SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 103

CONTRIBUTIONS TO THE GEOLOGY AND PALEONTOLOGY OF THE CANAL ZONE, PANAMA, AND GEOLOGICALLY RELATED AREAS IN CENTRAL AMERICA AND THE WEST INDIES

THE SMALLER FOSSIL FORAMINIFERA OF THE PANAMA CANAL ZONE

By JOSEPH AUGUSTINE CUSHMAN
Of the United States Geological Survey

Extract from Bulletin 103, pages 45–87, with Plates 19–33

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INTRODUCTION.

The collection of fossil foraminifera included in this report were sent to the writer by the United States Geological Survey. It consists almost entirely of material collected by Messrs. D. F. MacDonald and T. Wayland Vaughan in 1911, to whom I am indebted for data as to the geological correlation. The names applied to the geologic formations are those used in MacDonald's "Sedimentary formations of the Panama Canal Zone, with special reference to the stratigraphic relations of the fossiliferous beds," which appears in the latter part of this volume. Where former correlation has seemed not to apply to the foraminifera, especially those of three stations, 6033*c*, 6035, and 6036*a*, discussion of the data obtained from the foraminifera is given in detail later.

The orbitoids and nummulites are both well represented in the collection, but as these require special study in connection with those of the Coastal Plain and of the West Indian region it seems advisable to treat them in a separate paper which immediately follows the present one.

The following data are given for only the stations from which foraminifera were obtained and which are recorded in this paper.

LIST OF MATERIAL.

U.S.G.S. station 6009.—Oligocene—Culebra formation (upper part).
From section in Canal cut 600 feet south of Miraflores Locks.
Dark, soft, fairly well laminated clay rock.
Few foraminifera and rather poorly preserved.

6010.—Oligocene—Culebra formation (lower part).
From section—Pedro Miguel Locks to Paraiso Bridge.
Dark, well laminated, very soft, carbonaceous clay rocks.
Foraminifera in fairly good numbers and a rather varied assortment; mostly stained black, except certain of the Miliolidae, which still keep their calcareous tests more or less in their original condition.

6012.—Oligocene—Culebra formation.

From section—west side of Gaillard Cut.

a. Dark, well laminated soft and very friable carbonaceous shale.

Few foraminifera—some glauconitic, others well preserved.

c. From a lens of sandy limestone 5 feet thick.

Few foraminifera—some stained, some glauconitic, rather poorly preserved as to details.

d. From lenses of limy sandstone at base of gravel, 3 feet thick.

Few foraminifera and these poorly preserved.

6015.—Oligocene—Emperador limestone.

From old quarry, one-fourth mile north of west from Empire.

Cream-colored, coral limestone.

Few foraminifera.

6016.—Oligocene—Emperador limestone.

From old quarry, one-third mile north of west of Empire.

Few poorly preserved foraminifera.

6019.—Section on west side of Gaillard Cut near Las Cascadas.

a–f. Oligocene—Culebra formation.

a. Grayish, rather nodular, impure limestone.

Foraminifera few and poor.

b. Dark, well stratified, very friable, tufaceous material.

Foraminifera few and poor except *Orbitolites*, which are large and fine.

c. Grayish, well stratified, very friable, tufaceous sandstone.

Few casts of foraminifera and central portions of orbitoids.

d. Grayish-green, limy, tufaceous sandstone.

Very few foraminifera, poor specimens.

e. Thin-bedded, light gray to cream-colored, limy sandstone with some partings of light-colored clay.

orbitoids and *Orbitolites?* only.

f. Dark, very friable shales and tuffs.

Foraminifera fairly common, some well preserved, others glauconitic.

g. Oligocene—Emperador limestone.

Light gray to yellowish gray, somewhat sandy limestone.

Some orbitoids and *Orbitolites?* but little else in the way of foraminifera.

6020.—Oligocene—Culebra formation.

Same locality as 6019.

a–c. Dark-gray carbonaceous clays, friable shales and tuffs.

a. Foraminifera numerous but of few species, mostly glauconitic, at least in part.

c. A few *Orbitolites* in the coralliferous layer.

6024.—Section in railway cuts near New Frijoles.

a. Oligocene—Culebra formation.

Dark, basic, orbitoidal, tufaceous material.

Many worn central portions of Orbitoids and a very few other foraminifera poorly preserved.

6025.—Oligocene—Culebra formation (upper part).

About 200 yards south of southern end of switch at Bohio Ridge station relocated line Panama Railroad.

Contains a number of species of foraminifera but for the most part broken or poorly preserved.

6026.—Two miles south of Monte Lirio.

Somewhat coarse-grained sandstone.

Few poor specimens of foraminifera.

6029.—Section one-half mile from Camp Cotton, toward Monte Lirio, at big curve on railroad. Miocene—Gatun formation.

a. Bluish, fossiliferous argillite.

Very few foraminifera.

b. Bluish argillite.

Few foraminifera, but considerably more than in *a.*

c. Bluish, fossiliferous argillite.

Very few poor specimens of *Amphistegina.*

6030.—Railroad cut north side of Big Swamp, one and one-half miles north of Monte Lirio. Miocene—Gatun formation.

Bluish gray, argillaceous beds.

The only foraminifera consisted of a single specimen of *Triloculina.*

6031.—Section in cut one-half mile west of Camp Cotton toward Gatun. Miocene—Gatun formation.

Conglomerate bed and sandy marl 1 foot above.

A few poorly preserved specimens of *Quinqueloculina* were the only foraminifera.

6033.—Generalized section of the bluffs exposed along the Panama Railroad, relocated line, about 3,500 feet south of Gatun Railroad Station. Miocene Gatun—formation.

c. Dark-colored, marly, fossiliferous clay.

Rich in foraminifera, especially in specimens. A fair number of species, well preserved.

6035.—Vicinity of Mindi Hill. Miocene—Gatun formation.

Gray-green, fine grained sandy shell marl.

Very fine-grained material, but with numerous species and specimens of foraminifera representing an off-shore assemblage.

6036.—Monkey Hill, Mount Hope Station. Miocene—Gatun formation.

Dark-colored, fine grained, sandy clay marl.

Specimens of foraminifera numerous and well preserved, representing an off-shore assemblage comparable to 6035.

5850.—Near Mount Hope—Pleistocene.

Loose shells and marl obtained from ditch through swampy ground about one-fourth mile from present sea beach and about 6 to 8 feet above high tide.

Contains a few foraminifera of common shallow water, tropical species.

The geological position of certain material from near the Atlantic end of the canal seems from the evidence of the contained foraminifera to be younger than the position previously assigned to it—the upper Oligocene. By a reference to the table of distribution it will be noted that the great majority of the species occurring at the stations in question; 6533*c*, 6035, and 6036, do not occur in the material of definitely Oligocene age. In such cases as that of *Cristellaria rotulata* there is a slight difference in the specimens from these stations and those from the Pacific side, 6010, 6012*a*, 6012*c*, but the specimens at the latter stations were in small quantity, and the differences could not be made use of, mainly from lack of a sufficient number of specimens. In the case of *Cristellaria vaughani* this seems to be a well-characterized species occurring at several stations, but even in it there are very minor differences. Among the species of *Globigerina*, the more generalized species such as *G. bulloides*, which has a very wide geological range, occur more or less constantly throughout the collections, but the strongest evidence comes from the last three species and *Orbulina*, which are very rarely found fossil, and then only in the very latest tertiary. These were well characterized species, the specimens are very clean and complete, and resemble a modern Globigerina ooze of considerable depth. The three species of *Pulvinulina* also occur nowhere but at these stations. *Pulvinulina concentrica* is essentially a recent species and *P. menardii* is characteristic of modern *Globigerina* ooze. *Sigmoilina tenus* and *S. asperula* are also speces of recent *Globigerina* ooze of moderate depths. On the other hand, the lack of certain things is also significant. *Amphistegina*, which occurs more or less regularly in the other portion of the material, is entirely wanting in the three Pacific stations, 6033*c*, 6035, and 6036. *Polystomella* also does not occur. Both the last two genera are very characteristic of the coastal plain Oligocene of the United States. It may be argued in this case, however, that the stations were originally too far from shore to have these genera which are more characteristic of shallow littoral conditions.

On the whole, the foraminifera bear out the geological determinations based upon the other groups of organisms.

Table of distribution.

	Oligocene.																		Miocene.							Pleistocene.
	Culebra.					Emperador.		Culebra.											Gatun.							
	6009	6010	6012*a*	6012*c*	6012*d*	6015	6016	6019*a*	6019*b*	6019*c*	6019*d*	6019*e*	6019*f*	6020*a*	6020*c*	6021*a*	6025	6026	6029*a*	6029*b*	6029*c*	6030	6033*c*	6035	6036	5350
Textularia abbreviata d'Orbigny	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
sagittula Defrance	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	....	....	....	....	....	....	....	.....
agglutinans d'Orbigny	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
laminata, new species	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
subagglutinans, new species	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	....	.....
carinata d'Obigny	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	.....
panamensis, new species	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	+	.....
Chrysalidina pulchella, new species	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	.....
Bolivina punctata d'Orbigny	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	....	.....
acnariensis (Costa)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	+	.....
robusta H. B. Brady	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	.....
Bigenerina nodosaria d'Orbigny	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	.....
Gaudryina flintii Cushman	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
triangularis Cushman	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Clavulina parisiensis d'Orbigny	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
communis d'Orbigny	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Virgulina squamosa d'Orbigny	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Lagena striata, var. *strumosa* Reuss	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	+	.....
Nodosaria communis d'Orbigny	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	.....
insecta Schwager?	....	+	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
raphanistrum (Linnaeus)	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Cristellaria rotulata (Lamarck)	....	+	+	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	+	.....
italica Defrance	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	.....
protuberans, new species	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
vaughani, new species	....	+	....	....	....	....	....	....	....	....	....	....	+	....	....	....	+	....	....	....	....	....	....	+	+	.....
Urigerina canariensis d'Orbigny	....	?	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	.....
pygmaca d'Orbigny	....	....	....	....	+	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	.....
tenuistriata Reuss	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	.....
Siphogenerina raphanus, var. *transversus*, new variety	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Globigerina bulloides d'Orbigny	+	+	....	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	+	....	....	+	+	+	.....
inflata d'Orbigny	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	.....
dubia Egger	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....	+	+	+	.....
conglobata H. B. Brady	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	.....
sacculifera H. B. Brady	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	.....
acquilateralis H. B. Brady	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	+	.....

Orbulina universa d'Orbigny																							+	+	+	
Discorbis obtusa d'Orbigny																										+
Truncatulina americana, new species													+													
pygmea Hantken											+															
ungeriana (d'Orbigny)	+		+																							
wuellerstorfi (Schwager)		+			+								+													
culebrensis, new species					+																					
Pulvinulina oblonga (Williams)																								+	?	
concentrica Parker and Jones																								+		
menardii (d'Orbigny)																							+	+	+	
Siphonina reticulata (Czjzek)																									+	
Nonionina depressula (Walker and Jacob)																							+	+		
scapha (Fichtel and Moll)																							+			
panamensis, new species		+																								
anomalina Cushman, new species		+																								
Polystomella striato-punctata (Fichtel and Moll)														+					+							+
sagra d'Orbigny																										+
macella (Fichtel and Moll)						+	+																			
crispa (Linnaeus)																				+						
craticulata (Fichtel and Moll)																	+									
Amphistegina lessonii d'Orbigny	+		+		+	+	+			+	+								+	+	+					
Quinqueloculina seminulum (Linnaeus)																									+	+
var.		+						+									+									
contorta d'Orbigny																										+
auberiana d'Orbigny																										+
undosa Karrer							+										+									
bicornis (Walker and Jacob)																										+
panamensis, new species																									+	
Sigmoilina tenuis (Czjzek)																							+	+	+	
asperula (Karrer)																								+	+	
Triloculina trigonula (Lamarck)																										+
tricarinata d'Orbigny																	+									
bulbosa, new species																			+			+				
projecta, new species																								+		
Biloculina bulloides d'Orbigny																									+	
Spiroloculina excavata d'Orbigny																										
Orbiculina adunca (Fichtel and Moll)																										+
Orbitolites americana, new species									+					+	+		+									

DESCRIPTIONS OF SPECIES.

Family TEXTULARIIDAE.

Genus TEXTULARIA Defrance, 1824.

TEXTULARIA ABBREVIATA d'Orbigny.

Plate 19, fig. 1.

Textularia abbreviata d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 249, pl. 15, figs. 9–12 (7–12).

Description.—Test broad and short, somewhat compressed, chambers comparatively few in number, broad near the center and tapering to the periphery, sutures in these specimens indistinct, aperture an arched slit extending nearly across the test, wall comparatively smooth.

Length 0.65 mm., breadth about 1 mm. Cat. No. 324608, U.S.N.M.

Specimens from U.S.G.S. No. 6010, from the Culebra formation, dark clay north of Pedro Miguel Locks. Apparently the material is rather metamorphosed and more or less glauconitic so that little of the original test is preserved. This is a rather common Tertiary species.

TEXTULARIA SAGITTULA Defrance.

Plate 19, fig. 2.

Textularia sagittula Defrance, Dict. Sci. Nat., vol. 32, 1824, p. 177; vol. 53, 1828, p. 344; Atlas, Conch., pl. 13, fig. 5.

Description.—Test elongate, tapering, much compressed especially at sides, chambers numerous, sutures indistinct, aperture a curved slit occupying about one-half the width of the base of the chamber.

Length about 1.5 mm., breadth 1 mm. Cat. No. 324609, U.S.N.M.

A few poorly preserved specimens from U.S.G.S. No. 6025, from the Culebra formation, foraminiferal marl and coarse sandstone about 200 yards south of southern end of switch at Bohio Ridge station, relocated line, Panama Railroad.

Although this material is more or less glauconitic and poorly preserved the three specimens, one of which is here figured, are referred with a reasonable degree of certainty to this species.

A single fragmentary specimen from U.S.G.S. No. 6026, from the Culebra formation, coarse, sandy foraminiferal marl about half way between Monte Lirio and Bohio Ridge, relocated line, Panama Railroad, seems also to be this species.

TEXTULARIA AGGLUTINANS d'Orbigny.

Plate 19, fig. 3.

Textularia agglutinans d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 136, pl. 1, figs. 17, 18, 32–34.

Description.—Test elongate, tapering, but slightly compressed laterally, chambers high, sutures deep, outline sinuous, end view broadly elliptical, wall composed of rather coarse agglutinated material, aperture a narrow slit a little more than half the width of the base of the chamber.

Length 1.23 mm., breadth 0.65 mm. Cat. No. 324610, U.S.N.M.

A single specimen here figured seems referable to this species. It is from U.S.G.S. No. 6019–*f*, from the uppermost bed of the Culebra formation, the lower limestone of the Las Cascadas section, opposite Las Cascadas, Gaillard Cut. Although not so rounded in end view as this species usually is in recent specimens, the general characters, wall structure, high rotund chambers and lobulated outline seem to place it here.

TEXTULARIA LAMINATA, new species.

Plate 19, fig. 4.

Description.—Test elongate, cuneate, tapering from the widest part near the apertural end, gradually and evenly to the initial end which is subacute, median line raised thence tapering rapidly toward the periphery which is thin and extends out into a lamella-like border, chambers numerous, wide and low, sutural lines raised, somewhat curved backward; border irregular, wall finely arenaceous; aperture indistinct.

Length 2 mm., breadth 1.2 mm.

Specimen figured from U.S.G.S. No. 6010, from lower part of the Culebra formation, dark clay north of Pedro Miguel Locks. Specimen rather better preserved than most from this station. The end view of this specimen is mainly rhomboidal with the bordering carina extending outward in a thin carina. It is in some ways suggestive of *Textularia carinata* but differs in many respects from that species which is also figured on plate 19, fig. 6.

Type-specimen.—Cat. No. 324611, U.S.N.M.

TEXTULARIA SUBAGGLUTINANS, new species.

Plate 19, fig. 5.

Description.—Test subrhomboidal in front view tapering from the middle toward either end, in end view oblong, sides truncated; chambers comparatively few, somewhat inflated, sutures conspicuously de-

pressed, wall composed of rather coarse arenaceous material, aperture extending into the base of the chamber in a narrow rounded opening deeper than wide.

Length 1.3 mm., breadth 0.85 mm.

This species was fairly common from U.S.G.S. No. 6033*c*, the Gatun formation, in marl from second bed from bottom, just below lower clay, Gatun section, relocated line Panama Railroad.

This species may be distinguished from *Textularia agglutinans* by the truncated sides, the oblong end view and especially by the deep, narrow aperture.

Type specimen.—Cat. No. 324612, U.S.N.M.

TEXTULARIA CARINATA d'Orbigny.

Plate 19, fig. 6.

Textularia carinata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 263, No. 23; Foram Foss. Bass. Tert. Vienne, 1846, p. 247, pl. 14, figs. 32–34.

Description.—Test much compressed, rather abruptly tapering toward the initial end, sutures strongly limbate, in well-preserved specimens extending out from the periphery in angular spine-like projections, aperture narrow, elongate.

Length 1 mm., breadth 0.65 mm. Cat. No. 324613, U.S.N.M.

The only material of this species is from U.S.G.S. No. 6036, from the Gatun formation, a dark-colored, fine-grained, sandy clay marl from Monkey Hill, Mount Hope Station. It is very evidently this species and is well preserved.

TEXTULARIA PANAMENSIS, new species.

Plate 20, fig. 1.

Description.—Test rhomboid in front view, very much compressed, in end view long and narrow, the faces nearly parallel, sides rounded; composed of comparatively few chambers but variable; long and low, sutures somewhat depressed, wall rather coarsely arenaceous; aperture indistinct.

Length 0.85 mm., breadth 0.65 mm.

The figured specimen is from U.S.G.S. No. 6036, from the Gatun formation, a dark-colored, fine-grained sandy clay marl from Monkey Hill, Mount Hope Station. Specimens were common from U.S.G.S. No. 6033*c*, in marl from second bed from bottom, just below lower clay, Gatun section, relocated Panama Railroad.

This is a rather striking species, with its very flat, broad front view and very compressed character of the test.

Type-specimen.—Cat. No. 324614, U.S.N.M.

Genus CHRYSALIDINA d'Orbigny, 1846.

CHRYSALIDINA PULCHELLA, new species.

Plate 20, fig. 2.

Description.—Test elongate, gently tapering, broadest at the apical end; in end view triangular; early chambers triserial, later ones uniserial; chambers in uniserial portion triangular, the sutures distinct, gently curved backward at the angles, outline more or less irregular, apertural face gently convex, with indications of numerous circular apertural openings, wall smooth.

Length 0.5 mm., breadth 0.2 mm.

This species occurred at U.S.G.S. No. 6036, the Gatun formation, in dark-colored, fine-grained, sandy clay marl, from Monkey Hill, Mount Hope Station.

The species differs from the only known recent species, *Chrysalidina dimorpha*, in the more tapering and elongate test, the greater irregularity of the contour and test in general and its generally less trim and neat appearance. The specimen figured is well preserved in its general characters, except those of the apertural face, which are somewhat obscured.

Type-specimen.—Cat. No. 324615, U.S.N.M.

Genus BOLIVINA d'Orbigny, 1826.

BOLIVINA cf. B. PUNCTATA d'Orbigny.

Plate 21, fig. 3.

Bolivina punctata d'Orbigny, Voyage Amér. Mérid., vol. 5, pt. 5, "Foraminifères," 1839, p. 63, pl. 8, figs. 10–12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 417, pl. 52, figs. 18, 19.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 292, pl. 38, fig. 1.

Description.—Test much elongate, sides nearly parallel, abruptly tapering at the initial end, chambers numerous, usually higher than broad, inflated, sutures distinct but slightly depressed; wall finely punctate, occasionally becoming slightly striate.

Length 0.60 mm., breadth 0.15 mm. Cat. No. 324616*a*, *b*, U.S.N.M.

Specimens which seem referable to this species were obtained at U.S.G.S. No. 6033*c*, Gatun formation, marl from second bed from bottom, just below lower clay, Gatun section, relocated line Panama Railroad and 6035, Gatun formation, from gray green, fine grained, sandy shell marl, vicinity of Mindi Hill. There is a tendency for the specimens to take on a semi-striate appearance, an extreme form both in shape and striation shown in plate 21, figure 3.

BOLIVINA AENARIENSIS (Costa).

Plate 21, fig. 2.

Brizalina aenariensis Costa, Atti Acad. Pontaniana, vol. 7, 1856, p. 297, pl. 15, fig. 1, A. B.

Bolivina aenariensis H. B. Brady, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 711; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 423, pl. 53, figs. 10, 11.

Description.—Test much compressed, composed of numerous chambers about twice as broad as high, sutures distinct, slightly curved backward, chambers slightly inflated, especially in the center, test bordered by a narrow but distinct carina; surface smooth except for several longitudinal raised costae radiating from the initial end which carries also a short spine.

Length 0.65 mm., breadth 0.35 mm. Cat. No. 324617*a*, *b*, U.S.N.M.

A few specimens were obtained from U.S.G.S. No. 6033*c*, Gatun formation, in marl from second bed from bottom, just below lower clay, Gatun section, relocated line, Panama Railroad.

While these specimens are not absolutely typical they undoubtedly belong to this species.

Very typical specimens occur at U.S.G.S. No. 6036, Gatun formation, in dark colored, fine grained, sandy clay marl, from Monkey Hill, Mount Hope Station.

BOLIVINA ROBUSTA H. B. Brady.

Plate 21, fig. 4.

Bolivina robusta H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 57; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 421, pl. 53, figs. 7–9.

Description.—Test compressed, gradually tapering toward the apical end; chambers comparatively few; about twice as broad as high; sutures limbate, gently curved backward, often slightly lobulated or occasionally showing traces of reticulation on the surface, wall otherwise smooth but punctate, not spinose at the apical end.

Length 0.45 mm., breadth 0.25 mm. Cat. No. 324618, U.S.N.M.

These specimens, an extreme form of which is figured, are many of them very close to typical *B. robusta* which is at best either a variable species or one including more than one form. The sutures are usually limbate, as shown in some of Brady's figures, but no apical spine is apparently in any of the specimens in this material. They were from U.S.G.S. No. 6035, Gatun formation, from gray green, fine grained, sandy shell marl, vicinity of Mindi Hill.

BOLIVINA, species?

Plate 21, fig. 1.

This specimen is rather ill-defined and cannot be definitely determined from the single example, the sutures are limbate as in *Bolivina robusta* Brady, but have apparently no secondary extensions as in that species. The whole specimen seems to be replaced. The specimen is from U.S.G.S. 6010, lower part of the Culebra formation, from dark clay north of Pedro Miguel Locks. Cat. No. 324619, U.S.N.M.

Genus BIGENERINA d'Orbigny, 1826.

BIGENERINA NODOSARIA d'Orbigny.

Plate 21, fig. 5.

Bigenerina nodosaria d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 261, pl. 11, figs. 9–11.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 369, pl. 44, figs. 14–18.

Description.—Test elongate, subcylindrical, early portion consisting of a few chambers arranged as in *Textularia*, later ones uniserial, early portion tapering abruptly toward the apical end, wall coarsely arenaceous, sutures rather indistinct, aperture circular and central.

Length 2 mm., breadth 0.8 mm. Cat. No. 324620, U.S.N.M.

Several specimens in excellent condition were obtained from U.S.G.S. No. 6036, Gatun formation, in dark-colored, fine-grained, sandy clay marl from Monkey Hill, Mount Hope Station.

These specimens, as in the one figured, have but a slight indication of the biserial chambers from the exterior, but otherwise seem to be typical. At first glance they might be taken for a species of *Clavulina*.

Genus GAUDRYINA d'Orbigny, 1839.

GAUDRYINA FLINTII Cushman.

Plate 20, fig. 4.

Gaudryina subrotundata Flint (not *G. subrotundata* Schwager, 1866), Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 287, pl. 33, fig. 1.

Gaudryina flintii Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 63, fig. 102*a–c*.

Description.—Test subconical, early portion rounded conical, triserial, later portion subcylindrical, biserial chambers of later portion nearly semicircular in transverse section, sutures distinct; wall arenaceous; aperture subcircular, at the base of the inner margin of the chamber.

Length 1.20 mm., breadth 0.72 mm. Cat. No. 324621.

A single specimen which seems to be close to recent specimens of this species was obtained from U.S.G.S. No. 6010, lower part of the Culebra formation, in dark clay, north of Pedro Miguel Locks. The specimen is somewhat glauconitic and certain of the details are more or less obscured.

GAUDRYINA TRIANGULARIS Cushman.

Plate 20, fig. 3.

Gaudryina triangularis Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 65, figs. 104*a–c*.

Description.—Test somewhat longer than broad, early portion triangular, the faces somewhat concave, triserial; later portion biserial,

rounded in transverse section; wall coarsely arenaceous, chambers comparatively few, sutures indistinct, aperture a narrow slit at the base of the inner margin of the last formed chamber.

Length 1.7 mm., breadth 1.0 mm. Cat. No. 324622, U.S.N.M.

A single specimen which seems to belong to this species was found in material from U.S.G.S. No. 6010, lower part of the Culebra formation, in dark clay, north of Pedro Miguel Locks. The specimen, like many others from this station, is glauconitic and not well preserved in all its details.

Genus CLAVULINA d'Orbigny, 1826.

CLAVULINA PARISIENSIS d'Orbigny.

Plate 20, fig. 5.

Clavulina parisiensis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 268.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 395, pl. 48, figs. 14–18.

Description.—Test elongate, subcylindrical, early portion conical, later portion gradually increasing in diameter toward the apertural end, chambers comparatively few, those of the uniserial portion circular in cross section, wall coarsely arenaceous, somewhat rough; aperture circular, terminal.

Length nearly 2 mm., diameter 0.7 mm. Cat. No. 324623, U.S.N.M.

A single specimen representing this species was obtained in material from U.S.G.S. No. 6010, lower part of the Culebra formation, in dark clay north of Pedro Miguel Locks. Both this and the following are common Tertiary species.

CLAVULINA COMMUNIS d'Orbigny.

Plate 20, fig. 6.

Clavulina communis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 268; Foram. Foss. Bass. Tert. Vienne, 1846, p. 196, pl. 12, figs. 1, 2.

Description.—Test very elongate, subcylindrical, circular in transverse section, early portion triserial, later portion uniserial, of rather uniform diameter, sutures more or less indistinct, wall smooth; aperture terminal.

Length 2 mm., breadth 0.45 mm. Cat. No. 324624, U.S.N.M.

A single specimen of this species occurred with the preceding, U.S.G.S. No. 6010, in the lower part of the Culebra formation. It is fragmentary but probably represents this species.

Genus VIRGULINA d'Orbigny, 1826.

VIRGULINA SQUAMOSA d'Orbigny.

Plate 21, fig. 6.

Virgulina squamosa d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 267.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 91, fig. 145*a*, *b*.

Description.—Test elongate, tapering gradually to the apical end and again toward the apertural end, chambers comparatively few, inflated, sutures distinct, wall smooth, aperture a comma-like slit at the base of the last formed chamber.

Length 0.7 mm., breadth 0.25 mm. Cat. No. 324625*a*, *b*, *c*, U.S.N.M.

Specimens of this species occurred in the Gatun formation at the following three stations, U.S.G.S. No. 6033*c*, marl from second bed from bottom, just below lower clay, Gatun Section, relocated line Panama Railroad; U.S.G.S. No. 6035, in gray-green, fine-grained, sandy shell marl vicinity of Mindi Hill, and U.S.G.S. No. 6036, in dark-colored fine-grained, sandy clay marl, at Monkey Hill, Mount Hope Station.

At none of these stations were more than a few specimens found but all seem referable to this species.

Family LAGENIDAE.

Genus LAGENA Walker and Boys, 1784.

LAGENA STRIATA (d'Orbigny), var. STRUMOSA Reuss.

Plate 21, fig. 7.

Lagena strumosa Reuss, Zeitschr, geol. Ges., 1858, p. 434; Sitz, Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 328, pl. 4, fig. 49.

Lagena striata (d'Orbigny), var. *strumosa* Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 20, pl. 7, figs. 7–10.

Description.—Test clavate or subglobular, the body portion ornamented with numerous longitudinal raised costae, apical end with a single stout spine; neck short and stout, typically with a phialine lip and transverse costae.

Diameter 0.5 mm. Cat. No. 324626, U.S.N.M.

A single specimen of this variety was obtained in material from U.S.G.S. No. 6010, from the lower part of the Gatun formation, dark clay, north of Pedro Miguel Locks. This is the only representative of the genus in the whole series of samples examined. The specimen lacks the neck except the base and the tip of the apical spine.

Genus NODOSARIA Lamarck, 1812.

NODOSARIA COMMUNIS d'Orbigny.

Plate 21, fig. 8.

Nodosaria (*Dentalina*) *communis* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 35.

Nodosaria communis Reuss, Verst. Böhm. Kreid., pt. 1, 1845, p. 28, pl. 12, fig. 21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 504, pl. 62, figs. 19–22.

Description.—Test elongated, slender, gradually tapering, slightly curved, chambers slightly inflated in the middle, sutures distinct, slightly depressed, somewhat oblique; wall smooth.

Length 2 mm.? Cat. No. 324627.

A single fragment showing four chambers was obtained in material from U.S.G.S. No. 6036, Gatun formation, from dark-colored fine-grained, sandy clay marl at Monkey Hill, Mount Hope Station. The fragment with its general characters, its smooth surface, slightly inflated chambers and oblique sutures seem to clearly indicate this species.

NODOSARIA INSECTA Schwager?

Plate 21, fig. 9.

Nodosaria insecta Schwager, *Novara* Exped. Geol. Theil., pt. 2, 1866, p. 224, pl. 5, figs. 52, 53.

Description.—Test elongate, gradually tapering from the nearly acute slender base to a broad apical end, which is the greatest in diameter of any of the chambers of the test; chambers numerous, inflated, nearly spherical, sutures much depressed; wall smooth, apertures with a slight neck and circular opening.

Length 2.3 mm. Cat. No. 324628*a*, *b*, U.S.N.M.

Specimens were found in the lower part of Culebra formation both at U.S.G.S. No. 6010, in dark clay, north of Pedro Miguel Locks, and 6012*a*, from lower dark clay beneath lower conglomerate, one-fourth mile south of Empire Bridge.

The specimens are very close to the species described by Schwager from the Tertiary of Kar Nicobar. The two forms, megalospheric and microspheric, occur in the Panamanian material, the latter being much more slender at the initial end than in the megalospheric.

NODOSARIA RAPHANISTRUM (Linnaeus).

Plate 21, fig. 10.

Nautilus raphanistrum Linnaeus, Syst. Nat., ed. 10, 1758, p. 710.

Nodosaria raphanistrum Reuss, in Geinitz, Grundr. Verstein, 1845–46, p. 653, pl. 24, fig. 6.—Jones, Parker, and H. B. Brady, Monogr. Pal. Soc., vol. 19, 1866, p. 50, pl. 1, figs. 6–8.

Description.—Test elongate, subcylindrical, slightly tapering, chambers numerous, distinct, apertural end with a short tapering neck; wall ornamented with longitudinal costae continued clear to the aperture, about 12–15 in number.

Length 4 mm. Cat. No. 324629, U.S.N.M.

A single specimen of this species figured here was obtained from U.S.G.S. No. 6010, lower part of the Culebra formation, in dark clay, north of Pedro Miguel Locks. The specimen is not complete at the initial end but the last six chambers including the aperture are very well preserved.

NODOSARIA, species?

Plate 21, fig. 11.

A fragment consisting of one complete chamber and the adjacent parts of two others was found in the same material, U.S.G.S. No. 6010, as the above but nearly twice the diameter. The costae are also more numerous. Without further material it is unsafe to try to determine the fragment, but the occurrence of another species at this station should be at least recorded. Cat. No. 624630, U.S.N.M.

Genus CRISTELLARIA Lamarck, 1812.

CRISTELLARIA ROTULATA (Lamarck).

Plate 22, fig. 1.

"Cornu Hammonis seu Nautili" Plancus, Conch. Min., 1739, p. 13, pl. 1, fig. III.

Lenticulites rotulata Lamarck, Ann. Mus., vol. 5, 1804, p. 188, No. 3; vol. 8, 1806, pl. 62, fig. 11.

Cristellaria rotulata d'Orbigny, Mem. Soc. Géol. France, ser. 1, vol. 4, 1840, p. 26, pl. 2, figs. 16–18.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 547, pl. 69, figs. 13*a*, *b*.

Description.—Test comparatively large, biconvex, close coiled throughout, chambers variable in number in the coil, sutures distinct, periphery not lobulated, usually not keeled; previous apertures of the test usually visible as is often the preceding coil at least in part; wall smooth.

Diameter up to 2 mm. Cat. Nos. 324631*a*, *b*, *c*, *d*, *e*, U.S.N.M.

This seems to be the commonest species in the Panamanian material. It differs slightly in form in the various stations but all may be grouped under this species. It occurred in two groups of stations as noted in the chart of distribution. They are as follows: Lower part of the Culebra formation at U.S.G.S. No. 6010, in dark clay, north of Pedro Miguel Locks; No. 6012*a*, in lower dark clay beneath lower conglomerate, one-fourth mile south of Empire Bridge. Gatun formation at U.S.G.S. No. 6033*c*, in marl from second bed

from bottom just below lower clay, Gatun section, relocated line Panama Railroad; No. 6035, in gray green, fine-grained, sandy shell marl, vicinity of Mindi Hill; and No. 6036 in dark-colored, fine-grained, sandy clay marl of Monkey Hill, Mount Hope Station.

CRISTELLARIA ITALICA (Defrance).

Saracenaria italica Defrance, Dict. Sci. Nat., vol. 32, 1824, p. 177; vol. 47, 1827, p. 344; Atlas Conch., pl. 13, fig. 6.

Cristellaria (*Saracenaria*) *italica* d'Orbigny. Ann. Sci. Nat., vol. 7, 1826, p. 293, No. 26; Modèles, Nos. 19 and 85.

Cristellaria italica Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, pp. 21, 32, pl. 1, figs. 41, 42.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 544, pl. 68, figs. 17, 18, 20–23.

Description.—Test with the early portion close coiled, later portion more or less uncoiled, chambers numerous, those of the last-formed portion being triangular in cross section, periphery keeled, and the apertural face broad and flattened, the sides angled and extending on either side to the keel in flat faces, sutures but slightly depressed, wall smooth; apertures peripheral, radiate, usually with no neck.

Diameter 0.75 mm. Cat. No. 324632, U.S.N.M.

Two specimens are evidently of this species in a young stage, the uncoiling not yet having proceeded to a great degree. They are from U.S.G.S. No. 6036, Gatun formation, in dark-colored, fine-grained, sandy clay marl from Monkey Hill, Mount Hope Station.

CRISTELLARIA PROTUBERANS, new species.

Plate 22, fig. 2.

Description.—Test compressed, close coiled, biconvex, seven chambers in each coil, each much inflated in its central portion, space between much compressed, flattened, periphery sharply and broadly keeled; aperture peripheral, radiate.

Diameter 0.80–1.20 mm.

Three specimens of this species occurred at U.S.G.S. No. 6010, lower part of Culebra formation, in dark clay north of Pedro Miguel Locks. It is in some respects similar to species found in the Western Pacific, especially in comparatively deep water off the Philippines.

Type-specimen.—Cat. No. 324633, U.S.N.M.

CRISTELLARIA VAUGHANI, new species.

Plate 22, fig. 3.

Description.—Test much compressed, with a slight tendency to uncoiling in the last-formed chambers, periphery slightly keeled, not lobulated, rounded, about nine chambers in the last-formed whorl.

sutures slightly curved backward, extending in to the umbilicus so that only the last-formed coil is visible from the exterior, surface smooth except for lines of beads along the sutures extending from the umbilicus to the periphery; apertural face truncated or even slightly concave, aperture radiate, peripheral, with a short cylindrical neck.

Diameter 0.75 mm.

The type-sections of this species are from U.S.G.S. No. 6035, Gatun formation, in gray green, fine-grained, sandy shell marl from the vicinity of Mindi Hill. It also occurred at 6036, Gatun formation, in dark-colored, fine-grained, sandy clay marl from Monkey Hill, Mount Hope Station; No. 6019*f*, upper part of Culebra formation, fourth limy bed from bottom, section opposite Las Cascadas, Gaillard Cut; and No. 6010, lower part of Culebra formation, in dark clay, north of Pedro Miguel Locks.

This species is somewhat suggestive of some forms of *C. wetherelii*, but has no longitudinal ribbing. It is perhaps nearest to *C. gemmata* described by Brady from the Philippines and South Sea Islands, but lacks the typical papillate surface common in that species.

The species is named for Dr. T. Wayland Vaughan, whose collections in the Canal Zone have added much to the available foraminifera from this region.

Type-specimens.—Cat. No. 324634, U.S.N.M.

Genus UVIGERINA d'Orbigny, 1826.

UVIGERINA CANARIENSIS d'Orbigny.

Plate 22, fig. 5.

"Testae pineiforme minusculae" Soldani, Testaceographia, vol. 2, 1798, p. 18, pl. 4, figs. E, F, G, H.

Uvigerina nodosa, var. *B* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 269, No. 3.

Uvigerina canariensis d'Orbigny, Foram. Canaries, 1839, p. 138, pl. 1, figs. 25–27.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 573, pl. 74, figs. 1–3.

Description.—Test elongate, chambers numerous, spirally arranged, triserial, inflated, separated by distinct sutures; wall smooth except for the early chambers which may show traces of spines or longitudinal striae; apertural end usually with a tubular neck and often a phialine lip.

Length 0.75 mm., diameter 0.35 mm. Cat. No. 324635, U.S.N.M.

The only typical material of this species is from U.S.G.S. No. 6035, Gatun formation, in gray-green, fine-grained sandy shell marl from the vicinity of Mindi Hill.

UVIGERINA CANARIENSIS d'Orbigny, variety.

Plate 22, fig. 6.

A larger and much stouter, entirely smooth variety as shown in the above figure was found in material from U.S.G.S. No. 6010, lower part of Culebra formation, in dark clay, north of Pedro Miguel Locks. Cat. No. 324636. U.S.N.M.

UVIGERINA PYGMAEA d'Orbigny.

Plate 22, fig. 4.

"Polymorpha Pineiformia" Soldani, Testaceographia, vol. 1, pt. 2, 1791, pl. 130, figs. *ss*, *tt*.

Uvigerina pigmea d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 269, pl. 12, figs. 8, 9; Modèles, 1826, No. 67.

Uvigerina pygmaea d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 190, pl. 11, figs. 25, 26.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 575, pl. 74, figs. 11–14.

Description.—Test subcylindrical, triserially spiral, chambers numerous, inflated, sutures deep; wall ornamented by numerous longitudinal costae, those of each chamber usually independent of those of adjacent chambers; aperture with a short cylindrical neck and phialine lip.

Length 0.75 mm., breadth 0.32 mm. Cat. No. 324637*a*, *b*, *c*, U.S.N.M.

Specimens referable to this species occurred in the Culebra formation at U.S.G.S. No. 6012*a*, in lower dark clay beneath lower conglomerate, one-fourth mile south of Empire Bridge, Gaillard Cut, and No. 6012*d* in clay and sandstone just below conglomerate at base of green clay one-half to three-fourths of a mile north of Contractors Hill, Gaillard Cut.

Specimens of a slightly different character were abundant at No. 6035, Gatun formation, in gray-green, fine-grained sandy shell marl, vicinity of Mindi Hill.

UVIGERINA TENUISTRIATA Reuss.

Plate 22, fig. 7.

Uvigerina striata Reuss, Sitz. Kais. Akad. Wiss. Wien, vol. 52, 1870, p. 485.—von Schlicht, Foram. Pietzpuhl, 1870, pl. 22, figs. 34–36.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 574, pl. 74, figs. 4–7.

Description.—Test subcylindrical, chambers spirally arranged, triserial at least in the early portion, later portion sometimes biserial and more slender; chambers inflated, sutures deep, walls ornamented by numerous longitudinal costae, except the last chambers, which tend to become smooth or nearly so; aperture with a short tubular neck and often a phialine lip.

Length 0.85 mm., breadth 0.30 mm. Cat. No. 324638, U.S.N.M.

Specimens referred to this species were very common in material from U.S.G.S. No. 6036, Gatun formation, in dark-colored, fine-grained sandy clay marl, from Monkey Hill, Mount Hope Station. Many of the specimens become almost uniserial in the last-formed portion.

Genus SIPHOGENERINA Schlumberger, 1883.

SIPHOGENERINA RAPHANUS (Parker and Jones) var. TRANSVERSUS, new variety.

Plate 22, fig. 8.

Description.—Test subcylindrical, composed of comparatively few chambers, the earlier ones spirally arranged, later and greater portion of the test uniserial, sutures very prominently indented, between the longitudinal costae, aperture with a short cylindrical neck.

Length, 1.25 mm.; diameter, 0.54 mm. Cat. No. 324646, U.S.N.M.

This variety differs from the typical form in the much greater prominence of the transverse depressions marking the sutures, occasionally as in the figure suggesting the depressions of *S. dimorpha.* The specimens were frequent in material from U.S.G.S. No. 6010, lower part of the Culebra formation, in dark clay, north of Pedro Miguel Locks.

Family GLOBIGERINIDAE.

Genus GLOBIGERINA d'Orbigny, 1826.

GLOBIGERINA BULLOIDES d'Orbigny.

Globigerina bulloides d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 277, No. 1; Modèles, No. 17, and No. 76; in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, 1839, pt. 2, Foraminifères, p. 132, pl. 2, figs. 1–3, 28.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 593, pl. 77; pl. 79, figs. 3–7.

Description.—Test subglobose, spiral, visible portion composed of but few chambers from below, usually three to five, all visible from the dorsal side, sutures deep, chambers inflated, umbilicate below; surface reticulate; aperture single, from each chamber, of good size opening into the central umbilical cavity on the ventral side.

Diameter, 0.60 mm. Cat. Nos. 324639–45.

Specimens referable to this widely distributed species were obtained from the following stations: In the Culebra formation, U.S.G.S. No. 6009, from black clays and sandy beds at lower end of Pedro Miguel Locks; 6010 in dark clay, north of Pedro Miguel Locks; 6019*f*, in fourth limy bed from bottom, Las Cascadas section, Gaillard Cut. In the Gatun formation, U.S.G.S. No. 6029*b*,

in argillaceous and sandy indurated marl, one-fourth to one-half mile north of Camp Cotton on relocated line, Panama Railroad; 6033*c* in marl from second bed from bottom, just below lower clay, Gatun Section relocated line, Panama Railroad; 6035, in gray green, fine grained, sandy shell marl, near Mindi Hill; and 6036, in dark colored, fine grained, sandy clay marl, Monkey Hill, Mount Hope Station.

The specimens from the last three stations are very well preserved and in fact might almost be recent material, while those of the other stations were fragmentary, often glauconitic. *G. bulloides*, var. *triloba* Reuss was occasional in the last three stations where the genus was really very common.

GLOBIGERINA INFLATA d'Orbigny.

Globigerina inflata d'Orbigny, in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, 1839, Foraminifères, p. 134, pl. 2, figs. 7–9.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 601, pl. 79, figs. 8–10.

Description.—Test composed of numerous inflated chambers usually arranged in a spiral test with about three volutions, the last-formed one with four chambers, dorsal side of test nearly flat, ventral side extended, especially in the last-formed whorl; ventrally umbilicate; surface finely reticulate; aperture large, opening toward the umbilicus.

Diameter, 0.75 mm. Cat. Nos. 324647, 8, 9, U.S.N.M.

Specimens occurred at U.S.G.S. No. 6010, lower part of the Culebra formation, in dark clay north of Pedro Miguel Locks; and in the Gatun formation at the last two of the stations already referred to, namely, 6035 and 6036.

GLOBIGERINA DUBIA Egger.

Globigerina dubia Egger, Neues Jahrb. für Min., 1857, p. 281, pl. 9, figs. 7–9.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 595, pl. 79, figs. 17*a–c*.

Description.—Test composed of numerous inflated chambers arranged in a nautiloid spiral all visible from above, the last coil only, consisting of 5 to 6 chambers, visible from below, ventral side with a central umbilicus, surface reticulate; apertures opening into the central umbilical cavity.

Diameter 0.75 mm. Cat. Nos. 324650–54.

At the following stations specimens referable to this species were found: Culebra formation, U.S.G.S. No. 6010, in dark clay, north of Pedro Miguel Locks; 6025, in dark, hard, sandy clay about 200

yards south of southern end of switch at Bohio Ridge Station, relocated line, Panama Railroad. Gatun formation, U.S.G.S. No. 6033*c*, in marl from second bed from bottom, just below lower clay, Gatun Section, relocated line, Panama Railroad; 6035, in gray green, fine grained, sandy shell marl near Mindi Hill and 6036 in dark colored, fine grained, sandy clay marl, Monkey Hill, Mount Hope Station.

As in the case of the preceding species the specimens from the last three stations were very finely preserved while those of the others were glauconitic.

GLOBIGERINA CONGLOBATA H. B. Brady.

Globigerina conglobata H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 72; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 603, pl. 80, figs. 1–5; pl. 82, fig. 5.

Description.—Test subglobular, early chambers arranged in a compact spiral, the last three chambers in the complete adult test forming nearly the whole of the visible portion of the test, wall coarsely reticulate; main aperture at the inner margin of the chamber with several rounded secondary apertures along the margins of the chamber where it is attached to adjacent ones.

Diameter up to 1 mm. Cat. Nos. 324655–6.

Specimens of *G. conglobata* were found in small numbers in the Gatun formation at stations 6035 and 6036. They were typical but perhaps hardly as well developed as in some Recent material. Its occurrence here is rather interesting as it is almost unknown in the fossil condition.

GLOBIGERINA SACCULIFERA H. B. Brady.

Globigerina helicina Carpenter (not *G. helicina* d'Orbigny). Intr. Foram., 1862, pl. 12, fig. 11.

Globigerina sacculifera H. B. Brady, Geol. Mag., Dec. 2, vol. 4, 1877, p. 535; Quart. Journ. Micr. Sci., vol. 19, 1879, p. 73; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 604, pl. 80, figs. 11–17; pl. 82, fig. 4.

Description.—Test composed of numerous chambers, in its early stages very similar to *G. bulloides* but later developing a more oblong form, the chambers extended, somewhat compressed and with accessory apertural openings, the final chamber often flattened and irregularly formed toward the outer end; wall strongly reticulated in all but the final chamber which is much smoother than the others; aperture large, arched, with other accessory openings in the chambers of adult specimens.

Diameter up to 1 mm. Cat. Nos. 324657–8, U.S.N.M.

Specimens were not uncommon in material from the Gatun formation at stations 6035 and 6036. As in the case of *G. conglobata* the specimens were hardly as well developed as they are in recent specimens, but nevertheless had the characteristic marks of the species. As in *G. conglobata* the records of this species are almost entirely limited to Recent material, its occurrence as a fossil being practically unknown.

GLOBIGERINA AEQUILATERALIS H. B. Brady.

Cassidulina globulosa (part) Egger. Neues Jahrb. für Min., 1857, p. 296, pl. 11, fig. 4.

Globigerina aequilateralis H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 71; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 605, pl. 80, figs. 18–21.

Description.—Test composed of numerous inflated chambers, arranged in a planospiral manner, at least the last formed coil, chambers increasing rapidly in size as added, usually 5 to 6 in the last formed volution; sutures depressed, periphery lobulated; surface reticulate; aperture large, at the base of the inner margin of the chamber.

Diameter up to 1 mm. Cat. Nos. 324659–61, U.S.N.M.

In the material from the Gatun formation at three stations, Nos. 6033*c*, 6035, 6036, this species was not uncommon. The only character in which there seems to be a difference from the Recent material is in the early chambers which occasionally show at one side as a flat spiral while the later chambers are bilateral. The species is not a common one as a fossil.

Genus ORBULINA d'Orbigny, 1839.

ORBULINA UNIVERSA d'Orbigny.

Orbulina universa d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, Foraminifères, p. 3, pl. 1, fig. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 608, pl. 78; pl. 81, figs. 8–26; pl. 82, figs. 1–3.

Description.—Test in adult form typically consisting of a single, spherical visible chamber, which may or may not have contained within the early Globigerine stages; wall strongly reticulate, a single large circular aperture and smaller openings at the base of each reticulation.

Diameter up to 1 mm. Cat. Nos. 324662–3, U.S.N.M.

Specimens were not uncommon in the Gatun formation at the three stations, Nos. 6033*c*, 6035, and 6036. Occasional specimens show the double form as figured by Brady. The specimens otherwise are like the common run of Recent material.

Family ROTALIIDAE.

Genus DISCORBIS Lamarck, 1804.

DISCORBIS OBTUSA (d'Orbigny).

Plate 23, figs. 1*a–c*.

Rosalina obtusa d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 179, pl. 11, figs. 4–6.

Discorbina obtusa H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 644, pl. 91, figs. 9*a–c*.

Discorbis obtusa Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 13, figs. 12*a–c*.

Description.—Test biconvex, dorsal side more so than the ventral side, peripheral margin rounded; chambers comparatively few, about five in the last formed whorl; sutures curved, depressed; wall perforate; aperture an elongate narrow slit extending from the umbilicus nearly to the periphery.

Diameter 0.60 mm. Cat. No. 324664, U.S.N.M.

The only station from which this species was obtained is U.S.G.S. No. 5850, from Pleistocene marl near Mount Hope, a quarter mile from the present sea beach and 6 to 8 feet above high tide.

Genus TRUNCATULINA d'Orbigny, 1826.

TRUNCATULINA AMERICANA, new species.

Plate 23, figs. 2*a–c*.

Description.—Test nearly plano-convex; ventral side strongly convex, periphery keeled, dorsal side nearly flat; chambers numerous, up to nine in the last formed coil; sutures curved, prominent, slightly limbate, umbilicate below; surface smooth, aperture nearly peripheral.

Diameter 0.65 mm.

Type-specimen.—(Cat. No. 324665, U.S.N.M.) from the upper part of the Culebra formation, at U.S.G.S. No. 6019*f*, fourth limy bed from bottom, Las Cascades section, Gaillard Cut.

TRUNCATULINA PYGMEA Hantken.

Plate 23, figs. 3*a–c*.

Truncatulina pygmea Hantken, Mitth. Jahrb. ung. geol. Abstalt., vol. 4, 1875, p. 78, pl. 10, fig. 8.

Truncatulina pygmaea H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 666, pl. 95, figs. 9, 10.

Description.—Test nearly equally biconvex, peripheral margin bluntly rounded; chambers numerous, the sutures oblique, distinct, often limbate; aperture a narrow slit extending from near the periphery nearly to the umbilicus.

Diameter 0.65 mm. Cat. No. 324666–7, U.S.N.M.

The only station at which this species occurred is in the upper part of the Culebra formation, U.S.G.S. No. 6019*d*, upper part of second hard, limy, sandstone bed, Las Cascadas section, Gaillard Cut. It is rather larger than the usual run of *T. pygmaea* but is evidently this species.

Specimens from the Gatun formation, U.S.G.S. No. 6036, while having fewer chambers and somewhat larger size are questionably referred here. One specimen is figured on plate 24, figure 2.

TRUNCATULINA UNGERIANA (d'Orbigny).

Plate 24, fig. 1.

Rotalina ungeriana D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p 157, pl. 8, figs. 16–18.

Planorbulina ungeriana H. B. BRADY, Trans. Linn. Soc. London, vol. 24, 1864, p. 469, pl. 48, fig. 12.

Truncatulina ungeriana REUSS, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 161.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 664, pl. 94, figs. 9*a–d*.

Description.—Test biconvex, dorsal side less convex than the ventral; peripheral margin subacute, slightly carinate, chambers numerous, 10 to 12 in the last formed whorl, sutures distinct, slightly limbate on the dorsal side; aperture a narrow arched opening running ventrally from the peripheral margin.

Diameter 0.50 mm. Cat. Nos. 324668–9, U.S.N.M.

Specimens referable to this species but not entirely typical were obtained in material from lower part of the Culebra formation, as follows: U.S.G.S. No. 6009, from black clays and sandy beds at lower end of Pedro Miguel Locks; and 6012*a*, from lower dark clay beneath lower conglomerate, one-fourth mile south of Empire Bridge, west side Gaillard Cut, below Culebra.

TRUNCATULINA WUELLERSTORFI (Schwager).

Plate 24, fig. 3.

Anomalina wuellerstorfi SCHWAGER, *Novara* Exped., geol. Theil., vol. 2, 1866, p. 258, pl. 7, figs. 105, 107.

Truncatulina wuellerstorfi H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 662, pl. 93, figs. 8, 9.

Description.—Test plano-convex, dorsal side nearly flat, ventral side slightly convex; chambers numerous, elongate, curved; sutures

strongly curved, somewhat limbate, periphery bluntly rounded, slightly lobulated, especially near the apertural end of the last formed coil; wall coarsely punctate; aperture peripheral, a short curved opening.

Diameter of larger specimens slightly more than 1 mm.

Numerous very typical specimens of this species occurred in material from the lower part of the Culebra formation, U.S.G.S. No. 6010, from dark clay, north of Pedro Miguel Locks. Less typical specimens occurred in the upper part of the Culebra formation at U.S.G.S. 6012*d*, from clay and sandstone just below conglomerate at base of green clay, west side of Gaillard Cut, below Culebra; and 6019*f*, from fourth limy bed from bottom, Las Cascadas section, Gaillard Cut.

Cat. Nos. 324670–2, U.S.N.M.

TRUNCATULINA CULEBRENSIS, new species.

Plate 24, figs. 4*a*, *b*.

Description.—Test biconvex, much compressed, peripheral margin rounded; chambers numerous, as many as thirteen in the last formed coil, long and narrow, gently curved, sutures broad, limbate, smooth, the areas between very coarsely punctate; apertural face of chamber somewhat depressed, flattened, the carinate borders extending out beyond at either side; aperture a narrow slit situated at the base of the chamber on the periphery.

Diameter up to 1.5 mm.

The only occurrence of this species was in the upper part of the Culebra formation, U.S.G.S. No. 6012*c*, from top part of limy sandstone below upper conglomerate near foot of stairs, west side Gaillard Cut.

This, a large and striking species, in some of its characters suggesting *T. wuellerstorfi* but, as will be seen by a comparison of the figures of the two, really very different.

Type-specimen.—Cat. No. 324673, U.S.N.M.

Genus PULVINULINA Parker and Jones, 1862.

PULVINULINA SAGRA (d'Orbigny).

Plate 24, figs. 6*a*, *b*.

Rotalina sagra D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839. Foraminifères, p. 77, pl. 5, figs. 13–15.

Description.—Test ovate, biconvex, the ventral side more convex than the dorsal, peripheral margin subacute, carinate; chambers comparatively few in number increasing rapidly in size in the last formed

ones, the last formed chamber on the ventral side making up a large part of the area of the test, sutures distinct, curved, slightly depressed, more so on the ventral side; wall smooth except for the usual fine punctations; aperture ventral near the umbilicus.

Length 0.60 mm., breadth 0.40 mm. Cat. No. 324674.

The only record for this species from Panama is from the Gatun formation, U.S.G.S. No. 6035, in gray green, fine grained, sandy shell marl, near Mindi Hill. This species, described by d'Orbigny from Cuba, seems to be a common species in the American Miocene.

PULVINULINA CONCENTRICA Parker and Jones.

Plate 25, fig. 1.

Pulvinulina concentrica (Parker and Jones, MS.) H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 470, pl. 48, fig. 14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 686, pl. 105, figs. 1*a–c*.

Description.—Test biconvex, oval; peripheral margin rounded; chambers comparatively few, usually seven in the last formed coil, sutures covered by clear shell material joining with the carinal border and often covering a large portion of the test, both above and below, especially toward the center; wall smooth, finely punctate; aperture a narrow slit on the peripheral portion of the ventral side.

Diameter 1.2 mm. Cat. No. 324675, U.S.N.M.

The only specimen of this species is from the Gatun formation, U.S.G.S. No. 6035, in gray green, fine grained, sandy shell marl near Mindi Hill. The specimen as will be seen from the figure is very typical.

PULVINULINA MENARDII (d'Orbigny).

Plate 25, figs. 2, 3.

Rotalia menardii d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 273, No. 26; Modèles, No. 10.

Pulvinulina menardii Owen, Journ. Linn. Soc. London (Zool.), vol. 9, 1867, p. 148, pl. 5, fig. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 690, pl. 103, figs. 1, 2.

Description.—Test plano-convex, ventral side convex, dorsal side nearly flat; compressed, umbilicate; peripheral margin thin, slightly lobulated, carinate; chambers five or six in the last formed coil; sutures distinct, limbate and broad on the dorsal side, curved, on the ventral side more depressed, not limbate, nearly straight; wall smooth, finely punctate; aperture extending peripherally from the umbilicus, usually with an overhanging lip.

Diameter up to 1 mm. Cat. Nos. 324676–8, U.S.N.M.

Specimens apparently belonging to this species so widely distributed in the present oceans were obtained in the Gatun formation at U.S.G.S. No. 6035 in gray green, fine grained, sandy shell marl,

vicinity of Mindi Hill; and 6036 in dark colored, fine grained, sandy clay marl from Monkey Hill, near Mount Hope Station. A figure of one of these is shown in plate 25, figure 3. From 6033*c*, Gatun formation, in marl from second bed from bottom, just below lower clay, Gatun section, relocated line of the Panama Railroad, are even more typical specimens, one of which is here figured on plate 25, figure 2.

Genus SIPHONINA Reuss, 1849.

SIPHONINA RETICULATA (Czjzek).

Plate 24, fig. 5.

Rotalina reticulata Czjzek, Haidinger's Nat. Abh., vol. 2, 1848, p. 145, pl. 13, figs. 7–9.

Siphonina reticulata Brown, Lethaea Geognostica, ed. 3, vol. 3, 1853–56, p. 227, pl. 35 (?), figs. 23*a–c*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5. 1915, p. 43, fig. 48; pl. 16, fig. 4; pl. 28, fig. 3.

Truncatulina reticulata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 669, pl. 96, figs. 5–8.

Description.—Test biconvex, ventral side slightly more so than the dorsal, peripheral margin acute, carinate; chambers numerous rather indistinct, sutures slightly depressed, curved; wall rather coarsely perforate; aperture peripheral with a short, broad neck and somewhat flaring phialine lip.

Diameter 0.65 mm. Cat. No. 324679, U.S.N.M.

The only station at which this species occurred is in the Gatun formation, U.S.G.S. No. 6036, in dark colored, fine grained, sandy clay marl of Monkey Hill, Mount Hope Station.

Although the specimen is not perfectly preserved the tubuli of the peripheral margin are lacking as is the case in some large recent specimens.

Family NUMMULITIDAE.

Genus NONIONINA d'Orbigny, 1826.

NONIONINA DEPRESSULA (Walker and Jacob).

Plate 25, figs. 5*a*, *b*.

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

Nonionina depressula Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 4, 1859, pp. 339, 341.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 725, pl. 109, figs. 6, 7.—Bagg, Bull. U. S. Geol. Surv., No. 513, 1912, p. 88, pl. 26, figs. 16*a–c*; pl. 28, figs. 7, 8.

Description.—Test more or less rounded in side view, slightly elongate, about ten chambers in the last formed coil, apertural view narrow, periphery broadly rounded, sides nearly parallel, about two and a half times as high as broad, umbilicus slightly depressed,

usually filled with secondary shell material and a slight extension peripherally along the sutures which are slightly depressed; aperture a narrow curved slit.

Diameter 0.60 mm. Cat. Nos. 324680–1, U.S.N.M.

Distribution.—Specimens of this species occurred in the Gatun formation at U.S.G.S. No. 6033*c*, in marl from second bed from bottom, just below lower clay, Gatun Section, relocated line of the Panama Railroad; and 6035, in gray green, fine grained, sandy shell marl, vicinity of Mindi Hill. The specimens are rather typical, perhaps varying in the direction of increased length from most recent specimens.

NONIONINA SCAPHA (Fitchel and Moll).

Plate 25, figs. 6*a*, *b*.

Nautilus scapha Fichtel and Moll, Test. Micr., 1803, p. 105, pl. 19, figs. *d–f*.

Nonionina scapha Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 102, No. 4.—H. B. Brady, Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865, p. 106, pl. 12, figs. 10*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 730, pl. 109, figs. 14, 15, and 16.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 230, pl. 43, fig. 20.—Woodward and Thomas, Geol. Nat. Hist. Surv. Minnesota, vol. 3, 1893, p. 48, pl. E, figs. 35, 36.—Egger, Abh. kön. Bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 424, pl. 19, figs. 43, 44.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, 1894, p. 104, pl. 17, fig. 830.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 121, pl. 1, fig. 23.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 337, pl. 80, fig. 1.—Fornasini, Mem. Accad. Sci. Ist. Bologna, ser. 6, vol. 1, 1904, p. 12, pl. 3, fig. 4; pl. 13, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1904, p. 601.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 164.—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 53, No. 21, 1909, p. 13; vol. 54, No. 16, 1910, p. 29, pl. 3, fig. 13.—Bagg, Bull. U. S. Geol. Surv. No. 513, 1912, p. 88, pl. 27, figs. 1–5.

Polystomella crispa, var. (*Nonionina*) *scapha* Parker and Jones, Philos. Trans., vol. 155, 1865, p. 404, pl. 14, figs. 37, 38; pl. 17, figs. 55, 56.

Description.—Test in side view longer than wide, about ten chambers in the last formed coil, rapidly increasing in length as added, sutures evenly curved, slightly depressed, periphery broadly rounded, in apertural view the face of the last formed chamber making up a large part of the visible surface, wall smooth, finely punctate, somewhat umbilicate; aperture an arched slit at the base of the chamber.

Length 0.60 mm. Cat. No. 324682, U.S.N.M.

Specimens of this species were collected in the Gatun formation at a single station, U.S.G.S. No. 6033*c*, in marl from second bed from bottom, just below lower clay, Gatun section, relocated line of the Panama Railroad.

The specimen figured in apertural view was placed to show the aperture rather than the full size of the apertural face which is really

larger than appears in this view, the earlier portion of the coil being narrow.

NONIONINA PANAMENSIS, new species.

Plate 26, figs. 1*a*, *b*.

Description.—Test in side view subcircular, last formed chamber composed of about nine chambers, in front view bilaterally symmetrical, rapidly increasing in breadth as chambers are added, apertural face of chamber broadly rounded, early portion slightly keeled; sutures rather strongly curved, slightly limbate, slightly depressed; wall smooth, distinctly punctate; aperture a narrow curved slit at the base of the apertural face of the chamber.

Diameter 0.65 mm.

Specimens of this species were obtained from the lower part of the Culebra formation, U.S.G.S. No. 6010, north of Pedro Miguel Locks, in dark clay.

Type-specimen.—Cat. No. 324683, U.S.N.M.

NONIONINA ANOMALINA, new species.

Plate 26, figs. 2*a*, *b*.

Description.—Test in side view nearly circular, deeply umbilicate, peripheral margin broadly rounded, bilaterally symmetrical, about seven chambers in the last formed coil, sutures little if at all depressed, indistinct, last formed chambers extending but part way across the test, tending toward alternating arrangement; aperture a narrow slit at the base of the chamber.

Diameter 1.25 mm.

Type-specimen.—(Cat. No. 324684, U.S.N.M.) from the lower part of the Culebra formation, in dark clay, north of Pedro Miguel Locks (U.S.G.S. No. 6010).

The last two chambers suggest *Cassidulina*, but the similarity does not continue further.

Genus POLYSTOMELLA Lamarck, 1822.

POLYSTOMELLA STRIATO-PUNCTATA (Fitchel and Moll).

Plate 26, figs. 3*a*, *b*; 4*a*, *b*.

Nautilus striato-punctatus Fichtel and Moll, Test. Micr., 1803, p. 61, pl. 9, figs. *a*–*c*.

Polystomella striato-punctata Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 103, No. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 733, pl. 109, figs. 22, 23.

Description.—Test bilaterally symmetrical, subcircular in side view, umbilicate, peripheral margin broadly rounded, eight to ten chambers

in the last formed coil; sutures slightly curved, depressed; wall smooth, distinctly punctate; septal lines with regularly arranged, narrow bridging; aperture a narrow semicircular opening at the base of the apertural face of the chamber, showing occasionally traces of division into a series of smaller openings.

Diameter 0.50 to 0.65 mm. Cat Nos. 324685–7, U.S.N.M.

Specimens were obtained in the Culebra formation, U.S.G.S. No. 6020*a*, opposite Las Cascadas, in lowest fossiliferous bed, third bed below lowest limestone. These were very largely glauconitic, and of the form figured in 4*a*, *b*. The species was also found in the Gatun formation, U.S.G.S. No. 6029*a*, one-fourth to one-half mile north of Camp Cotton, relocated line of the Panama Railroad, in the softer sandy marls at the base of the section. The form figured in 3*a*, *b*, is from a Pleistocene deposit at U.S.G.S. No. 5850, loose shells and marl from near Mount Hope, one-fourth mile from present beach, 6 to 8 feet above high tide.

POLYSTOMELLA SAGRA d'Orbigny.

Plate 26, figs. 5*a*, *b*.

Polystomella Sagra D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, Foraminifères, p. 55, pl. 6, figs. 19, 20.

Description.—Test bilaterally symmetrical, subcircular in side view; peripheral margin rounded, ten or more chambers in the last formed coil; sutures distinct, curved, slightly depressed in the last formed portion, not at all depressed in the early part of the coil; early half of the coil with definite raised, longitudinal ribs, corresponding to the bridging over the sutures, persisting longest on the peripheral portion of the test, later portion smooth; bridging of earliest portion of coil regular, short, in the last formed sutures increasing considerably in length; apertural face smooth, punctate; roughly triangular in outline, the angles rounded; aperture a very narrow slit at the base of the apertural face of the chamber.

Diameter 0.65 mm. Cat. No. 324688, U.S.N.M.

The only station at which this species was obtained is a Pleistocene deposit at U.S.G.S. No. 5850, loose shells and marl from near Mount Hope, one-fourth mile from present beach and 6 to 8 feet above high tide.

A comparison of this figure with the original given by d'Orbigny in his Cuba monograph will show the very striking similarity between the Cuba and Panama specimens, and I have no hesitation in referring this material to d'Orbigny's species.

POLYSTOMELLA MACELLA (Fichtel and Moll).

Plate 27, figs. 1*a*, *b*.

Nautilus macellus, var. *a*, Fichtel and Moll, Test. Micr., 1803, p. 66, pl. 10, figs. *e–g*.

Polystomella macella Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 104, No. 8.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 737, pl. 110, figs. 8, 9, 11.

Description.—Test compressed, bilaterally symmetrical, peripheral margin acute, somewhat carinate, not lobulated, sixteen to twenty chambers in the last formed coil; reticulated bridgings occupying a greater area than the intermediate portions; umbilical region slightly depressed, with a few large pores; aperture a curved or V-shaped slit at the base of the apertural face, either simple or divided into secondary openings.

Diameter, 0.75 mm. Cat. Nos. 324689–90, U.S.N.M.

Specimens were obtained from two stations in the Emperador limestone, as follows: U.S.G.S. 6015, from cream-colored coral limestone, old quarry one-quarter mile north of west from Empire; and 6016, one-third mile north of west of the same place.

POLYSTOMELLA CRISPA (Linnaeus).

Plate 27, figs. 2*a*, *b*.

"Cornu Hammonis orbiculatum" Plancus, Conch. Min., 1739, p. 10, pl. 1, fig. 2.

Nautilus crispus Linnaeus, Syst. Nat., ed. 12, 1767, p. 1162.

Polystomella crispa Lamarck, Anim. sans Vert., vol. 7, 1822, p. 625, No. 1.—d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 125, pl. 6, figs. 9–14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 736, pl. 110, figs. 6, 7.

Description.—Test bilaterally symmetrical, much compressed, peripheral margin obtusely angled; umbilical region not depressed; chambers numerous, eighteen to twenty chambers in the last formed coil, sutures indistinct, bridging wider than the intermediate clear space; margin not lobulated; umbilical region umbonate, filled with clear shell material, often with a few pores; aperture a narrow slit at the base of the apertural face of the chamber, usually showing more or less division into secondary openings.

Diameter, up to 1.25 mm. Cat. No. 324691, U.S.N.M.

Specimens referable to this species were obtained from the Gatun formation at U.S.G.S. No. 6029*b*, one-fourth to one-half mile north of Camp Cotton on relocated line of the Panama Railroad, indurated argillaceous and sandy marl.

POLYSTOMELLA CRATICULATA (Fichtel and Moll).

Plate 27, figs. 3*a*, *b*.

Nautilus craticulatus Fichtel and Moll, Test. Micr., 1803, p. 51, pl. 5, figs. *h–k*.

Polystomella craticulata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 284, No. 3.—Carpenter, Intr. Foram., 1862, p. 279, pl. 16, figs. 1, 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 739, pl. 110, figs. 16, 17.

Description.—Test bilaterally symmetrical, somewhat compressed; peripheral margin broadly rounded; not lobulated, chambers very numerous, forty or more in the last formed coil, narrow; umbilical region filled with clear shell material with numerous pores; bridged area about equal to that between; aperture a series of openings at the base of the apertural face.

Diameter, 1 mm. Cat. No. 324692, U.S.N.M.

This species was found in considerable numbers in the Culebra formation at U.S.G.S. No. 6025, in foraminiferal marl and coarse sandstone about 200 yards south of the southern end of the switch at Bohio Ridge station, relocated line, Panama Railroad.

The specimens have not as subglobose a form as many recent specimens, but in other respects the characters are very similar.

POLYSTOMELLA, species?

Numerous stations have a species of *Polystomella* which is very much like *P. sagra* and yet is not so definitely characterized as are the specimens of that species from station 6025.

The stations at which this form of *Polystomella* occurs are in the lower part of the Culebra formation at U.S.G.S. No. 6009, black clays, six or seven hundred feet south of Miraflores Locks. In Las Cascadas section, Gaillard Cut, 6019*b*, from the 4 feet of dark stratified tuff and clay overlying the lower limestone bed; 6019*f*, from fourth limy bed from bottom; 6020*a*, from the lowest fossiliferous bed. In the Emperador limestone at 6015 and 6016 from cream-colored coral limestone, old quarry, one-quarter mile north of west from Empire. In the Gatun formation at 6029*a*, from lowest horizon, one-fourth to one-half mile north of Camp Cotton.

Cat. Nos. 324693–8, U.S.N.M.

Genus AMPHISTEGINA d'Orbigny, 1826.

AMPHISTEGINA LESSONII d'Orbigny.

Amphistegina lessonii d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 304, No. 3, pl. 17, figs. 1–4; Modèles, No. 98.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 740, pl. 111, figs. 1–7.

Description.—Test lenticular, usually more convex on one side than the other; composed of about twenty-five chambers in the last formed

coil, wall smooth except near the aperture on the ventral side where there is usually a papillose area of greater or less extent; periphery usually somewhat rounded; sutures on the dorsal side with a single simple angle; below usually divided into two deep lobes by deep constrictions.

Diameter, 1–2.5 mm. Cat. Nos. 324699–08, U.S.N.M.

This species is common in the lower horizons of the area occurring at the following stations: Culebra formation, 6009, 6012*a*, *d*, 6019*c*, *d*, 6027; Emperador limestone, 6015, 6016; Gatun formation, 6029*a*, *b*, *c*.

At some of these stations specimens are rather frequent. In the matrix this species may often be indistinguishable in a superficial examination from worn centers of Orbitoids or Nummulites. It is a common Tertiary species.

Family MILIOLIDAE.

Genus QUINQUELOCULINA d'Orbigny, 1826.

QUINQUELOCULINA SEMINULUM (Linnaeus).

Plate 27, figs. 4*a*, *b*; plate 28; plate 29, figs. 1*a–c*.

Serpula seminulum Linnaeus, Syst. Nat., ed. 10, 1758, p. 786; ed. 13 (Gmelin), 1758, pp. 37, 39.

Quinqueloculina seminulum d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 303, No. 44.

Miliolina seminulum Williamson, Rec. Foram. Great Britain, 1858, p. 85, pl. 7, figs. 183–189.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 157, pl. 5, figs. 6*a*, *b*, *c*.

Description.—Test oval in front view; thickest in the middle, visible exterior composed of five chambers, three visible from one side and four from the other, sutures slightly depressed, distinct; wall smooth, periphery rounded, aperture somewhat contracted, usually with a single simple tooth.

Length about 1 mm. Cat. Nos. 324709–13, U.S.N.M.

Very typical specimens were obtained from U.S.G.S. No. 5850, among loose shells and marl from near Mount Hope, from ditch through swampy ground, one-fourth mile from present sea beach and 6 to 8 feet above high tide (Pleistocene). Specimens very similar but slightly more rotund were obtained from the Gatun formation, No. 6036, in dark colored, fine grained, sandy clay marl, at Monkey Hill, Mount Hope Station.

Varietal forms here figured and which may be referred to *Q. seminulum* were obtained from the Culebra formation at No. 6010, from dark clay, north of Pedro Miguel Locks; 6019*a*, a single specimen from lower limestone of Las Cascadas section; 6025, a single glauconitic specimen from foraminiferal marl about 200 yards south of

southern end of switch at Bohio Ridge Station, relocated line of the Panama Railroad. Another much flattened glauconitic specimen from this last station is also referred here.

QUINQUELOCULINA CONTORTA d'Orbigny.

Plate 29, figs. 2*a–c*.

Quinqueloculina contorta d'Orbigny, Foram. Foss. Bass. Tert, Vienne, 1846, p. 298, pl. 20, figs. 4–6.

Description.—Test about twice as long as broad, chambers rather narrow and elongate, in end view polygonal, peripheral margin broadly curved, sides nearly at right angles to the peripheral face with a sharp angle at the junction; sutures deep, apical end and initial end of final chamber truncated; aperture rounded with a single tooth; wall smooth.

Length 0.65 mm. Cat. No. 324714, U.S.N.M.

The only material of this species was obtained from U.S.G.S. 5850, among loose shells and marl, from near Mount Hope, from ditch through swampy ground, about one-fourth mile from present sea beach and 6 to 8 feet above high tide (Pleistocene).

QUINQUELOCULINA AUBERIANA d'Orbigny.

Plate 29, figs. 3*a–c*.

Quinqueloculina auberiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, Foraminifères, p. 193, pl. 12, figs. 1–3.

Miliolina auberiana H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 162, pl. 5, figs. 8, 9.

Description.—Test slightly longer than broad, periphery of the chambers angled with a concave area at each side of the angle, sutures somewhat depressed, distinct; wall smooth; aperture with a single, usually simple, occasionally slightly bifid tooth.

Length about 1 mm. Cat. No. 324715, U.S.N.M.

Two specimens of this species were obtained in material from U.S.G.S. 5850, among loose shells and marl, from near Mount Hope, from ditch through swampy ground, about one-fourth mile from present sea beach and 6 to 8 feet above high tide (Pleistocene). This is a common species of the shallow-water littoral of tropical seas.

QUINQUELOCULINA UNDOSA Karrer.

Plate 30, figs. 1*a–c*.

Quinqueloculina undosa Karrer, Sitz. Akad. Wiss. Wien, vol. 58, abth. 1, 1868, p. 150, pl. 3, fig. 1.

Miliolina undosa Karrer, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 176, pl. 6, figs. 6–8.

Description.—Test elongate, two or two and a half times as long as wide; chambers sub-polygonal, the angles more or less irregular·giv-

ing an undulate appearance to the chambers, apertural end typically with a slightly projecting neck, aperture with a single tooth; wall smooth.

Length 1.25 mm. Cat. Nos. 324716–17, U.S.N.M.

Specimens referable to this species were obtained in the Emperador limestone, at U.S.G.S. 6016, from old quarry, one-third mile north of west of Empire; and in the Culebra formation, at 6025, in foraminiferal marl about 200 yards south of the southern end of the switch at Bohio Ridge Station, relocated line, Panama Railroad.

The specimens are not so contorted as in some recent ones but show characteristic undulations of the chamber borders.

QUINQUELOCULINA BICORNIS (Walker and Jacob).

Plate 30, figs. 2*a–c*; 3*a*, *b*.

"Serpula bicornis ventricosa," Walker and Boys, Test. Min., 1784, p. 1, pl. 1, fig. 2.

"Frumentaria *foeniculum*" Soldani, Testaceographia, vol. 1, pt. 3, 1795, p. 229, pl. 154, figs. *bb*, *cc*.

Serpula bicornis Walker and Jacob, Adams's Essays, Kanmacher's ed., 1798, p. 633, pl. 14, fig. 2.

Miliolina bicornis Williamson, Rec. Foram. Great Britain, 1858, p. 87, pl. 7, figs. 190–192.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 171, pl. 6, figs. 9, 11, 12.

Description.—Test in side view about twice as long as wide; sutures rather deep, distinct, chambers more or less keeled, wall ornamented with numerous rather fine longitudinal raised costae; aperture slightly exserted, rounded, with a single tooth.

Length 0.75 mm. Cat. Nos. 324718–9, U.S.N.M.

Specimens were obtained in a Pleistocene deposit at U.S.G.S. 5850, among loose shells and marl, from near Mount Hope, from ditch through swampy ground about one-fourth mile from present sea beach, and 6 to 8 feet above high tide.

From the Culebra formation, U.S.G.S. 6025, in foraminiferous marl about 200 yards south of southern end of switch at Bohio Ridge Station, relocated line, Panama Railroad, were obtained, rather poorly preserved and somewhat glauconitic specimens, but showing traces of a longitudinal series of raised ridges. They are questionably referred here and one is figured, on plate 30, figure 3.

QUINQUELOCULINA PANAMENSIS, new species.

Plate 31, figs. 1*a–c*.

Description.—Test nearly as wide as long, the last formed chamber tending to become loose coiled, growing away from the preceding ones on the apertural half of the inner margin, apertural end free.

peripheral margin broadly rounded, sutures much depressed; wall smooth; aperture circular.

Length 0.85 mm.

This species was obtained from the Gatun formation, U.S.G.S. 6036, in dark colored, fine grained, sandy clay marl, from Monkey Hill, Mount Hope Station.

It is unusual in the breaking away of the last formed chamber from the original close coiled method of growth.

Type-specimen.—Cat. No. 324720, U.S.N.M.

Genus SIGMOILINA Schlumberger, 1887.

SIGMOILINA TENUIS (Czjzek).

Plate 31, figs. 4*a–c*.

Quinqueloculina tenuis Czjzek, Haidinger's Nat. Abhandl., vol. 2, 1847, p. 149, pl. 13, figs. 31–34.

Spiroloculina tenuis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 152, pl. 10, figs. 7–11.

Sigmoilina tenuis Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 48, No. 5, 1904, p. 6.

Description.—Test about twice as long as wide, narrow, compressed, visible chambers 5 or 6 on either side, chambers, narrow, rounded, sutures depressed, distinct; wall smooth, aperture exserted, rounded.

Length 0.65 mm. Cat. Nos. 324721–3, U.S.N.M.

Specimens of this species were obtained in the Gatun formation at the following three stations: U.S.G.S. 6033*c*, in marl from second bed from bottom, just below lower clay, Gatun section, relocated line of the Panama Railroad; 6035, in gray green, fine grained, sandy shell marl, vicinity of Mindi Hill; and 6036, in dark colored, fine grained, sandy clay marl, from Monkey Hill, Mount Hope Station.

These three stations have several species in common as will be seen by a glance at the accompanying chart of distribution.

SIGMOILINA ASPERULA (Karrer).

Plate 31, figs. 3 *a*, *b*.

Spirolucina asperula Karrer, Sitz. Akad. Wiss. Wien, vol. 57, 1868, p. 136, pl. 1, fig. 10.—H. B. Brady, Rep. Vol. *Challenger*, Zoology, vol. 9, 1884, p. 152, pl. 8, figs. 13, 14, and 11.

Description.—Test but slightly longer than wide, very much compressed, sutures somewhat indistinct, several chambers visible from each of the flattened sides; wall covered with fine arenaceous particles; aperture exserted, nearly circular.

Length, 0.8 mm. Cat. Nos. 324724–5, U.S.N.M.

Specimens were not uncommon in the Gatun formation at two stations, U.S.G.S. 6035, in gray green, fine grained, sandy shell marl, vicinity of Mindi Hill, and 6036, in dark colored, fine grained, sandy clay marl, from Monkey Hill, Mount Hope Station.

Genus TRILOCULINA d'Orbigny, 1826.

TRILOCULINA TRIGONULA (Lamarck).

Plate 32, fig. 1.

Miliolites trigonula Lamarck, Ann. Mus., vol. 5, 1804, p. 351, No. 3.
Triloculina trigonula d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 1, pl. 16, figs. 5–9.
Miliolina trigonula Williamson, Rec. Foram. Great Britain, 1858, p. 83, pl. 7, figs. 180–182.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 164, pl. 3, figs. 14–16.

Description.—Test in apertural view triangular, angles rounded, chambers rapidly increasing in size as added, but three visible in adult test; outer wall broadly rounded, in front view oval, sutures distinct, aperture not produced, lip and tooth indistinct.

Length, 0.75 mm. Cat. No. 324726, U.S.N.M.

A single specimen referable to this species occurred at U.S.G.S. 5850, in Pleistocene marly material from near Mount Hope, one-fourth mile from present sea beach and about 6 to 8 feet above high tide.

This is a common species in shallow water of recent oceans.

TRILOCULINA TRICARINATA d'Orbigny.

Plate 32, fig. 2.

Triloculina tricarinata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 7; Modèles, No. 94.—H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 446, pl. 48, fig. 3.
Miliolina tricarinata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 165, pl. 3, figs. 17*a*, *b*.

Description.—Test differing from *T. trigonula* largely in the angles, which are acute, the sides concave, at least toward the borders, center of the side either flat or slightly convex, in end view rather sharply triangular, in front view oval; neck slightly produced, aperture rounded, tooth wanting in this specimen.

Length, 0.60–0.70 mm.

Four specimens were collected in the Culebra formation at U.S.G.S. No. 6025, foraminiferal marl about 200 yards south of southern end of switch at Bohio Ridge Station, relocated line, Panama Railroad.

Two of the four specimens had the neck somewhat elongated, the others were more nearly normal in this respect. The specimens were

somewhat altered and showed traces of apparently a glauconitic interior.

TRILOCULINA BULBOSA, new species.

Plate 32, fig. 3.

Description.—Test from exterior composed of three visible chambers, the last formed one making the largest part of the test. The next to the last about half the size of the last and the first formed one very small in comparison, test in end view nearly biloculine, with the last formed chamber nearly as wide as the whole test in its greatest width, in front view breadth and height about equal, chambers very rotund, sutures deep, aperture without a neck, rounded, tooth indistinct or wanting.

Length, about 0.65 mm.

Type-specimen.—(Cat. No. 324728, U.S.N.M.) from the Gatun formation, U.S.G.S. Station 6029*a*, lowest horizon, one-fourth to one-half mile north of Camp Cotton on relocated line Panama Railroad. Another specimen was obtained, also in the Gatun formation, at No. 6030, from fossiliferous marl, from cut on north side of swamp 1½ miles north of Monte Lirio, relocated line of the Panama Railroad.

In each case a single somewhat glauconitic specimen was obtained. The species has the last two chambers developed greatly, the third one very small, the whole test appearing almost biloculine. The specimens from the two stations were practically identical.

TRILOCULINA PROJECTA, new species.

Plate 33, fig. 1.

Description.—Test in end view composed of three radially projecting portions, the intervening portions deeply concave, in side view about as long as wide, sutures somewhat indistinct, periphery broadly rounded; wall covered with a thick encrustation of sand grains giving the whole exterior a decidedly arenaceous appearance; aperture with a slightly projecting neck and phialine lip; apertural opening circular, in the specimen figured without a distinct tooth.

Length 0.75 mm.

Type-specimen.—(Cat. No. 324729, U.S.N.M.) From gray green, fine grained, sandy shell marl from vicinity of Mindi Hill, U.S.G.S. No. 6035, Gatun formation.

This is an interesting modification of this genus, comparable in the structure of the test to *Quinqueloculina agglutinans* d'Orbigny and others of the same character.

Genus BILOCULINA d'Orbigny, 1826.

BILOCULINA BULLOIDES d'Orbigny.

Plate 33, fig. 2.

Biloculina bulloides d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 297, No. 1, pl. 16, figs. 1–4; Modèles, No. 90.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 142, pl. 2, figs. 5, 6.

Description.—Test with but two visible chambers in the adult, in end view, each semicircular, in front view elliptical, very rotund, inflated, suture distinct; aperture usually nearly circular, somewhat produced.

Length 0.60 mm. Cat. No. 324730, U.S.N.M.

The only specimen of this species is from the Gatun formation, U.S.G.S. 6036, from dark colored, fine grained, sandy clay marl from Monkey Hill, Mount Hope Station.

Genus SPIROLOCULINA d'Orbigny, 1826.

SPIROLOCULINA EXCAVATA d'Orbigny.

Plate 31, fig. 2.

Spiroloculina excavata d'Orbigny, Foram. Foss. Bass. Tert. Vienne, 1846, p. 271, pl. 16, figs. 19–21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 151, pl. 9, figs. 5, 6.

Description.—Test planospiral, chambers much elongated, thickest at the basal end, apertural end slightly produced, central portions much excavated, due to the gradual increase in the width of the chambers as added; periphery somewhat convex, angles rounded; sutures distinct except toward the center; apertural end produced, aperture rounded; tooth wanting in our specimen.

Length 1.4 mm. Cat. No. 324731, U.S.N.M.

Specimens were obtained at Station No. 5850, in marl of Pleistocene, Mount Hope, Canal Zone, by D. F. MacDonald.

Genus ORBICULINA Lamarck, 1816.

ORBICULINA ADUNCA (Fichtel and Moll).

Plate 33, fig. 3.

Nautilus orbiculus Fichtel and Moll, Test. Micr., 1803, p. 112, pl. 21.
Orbiculina adunca Lamarck, Tabl. Encycl. et Méth., 1816, pl. 468, figs. 2*a–c*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 209, pl. 14, figs. 1–13.

Description.—Test planospiral, chambers very long, divided into simple chamberlets, sides with alar projections extending nearly to the umbilicus, sutures distinct; apertures numerous, peripheral.

Diameter 1.6 mm. Cat. No. 324732, U.S.N.M.

A few specimens were obtained from U.S.G.S. 5850, from Pleistocene marl near Mount Hope, about one-fourth mile from present sea beach and about 6 to 8 feet above high tide.

EXPLANATION OF PLATES.

PLATE 19.

FIG. 1. *Textularia abbreviata* d'Orbigny. × 50. *a*, apertural view; *b*, front view.
2. *Textularia sagittula* Defrance. × 30. *a*, apertural view; *b*, front view.
3. *Textularia agglutinans* d'Orbigny. × 50. *a*, apertural view; *b*, front view.
4. *Textularia laminata*, new species. × 30. *a*, apertural view; *b*, front view.
5. *Textularia subagglutinans*, new species. × 35. *a*, apertural view; *b*, front view.
6. *Textularia carinata* d'Orbigny. × 50. *a*, apertural view; *b*, front view.

PLATE 20.

FIG. 1. *Textularia panamensis*, new species. × 65. *a*, aperture view; *b*, front view.
2. *Chrysalidina pulchella*, new species. × 110. *a*, apertural view; *b*, viewed from flat side; *c*, viewed from angle.
3. *Gaudryina triangularis* Cushman. × 35. *a*, apertural view; *b*, front view.
4. *Gaudryina flintii* Cushman. × 50.
5. *Clavulina parisiensis* d'Orbigny. × 35.
6. *Clavulina communis* d'Orbigny. × 35.

PLATE 21.

FIG. 1. *Bolivina*, species. × 65.
2. *Bolivina aenariensis* (Costa). × 65.
3. *Bolivina* cf. B. *punctata* d'Orbigny. × 65.
4. *Bolivina robusta* H. B. Brady. × 135.
5. *Bigenerina nodosaria* d'Orbigny. × 27. *a*, apertural view; *b*, front view.
6. *Virgulina squamosa* d'Orbigny. × 65.
7. *Lagena striata* (d'Orbigny), var. *strumosa* Reuss. × 65.
8. *Nodosaria communis* d'Orbigny. × 65.
9. *Nodosaria* cf. *N. insecta* Schwager. × 35.
10. *Nodosaria raphanistrum* (Linnaeus). × 35.
11. *Nodosaria*, species ? × 35.

PLATE 22.

FIG. 1. *Cristellaria rotulata* (Lamarck). × 35.
2. *Cristellaria protuberans*, new species. × 65.
3. *Cristellaria vaughani*, new species. × 65.
4. *Uvigerina pygmaea* d'Orbigny. × 65.
5. *Uvigerina canariensis* d'Orbigny. × 65.
6. *Uvigerina canariensis* d'Orbigny var. × 65.
7. *Uvigerina tenuistriata* Reuss. × 65.
8. *Siphogenerina raphanus* (Parker and Jones) var. *transversus*, new variety. × 35.

PLATE 23.

FIG. 1. *Discorbis obtusa* (d'Orbigny). *a*, dorsal view; *b*. ventral view; *c*, peripheral view. × 65.
2. *Truncatulina americana*, new species. *a*, dorsal view; *b*, ventral view; *c*, peripheral view. × 65.
3. *Truncatulina pygmea* Hantken. *a*, dorsal view; *b*, ventral view; *c*, peripheral view. × 65.

PLATE 24.

FIG. 1. *Truncatulina ungeriana* (d'Orbigny.) × 65.
2. *Truncatulina* cf. *T. pygmea* Hantken. × 33.
3. *Truncatulina wuellerstorfi* (Schwager). × 50.
4. *Truncatulina culebrensis*, new species. × 33. *a*, dorsal view; *b*, peripheral view.
5. *Siphonina reticulata* (Czjzek). × 65.
6. *Pulvinulina sagra* (d'Orbigny). × 65. *a*, dorsal view; *b*, ventral view.

PLATE 25.

FIG. 1. *Pulvinulina concentrica* Parker and Jones. × 35.
2. *Pulvinulina menardii* (d'Orbigny). × 65.
3. *Pulvinulina menardii* (d'Orbigny). × 65.
4. *Pulvinulina*, species ? × 65.
5. *Nonionina depressula* (Walker and Jacob). × 65. *a*, side view; *b*, apertural view.
6. *Nonionina scapha* (Fichtel and Moll). × 65. *a*, side view; *b*, apertural view.

PLATE 26.

FIG. 1. *Nonionina panamensis*, new species. × 65. *a*, side view; *b*, apertural view.
2. *Nonionina anomalina*, new species. × 65. *a*, side view; *b*, apertural view.
3. *Polystomella striato-punctata* (Fichtel and Moll). × 65. *a*, side view; *b*, apertural view.
4. *Polystomella striato-punctata* (Fichtel and Moll). × 65. *a*, side view; *b*, apertural view.
5. *Polystomella sagra* d'Orbigny. × 65. *a*, side view; *b*, apertural view.

PLATE 27.

FIG. 1. *Polystomella macella* (Fichtel and Moll). × 65. *a*, side view; *b*, apertural view.
2. *Polystomella crispa* (Linnaeus). × 35. *a*, side view; *b*, apertural view.
3. *Polystomella craticulata* (Fichtel and Moll). × 50. *a*, side view; *b*, apertural view.
4. *Quinqueloculina seminulum* (Linnaeus). × 65. *a*, rear view; *b*, apertural view.

PLATE 28.

FIG. 1. *Quinqueloculina seminulum* (Linnaeus). × 65. *a*, front view; *b*, rear view; *c*, apertural view.
2. *Quinqueloculina seminulum* (Linnaeus). × 130. *a*, front view; *b*, rear view; *c*, apertural view.
3. *Quinqueloculina seminulum* (Linnaeus) var. × 65. *a*, front view; *b*, rear view; *c*, apertural view.

PLATE 29.

FIG. 1. *Quinqueloculina seminulum* (Linnaeus) var. × 80. *a*, front view; *b*, rear view; *c*, apertural view.
2. *Quinqueloculina contorta* d'Orbigny. × 65. *a*, front view; *b*, rear view; *c*, apertural view.
3. *Quinqueloculina auberiana* d'Orbigny. × 65. *a*, front view; *b*, rear view; *c*, apertural view.

PLATE 30.

FIG. 1. *Quinqueloculina undosa* Karrer. × 50. *a*, front view; *b*, rear view; *c*, apertural view.
2. *Quinqueloculina bicornis* (Walker and Jacob). × 65. *a*, front view; *b*, rear view; *c*, apertural view.
3. *Quinqueloculina bicornis* (Walker and Jacob)?. × 50. *a*, front view; *b*, rear view.

PLATE 31.

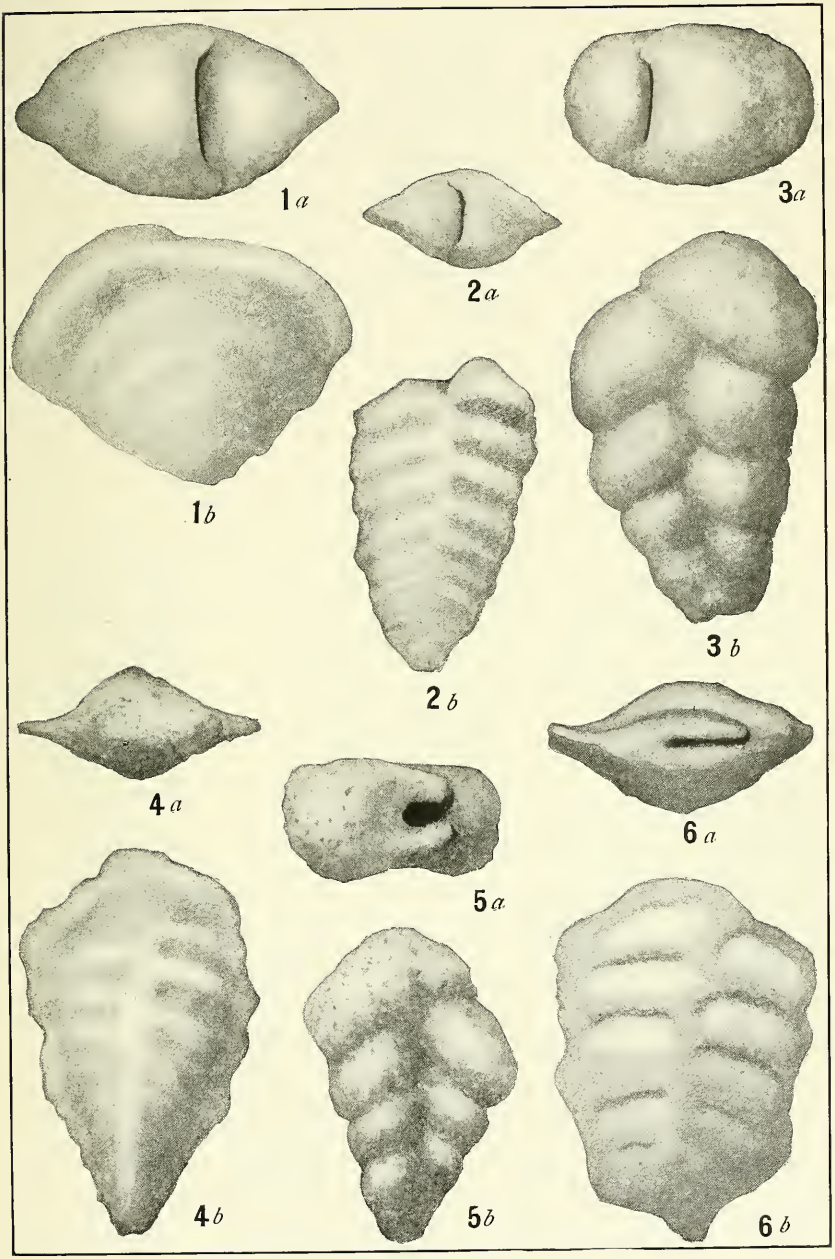
FIG. 1. *Quinqueloculina panamensis*, new species. × 65. *a*, front view; *b*, rear view; *c*, apertural view.
2. *Spiroloculina excavata* d'Orbigny. × 40. *a*, front view; *b*, apertural view.
3. *Sigmoilina asperula* (Karrer). × 65. *a*, front view; *b*, apertural view.
4. *Sigmoilina tenius* (Czjzek). × 65. *a*, front view; *b*, rear view; *c*, apertural view.

PLATE 32.

FIG. 1. *Triloculina trigonula* (Lamarck). × 65. *a*, front view; *b*, side view; *c*, apertural view.
2. *Triloculina tricarinata* d'Orbigny. × 65. *a*, rear view; *b*, side view; *c*, apertural view.
3. *Triloculina bulbosa*, new species. × 65. *a*, rear view; *b*, side view; *c*, apertural view.

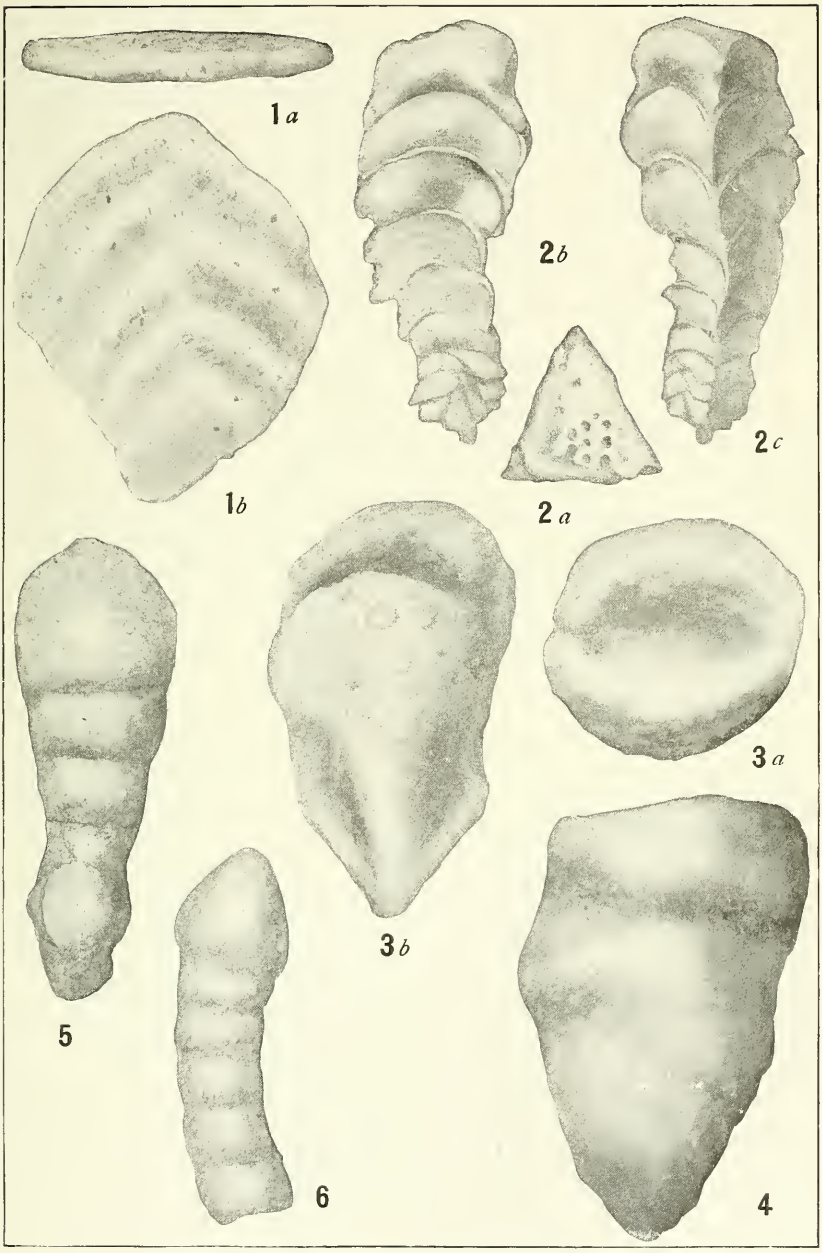
PLATE 33.

FIG. 1. *Triloculina projecta*, new species. × 65. *a*, front view; *b*, rear view; *c*, apertural view.
2. *Biloculina bulloides* d'Orbigny. × 65. *a*, front view; *b*, side view; *c*, apertural view.
3. *Orbiculina adunca* (Fichtel and Moll). × 30.



SMALLER FOSSIL FORAMINIFERA FROM PANAMA.

FOR EXPLANATION OF PLATE SEE PAGE 85.



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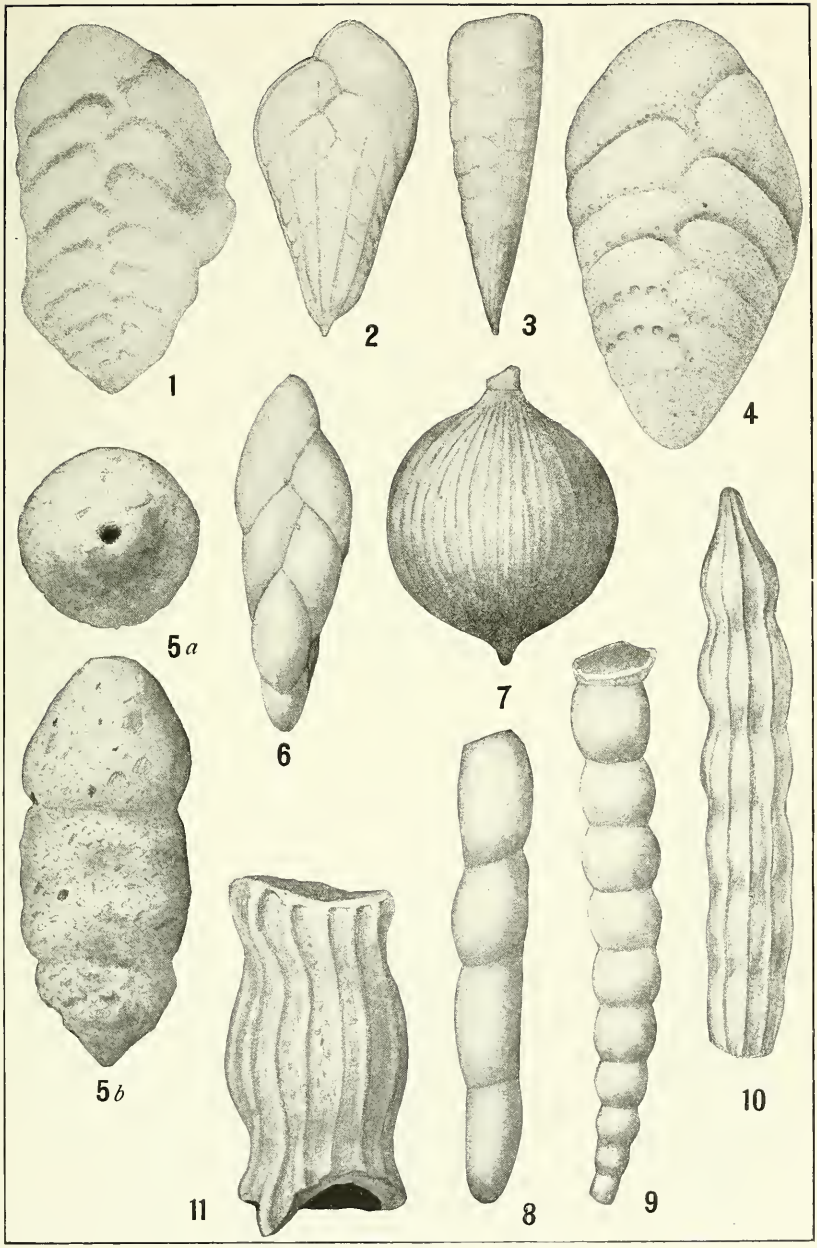

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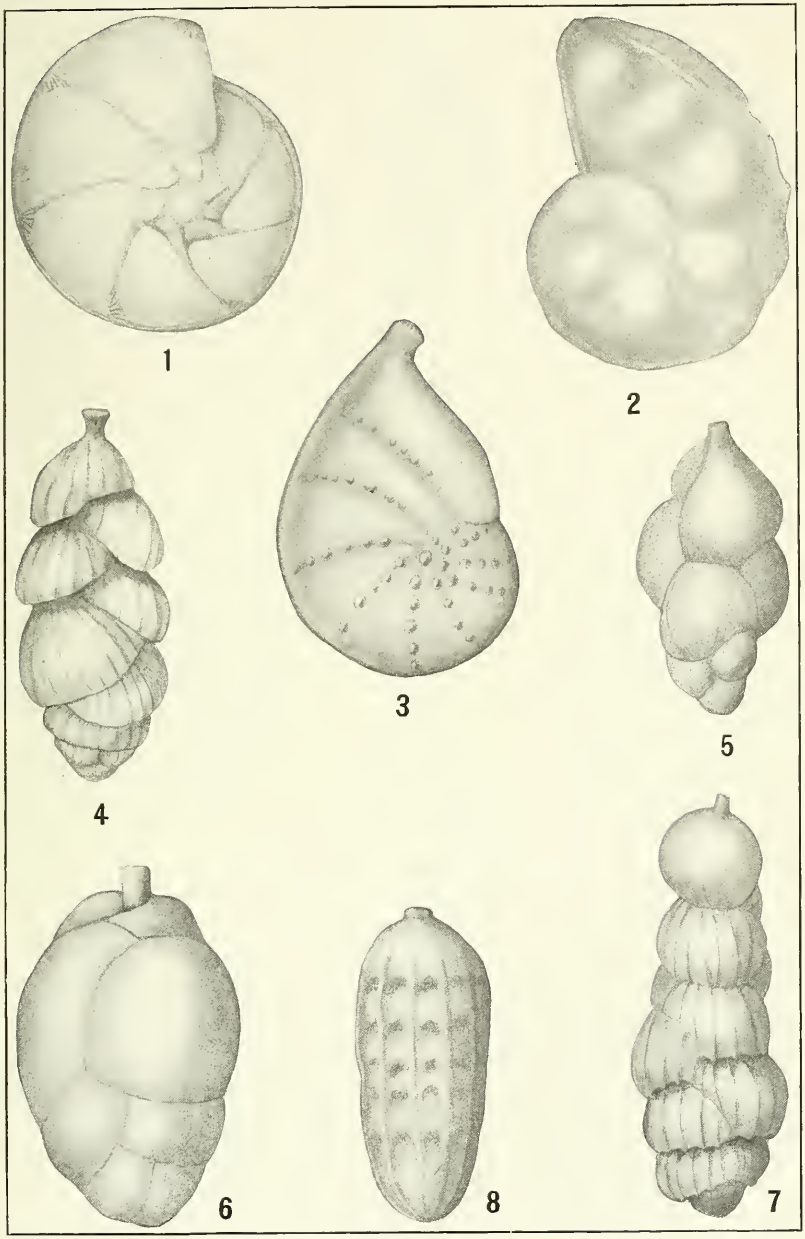

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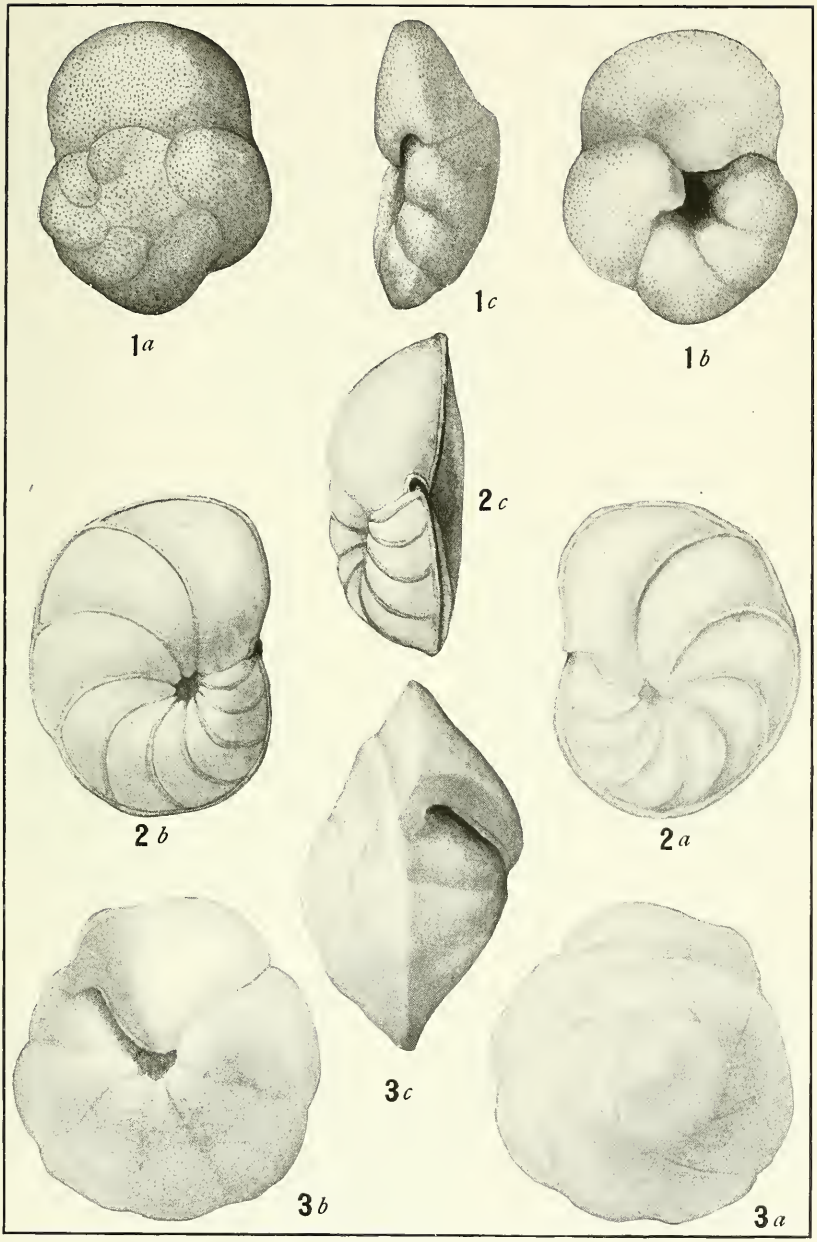

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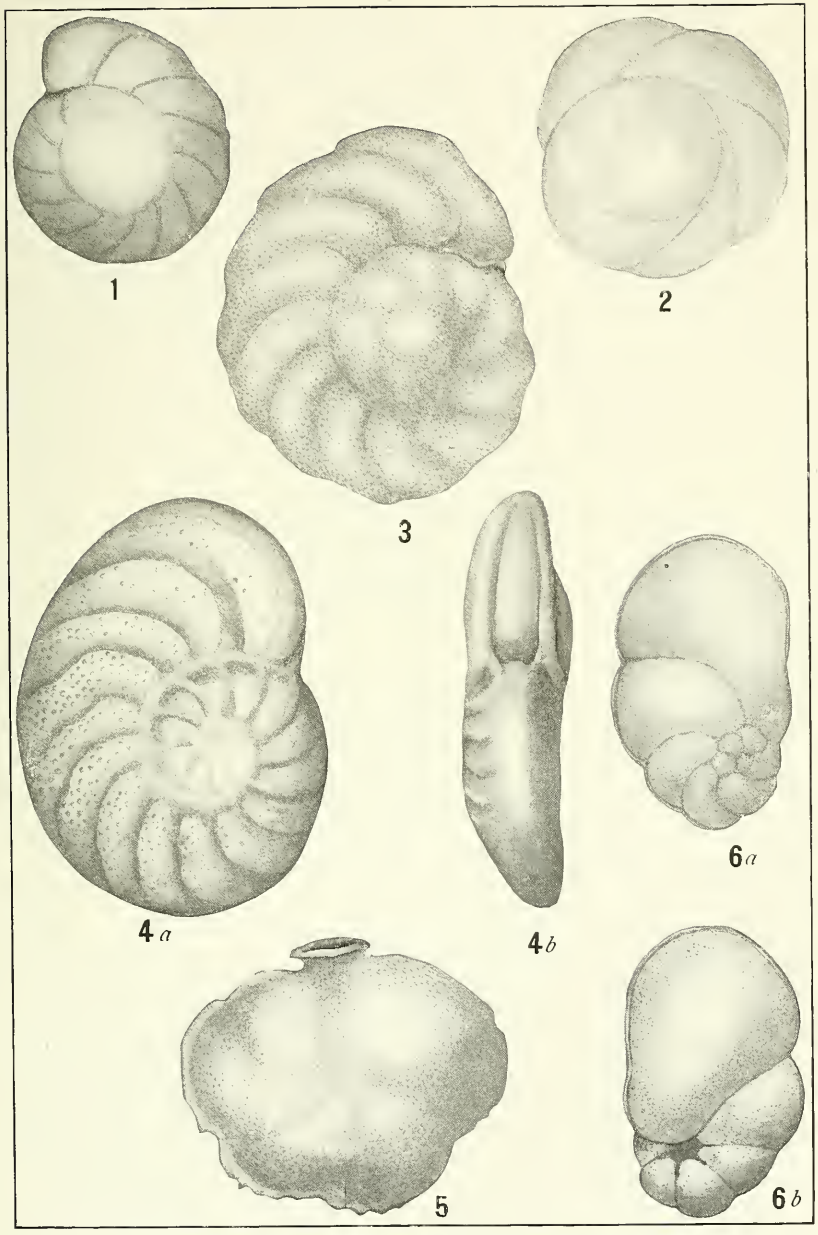

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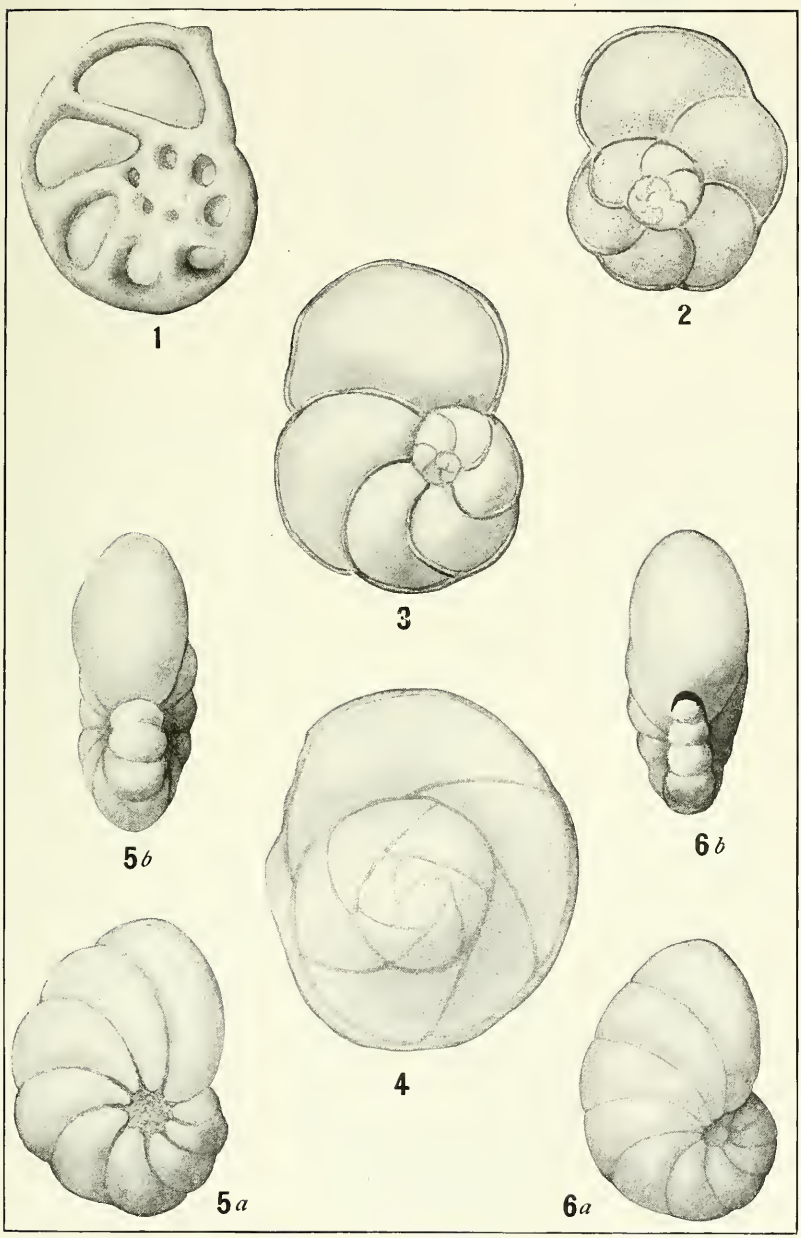

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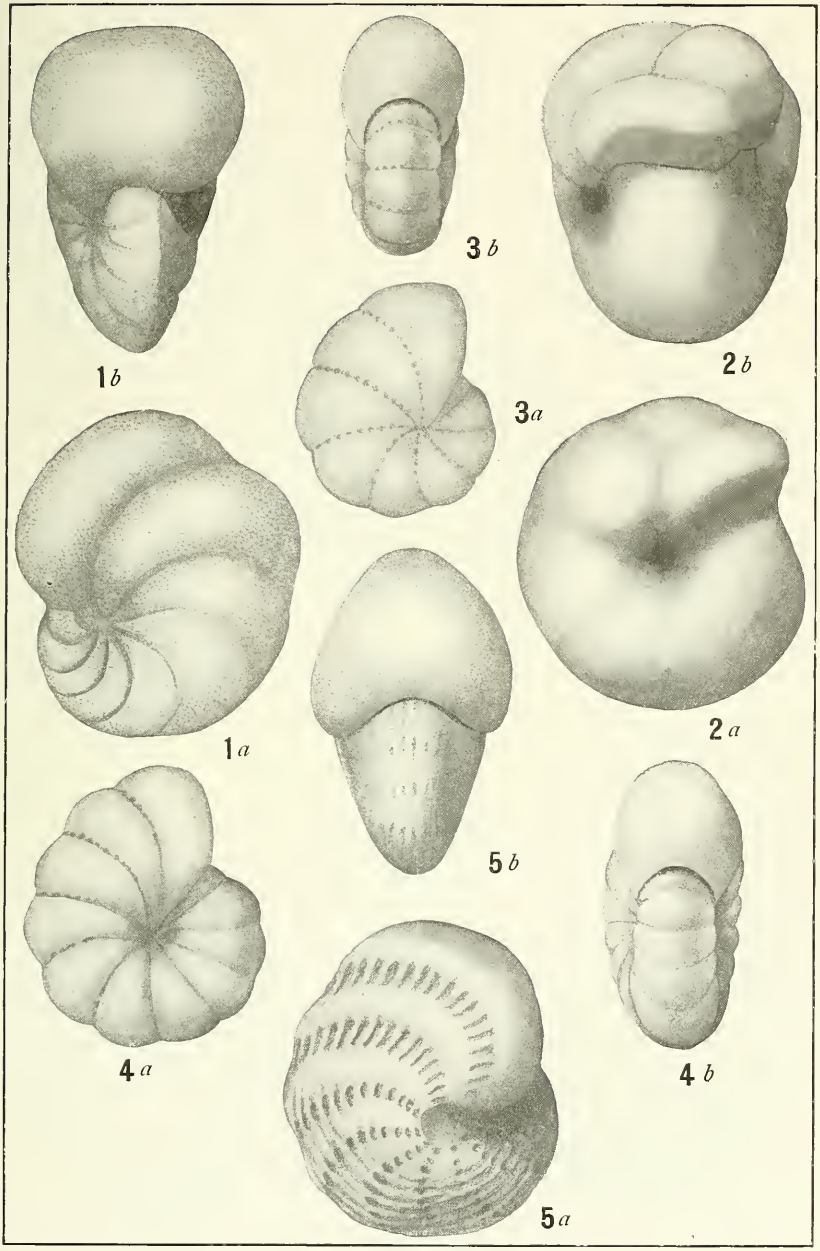

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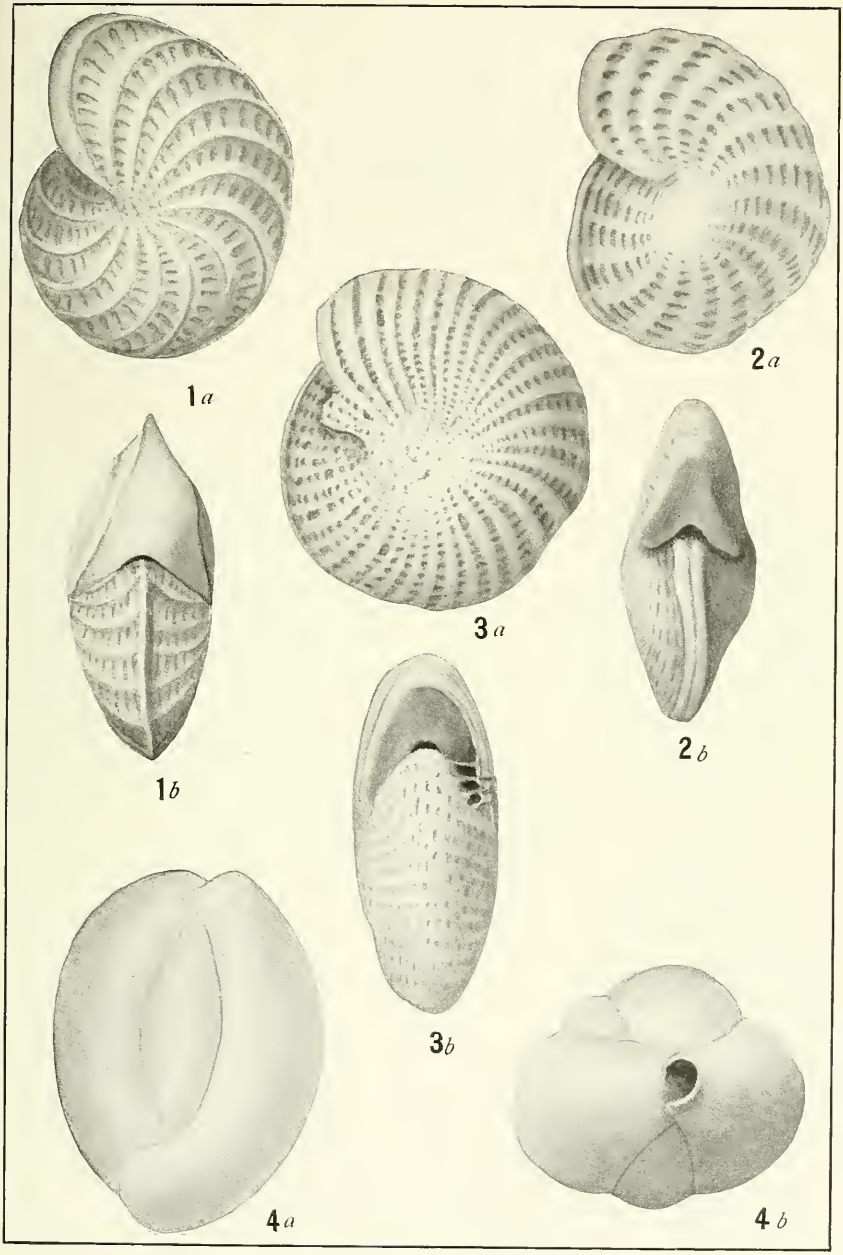

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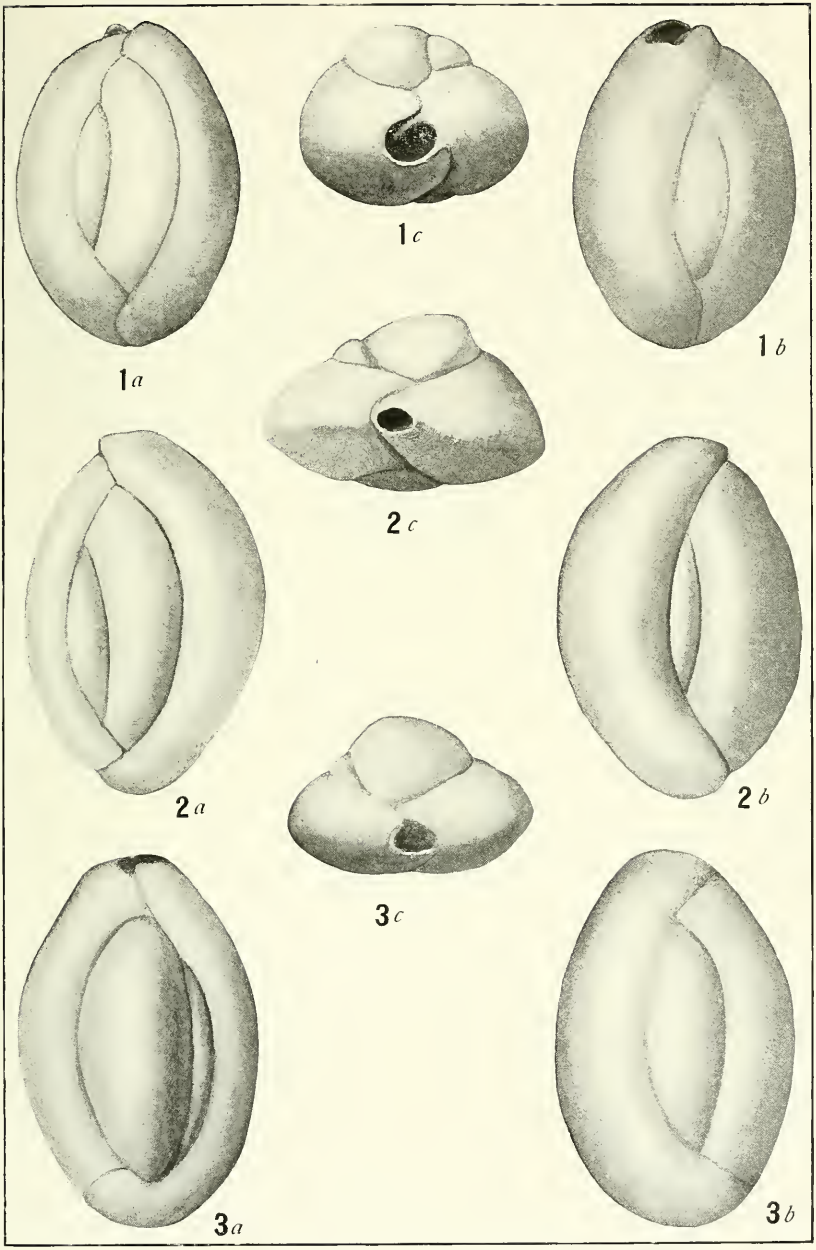

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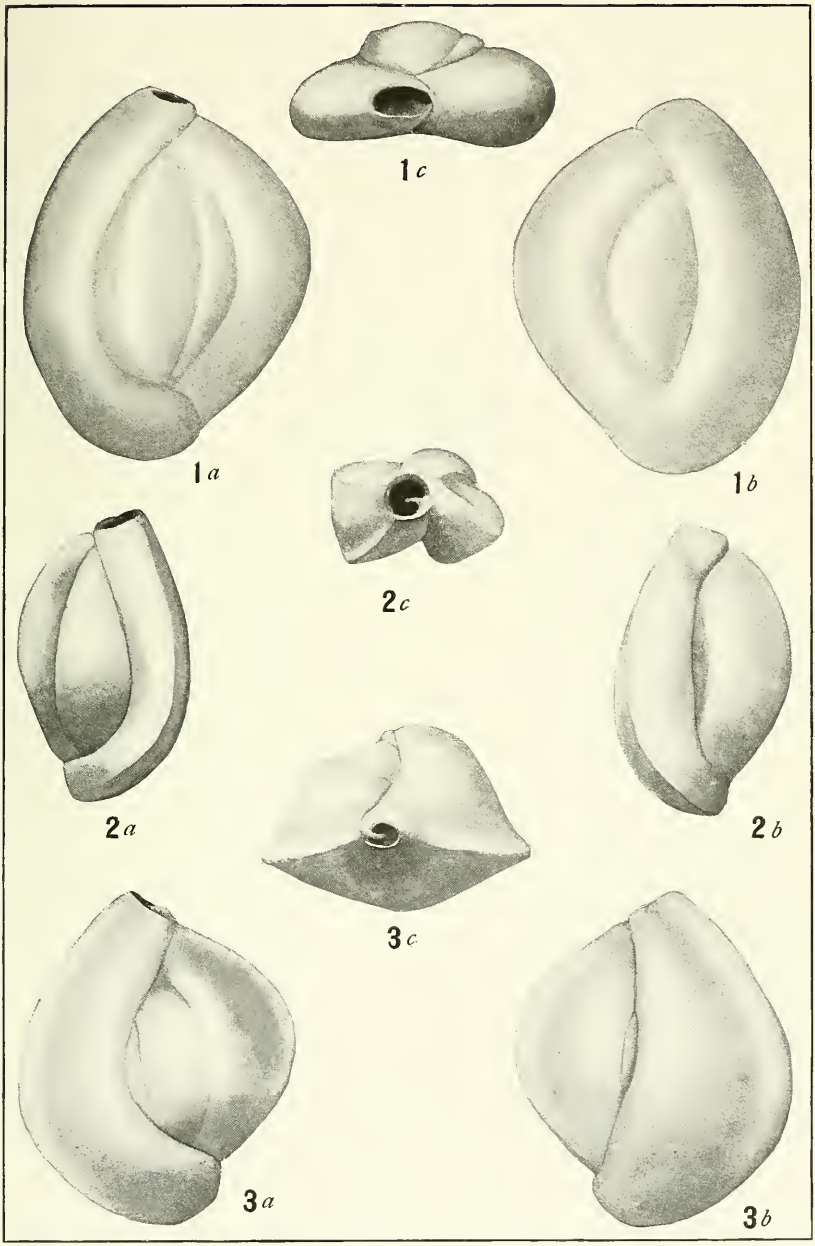

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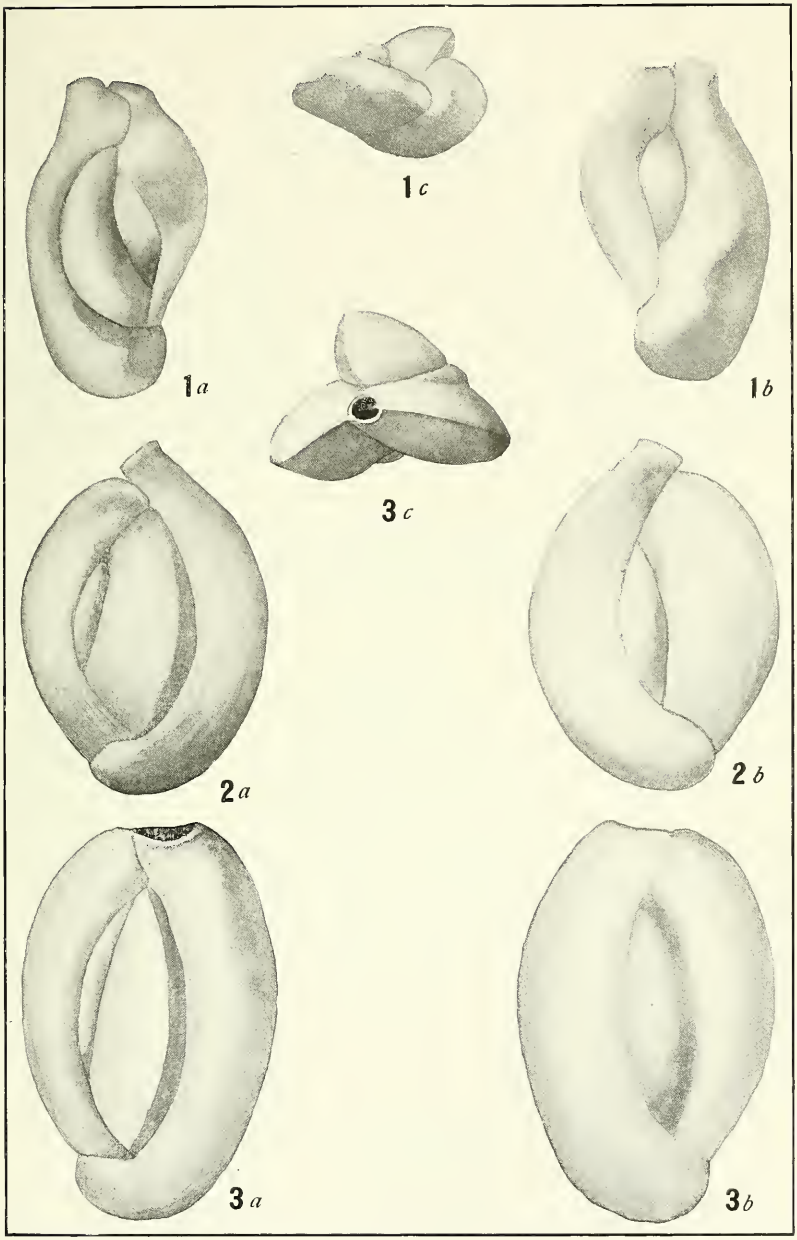

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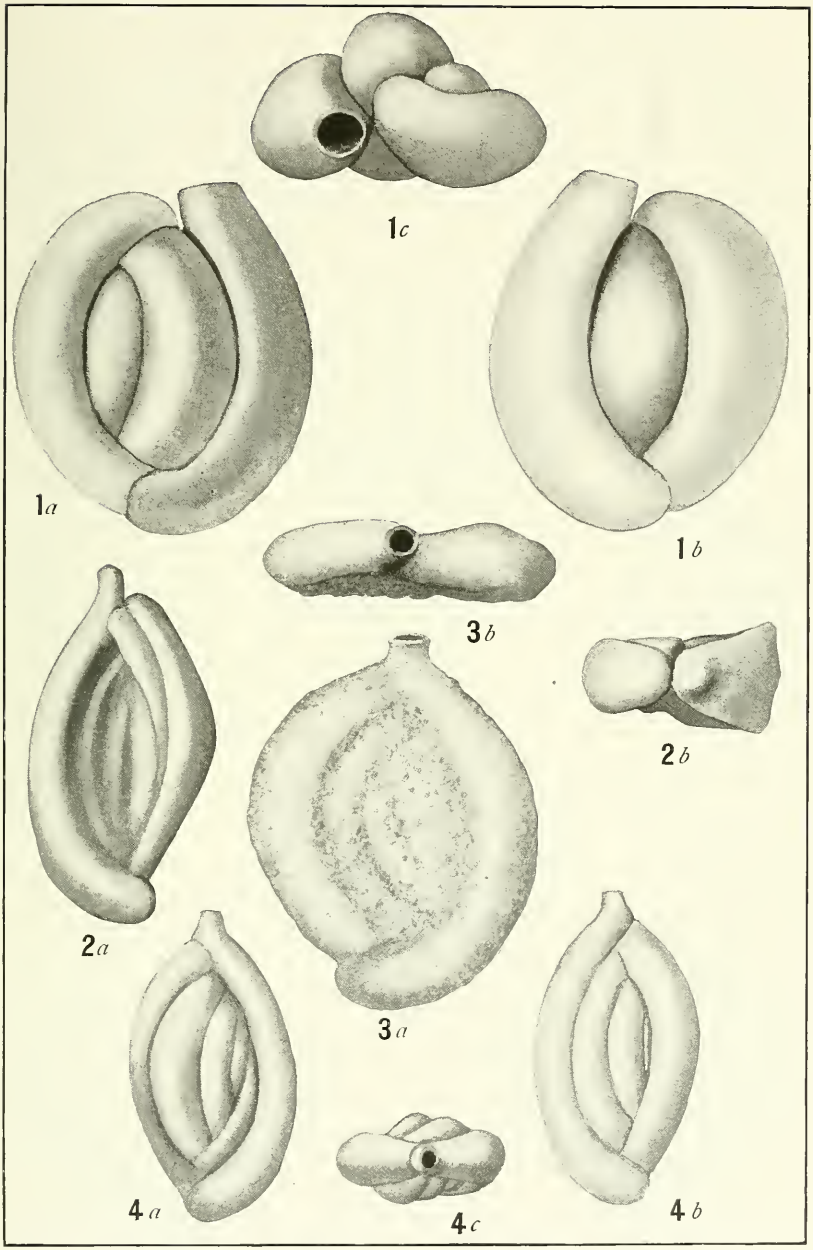

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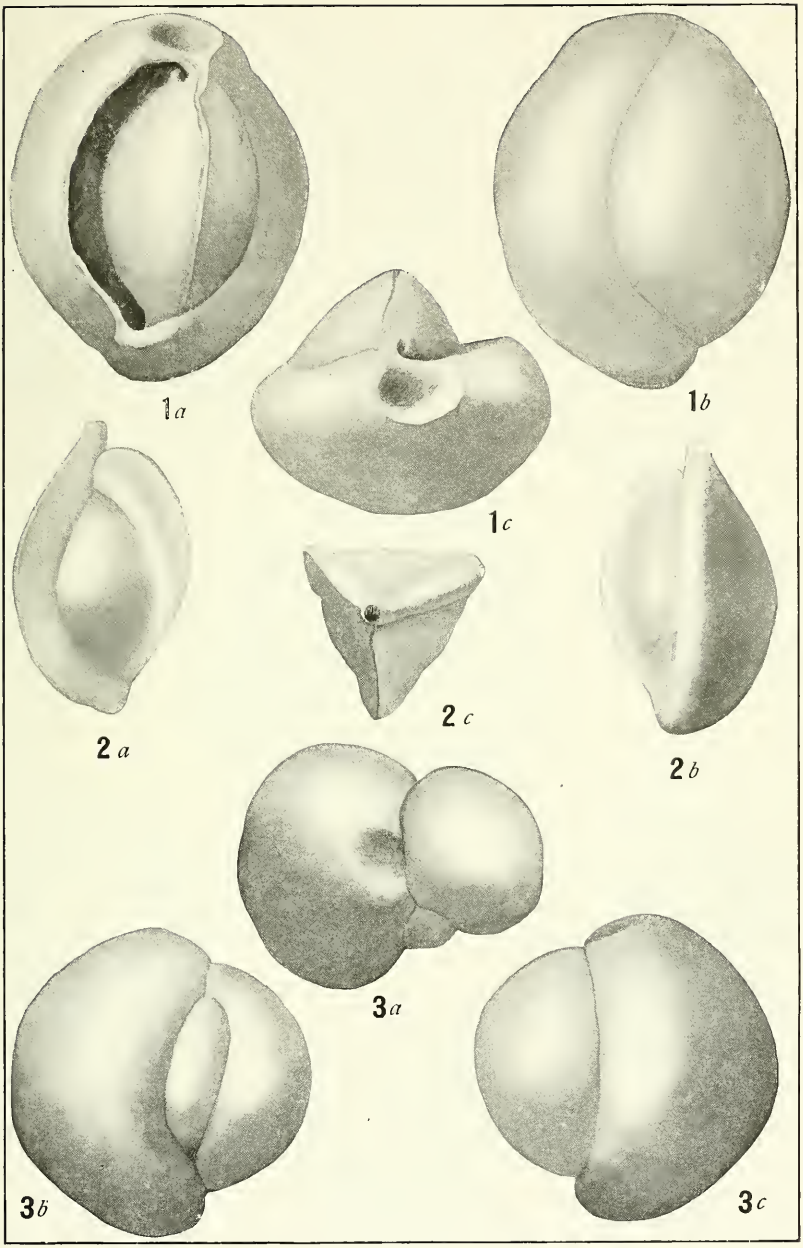

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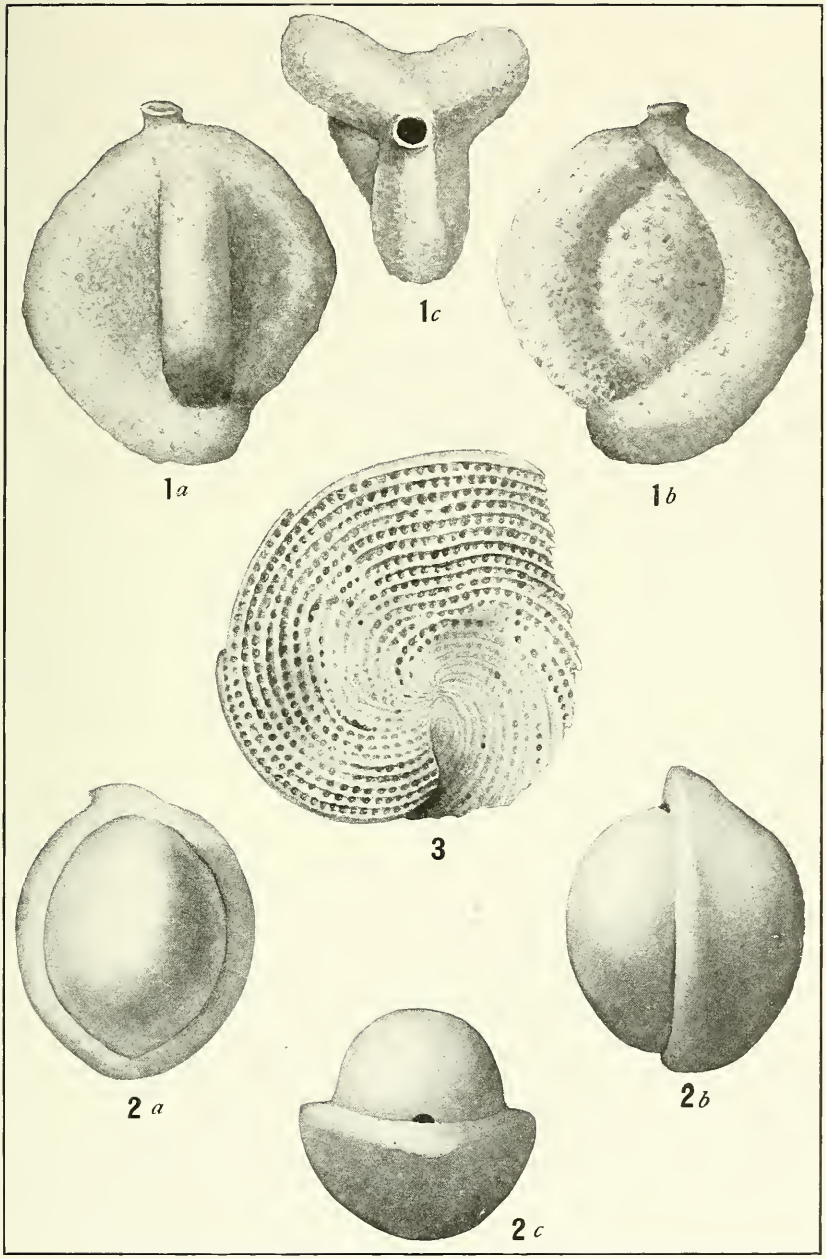

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