test, becoming obsolescent on the last-formed chambers. Length, 1.50 millimeters.

Type specimen (U. S. N. M. No. 325317) from the Choctawhatchee marl 1 mile south of Red Bay, Fla.

This variety differs from the typical species in the larger number of the costae and in their continuation practically to the apertural end of the test.

Bolivina floridana Cushman, n. sp.

Plate X, figure 4.

Test elongate, rather rounded in end view, gradually tapering from the initial end, chambers numerous, sutures indistinct except near the apertural end, where they are undulate with numerous excavated reentrants. Length, 0.60 millimeter.

Type specimen (U. S. N. M. No. 325334) from the Choctawhatchee marl 1 mile south of Red Bay, Fla.

This species resembles in some ways *B. robusta* Brady, which differs in its more rotund form and more numerous chambers and has no trace of a spine at the initial end.

Bolivina beyrichi Reuss var. alata (Sequenza) Brady.

Valvulina alata Sequenza, Accad. gioenia sci. nat. Atti, 2d ser., vol. 18, p. 115, pl. 2, figs. 5, 5*a*, 1862.

Bolivina beyrichi Reuss var. *alata* Brady, *Challenger* Rept., Zoology, vol. 9, p. 422, pl. 53, figs. 2–4, 1884.

Bagg, Maryland Geol. Survey, Miocene, p. 473, pl. 132, fig. 14, 1904.

This species is a modification of *Bolivina beyrichi* and is closely related to *Bolivina gramen* (*Valvulina gramen* D'Orbigny). The former is, however, more slender and somewhat narrower and has greater depth and subtriangular outline of its later chambers. In the variety *alata* there is a well-defined wing and keel around the periphery, and the test is rather more flattened than in *Bolivina beyrichi*.—Bagg.

Bagg records this species from the Calvert formation of Chesapeake Beach, Md. I have examined the material, which does not seem nearly so regular as shown by the figure, and that it belongs to this variety seems to be decidedly questionable.

Bolivina punctata D'Orbigny.

Bolivina punctata D'Orbigny, Voyage dans l'Amérique méridionale, Foraminifères, p. 63, pl. 8, figs. 10–12, 1839.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 417, pl. 52, figs. 18, 19, 1884.

Test elongate, somewhat compressed, usually straight, apical end bluntly pointed; chambers numerous; sutures but slightly depressed, chambers increasing in height toward the apertural end; wall smooth, finely punctate. Length, 0.40 millimeter.

In the Johns Hopkins material which I have examined there is a specimen of this species from the Miocene, labeled "Natural Well, N. C., the Duplin marl."

Genus BULIMINA D'Orbigny, 1826.

Bulimina buchiana D'Orbigny.

Bulimina buchiana D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 186, pl. 11, figs. 15–18, 1846.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 407, pl. 51, figs. 18, 19, 1884.

Test ovate, composed of numerous inflated chambers, sutures more or less distinct, apical end somewhat pointed, apertural end broadly rounded, surface ornamented by raised costae, those of each chamber confluent with those of the chambers above and below; in side view serrate. Length, 0.50 millimeter.

Material in the Johns Hopkins collection is labeled "Miocene (685 feet), Norfolk, Va." It is fairly typical of this species.

Family LAGENIDAE.

Genus NODOSARIA Lamarck, 1812.

Nodosaria communis D'Orbigny.

Plate X, figure 8.

Nodosaria (*Dentalina*) *communis* D'Orbigny, Annales sci. nat., vol. 7, p. 254, No. 35, 1826.
Dentalina communis D'Orbigny, Soc. géol. France Mém., vol. 4, p. 13, pl. 1, fig. 4, 1840.
Nodosaria communis Reuss, Die Versteinerungen der böhmischen Kreideformation, pt. 1, p. 28, pl. 12, fig. 21, 1845.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 504, pl. 62, figs. 19–22, 1884.

Test elongate, slender, slightly tapering, slightly curved, composed of several chambers, those toward the apertural end inflated, sutures depressed, those toward the initial end less distinct, sutures more or less oblique; wall smooth. Length, 2 millimeters.

The only Miocene material that I have had came from the Choctawhatchee marl 1 mile south of Red Bay, Fla. The specimen is a rather poor one, broken toward the apertural end. As a fossil the species is known through the Tertiary, and specimens referred to this species have been found in the Cretaceous.

Genus CRISTELLARIA Lamarck, 1812.

Cristellaria americana Cushman, n. sp.

Plate X, figures 5, 6.

Test closely coiled, slightly keeled, composed of but six or seven chambers in the last-formed whorl, sutures raised and ending in a raised umbonal area, surface otherwise smooth; aperture radiate without a definite projection. Diameter 1.50 millimeters.

Type specimen (U. S. N. M. No. 325318) from Duplin marl, Muldrows Mills, S. C. Specimens were not common in the Choctawhatchee marl 1 mile south of Red Bay, Fla.

This species may be distinguished by its closely coiled form with comparatively few chambers, the raised costae, and the umbonal portion.

Cristellaria americana var. spinosa Cushman, n. var.

Plate X, figure 7.

Variety differing from the typical form by the addition of short spines on the peripheral margin.

Type specimen (U. S. N. M. No. 325319) found with the typical form in the Choctawhatchee marl 1 mile south of Red Bay, Fla.

Cristellaria floridana Cushman, n. sp.

Plate XI, figure 1.

Test elongate, crosier-form, early portion closely coiled, later chambers becoming uncoiled and more elongate, test comparatively thick in front view, peripheral margin rounded; wall smooth except for slight raised areas above the sutures, which are otherwise indistinct; aperture peripheral. Length, 2 millimeters.

Type specimen (U. S. N. M. No. 325320) from Choctawhatchee marl 1 mile south of Red Bay, Fla. This species does not agree at all well with any described species; therefore it is described here.

Cristellaria catenulata Cushman, n. sp.

Plate XI, figure 2.

Test comparatively large, compressed, oval, composed of numerous chambers, ten or more in the last-formed coil, peripheral margin narrowed but rounded, the area above the sutures with broad raised ribs curving toward the umbilical region, the inner ends often terminating in rounded knobs which are so placed that they often form a semblance of a chain; aperture radiate, slightly projecting. Diameter, 2 millimeters.

Type specimen (U. S. N. M. No. 325321) from Choctawhatchee marl 1 mile south of Red Bay, Fla.

Cristellaria cultrata (Montfort) Parker and Jones.

Robulus cultratus Montfort, Conchyliologie systématique, vol. 1, p. 214, 54e genre, 1808.
Cristellaria cultrata (Montfort) Parker and Jones, Philos. Trans., vol. 155, p. 344, pls. 13, 17, 18; pl. 16, fig. 5, 1865.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 550, pl. 70, figs. 4, 5, 6, 1884.
Bagg, Maryland Geol. Survey, Miocene, p. 474, pl. 132, fig. 15, 1904.
Robulina cultrata (Montfort) D'Orbigny, Annales sci. nat., vol. 7, p. 287, No. 1, 1826; Modèles, No. 82, 1826; Foraminifères fossiles du bassin tertiaire de Vienne, p. 96, pl. 4, figs. 14, 15, 1846.

Test circular, biconvex, smooth and glistening, margin sharp and broadly keeled, chambers seven to eleven in the last volution, somewhat convex, either smooth or costate; aperture radiate. The width of the marginal keel is very variable, though

always more or less developed, and so constitutes the significant feature of the species.—Bagg.

This species was found in the St. Marys [?] formation at a depth of 776 feet in the Crisfield well, Md. Bagg also records it from the well at Norfolk, Va. (695 feet).

Cristellaria wetherellii (Jones) Prestwich.

Marginulina wetherellii Jones. Morris, Catalogue of British Fossils, 2d ed., p. 37, 1854.

Cristellaria wetherellii Prestwich. London Geol. Soc. Quart. Jour., vol. 8, p. 267, 1852.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 537, pl. 114, fig. 14, 1884.

Bagg, Maryland Geol. Survey, Miocene, p. 475, pl. 132, fig. 16, 1904.

Test elongate, compressed, podlike primordial segments more or less involute, ultimate segments extending into a straight or nearly straight series, the surface of the shell ornamented externally by raised tubercles more or less regularly arranged between the septal lines of some of the chambers and also upon the septal lines. Transverse sections are elliptical and show in some forms an angular periphery and when so they approach *Cristellaria decorata* Reuss in outline.—Bagg.

Recorded by Bagg from the well (776 feet deep) at Crisfield, Md. (St. Marys formation?).

Genus POLYMORPHINA D'Orbigny, 1826.

Polymorphina gibba D'Orbigny.

Plate XI, figure 5.

Polymorphina (*Globulina*) *gibba* D'Orbigny, Annales sci. nat., vol. 7, p. 226, No. 20, 1826; Modèles, No. 63, 1826.

Polymorphina gibba Brady, Parker, and Jones [part], Linnaean Soc. London Trans., vol. 27, p. 216, pl. 39, figs. 2*a–d*, 1870.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 561, pl. 71, figs. 12*a*, *b*, 1884.

Bagg, Maryland Geol. Survey, Miocene, p. 477, pl. 133, fig. 4, 1904.

Test subglobose, somewhat extended at the apertural end, initial end broadly rounded, visible portion consisting of two to four chambers, sutures distinct; wall smooth; aperture radiate, slightly extended. Length 0.75 millimeter.

Bagg records this species from the Calvert formation at Chesapeake Beach, Md. I have had material from the Duplin marl of Marysville, S. C.

It seems to be a common fossil in the Tertiary and has been recorded from the Eocene by Bagg.

Polymorphina lactea (Walker and Jacob) Macgillivray.

Plate XI, figure 6.

Serpula lactea Walker and Jacob, Adam's Essays on the microscope, 2d ed., p. 634, pl. 24, fig. 4, 1798.

Polymorphina lactea (Walker and Jacob) Macgillivray, A history of the molluscous animals of the counties of Aberdeen [etc.], p. 320, 1843.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 559, pl. 71, fig. 11, 1884.

Bagg, Maryland Geol. Survey, Miocene, p. 477, pl. 133, figs. 5, 6, 1904.

Polymorphina lactea (Walker and Jacob) Macgillivray var. *amygdaloides* Brady, Parker, and Jones, Linnaean Soc. London Trans., vol. 27, p. 214, wood cuts, 1870.

Test rotund, circular or elliptical in front view, end view broadly oval, visible chambers few; sutures slightly if at all excavated; wall smooth; aperture often slightly extended, radiate. Length 0.75 millimeter.

Bagg records the species from the Choptank formation of Jones Wharf and from the Calvert formation of Plum Point, Md. Material I have had was from the Choctawhatchee marl 1 mile south of Red Bay, Fla. The species is known from the Eocene of Maryland and is also recorded by Bagg from the Kirkwood formation near Mullica Hill, N. J.

Polymorphina compressa D'Orbigny.

Polymorphina compressa D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 233, pl. 12, figs. 32-34, 1846.

Bagg, Maryland Geol. Survey, Miocene, p. 476, pl. 133, fig. 1, 1904.

The following description is given by Bagg, copied from Brady, Parker, and Jones:

Shell oblong, in equilateral, compressed, more or less fusiform; chambers numerous, arranged in two inequal series, somewhat inflated; septal lines depressed, surface smooth or faintly striate; aperture variable, usually simple, circular, coronate; sometimes labyrinthic or porous.

Bagg records the species from the Choptank formation at Jones Wharf and 1 mile north of Governor Run, Md.; also from the Calvert formation at Plum Point and Chesapeake Beach, Md.

Polymorphina compressa D'Orbigny var. striata Bagg.

Polymorphina compressa D'Orbigny var. *striata* Bagg, Maryland Geol. Survey, Miocene, p. 476, pl. 133, fig. 2, 1904.

Test similar in size, amount of compression, arrangement of chambers, and in their number to *P. compressa*, but it differs from the latter in having a number of definite costae running over every chamber, and there would be some doubt about the validity of this variety were it not for the fact that the amount of striation is so great and so entirely different from the common *P. compressa*. It is no doubt easy to find in Brady's illustration of the species indications of costae, but when these become constant and well developed there is good reason to regard the forms as a variety.—Bagg.

Bagg's specimens of this variety came from the Choptank formation of Jones Wharf and Governor Run, Md.

Polymorphina elegantissima Parker and Jones.

Polymorphina elegantissima Parker and Jones, Philos. Trans., vol. 155, p. 438, 1865.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 566, pl. 72, figs. 12–15, 1884.
Bagg, Maryland Geol. Survey, Miocene, p. 476, pl. 133, fig. 3, 1904.

Test ovoidal, anterior end acute, posterior end obtusely rounded; chambers four or five, elongate, arranged in an unequal biserial manner and overlapping in such a way that while one side remains nearly flat the opposite is more or less irregularly vaulted and shows all the chambers in parallel arrangement; final segment broad below, embracing and bearing the mammillate aperture upon the anterior end; shell surface smooth; finely perforate.—Bagg.

Bagg records this species from the Calvert formation of Chesapeake Beach, Md.

Polymorphina regina Brady, Parker, and Jones.

Plate XI, figures 3, 4.

Polymorphina regina Brady, Parker, and Jones, Linnaean Soc. London Trans., vol. 27, p. 241, pl. 41, figs. 32 *a*, *b*, 1870.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 571, pl. 73, figs. 11–13, 1884.
Bagg, Maryland Geol. Survey, Miocene, p. 478, pl. 133, fig. 7, 1904.

Test fusiform, chambers several, elongate, inflated, sutures distinct, depressed; wall ornamented with numerous elongate raised costae, running more or less independent of the individual chambers; aperture radiate, somewhat extended. Length, 1 millimeter.

Bagg records this species from the Calvert formation of Chesapeake Beach, Md. In the material I have had the species has occurred in the Duplin marl of Mayesville, S. C., in considerable numbers. This fossil occurrence of the species seems rare. Apparently it is unknown from the Tertiary of Europe and at the present time seems to be typical of the shallow water of the tropical and subtropical Pacific.

Genus UVIGERINA D'Orbigny, 1826.

Uvigerina canariensis D'Orbigny.

Plate XII, figure 2.

Uvigerina canariensis D'Orbigny, in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, p. 138, pl. 1, figs. 25–27, 1839.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 573, pl. 74, figs. 1–3, 1884.

Test elongate, fusiform, composed of numerous chambers, usually three in each whorl, inflated; sutures depressed; wall marked occasionally with traces of costae, especially on the earlier chambers; aperture with a short tubular neck and broad phialine lip. Length, 0.75 millimeter.

Bagg had material of this species from the St. Marys formation (?) at a depth of 776 feet in the well at Crisfield, Md. I have had the

species from the Yorktown formation, near Suffolk, Va. This species is found in the Tertiary of Europe.

Uvigerina tenuistriata Reuss.

Plate XII, figure 1.

[For description see paper on Pliocene Foraminifera, p. 10.]

Bagg records this species from the St. Marys formation (?) in the well at Crisfield, Md. (depth, 776 feet). The material I have had was from the Choctawhatchee marl 1 mile south of Red Bay, Fla. This species was described by Reuss from the Tertiary of Europe.

Uvigerina pygmaea D'Orbigny.

Uvigerina pygmea D'Orbigny, Annales sci. nat., vol. 7, p. 269, pl. 12, figs. 8, 9, 1826; Modèles, No. 67, 1826.

Uvigerina pygmaea D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 190, pl. 11, figs. 25, 26, 1846.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 575, pl. 74, figs. 11–14, 1884.

Bagg, Maryland Geol. Survey, Miocene, p. 479, pl. 133, fig. 9, 1904.

Test more or less broadly ovate, stoutly built, with thick shell wall. The chambers are numerous, large, and globose, separated by depressed septal lines. The surface is marked by a number of prominent longitudinal costae, which are less numerous and larger than in the longer and more tapering *U. striata* Reuss. The primordial end is rounded, and the anterior extended into a short tubular neck with flaring aperture. This interesting little species occurs quite frequently in the well boring at Crisfield. Its geological range is from the Miocene to Recent.—Bagg.

In addition to the occurrence at Crisfield Bagg mentions this species as occurring in the St. Marys (?) formation in the well at Norfolk, Va. (depth, 645 feet).

Genus SIPHOGENERINA Schlumberger, 1883.

Siphogenerina spinosa Bagg.

Siphogenerina spinosa Bagg, Maryland Geol. Survey, Miocene, p. 480, pl. 133, fig. 11, 1904.

This peculiar and interesting species somewhat resembles *S. raphanus* Parker and Jones, but differs from the latter in several particulars. The surface ridges in our specimen end in a series of projecting points, which at the distal end become definite spines, though these are short and stubby. Again, there are arched cross ridges between these costae which, while they may not indicate the internal structure, serve to mark their location. The aperture ends in a neat raised, phialine, everted lip with a central rounded orifice.—Bagg.

Bagg's material was from the Choptank formation at Jones Wharf, Md.

Siphogenerina lamellata Cushman, n. sp.

Plate XII, figure 3.

Test elongate, tapering gradually from the initial end, broadly rounded at the apertural end, chambers comparatively few, indistinct, surface ornamentation consisting of several equidistant,

longitudinal lamellae extending from the initial end to the apertural end, where they fuse; aperture with a tubular neck and phialine lip. Length, 1 millimeter.

Type specimen, U. S. N. M. No. 325322.

This species was found in the Choctawhatchee marl 1 mile south of Red Bay, Fla. It is distinct from *S. raphanus*, which it somewhat resembles, but the extraordinary development of the longitudinal lamellae presents a marked characteristic.

Family GLOBIGERINIDAE.

Genus GLOBIGERINA D'Orbigny, 1826.

Globigerina bulloides D'Orbigny.

Plate XII, figures 4, 6.

[For description see paper on Pliocene Foraminifera, p. 12.]

Bagg records this species from the Choptank formation at Jones Wharf and Peach Blossom Creek, Md., and from the Calvert formation at Plum Point and Chesapeake Beach, Md. The specimens from Chesapeake Beach I have seen. That from this locality figured on Bagg's plate 132, figure 2, seems to be this species, but that shown on plate 132, figure 1, seems to be more like *G. dubia*. In the Miocene material which I have examined this species has occurred in the Yorktown formation at Suffolk, Va., and in the Choctawhatchee marl 1 mile south of Red Bay, Fla. Bagg's list includes Darlington, S. C.; James River, Yorktown, and the Norfolk well, Va.

Globigerina cretacea D'Orbigny.

Plate XIII, figure 3.

Globigerina cretacea D'Orbigny, Soc. géol. France Mém., 1st ser., vol. 4, p. 34, pl. 3, figs. 12–14, 1840.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 596, pl. 82, figs. 10*a–c* (?), 1884.
Bagg, Maryland Geol. Survey, Miocene, p. 469, pl. 132, fig. 3, 1904.

Test spiral, strongly depressed, six or more chambers in each coil, all visible from the dorsal side, only those of the last-formed coil visible from the ventral side, umbilicate. Diameter, about 0.60 millimeter.

Bagg records this species from the Calvert formation of Chesapeake Beach, Md. I have had good material from the Choctawhatchee marl at Jackson Bluff, Fla.

Globigerina dubia? Egger.

Plate XIII, figure 1.

Globigerina dubia Egger, Neues Jahrb., 1857, p. 281, pl. 9, figs. 7–9.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 595, pl. 79, figs. 17*a–c*, 1884.

Test composed of numerous inflated chambers in a spiral, chambers higher than broad, all visible from the dorsal side, only three to five

chambers of the last-formed coil visible from below; aperture opening into a central umbilical cavity. Diameter, 0.80 millimeter.

Specimens that seem doubtfully to belong to this species were obtained from the Duplin marl at Muldrows Mills, S. C. They have the characteristic high chambers, but the umbilical cavity is not distinct, as is usual in recent specimens.

Globigerina sacculifera Brady.

Plate XIII, figure 2.

Globigerina helicina [not D'Orbigny] Carpenter, Parker, and Jones, Introduction to the study of the Foraminifera, pl. 12, fig. 11, 1862.

Globigerina sacculifera Brady, *Challenger* Rept., Zoology, vol. 9, p. 604, pl. 80, figs. 11–17; pl. 82, fig. 4, 1884.

Test composed of several chambers, the early ones coiled, later ones very large, increasing in size and with openings on the dorsal side between the chambers; wall strongly reticulate; aperture large. Diameter, 0.80 millimeter.

The specimens that are here referred to this species were from the Choctawhatchee marl at Jackson Bluff, Fla. In the figured specimen the ventral side has the umbilical area filled with a mass of material which may be of foreign origin, but the dorsal side distinctly shows the accessory openings characteristic of this species, although the specimen is not perfect. Apparently this species has not been recorded as a fossil.

Globigerina apertura Cushman, n. sp.

Plate XII, figure 8.

Test spiral, depressed, all the chambers visible from the dorsal side, the four chambers making the last-formed coil visible from the ventral side, chambers rapidly increasing in size; aperture very large, semicircular, opening into the central umbilical cavity. Diameter, 0.50 millimeter.

Type specimen (U. S. N. M. No. 325323) found in the Yorktown formation at Suffolk, Va. This species may be distinguished by its extremely large semicircular aperture, compressed test, and few chambers.

Globigerina sp.?

Plate XII, figures 5, 7.

Specimens of *Globigerina* have been found in the Yorktown formation of Suffolk, Va., which are either too few in number or too imperfectly preserved to be definitely determined, but their occurrence should be noted.

Family ROTALIIDAE.

Genus SPIRILLINA Ehrenberg, 1841.

Spirillina orbicularis Bagg.

Plate XIV, figure 1.

Spirillina orbicularis Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 33 (327), pl. 2 (22), figs. 2*a–c*, 1898.

Test compressed, coiled, coils increasing in diameter as added, peripheral edge broadly rounded, surface granular, inner border on the dorsal side undulate, the projecting portion having directly behind it a depressed area, giving a pitted appearance to the inner border of the chambers; aperture arched, comparatively narrow. Diameter, 0.50 millimeter.

Bagg's single specimen of this species was from the Miocene of Yorktown, Va. (Yorktown formation). The peculiar ornamentation of this species well distinguishes it. I have a specimen identical with this species from the Duplin marl at Mayesville, S. C., which shows fully as strikingly the specific characters, especially those of the ornamentation.

Genus DISCORBIS Lamarck, 1804.

Discorbis vilardeboana (D'Orbigny) Cushman.

Plate XIV, figures 3, 5; Plate XV, figure 4.

[For description see paper on Pliocene Foraminifera, p. 14.]

This species seems to be fairly common in the Duplin marl at Mayesville, S. C., and to be present in considerable numbers in the Yorktown formation at Suffolk, Va.

Discorbis bertheloti (D'Orbigny) Cushman.

Plate XV, figures 1–3.

Rosalina bertheloti D'Orbigny, in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, p. 135, pl. 1, figs. 28–30, 1839.

Discorbis bertheloti (D'Orbigny) Cushman, U. S. Nat. Mus. Bull. 71, pt. 5, p. 20, pl. 7, fig. 3; fig. 23 in text, 1915.

Discorbina bertheloti (D'Orbigny) Brady, Linnaean Soc. London Trans., vol. 24, p. 469, pl. 48, fig. 10, 1864; *Challenger* Rept., Zoology, vol. 9, p. 650, pl. 89, figs. 10–12, 1884.

Test unequally biconvex, usually six to seven chambers in the last-formed coil, dorsal side usually flattened, ventral side more convex; sutures curved, fairly distinct on both sides, occasionally slightly limbate; aperture usually extending into the dorsal side so that a portion of the aperture is peripheral. Diameter 0.80 millimeter or less.

This species occurs in the Choctawhatchee marl 1 mile south of Red Bay, Fla.; in the Duplin marl (?) of South Carolina (locality unknown); and in the Yorktown formation at Suffolk, Va.

Discorbis rosacea (D'Orbigny) Cushman.

Plate XIV, figure 4.

Rotalia rosacea D'Orbigny, Annales sci. nat., vol. 7, p. 273, No. 15, 1826.
Discorbis rosacea (D'Orbigny) Cushman, U. S. Nat. Mus., pt. 5, p. 13, fig. 13 in text, 1915.
Discorbina rosacea (D'Orbigny) Jones, Parker, and Brady, Foraminifera of the Crag, pl. 4, fig. 17, 1866.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 644, pl. 89, figs. 1, 4, 1884.

Test planoconvex, dorsal side convex, ventral side flattened or slightly concave, chambers numerous, much elongated in those last formed; sutures very oblique, five chambers in the last-formed coil; margins acute, carinate from below, umbilicate; aperture entirely ventral, umbilical cavity distinct. Diameter, 0.50 millimeter.

Excellent specimens of this species have been found in the Yorktown formation at Suffolk, Va. Woodward records this species from the "greensand" of the artesian well at Mobile, Ala. (depth 700–735 feet).

Discorbis orbicularis (Terquem) Berthelin.

[For description see paper on Pliocene Foraminifera, p. 13.]

Bagg records this species from the Choptank formation of Jones Wharf, Md., and from Darlington, S. C. (Duplin marl). This species is recorded as a fossil from the Miocene and Pliocene of Italy.

Discorbis turrita Cushman, n. sp.

Plate XIV, figure 2.

Test minute, the central portion closely coiled and conical, the later portion broader and more extended, ventral side nearly flat, five to six chambers in the last-formed coil, ventral peripheral margin with a definite keel, in side view subconical; wall smooth, punctate; aperture extending from the ventral edge to the umbilicus, narrow with a definite raised margin. Diameter, 0.4 millimeter.

Type specimen (U. S. N. M. No. 325324) found in the Yorktown formation at Suffolk, Va. This species is interesting, especially in side view, where it presents a definite turreted appearance that is unusual in this genus, due largely to the central portion, which is conical, the later portion being flattened and extended.

Genus ANOMALINA D'Orbigny, 1826.

Anomalina ammonoides (Reuss) Brady.

Plate XVI, figure 1.

Rosalina ammonoides Reuss, Geognostiche Skizzen aus Böhmen, Band 2, p. 214, 1844; Versteinerungen der bohmischen Kreideformation, vol. 1, p. 36, pl. 8, fig. 53; pl. 13, fig. 66, 1845, 1846.

Anomalina ammonoides (Reuss), Brady, *Challenger* Rept., Zoology, vol. 9, p. 672, pl. 94, figs. 2, 3, 1884.

Test biconvex, peripheral margin broadly rounded, all chambers visible from the dorsal side, those of the ventral side of the last-formed coil entirely visible, only the inner ends of the previous ones visible, chambers numerous, ten in the last-formed coil, more coarsely punctate, umbilical areas depressed; aperture peripheral. Diameter, 0.60 millimeter.

This species was found in the Duplin marl at Wilmington, N. C. It is a common species in the Tertiary and in present oceans.

Anomalina grosserugosa (Gümbel) Brady.

[For description see paper on Pliocene Foraminifera, p. 15]

Bagg records this species from the Choptank formation at Peach Blossom Creek and from the Calvert formation at Chesapeake Beach, Md. This species was described from specimens found in the Eocene of Europe and seems to occur through the Tertiary and in the present oceans.

Anomalina sp.

Plate XVI, figure 2.

A specimen which seems to belong to this genus but which is an irregular species on the dorsal side occurred in the Duplin marl of Mayesville, S. C. As this is a unique specimen it has not been definitely referred to any described species.

Genus PLANORBULINA D'Orbigny, 1826.

Planorbulina mediterranensis D'Orbigny.

Bagg[1] records this species from the Choptank formation at Jones Wharf and from the Calvert formation at Chesapeake Beach, Md.

TRUNCATULINA D'Orbigny, 1826.

Truncatulina lobatula (Walker and Jacob) D'Orbigny.

Plate XVII, figures 1–3.

[For description see paper on Pliocene Foraminifera, p. 16.]

This species is as common in the Miocene as it is in the Pliocene and along the Atlantic coast of the present time. It was present in

[1] Maryland Geol. Survey, Miocene, p. 463, pl. 131, fig. 6, 1904.

practically all the Miocene material which I have had—the Choctawhatchee marl in Florida, the Duplin marl in South Carolina, the Yorktown and St. Marys formations in Virginia, and the Choptank and Calvert formations in Maryland. Bagg records it from numerous stations in the Maryland Miocene from both the Choptank and the Calvert formations.

Truncatulina lobatula (Walker and Jacob) D'Orbigny var. ornata Cushman, n. var.

Plate XVIII, figures 1, 2.

Test differing from the typical form in the ornamentation, especially the well-developed bands outlining the chambers on the dorsal side.

Type specimen (U. S. N. M. No. 325325) from the Choctawhatchee marl at Coes Mill, Fla., and also from the Yorktown formation at Suffolk, Va.

Truncatulina refulgens (Montfort) D'Orbigny.

Plate XVIII, figure 3.

Cibides refulgens Montfort, Conchyliologie systématique, vol. 1, p. 122, 1808.
Truncatulina refulgens (Montfort) D'Orbigny, Annales sci. nat., vol. 7, p. 279, pl. 13, figs. 8–11, 1826; Modèles, No. 77, 1826.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 659, pl. 92, figs. 7–9, 1884.

Test planoconvex, dorsal side flattened or slightly concave, ventral side much convex toward the periphery, becoming extended and compressed, so that there is a definite flange about the periphery, forming a thin keel; six to eight chambers in the last-formed whorl, edge carinate, rather coarsely punctate dorsally, ventral side more finely punctate; aperture a narrow slit, occasionally coming to the peripheral margin. Diameter, 0.6 millimeter.

The only material I have had containing this species is from the Choctawhatchee marl at Coes Mill, Fla. It is decidedly typical. This species is known along the eastern coast of the United States but is not widely distributed as a fossil, being known only from the later Tertiary of Europe.

Truncatulina variabilis D'Orbigny.

Truncatulina variabilis D'Orbigny, Annales sci. nat., vol. 7, p. 279, No. 8, 1826.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 661, pl. 93, figs. 6, 7, 1884.
Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 36 (330,) pl. 2 (22), fig. 5, 1898; Maryland Geol. Survey, Miocene, p. 465, pl. 131, figs. 9, 10, 1904.

Test consisting of a depressed planoconvex, exceedingly variable form, the segments of which are never uniform or regular in arrangement, as in *T. lobatula*, but are more or less evolute and vary also in the amount of compression and form. The shell is coarsely perforate. The aperture is a wide gaping arch extending along the inner margin of the final convolution.—Bagg.

Bagg records this species from the Choptank formation of Jones Wharf, Pawpaw Point, Governor Run, and Peach Blossom Creek and from the Calvert formation of Plum Point, Md. Among his material which I have examined is a specimen from Leonardtown, Md. In his list[1] Bagg records this species from Yorktown, Va., Yorktown formation.

Truncatulina haidingerii D'Orbigny.

Bagg[2] records this species from a depth of 685 feet in the well boring at Norfolk, Va.

Truncatulina variolata (D'Orbigny) Cushman.

Plate XVI, figure 3.

Anomalina variolata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 170, pl. 9, figs. 27–29, 1846.

Test planoconvex, dorsal side flat or somewhat concave, ventral side convex, seven to eight chambers in the last-formed whorl, peripheral margin bluntly rounded and angled; sutures more or less distinct, especially on the ventral side; umbilicus not open; surface coarsely punctate; aperture peripheral. Diameter, 0.5 millimeter.

Specimens which seem identical with D'Orbigny's species occur in the Choctawhatchee marl at Jackson Bluff, Fla. D'Orbigny's description was based on specimens from the Tertiary of the Vienna Basin.

Truncatulina subloba Cushman, n. sp.

Plate XIX, figure 1.

Test planoconvex, dorsal side flattened, ventral side slightly convex; chambers comparatively few, six or seven in the last-formed coil, peripheral margin carinate, lobular in face view; sutures distinct, depressed, especially on the ventral side, with an anteriorly projecting lobe on the dorsal side; wall coarsely punctate. Diameter, 0.6 millimeter.

Type specimen (U. S. N. M. No. 325326) from the Yorktown formation at Suffolk. This species is allied to *T. lobatula* but differs in several important points.

Truncatulina floridana Cushman, n. sp.

Plate XIX, figure 2.

Test biconvex, dorsal side less convex than the ventral, chambers numerous, about twelve in the last-formed coil, peripheral margin acute-angled, dorsal side ornamented with a secondary growth about

[1] Bull. Am. Paleontology, vol. 2, No. 10, p. 47 (341), 1898.
[2] Idem, p. 35 (329).

the sutures and along the margins of the chamber, in the central portion fusing and almost covering the chambers, ventral side umbonate, raised areas about the sutures uniting in the umbilical region; aperture ventral; wall coarsely punctate. Diameter, 0.75 millimeter.

Type specimen (U. S. N. M. No. 325327) from the Choctawhatchee marl 1 mile south of Red Bay, Fla.

Truncatulina wuellerstorfi (Schwager) Brady.

Plate XIX, figure 3; Plate XX, figure 1.

Anomalina wüllerstorfi Schwager, Novara-Exped., Geol. Theil, vol. 2, p. 258, pl. 7, figs. 105, 107, 1866.

Truncatulina wuellerstorfi (Schwager) Brady, *Challenger* Rept., Zoology, vol. 9, p. 662, pl. 93, figs. 8, 9, 1884.

Test planoconvex, compressed, ventral sides lightly convex, dorsal side flattened or nearly so, peripheral edge usually acute, occasionally slightly rounded, chambers narrow, much curved, nine or ten in the last-formed whorl; sutures distinct, much curved; peripheral margin slightly keeled, inner margin of the chambers, especially on the dorsal side, slightly overlapping; surface coarsely punctate; aperture peripheral. Diameter, 0.75 to 1 millimeter.

Specimens referred to this species were found in the Choctawhatchee marl at Jackson Bluff, Fla., and in the Duplin marl at Mayesville, S. C. The species was described by Schwager from specimens collected in the Pliocene of Kar Nicobar, in the Indian Ocean.

Truncatulina americana Cushman, n. sp.

Plate XX, figures 2, 3; Plate XXI, figure 1.

Test planoconvex, dorsal side nearly flat, ventral side slightly convex, chambers numerous, eight to ten in the last-formed coil, rather rapidly increasing in size, peripheral margin subangular, dorsal side with the last few chambers failing to meet the umbilicus, ventral side similar in this respect in most specimens; sutures distinct, slightly limbate on the dorsal side, depressed on the ventral side; wall smooth, punctate; aperture peripheral with a slight lip. Diameter, 0.75 millimeter or less.

This species seems to be common in the Miocene of the Atlantic Coastal Plain, especially in North and South Carolina and Florida. It is found in the Choctawhatchee marl, at Coes Mill, Fla.; in the Duplin marl at Mayesville, S. C., and Wilmington, N. C., in considerable quantities; and as scattering specimens in the other localities given in the table.

This species seems to be distinctive in many ways from the other species of this genus and also seems to be a characteristic Miocene

species of this region. Where found it is usually in very considerable numbers, often being the most abundant foraminifer in the material. Type specimen (U. S. N. M. No. 325328) from Mayesville, S. C.

Truncatulina rostrata? Brady.

Plate XXXI, figure 3.

Truncatulina rostrata Brady, Quart. Jour. Micr. Sci., vol. 21, p. 65, 1881; *Challenger* Rept., Zoology, vol. 9, p. 668, pl. 94, figs. 6*a–c*, 1884.

Test biconvex, chambers numerous, ten or more in the last-formed coil, sutures thick, externally limbate, fusing in a central umbonal mass, periphery keeled, surface between the limbate sutures granular, the periphery at the apertural end extending outward; aperture at the base of the apertural face, median. Diameter, 0.65 millimeter.

Material that seems possibly referable to this species was obtained from the Duplin marl at Mayesville, S. C. It has the peculiar surface ornamentation as regards both the sutures and the intermediate areas shown in Brady's specimens and has the extended apertural periphery. His specimens, however, came from the tropical Pacific, and it is questionable whether this South Carolina form is really identical with them.

Truncatulina basiloba Cushman, n. sp.

Plate XXI, figure 2.

Test planoconvex, dorsal side flattened, ventral side convex, peripheral margin subangular, about seven chambers in the last-formed whorl, chambers on the ventral side failing to reach the umbilicus, leaving a definite umbilical depression, on the dorsal side each chamber with a definite basal lobe extending backward, leaving a depression in the angle thus formed, which persists even in later growth; surface smooth, finely punctate; aperture peripheral with a definite lip. Diameter, 0.8 millimeter.

Type specimen (U. S. N. M. No. 325335) from the Miocene of South Carolina (locality not known). This species is peculiar in that the basal lobes of the chambers form a series of depressions on the dorsal side throughout the last-formed coil.

Truncatulina concentrica Cushman, n. sp.

Plate XXI, figure 3.

Test biconvex, dorsal side very slightly convex, ventral side strongly so, peripheral margin subcarinate, nine chambers in the last-formed coil, umbilicate on the ventral side; sutures deep, chambers on the dorsal side with a definite proximate portion, forming a concentric band about the umbilical region and more or

less separate from its coil by a series of depressions; wall smooth; aperture peripheral. Diameter, 1 millimeter.

Type specimen (U. S. N. M. No. 325329) from the Choctawhatchee marl 1 mile south of Red Bay, Fla. This species seems to be an extreme development of *T. basiloba*. In it the basal lobes of the chambers are almost separated from the chambers themselves.

Genus PULVINULINA Parker and Jones, 1862.

Pulvinulina menardii? (D'Orbigny) Owen.

Plate XXII, figure 1.

Rotalia menardii D'Orbigny, Annales sci. nat., vol. 7, p. 273, No. 26, 1826; Modèles, No. 10, 1826.

Pulvinulina menardii (D'Orbigny) Owen, Linnaean Soc. London Jour., vol. 9, p. 148, pl. 5, fig. 16, 1867.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 690, pl. 103, figs. 1, 2, 1884.

Test unequally biconvex, dorsal side more convex than the ventral, chambers in the last-formed whorl few in number, the margins carinate, chambers curved, especially on the dorsal side, ventrally sutures depressed without carinae; aperture ventral, large; wall smooth. Diameter, 0.75 millimeter.

The specimen figured from the Miocene of Lancaster County, Va., is referred with a question to this species. It does not agree well with recent material of this species and may be a different species or variety.

Pulvinulina sagra (D'Orbigny) Cushman.

Plate XXII, figure 3; Plate XXIII, figure 1.

Rotalina sagra D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 77, pl. 5, figs. 13–15, 1839.

Test longer than broad, biconvex, the ventral side more convex than the dorsal, chambers few in number, six to seven in the last-formed coil, increasing rapidly in size as added; sutures slightly if at all depressed on the dorsal side, ventral side decidedly depressed; chambers slightly carinate above in some specimens; wall smooth; aperture a narrow slit on the umbilical region of the ventral side. Diameter, 0.5 millimeter.

This species occurred in the Choctawhatchee marl 1 mile south of Red Bay, Fla., and also in the Yorktown formation at Suffolk, Va. The specimens certainly seem identical with the *Rotalina sagra* of D'Orbigny as described and figured in the Cuba monograph. They seem to be much more closely allied to this species than to any other described or figured species, and as they occur in the late Tertiary of an adjacent region it is not surprising that they should be identical with recent West Indian species.

Pulvinulina repanda (Fichtel and Moll) Jones.

Plate XXIII, figure 2.

Nautilus repandus Fichtel and Moll, Testacea microscopica, p. 35, pl. 3, figs. *a–d*, 1803.

Pulvulina repanda (Fichtel and Moll) Jones, Foraminifera of the Crag, pt. 4, pp. 317–319, pl. 2, figs. 25–27, 1897.

The specimen figured and referred to this species was found in the Choctawhatchee marl 1 mile south of Red Bay, Fla.

Pulvinulina sp.?

Plate XXII, figure 2.

The specimen figured, although slightly incomplete, represents a species with very long, curved chambers, slightly limbate sutures, and a more or less irregular contour in side view. It does not seem to be identical with any common recent species, and, being a single specimen, seems not to justify the founding of a new species. The specimen is from the Choctawhatchee marl at Jackson Bluff, Fla.

Genus ROTALIA Lamarck, 1804.

Rotalia beccarii (Linnaeus) D'Orbigny.

Plate XXIII, figure 3; Plate XXIV, figures 1, 2; Plate XXV, figure 1.

[For description see paper on Pliocene Foraminifera, p. 18.]

This species is abundant in the Miocene of the Coastal Plain region, as also in the Pliocene and along the Atlantic coast at the present time. Numerous variations occur, some of which are here figured. It occurs in the Choctawhatchee marl of Florida, in the Duplin marl of North and South Carolina, and in Virginia and Maryland, as will be seen by the accompanying table of distribution. Bagg records it from both the St. Marys formation and the Choptank formation of Maryland. Woodward [1] records this species from the Miocene of Alabama in the "greensand" of the Mobile artesian well at a depth of 700 to 735 feet.

Rotalia reticulata Cushman, n. sp.

Plate XXIV, figure 3.

Test nearly equally biconvex, eight to ten chambers in the last-formed whorl; sutures obscured by the surface ornamentation, which consists of numerous reticulate raised lines between the sutures, which are also represented by raised costae on both the dorsal and ventral sides. Diameter, 0.5 millimeter.

[1] Smith, E. A., and others, On the geology of the Coastal Plain of Alabama, p. 93, Alabama Geol. Survey, 1894.

Type specimen (U. S. N. M. No. 325330) from the Duplin marl at Wilmington, N. C. This species is similar in many ways to *R. clathrata* Brady but differs in the arrangement of the reticulate ornamentation and in the general form of the test, which is not nearly so flattened as in Brady's specimen.

Rotalia broeckhiana Karrer (?).

Rotalia broeckhiana Karrer, in Drasche, Fragmente zu einer Geologie der Insel Luzon, p. 98, pl. 5, fig. 26, 1878.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 705, pl. 107, figs. 4*a–c*, 1884.
Rotalia beccarii var. *broeckhiana* Bagg, Maryland Geol. Survey, Miocene, p. 467, pl. 131, fig. 14, 1904.

The specimens of this species recorded by Bagg from the Choptank formation 1 mile north of Governor Run, and on Peach Blossom Creek, Md., do not seem, on examination, to belong to this species as figured by Brady. They seem to be simply forms of *R. beccarii*.

Rotalia soldanii D'Orbigny.

Rotalia (*Gyroidina*) *soldanii* D'Orbigny, Annales sci. nat., vol. 7, p. 278, No. 5, 1826.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 706, pl. 107, figs. 6, 7, 1884.
Woodward, in Smith and others, on the geology of the Coastal Plain of Alabama, p. 93, 1894.
Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 39 (333), 1898.

This species is recorded by Woodward from the Miocene of Alabama in the "greensand" of the Mobile artesian well at a depth of 700 to 735 feet, and by Bagg from the Miocene of Virginia from a well boring at Norfolk, at a depth of 645 feet. I have seen no material from either of these stations nor any specimens that may be referred to this species from any of the material which I have examined.

Rotalia orbicularis D'Orbigny.

Rotalia (*Gyroidina*) *orbicularis* D'Orbigny, Annales sci. nat., vol. 7, p. 278, No. 1, 1826.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 706, pl. 107, fig. 5; pl. 115, fig. 6, 1884.
Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 38 (332), 1898.

Bagg records this species from the Miocene of Virginia in material from a depth of 685 feet in the Norfolk well.

Family NUMMULINIDAE.

Genus NONIONINA D'Orbigny, 1826.

Nonionina depressula (Walker and Jacob) Parker and Jones.

Plate XXVI, figure 1.

[For description see paper on Pliocene Foraminifera, p. 19.]

Woodward records this species from the Miocene of Alabama in the "greensand" of the Mobile artesian well at a depth of 700 to 735 feet. Bagg records it from the Miocene of Yorktown, Va.

In the material I have had specimens occur in the Yorktown formation at Suffolk, Va.

Nonionina scapha (Fichtel and Moll) Parker and Jones.

Plate XXV, figure 2; Plate XXVI, figures 2, 3.

Nautilus scapha Fichtel and Moll, Testacea microscopica, p. 105, pl. 19, figs. *d–f*, 1803.
Nonionina scapha (Fichtel and Moll) Parker and Jones, Annals and Mag. Nat. Hist., 3d ser., vol. 5, p. 102, No. 4, 1860.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 730, pl. 109, figs. 14, 15, and 16?, 1884.
Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 41 (335), pl. 3 (23), fig. 4*a*, *b*, 1898; Maryland Geol. Survey, Miocene, p. 460, pl. 131, figs. 1–3, 1904.

Test somewhat compressed, peripheral margin rounded, elongate, chambers increasing rapidly in length toward the apertural end of the test, chambers ten to twelve in the last-formed coil, umbilical region depressed; sutures depressed; wall smooth; aperture a narrow slit peripherally located, simple. Diameter, 0.5 to 0.6 millimeter.

Bagg records this species from James River, Yorktown, and Norfolk, Va., from the Calvert formation of Chesapeake Beach and Plum Point, Md., and from the Choptank formation at Jones Wharf, Md. I have had the species from the Choctawhatchee marl at Jackson Bluff, Fla., from the Duplin marl at Mayesville, S. C., and from the Yorktown formation at Suffolk, Va. This species seems to be a common one in the Miocene, both in this country and in Europe.

Nonionina boueana D'Orbigny.

Plate XXV, figure 3.

Nonionina boueana D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 108, pl. 5, figs. 11, 12, 1846.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 729, pl. 109, figs. 12, 13, 1884.
Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 40 (334), 1898.

Test compressed, much elongate, peripheral margin rounded, chambers increasing rapidly in length as added; sutures depressed, twelve to fifteen in the last-formed coil, umbilical region slightly depressed; wall smooth; aperture at the base of the chamber, simple, peripheral. Diameter, 0.5 to 0.75 millimeter.

Bagg records this species from the Miocene of Virginia from a well at Norfolk, depth 645 feet. The Miocene material I have had is from the Choctawhatchee marl 1 mile south of Red Bay, Fla. This species is also found in the Miocene of Europe.

Nonionina umbilicatula (Montagu) Parker, Jones, and Brady.

Plate XXVI, figure 6.

Nautilus umbilicatulus Montagu, Testacea Britannica, p. 191, 1803; Suppl., p. 78, pl. 18, fig. 1, 1808.
Nonionina umbilicatula (Montagu) Parker, Jones, and Brady, Annals and Mag. Nat. Hist., 4th ser., vol. 8, p. 242, pl. 12, fig. 157, 1871.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 726, pl. 109, figs. 8, 9, 1884.

Test biconvex, peripheral margin rounded, chambers ten or more in the last-formed coil, sutures limbate but not depressed, deep, umbilicate; wall smooth, punctate toward the periphery; aperture a very narrow curved opening at the base of the chamber, peripheral. Diameter, 0.5 to 0.6 millimeter.

The only material I have had is from a point near Centerville, Md.

Nonionina extensa Cushman, n. sp.

Plate XXV, figure 4.

Test elongate, peripheral margin rounded, umbilical margin depressed, about eight chambers in the last-formed coil, rapidly increasing in size as added; sutures very slightly depressed, margin not lobulated; wall coarsely punctate; aperture a narrow opening on the periphery. Diameter, 0.5 millimeter.

Type specimen (U. S. N. M. No. 325331) from the Duplin marl, Mayesville, S. C. This species differs from *N. scapha* in the fewer, broader chambers, the very slightly depressed sutures, and the peculiar form of the last-formed chamber, especially near the peripheral end.

Genus POLYSTOMELLA Lamarck, 1822.

Polystomella striatopunctata (Fichtel and Moll) Parker and Jones.

Plate XXVI, figure 4; Plate XXVII, figure 2.

[For description see paper on Pliocene Foraminifera, p. 19.]

Bagg records this species from the Choptank formation at Jones Wharf, Md. I have had typical Miocene material from the Choctawhatchee marl at Coes Mills, Fla., and other localities noted in the accompanying table. The specimen figured in Plate XXVI, figure 4, from the Duplin marl at Mayesville, S. C., is much more depressed than usual but in its bridging seems to belong to this species.

Polystomella crispa (Linnaeus) Lamarck.

Plate XXVII, figures 1, 4, 5.

[For description see U. S. Nat. Mus. Bull. 71, pt. 4, p. 32, 1914.]

This species seems to be abundant in the Miocene of the Coastal Plain, especially in the Choctawhatchee marl of Florida and in the

Duplin marl in the Carolinas. It also seems to be common in the Miocene of a large portion of Europe.

Polystomella subnodosa (Münster) Reuss.

Plate XXVII, figure 6.

[For description see U. S. Nat. Mus. Bull. 71, pt. 4, p. 32, 1914.]

This species occurred only in the Duplin marl at Mayesville, S. C. It does not seem to be a common recent species, and its fossil distribution is limited to a few Tertiary localities in Europe.

Genus AMPHISTEGINA D'Orbigny, 1826.

Amphistegina lessonii D'Orbigny.

Plate XXVI, figure 5; Plate XXVII, figure 3; Plate XXVIII, figure 1.

[For description see paper on Pliocene Foraminifera, p. 20.]

This species is common throughout the Miocene of the Coastal Plain, especially the Choctawhatchee marl in Florida and in the Duplin marl in South Carolina. It is also abundant in the Miocene of Europe.

Family MILIOLIDAE.

Genus QUINQUELOCULINA D'Orbigny, 1826.

Quinqueloculina seminulum (Linnaeus) D'Orbigny.

Plate XXVIII, figures 2, 4, 5; Plate XXIX, figure 1.

[For description see paper on Pliocene Foraminifera, p. 22.]

Woodward records this species from the Miocene of Alabama in the "greensand" of the Mobile artesian well at a depth of 735 feet. Bagg records it from the Miocene of Yorktown, Va., Yorktown formation, and James River; from the St. Marys formation of St. Marys River, Md.; and from the Choptank formation of Jones Wharf and Governor Run, Md. In the material I have seen it has been common mainly in the Duplin marl in South Carolina and in the Yorktown formation in Virginia; the definite localities are given in the accompanying table of distribution.

Quinqueloculina venusta? Karrer.

Plate XXVIII, figure 3; Plate XXIX, figure 2.

[For description see paper on Pliocene Foraminifera, p. 23.]

The material which is questionably referred to this species was from the Choctawhatchee marl at Jackson Bluff, Fla., and also from material taken from the valves of *Balanus proteus* from the Miocene of Virginia (localities not given). It has the angled chambers and the general appearance of this species, though it may belong elsewhere.

Quinqueloculina auberiana D'Orbigny.

Plate XXX, figure 1.

[For description see paper on Pliocene Foraminifera, p. 23.]

The only specimens that seem referable to this species were from the Miocene of Lancaster County, Va.

Quinqueloculina subdecorata Cushman, n. sp.

Plate XXIX, figure 3.

Test large, rotund, chambers tumid, sutures deep, clearly cut; aperture semicircular with a definite lip; wall smooth except for traces of costae near the inner margin. Length, 2 millimeters.

Type specimen, U. S. N. M. No. 325332.

This species was found in Miocene material collected by Tuomey in Virginia. It is a large and characteristic species, but unfortunately the material in which it occurred was assigned to no definite locality. It is not found in any other Miocene material.

Genus TRILOCULINA D'Orbigny, 1826.

Triloculina oblonga (Montagu) D'Orbigny.

Plate XXX, figure 2.

Vermiculum oblongum Montagu, Testacea Britannica, p. 522, pl. 14, fig. 9, 1803.

Triloculina oblonga (Montagu) D'Orbigny, Annales sci. nat., vol. 7, p. 300, No. 16, 1826; Modèles, No. 95, 1826; in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 155, pl. 10, figs. 3–5, 1839.

Miliolina oblonga Brady, *Challenger* Rept., Zoology, vol. 9, p. 160, pl. 5, figs. 4, 8*a*, *b*, 1884.

Test elongate, more or less oblong in side view, chambers curved, especially at the basal end, sutures well defined, smooth, depressed; aperture with a single tooth, often with a bifid lip; wall smooth. Length 1 millimeter.

The only material referable to this species was from the valves of *Balanus proteus* from the Miocene of Virginia, locality unknown. D'Orbigny records and figures a very similar specimen in his Cuba monograph.

Triloculina schreiberiana D'Orbigny.

Plate XXX, figure 4.

Triloculina schreiberiana D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 174, pl. 9, figs. 20–22, 1839.

Test elongate, oval, chambers broadest at the basal end, tapering gradually at the apertural end, chambers tumid, sutures depressed; aperture with a simple tooth, chambers rounded in end view; wall smooth. Length, 0.85 millimeter.

Found in Choctawhatchee marl at Coes Mills, Fla.

Triloculina asperula Cushman, n. sp.

Plate XXX, figure 3.

Test subcircular in side view, chambers tapering toward either end, irregularly roughened, sutures distinct; aperture with a simple tooth. Diameter, 0.25 millimeter.

This small species occur in the Choctawhatchee marl at Coes Mills, Fla., type specimen (U. S. N. M. No. 325333).

Genus BILOCULINA D'Orbigny, 1826.

Biloculina bulloides D'Orbigny.

Plate XXXI, figure 1.

Biloculina bulloides D'Orbigny, Annales sci. nat., vol. 7, p. 297, No. 1, pl. 16, figs. 1–4, 1826.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 142, pl. 2, figs. 5, 6, 1884.

Test nearly circular in both end and face views, chambers semicircular in end view, tumid, sutures distinct, depressed; aperture oval with a bifid tooth; wall smooth. Diameter, 0.75 millimeter.

The only material of this species which I have had from the Miocene was from the Choctawhatchee marl at Jackson Bluff, Fla.

Genus SPIROLOCULINA D'Orbigny, 1826.

Spiroloculina limbata D'Orbigny.

Plate XXXI, figure 2.

Spiroloculina limbata D'Orbigny, Annales sci. nat., vol. 7, p. 299, No. 12, 1826.

Parker, Jones, and Brady, Annals and Mag. Nat. Hist., 4th ser., vol. 8, p. 248, pl. 8, fig. 22, 1871.

Brady, *Challenger* Rept., Zoology, vol. 9, p. 150, pl. 9, figs. 15–17, 1884.

Test subcircular in face view, depressed at both sides in end view, periphery slightly convex, chambers with the margins limbate; aperture with a single simple tooth. Diameter, 0.65 millimeter.

The only material of this species which I have had was from the Choctawhatchee marl at Jackson Bluff, Fla.

Spiroloculina planulata (Lamarck) Brady.

Miliolites planulata Lamarck, Annales du Muséum, vol. 5, p. 352, No. 4, 1805; Histoire naturelle des animaux sans vertèbres, vol. 7, p. 613, No. 4, 1822.

Spiroloculina planulata (Lamarck) Brady, *Challenger* Rept., Zoology, vol. 9, p. 148, pl. 9, figs. 2*a*, *b*, 1884.

Bagg, Bull. Am. Paleontology, vol. 2, No. 10, p. 22 (316), 1898.

Test free, calcareous, perforate, oval, complanate, and only slightly depressed at the center, chambers smooth, compressed, placed alternately on the open side of the shell. The peripheral margins are gently rounded. The aperture is in the form of a narrow, high-arched or horse shoe-shaped opening with a projecting tongue at the lower margin. Length, 0.90 millimeter; breadth, 0.60 millimeter. I have only one specimen of this species.—Bagg.

Bagg records this species from the Yorktown formation at Yorktown, Va.

Spiroloculina grata Terquem.

Spiroloculina grata Terquem, Soc. géol. France Mém., 3d ser., vol. 1, p. 55, pl. 10, figs. 14, 15, 1878.
Brady, *Challenger* Rept., Zoology, vol. 9, p. 155, pl. 10, figs. 16, 17, 22, 23, 1884.
Bagg, Maryland Geol. Survey, Miocene, p. 482, pl. 133, fig. 14, 1904.

Test broadly oval or almost circular in outline; chambers four, milioline, covered with definite striations upon the outer surface, which is the chief characteristic of this species. The umbilical region is depressed, and the outer chambers are somewhat enlarged toward their margin, suggesting a thickening of the shell as well as an increase in size. The surface striations are in our specimen nearly parallel to the several chambers, but Brady mentions the fact that these are sometimes oblique and often irregular, while in typical forms the aperture ends in an elongated neck. In our specimen it appears broken, so that this feature is not apparent.—Bagg.

Bagg records this species from the Calvert formation at Chesapeake Beach, Md.

Spiroloculina tenuis (Czjzek) Brady.

Quinqueloculina tenuis Czjzek, Haidinger's Naturwiss. Abh., vol. 2, p. 149, pl. 13, figs. 31–34, 1847.
Spiroloculina tenuis (Czjzek) Brady, *Challenger* Rept., Zoology, vol. 9, p. 152, pl. 10, figs. 7–11, 1884.
Bagg, Maryland Geol. Survey, Miocene, p. 483, pl. 133, fig. 13, 1904.

The test of *Spiroloculina tenuis* is in small, delicate specimens spiroloculine from beginning to end, but in larger forms it shows a thickening at the center on account of the earliest segments not being set in one plane, and it is probably on this account that the species has so often been grouped with *Quinqueloculina*. It has a rather broadly oval contour in our Miocene specimen, and the several chambers are smooth and run in alternate series from end to end.—Bagg.

Bagg records this species from the Choptank formation at Pawpaw Point, Md.

Other species.

The following species recorded from the Miocene of the localities given are not included in the preceding descriptions, as they are not, so far as I can find, represented by available material.

Bulimina aculeata D'Orbigny, recorded by Bagg from James River, Va.
Bulimina elongata D'Orbigny, recorded by Bagg from Norfolk and Yorktown, Va., and Plum Point, Md.
Bulimina elegans D'Orbigny, *Bulimina elegantissima* D'Orbigny, and *Cristellaria crepidula* (Fichtel and Moll), recorded by Woodward from the "greensand" of the artesian well at Mobile, Ala.
Nodosaria obliqua (Linnaeus) and *Nodosaria aculeata* (D'Orbigny), recorded by Bagg from the well boring at Norfolk, Va.
Polymorphina communis D'Orbigny, listed by Bagg from Plum Point, Md.

PLATES IX–XXXI.

PLATE IX.

FIGURE 1. *Saccammina glabra* Cushman, n. sp., × 60. *a*, Apertural view; *b*, side view. Collected by Tuomey in Virginia.

2. *Textularia gramen* D'Orbigny, × 60. *a*, Front view; *b*, apertural view. South Carolina.

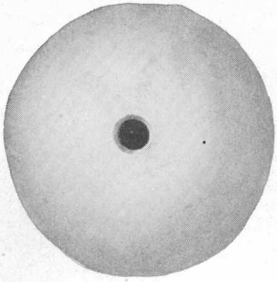
3. *Textularia gramen* D'Orbigny, × 60. One mile south of Red Bay, Fla.

4. *Textularia gramen* D'Orbigny, × 60. *a*, Front view; *b*, apertural view. Jackson Bluff, Fla.

5. *Textularia gramen* D'Orbigny, × 33. *a*, Front view; *b*, apertural view. Lancaster County, Va.

6. *Textularia agglutinans* D'Orbigny, × 40. *a*, Front view; *b*, apertural view. Near Suffolk, Va.

7. *Textularia* sp.? × 60. One mile south of Red Bay, Fla.



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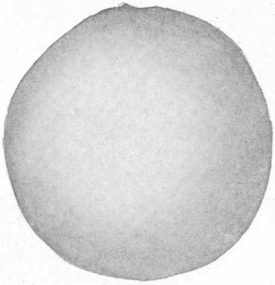

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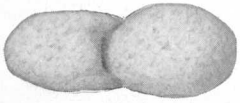

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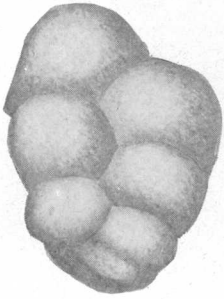

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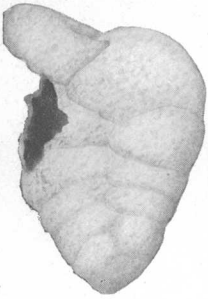

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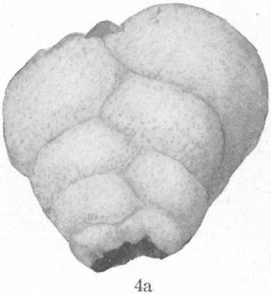

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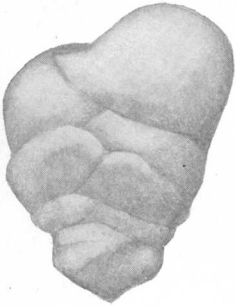

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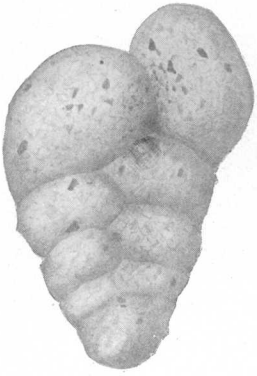

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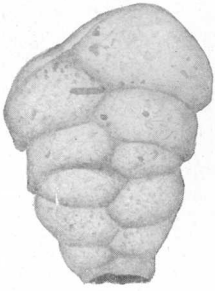
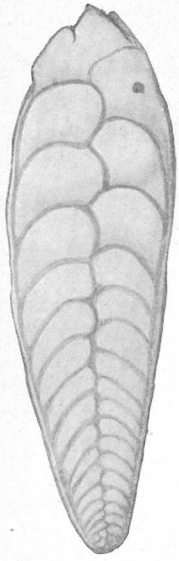


5a

MIOCENE FORAMINIFERA.



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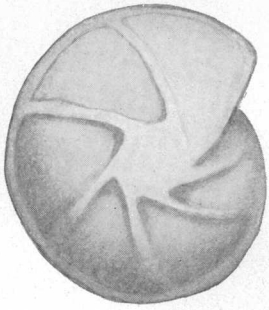

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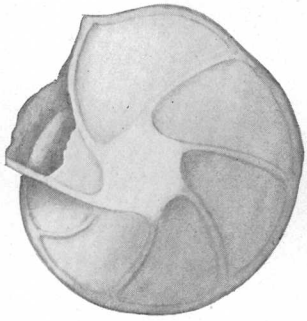

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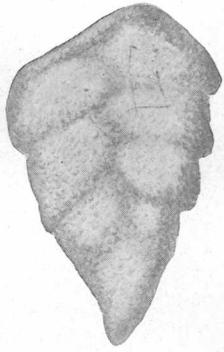

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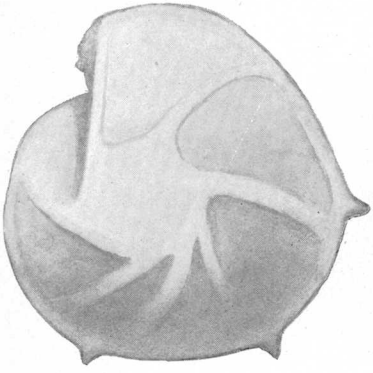

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4

MIOCENE FORAMINIFERA.

PLATE X.

FIGURE 1. *Bolivina marginata* Cushman, n. sp., × 60. One mile south of Red Bay, Fla.

2. *Bolivina aenariensis* (Costa) Brady var. *multicosta* Cushman, n. var., × 60. One mile south of Red Bay, Fla.

3. *Textularia virginiana* Cushman, n. sp., × 25. *a*, Front view; *b*, apertural view. From interior of valves of *Balanus proteus* from Virginia.

4. *Bolivina floridana* Cushman, n. sp., × 60. One mile south of Red Bay, Fla.

5. *Cristellaria americana* Cushman, n. sp., × 25. One mile south of Red Bay, Fla.

6. *Cristellaria americana* Cushman, n. sp., × 25. Muldrows Mills, S. C.

7. *Cristellaria americana* var. *spinosa* Cushman, n. var., × 40. One mile south of Red Bay, Fla.

8. *Nodosaria communis* D'Orbigny, × 33. One mile south of Red Bay, Fla.

PLATE XI.

FIGURE 1. *Cristellaria floridana* Cushman, n. sp., × 60. *a*, Front view; *b*, apertural view. One mile south of Red Bay, Fla.

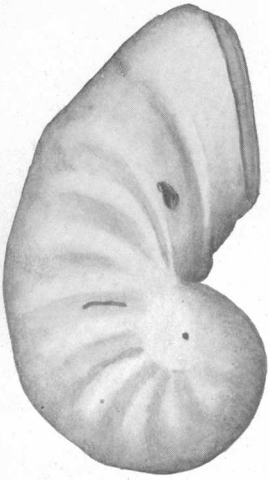
2. *Cristellaria catenulata* Cushman, n. sp., × 60. One mile south of Red Bay, Fla.

3. *Polymorphina regina* Brady, Parker, and Jones, × 50. *a*, Front view; *b*, apertural view. Mayesville, S. C.

4. *Polymorphina regina* Brady, Parker, and Jones, × 50. South Carolina.

5. *Polymorphina gibba* D'Orbigny, × 60. Mayesville, S. C.

6. *Polymorphina lactea* (Walker and Jacob) Macgillivray, × 50. One mile south of Red Bay, Fla.



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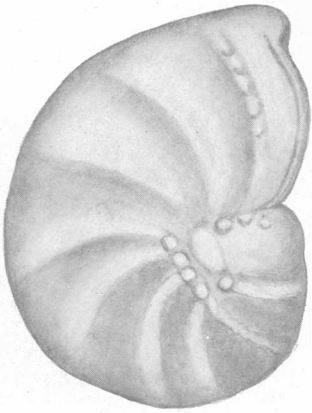

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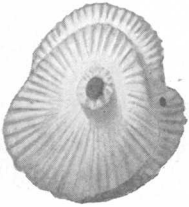

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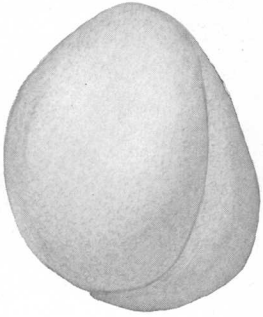

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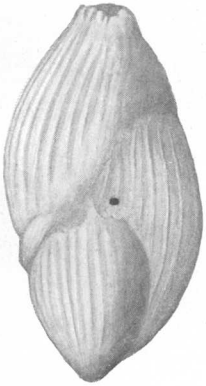

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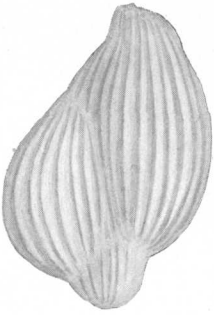
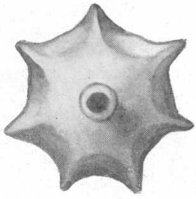


4

6

MIOCENE FORAMINIFERA

1



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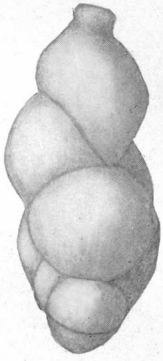

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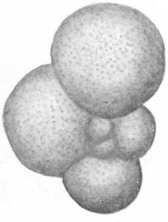

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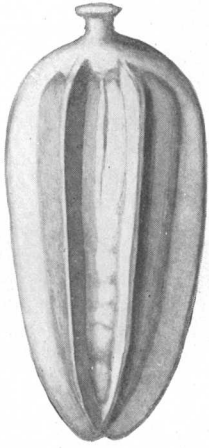

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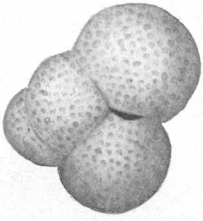

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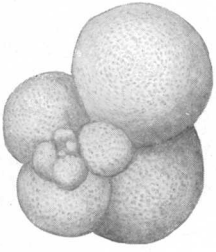

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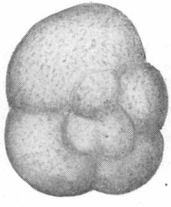

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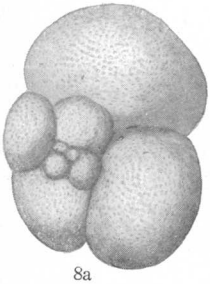

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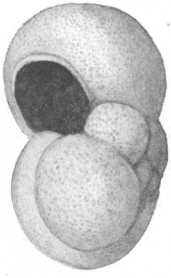

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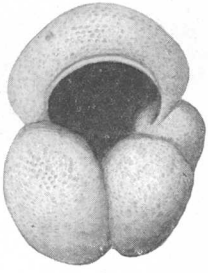


8c

MIOCENE FORAMINIFERA.

PLATE XII.

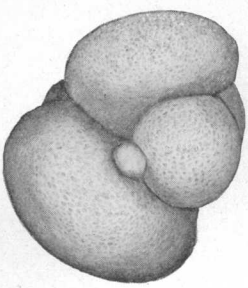
FIGURE 1. *Uvigerina tenuistriata* Reuss, × 60. One mile south of Red Bay, Fla.
2. *Uvigerina canariensis* D'Orbigny, × 80. Near Suffolk, Va.
3. *Siphogenerina lamellata* Cushman, n. sp., × 60. *a*, Front view; *b*, apertural view. One mile south of Red Bay, Fla.
4. *Globigerina bulloides* D'Orbigny, × 60. One mile south of Red Bay, Fla.
5. *Globigerina* sp. ?, × 60. One mile south of Red Bay, Fla.
6. *Globigerina bulloides* D'Orbigny, × 60. Suffolk, Va.
7. *Globigerina* sp.?, × 60.
8. *Globigerina apertura* Cushman, n. sp., × 60. *a*, Dorsal view; *b*, side view; *c*, ventral view. Suffolk, Va.

PLATE XIII.

FIGURE 1. *Globigerina dubia?* Egger, × 60. *a*, Side view; *b*, dorsal view; *c*, ventral view. Muldrows Mills, S. C.

2. *Globigerina sacculifera* Brady, × 60. *a*, Dorsal view; *b*, ventral view; *c*, side view. Jackson Bluff, Fla.

3. *Globigerina cretacea* D'Orbigny, × 60. *a*, Dorsal view; *b*, ventral view; *c*, side view. Jackson Bluff, Fla.



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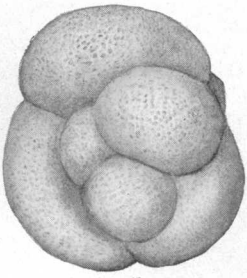

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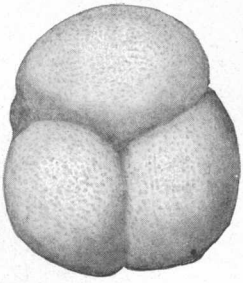

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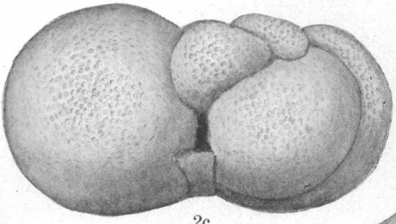

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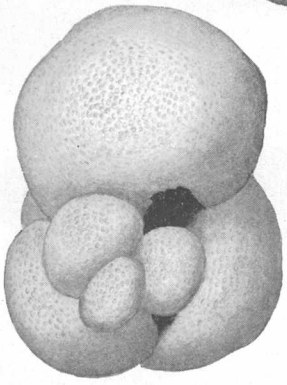

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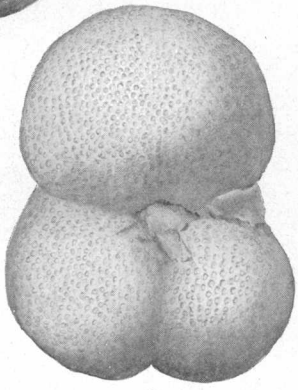

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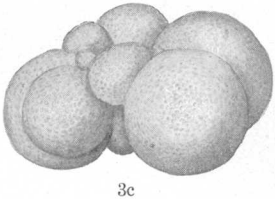

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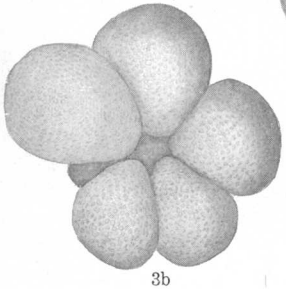

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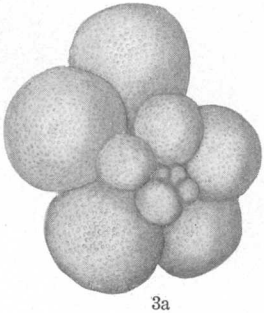

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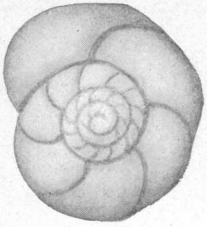
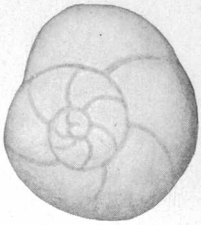
MIOCENE FORAMINIFERA.



2a

2c

3c



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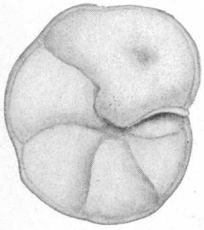

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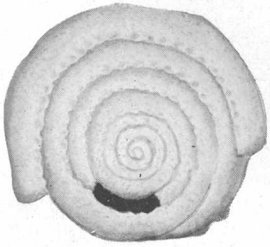

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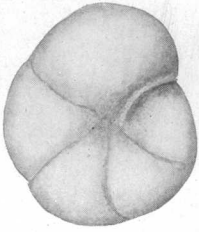
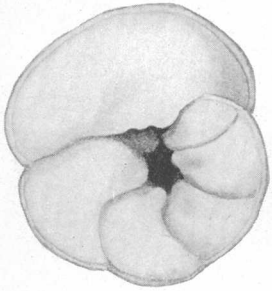


3b

1b



4b

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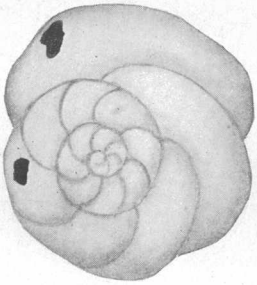

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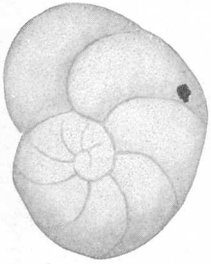
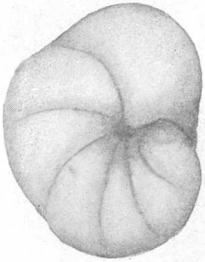


5a

5c



5b

MIOCENE FORAMINIFERA.

PLATE XIV.

FIGURE 1. *Spirillina orbicularis* Bagg, × 60. *a*, From above; *b*, from side. Mayesville, S. C.

2. *Discorbis turrita* Cushman, n. sp., × 60. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

3. *Discorbis vilardeboana* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

4. *Discorbis rosacea* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

5. *Discorbis vilardeboana* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

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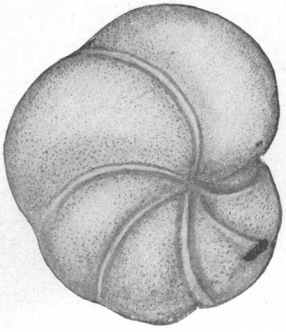
PLATE XV.

FIGURE 1. *Discorbis bertheloti* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. One mile south of Red Bay, Fla.

2. *Discorbis bertheloti* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. South Carolina.

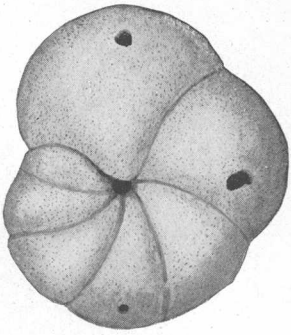
3. *Discorbis bertheloti* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

4. *Discorbis vilardeboana* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. Mayesville, S. C.



1a

1c



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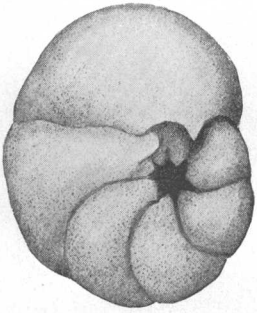

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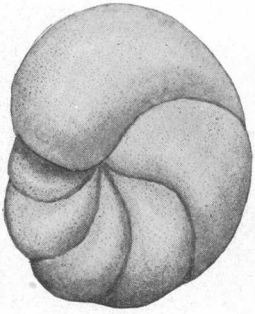
2c



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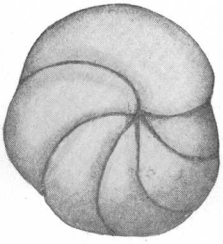

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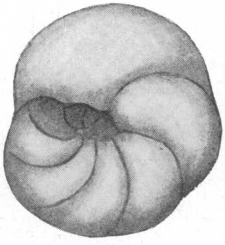
3c



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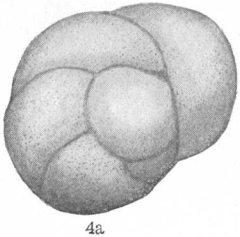

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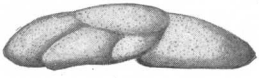

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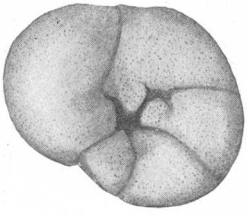

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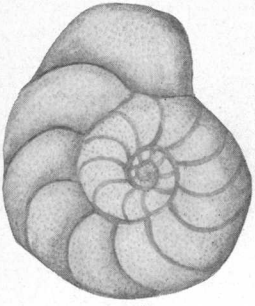
MIOCENE FORAMINIFERA.



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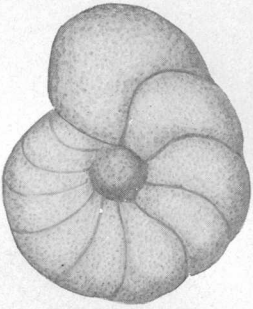
1c



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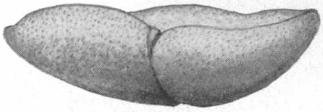

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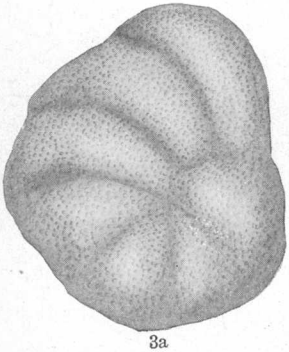

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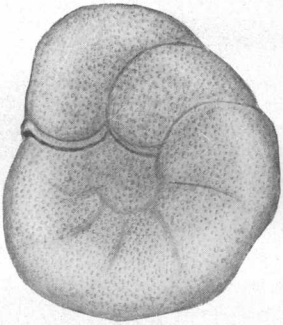

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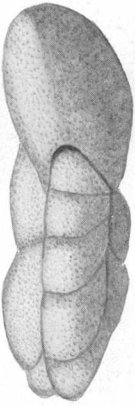

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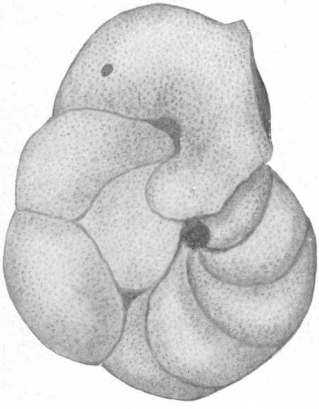

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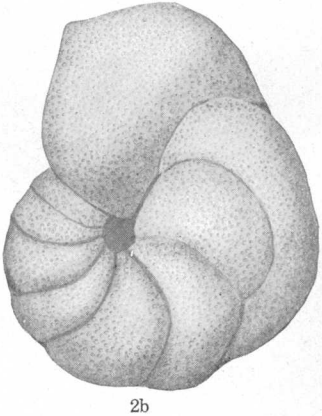


2b

MIOCENE FORAMINIFERA.

PLATE XVI.

FIGURE 1. *Anomalina ammonoides* (Reuss) Brady, × 60. *a*, From above; *b*, from below; *c*, from side. Wilmington, N. C.

2. *Anomalina sp.?*, × 60. *a*, From above; *b*, from below; *c*, from side. Mayesville, S. C.

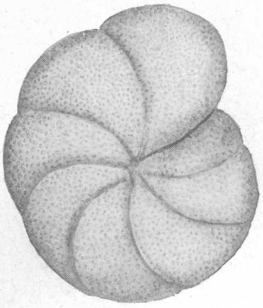
3. *Truncatulina variolata* (D'Orbigny) Cushman, × 60. *a*, From above; *b*, from below; *c*, from side. Jackson Bluff, Fla.

PLATE XVII.

FIGURE 1. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny, × 100. *a*, From above; *b*, from below; *c*, from side. South Carolina.

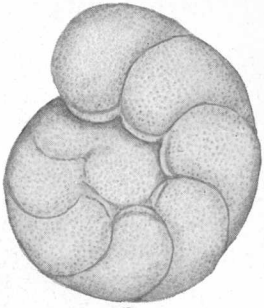
2. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny, × 100. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

3. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny, × 75. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.



1a

1c



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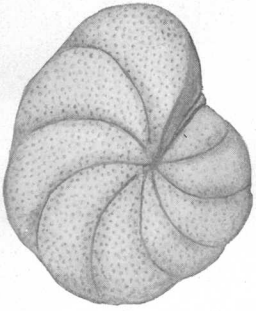

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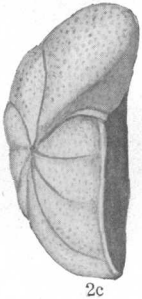

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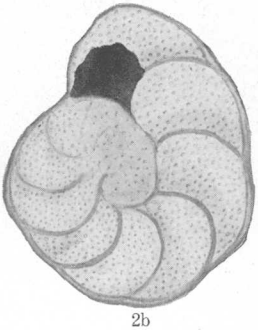
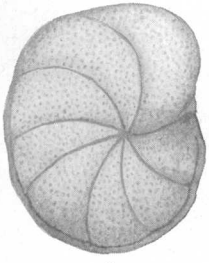
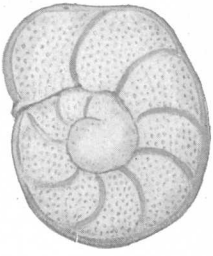


2b

3c

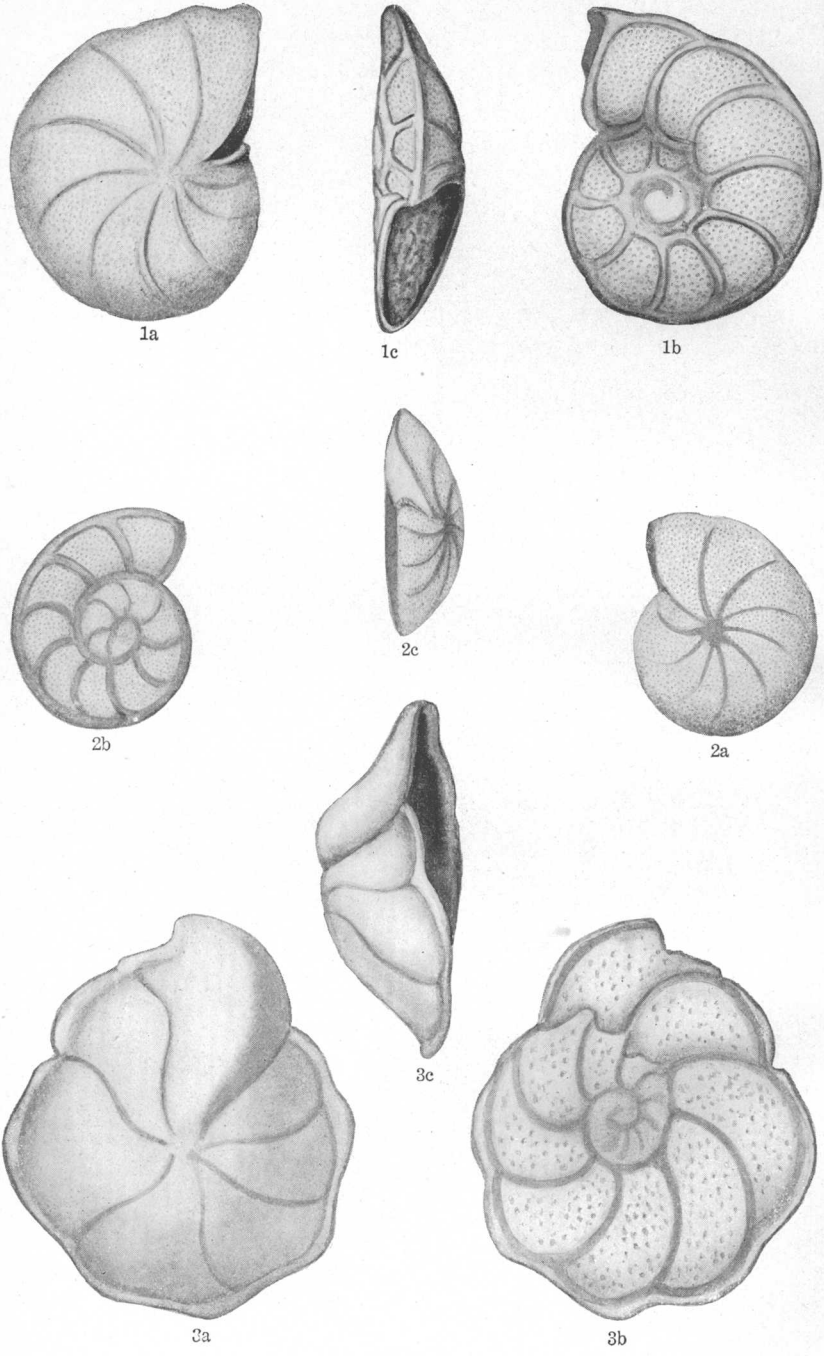


3a



3b

MIOCENE FORAMINIFERA.



1a 1c 1b

2c

2b 2a

3c

3a 3b

MIOCENE FORAMINIFERA.

PLATE XVIII.

FIGURE 1. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny var. *ornata* Cushman, n. var., × 65. *a*, From above; *b*, from below; *c*, from side. Coes Mills, Fla.

2. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny var. ornata Cushman, n. var., × 65. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

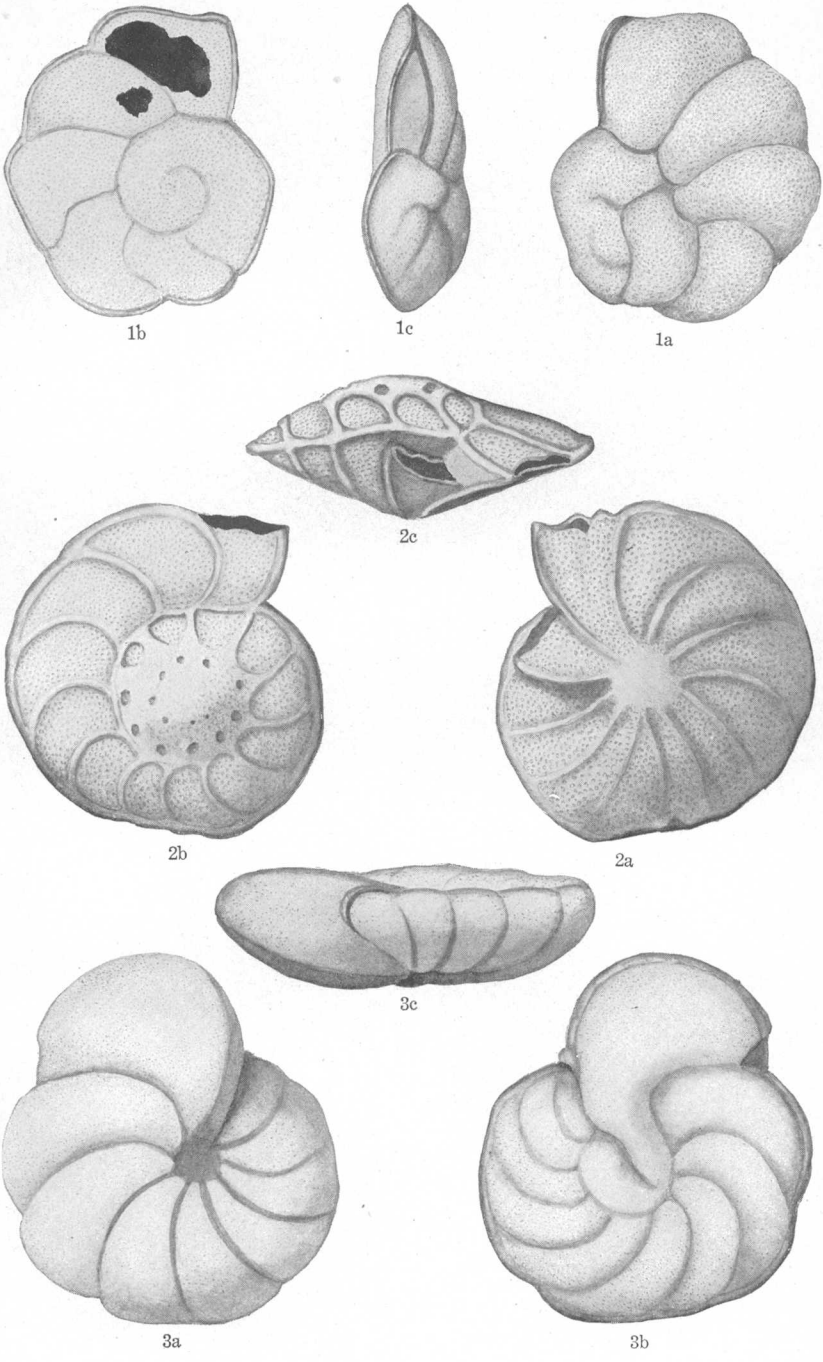
3. *Truncatulina refulgens* (Montfort) D'Orbigny, × 130. *a*, From above; *b*, from below; *c*, from side. Coes Mills, Fla.

PLATE XIX.

FIGURE 1. *Truncatulina subloba* Cushman, n. sp., × 65. *a*, From above; *b*, from below; *c*, from side. Suffolk, Va.

2. *Truncatulina floridana* Cushman, n. sp., × 65. *a*, From above; *b*, from below; *c*, from side. One mile south of Red Bay, Fla.

3. *Truncatulina wuellerstorfi* (Schwager) Brady, × 65. *a*, From above; *b*, from below; *c*, from side. Jackson Bluff, Fla.



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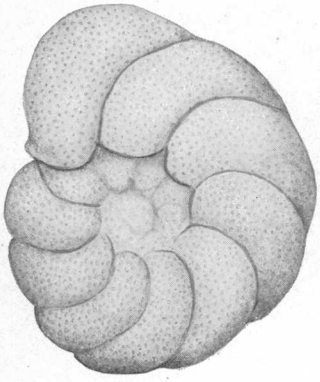

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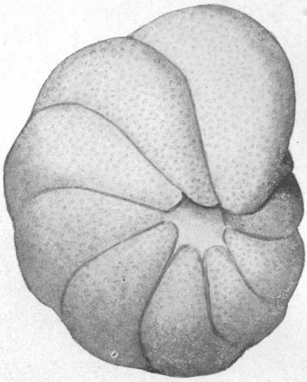

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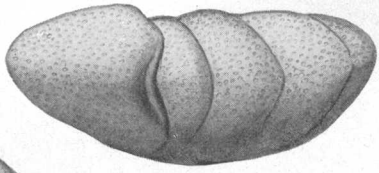

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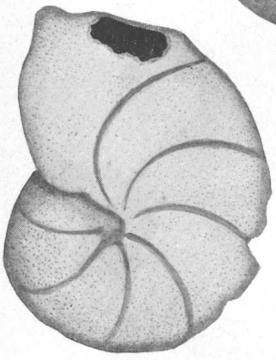

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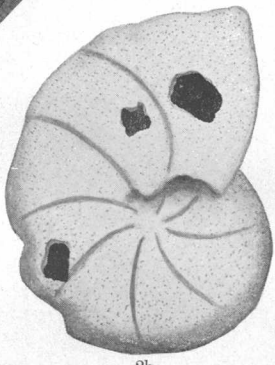

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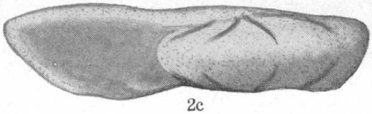

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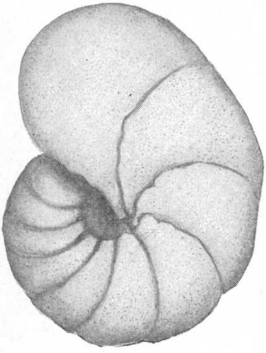

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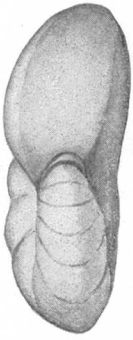

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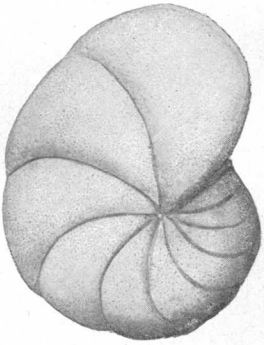


3b

MIOCENE FORAMINIFERA.

PLATE XX.

FIGURE 1. *Truncatulina wuellerstorfi* (Schwager) Brady, × 65. *a*, Dorsal view; *b* ventral view; *c*, side view. Mayesville, S. C.

2. *Truncatulina americana* Cushman, n. sp., × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. Wilmington, N. C.

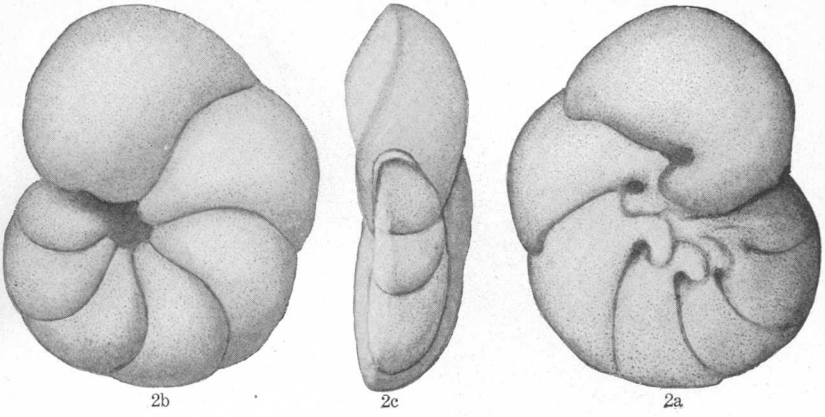
3. *Truncatulina americana* Cushman, n. sp., × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. Wilmington, N. C.

PLATE XXI.

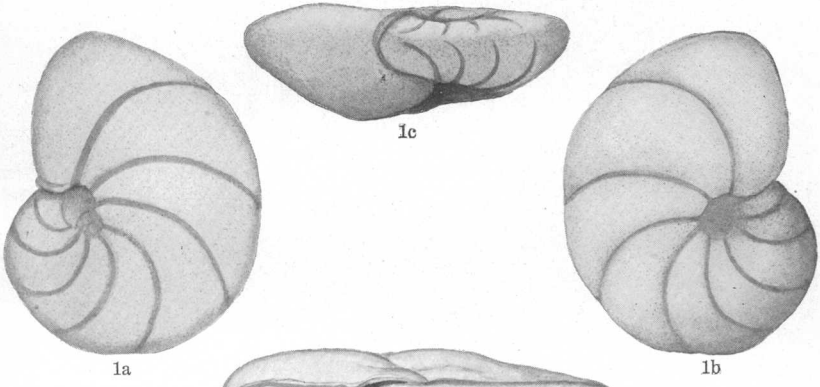
FIGURE 1. *Truncatulina americana* Cushman, n. sp., × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. Mayesville, S. C.

2. *Truncatulina basiloba* Cushman, n. sp., × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. South Carolina.

3. *Truncatulina concentrica* Cushman, n. sp., × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. One mile south of Red Bay, Fla.

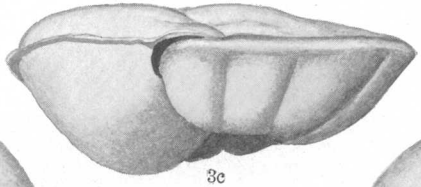


2b 2c 2a



1c

1a 1b



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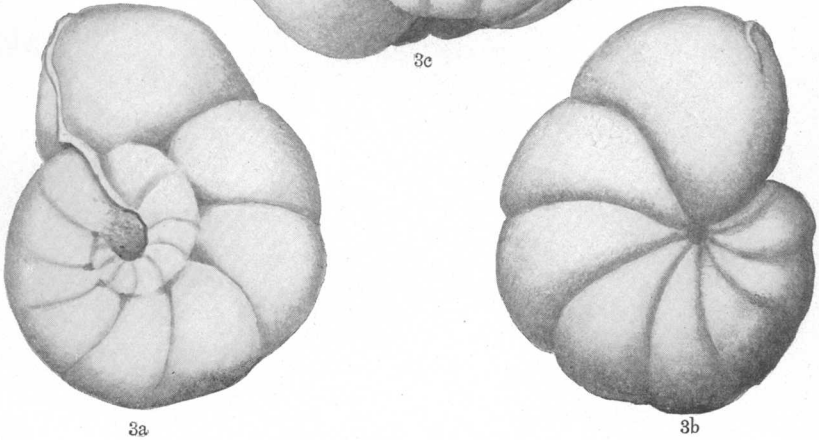
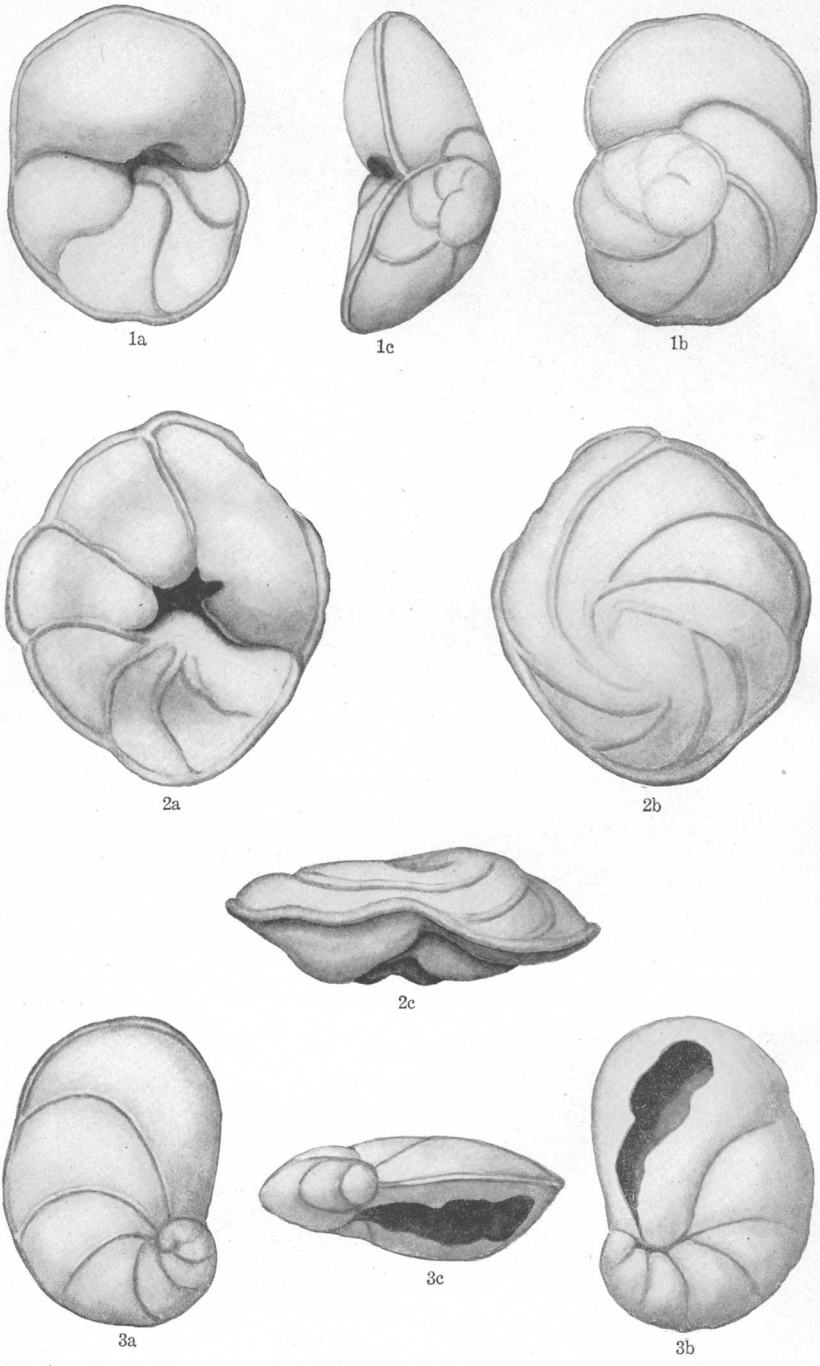


3a 3b

MIOCENE FORAMINIFERA.



MIOCENE FORAMINIFERA.

PLATE XXII.

FIGURE 1. *Pulvinulina menardii?* (D'Orbigny) Owen, × 65. *a*, Ventral view; *b*, dorsal view; *c*, side view. Lancaster County, Va.

2. *Pulvinulina sp.?*, × 33. *a*, Ventral view; *b*, dorsal view; *c*, side view. Jackson Bluff, Fla.

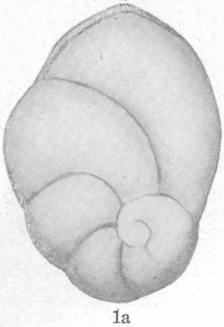
3. *Pulvinulina sagra* (D'Orbigny) Cushman, × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. One mile south of Red Bay, Fla.

PLATE XXIII.

FIGURE 1. *Pulvinulina sagra* (D'Orbigny) Cushman, × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. Suffolk, Va.

2. *Pulvinulina repanda* (Fichtel and Moll) Jones, × 65. One mile south of Red Bay, Fla.

3. *Rotalia beccarii* (Linnaeus) D'Orbigny, × 130. *a*, Dorsal view; *b*, ventral view; *c*, side view. Wilmington, N. C.



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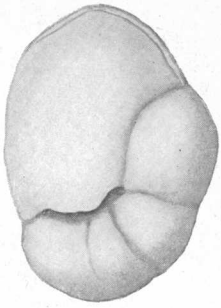

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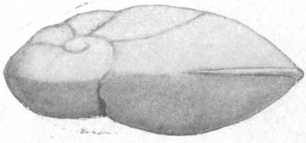

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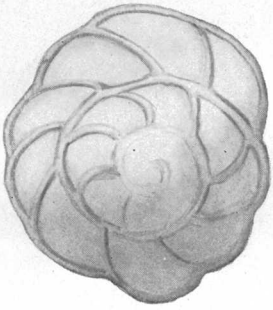

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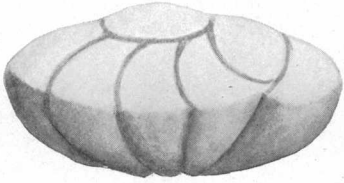

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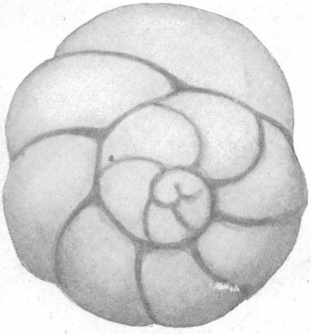

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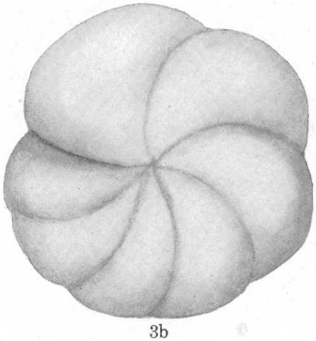
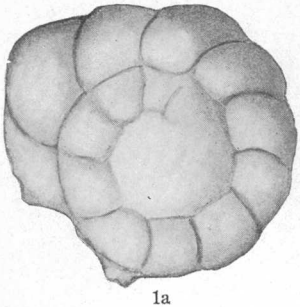


3b

MIOCENE FORAMINIFERA.



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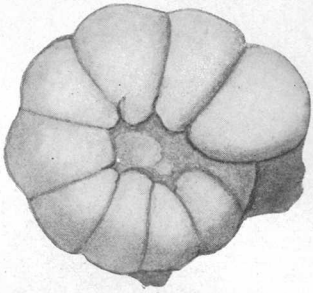

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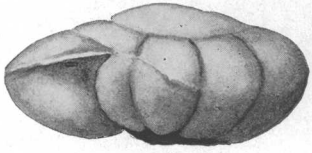

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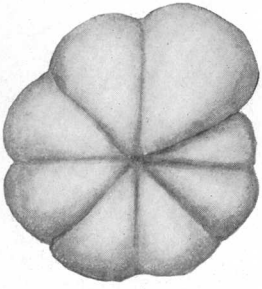

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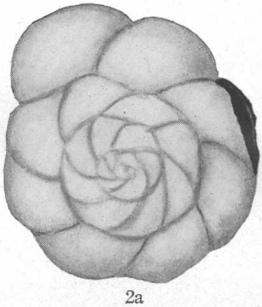

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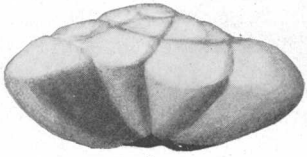
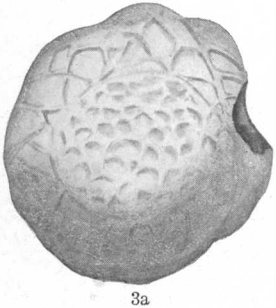
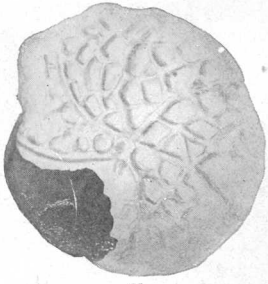


2c



3a

3c



3b

MIOCENE FORAMINIFERA.

PLATE XXIV.

FIGURE 1. *Rotalia beccarii* (Linnaeus) D'Orbigny, × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. Mayesville, S. C.

2. *Rotalia beccarii* (Linnaeus) D'Orbigny, × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. Jackson Bluff, Fla.

3. *Rotalia reticulata* Cushman, n. sp., × 65. *a*, Dorsal view; *b*, ventral view; *c*, side view. Wilmington, N. C.

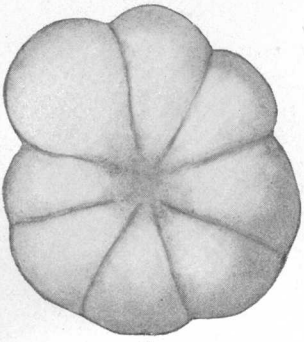
PLATE XXV.

FIGURE 1. *Rotalia beccarii* (Linnaeus) D'Orbigny, × 130. *a*, Dorsal view; *b*, ventral view; *c*, side view. Coes Mills, Fla.

2. *Nonionina scapha* (Fichtel and Moll) Parker and Jones, × 65. *a*, Side view; *b*, apertural view. Mayesville, S. C.

3. *Nonionina boueana* D'Orbigny, × 65. One mile south of Red Bay, Fla.

4. *Nonionina extensa* Cushman, n. sp., × 65. *a*, Side view; *b*, apertural view. Mayesville, S. C.



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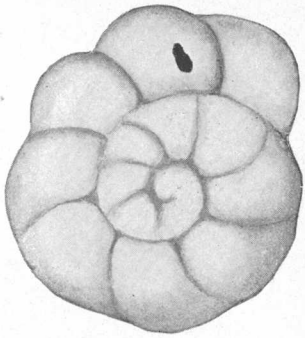

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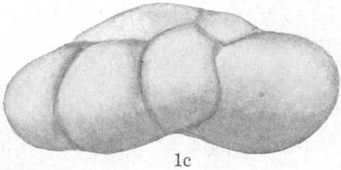
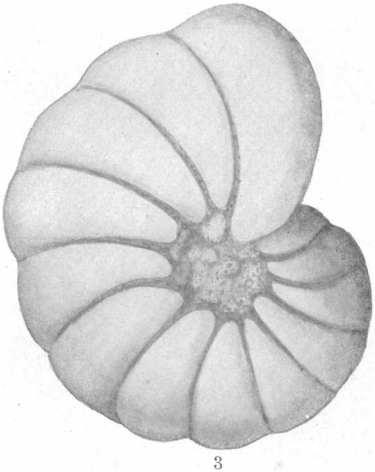


1c

2b

4b



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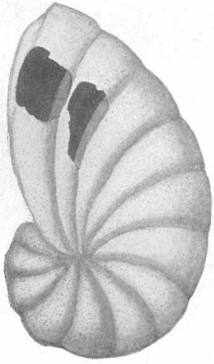
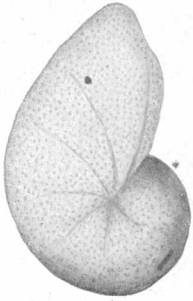


2a



4a

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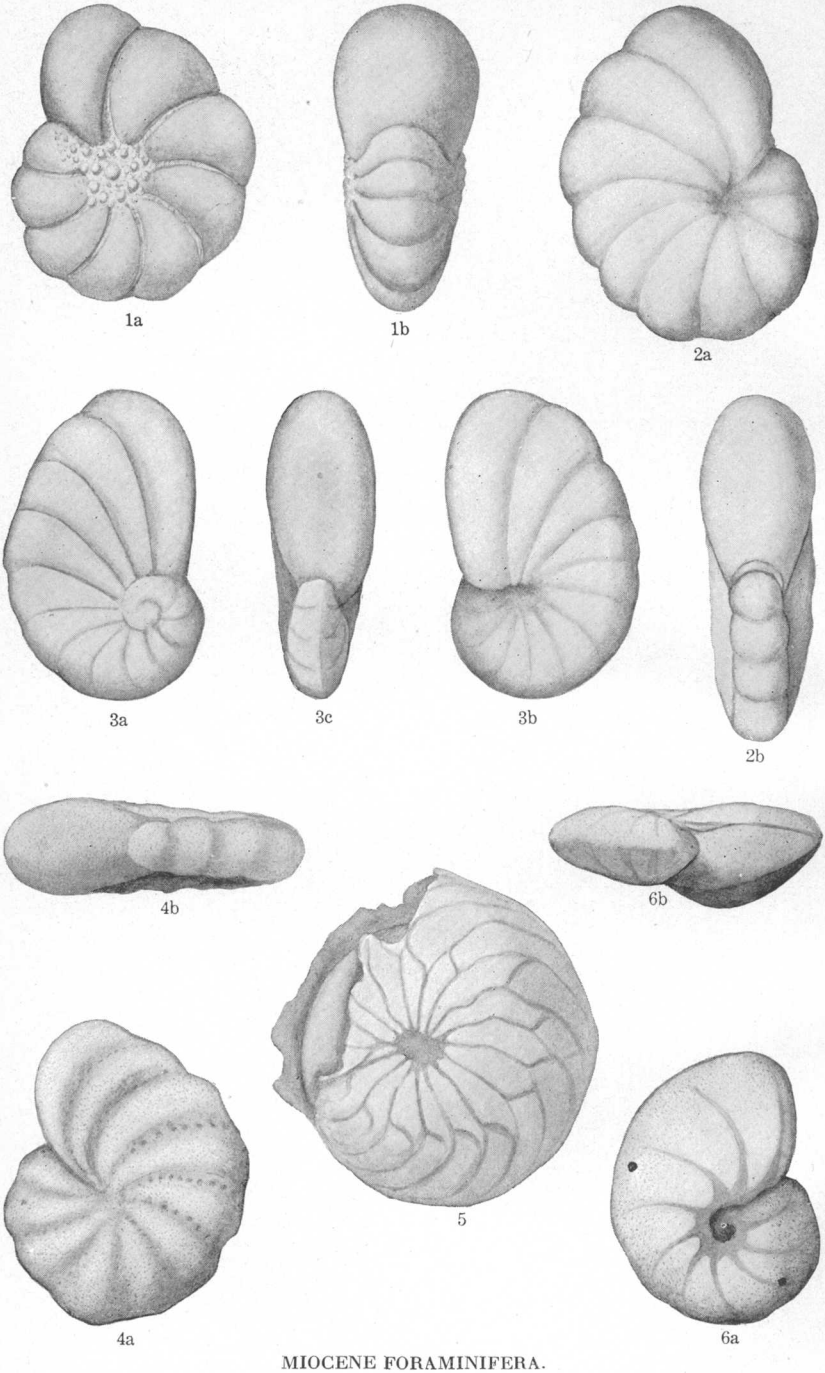


MIOCENE FORAMINIFERA.

PLATE XXVI.

FIGURE 1. *Nonionina depressula* (Walker and Jacob) Parker and Jones, × 65. *a*, Side view; *b*, apertural view. Suffolk, Va.

2. *Nonionina scapha* (Fichtel and Moll) Parker and Jones, × 65. *a*, Side view; *b*, apertural view. Jackson Bluff, Fla.

3. *Nonionina scapha* (Fichtel and Moll) Parker and Jones, × 65. *a*, Dorsal view; *b*, ventral view; *c*, apertural view. Suffolk, Va.

4. *Polystomella striatopunctata* (Fichtel and Moll) Parker and Jones, × 65. *a*, Side view; *b*, apertural view. Mayesville, S. C.

5. *Amphistegina lessonii* D'Orbigny, × 27. Muldrows Mills, S. C.

6. *Nonionina umbilicatula* (Montagu) Parker, Jones, and Brady, × 65. *a*, Side view; *b*, apertural view. Centerville, Md.

PLATE XXVII.

FIGURE 1. *Polystomella crispa* (Linnaeus) Lamarck, × 65. *a*, Side view; *b*, apertural view. Coes Mills, Fla.

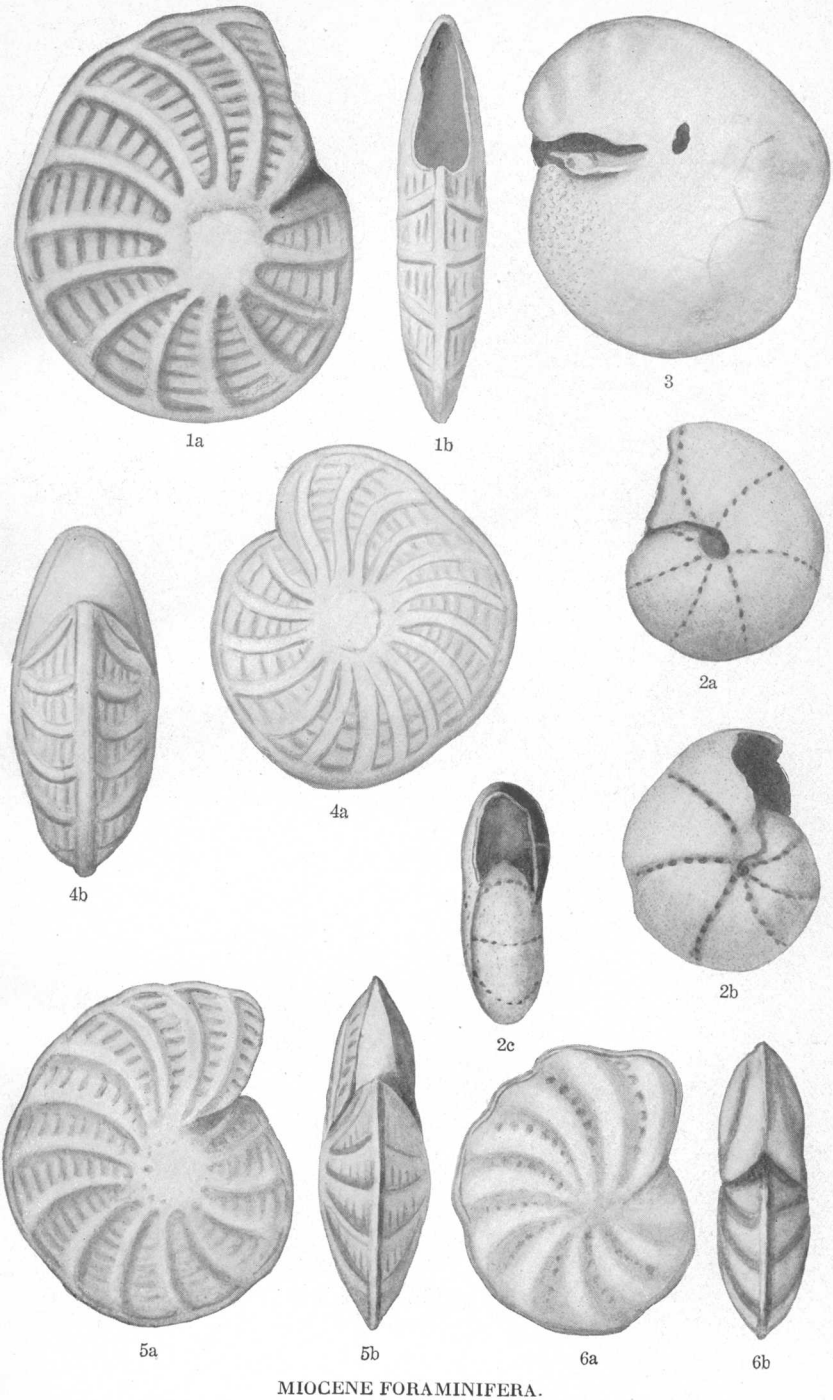
2. *Polystomella striatopunctata* (Fichtel and Moll) Parker and Jones, × 65. *a*, Dorsal view; *b*, ventral view; *c*, apertural view. Coes Mills, Fla.

3. *Amphistegina lessonii* D'Orbigny, × 33. One mile south of Red Bay, Fla.

4. *Polystomella crispa* (Linnaeus) Lamarck, × 60. *a*, Side view; *b*, apertural view. Wilmington, N. C.

5. *Polystomella crispa* (Linnaeus) Lamarck, × 60. *a*, Side view; *b*, apertural view. Jackson Bluff, Fla.

6. *Polystomella subnodosa* (Münster) Reuss, × 65. *a*, Side view; *b*, apertural view. Mayesville, S. C.



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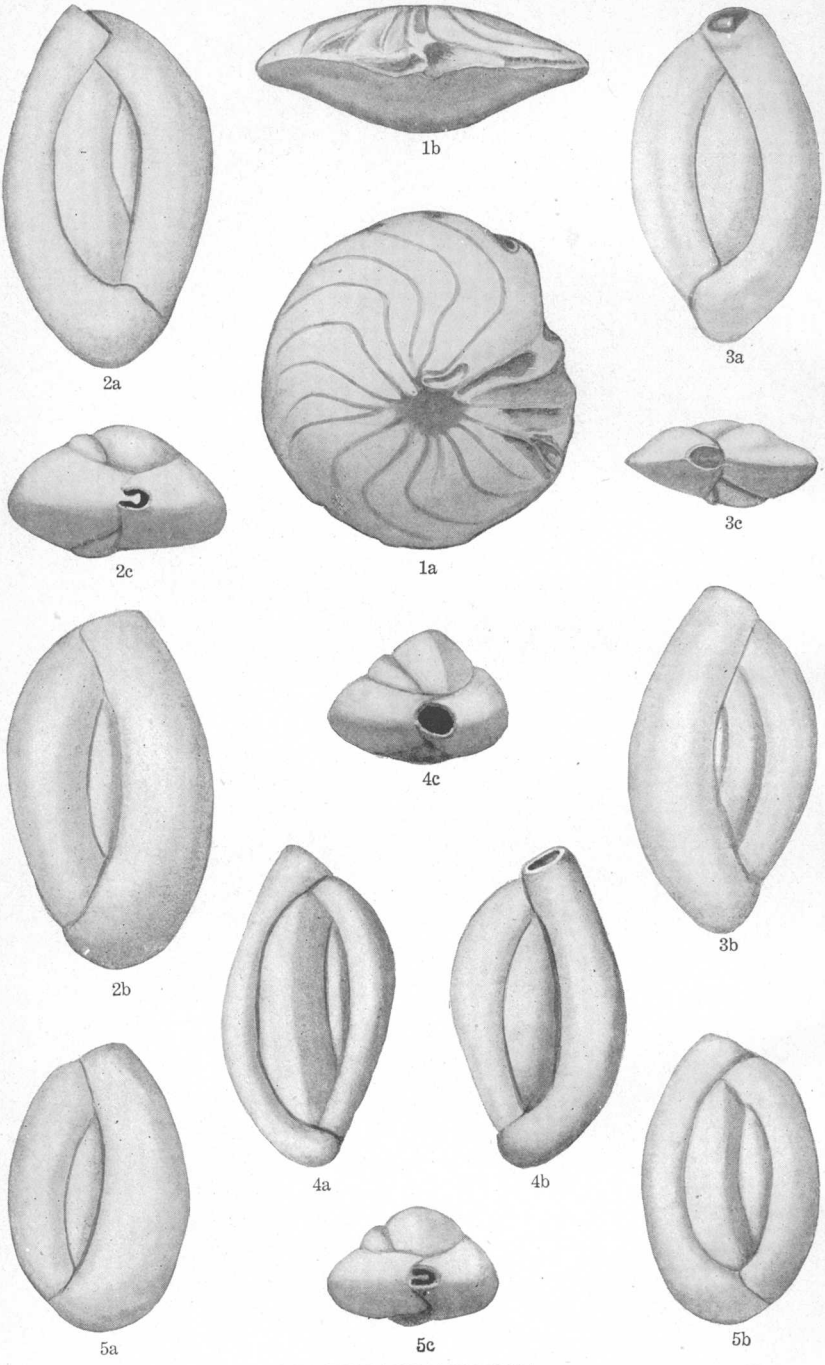


MIOCENE FORAMINIFERA.

PLATE XXVIII.

FIGURE 1. *Amphistegina lessonii* D'Orbigny, × 25. *a*, Side view; *b*, apertural view. Jackson Bluff, Fla.

2. *Quinqueloculina seminulum* (Linnaeus) D'Orbigny, × 60. *a*, *b*, Opposite sides; *c*, apertural view. Suffolk, Va.

3. *Quinqueloculina venusta?* Karrer, × 33. *a*, *b*, Opposite sides; *c*, apertural view. Virginia.

4. *Quinqueloculina seminulum* (Linnaeus) D'Orbigny, × 65. *a*, *b*, Opposite sides; *c*, apertural view. Muldrows Mills, S. C.

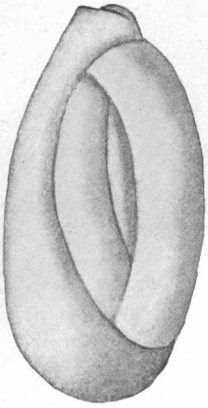
5. *Quinqueloculina seminulum* (Linnaeus) D'Orbigny, × 65. *a*, *b*, Opposite sides; *c*, apertural view. Lancaster County, Va.

PLATE XXIX.

FIGURE 1. *Quinqueloculina seminulum* (Linnaeus) D'Orbigny, × 65. *a*, *b*, Opposite sides; *c*, apertural view. Lancaster County, Va.

2. *Quinqueloculina venusta?* Karrer, × 55. *a*, *b*, Opposite sides; *c*, apertural view. Jackson Bluff, Fla.

3. *Quinqueloculina subdecorata* Cushman, n. sp., × 27. *a*, *b*, Opposite sides; *c*, apertural view. Collected by Tuomey in Virginia.



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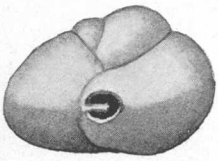

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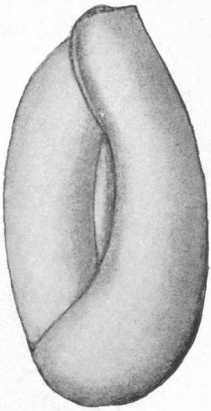

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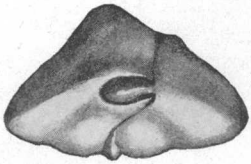

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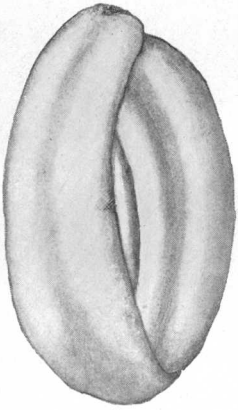

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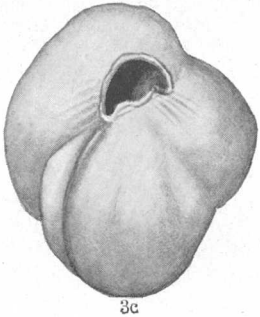

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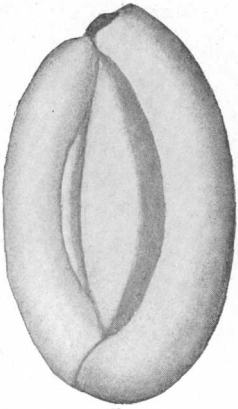

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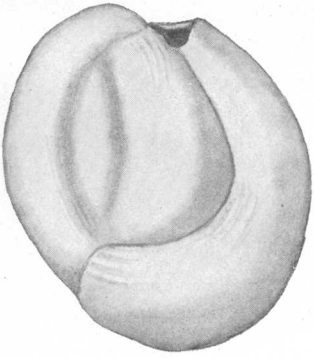

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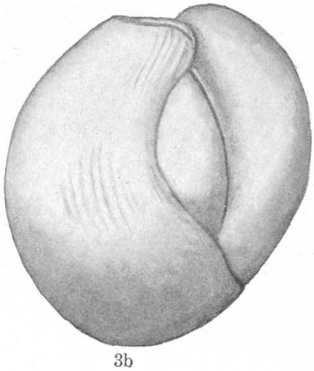

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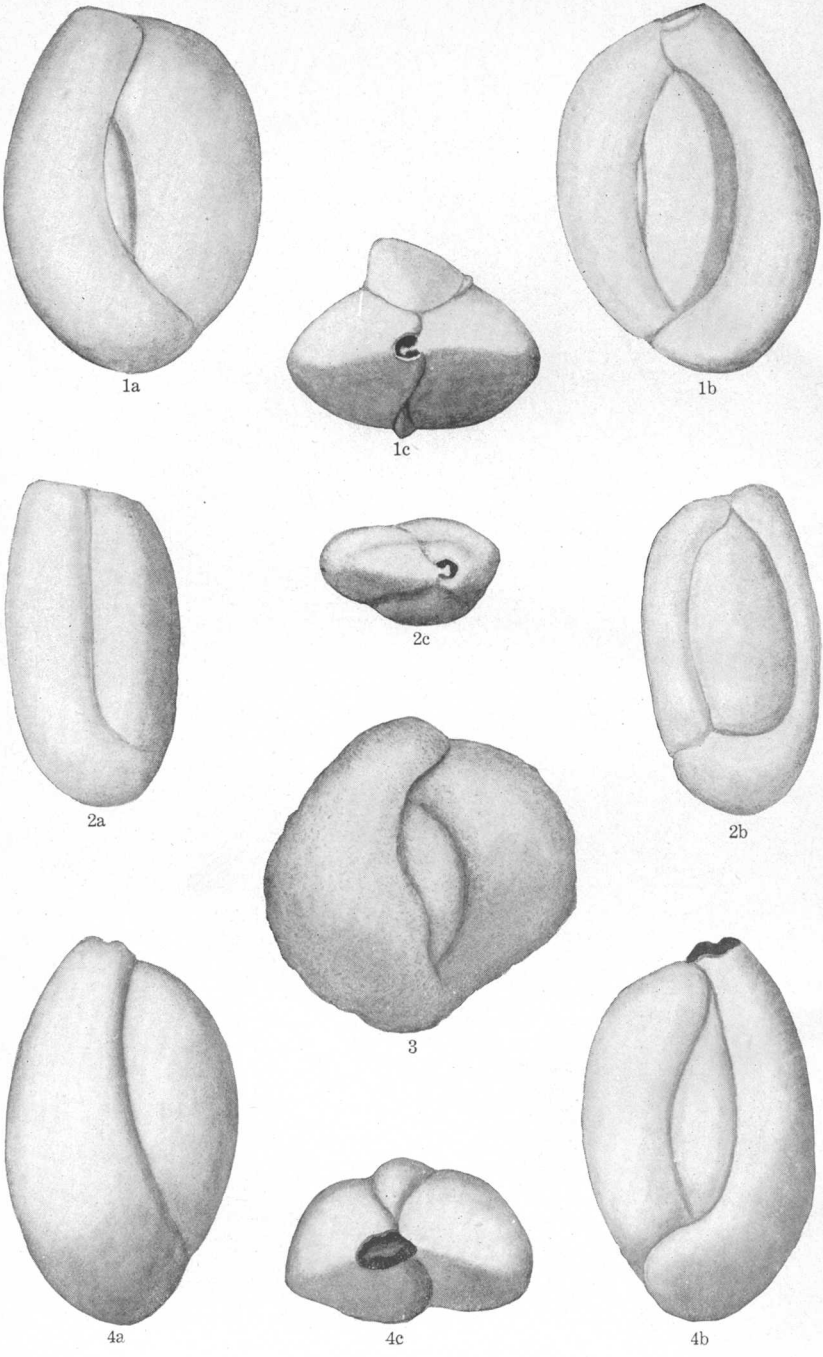
MIOCENE FORAMINIFERA.



MIOCENE FORAMINIFERA.

PLATE XXX.

FIGURE 1. *Quinqueloculina auberiana* D'Orbigny, × 65. *a*, *b*, Opposite sides; *c*, apertural view. Lancaster County, Va.

2. *Triloculina oblonga* (Montagu) D'Orbigny, × 33. *a*, *b*, Opposite sides; *c*, apertural view. Virginia.

3. *Triloculina asperula* Cushman, n. sp., × 133. Coes Mills, Fla.

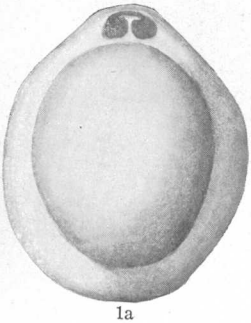
4. *Triloculina schreiberiana* D'Orbigny, × 65. *a*, *b*, Opposite sides; *c*, apertural view. Coes Mills, Fla.

PLATE XXXI.

FIGURE 1. *Biloculina bulloides* D'Orbigny, × 55. *a*, Front view; *b*, side view; *c*, apertural view. Jackson Bluff, Fla.

2. *Spiroloculina limbata* D'Orbigny, × 65. *a*, Front view; *b*, apertural view. Jackson Bluff, Fla.

3. *Truncatulina rostrata?* Brady, × 135. *a*, Side view; *b*, apertural view. Mayesville, S. C.



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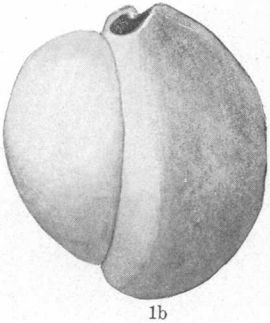

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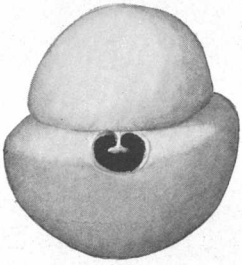

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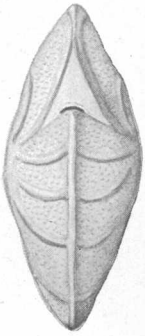

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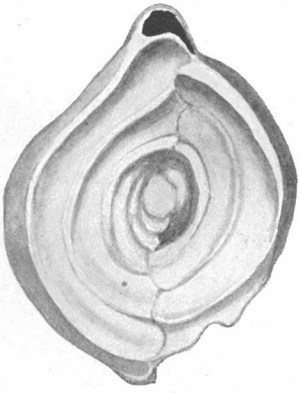

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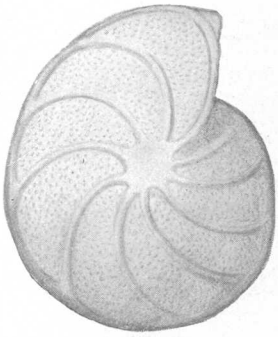

3a

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