

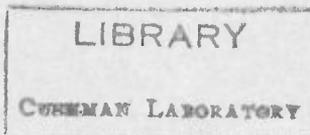
CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

VOLUME 23, PART 2
June, 1947

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1947



CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

90 Brook Road, Sharon, Mass., U. S. A.

JOSEPH A. CUSHMAN, Sc.D., *Director*

ALICE E. CUSHMAN, *Secretary, in charge of Publications*

RUTH TODD, M. S., *Research Associate*

RITA J. JOHNSON, B. A., *Laboratory Assistant*

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CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

290. SOME CUBAN FORAMINIFERA
OF THE GENUS *ROTALIA**

BY JOSEPH A. CUSHMAN and PEDRO J. BERMUDEZ

A number of species of the genus *Rotalia* occur in various formations of the Upper Cretaceous and Tertiary of Cuba. Some of these seem to be good index fossils and may have a wider areal distribution than is known at present. Figures and descriptions are given and some of the variations shown. We are indebted to Caridad V. Bermudez, wife of the junior author, for the drawings illustrating these species.

ROTALIA PRIMITIVA Cushman and Bermudez, n. sp. (Pl. 5, figs. 1-3)

Test small, biconvex, ventral side slightly more convex than the dorsal, periphery subacute; chambers rather indistinct except the last few which are slightly inflated, about 9 in the adult whorl; sutures indistinct except in the last part of the final whorl where they are nearly radial on the ventral side and only slightly curved on the dorsal side; wall on the dorsal side with numerous rounded papillae in the central portion becoming smaller toward the periphery, ventral side smooth except for the slightly depressed sutures and the distinct, rounded umbilical boss; aperture a low opening on the ventral side of the last-formed chamber, without a distinct lip. Length 0.37-0.45 mm.; breadth 0.40-0.45 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 48698) from the Upper Cretaceous, 0.5 kilometer south of Central San Antonio, Madruga, Habana Province, Cuba (Bermudez sta. 77).

This species differs from *R. fimbriatula* Cushman and Hedberg from the Upper Cretaceous of Colombia in the less distinct chambers, sutures on the dorsal side depressed instead of elevated, and the very different ornamentation.

This species is frequent in samples of Upper Cretaceous age from the vicinity of Madruga, Habana Province. It is usually associated with *Globotruncana arca* (Cushman) and several species of *Gumbelina*.

* Published by permission of the Standard Oil Company of Cuba.

ROTALIA MADRUGAENSIS Cushman and Bermudez, n. sp. (Pl. 5, fig. 4)

Test of medium size, strongly biconvex but with the central areas of both sides slightly depressed, periphery broadly rounded; chambers strongly inflated in the later portion, about 10 in the adult whorl, increasing in size rather rapidly as added in the last portion, earlier ones indistinct; sutures indistinct except in the last whorl where they are radial on both sides and become increasingly depressed; wall strongly ornamented with longitudinal costae confined to each chamber, those of the earlier portion of the final whorl broken up into very short ones almost papillate, ventral side with several large papillae in the umbilical area; aperture a low opening on the ventral edge of the last-formed chamber, toward the periphery. Length of holotype 0.85 mm.; breadth 0.65 mm.; thickness 0.37 mm.

Holotype (Cushman Coll. No. 48700) from the Paleocene, under bridge in the highway, Central San Antonio, Madruga, Habana Province, Cuba (Bermudez sta. 76).

This is a very unique species in its form and ornamentation. It is present in numerous samples of Paleocene age from the vicinity of Madruga, Habana Province.

ROTALIA HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 5, fig. 5)

Test rather small, strongly and nearly evenly biconvex, periphery rounded; chambers fairly distinct, very slightly if at all inflated, 9 or 10 in the adult whorl, increasing very gradually in size as added; sutures fairly distinct, very slightly curved but nearly radial, little if at all depressed; wall fairly smooth, except near the aperture on the ventral side where it is distinctly papillate, on the dorsal side with a series of fine linear papillae near the periphery and on the ventral side with a series of short oblique costae on each chamber at the basal peripheral angle, umbonal boss strongly developed; aperture a low opening just below the periphery on the ventral side of the last-formed chamber. Length of holotype 0.60 mm.; breadth 0.50 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 48701) from the Paleocene, water well, 200 meters north of Cerro Avenue on Rancho Boyeros road, Habana Province, Cuba (Bermudez sta. 530).

This species may be distinguished by its very strongly biconvex form with rounded periphery and the peculiar ornamentation. It is frequent in samples of Paleocene age from the vicinity of Habana.

ROTALIA CAPDEVILENSIS Cushman and Bermudez, n. sp. (Pl. 6, figs. 1-3)

Test rather small, unequally biconvex, ventral side slightly convex, dorsal side nearly flat, periphery acute with short spines, about one to a chamber increasing in size as growth progresses; chambers fairly distinct, slightly inflated, 9 or 10 in the adult whorl, increasing rather gradually in size as added; sutures distinct, raised, nearly straight and radial on the dorsal side, slightly curved on the ventral side; wall of the dorsal side irregularly papillate, ventrally with a distinct umbilical boss; aperture a low opening on the ventral margin of the last-formed chamber just below the periphery. Length 0.50-0.55 mm.; breadth 0.40 mm.; thickness 0.18 mm.

Holotype (Cushman Coll. No. 48702) from the lower Eocene, Capdevila formation, 1.8 kilometers N. 22° E. of Punta Brava, Habana Province, Cuba (Bermudez sta. 529).

This species somewhat resembles *R. byramensis* Cushman from the Oligocene but differs in the papillate dorsal surface, the strongly raised sutures, and narrower chambers. The species has been observed only in samples from the lower Eocene, Capdevila formation, and is a good index fossil for this formation.

ROTALIA PEÑONENSIS Cushman and Bermudez, n. sp. (Pl. 6, fig. 4)

Test of medium size, biconvex, with the central areas of both sides somewhat flattened, periphery rounded with slightly projecting raised costae and in the last-formed portion with the chambers angled; chambers distinct, the later ones somewhat inflated and angled at the periphery, 12 or more in the adult whorl; sutures distinct, those of the earlier portion distinctly raised, later ones depressed, slightly curved; wall highly ornamented by the raised costae and the area between in the early portion with fine papillae, later chambers with oblique costae, the central area of both sides with a few large rounded papillae; aperture a narrow, curved opening just below the periphery on the ventral side of the last-formed chamber. Length of holotype 0.70 mm.; breadth 0.60 mm.; thickness 0.28 mm.

Holotype (Cushman Coll. No. 48704) from the middle Eocene, 850 meters NW. of Peñon, 7 kilometers S. of Marti, Matanzas Province, Cuba (Bermudez sta. 110).

This species is abundant in samples from the early middle Eocene, associated with a rich *Dictyoconus* fauna. It is very distinctive in its elaborate ornamentation.

ROTALIA (?) PALMERAE Cushman and Bermudez, n. sp. (Pl. 6, figs. 5-7)

Test fairly large, both sides somewhat excavated, periphery somewhat crenulate, in edge view showing one side to be larger than the other so that there is a distinct peripheral angle; chambers distinct, 11 or 12 in the adult whorl, slightly inflated on the dorsal side, more separated in the last portion with distinct peripheral angles, ventrally less inflated; sutures distinct, strongly curved, later ones strongly depressed; wall of the last portion ornamented with oblique costae on both sides and on the peripheral angle; aperture a short, low opening at the base of the last-formed chamber, on the ventral side near the periphery. Length 0.75-0.85 mm.; breadth 0.60-0.62 mm.; thickness 0.32 mm.

Holotype (Cushman Coll. No. 48705) from the middle Eocene, 850 meters NW. of Peñon, 7 kilometers S. of Marti, Matanzas Province, Cuba (Bermudez sta. 110).

This is a peculiar species and the generic position is somewhat doubtful. Although it has many of the characters of some of the preceding species, the broad, angled periphery is unusual in this genus.

ROTALIA BYRAMENSIS Cushman (Pl. 7, fig. 1)

Rotalia byramensis CUSHMAN. U. S. Geol. Survey Prof. Paper 129-E, 1922, p. 99, pl. 23, fig. 1; Prof. Paper 129-F, 1922, p. 138; Prof. Paper 133, 1923, p. 46.—CUSHMAN and McGLAMERY, l. c., Prof. Paper 189-D, 1938, p. 110, pl. 27, fig. 3.—GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Ids., vol. 3, pt. 4, 1941, p. 378, pl. 19, fig. 1.—CUSHMAN and McGLAMERY, U. S. Geol. Survey Prof. Paper 197-B, 1942, p. 74.—APPLIN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 28, No. 12, 1944, pl. 1, fig. 1.—APPLIN and JORDAN, Journ. Pal., vol. 19, 1945, pp. 129, 142 (lists).—CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 22, 1946, p. 100, pl. 16, fig. 23.

The figured specimen from 20 meters N. of Noroña main house, N. of Guanajay, Pinar del Rio Province, Cuba (Bermudez sta. 275), seems identical with this species originally described from the Oligocene Byram marl of Mississippi and recorded at many localities in the Oligocene.

ROTALIA ORIENTALIS Cushman and Bermudez, n. sp. (Pl. 7, fig. 2)

Test of medium size, strongly and almost equally biconvex, periphery subacute; chambers distinct, about 9 in the adult whorl, very slightly inflated on the ventral side, of uniform shape and increasing very gradually as added; sutures distinct, on the dorsal side strongly oblique and slightly curved, ventrally somewhat depressed and radial; wall smooth, with a large umbilical boss on the ventral side; aperture a low, elongate opening on the ventral side of the last-formed chamber extending from

slightly below the periphery to the umbilical region with a slight lip. Length of holotype 0.65 mm.; breadth 0.60 mm.; thickness 0.36 mm.

Holotype (Cushman Coll. No. 48708) from the upper Eocene, 4.5 kilometers ENE. of Casimba Abajo, Guantanamo, Oriente Province, Cuba.

The species is frequent at the type locality associated with *Hantkenina alabamensis* Cushman.

ROTALIA MEXICANA Nuttall (Pl. 7, fig. 3)

Rotalia mexicana NUTTALL, Journ. Pal., vol. 2, 1928, p. 374, pl. 50, figs. 6-8.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 12, 1938, p. 22.—GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Ids., vol. 3, pt. 4, 1941, p. 380, pl. 19, fig. 3.—APPLIN and JORDAN, Journ. Pal., vol. 19, 1945, p. 129 (list).

The types of this species are from the upper Eocene, Isthmus of Tehuantepec, Mexico. It has been recorded from the Eocene of Cuba, from the Oligocene, Ponce formation, of Puerto Rico, and from the Oligocene, Suwannee limestone of Florida. The species is especially abundant in the upper Eocene throughout the island of Cuba. The figured specimen is from the upper Eocene, about 3 kilometers N. of Guanajay, Pinar del Rio Province, Cuba (Bermudez sta. 269).

ROTALIA MEXICANA Nuttall, var. **MECATEPECENSIS** Nuttall (Pl. 8, figs. 1-3)

Rotalia sp. CUSHMAN, Journ. Pal., vol. 1, 1927, p. 166, pl. 26, fig. 5.
Rotalia mexicana NUTTALL, var. *mecatepecensis* NUTTALL, l. c., vol. 6, 1932, p. 26, pl. 4, figs. 11, 12.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 12, 1938, p. 22.—GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Ids., vol. 3, pt. 4, 1941, p. 380, pl. 19, fig. 4.—APPLIN and JORDAN, Journ. Pal., vol. 19, 1945, p. 130 (list).

The types of this variety are from the lower Oligocene of Mexico. It has been recorded from the Eocene of Cuba, the Oligocene, Ponce formation, of Puerto Rico, and from the Oligocene, Suwannee limestone, of Florida. The variety has been observed in numerous samples from Cuba ranging from the upper Eocene to the middle Oligocene. Our figures show some of the variations in this variety. They are from the following localities: fig. 1, middle Oligocene, kilometer post 39 plus 750 meters, Carretera Central, W. of Caimito del Gayabal, Pinar del Rio Province, Cuba (Bermudez sta. 569); fig. 2, lower Oligocene, about 20 meters from grúa at Noroña, N. of Guanajay, Pinar del Rio Province, Cuba (Bermudez sta. 273); fig. 3, upper Eocene, about 20 meters N. of Noroña main house, N. of Guanajay, Pinar del Rio Province, Cuba (Bermudez sta. 275).

ROTALIA GUANTANAMENSIS Cushman and Bermudez, n. sp. (Pl. 9, figs. 1, 2)

Test of medium size, very strongly biconvex, dorsal side usually less convex than the ventral, periphery acute with spines, one to a chamber, projecting strongly forward; chambers distinct, on the ventral side and somewhat inflated, rather indistinct on the dorsal side, usually 8-10 in the adult whorl, of uniform shape and increasing in size very gradually as added; sutures distinct on the ventral side, depressed, slightly oblique, on the dorsal side mostly indistinct, strongly curved; wall distinctly papillate, with a large, ventral, umbilical boss; aperture a narrow opening on the ventral margin of the last-formed chamber, from just below the periphery nearly half way to the umbilical plug. Length 0.70-1.05 mm.; breadth 0.68-0.87 mm.; thickness 0.30-0.58 mm.

Holotype (Cushman Coll. No. 48715) from the lower Oligocene, 4.5 kilometers N. of Felicidad, Guantanamo, Oriente Province, Cuba. The figured paratype is from the lower Oligocene, cliff under hotel Puerto Tarafa, Nuevitas, Camagüey Province, Cuba (Bermudez sta. 157). This is a lower Oligocene species, especially well distributed in Oriente Province, Cuba.

This species resembles *R. byramensis* Cushman but differs from that species in its papillate surface, more convex ventral side, and the spinose processes pointing decidedly forward instead of radiate.

ROTALIA PINARENSIS Cushman and Bermudez, n. sp. (Pl. 9, fig. 3)

Test fairly large, nearly equally biconvex, ventral side slightly more convex than the dorsal, periphery subacute, the last portion slightly crenulate; chambers on the ventral side fairly distinct, of nearly equal shape and size, 10-12 in the adult whorl, indistinct on the dorsal side except the last two or three; sutures on the dorsal side mostly indistinct, slightly curved, on the ventral side depressed and radiate; wall on the dorsal side with some irregularly scattered papillae, especially toward the periphery, ventrally with the ornamentation consisting of short costae parallel to the periphery and extending from the periphery to the large, somewhat lobed umbilical boss; aperture at the base of the last-formed chamber on the ventral margin near the periphery and extending part way to the umbilicus. Length of holotype 1.25 mm.; breadth 0.87 mm.; thickness 0.46 mm.

Holotype (Cushman Coll. No. 48716) from the lower Oligocene, Baños well No. 1 (4102-4112 feet), San Diego de los Baños, Pinar del Rio Province, Cuba.

This species is frequent in samples from the lower Oligocene of Pinar

del Rio Province, Cuba. It is related to *R. viennoti* Grieg (Journ. Pal., vol. 9, 1935, p. 524, pl. 58, figs. 1-14) from the Oligocene of Palestine, but our species differs in the much narrower and more even test in peripheral view, and less highly ornamented wall.

ROTALIA JABACOENSIS Cushman and Bermudez, n. sp. (Pl. 10, figs. 1-3)

Test fairly large, strongly and nearly evenly biconvex, periphery subacute, slightly crenulate; chambers rather indistinct on both sides, except the last few in the adult whorl, increasing very gradually and evenly in size as added; sutures largely indistinct, nearly radial; wall highly ornamented with large, rounded papillae, those near the center of each side largest, the inner end of each chamber on the ventral side with a distinct, rounded projection and the umbilical boss with about three large papillae; aperture a very low opening at the ventral margin of the last-formed chamber slightly below the periphery. Length 1.00-1.12 mm.; breadth 0.92-0.98 mm.; thickness 0.60-0.64 mm.

Holotype (Cushman Coll. No. 48710) from the upper Eocene at Jabaco, 4.5 kilometers W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez sta. 337-A).

This species has been observed in samples from the upper and middle Eocene. It may be the ancestral form of the Rotalias of the *mexicana* type. It differs from *R. pinarensis* n. sp. in the broader test in edge view, the strongly papillose central regions, and the obscurity of the chambers.

291. TWO NEW SPECIES OF LOWER CRETACEOUS FORAMINIFERA FROM FLORIDA

BY J. A. CUSHMAN and E. R. APPLIN

TROCHOLINA FLORIDANA Cushman and Applin, n. sp. (Pl. 10, figs. 6-10)

Test conical, low, dorsal side very slightly raised, ventral side flattened or slightly convex, periphery subacute to slightly rounded; chambers consisting of about five or six coils, increasing rather evenly as added, the last-formed one much broader than the others due partly to overlapping, visible only from the dorsal side, ventral side with an irregular pattern formed by the slightly projecting ends of the pillars and the lighter-colored filling between; wall calcareous; spiral suture

not depressed; aperture at the end of the tubular chamber. Diameter 0.67-1.00 mm.; height 0.32-0.45 mm.

Holotype (Cushman Coll. No. 47367) from the upper part of the Lower Cretaceous, 5519-5528', middle core 18, Ohio Oil Co.'s, Hernasco Corporation No. 1 well, sec. 19, T.23S., R.20E., Hernando Co., Florida.

This species differs from *T. conica* (Schlumberger) from the Jurassic of Germany in the much lower spire, more convex ventral face with the whole surface covered with the projecting bosses. In vertical section the coiling chamber is seen near the surface and the interior filled with irregular masses of calcareous material.

CUNEOLINA WALTERI Cushman and Apolin, n. sp. (Pl. 10, figs. 4, 5)

Test large, compressed, early stage triangular in front view, in the adult spreading at the sides beyond the line of the earlier stage, early portion angular in transverse section with three or more chambers to the whorl, in the adult biserial throughout, apertural face with a shallow furrow; chambers rather indistinct, of nearly uniform height, the interior labyrinthic except in the earliest chambers, the interior structure showing through in varying degrees on the surface; sutures not depressed, rather indistinct; wall arenaceous with an outer coating of very fine grained material, surface smoothly finished; aperture elongate, at the inner margin of the last-formed chamber. Length up to 1.00 mm.; breadth up to 1.40 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 47365) from the upper part of the Lower Cretaceous, 5519-5528', middle core 18, Ohio Oil Co.'s, Hernasco Corporation No. 1 well, sec. 19, T.23S., R.20E., Hernando Co., Florida.

This species differs from *C. angusta* Cushman in the much smaller size, more broad and flaring shape in front view, and the sutures not depressed and much more curved. It differs from *C. pavonia* d'Orbigny also in the smaller size and the sutures not depressed.

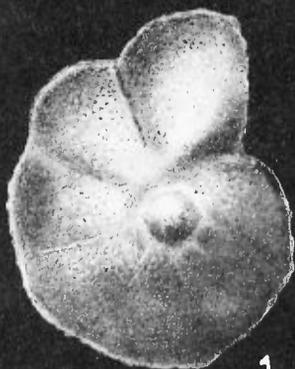
The species is named for Mr. H. Glenn Walter, district geologist of the Ohio Oil Co., whose help in furnishing material for the study of this species is much appreciated.

EXPLANATION OF PLATE 5

Figs. 1-3. *Rotalia primitiva* Cushman and Bermudez, n. sp. $\times 130$. 1, 2, Paratypes, ventral and peripheral views. 3, Holotype, dorsal view. 4. *R. madruagaensis* Cushman and Bermudez, n. sp. $\times 70$. a, dorsal view; b, ventral view; c, peripheral view. 5. *R. havanensis* Cushman and Bermudez, n. sp. $\times 100$. a, dorsal view; b, ventral view; c, peripheral view.

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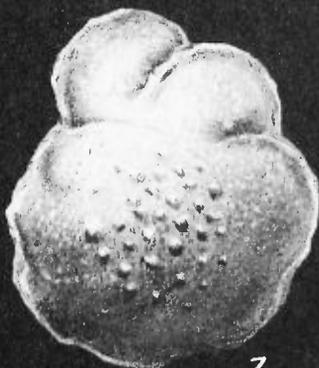
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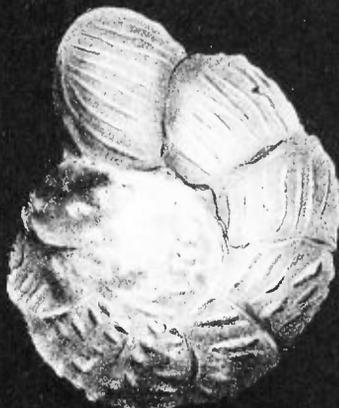
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4b



4c



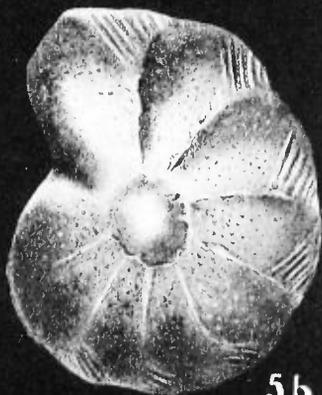
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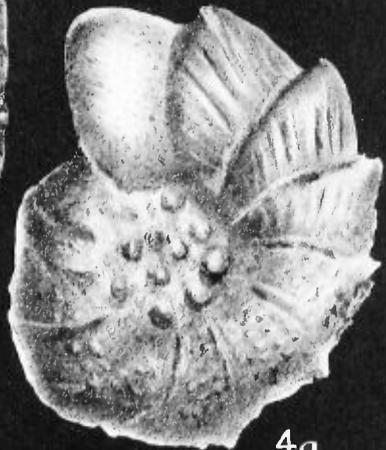
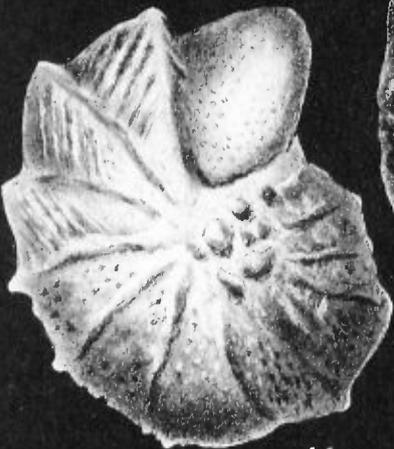
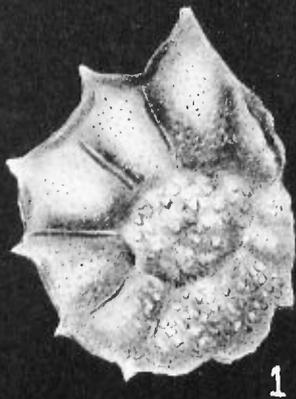
5a



5c



5b



292. FURTHER NOTES ON THE CRETACEOUS
FORAMINIFERA OF TRINIDAD

BY J. A. CUSHMAN and H. H. RENZ

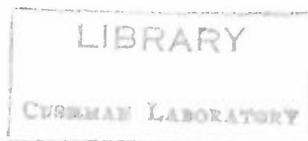
The richest and best preserved Cretaceous foraminifera of Trinidad are found in the Lizard Springs marl which has recently been published (Cushman and Renz, The Foraminiferal Fauna of the Lizard Springs Formation of Trinidad, British West Indies, Special Publ. 18, Cushman Lab. Forum. Res., 1946). The present paper includes the faunas of the beds that underlie the Lizard Springs formation: the Chaudière and Tarouba formations. Many species are common to all of these formations but a number of species were found in the lower formations that were not found in the Lizard Springs and a considerable number that were found only in the lower zone of the Lizard Springs marl.

In comparing these species with those of the southern United States a number of them are limited in their range to beds of Taylor age or older. Many of the species of the Trinidad Cretaceous are found in the Santa Anita formation of Venezuela recently published (Cushman, A Foraminiferal Fauna from the Santa Anita Formation of Venezuela, Contr. Cushman Lab. Forum. Res., vol. 23, 1947, pp. 1-18, pls. 1-4).

For the stratigraphic relationships of these Trinidad formations reference may be made to the work by H. H. Renz, Stratigraphy of Northern South America, Trinidad, and Barbados (Proc. 8th Amer. Sci. Congress, 1942, pp. 513-571, table), in which the Tarouba formation and Chaudière shale are discussed. Both formations appear to represent approximate time equivalents; the typical development of the former is in the San Fernando Area (Naparima Hill, central west coast of Trinidad) and the latter in the Central Range. In the present paper the two parts of the Tarouba formation are referred to as upper Tarouba (formerly called "Hobson clay") and lower Tarouba (siliceous shale, argiline). The Chaudière shale typically is a fine grained shale but the probably lower part has a marl developed particularly in the western Central Range and known as the Pointe-à-Pierre Railway Cut marl. This is referred to in our text as the Railway Cut marl.

EXPLANATION OF PLATE 6

FIGS. 1-3. *Rotalia capdevilensis* Cushman and Bermudez, n. sp. $\times 110$. 1, Holotype, dorsal view. 2, 3, Paratypes, peripheral and ventral views. 4. *R. peñonensis* Cushman and Bermudez, n. sp. $\times 100$. a, dorsal view; b, ventral view; c, peripheral view. 5-7. *R. (?) palmerae* Cushman and Bermudez, n. sp. $\times 70$. 5, Holotype, dorsal view. 6, 7, Paratypes, peripheral and ventral views.



Another development of the marl is on the Lantern Estate, Piparo area, in the Central Range and is here referred to as the Lantern marl.

The faunas described in the present paper originate from the following localities:

Chaudière formation

(a) *Chaudière shale s. s.*

Locality: Chaudière River, Eastern Central Range, Trinidad, B.W.I. Cunapo Southern Road, below bridge near 9¾ mile-post.

Trinidad Government Cadastral Co-ordinates:
North 349.345 links; East 542.160 links.

Lithology: Greenish-gray, finely textured, well-bedded silty clay-shale.

(b) *Pointe-à-Pierre Railway Cut marl* (interbedded in Chaudière shale)

Locality: Pointe-à-Pierre, Western Central Range, Trinidad, B.W.I. 80-90 meters north of the gate at Pointe-à-Pierre Railway Station in the east bank of the cutting.

Trinidad Government Cadastral Co-ordinates:
North 260.260 links; East 362.840 links.

Lithology: Yellowish-grey, massive indurated glauconitic marl with dark streaks. CaCO_3 -content: 27.3%

(c) *Lantern marl* (interbedded in Chaudière shale)

Locality: Lantern Estate, Piparo Area, Central Range, Trinidad, B.W.I. River bed, immediately south of a small bridge near 12¼ mile-post of the Guaracara-Tabaquite Road, about 5 miles northeast of the Kelly Junction.

Trinidad Government Cadastral Co-ordinates:
North 287.800 links; East 431.710 links.

Lithology: Light grey, khaki weathering marl. CaCO_3 -content: 22.6%

Tarouba formation

(a) *Lower Member*

Locality: San Fernando, Naparima Hill, Trinidad, B.W.I. Power Station, eastern cliff opposite high level water resevoir.

Trinidad Government Cadastral Co-ordinates:
North 234.170 links; East 360.790 links.

Lithology: Well-bedded, cream-yellowish marl, interbedded in hard siliceous shale (argiline). CaCO_3 -contents: 23.8%

(b) *Upper Member* (Formerly called Hobson clay)

Locality: San Fernando, Trinidad, B.W.I. Junction of Pointe-à-Pierre Road and Chacon Street (Naparima Hill side).

Trinidad Government Cadastral Co-ordinates:
North 235.880 links; East 360.130 links.

Lithology: Light grey, well-bedded argillaceous shale, indurated on weathering surface.

Notes are given on the occurrences of the species in these various formations, references are made to the papers already mentioned and to the monograph of the Upper Cretaceous foraminifera (Cushman, Upper Cretaceous Foraminifera of the Gulf Coastal Region of the United States and Adjacent Areas, U. S. Geol. Survey Prof. Paper 206, 1946) where full synonymies of the various species may be found, and most of the species not occurring in the Lizard Springs formation are figured. It is hoped that the following notes will help in developing the knowledge of the Upper Cretaceous foraminifera of this region.

To save space in references, the paper on the Lizard Springs marl is referred to as Cushman and Renz, 1946; the paper on the Santa Anita formation of Venezuela as Cushman, 1947; and Prof. Paper 206 as Cushman, 1946.

Family ASTRORHIZIDAE

Genus RHABDAMMINA M. Sars, 1869

RHABDAMMINA DISCRETA H. B. Brady

(CUSHMAN, 1946, p. 14; 1947, p. 3; CUSHMAN and RENZ, 1946, p. 12.)

Specimens are fairly common in the upper Tarouba shale and Lantern marl.

RHABDAMMINA DISCRETA H. B. Brady, var.

Specimens similar to those figured (Cushman and Renz, 1946, p. 12, pl. 1, figs. 2, 3) from the Lizard Springs marl occurred in the Chaudière shale.

Family RHIZAMMINIDAE

Genus BATHYSIPHON M. Sars, 1872

BATHYSIPHON ? DUBIA (White)

Specimens in some respects similar to those already recorded from

the lower zone of the Lizard Springs marl (Cushman and Renz, 1946, p. 12, pl. 1, figs. 4, 5) occur in the Chaudière shale but attain a larger size.

BATHYSIPHON ALEXANDERI Cushman (Pl. 11, fig. 1)

Bathysiphon alexanderi CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 49, pl. 5, fig. 1; U. S. Geol. Survey Prof. Paper 206, 1946, p. 14, pl. 1, fig. 5.

Specimens apparently identical with this species previously known only from the Upper Cretaceous of Austin age of Texas occur in the Railway Cut marl.

Family SACCAMMINIDAE

Genus SACCAMMINA M. Sars, 1869

SACCAMMINA RHUMBLERI (Franke)

(CUSHMAN, 1946, p. 14; CUSHMAN and RENZ, 1946, p. 13).

Specimens occur in the upper Tarouba formation.

SACCAMMINA RHUMBLERI (Franke). var. TRINITATENSIS Cushman and Renz, n. var. (Pl. 11, fig. 2)

Variety differing from the typical form in the very much smaller size. Diameter 0.23 mm.

Holotype of variety (Cushman Coll. No. 47339) from the Upper Cretaceous, Chaudière shale, Lantern marl beds, river bed, immediately S. of small bridge near 12¼ mile post of Guaracara-Tabaquite Rd., about 5 miles NE. of Kelly Junction, Lantern Estate, Piparo area, Central Range, Trinidad, B. W. I.

This variety appears to be distinct from the typical form and occurs also in the Chaudière shale, Cunapo Southern road, under bridge near 9¾ mile post, Chaudière River, Eastern Central Range, Trinidad.

Genus PELOSINA H. B. Brady, 1879

PELOSINA COMPLANATA Franke

(CUSHMAN, 1946, p. 15; 1947, p. 3; CUSHMAN and RENZ, 1946, p. 13.)

Specimens occur in the lower Tarouba shale and the Chaudière shale in the Lantern marl and Railway Cut marl sections.

Family HYPERAMMINIDAE

Genus SACCORHIZA Eimer and Fickert, 1899

SACCORHIZA RAMOSA (H. B. Brady)

(CUSHMAN, 1946, p. 15; CUSHMAN and RENZ, 1946, p. 13.)

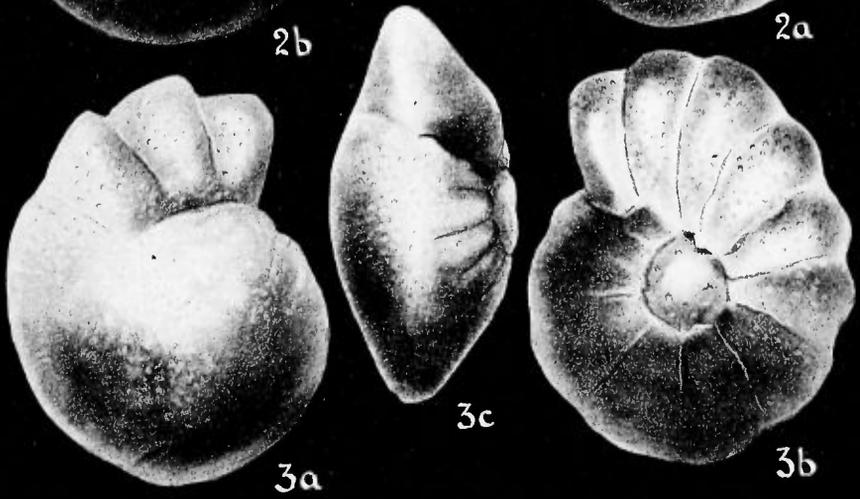
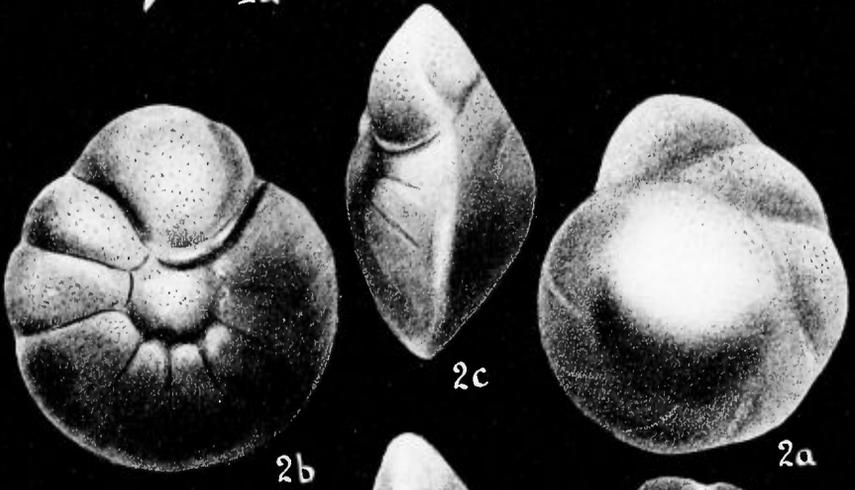
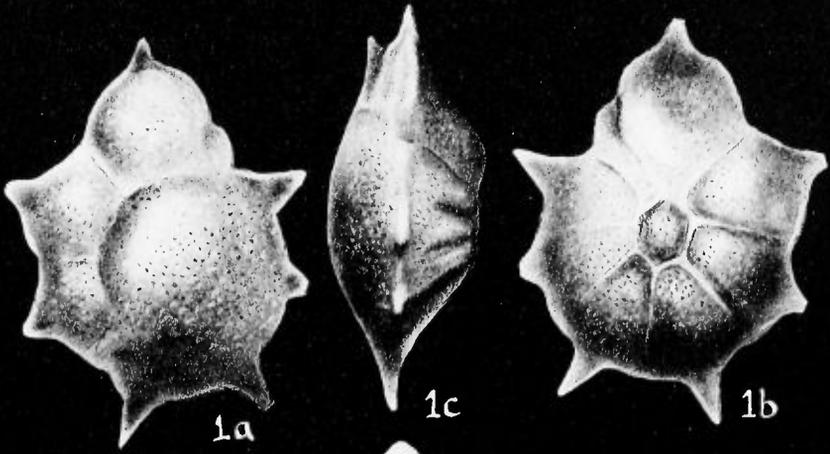
Numerous specimens occur in the upper Tarouba shale.

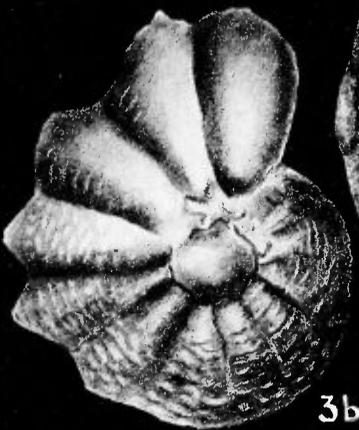
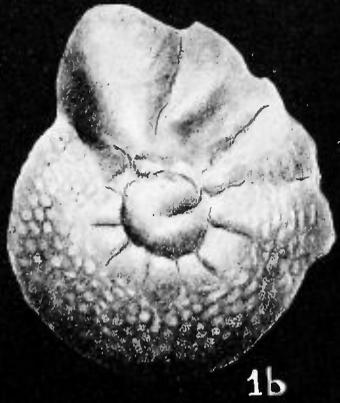
EXPLANATION OF PLATE 7

FIG. 1. *Rotalia byramensis* Cushman. × 110. *a*, dorsal view; *b*, ventral view; *c*, peripheral view. 2. *R. orientalis* Cushman and Bermudez, n. sp. × 90. *a*, dorsal view; *b*, ventral view; *c*, peripheral view. 3. *R. mexicana* Nuttall. × 70. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

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Family REOPHACIDAE

Genus REOPHAX Montfort, 1808

REOPHAX cf. DENTALINOIDES (Reuss) (Pl. 11, fig. 4)

(CUSHMAN, 1946, p. 16.)

Rare specimens from both the upper and lower Tarouba shales seem close to this species which in the United States is recorded only from beds of Taylor age.

REOPHAX sp.

Fragmentary specimens in the Chaudière and lower Tarouba shales are similar to those recorded from the Lizard Springs marl (Cushman and Renz, 1946, p. 14, pl. 1, figs. 14, 25).

Genus HORMOSINA H. B. Brady

HORMOSINA GLOBULIFERA H. B. Brady, var. TRINITATIENSIS Cushman and Renz

This variety recently described from the lower zone of the Lizard Springs marl (Cushman and Renz, 1946, p. 14, pl. 1, figs. 15-19) occurs commonly in the upper Tarouba shale and in various divisions of the Chaudière shale.

Genus NODELLUM Rhumbler, 1913

NODELLUM VELASCOENSE (Cushman)

(CUSHMAN, 1946, p. 17; CUSHMAN and RENZ, 1946, p. 14.)

This species occurs commonly in the upper Tarouba shale and the various divisions of the Chaudière shale. It is recorded from the Lizard Springs marl of Trinidad and the Velasco shale of Mexico.

Family AMMODISCIDAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS GLABRATUS Cushman and Jarvis

(CUSHMAN, 1946, p. 17; 1947, p. 3; CUSHMAN and RENZ, 1946, p. 14.)

This species originally described from the Lizard Springs marl occurs in the upper Tarouba shale and in the various divisions of the Chaudière shale.

AMMODISCUS PENNYI Cushman and Jarvis

(CUSHMAN, 1946, p. 17; 1947, p. 3; CUSHMAN and RENZ, 1946, p. 14.)

This species occurs in the Lantern marl and Railway Cut marl of the Chaudière shale. It is known from the lower zone of the Lizard Springs marl, the Velasco shale of Mexico, Colon and Santa Anita shales of Venezuela, and the Corsicana marl of Texas.

EXPLANATION OF PLATE 8

FIGS. 1-3. *Rotalia mexicana* Nuttall, var. *mecatepecensis* Nuttall. $\times 50$. a, a, a, dorsal views; b, b, b, ventral views; c, c, c, peripheral views.

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Genus *GLOMOSPIRA* Rzehak, 1888*GLOMOSPIRA GORDIALIS* (Jones and Parker), var. *DIFFUNDENS* Cushman and Renz

This variety recently described from the Lizard Springs marl (Cushman and Renz, 1946, p. 15, pl. 1, fig. 30) also occurs in the upper Tarouba shale, in the Chaudière shale and the Lantern marl beds. It is also recorded from the Velasco shale of Mexico.

GLOMOSPIRA CHAROIDES (Jones and Parker), var. *CORONA* Cushman and Jarvis (CUSHMAN, 1946, p. 19; CUSHMAN and RENZ, 1946, p. 15.)

Specimens occur in the upper and lower Tarouba shales and in the typical Chaudière shale and the Lantern marl beds. It also occurs in the Lizard Springs marl.

Genus *LITUOTUBA* Rhumbler, 1895*LITUOTUBA LITUIFORMIS* (H. B. Brady)

(CUSHMAN, 1946, p. 19; CUSHMAN and RENZ, 1946, p. 15.)

The only specimens of this species in the present material are from the Chaudière shale. It is recorded from the lower zone of the Lizard Springs marl and the Velasco shale of Mexico.

Genus *AMMOLAGENA* Eimer and Fickert, 1899*AMMOLAGENA CLAVATA* (Jones and Parker)

(CUSHMAN, 1946, p. 19; CUSHMAN and RENZ, 1946, p. 15.)

This species occurs in the Lantern marl and Railway Cut marl phases of the Chaudière shale and in the lower zone of the Lizard Springs marl.

Family *LITUOLIDAE*Genus *TROCHAMMINOIDES* Cushman, 1910*TROCHAMMINOIDES* cf. *VELASCOENSIS* Cushman

(CUSHMAN, 1946, p. 19.)

A few specimens from the Lantern marl beds of the Chaudière shale may belong in this species known only from the Velasco shale of Mexico. There are eight chambers in the final whorl, as in the types, but the specimens are somewhat larger.

Genus *HAPLOPHRAGMOIDES* Cushman, 1910*HAPLOPHRAGMOIDES CORONATA* H. B. Brady

(CUSHMAN, 1946, p. 20; CUSHMAN and RENZ, 1946, p. 18.)

Specimens occurred in the upper Tarouba shale, the Chaudière shale, and the Lantern marl section.

HAPLOPHRAGMOIDES GLABRA Cushman and Waters

(CUSHMAN, 1946, p. 20; CUSHMAN and RENZ, 1946, p. 18.)

Specimens occur in the typical Chaudière shale and in the Lantern marl, also in both zones of the Lizard Springs marl.

HAPLOPHRAGMOIDES FLAGLERI Cushman and Hedberg.
var. **TRINITATENSIS** Cushman and Renz

This variety was recently described from the lower zone of the Lizard Springs marl (Cushman and Renz, 1946, p. 18, pl. 2, figs. 2, 3). It occurs also in the upper Tarouba and Chaudière shales.

Genus **CRIBROSTOMOIDES** Cushman, 1910

CRIBROSTOMOIDES TRINITATENSIS Cushman and Jarvis

(CUSHMAN, 1946, p. 22; 1947, p. 4; CUSHMAN and RENZ, 1946, p. 19.)

The types are from the Lizard Springs marl where it occurs in both zones. It was found in the upper Tarouba shale and in the Lantern marl section of the Chaudière shale. It also occurs in the Santa Anita shale of Venezuela.

Genus **AMMOBACULITES** Cushman, 1910

AMMOBACULITES cf. **ALEXANDERI** Cushman (Pl. 11, fig. 6)

(CUSHMAN, 1946, p. 22.)

Rare specimens, one of which is figured, seem related to this species recorded only from the upper part of the Taylor marl of Texas. They are from the lower Tarouba.

AMMOBACULITES COPROLITHIFORMIS (Schwager)

(CUSHMAN, 1946, p. 22; CUSHMAN and RENZ, 1946, p. 19.)

A few specimens from the upper Tarouba and Chaudière shales seem to belong to this species although they show considerable variation.

AMMOBACULITES JARVISI Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 19; CUSHMAN, 1947, p. 4.)

Rare specimens from the Railway Cut marl of the Chaudière shale seem to belong to this large species recently described from the Lizard Springs marl and recorded from the Santa Anita shale of Venezuela.

Family **TEXTULARIIDAE**

Genus **SPIROPLECTAMMINA** Cushman, 1927

SPIROPLECTAMMINA DENTATA (Aith) (Pl. 11, fig. 3)

(CUSHMAN, 1946, p. 27.)

Numerous specimens of this species were found in the upper Tarouba shale and in the Lantern marl member of the Chaudière shale. There is a considerable variation in the thickness of the early portion of the microspheric and megalospheric forms.

SPIROPLECTAMMINA ? GRZYBOWSKII Frizzell

(CUSHMAN and RENZ, 1946, p. 20; CUSHMAN, 1947, p. 5.)

Specimens evidently of this species occur in the Chaudière shale, Lantern marl, Railway Cut marl, and lower Tarouba shale. It also

occurs in the Santa Anita shale of Venezuela. These forms need more study to make certain their generic relationships.

Family VERNEUILINIDAE

Genus GAUDRYINA d'Orbigny, 1839

GAUDRYINA FOEDA (Reuss)

(CUSHMAN, 1946, p. 32; CUSHMAN and RENZ, 1946, p. 21.)

Specimens occurred in the upper Tarouba shale and in the Lantern marl and Railway Cut marl units of the Chaudière shale.

GAUDRYINA BENTONENSIS (Carman)

(CUSHMAN, 1946, p. 33; CUSHMAN and RENZ, 1946, p. 21.)

Numerous specimens of this species occur in the upper Tarouba shale and in the typical Chaudière shale as well as in both the Lantern marl and Railway Cut marl members. It occurred in the lower zone of the Lizard Springs marl.

GAUDRYINA (PSEUDOGAUDRYINA) PYRAMIDATA Cushman

(CUSHMAN, 1946, p. 36; CUSHMAN and RENZ, 1946, p. 21.)

Typical specimens were found in the lower Tarouba shale and the Railway Cut marl member of the Chaudière shale. It also occurs in the lower zone of the Lizard Springs marl and the Velasco shale of Mexico.

Genus PSEUDOCLAVULINA Cushman, 1936

PSEUDOCLAVULINA AMORPHA (Cushman)

(CUSHMAN, 1946, p. 37; CUSHMAN and RENZ, 1946, p. 21.)

A single specimen of this species was found in the upper Tarouba shale. It occurs in the upper zone of the Lizard Springs marl and the Velasco shale of Mexico.

Genus CLAVULINOIDES Cushman, 1936

CLAVULINOIDES ASPERA (Cushman)

(CUSHMAN, 1946, p. 38; 1947, p. 7; CUSHMAN and RENZ, 1946, p. 22.)

Numerous specimens occur in the Railway Cut marl member of the Chaudière shale.

Family VALVULINIDAE

Genus ARENOBULIMINA Cushman, 1927

ARENOBULIMINA AMERICANA Cushman (Pl. 11, fig. 7)

(CUSHMAN, 1946, p. 42; 1947, p. 7.)

This species, although widely recorded in America in beds of Navarro, Taylor, and Austin age and in the Velasco and Mendez shales of Mexico and the Santa Anita shale of Venezuela, has not previously been recorded from Trinidad. Specimens occurred in the upper Tarouba shale and the Lantern marl member of the Chaudière shale.

Genus *EGGERELLA* Cushman, 1933*EGGERELLA* ? *TROCHOIDES* (Reuss)

(CUSHMAN, 1946, p. 43; CUSHMAN and RENZ, 1946, p. 22.)

A few specimens from the Lantern marl member of the Chaudière shale seem to belong to this species.

Genus *MARSSONELLA* Cushman, 1933*MARSSONELLA OXYCONA* (Reuss), var. *TRINITATENSIS* Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 22; CUSHMAN, 1947, p. 7.)

This variety, recently described from the lower zone of the Lizard Springs marl occurs in the upper and lower Tarouba shales and in the Railway Cut marl member of the Chaudière shale. It also occurs in the Santa Anita shale of Venezuela.

MARSSONELLA INDENTATA (Cushman and Jarvis)

(CUSHMAN, 1946, p. 44; 1947, p. 7; CUSHMAN and RENZ, 1946, p. 23.)

A few specimens occur in the Lantern marl member of the Chaudière shale.

Genus *TEXTULARIELLA* Cushman, 1927*TEXTULARIELLA TRINITATENSIS* Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 22; CUSHMAN, 1947, p. 8.)

This species recently described from the lower zone of the Lizard Springs marl and recorded in the Santa Anita shale of Venezuela occurs in the lower Tarouba shale and in the Lantern marl and Railway Cut marl members of the Chaudière shale.

TEXTULARIELLA TRINITATENSIS Cushman and Renz,var. *SUBCYLINDRICA* Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 23.)

This variety recently described from the lower zone of the Lizard Springs marl occurs also in the lower Tarouba shale.

Family *SILICINIDAE*Genus *RZEHAKINA* Cushman, 1927*RZEHAKINA EPIGONA* (Rzehak), var. *LATA* Cushman and Jarvis

(CUSHMAN, 1946, p. 47; 1947, p. 9; CUSHMAN and RENZ, 1946, p. 23.)

This variety is common in the upper and lower Tarouba shales, in the typical Chaudière shale and the Lantern marl and Railway Cut marl members.

RZEHAKINA EPIGONA (Rzehak), var. *MINIMA* Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 24.)

This variety recently described from the Lizard Springs marl occurs in the lower Tarouba shale, the typical Chaudière shale and the Lantern marl member.

Family TROCHAMMINIDAE

Genus TROCHAMMINA Parker and Jones, 1859

TROCHAMMINA GLOBIGERINIFORMIS (Parker and Jones),

var. ALTIFORMIS Cushman and Renz

This variety recently described from the Lizard Springs marl (Cushman and Renz, 1946, p. 24, pl. 3, figs. 7-11) occurs also in the upper Tarouba shale, the typical Chaudière shale and in the Lantern marl and Railway Cut marl members.

TROCHAMMINA cf. TEXANA Cushman and Waters (Pl. 11, fig. 5)

(CUSHMAN, 1946, p. 50, pl. 15, figs. 4, 5.)

This species has been known only from the Upper Cretaceous of Navarro age from Texas and Arkansas. Very similar specimens occur in the upper Tarouba shale, in the typical Chaudière shale, and in the Lantern marl section.

Family LAGENIDAE

Genus ROBULUS Montfort, 1808

ROBULUS MACRODISCUS (Reuss)

(CUSHMAN, 1946, p. 54; 1947, p. 9; CUSHMAN and RENZ, 1946, p. 25.)

The only specimens in this material are from the Lantern marl member of the Chaudière shale. It also occurs in the Santa Anita shale of Venezuela.

ROBULUS DISCREPANS (Reuss)

(CUSHMAN, 1946, p. 54; 1947, p. 10; CUSHMAN and RENZ, 1946, p. 24.)

Specimens occurred in the lower Tarouba shale and the Railway Cut marl.

ROBULUS STERNALIS (Berthelin)

(CUSHMAN, 1946, p. 54; CUSHMAN and RENZ, 1946, p. 25.)

The only specimens in this material are from the Lantern marl member of the Chaudière shale.

ROBULUS WILLIAMSONI (Reuss)

(CUSHMAN, 1946, p. 54; CUSHMAN and RENZ, 1946, p. 25.)

Rare specimens occurred only in the Lantern marl.

Genus SARACENARIA Defrance, 1824

SARACENARIA TRIANGULARIS (d'Orbigny)

(CUSHMAN, 1946, p. 58; 1947, p. 10; CUSHMAN and RENZ, 1946, p. 30.)

Specimens occur in the lower Tarouba shale and Railway Cut marl.

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA cf. BULLATA Reuss

(CUSHMAN, 1946, p. 62; 1947, p. 10; CUSHMAN and RENZ, 1946, p. 27.)

Rare specimens occur in the lower Tarouba shale.

MARGINULINA cf. TEXASENSIS Cushman

(CUSHMAN, 1946, p. 61; CUSHMAN and RENZ, 1946, p. 27.)

Specimens similar to those already recorded from the Lizard Springs marl occurred in the lower Tarouba shale and in the Lantern marl and Railway Cut marl members of the Chaudière shale.

MARGINULINA ? TRILOBATA d'Orbigny

(CUSHMAN, 1946, p. 64; CUSHMAN and RENZ, 1946, p. 27.)

A few specimens from the Railway Cut marl belong here.

MARGINULINA JARVISI Cushman

(CUSHMAN, 1946, p. 63; 1947, p. 11; CUSHMAN and RENZ, 1946, p. 27.)

Specimens occurred in the Lantern marl and Railway Cut marl and also in the lower Tarouba shale.

Genus DENTALINA d'Orbigny, 1826**DENTALINA MEGALOPOLITANA** Reuss

(CUSHMAN, 1946, p. 67; 1947, p. 11; CUSHMAN and RENZ, 1946, p. 28.)

Specimens occur in the Lantern marl and Railway Cut marl members of the Chaudière shale.

DENTALINA GRACILIS d'Orbigny (Pl. 11, fig. 9)

(CUSHMAN, 1946, p. 65.)

This widely ranging species has not been recorded from the Cretaceous of Trinidad. Rare specimens from the lower Tarouba shale seem to belong to this very variable species.

DENTALINA CATENULA Reuss (Pl. 11, fig. 8)

(CUSHMAN, 1946, p. 67.)

A few specimens from the Lantern marl member of the Chaudière shale seem to belong to this species.

Genus NODOSARIA Lamarck, 1812**NODOSARIA LIMBATA** d'Orbigny

(CUSHMAN, 1946, p. 74; CUSHMAN and RENZ, 1946, p. 29.)

Specimens usually broken but apparently belonging to this species occur in the lower Tarouba shale and in the Railway Cut marl.

NODOSARIA cf. MARCKI Reuss

(CUSHMAN, 1946, p. 74; CUSHMAN and RENZ, 1946, p. 30.)

Rare specimens resembling this species occur in the lower Tarouba shale and the Lantern marl member of the Chaudière shale.

NODOSARIA PAUPERCULA Reuss

(CUSHMAN, 1946, p. 75; 1947, p. 12; CUSHMAN and RENZ, 1946, p. 30.)

Rare specimens occurred in the Lantern marl.

NODOSARIA cf. **AFFINIS** Reuss

A few broken specimens from the Railway Cut marl member of the Chaudière shale may belong to this species.

NODOSARIA cf. **GRACILITATIS** Cushman (Pl. 11, figs. 10, 11)
(CUSHMAN, 1946, p. 72.)

Rare specimens from the lower Tarouba shale and the Lantern marl member of the Chaudière shale may belong to this species known only from the Taylor marl of Texas. The shape of the chambers and the ornamentation are like the types but the proloculum is not as elongate.

Genus CHRYSALOGONIUM Schubert, 1907**CHRYSALOGONIUM VELASCOENSE** (Cushman)

(CUSHMAN, 1946, p. 73; CUSHMAN and RENZ, 1946, p. 29.)

A reëxamination of specimens of this species from Mexico and Trinidad shows that the aperture is really made of a convex, terminal plate with numerous openings. Specimens occurred in the Lantern marl and Railway Cut marl members of the Chaudière shale.

Genus PSEUDOGLANDULINA Cushman, 1929**PSEUDOGLANDULINA MANIFESTA** (Reuss)

(CUSHMAN, 1946, p. 76.)

Specimens are very rare in the lower Tarouba shale.

PSEUDOGLANDULINA BISTEGIA (Olszewski)

(CUSHMAN, 1946, p. 76; CUSHMAN and RENZ, 1946, p. 31.)

This species recorded from the lower zone of the Lizard Springs marl occurs also in the lower Tarouba shale and in the Lantern marl.

PSEUDOGLANDULINA CYLINDRACEA (Reuss)

(CUSHMAN, 1946, p. 76; CUSHMAN and RENZ, 1946, p. 31.)

Rare specimens occurred in the Railway Cut marl.

PSEUDOGLANDULINA PARALLELA (Marsson)

(CUSHMAN, 1946, p. 77; CUSHMAN and RENZ, 1946, p. 31.)

Specimens are recorded from the lower zone of the Lizard Springs marl and occur in the Railway Cut marl.

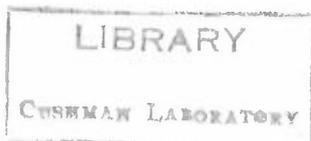
Genus PALMULA Lea, 1833**PALMULA SEMIRETICULATA** (Cushman and Jarvis)

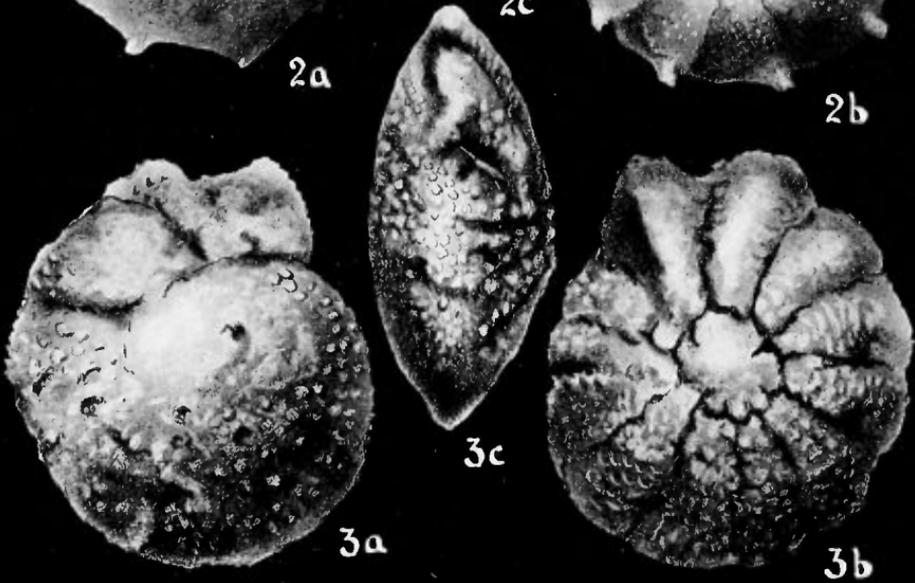
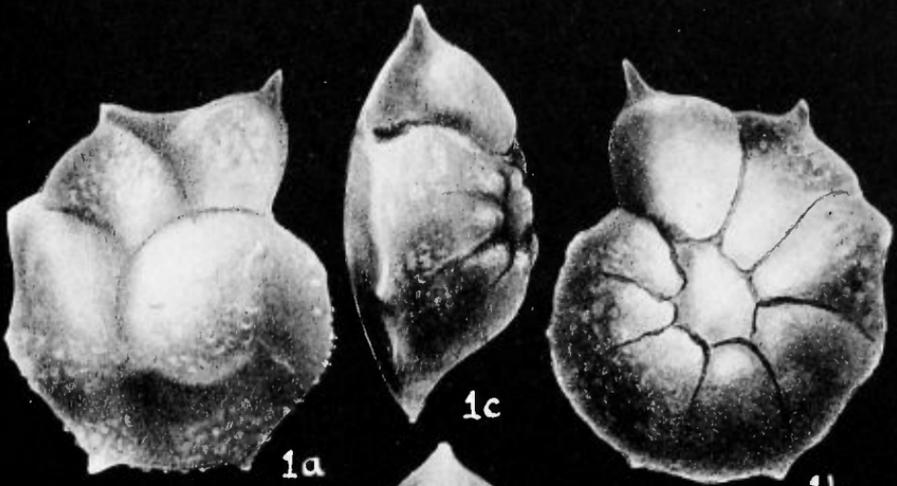
(CUSHMAN, 1946, p. 85; 1947, p. 13; CUSHMAN and RENZ, 1946, p. 31.)

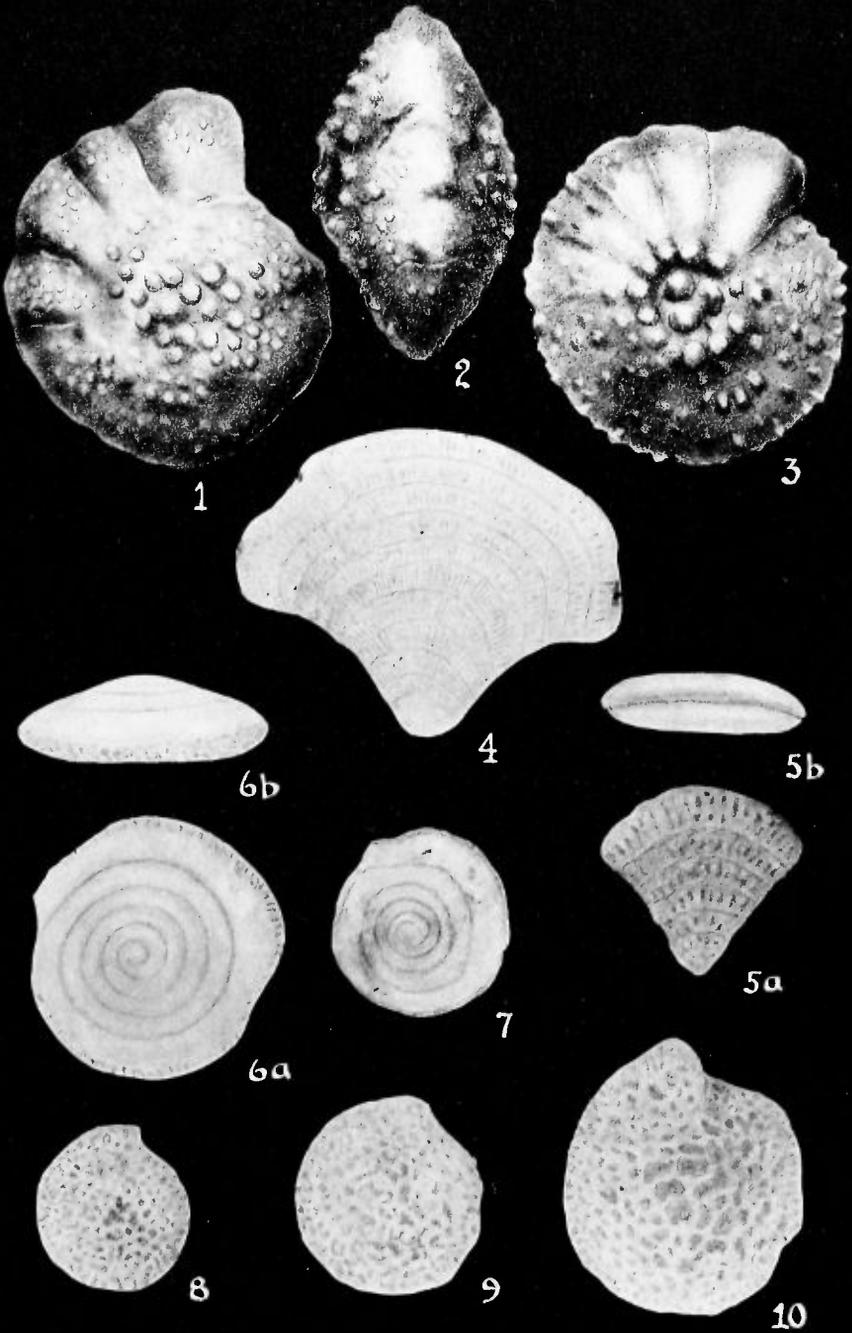
This species recorded from the lower zone of the Lizard Springs marl occurs also in the Railway Cut marl.

EXPLANATION OF PLATE 9

Figs. 1, 2. *Rotalia guantanamoensis* Cushman and Bermudez, n. sp. 1, Holotype. $\times 90$. 2, Paratype. $\times 50$. *a, a*, dorsal views; *b, b*, ventral views; *c, c*, peripheral views. 3. *R. pinarensis* Cushman and Bermudez, n. sp. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.







PALMULA JARVISI (Cushman)

(CUSHMAN, 1946, p. 85; CUSHMAN and RENZ, 1946, p. 31.)

This species described from the Lizard Springs marl, common in the lower zone, was found in the Lantern marl and the lower Tarouba shale.

Genus FRONDICULARIA Defrance, 1826**FRONDICULARIA LINGUIFORMIS** Marsson

(CUSHMAN, 1946, p. 89; CUSHMAN and RENZ, 1946, p. 31.)

Fragments evidently belonging to this species occurred in the Railway Cut marl.

FRONDICULARIA MUCRONATA Reuss

(CUSHMAN, 1946, p. 87; 1947, p. 13; CUSHMAN and RENZ, 1946, p. 34.)

Rare specimens of this species occurred in the Railway Cut marl and the lower Tarouba shale.

Family **POLYMORPHINIDAE****Genus GUTTULINA** d'Orbigny, 1839**GUTTULINA ADHAERENS** (Olszewski)

(CUSHMAN, 1946, p. 96; CUSHMAN and RENZ, 1946, p. 34.)

The only specimens are from the Lantern marl. It occurred in the lower zone of the Lizard Springs marl.

GUTTULINA TRIGONALIS (Reuss)

(CUSHMAN, 1946, p. 95; CUSHMAN and RENZ, 1946, p. 34.)

This species was found in the lower zone of the Lizard Springs marl and occurs commonly in the Lantern marl and lower Tarouba shale.

Genus GLOBULINA d'Orbigny, 1839**GLOBULINA LACRIMA** Reuss, var. **SUBSPHAERICA** (Berthelin)

(CUSHMAN, 1946, p. 96; CUSHMAN and RENZ, 1946, p. 34.)

This form found in the lower zone of the Lizard Springs marl occurs in the Lantern marl, Railway Cut marl, and lower Tarouba shale.

Genus PYRULINA d'Orbigny, 1839**PYRULINA CYLINDROIDES** (Roemer)

(CUSHMAN, 1946, p. 97; CUSHMAN and RENZ, 1946, p. 35.)

This species was found in the Lantern marl, Railway Cut marl, and lower Tarouba shale.

EXPLANATION OF PLATE 10

FIGS. 1-3. *Rotalia jaboensis* Cushman and Bermudez, n. sp. $\times 50$. 1, Holotype, dorsal view. 2, 3, Paratypes, peripheral and ventral views. 4, 5. *Cuneolina walteri* Cushman and Applin, n. sp. 4, Holotype. $\times 45$. 5, Paratype. $\times 60$. Early stage. a, front view; b, apertural view. 6-10. *Trocholina floridana* Cushman and Applin, n. sp. $\times 45$. 6, Holotype. a, dorsal view; b, side view. 7-10, Paratypes. 7, Dorsal view. 8-10, Ventral views.

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PYRULINA cf. VELASCOENSIS (Cushman)

(CUSHMAN, 1946, p. 97; CUSHMAN and RENZ, 1946, p. 35.)

Rare specimens occurred in the Lantern marl. It also occurred in the lower zone of the Lizard Springs marl.

Genus SIGMOMORPHINA Cushman and Ozawa, 1928**SIGMOMORPHINA SEMITECTA** (Reuss), var. **TERQUEMIANA** (Fornasini)

(CUSHMAN, 1946, p. 98; CUSHMAN and RENZ, 1946, p. 35.)

Specimens were found only in the lower Tarouba shale.

Family **HETEROHELICIDAE****Genus GUMBELINA** Egger, 1899**GUMBELINA PLUMMERAE** Loetterle

(CUSHMAN, 1946, p. 104, pl. 45, figs. 1-3.)

Specimens of this species were found in the Lantern marl and lower Tarouba shale, but it was not found in the Lizard Springs marl.

GUMBELINA ULTIMATUMIDA White

(CUSHMAN, 1946, p. 107; 1947, p. 13; CUSHMAN and RENZ, 1946, p. 36.)

A few specimens occurred in the Lantern marl.

GUMBELINA EXCOLATA Cushman (Pl. 11, figs. 13, 14)

(CUSHMAN, 1946, p. 108, pl. 46, fig. 15.)

Typical specimens occurred in the Lantern marl. It was not found in the Lizard Springs marl.

Genus BOLIVINOIDES Cushman, 1927**BOLIVINOIDES TRINITATENSIS** Cushman and Jarvis

(CUSHMAN, 1946, p. 114; CUSHMAN and RENZ, 1946, p. 36.)

This species has been known only from the lower zone of the Lizard Springs marl, from which it was described. Additional specimens have been found in the Lantern marl and Railway Cut marl.

Genus BOLIVINITA Cushman, 1927**BOLIVINITA ELEYI** Cushman (Pl. 11, fig. 12)

(CUSHMAN, 1946, p. 114, pl. 48, figs. 18-20.)

This species has not previously been recorded from Trinidad, and in the United States occurs in the Taylor and Austin portions of the Upper Cretaceous. A number of specimens occurred in the lower Tarouba shale.

Genus SIPHOGENERINOIDES Cushman, 1927**SIPHOGENERINOIDES EWALDI** (Karsten) (Pl. 12, fig. 6)

(CUSHMAN, 1947, p. 118, pl. 50, figs. 9-11.)

A single specimen was found in the lower Tarouba formation from which it had already been recorded.

Family BULIMINIDAE

Genus BULIMINELLA Cushman, 1911

BULIMINELLA COLONENSIS Cushman and Hedberg (Pl. 12, fig. 2)

(CUSHMAN, 1946, p. 120.)

A few specimens from the Lantern marl seem to belong to this species described from the Upper Cretaceous, Colon shale, of Colombia.

BULIMINELLA CARSEYAE Plummer, var. **PLANA** Cushman and Parker (Pl. 12, fig. 1)
(CUSHMAN, 1946, p. 120.)

Specimens from the Lantern marl and lower Tarouba shale seem to belong to this variety recorded from the Colon shale of Colombia and from Upper Cretaceous beds of Navarro age of the southern United States.

Genus BULIMINA d'Orbigny, 1826

BULIMINA KICKAPOOENSIS Cole, var. **PINGUA** Cushman and Parker (Pl. 12, fig. 3)
(CUSHMAN, 1946, p. 123.)

Rare specimens from the lower Tarouba shale are apparently this variety known from the Colon shale of Colombia and Upper Cretaceous beds of Navarro age of the southern United States.

BULIMINA PETROLEANA Cushman and Hedberg

(CUSHMAN, 1946, p. 125; 1947, p. 14; CUSHMAN and RENZ, 1946, p. 37.)

A few specimens from the Lantern marl may be included in this species described from the Colon shale of Colombia and recorded from the lower zone of the Lizard Springs marl and the Santa Anita shale of Venezuela.

BULIMINA PETROLEANA Cushman and Hedberg, var. **SPINEA** Cushman and Renz

Specimens of this variety recently described from the lower zone of the Lizard Springs marl (Cushman and Renz, 1946, p. 37, pl. 6, fig. 13) occur commonly in the Railway Cut marl.

BULIMINA LIMBATA White (Pl. 12, fig. 4)

(CUSHMAN, 1946, p. 124.)

This species described from the Upper Cretaceous of Mexico is common in this Trinidad material, occurring in the Lantern marl, Railway Cut marl and in the lower Tarouba shale.

Genus ENTOSOLENIA Ehrenberg, 1848

ENTOSOLENIA MARGINATA (Walker and Jacob)

(CUSHMAN, 1946, p. 126; CUSHMAN and RENZ, 1946, p. 38.)

Rare specimens from the Lantern marl and Railway Cut marl are similar to those recorded from the lower zone of the Lizard Springs marl.

ENTOSOLENIA cf. ORBIGNYANA Seguenza

(CUSHMAN, 1946, p. 126; CUSHMAN and RENZ, 1946, p. 38.)

Specimens from the Lantern marl and Railway Cut marl may be referred with some question to this species.

ENTOSOLENIA ORBIGNYANA Seguenza,var. **PERFECTO-COSTATA** Cushman and Renz, n. var. (Pl. 12, fig. 5)

Variety differing from the typical in having the entire surface ornamented with longitudinal costae which extend to the outer edge of the keel.

Holotype of variety (Cushman Coll. No. 47354) from the Upper Cretaceous, Chaudière shale, Lantern marl beds, river bed immediately S. of small bridge near 12¼ mile-post of Guaracara-Tabaquite Road, about 5 miles NE. of Kelly Junction, Lantern Estate, Piparo area, Central Range, Trinidad, B.W.I.

This differs from var. *praeclara* Cushman and Renz in having the ornamentation extending over the whole surface instead of being limited to the central portion.

Genus VIRGULINA d'Orbigny, 1826**VIRGULINA cf. NAVARROANA Cushman**

(CUSHMAN, 1946, p. 126, pl. 53, figs. 5-7.)

Specimens from the Lantern marl and lower Tarouba shale resemble this species from the Navarro group of the Upper Cretaceous of Texas.

Genus LOXOSTOMUM Ehrenberg, 1854**LOXOSTOMUM LIMONENSE (Cushman)**

(CUSHMAN, 1946, p. 131; CUSHMAN and RENZ, 1946, p. 39.)

Specimens from the Lantern marl, Railway Cut marl and lower Tarouba shale seem identical with this species known only from the Upper Cretaceous, Mendez and Velasco shales of Mexico and the lower zone of the Lizard Springs marl of Trinidad.

LOXOSTOMUM cf. TRINITATENSIS Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 39, pl. 6, figs. 24, 25.)

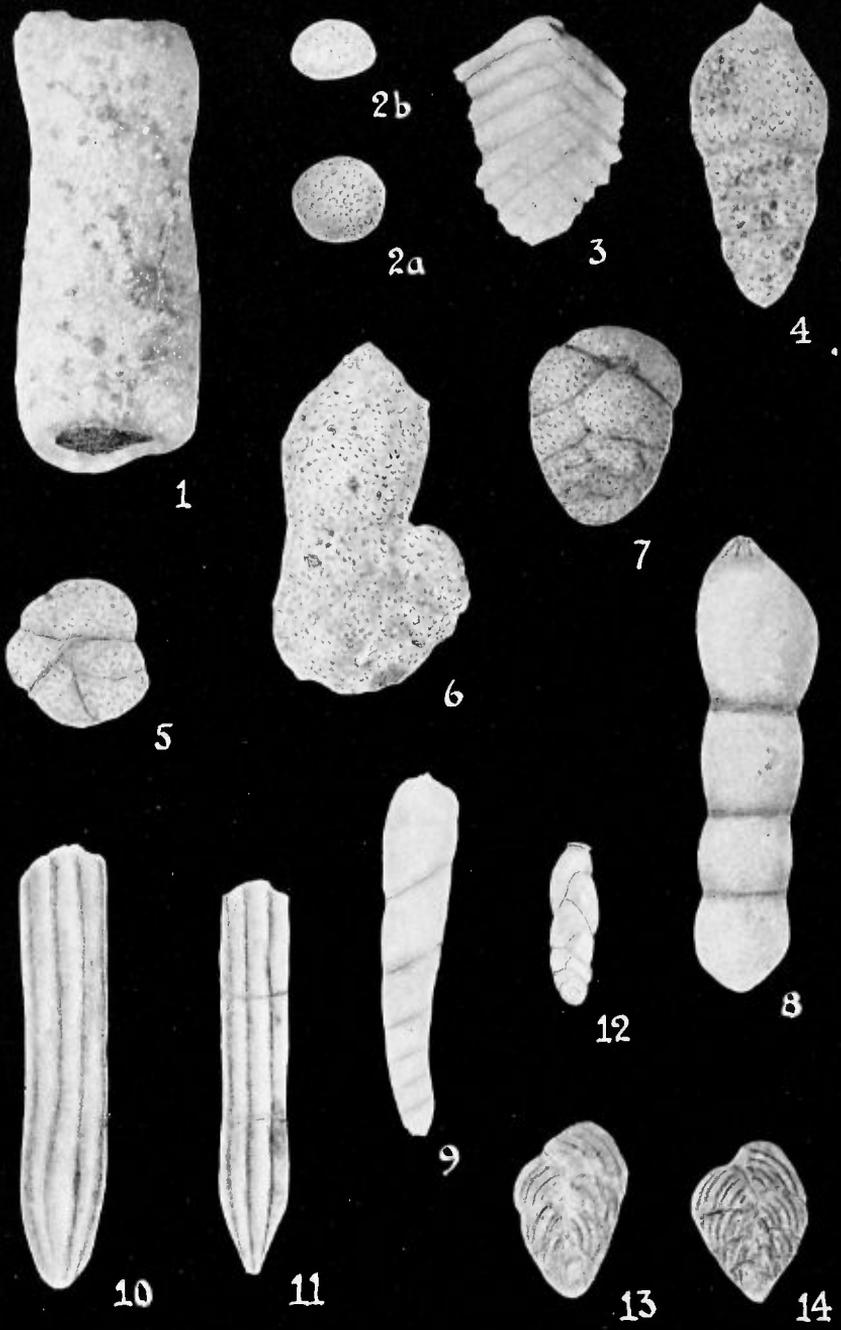
A single specimen from the Railway Cut marl resembles this species

EXPLANATION OF PLATE 11

FIG. 1. *Bathysiphon alexanderi* Cushman. × 45. 2. *Saccammmina rhumbleri* (Franke), var. *trinitatensis* Cushman and Renz, n. var. × 60. a, dorsal view; b, side view. 3. *Spiroplectammmina dentata* (Alth). × 60. 4. *Reophax cf. dentalinoides* (Reuss). × 45. 5. *Trochammmina cf. texana* Cushman and Waters. × 60. 6. *Ammobaculites cf. alexanderi* Cushman. × 45. 7. *Arenobulimina americana* Cushman. × 45. 8. *Dentalina catenula* Reuss. × 45. 9. *D. gracilis* d'Orbigny. × 45. 10, 11. *Nodosaria cf. gracilitatis* Cushman. × 45. 12. *Bolivinita eleyi* Cushman. × 60. 13, 14. *Gümbelina excolata* Cushman. × 60.

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recently described from the lower zone of the Lizard Springs marl, but the sutures are much more oblique than in the types.

Family ELLIPSOIDINIDAE

Genus PLEUROSTOMELLA Reuss, 1860

PLEUROSTOMELLA CLAVATA Cushman

(CUSHMAN, 1946, p. 132; CUSHMAN and RENZ, 1946, p. 42.)

This species is rather common in the Railway Cut marl.

PLEUROSTOMELLA SUBNODOSA Reuss (Pl. 12. fig. 7)

(CUSHMAN, 1946, p. 132.)

A few specimens from the Lantern marl and lower Tarouba shale seem to belong to this species which occurs in the Mendez shale of Mexico and in beds of Taylor age in Texas.

PLEUROSTOMELLA TORTA Cushman

(CUSHMAN, 1946, p. 133; CUSHMAN and RENZ, 1946, p. 39.)

Specimens occur in the Railway Cut marl and lower Tarouba shale. The types are from Mendez shale of Mexico and it occurs also in the Lizard Springs marl.

Genus ELLISOPLEUROSTOMELLA A. Silvestri, 1903

ELLISOPLEUROSTOMELLA CURTA Cushman

(CUSHMAN, 1946, p. 133; CUSHMAN and RENZ, 1946, p. 42.)

A single specimen from the lower Tarouba shale seems to belong to this species known from the lower zone of the Lizard Springs marl and the Velasco shale of Mexico.

Genus NODOSARELLA Rzehak, 1895

NODOSARELLA COALINGENSIS Cushman and Church

(CUSHMAN, 1946, p. 133; CUSHMAN and RENZ, 1946, p. 43.)

Specimens occur in the Railway Cut marl and lower Tarouba shale.

Genus ELLIPSONODOSARIA A. Silvestri, 1900

ELLIPSONODOSARIA SUBNODOSA (Guppy)

(CUSHMAN, 1946, p. 137; CUSHMAN and RENZ, 1946, p. 43.)

Numerous specimens from the Railway Cut marl and rare ones from

EXPLANATION OF PLATE 12

FIG. 1. *Buliminella carseyae* Plummer, var. *plana* Cushman and Parker. $\times 60$. 2. *B. colonensis* Cushman and Hedberg. $\times 60$. 3. *Bulimina kickapoensis* Cole, var. *pingua* Cushman and Parker. $\times 45$. 4. *B. limbata* White. $\times 45$. 5. *Entosolenia orbignyana* Seguenza, var. *perfecto-costata* Cushman and Renz, n. var. $\times 60$. 6. *Siphogenerinoides ewaldi* (Karsten). $\times 60$. 7. *Pleurostomella subnodosa* Reuss. $\times 45$. 8. *Pullenia minuta* Cushman. $\times 60$. 9, 10. *Ellipsonodosaria alexanderi* Cushman. $\times 60$. 11. *Globotruncana arca* (Cushman). $\times 60$. 12. *G. conica* White. $\times 60$. 13. *G. conica* White, var. *plicata* White. $\times 60$. 14. *Anomalina beccariformis* White. $\times 60$. 15. *Cibicides stephensoni* Cushman. $\times 45$.

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the lower Tarouba shale seem to belong to this species described from Trinidad and known from the Lizard Springs marl and the Velasco shale of Mexico.

ELLIPSONODOSARIA PSEUDOSCRIPTA Cushman

(CUSHMAN, 1946, p. 135; CUSHMAN and RENZ, 1946, p. 43.)

A few specimens from the lower Tarouba shale seem to belong here.

ELLIPSONODOSARIA ALEXANDERI Cushman,
var. **IMPENSIA** Cushman (Pl. 12, figs. 9, 10)

(CUSHMAN, 1946, p. 136; 1947, p. 15.)

Rare specimens from the lower Tarouba shale are identical with this variety. It is known from Upper Cretaceous beds of Navarro age of the southern United States, from the Mal Paso shale of Peru, and the Santa Anita shale of Venezuela.

Genus ELLIPSOGLANDULINA A. Silvestri, 1900

ELLIPSOGLANDULINA EXPONENS (H. B. Brady)

(CUSHMAN, 1946, p. 137; 1947, p. 15; CUSHMAN and RENZ, 1946, p. 43.)

Specimens referable to this species occur in the Lantern marl, Railway Cut marl and lower Tarouba shale. It is common in the Lizard Springs marl and the Santa Anita shale of Venezuela. These seem to be the only American records.

Family ROTALIIDAE

Genus VALVULINERIA Cushman, 1926

VALVULINERIA ALLOMORPHINOIDES (Reuss)

(CUSHMAN, 1946, p. 138; CUSHMAN and RENZ, 1946, p. 44.)

Specimens occur in the Lantern marl, Railway Cut marl, and lower Tarouba shale.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA DEPRESSA (Alth)

(CUSHMAN, 1946, p. 139; 1947, p. 15; CUSHMAN and RENZ, 1946, p. 44.)

A few specimens from the Lantern marl seem to belong here.

GYROIDINA DEPRESSA (Alth), var. **COLOMBIANA** Cushman and Hedberg

(CUSHMAN, 1946, p. 140; 1947, p. 15; CUSHMAN and RENZ, 1946, p. 44.)

The only specimens of this variety were found in the Lantern marl.

GYROIDINA GLOBOSA (Hagenow)

(CUSHMAN, 1946, p. 140; 1947, p. 15; CUSHMAN and RENZ, 1946, p. 44.)

Specimens from the Lantern marl, Railway Cut marl and the lower Tarouba shale belong to this species.

GYROIDINA GIRARDANA (Reuss)

(CUSHMAN, 1946, p. 140; CUSHMAN and RENZ, 1946, p. 44.)

Typical specimens occurred in the lower Tarouba shale.

Genus *EPONIDES* Montfort, 1808*EPONIDES BOLLI* Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 44, pl. 7, fig. 23; CUSHMAN, 1947, p. 16, pl. 4, fig. 25.)

Specimens of this species recently described from the Lizard Springs marl are common in the Lantern marl, Railway Cut marl and lower Tarouba shale. It occurs also in the Santa Anita shale of Venezuela.

EPONIDES BRONNIMANNI Cushman and Renz

(CUSHMAN and RENZ, 1947, p. 45, pl. 7, fig. 24; CUSHMAN, 1947, p. 16.)

A few specimens of this species recently described from the Lizard Springs marl occur in the Lantern marl and Railway Cut marl.

EPONIDES BRONNIMANNI Cushman and Renz, var. *MERA* Cushman and Renz

(CUSHMAN and RENZ, 1946, p. 45, pl. 7, fig. 25; CUSHMAN, 1947, p. 16, pl. 4, fig. 26.)

Specimens of this variety recently described from the lower zone of the Lizard Springs marl occur in few numbers in the Lantern marl and the lower Tarouba shale. It also occurs in the Santa Anita shale of Venezuela.

Family CASSIDULINIDAE

Genus *PULVINULINELLA* Cushman, 1926*PULVINULINELLA FLOREALIS* (White)

(CUSHMAN, 1946, p. 144; CUSHMAN and RENZ, 1946, p. 46.)

Specimens are common in the Lantern marl and Railway Cut marl but rare in the lower Tarouba shale.

Family CHILOSTOMELLIDAE

Genus *ALLOMORPHINA* Reuss, 1850*ALLOMORPHINA VELASCOENSIS* Cushman

(CUSHMAN, 1946, p. 46; CUSHMAN and RENZ, 1946, p. 46.)

This species recorded from the Velasco shale of Mexico, Colon formation of Colombia, and from the lower zone of the Lizard Springs marl, occurs in the Lantern marl and Railway Cut marl.

ALLOMORPHINA TROCHOIDES (Reuss)

(CUSHMAN, 1946, p. 145; CUSHMAN and RENZ, 1946, p. 46.)

Rare specimens of this species occurred in the Lantern marl.

Genus *PULLENIA* Parker and Jones, 1862*PULLENIA CORYELLI* White

(CUSHMAN, 1946, p. 147; 1947, p. 17; CUSHMAN and RENZ, 1946, p. 47.)

Typical specimens were found in the Lantern marl and Railway Cut marl. It occurs in the lower zone of the Lizard Springs marl, in the Santa Anita shale of Venezuela, in the Velasco shale of Mexico and beds of Navarro and Taylor age in Arkansas.

PULLENIA JARVISI Cushman

(CUSHMAN, 1946, p. 147; CUSHMAN and RENZ, 1946, p. 47.)

Specimens occurred rarely in the Lantern marl, Railway Cut marl and lower Tarouba shale. The types are from the Lizard Springs marl and it also occurs in the Velasco shale of Mexico.

PULLENIA MINUTA Cushman (Pl. 12, fig. 8)

(CUSHMAN, 1946, p. 147.)

A few specimens from the Lantern marl seem to be identical with this species known previously from beds of Navarro age in Texas and Mississippi.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA MEMBRANACEA (Ehrenberg)

(CUSHMAN, 1946, p. 152; CUSHMAN and RENZ, 1946, p. 48.)

A few specimens of this species occurred in the Lantern marl.

Genus GLOBOTRUNCANA Cushman, 1927

GLOBOTRUNCANA ARCA (Cushman) (Pl. 12, fig. 11)

(CUSHMAN, 1946, p. 150.)

Specimens from the Lantern marl and Railway Cut marl seem to belong to this species which is common in the Mexican Cretaceous.

GLOBOTRUNCANA CONICA White (Pl. 12, fig. 12)

(CUSHMAN, 1946, p. 151, pl. 61, fig. 20.)

The types of this species are from the Mendez shale of Mexico. A few specimens from the lower Tarouba shale seem to belong here.

GLOBOTRUNCANA CONICA White, var. **PLICATA** White (Pl. 12, fig. 13)

(CUSHMAN, 1946, p. 151, pl. 61, fig. 21.)

A few specimens from the Lantern marl are close to this variety described from the Mendez shale of Mexico.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA RUBIGINOSA Cushman

(CUSHMAN, 1946, p. 156; 1947, p. 18; CUSHMAN and RENZ, 1946, p. 48.)

Already known from the Velasco shale of Mexico and the Lizard Springs marl, this species occurs also in the Lantern marl, Railway Cut marl and lower Tarouba shale.

ANOMALINA BECCARIIFORMIS White (Pl. 12, fig. 14)

(CUSHMAN and RENZ, 1946, p. 48.)

Specimens referable to this species occur in the Railway Cut marl. It is recorded from the Lizard Springs marl and the types are from the Velasco shale of Mexico.

ANOMALINA cf. POLYRRAPHES (Reuss)

(CUSHMAN and RENZ, 1946, p. 48, pl. 8, figs. 19, 20.)

A few specimens from the Railway Cut marl and lower Tarouba shale may be referred to this species with some question.

Genus CIBICIDES Montfort, 1808**CIBICIDES CONSTRICTUS (Hagenow)**

(CUSHMAN, 1946, p. 160; CUSHMAN and RENZ, 1946, p. 48.)

A single specimen from the lower Tarouba shale is the only one of this species found in the material examined.

CIBICIDES STEPHENSONI Cushman (Pl. 12, fig. 15)

(CUSHMAN, 1946 p. 48.)

Numerous specimens from the Railway Cut marl may be included in this species.

RECENT LITERATURE ON THE FORAMINIFERA

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

Cizancourt, M^{me} de. Nummulites nouvelles ou peu connues d'Aquitaine.—Bull. Soc. Géol. France, ser. 5, vol. 15, 1945, pp. 643-655, pl. 10, 4 text figs.—Several species and varieties described and figured, the following new: *Nummulites umbilicata* n. sp. (= *N. fossulata* n. name); *N. anomala* de la Harpe, var. *granulosa* n. var.; *N. bironensis* n. sp.; *N. fossulata* n. name (for *N. umbilicata* M^{me} de Cizancourt (not Rutten)); *Assilina lacunata* n. name (for *A. umbilicata* M^{me} de Cizancourt (not Rutten)); *A. sublacunata* n. name (for *A. subumbilicata* M^{me} de Cizancourt).

Cosijn, A. J. On the Phylogeny of the Embryonic Apparatus of Some Foraminifera.—Leidsche Geol. Med., vol. 13, pt. 1, 1942, pp. 140-171, text figs. and tables.—The data is discussed and given in numerous tables, with a number of species included.

Gallitelli, E. Montanaro. Per la geologia delle argille ofolitifere appenninche. Nota I. L'argilla scagliosa di Varana (Modena).—Atti Soc. Toscana Sci. Nat., Memorie, vol. 52, 1943, pp. 1-16, table.—Lists numerous species and gives distribution data.

Nota II. Foraminiferi dell'argilla scagliosa di Varana.—L. c., pp. 1-19, pls. 1, 2, 1 text fig.—Records and figures numerous species, the following new: *Trochamminoides glomospiroides* n. sp.; *Pseudogaudryina?* *apenninica* n. sp.

Le due vie per lo studio dell'età e della facies delle Liguridi.—L. c., Memorie, vol. 53, 1946, pp. 1-12.—Mentions several species of foraminifera.

di Napoli Alliata, E. Contributo alla Conoscenza della Stratigrafia del Pliocene e del Calabriano nella regione di Rovigo.—Riv. Ital. Pal., Anno 52, fasc. 2, 1946,