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TROCHAMMINIDAE AND CERTAIN
LITUOLIDAE (FORAMINIFERA) FROM
THE RECENT BRACKISH-WATER
SEDIMENTS OF TRINIDAD,
BRITISH WEST INDIES

(WITH 4 PLATES)

By

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INTRODUCTION

The study of foraminiferal material obtained during a comprehensive program of sampling in the brackish-water environment around the coasts of Trinidad, B.W.I., has brought to light a number of taxonomic problems. This paper describes all the Recent brackish-water Trochamminidae known from Trinidad, some Lituolidae requiring emendation, and others not previously recorded from Trinidad.

In 1948, Cushman and Bronnimann published two papers (1948a, 1948b) on the brackish-water Foraminifera of Trinidad. These papers were pioneers in this branch of the study of Recent faunas. Since then, many papers written in North America have added considerably to the knowledge of brackish-water faunas there.

In the inshore, brackish-water environment in Trinidad, salinities are always lower than in the open sea as precipitation is higher than evaporation and streams continue to bring down fresh water into the marsh areas throughout the year. The range of salinities is higher than in the open sea, especially in river estuaries. Temperatures are exceedingly variable, as mud banks may be under only a very shallow water cover at low tide. The percentage of dissolved oxygen is also variable, depending on whether fresh water is being introduced or whether semistagnant conditions exist.

The calcareous forms that can flourish in the coastal swamps and river estuaries belong mainly to the genera *Rotalia* and *Criboelphidium*. The arenaceous forms are described herein, except for

Ammonoastuta inepta (Cushman and McCulloch) and species of *Ammonobaculites*. The arenaceous tests are all thin walled and fragile, often with a "chitinous" inner layer which may be the only wall in the early chambers. Several of the lituolid genera develop multiple apertures, at least in the late stages (*Ammonoastuta*, *Haplophragmium*, and *Trochamminita*). It is possible that this is an adaptation to the environment. This being the case, the danger of erecting new genera based on multiple apertures alone becomes apparent, as has been stressed previously (e.g., Glaessner, 1955).

Two new genera, *Siphotrochammina* and *Tiphotrocha*, are erected for Trochamminidae with stable apertural features that prevent their inclusion in the genus *Trochammina*. It is to be expected that this specialized environment should cause the development of new genera especially adapted to it. Their recognition is of value, as they may be of great help in the detection of similar biofacies in fossil deposits.

All figured types are deposited in the United States National Museum, Washington, D. C. An additional set of types will be deposited in the British Museum (Natural History), London.

Sincere thanks are due Dr. Helen Tappan Loeblich and Dr. Alfred R. Loeblich, Jr., who have been consulted at all stages and who have compared the author's material with that in the U. S. National Museum. The excellent illustrations were prepared by Patricia Isham, scientific illustrator at the U. S. National Museum. Dr. H. M. Bolli has read the manuscript and made many valuable suggestions for which the author is indebted to him. Acknowledgment is made to the Management of Trinidad Leaseholds, Ltd., for the use of laboratory facilities.

SYSTEMATIC DESCRIPTIONS

Family LITUOLIDAE Reuss, 1861

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES MANILAENSIS Andersen

PLATE I, FIGURES 1, 2

Haplophragmoides manilaensis ANDERSEN, Contr. Cushman Found. Foram. Res., vol. 4, pt. 1, p. 22, pl. 4, fig. 8, 1953.

Diagnosis.—*Shape of test:* Planispiral, completely or almost completely involute, with a lobate equatorial periphery; area around the umbilicus depressed relative to the periphery. Axial periphery rounded. *Wall:* Fine sand grains with little cement; an inner, flexible, "chitinous" layer is exposed on abraded specimens where the agglutinated, outer layer has been removed. The surface exhibits a fine "sugary"

texture. Color light brown to fawn. *Chambers*: Wedge shaped when viewed both equatorially and axially; 7 to 10 (usually 8) in the last whorl, increasing rapidly in size. Chamber shape tends to be irregular in the last whorl of some specimens. The last chamber may become wider and flattened across the axial periphery with a terminal face that is flattened or even slightly concave (pl. 1, fig. 1). *Sutures*: Radial, slightly depressed in the umbilical area becoming more depressed toward the periphery. *Aperture*: An equatorial, interiomarginal, symmetrical, low-arched slit surmounted by a narrow, projecting lip. *Size of hypotype* of figure 2: Maximum diameter 0.55 mm., maximum thickness 0.28 mm.

Locality.—Figured hypotypes (U.S.N.M. Nos. P5092a, b) from sample J.S. 273, Carenage Swamp, west coast of Trinidad, B.W.I.

Distribution.—*Haplophragmoides manilaensis* Andersen is more restricted in its distribution in Trinidad than is *Haplophragmoides wilberti* Andersen. It is uncommon in the river estuaries and in most of the swamps, though it occurs in great numbers in the Carenage Swamp on the west coast. Here it may be found in shallow drains cut through mangroves and water-logged coconut plantations. At low tide the mud is above water level.

Remarks.—Trinidad representatives of this species resemble closely Andersen's holotype described from Louisiana (Andersen, 1953).

HAPLOPHRAGMOIDES WILBERTI Andersen

PLATE 2, FIGURE 1

Haplophragmoides wilberti ANDERSEN, Contr. Cushman Found. Foram. Res., vol. 4, pt. 1, p. 21, pl. 4, fig. 7, 1953.

Diagnosis.—*Shape of test*: Planispiral, involute, with a smooth or very slightly lobate equatorial periphery; the small, deep umbilici may be closed by the chambers of the last whorl. Axial periphery symmetrically rounded. *Wall*: Fine sand grains set in abundant cement; surface smooth, polished. The sutural faces of the chambers are frequently of a somewhat coarser texture than the lateral walls. Color red-brown to light fawn. *Chambers*: Slightly inflated; wedge shaped in side view, with apices meeting around a small umbilicus or completely closing it; seven to nine chambers in the last whorl, increasing gradually in size. Terminal face of last chamber somewhat convex with a slight depression parallel to each lateral margin. *Sutures*: Distinct, very slightly depressed, straight or faintly sigmoid. *Aperture*: An equatorial, interiomarginal, symmetrical, low-arched slit surmounted by a narrow but prominent lip. *Size of figured hypotype*:

Diameter 0.32 mm., thickness 0.16 mm.

Locality.—Figured hypotype (U.S.N.M. No. P5114) from sample Bo. 262, Ortoire River, east coast of Trinidad, B.W.I.

Distribution.—*Haplophragmoides wilberti* lives in large numbers in all the swamps and in the brackish sections of the rivers in Trinidad.

Remarks.—Specimens from Trinidad resemble very closely those described by Andersen (1953) from the Louisiana coast, although Andersen's holotype is larger than the average size for Trinidad material.

Genus **TROCHAMMINITA** Cushman and Bronnimann emend. Saunders

Type species.—*Trochamminita irregularis* Cushman and Bronnimann emend. Saunders.

Emended diagnosis.—Test planispiral throughout or planispiral in the early stage with adult chambers added very irregularly. Wall arenaceous. Aperture in planispiral tests either a single areal opening or multiple areal openings on the terminal face of the final chamber; where adult chambers are irregularly added, multiple apertures are usual, their position being very variable. All apertures are surrounded by prominent lips.

Remarks.—Emendation of the type species necessitates these changes in the generic definition, including the removal of *Trochamminita* from the Trochamminidae to the Lituolidae.

The type species, *Trochamminita irregularis* Cushman and Bronnimann emend. Saunders, shows all transitions of test form from wholly planispiral to almost completely irregular. A second species, *Trochamminita salsa* (Cushman and Bronnimann) emend. Saunders, is included in the genus. In this species only planispiral forms are developed though some tests show a slight tendency toward irregular growth. The taxonomic position of *Trochamminita salsa* is discussed in the remarks on that species (p. 7).

TROCHAMMINITA IRREGULARIS Cushman and Bronnimann
emend. Saunders

PLATE 2, FIGURES 2-8

Trochamminita irregularis CUSHMAN and BRONNIMANN, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 1, p. 17, pl. 4, figs. 1-3, 1948.

Emended diagnosis.—*Shape of test:* All intermediate stages found between forms that are planispiral throughout and those that have a planispiral or slightly irregularly planispiral early portion followed by

an adult stage of very irregularly arranged chambers. *Wall*: Thin, of coarse sand grains with almost no cement; in the late chambers of very irregular forms, large quartz grains may be incorporated. An inner "chitinous" layer is present. Surface rough. Color brown. *Chambers*: In planispiral tests, normally six to seven inflated chambers in the last whorl increasing fairly rapidly in size; where an additional irregular stage is present, the later chambers are inflated, of variable size, and added at random. *Sutures*: Radial, depressed in the planispiral portion of the test. *Apertures*: Single or multiple areal apertures in chambers of the last whorl of planispiral tests. In tests with irregular adult chambers the aperture is single or multiple and areal in the planispiral early part, normally multiple (usually from two to six openings) in irregular later development. *Size*: Planispiral form of figure 2, maximum diameter 0.45 mm., approximate thickness 0.23 mm. Irregular form of figure 5, length approximately 0.7 mm. Irregular form of figure 6, length 0.64 mm., maximum thickness approximately 0.37 mm.

Locality.—Figured hypotypes (U.S.N.M. Nos. P5093 to P5099) from sample J.S. 65, Maracas Bay River, north coast of Trinidad.

Distribution.—*Trochamminita irregularis* Cushman and Bronnimann emend. Saunders occurs in great numbers in the Maracas Bay River on the north coast of Trinidad; elsewhere on the island its distribution seems to be sporadic. The rich locality in Maracas Bay (sample J.S. 65) is in a shallow tributary drain of the Maracas Bay River. The drain runs parallel to the sea a short distance behind the beach, from which it is separated by a screen of mangroves and coconut palms.

Remarks.—The very well preserved material used in the present study has shown that the original description is incorrect. The main difference lies in the discovery of all types of test form, from regular planispiral tests with one or more areal apertures in the last chamber (pl. 2, fig. 2) to forms with only a small planispiral or very slightly trochospiral early stage followed by irregular chambers in which areal apertures are usually multiple (pl. 2, figs. 6-8). Commonly found are intermediate types which are largely planispiral but have one or two final chambers added out of the original plane of coiling, and normally have multiple apertures in the last chamber (pl. 2, figs. 3, 4). All stages may be found in the same sample. The final, highly irregular forms are close to the figures of the holotype and paratypes of *Trochamminita irregularis* given by Cushman and Bronnimann (1948a, pl. 4, figs. 1-3). However, Cushman and Bronnimann did not record the presence of multiple apertures.

The present author has dissected a number of specimens to study the apertures in what Cushman and Bronnimann (1948a, p. 17) called "the early trochoid stage." Results show a planispiral or slightly irregularly planispiral early stage with single or multiple (usually two), areal apertures between the chambers. All apertures are definitely areal and are completely surrounded by very prominent lips. No sign of the interiomarginal apertures mentioned by Cushman and Bronnimann has been seen; if present at all they can only be in the very early chambers of the planispiral portion of the test.

TROCHAMMINITA SALSA (Cushman and Bronnimann)
emend. Saunders

PLATE I, FIGURES 3-8

Labrospira salsa CUSHMAN and BRONNIMANN, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 1, p. 16, pl. 3, figs. 5, 6, 1948.

Emended diagnosis.—*Shape of test:* Planispiral, semi-involute or involute, with a lobate equatorial periphery. Axial periphery rounded. Although normally symmetrically planispiral, some individuals show slight irregularity of coiling. *Wall:* Sand grains set in fine cement; surface smooth, may be somewhat polished. Coarseness of wall varies considerably in specimens from different localities. Color fawn to light brown. *Chambers:* Slightly inflated; seven to eight in the last whorl, increasing fairly rapidly in size. Earlier chambers may be partially visible. *Sutures:* Slightly curved, depressed. *Aperture:* In the adult stage may be represented by a single areal slit near the base of the terminal face of the chamber, or multiple pores of rounded, though somewhat irregular, shape. If the aperture is multiple, the pores are usually in a linear series where the single areal aperture would otherwise be situated (pl. 1, fig. 6), though some specimens show multiple apertures distributed widely across the terminal face. If a single aperture is present, it may show one or more constrictions, suggesting a tendency toward the formation of a number of separate openings. All apertural openings are completely surrounded by prominent lips. Dissection shows that multiple apertures are not restricted to the last chamber but may be present in several of the chambers of the last whorl. *Size:* Hypotype of figure 3—maximum diameter 0.32 mm., maximum thickness 0.16 mm. Hypotype of figure 7, maximum diameter 0.43 mm., maximum thickness, 0.2 mm. Hypotype of figure 8, maximum diameter 0.65 mm., maximum thickness 0.29 mm.

Locality.—All figured hypotypes (U.S.N.M. Nos. P5100 to P5105) are from sample Bo. 262, Ortoire River, east coast of Trinidad.

Distribution.—*Trochamminita salsa* (Cushman and Bronnimann) emend. Saunders occurs commonly in all inshore, brackish-water areas of Trinidad.

Remarks.—The specific description has been emended to cover the presence of multiple apertures in some individuals. Presumably this feature was not seen by Cushman and Bronnimann in their material, but examination of a large number of specimens from all coasts of Trinidad has shown that the development of more than one aperture in the adult stage of the test is quite a common feature. A number of specimens, when dissected, show multiple apertures in up to four chambers of the last whorl before which a single areal aperture is seen.

Cushman and Bronnimann placed this species in the genus *Labrospira* Höglund. *Labrospira* is considered to be a junior synonym of *Cribrostomoides* Cushman by Frizzell and Schwartz (1950). Loeblich and Tappan (1953, p. 28) maintain that *Labrospira* is a junior synonym of *Alveolophragmium* Stschendrina whereas *Cribrostomoides* is a distinct genus. The present author's examination of the species under discussion shows that it cannot be placed in the genus *Alveolophragmium* owing to the presence of multiple apertures. In addition, he considers that it should not be placed in the genus *Cribrostomoides* Cushman emend. Frizzell and Schwartz, the holotype of which is a deep-water form in which multiple apertures, if present, are produced by the fusion of toothlike projections across the normal single areal aperture. The multiple apertures of *Cribrostomoides bradyi* Cushman are situated in a single line near the base of the terminal face of the chamber.

Reexamination of *Trochamminita irregularis* Cushman and Bronnimann has led to an emendation of the species (see p. 4) and therefore of the genus (see p. 4). The new information shows that *Trochamminita salsa* (Cushman and Bronnimann) emend. Saunders and planispiral forms of *Trochamminita irregularis* Cushman and Bronnimann emend. Saunders only differ in chamber shape and coarseness of wall texture. These features are constant, even when the two species are found in the same sample, but they are only of specific value. Therefore, the inclusion of the two species under the same genus appears to be the only logical course.

Family TROCHAMMINIDAE Schwager, 1877

Genus TROCHAMMINA Parker and Jones, 1859

TROCHAMMINA LAEVIGATA Cushman and Bronnimann

PLATE 3, FIGURE 3

Trochammina laevigata CUSHMAN and BRONNIMANN, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 2, p. 41, pl. 7, figs. 21, 22, 1948.

Diagnosis.—*Shape of test:* Trochospiral, with a round, slightly lobate equatorial periphery; dorsal side slightly convex or almost flat, ventral side concave owing to the presence of a small, deep umbilicus; axial periphery rounded. In large specimens, with highly inflated last chambers, the dorsal side may be very slightly concave. *Wall:* Minute sand grains set in a fine cement; surface smooth, somewhat polished. Color reddish brown to fawn. The protoconch and first whorl are dark brown; the wall of this early portion of the test is apparently composed of a chitinous layer with no adherent agglutinated material. Being extremely fragile, the early chambers have often been excavated. *Chambers:* Inflated ventrally, less strongly dorsally. Seventeen to twenty chambers arranged in about three whorls with five to six chambers in the last whorl. The rate of increase in size of the chambers in the last whorl varies, some specimens having relatively larger, more inflated, final chambers than others. *Sutures:* Distinct, almost flush with surface dorsally, depressed ventrally. Straight or slightly curved. *Aperture:* An interiomarginal slit on the ventral side of the last chamber extending from the umbilicus one-third to one-half the distance to the periphery; a narrow, prominent lip is seen in well-preserved specimens. *Size:* Maximum diameter of figured hypotype 0.48 mm., thickness of hypotype 0.21 mm.

Range for species.—Diameter approximately 0.3 mm. to approximately 0.8 mm. Thickness approximately 0.15 mm. to approximately 0.37 mm.

Locality.—Figured hypotype (U.S.N.M. No. P5106) from sample J.S. 273, Carenage Swamp, west coast of Trinidad, B.W.I.

Distribution.—*Trochammina laevigata* Cushman and Bronnimann is widespread in all inshore, brackish-water areas of Trinidad.

Remarks.—This species is very close to *Trochammina inflata* (Montagu). Montagu's original figure and description of *Nautilus inflatus* (Montagu, 1808, p. 81, pl. 18, fig. 3) are too poor to be used for comparison. Brady's description and figures of *Trochammina inflata* (Montagu) (Brady, 1884, p. 338, pl. 41, figs. 4a-c), shows extremely slight differences between this species and *Trochammina*

laevigata Cushman and Bronnimann. *Trochammina inflata* has a slightly more convex dorsal surface with more deeply incised sutures and its last chambers are more inflated. Papers on brackish faunas of the coasts of North America (Phleger and Walton, 1950; Parker, Phleger, and Peirson, 1953; Ronai, 1955) describe as *Trochammina inflata* (Montagu) specimens that are almost certainly identical to *Trochammina laevigata* Cushman and Bronnimann.

SIPHOTROCHAMMINA Saunders, new genus

Type species.—*Siphotrochammina lobata* Saunders, new species,

Diagnosis.—Test trochospiral, involute ventrally. Dorsal side flat or convex, ventral side concave. Wall arenaceous; some specimens have very little agglutinated material on the basic "chitinous" wall. The last chamber has a ventral, siphonlike lobe extending partially across the umbilicus. The aperture is situated at the umbilical end of this lobe and is directed forward. The aperture of the penultimate chamber opens into the ventral lobe of the last chamber. A plate may extend across the umbilicus concealing the primary aperture; in this case, irregular secondary apertures are present on one or both sides of the plate.

Remarks.—*Siphotrochammina* is closely related to *Trochammina* Parker and Jones, 1859, from which it differs in the nature of its aperture. In *Trochammina* the aperture is an arched slit at the inner margin of the ventral side of the chamber whereas in *Siphotrochammina* the aperture is a forward-directed, circular opening at the inner end of a siphonlike lobe that extends from the last chamber into the umbilicus. The aperture of the penultimate chamber opens into the "siphon" of the last chamber. *Siphotrochammina* is somewhat similar to the free stage of *Tritaxis* Schubert, 1920, emend. Loeblich and Tappan, 1955. In the emended description of this latter genus the aperture in the free stage is "an ovate opening at the base of the last-formed chamber near the umbilicus, and surrounded by a distinct lip . . ." (Loeblich and Tappan, 1955).

SIPHOTROCHAMMINA LOBATA Saunders, new species

PLATE 3, FIGURES 1, 2

Diagnosis.—*Shape of test:* Trochospiral, with a lobate equatorial periphery; dorsal side convex, ventral side slightly concave. Axial periphery rounded. *Wall:* Thin, consisting of fine sand grains with little cement. Surface smooth and somewhat polished. An inner "chitinous" layer is present and, in very fragile specimens, agglutinated

material may be almost entirely lacking. This is the case in the first whorl of nearly all specimens, the chambers of which have often been excavated. Color light brown to fawn with dark brown early chambers. *Chambers*: Test of three to three and a half whorls with five or six chambers in the last whorl. Chambers increasing regularly in size; slightly inflated dorsally, more so ventrally. The last chamber possesses a narrow, siphonlike lobe which may partially obscure the umbilicus. From this ventral lobe of the last chamber, a "plate" of sand grains may extend over the whole umbilicus. *Sutures*: Depressed; straight dorsally and straight or slightly sinuous ventrally. *Aperture*: Typically situated at the umbilical end of the ventral lobe of the last chamber and directed forward. In some specimens it is possible to look into the last aperture and see the penultimate aperture opening into the back of the siphonlike lobe of the last chamber. If a plate extends across the umbilicus, there may be irregularly shaped secondary apertures present on one or both sides of it. *Size*: Maximum diameter of holotype 0.43 mm. Maximum thickness of holotype 0.20 mm.

Locality.—Holotype (U.S.N.M. No. P5107) and figured paratype (U.S.N.M. No. P5108) from sample J.S. 273, Carenage Swamp, west coast of Trinidad.

Distribution.—This species is fairly common in some of the Trinidad swamps as, for example, in the Carenage Swamp where it is found in considerable numbers associated with *Haplophragmoides manilaensis* Andersen (see p. 3 for note on conditions in this area). In the rivers its distribution is sporadic.

Remarks.—*Siphotrochammina lobata* Saunders differs from *Trochammina laevigata* Cushman and Bronnimann in the nature of its aperture. *Siphotrochammina lobata* has a circular aperture at the umbilical end of a ventral lobe of the last chamber whereas *Trochammina laevigata* has an interiomarginal slit surmounted by a lip and situated on the ventral side of the last chamber. In *Siphotrochammina lobata* the umbilicus, and the primary aperture as well, may be obscured by a "plate" of sand grains, but such a phenomenon has not been observed in Trinidad material of *Trochammina laevigata*. The two species are found associated in the same localities.

Siphotrochammina lobata differs from *Tiphotrocha comprimata* (Cushman and Bronnimann) emend. Saunders in that the apertures do not open separately into the umbilicus. In both species, the umbilicus may be covered by a platelike outgrowth from the chambers.

TIPHOTROCHA Saunders, new genus

Type species.—*Trochammina comprimata* Cushman and Bronnimann, 1948, emend. Saunders.

Diagnosis.—Test trochospiral, involute ventrally. Dorsal side flat or convex, ventral side concave. In well-developed specimens the chambers of the last whorl have inflated projections into the umbilicus. Wall arenaceous. The apertures of the chambers of the last whorl open separately into the umbilicus at the ends of the inflated chamber projections, if these are present. The last chamber may have a lip extending partially or wholly across the umbilicus and concealing all but the last aperture. The umbilical area may be covered by a "plate" formed by the coalescence of the lips of the ventral, inflated lobes of the chambers in the last whorl; in this case, most if not all of the primary apertures may be concealed.

Remarks.—The new genus differs from *Trochammina* Parker and Jones, 1859, in that the aperture of each chamber in the last whorl opens separately into the umbilicus and not into the next succeeding chamber as in the latter. Also, the umbilicus of the new genus may be concealed beneath a platelike outgrowth from the chambers. A similar umbilical cover may be present in *Siphotrochammina*, which differs from *Tiphotrocha* in lacking separate apertures from the chambers into the umbilicus.

TIPHOTROCHA COMPRIMATA (Cushman and Bronnimann)
emend. Saunders

PLATE 4, FIGURES 1-4

Trochammina comprimata CUSHMAN and BRONNIMANN, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 2, p. 41, pl. 8, figs. 1-3, 1948.

Emended diagnosis.—*Shape of test:* Trochospiral, compressed, with an irregularly lobate equatorial periphery; dorsal side slightly convex, ventral side concave. Axial periphery rounded; subangular in very compressed forms. *Wall:* Thin, consisting of fine sand grains with little cement. Surface smooth but not polished. Color brown to fawn, the first whorl may be darker in color than the rest of the test. *Chambers:* Test of two to three whorls with four to six (usually five) chambers in the last whorl. The chambers of the early whorls increase regularly in size but those in the last whorl may be rather irregular in shape and are considerably elongated in the direction of coiling. The chambers of the last whorl have inflated lobes projecting into the umbilicus. In large specimens, the last chambers are inflated

and roughly T-shaped in ventral aspect. *Sutures*: Slightly depressed and markedly curved on the dorsal surface in the last whorls; less depressed and less curved in earlier whorls. Ventrally, depressed, especially toward the umbilicus. *Apertures*: In the last whorl situated at the umbilical ends of the ventral lobes of the chambers. They point into the umbilicus under shelflike lips and may be directed toward the center of the umbilicus or backward toward the earlier chambers of the whorl. Where the last chamber is highly developed, the lip on its umbilical projection may obscure the earlier apertures. Many specimens show a fusion of the umbilical projections of the chambers, obscuring most if not all of the apertures. *Size*: Hypotype of figure 1, maximum diameter 0.53 mm., approximate thickness 0.16 mm. Hypotype of figure 2, maximum diameter 0.35 mm., approximate thickness 0.13 mm.

Locality.—Hypotypes (U.S.N.M. Nos. P5109a, b) from sample Bo. 262, Ortoire River, east coast, Trinidad. Hypotype (U.S.N.M. No. P5110) from sample Bo. 261, Ortoire River, east coast, Trinidad. Hypotype (U.S.N.M. No. P5112) from sample J.S. 135, Ortoire River, east coast, Trinidad.

Distribution.—This species is especially characteristic of the brackish-water sections of the Trinidad rivers; it is found less commonly in the swamps.

Remarks.—The true character of the apertures in this species was not described by Cushman and Bronnimann. The apertural features noted in this emended diagnosis make it necessary to remove this species from the genus *Trochammina* Parker and Jones, 1859. In *Trochammina*, only the last aperture opens to the exterior; each earlier aperture is concealed by the addition of the next chamber.

Genus **ARENOPARRELLA** Andersen, 1951, emend. Andersen, 1951

ARENOPARRELLA MEXICANA (Kornfeld) emend. Andersen

PLATE 4, FIGURE 5

Trochammina inflata (Montagu) var. *mexicana* KORNFELD, Contr. Stanford Univ. Geol. Dept., vol. 1, p. 86, pl. 13, figs. 5a-c, 1931.

Arenoparrella mexicana (Kornfeld) ANDERSEN, Journ. Paleontol., vol. 25, No. 1, p. 31, figs. 1a-c, 1951. ANDERSEN, Contr. Cushman Found. Foram. Res., vol. 2, pt. 3, p. 96, pl. 11, figs. 4a-c, 1951.

Diagnosis.—*Shape of test*: Trochospiral, involute ventrally with a smooth or very slightly lobate equatorial periphery; dorsal side slightly convex; ventral side with a small, depressed, closed umbilicus. Axial periphery rounded. *Wall*: Fine sand grains set in abundant cement;

surface smooth, may be polished. Color brown to fawn. *Chambers*: Slightly inflated dorsally, more strongly so ventrally, especially toward the umbilicus; five to six, or more rarely seven, in the last whorl; increasing in size regularly and gradually. *Sutures*: Distinct, almost flush with the surface dorsally, depressed ventrally; straight or slightly curved. *Apertures*: Primary aperture: a narrow slit in the terminal face of the chamber commencing in an interiomarginal position and with its long axis roughly parallel to the dorsal surface. In shape it may be a straight slit though it is more usually arcuate and may even be slightly sigmoid; though normally parallel sided, it is sometimes enlarged toward the ends. Supplementary apertures: at the apex of the last chamber is an area, commonly triangular in shape, where the wall is perforated by up to 11 or 12 circular, cribrate openings. Really well-preserved specimens invariably show these cribrate apertures; when not seen, they are presumed to have been filled and obscured by foreign matter. The sievelike area of the wall forms a weak point in the test which, in many specimens, has been broken out leaving one or more irregular holes. In one test the cribrate apertures were observed in an earlier chamber of the last whorl though normally they are obscured, as was stated by Andersen (1951b). *Size*: Maximum diameter of figured hypotype 0.47 mm., thickness 0.18 mm.

Locality.—Figured hypotype (U.S.N.M. No. P5113) from sample Bo. 261, Ortoire River, east coast of Trinidad, B.W.I.

Distribution.—This species is exceedingly common and widespread in all inshore, brackish-water areas of Trinidad.

Remarks.—The Trinidad representatives of the species are identical to those described by Andersen from Louisiana.

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EXPLANATION OF PLATES

PLATE I

LITUOLIDAE

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| Figs. 1, 2. <i>Haplophragmoides manilaensis</i> Andersen..... | 2 |
| 1a, Side view of hypotype (U.S.N.M. No. P5092a). 1b, Edge view. This large specimen shows a wide, flattened last chamber, a condition commonly seen in Trinidad specimens of this species. 2a, Side view of another hypotype (U.S.N.M. No. P5092b). 2b, Edge view. This specimen is typical for the species in Trinidad. Both from Carenage Swamp, Trinidad. $\times 87$. | |
| Figs. 3-8. <i>Trochamminita salsa</i> (Cushman and Bronnimann) emend. Saunders | 6 |

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- 3, Edge view of hypotype (U.S.N.M. No. P5100) showing a single oval areal aperture surrounded by a prominent lip. This type of aperture is shown by Cushman and Bronnimann (1948a) in their illustration of *Labrospira salsa*. 4, Edge view of hypotype (U.S.N.M. No. P5101) showing a slitlike areal aperture surrounded by a prominent lip. 5, Edge view of hypotype (U.S.N.M. No. P5102) showing two circular areal apertures. 6, Edge view of hypotype (U.S.N.M. No. P5103) showing three circular areal apertures in a transverse line across the chamber. 7a, Side view of hypotype (U.S.N.M. No. P5104). 7b, Edge view showing three circular areal apertures. 8, Edge view of hypotype (U.S.N.M. No. P5105) showing a partly constricted slitlike areal aperture and two irregular-shaped areal apertures. The specimens in figures 3-8 show the range of apertural pattern to be found in the adult stage of this species. All from Ortoire River, Trinidad. $\times 100$.

PLATE 2

LITUOLIDAE

- Fig. 1. *Haplophragmoides wilberti* Andersen..... 3
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PLATE 3

TROCHAMMINIDAE

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 1a, Dorsal view of paratype (U.S.N.M. No. P5108). 1b, Ventral view.
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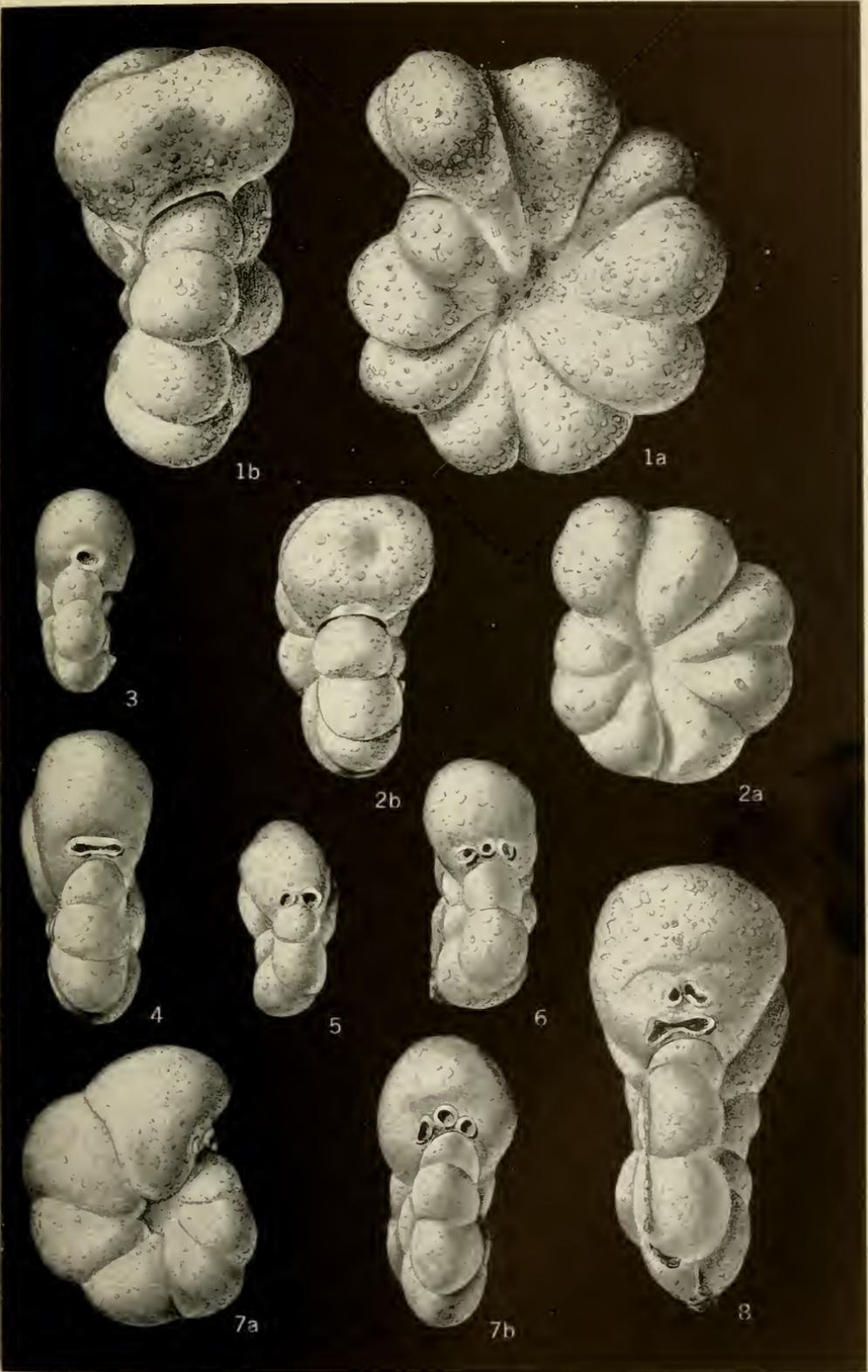
the "siphon" of the final chamber. $\times 165$. 2a, Dorsal view of holotype (U.S.N.M. No. P5107). 2b, Ventral view. 2c, Edge view. From Carenage Swamp, Trinidad. $\times 165$.

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PLATE 4

TROCHAMMINIDAE

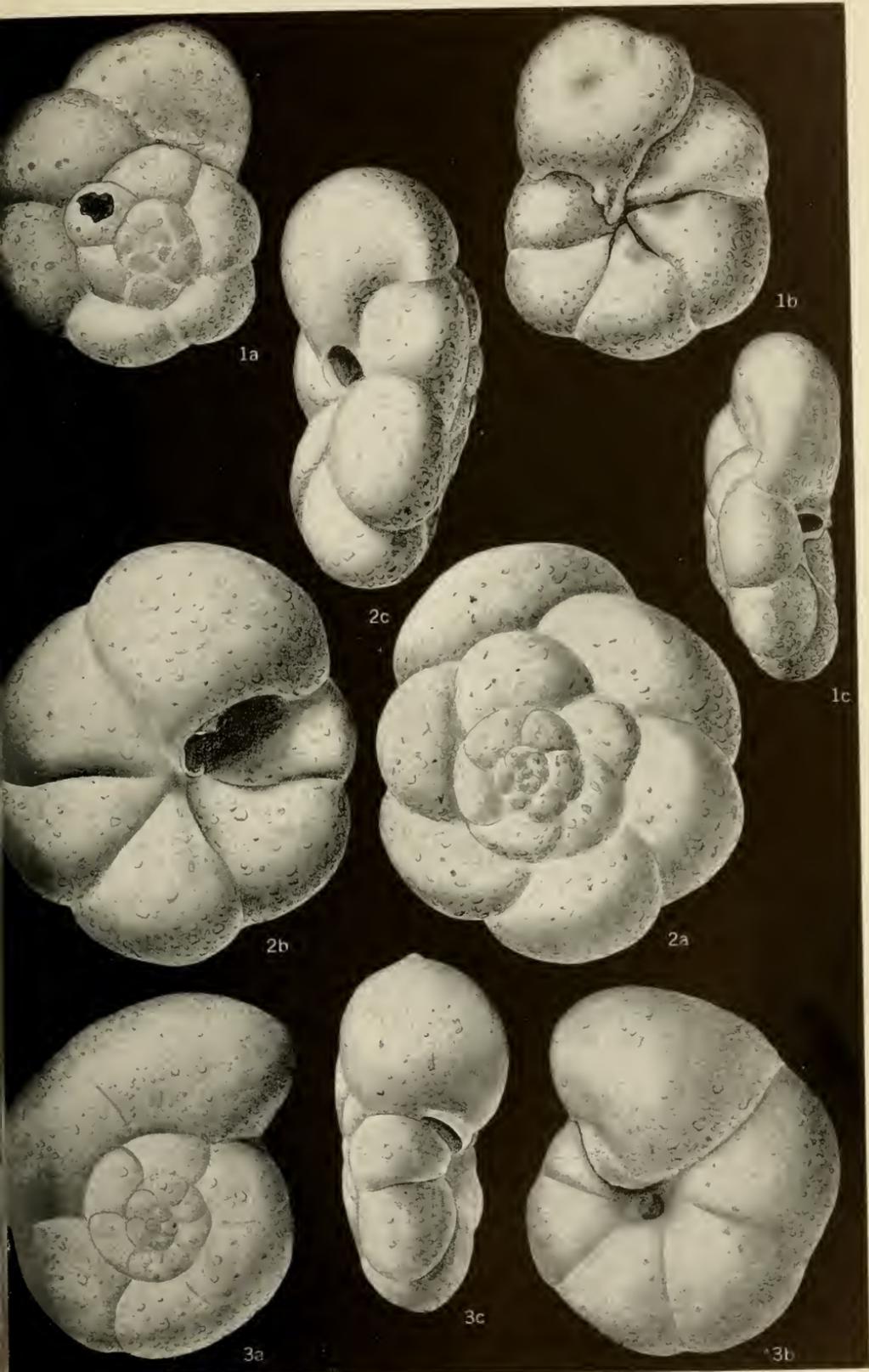
- Figs. 1-4. *Tiphotrocha comprimata* (Cushman and Bronnimann) emend. Saunders 11
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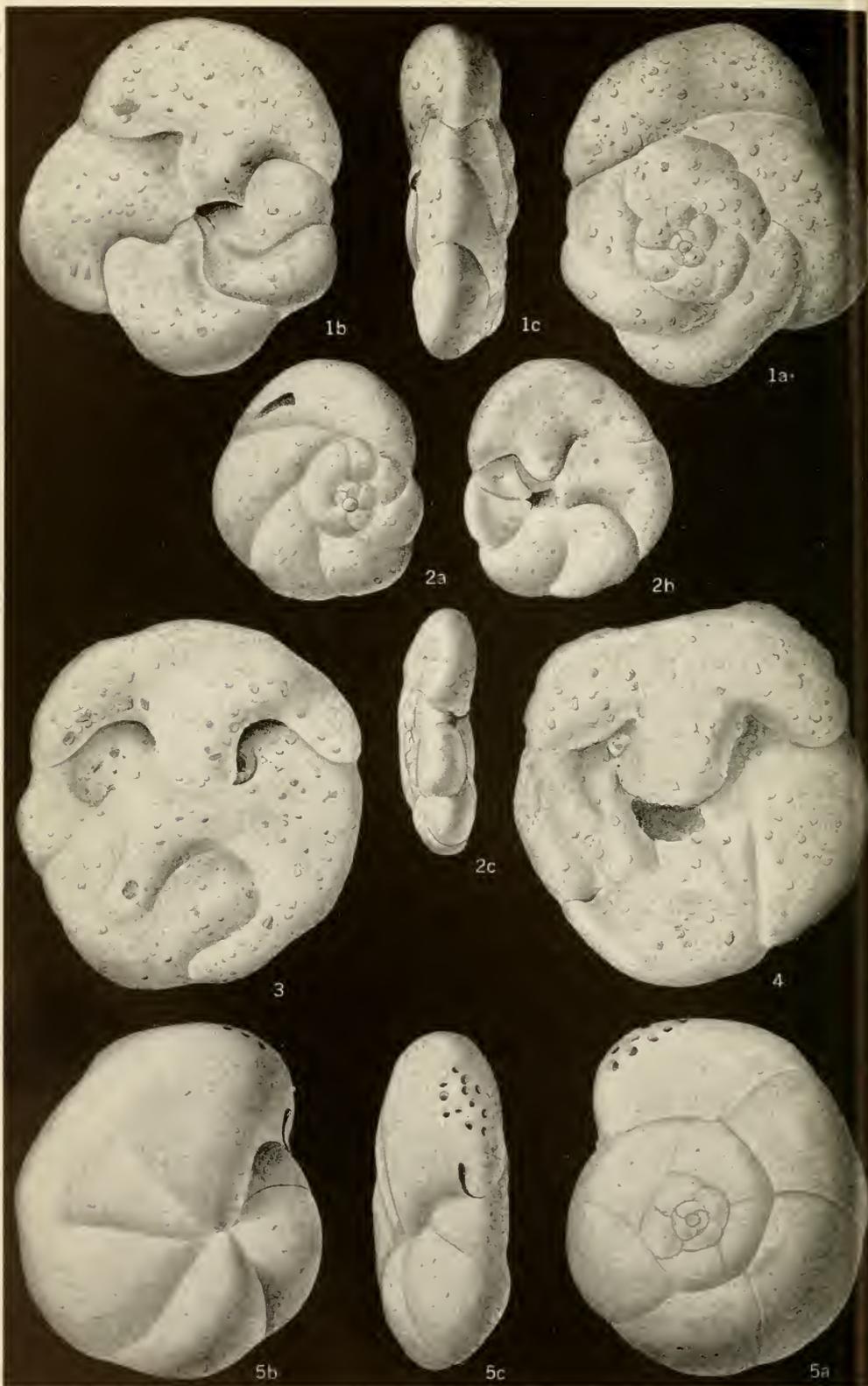
LITUOLIDAE
 HAPLOPHRAGMOIDES AND TROCHAMMINITA
 (See explanation at end of text.)



LITUOLIDAE
HAPLOPHRAGMOIDES AND TROCHAMMINITA



TROCHAMMINIDAE
SIPHOTROCHAMMINA AND TROCHAMMINA



TROCHAMMINIDAE

TIPHOTROCHA AND ARENOPARRELLA

(See explanation at end of text.)