CUSHMAN FOUNDATION FOR FORAMINIFERAL RESEARCH

SPECIAL PUBLICATION NO. 3

RECENT FORAMINIFERA AND THECAMOEBINA FROM THE EASTERN GULF OF PARIA

BY

RUTH TODD and PAUL BRONNIMANN

APRIL 30, 1957

Price $1.90 postpaid

CONTENTS

ILLUSTRATIONS

TABLES

RECENT FORAMINIFERA AND THECAMOEBINA FROM THE EASTERN GULF OF PARIA, TRINIDAD[1]

By

RUTH TODD[2] AND PAUL BRONNIMANN[3]

ABSTRACT

A fauna consisting of about 200 species of mostly benthonic Foraminifera and 9 of Thecamoebina occurs along the west coast of Trinidad and out into the eastern Gulf of Paria. Three environmental zones roughly paralleling the coastline are recognized: tidal zone, nearshore zone (from the tidal zone out to 2 fathoms), and offshore zone (from 2 to 18 fathoms). Assemblages of the tidal zone consist predominantly of arenaceous species. The arenaceous fraction decreases progressively from the tidal through the nearshore to the offshore zone. It changes character from mostly **Haplophragmoides** and **Trochammina** (with minor amounts of fresh-water Thecamoebina) in the tidal zone to predominantly **Ammobaculites** in the nearshore zone, and predominantly **Textularia** in the offshore zone.

In assemblages of the nearshore and offshore zones calcareous species predominate. The calcareous fraction decreases progressively from the offshore through the nearshore to the tidal zone.

Although the various species of **Streblus** (with one exception) and of **Elphidium** are restricted to one or two zones, these two genera are found abundantly in all three zones. In addition to these genera, the calcareous fraction consists mainly of **Rosalina** and **Palmerinella** in the tidal zone. The calcareous fractions of the nearshore and offshore zones together differ from the tidal zone in the additional presence of miliolids, lagenids, nonionids, and buliminids. The nearshore and offshore zones are further distinguished from each other in that the latter includes planktonic species but lacks **Rosalina** and **Palmerinella.**

Study of distribution elsewhere of the species characteristic of the three zones shows similarity of the tidal zone fauna to those of shallow brackish environments from various parts of the world. The species characteristic of the nearshore and offshore zones seem to be, with a few exceptions such as certain species of **Streblus**, an immigrant fauna from the surrounding areas that have normal marine conditions. The immigrant species show evidence of modification in the abnormally small size and extreme fragility of most of the specimens.

Microenvironments of the tidal and nearshore zones in two estuaries are described in detail.

Ten species are described as new, 160 are referred to already known forms, and 40 remain indeterminate. The new species are: **Eggerella humboldti, Fissurina agassizi, Haplophragmoides bonplandi, Lagena höglundi, Miliammina pariaensis, Quinqueloculina goësi, Rosalina sagrai, Spiroloculina anderseni, S. guppyi,** and **Streblus limnetes.**

INTRODUCTION

General Statement

The present paper describes the Recent Foraminifera and Thecamoebina found in mangrove swamps and tidal mudflats, river mouths, and deltas along the western coast of Trinidad, and also in the deeper part of the eastern Gulf of Paria.[4] The study was undertaken as a part of the U. S. Geological Survey's long range program of paleoecologic investigations.

Provenance and composition of the predominantly benthonic microfaunas reflect three rather vaguely defined major environmental zones. The zonal separation was originally made on the basis of depth and sediment type, hence the zones are more or less parallel to the coastline as follows:

a. *Tidal zone*, which includes the sandy and silty littoral areas with the mangrove swamps, mudflats, and estuaries.

b. *Nearshore zone*, to a depth of about 2 fathoms, which represents mostly sandy and silty sublittoral and shallow deltaic areas.

c. *Offshore zone*, from a depth of about 2 fathoms to 18 fathoms, characterized by soft, gray-blue to green mud in the deeper parts.

The taxonomic investigation of the microfaunas from these three zones was started by Cushman and Bronnimann (1948a), and in their first note the microfaunas from the mangrove swamps and from some of the small estuaries between the Caroni River in the north and the Oropouche (Godineau) River in the south were described. This paper reported on an unusual brackish water microfauna with three new genera, viz. *Ammoastuta, Trochamminita,* and *Cribroelphidium.*[5] In a second note the arenaceous members of the microfauna of the nearshore zone were described by Cushman and Bronnimann (1948b). Further work on the remaining rich assemblages from the nearshore and offshore zones, however, came to a standstill by the untimely death of Dr. Cushman in 1949. The work was later resumed by Todd, and the present paper contains the descriptions of the complete set of Foraminifera and Thecamoebina from the three environmental zones, including the forms previously reported by Cushman and Bronnimann (1948a, 1948b). It is primarily a faunal inventory, and as such is a necessary preparatory step for future ecologic studies. No quantitative data have been compiled, with the exception of those from two environments typical of the tidal and nearshore zones represented by the estu-

1 Publication authorized by the Director, U. S. Geological Survey.

2 U. S. Geological Survey, Washington, D. C.

3 Esso Standard Oil, S.A., Havana

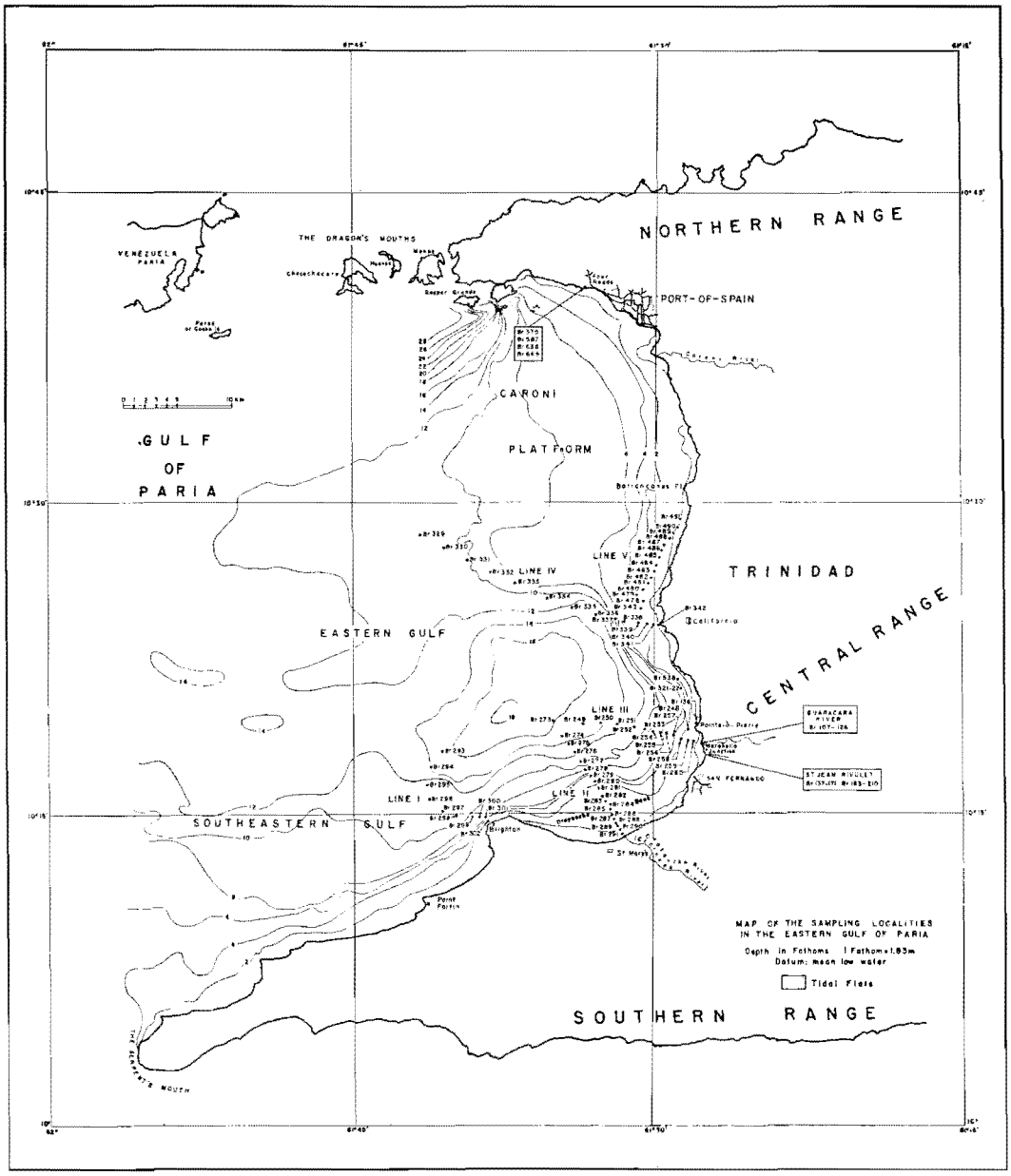
4 The eastern Gulf of Paria in this paper includes Eastern Gulf, Caroni Platform, and Southeastern Gulf as defined by van Andel and Postma (1954, map II, bathymetrical chart).

5 **Cribroelphidium** Cushman and Bronnimann is here regarded as a synonym of **Elphidium** Montfort as noted by Loeblich and Tappan (1953, p. 105).

aries of the St. Jean Rivulet and the Guaracara River and the delta of the Guaracara River. The general ecologic remarks on the microfaunas of the nearshore and offshore zones are largely based on the investigation of the physical properties of these environments by the Dutch Orinoco Shelf Expedition (van Andel and Postma, 1954).

Disposition of Material

All figured specimens are deposited in the U. S. National Museum, Washington, D. C. Duplicate sets of the assemblages from the three zones are in the collections of the Department of Micropaleontology of the American Museum of Natural History in New York; of Trinidad Oil Co., Ltd., (formerly Trinidad Leaseholds, Ltd.) in Pointe-à-Pierre, Trinidad, B.W.I.; and in the personal collection of P. Bronnimann. Unwashed material from the sampling lines I to V has been sent to the Scripps Institution of Oceanography, University of California, at La Jolla, and to the De-



Text figure 1. Map of eastern Gulf of Paria showing sampling stations.

partment of Micropaleontology of the American Museum of Natural History in New York.

Acknowledgments

The sampling in the Gulf of Paria has been sponsored by the managements of Trinidad Northern Areas, Ltd., and the former Trinidad Leaseholds, Ltd. The authors gratefully acknowledge the support received from these companies in the course of field and laboratory work. They are particularly indebted to Drs. K. W. Barr, H. G. Kugler, and H. H. Suter, Pointe-à-Pierre, Trinidad, who encouraged this work and actively participated in the sampling of the offshore material. The authors are further indebted to Miss Frances L. Parker and William R. Walton for many helpful suggestions and invaluable critical evaluation during the study of material and writing of results. The illustrations of specimens are mostly the work of Mrs. Ann Shepard Harris.

COLLECTION OF MATERIAL

The microfaunas from the tidal zone originate from numerous samples collected along the western coast of Trinidad. The microfauna designated as *Mangrove I* represents a composite assemblage from the tidal zone between St. Mary's in the south and California in the north. The microfauna designated as *Mangrove II* (stations Br. 375, 587, 636, 665 as shown on the locality map, fig. 1), on the other hand, originates from an inshore mangrove swamp at Four Roads, west of Port-of-Spain, which is somewhat separated from the nearshore area, and close to the detrital fans from the Northern Range with their abundance of metamorphic debris. Faunally and environmentally Mangrove II has a character of its own. Where the same species occur, specimens from Mangrove II differ from those from Mangrove I by the larger size of the tests and by the use of detrital material derived from the metamorphic rocks of the Northern Range in the formation of the arenaceous tests. Furthermore, the predominantly arenaceous microfauna from the locality contains species which are not recorded from the Mangrove I assemblage or from the nearshore zone.

The nearshore and offshore faunas are composite assemblages from the following five sampling lines (see map of the sampled locations, fig. 1):

a. Line I off Brighton: stations Br. 293-302;
b. Line II across the Oropouche Delta: stations Br. 273-291;
c. Line III off Pointe-à-Pierre: stations Br. 248-260;
d. Line IV off California, across the southern edge of the Caroni Platform: stations Br. 329-342;
e. Line V along the western coast from Pointe-à-Pierre northward to near Barrancones Point: stations Br. 136, 321, 322, 343, 478-491, 538.

Because of the transitional boundaries between the three zones, the assemblages contain species which are common to two adjoining or to all three environments. As the material upon which the present study is based consists of composite assemblages, in which records were not kept of the particular station but only the zones from which individual specimens originated, no references to specific station numbers are included in discussion of the species.

The Foraminifera and Thecamoebina described herein are regarded as Recent forms, although no tests have been carried out in order to verify the presence of protoplasm. Kruit (*in* van Andel and Postma, 1954, p. 118-119) found protoplasm only in a few tests of *Nonionella atlantica* Cushman and *Cancris sagra* (d'Orbigny) at station 335 on the northern edge of the Caroni Platform from a depth of 6 to 10 fathoms. Additional tests will have to be made in the course of future ecologic work to definitely establish the presence of living specimens in the sampled area.

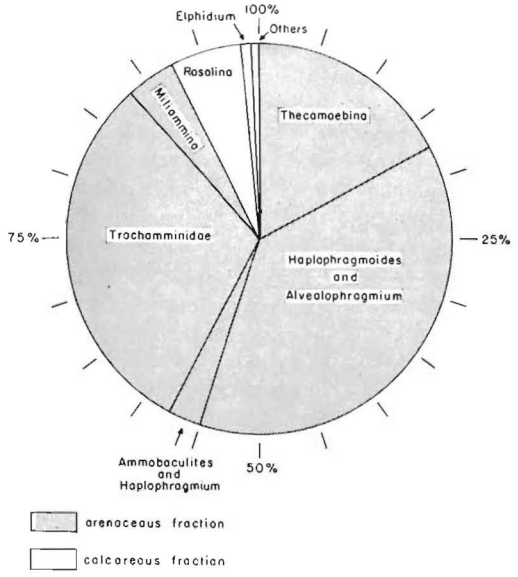
The rare planktonic specimens found in the offshore material are believed to have been transported from the Atlantic Ocean by the westerly currents branching off the Atlantic North Equatorial current and entering the Gulf of Paria through the Serpent's Mouth. The preservation distinguishes them clearly from the fossil specimens of *Globigerina, Orbulina,* and *Globorotalia* which at places, particularly along the Cipero coast, are redeposited in great quantities in the Recent sediments.

The Thecamoebina recorded from the mangrove swamps and nearshore zone are fresh water organisms carried by rivers and rivulets into the saline environment. Bolli and Saunders (1954) have shown that they inhabit certain environmental zones of the streams. The Thecamoebina reported herein therefore are, with one exception, redeposited and form composite heterogeneous assemblages derived from the various stream zones. In the St. Jean Rivulet (table 3) *Difflugia urceolata* Carter was the only micro-organism found above the highest tidal influence; it is believed to be *in situ*. This observation is in agreement with that of Lowman (1949, p. 1953), who noted *Difflugia* and *Centropyxis* but no Foraminifera in the fresh water swamps of the Mississippi delta.

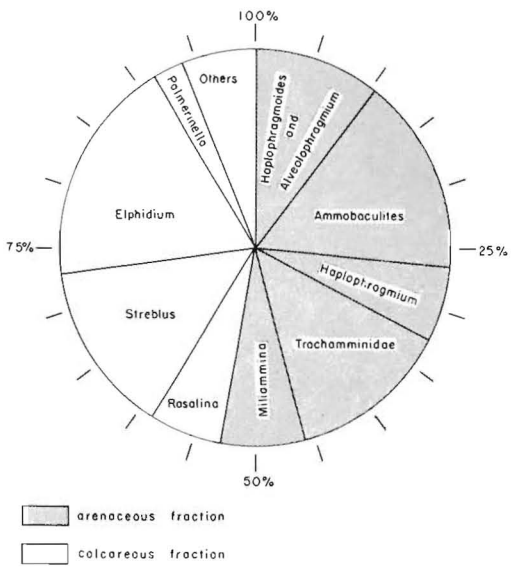
From 1947 to 1950 Bronnimann collected the samples for this study. The marine samples were collected with a simple bucket dredge and are without exception surface samples. As a rule, large quantities of mud were needed in order to obtain a representative microfauna. The material was washed through an 180-mesh sieve (Tyler standard). Part of the washed material was picked and part stored unpicked for future reference in the collections of the Geological Laboratory of Trinidad Oil Co., Ltd., in Pointe-à-Pierre, Trinidad, B. W. I.

COMPOSITION AND DISTRIBUTION OF THE MICROFAUNAS

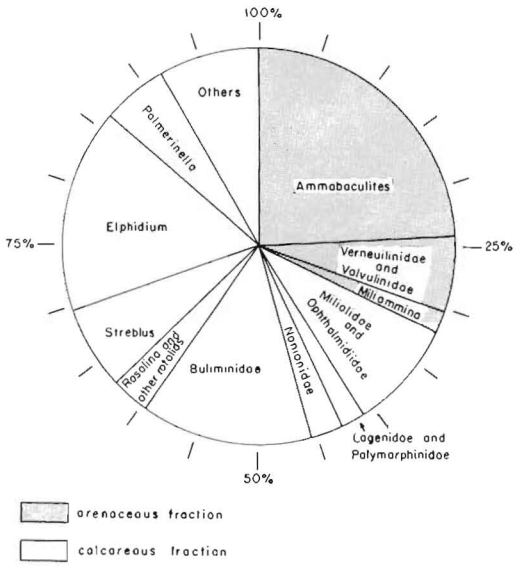
Graphs (figs. 2-5) were made up as rough approximations of percentage composition by number of specimens of Foraminifera in the zones. The arenaceous portion of the tidal assemblages (Mangrove I, II) is much larger than that of the nearshore and offshore zones. In Mangrove II more than 90 percent of the specimens fall in arenaceous species, whereas Mangrove I, which is in part from stations transitional to the nearshore zone, has only about 55 percent of arenaceous specimens. The arenaceous specimens of the nearshore zone constitute about 35 percent of the microfauna; that of the offshore zone about 20 percent. From the tidal areas to the deeper waters of the Gulf of Paria, the number of arenaceous specimens decreases, whereas that of the calcareous ones increases. Apart from Mangrove II, which is environmentally and faunally distinct from Mangrove I, the composition of the



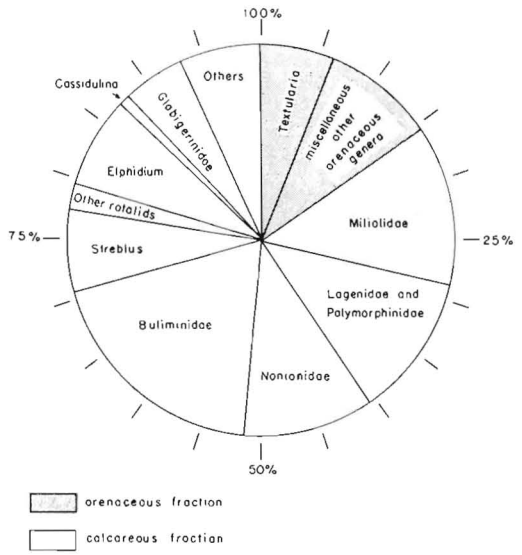
Text figure 2. Composition of composite microfaunal assemblage in Mangrove II subzone.



Text figure 3. Composition of composite microfaunal assemblage in Mangrove I subzone.



Text figure 4. Composition of composite microfaunal assemblage in the nearshore zone.



Text figure 5. Composition of composite microfaunal assemblage in the offshore zone.

arenaceous groups changes from a *Trochammina - Ammobaculites - Haplophragmium - Haplophragmoides - Alveolophragmium - Miliammina* association in Mangrove I, to an *Ammobaculites - Eggerella* - Verneuilinidae - *Miliammina* association in the nearshore zone, to a predominantly *Textularia* association in the offshore zone. The calcareous group passes from an *Elphidium - Streblus - Rosalina - Palmerinella* association in Mangrove I to a Buliminidae - Miliolidae - Ophthalmidiidae - *Elphidium - Streblus - Palmerinella* association in the nearshore zone to a Buliminidae - Nonionidae - Lagenidae - Polymorphinidae - Miliolidae - *Elphidium - Streblus* - Globigerinidae association in the offshore zone. The main faunal break in the arenaceous group occurs between the nearshore and the deeper water zones. The calcareous species show distinct faunal breaks between each of the three zones, although the number of the species of *Streblus*, Buliminidae, and Nonionidae remains practically unchanged from the nearshore to the offshore assemblages. Of special interest is the occurrence of *Streblus* in all three zones, a fact which supports the opinion that this genus obviously is able to stand varying ecologic conditions.

The following check list of the Thecamoebina and Foraminifera, arranged systematically, shows abundance and zonal distribution for each species and variety. Study of additional samples would undoubtedly widen the range of certain species into their adjacent zone or zones, but the general characterization of the three zones would probably remain the same.

Table 1.—Distribution of Thecamoebina and Foraminifera in the Eastern Gulf of Paria

	Tidal Zone		Nearshore Zone	Offshore Zone
	Mangrove II	Mangrove I	0 - 2 fms.	2 - 18 fms.
Thecamoebina				
Difflugia urceolata Carter	C	C	..	..
D. pyriformis Perty	R	..	..	..
D. capreolata Penard	R	..	..	..
Pontigulasia compressa (Carter)	A	..	R	..
Centropyxis (Centropyxis) constrictus (Ehrenberg)	A	..	R	..
C. (C.) excentricus (Cushman and Bronnimann)	C	..	C	..
C. (C.) sp. A	R	..	..	..
Centropyxis (Cyclopyxis) arenatus (Cushman)	A	..	R	..
C. (C.) salsus (Cushman and Bronnimann)	C	R	C	..

Table 1 (continued)

	Tidal Zone		Nearshore Zone	Offshore Zone
	Mangrove II	Mangrove I	0 - 2 fms.	2 - 18 fms.
Foraminifera				
SACCAMMINIDAE				
Psammosphaera fusca Schulze	..	..	A	..
Sorosphaera? sp. A	..	..	R	..
Saccammina atlantica (Cushman)	..	..	..	C
S. difflugiformis (Brady)	..	..	R	C
S. sphaerica M. Sars	C	..	..	..
HYPERAMMINIDAE				
Hippocrepina? sp. A	..	R	..	..
REOPHACIDAE				
Reophax dentaliniformis Brady	..	..	..	C
R. nana Rhumbler	..	..	..	A
R. scorpiurus Montfort	..	..	..	C
TOLYPAMMINIDAE				
Involutina minima (Höglund)	..	..	R	..
Glomospira glomerata Höglund	..	..	..	R
G. gordialis (Jones and Parker)	..	..	..	A
LITUOLIDAE				
Haplophragmoides canariense (d'Orbigny)	A	..	..	..
H. hancocki Cushman and McCulloch	A	..	..	..
H. manilaense Andersen	A	..	..	..
H. wilberti Andersen	A	A	C	..
H. bonplandi Todd and Bronnimann, n. sp.	A	..	..	..
Alveolophragmium salsum (Cushman and Bronnimann)	A	A	R	R
Ammoastuta inepta (Cushman and McCulloch)	..	A	R	..
Ammobaculites dilatatus Cushman and Bronnimann	..	R	A	A
A. directus Cushman and Bronnimann	..	..	A	R
A. diversus Cushman and Bronnimann	..	..	A	..
A. exiguus Cushman and Bronnimann	..	..	A	R
A. exilis Cushman and Bronnimann	..	..	A	A
A. pseudocassis Cushman and Bronnimann	..	A	A	..
A. salsus Cushman and Bronnimann	C	A	A	..
A. salsus var. **distinctus** Cushman and Bronnimann	..	C	A	R
A. salsus Cushman and Bronnimann variants	R	..	A	C
A. sp. A	..	..	C	..
Haplophragmium salsum Cushman and Bronnimann	C	A	..	..
TEXTULARIIDAE				
Textularia agglutinans d'Orbigny	..	..	..	C
T. candeiana d'Orbigny	..	..	..	A
T. cf. **T. earlandi** Parker	..	..	..	A
T. gramen d'Orbigny	..	..	..	A
T. mayori Cushman	..	..	..	C
T. sp. A	..	..	..	C
T. sp. B	..	..	..	R
Bigenerina nodosaria d'Orbigny	..	..	..	R

Table 1 (continued)

	Tidal Zone		Nearshore Zone	Offshore Zone
	Mangrove II	Mangrove I	0 - 2 fms.	2 - 18 fms.
VERNEUILINIDAE				
Gaudryina exilis Cushman and Bronnimann	..	R	A	A
Pseudoclavulina curta Cushman and Bronnimann	..	R	A	..
P. gracilis Cushman and Bronnimann	..	..	A	..
VALVULINIDAE				
Eggerella humboldti Todd and Bronnimann, n. sp.	..	..	A	A
SILICINIDAE				
Miliammina fusca (Brady)	A	A	A	R
M. pariaensis Todd and Bronnimann, n. sp.	..	A	..	..
Spirolocammina sp. A	..	..	..	R
MILIOLIDAE				
Quinqueloculina agglutinans d'Orbigny	..	..	R	C
Q. cultrata (Brady)	..	..	R	C
Q. lamarckiana d'Orbigny	..	..	..	R
Q. poeyana d'Orbigny	..	..	C	R
Q. seminulum (Linné)	..	..	A	C
Q. semireticulosa Cushman	..	..	R	..
Q. goësi Todd and Bronnimann, n. sp.	..	R	C	R
Q. sp. A	..	..	C	R
Q. sp. B	..	C	..	R
Q. sp. C	..	..	R	..
Triloculina oblonga (Montagu)	..	..	C	R
T. tricarinata d'Orbigny	..	..	..	C
T. trigonula (Lamarck)	..	..	C	A
T. sp. A	..	..	R	R
Miliolinella labiosa (d'Orbigny)	..	..	R	R
M. sp. A	..	..	R	R
Spiroloculina anderseni Todd and Bronnimann, n. sp.	..	..	R	C
S. deutata Cushman and Todd	..	..	..	R
S. eximia Cushman	..	..	R	C
S. grata Terquem	..	..	..	R
S. guppyi Todd and Bronnimann, n. sp.	..	..	R	C
Sigmoilina tenuis (Czjzek)	..	..	..	C
Pyrgo nasutus Cushman	..	..	..	R
OPHTHALMIDIDAE				
Cornuspira incerta (d'Orbigny)	..	R	..	..
C. planorbis Schultze	..	..	C	R
Ophthalmidium balkwilli Macfadyen	..	..	..	R
TROCHAMMINIDAE				
Trochammina advena Cushman	..	..	..	R
T. comprimata Cushman and Bronnimann	R	C	..	..
T. laevigata Cushman and Bronnimann	A	A	C	..
Trochamminita irregularis Cushman and Bronnimann	A	..	..	..
Arenoparrella mexicana (Kornfeld)	A	A	..	..
Nouria polymorphinoides Heron-Allen and Earland	..	..	..	R
N. sp. A	..	..	..	C

Table 1 (continued)

	Tidal Zone		Nearshore Zone	Offshore Zone
	Mangrove II	Mangrove I	0 - 2 fms.	2 - 18 fms.
LAGENIDAE				
Robulus cf. **R. cultratus** Montfort	..	..	R	R
Astacolus sp. A	..	..	..	R
Dentalina? sp. A	..	..	R	..
Nodosaria catesbyi d'Orbigny	..	..	..	R
Lagena chasteri Millett	..	..	R	..
L. clavata (d'Orbigny)	..	..	..	C
L. crenata Parker and Jones	..	..	R	..
L. elongata (Ehrenberg)	..	..	..	R
L. filicosta Reuss	..	..	R	C
L. gracilis Williamson	..	..	R	..
L. hispidula Cushman	..	..	R	..
L. höglundi Todd and Bronnimann, n. sp.	..	..	..	C
L. perlucida (Montagu)	..	..	R	C
L. semilineata Wright	..	..	..	C
L. striata (d'Orbigny)	..	..	R	A
L. sp. A	..	..	R	..
Rectoglandulina sp. A	..	..	..	C
POLYMORPHINIDAE				
Glandulina glans d'Orbigny	..	..	R	A
G. laevigata d'Orbigny	..	..	C	A
G.? spinata Cushman	..	..	..	C
Laryngosigma williamsoni (Terquem)	..	..	..	R
NONIONIDAE				
Nonion boueanum (d'Orbigny)	..	..	..	C
N. grateloupi (d'Orbigny)	..	..	C	A
N. sp. A	..	..	R	C
Nonionella atlantica Cushman	..	R	C	A
N. auricula Heron-Allen and Earland	..	..	C	..
N. opima Cushman	..	..	C	A
N. turgida (Williamson)	..	..	..	A
N. sp. A	..	..	..	R
BULIMINIDAE				
Buliminella elegantissima (d'Orbigny)	..	..	A	..
B. subfusiformis Cushman	..	..	R	..
Bulimina marginata d'Orbigny	..	..	..	A
B. sp. A	..	..	R	..
Virgulina (Virgulinella) pertusa Reuss	..	..	..	A
Virgulina punctata d'Orbigny	..	..	C	A
Bolivina barbata Phleger and Parker	..	..	R	C
B. cf. **B. difformis** (Williamson)	..	..	..	R
B. goësii Cushman	..	..	R	..
B. hastata Phleger and Parker	..	..	R	C
B. inflata Heron-Allen and Earland	..	..	A	..
B. lowmani Phleger and Parker	..	..	R	R
B. plicatella Cushman var. **mera** Cushman and Ponton	..	..	R	..
B. pseudoplicata Heron-Allen and Earland	..	..	C	..
B. pseudopunctata Höglund	..	..	..	A
B. pulchella (d'Orbigny) var. **primitiva** Cushman	..	..	C	C
B. spathulata (Williamson)	..	..	..	A
B. striatula Cushman	..	..	A	A

Table 1 (continued)

	Tidal Zone		Nearshore Zone	Offshore Zone
	Mangrove II	Mangrove I	0 - 2 fms.	2 - 18 fms.
B. subacnariensis Cushman	..	..	A	..
B. subexcavata Cushman and Wickenden	..	..	C	R
B. tongi Cushman	..	..	C	..
B. tortuosa Brady	..	..	R	..
B. variabilis (Williamson)	..	..	C	C
B. sp. A	..	..	R	R
Loxostomum hiwanneense Howe	..	..	R	..
L. mayori (Cushman)	..	..	..	R
L. porrectum (Brady)	..	..	..	C
Uvigerina peregrina var. **parvula** Cushman	..	..	R	A
Hopkinsina pacifica Cushman	..	..	C	C
Angulogerina occidentalis (Cushman)	..	..	C	..
Siphogenerina raphana (Parker and Jones)	..	..	C	..
Siphonodosaria matanzana (Palmer and Bermudez)	..	..	R	..
S. recta (Palmer and Bermudez)	..	..	R	..
S. sp. A	..	..	R	..
S? sp. B	..	..	R	..
Fissurina agassizi Todd and Bronnimann, n. sp.	..	..	..	C
F. flintii (Cushman)	..	..	..	R
ELLIPSOIDINIDAE				
Pleurostomella sp. A	..	..	R	..
DISCORBIDAE				
Rosalina floridana (Cushman)	A	C	C	R
R. sagrai Todd and Bronnimann, n. sp.	..	..	C	..
Discorbis? aguayoi Bermudez	..	A	..	..
D? sp. A	..	..	R	..
Caneris sagra (d'Orbigny)	..	..	R	A
Gyroidina sp. A	..	..	..	C
Eponides? sp. A	..	..	R	..
Heronallenia lingulata (Burrows and Holland)	..	..	R	..
CYMBALOPORIDAE				
Cymbaloporetta bradyi (Cushman)	..	..	R	..
ROTALIIDAE				
Streblus advenus (Cushman)	..	..	C	C
S. beccarii (Linné) var. **sobrina** (Shupack)	..	C	C	..
S. beccarii (Linné) var. **tepida** (Cushman)	..	A	A	A
S. beccarii (Linné) variant	..	..	R	..
S. limnetes Todd and Bronnimann, n. sp.	..	A	..	..
S. paniloculatus (Phleger and Parker)	..	..	..	A
S? sp. A	..	..	A	..
Rolshausenia rolshauseni (Cushman and Bermudez)	..	..	R	A
ELPHIDIIDAE				
Elphidium advenum (Cushman)	..	..	C	A
E. discoidale (d'Orbigny)	..	..	C	A
E. excavatum (Terquem)	..	..	A	C

Table 1 (continued)

	Tidal Zone		Nearshore Zone	Offshore Zone
	Mangrove II	Mangrove I	0 - 2 fms.	2 - 18 fms.
E. hispidulum Cushman	..	..	R	..
E. incertum (Williamson) var. **clavatum** Cushman	..	..	C	..
E. kugleri (Cushman and Bronnimann)	..	C	..	..
E. limosum (Cushman and Bronnimann)	..	A	C	..
E. poeyanum (d'Orbigny)	..	..	A	R
E. sagrum (d'Orbigny)	..	..	R	..
E. salsum (Cushman and Bronnimann)	R	A	..	..
E. translucens Natland	..	..	..	R
E. trinitatense (Cushman and Bronnimann)	..	..	A	..
E. tumidum Natland	..	..	A	..
E. vadescens (Cushman and Bronnimann)	..	A	A	..
E. sp. A	..	..	..	C
E. sp. B	..	..	R	..
E. sp. C	..	..	..	C
CASSIDULINIDAE				
Cassidulina sp. A	..	..	..	R
C. sp. B	..	..	..	R
Cassidulinoides sp. A	..	..	R	..
Epistominella sp. A	..	..	R	..
CHILOSTOMELLIDAE				
Sphaeroidina bulloides d'Orbigny	..	..	R	..
GLOBIGERINIDAE				
Globigerina bulloides d'Orbigny	..	..	..	A
G. cf. G. quinqueloba Natland	..	..	..	A
G.? sp. A	..	..	R	..
Globigerinoides rubra (d'Orbigny)	..	..	..	R
G. sacculifera (Brady)	..	..	..	R
Globigerinella aequilateralis (Brady)	..	..	..	R
GLOBOROTALIIDAE				
Globorotalia menardii (d'Orbigny)	..	..	..	R
ANOMALINIDAE				
Laticarinina sp. A	..	..	R	..
Palmerinella palmerae Bermudez	..	C	A	R
Cibicides lobatulus (Walker and Jacob)	..	..	R	..
C. refulgens Montfort	..	..	R	..
C. cf. C. robertsonianus (Brady)	..	..	R	..
C. sp. A	..	..	R	..
C.? sp. B	..	..	R	..
Hanzawaia cf. H. strattoni (Applin)	..	..	C	..
Cibicidella sp. A	..	..	R	..
Dyocibicides biserialis Cushman and Valentine	..	..	R	..

ECOLOGY

General Statement

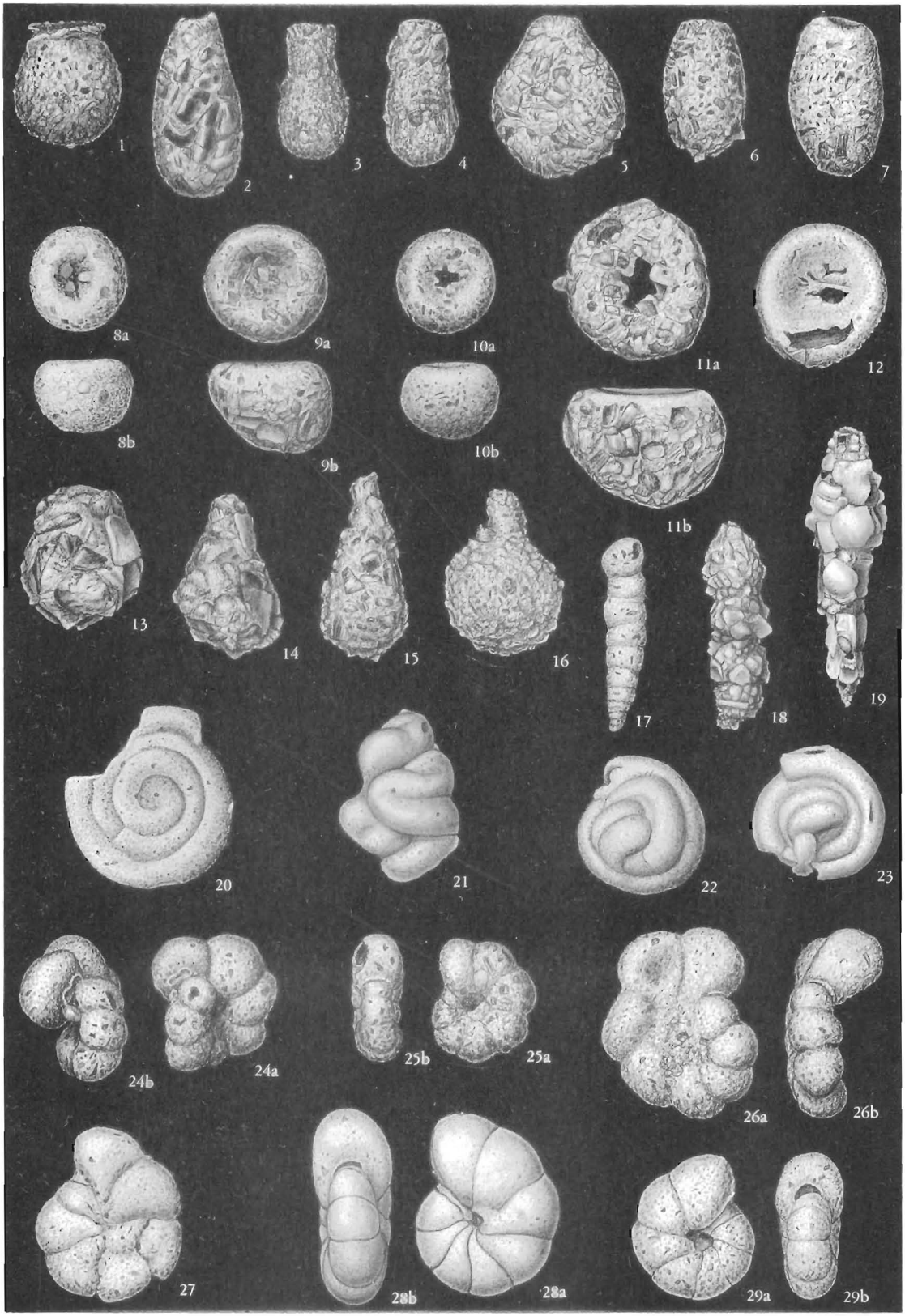
Ecologic investigations in the Gulf of Paria were carried out in 1952 by the Dutch Orinoco Shelf Expedition. The results of this work, as far as the microfaunas are concerned, has been discussed by Kruit (*in*

van Andel and Postma, 1954), based on identifications of the Foraminifera and Ostracoda by Key (*in* van Andel and Postma, 1954). The detailed analysis of the microfaunas was beyond the scope of this essentially sedimentary study, and Kruit noted the distribution of only a few of the characteristic foraminifers and ostracodes of the deeper part of the eastern Gulf of Paria in relation to the physical properties of the environment. The nearshore and tidal zones along the western coast of Trinidad are reported by Kruit (*in* van Andel and Postma, 1954, p. 119, 125, text figs. 61, 63) to be without a benthonic microfauna. This erroneous observation may be explained by the fact that the only collections made in the nearshore and tidal areas by the Dutch expedition were in the northern part of the Caroni Platform and over the Oropouche Bank where

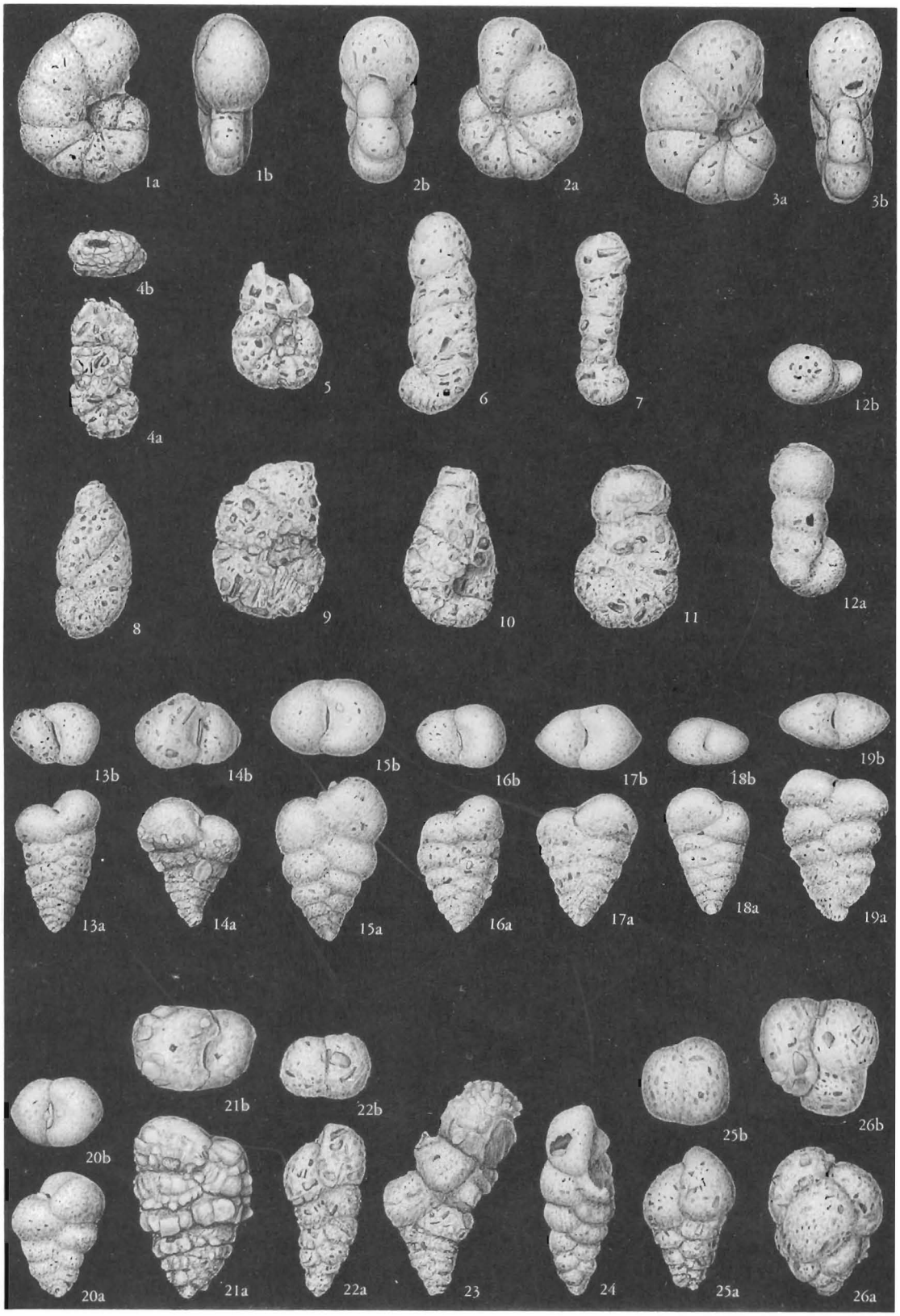
EXPLANATION OF PLATE 1

THECAMOEBINA and FORAMINIFERA (SACCAMMINIDAE, REOPHACIDAE, TOLYPAMMINIDAE, and LITUOLIDAE)

[Figures 1-12, Thecamoebina; figures 13-29, Foraminifera]



Todd and Bronnimann: Gulf of Paria, Trinidad



Todd and Bronnimann: Gulf of Paria, Trinidad

the Recent microfauna apparently is poorly developed or absent (see van Andel and Postma, 1954, map I, sample locations). The transition zone, mentioned by Kruit (*in* van Andel and Postma, 1954, p. 125), between the *Nonionella atlantica-Rotalia rolshauseni* area and the so-called sterile zone of the eastern Gulf of Paria, populated by few and small (less than 0.15 mm.) species of foraminifers and ostracodes, has not been recognized by us. On the contrary, the nearshore zone furnished a rich assemblage which toward the Gulf is superseded by the equally rich deeper water microfaunas.

It is the authors' opinion that the main factors influencing the distribution of benthonic micro-organisms are temperature, salinity, grain size of the bottom sediments, depth, light penetration, water movements, and amount of available nutrients. Of these, temperature and salinity seem to be by far the most important factors in most environments. Postma (*in* van Andel and Postma, 1954, p. 28-64) has discussed in detail the behavior of these and other biologically critical properties of sea water in the Gulf of Paria. In the following table is summarized the information given by Postma

EXPLANATION OF PLATE 2

FORAMINIFERA (LITUOLIDAE, TEXTULARIIDAE, VERNEUILINIDAE, and VALVULINIDAE)

[*a*, Side views; *b*, peripheral views—except as indicated]

(idem, p. 36, text figs. 14, 15A, 15B) regarding seasonal and vertical ranges of temperature and salinity in the eastern Gulf of Paria.

Table 2.—Temperature and salinity ranges in the eastern Gulf of Paria

(First two columns compiled from Postma, *in* van Andel and Postma, 1954; third column computed using the formula: Salinity = 0.03 + 1.805 × Chlorinity)

	Temperature (°C)	Chlorinity (o/oo)	Salinity (o/oo)
Dry season			
Surface	29	19.4	35.0
Bottom	27	19.4	35.0
Rainy season			
Surface	27-28	17-18	30.7-32.5
Bottom	27	18	32.5

Nearshore and Offshore Zones

The salinity of the eastern Gulf of Paria is very close to that of the adjacent water outside the Dragon's Mouths. The chlorinity of the surface water of the North Atlantic Current in the southeast Caribbean and adjoining Atlantic is reported to range between 19.2 and 20.0°/oo Cl (Postma, *in* van Andel and Postma, 1954, p. 32). The range of the seasonal variation of the bottom salinity in the eastern Gulf of Paria of about 2.5°/oo is very small and probably does not fundamentally influence the benthonic microfaunas. On the other hand, the seasonal variations of the surface salinity of the shallower nearshore zone along the western coast of Trinidad shows much greater ranges from about 20°/oo in the rainy season to about 34°/oo in the dry season (computed from Postma, idem, p. 31, 32, text fig. 9). No data on the temperature of the nearshore waters are available. This factor is expected to have somewhat greater daily variation in the shallow areas than in the deeper waters of the Gulf of Paria and its increased range may affect or control the distribution of certain benthonic species. The temperature difference between bottom and surface is 1°C to 2°C; the surface temperature probably is more or less constant for the surface waters of the whole area. Strong surface and bottom currents are well developed in the Gulf of Paria (van Andel and Postma, 1954, p. 45-48). Consequently, the benthonic forms of the deeper eastern Gulf of Paria live in a rather stable, probably well oxygenated, virtually marine tropical environment, whereas those of the nearshore zone are subject to considerable changes in salinity, which range from mesohaline to marine waters, using the values of Hiltermann (1949, p. 5, 6). The composition of the benthonic faunas of the nearshore and offshore zones, therefore, appears to be governed chiefly by the differences in salinity ranges between the two areas.

Tidal Zone

The tidal zone of the western coast of Trinidad is represented by the littoral areas, the estuaries of the rivers and rivulets, and the accompanying mangrove swamps and mudflats. The formation of the mangrove swamps and mudflats is favored by the relatively small tidal amplitudes, which range between 40 and 50 cm. along the north coast of Trinidad and about 150 cm. at the Serpent's Mouth. At the river mouths the mangrove plants generally line the banks and cover the adjoining tidal plains. In places, they form a continuous belt of vegetation along the coast, leading from one river to the neighboring one. Upstream, the mangrove plants can be traced approximately as far as the tide reaches. During high tide, the mangrove swamps and mudflats are flooded by mesohaline to marine water, and during low tide they are exposed with the exception of occasional marsh pools. Influx of fresh water is restricted to the river and rivulets proper. This tidal interplay produces environments from very low saline to marine to hypersaline conditions where only euryhaline forms are able to survive. It is, therefore, expected that typical stenohaline offshore forms will not be found in the tidal areas. It also seems from the distribution of the tidal species that, as a rule, they do not live in the deeper water of the Gulf of Paria. This has already been recognized by Kruit (*in* van Andel and Postma, 1954, p. 130), who stated that the typical species of the marsh faunas recorded by Cushman and Bronnimann (1948a) have not penetrated into the marine environment of the Gulf of Paria.

The dark gray and black mud accumulated between the roots of the mangrove plants presumably under reducing conditions seems to offer excellent living conditions for certain arenaceous Foraminifera such as *Ammoastuta, Ammobaculites, Haplophragmoides, Trochammina, Arenoparrella*, etc., and many other bottom dwelling organisms. Suter (1954, p. 37) regards these mud banks and mangrove deposits as being "lignite *in statu nascendi*" and states that in the Guaracara delta area accumulation is taking place at rates of up to one foot per year before consolidation.

Microenvironments of Tidal and Nearshore Zones

During field work it was noticed that within the tidal and nearshore zones microenvironments exist that are characterized by special ecologic conditions. The microfaunas of two of these microenvironments are described below. They show distinct grouping into a number of biotopes, believed to be governed primarily by the salinity and secondarily by the constitution of the sea bottom.

St. Jean Rivulet

The St. Jean Rivulet at Marabella, a small village south of Pointe-à-Pierre, flows just south of Marabella railroad junction in the Tarouba Bay of the Gulf of Paria (see map of the sampled localities, fig. 6). The mouth of the rivulet is distinctly curved southward. The estuarine section from the mouth of the rivulet to the highest tidal influence has been closely sampled, working downstream from just above the highest tidal influence: stations Br. 183-210 and Br. 137-171. The estuary grades upstream into the fresh-water environment and downstream into the saline environment of the mouth of the rivulet and delta of the rivulet.

The mouth of the St. Jean Rivulet is surrounded by a fairly dense mangrove growth. These mangrove plants can be traced upstream to station Br. 188; they do not advance above the highest tidal influence at station Br. 187. In this instance, the mangrove plants are quite reliable indicators of saline waters. The current in the rivulet is strong and causes erosion of the central part of the bed of the rivulet, so that mud is deposited only at the banks. The samples investigated come from this mud deposit along the banks of the rivulet. It is obvious that the influence of the salinity is here much more important for the development of the microfaunas than temperature, type of bottom sediment, and other factors.

It seems that particularly the arenaceous Foraminifera are well adapted to this type of environment, characterized by semi-daily changes in salinity. The calcareous species are rare and the number of specimens increases somewhat toward the lower part of the estuary, particularly near the mouth of the rivulet where the water is more saline and less variable. The dominant calcareous species in the estuary are:

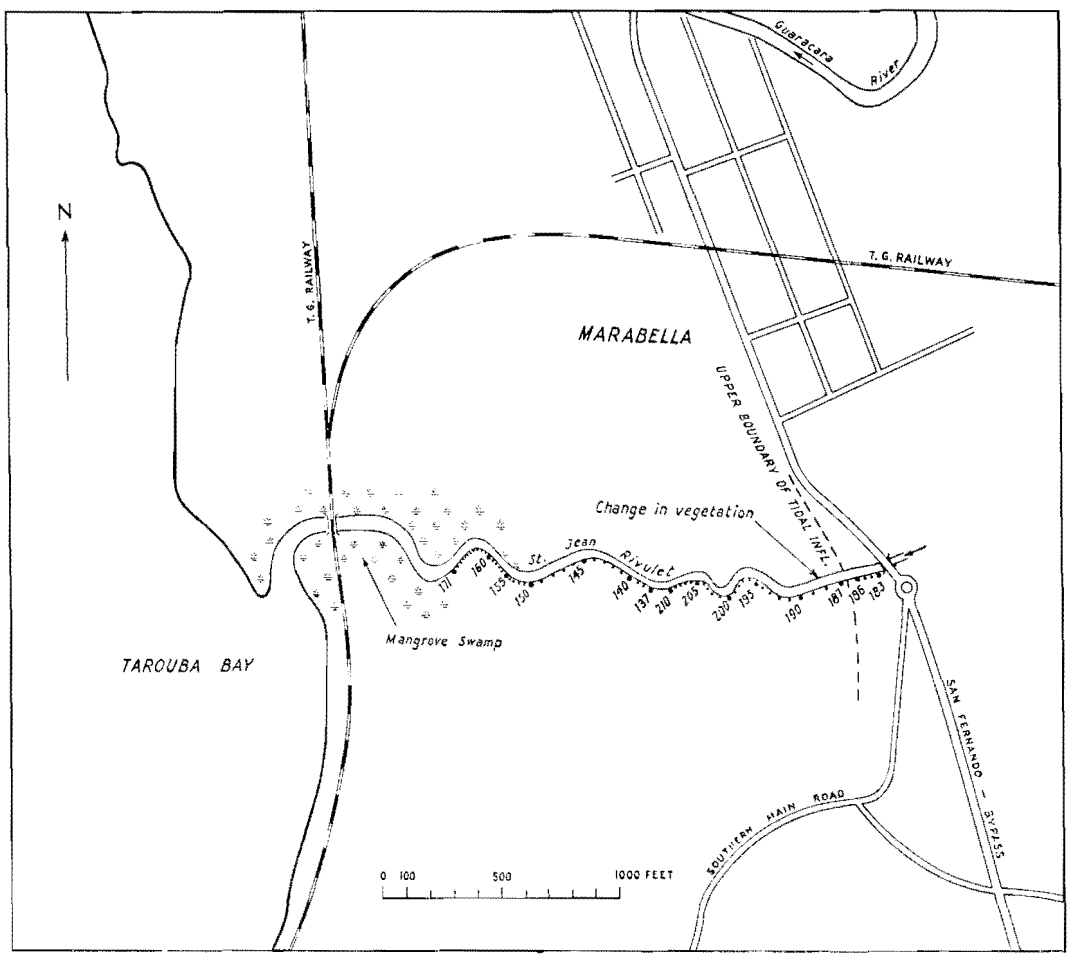
Quinqueloculina sp. B

Elphidium salsum (Cushman and Bronnimann)

The most common arenaceous Foraminifera are:

Ammoastuta inepta (Cushman and McCulloch)

Haplophragmoides wilberti Andersen



Text figure 6. Detailed map of lower part of St. Jean Rivulet.

Alveolophragmium salsum (Cushman and Bronnimann)
Arenoparrella mexicana (Kornfeld)
Trochammina laevigata Cushman and Bronnimann
Sorosphaera? sp.

Two representatives of the Thecamoebina are:
Difflugia urceolata Carter
Centropyxis (Cyclopyxis) sp.

These Thecamoebina are rare and only *D. urceolata* has been observed at station Br. 184, in the absence of all Foraminifera above the highest tidal influence.

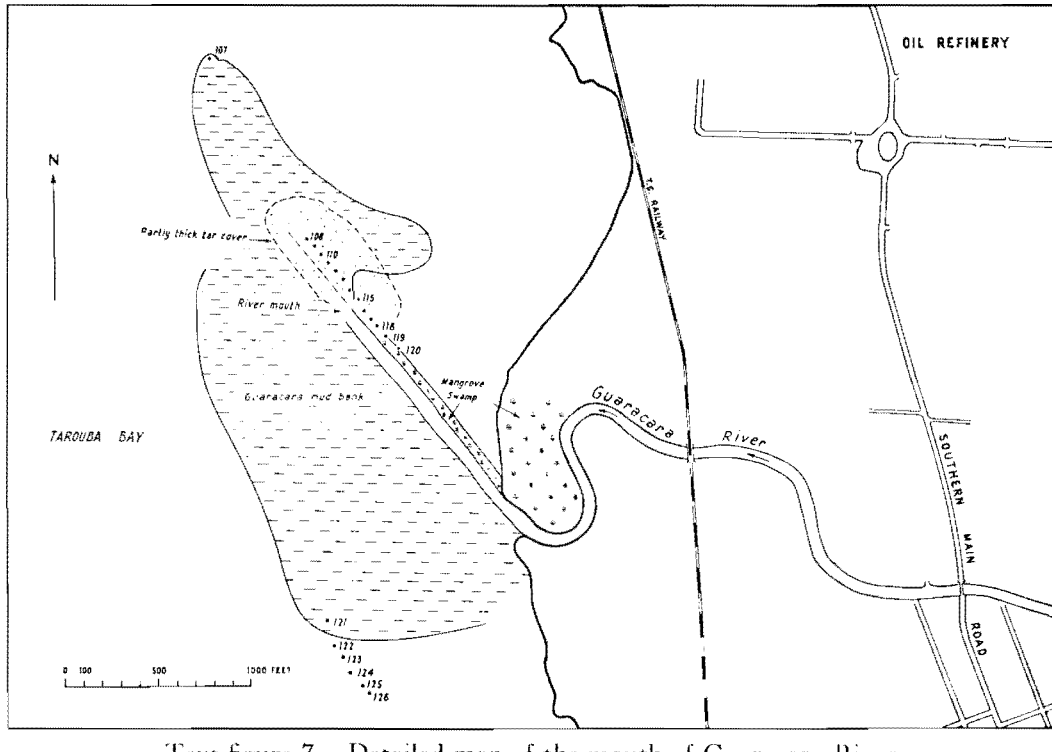
On the basis of the distribution of the Foraminifera and Thecamoebina, the estuary of the St. Jean Rivulet has been subdivided from the mouth to the fresh water zone into four faunal groups as follows (see distribution chart, table 3):

1. Stations Br. 162-171:
   Palmerinella-Arenoparrella biotope
2. Stations Br. 151-161:
   Haplophragmoides wilberti biotope
3. Stations Br. 150-187:
   Alveolophragmium salsum biotope
4. Stations Br. 183-186:
   Difflugia urceolata biotope

Fossil Foraminifera are common in the analyzed samples from the St. Jean Rivulet. They have been redeposited from strata of Upper Cretaceous to Oligocene age cropping out in and south of the Central Range. The preservation of the derived specimens, especially of the arenaceous forms, is generally unusually good. The derived specimens seem to be mechanically selected. In certain samples the redeposited components are very much like the autochthonous assemblages from beds of the Nariva formation of Oligocene age near Kelly Junction. Where Recent species are scarce or absent, as in stations Br. 143, 149, 183-186, it might be difficult to discover the derived character of the fossil assemblages. Similar observations have also been made in marine samples from the Cipero coast, south of San Fernando, where the Recent components are completely masked by the abundance of redeposited forms, especially specimens of *Globigerina* from the marls of Oligocene age. The admixture of specimens of *Globigerina* from marls of the Cipero coast has already been noted by Guppy (1900) in dredgings off San Fernando.

Guaracara River

General statement.—The Guaracara River, south of Pointe-à-Pierre and just north of the St. Jean Rivulet, flows into the Tarouba Bay of the Gulf of Paria. Like the St. Jean Rivulet, the Guaracara River turns abruptly southward before opening into the sea. The river mouth is artificially dredged and surrounded by a shallow mud bank (see map, figure 7).



Text figure 7. Detailed map of the mouth of Guaracara River.

Palmerinella-Arenoparrella biotope

ST. JEAN RIVULET — STATION Br.	171	170	169	168	167	162
FORAMINIFERA						
Ammoastuta inepta	X	X	●	X	O	O
Ammobaculites pseudocassis		X	X		X	
Ammobaculites salsus			X	X	X	O
Ammobaculites salsus var. *distinctus*				X		O
Arenoparrella mexicana	O	●	●	●	●	●
Elphidium salsum			X	O	O	O
Haplophragmium salsum	X	X	X		X	X
Haplophragmoides wilberti	O	O	O	O	O	O
Hippocrepina ? sp. A						
Alveolophragmium salsum	O	X	X	O		O
Palmerinella palmerae					X	O
Quinqueloculina sp. B			X	X	O	O
Sorosphaera ? sp. A	O	O	O	X	X	X
Streblus beccarii var. *sobrina*			O			
Trochammina comprimata		X	O			
Trochammina laevigata	O	O	O	O	O	O
THECAMOEBINA						
Centropyxis (Cyclopyxis) sp.						
Difflugia urceolata						

Haplophragmoides wilberti biotope

ST. JEAN RIVULET — STATION Br.	161	160	159	158	157	156	155	152	151
FORAMINIFERA									
Ammoastuta inepta	X	O	O	O		X	X	X	
Ammobaculites pseudocassis									
Ammobaculites salsus	X	X							
Ammobaculites salsus var. *distinctus*	X	X							
Arenoparrella mexicana	●	●	O	●	O	O	●	X	O
Elphidium salsum									
Haplophragmium salsum	X	X		X					X
Haplophragmoides wilberti	●	●	●	●	●	●	●	●	●
Hippocrepina ? sp. A									
Alveolophragmium salsum		O			O		O	X	O
Palmerinella palmerae									
Quinqueloculina sp. B				X	X				
Sorosphaera ? sp. A	X	●			X	X	X	X	
Streblus beccarii var. *sobrina*									
Trochammina comprimata		O	X	X		X		X	
Trochammina laevigata	O	●		X	X		X		
THECAMOEBINA									
Centropyxis (Cyclopyxis) sp.	X								
Difflugia urceolata									

Alveolophragmium salsum biotope

ST. JEAN RIVULET — STATION Br.	150	149	148	147	146	145	144	143	142	141	140	139	138	137
FORAMINIFERA														
Ammoastuta inepta	X		X			X	X	X	X	O		X	O	X
Ammobaculites pseudocassis														
Ammobaculites salsus														
Ammobaculites salsus var. *distinctus*														
Arenoparrella mexicana	X	X	O	X	X	O	●	X		X		X	O	X
Elphidium salsum					X	X	X							
Haplophragmium salsum										X				X
Haplophragmoides wilberti	X	X	X	X						X				
Hippocrepina ? sp. A														X
Alveolophragmium salsum	O	O	X	O	X	X	●		X	●	O	●	X	O
Palmerinella palmerae														
Quinqueloculina sp. B		X	X			X			O		X	X	X	X
Sorosphaera ? sp. A														
Streblus beccarii var. *sobrina*										X				
Trochammina comprimata										X				
Trochammina laevigata							O	X		X				
THECAMOEBINA														
Centropyxis (Cyclopyxis) sp.														
Difflugia urceolata														

Alveolophragmium salsum biotope (continued)

ST. JEAN RIVULET — STATION Br.	210	209	208	207	206	205	204	203	202	201	200	199	198	197	196	195	194	193	192	191	190	189	188	187
FORAMINIFERA																								
Ammoastuta inepta					X	X								X			X	X						
Ammobaculites pseudocassis																								
Ammobaculites salsus																								
Ammobaculites salsus var. *distinctus*																								
Arenoparrella mexicana			X	O	O	O				O	●	O	O	O	X	X	O	O	X					
Elphidium salsum																								
Haplophragmium salsum													X											
Haplophragmoides wilberti																								
Hippocrepina ? sp. A					X																			
Alveolophragmium salsum	O	O	O	●	O	O	X	X	O	O	●	O	●	●	O	O	●	●	X	X		●	X	O
Palmerinella palmerae																								
Quinqueloculina sp. B						O																		
Sorosphaera ? sp. A																								
Streblus beccarii var. *sobrina*																								
Trochammina comprimata																								
Trochammina laevigata												X	X											
THECAMOEBINA																								
Centropyxis (Cyclopyxis) sp.																								
Difflugia urceolata					X											X								

Difflugia urceolata biotope

ST. JEAN RIVULET — STATION Br.	186	185	184	183
FORAMINIFERA				
Ammoastuta inepta				
Ammobaculites pseudocassis				
Ammobaculites salsus				
Ammobaculites salsus var. *distinctus*				
Arenoparrella mexicana				
Elphidium salsum				
Haplophragmium salsum				
Haplophragmoides wilberti				
Hippocrepina ? sp. A				
Alveolophragmium salsum				
Palmerinella palmerae				
Quinqueloculina sp. B				
Sorosphaera ? sp. A				
Streblus beccarii var. *sobrina*				
Trochammina comprimata				
Trochammina laevigata				
THECAMOEBINA				
Centropyxis (Cyclopyxis) sp.				
Difflugia urceolata			X	

X scarce O common ● abundant

Table 3. Distribution of Foraminifera and Thecamoebina in St. Jean Rivulet.

River mouth.—The mouth of the Guaracara River represents an environment intermediate between the littoral zone and the nearshore zone. It is subject to the tidal influence and, as one might expect, it yields a microfauna with some similarities to those of the *Palmerinella-Arenoparrella* and *Haplophragmoides wilberti* biotopes described from the mouth of the St. Jean Rivulet. The north bank of the dredged mouth of the Guaracara River is lined by a sparse mangrove growth, and at the river mouth a thick layer of tar and heavy oil covers the bottom.

The following are the most common Foraminifera collected at stations Br. 107-120 (see distribution chart, table 4):

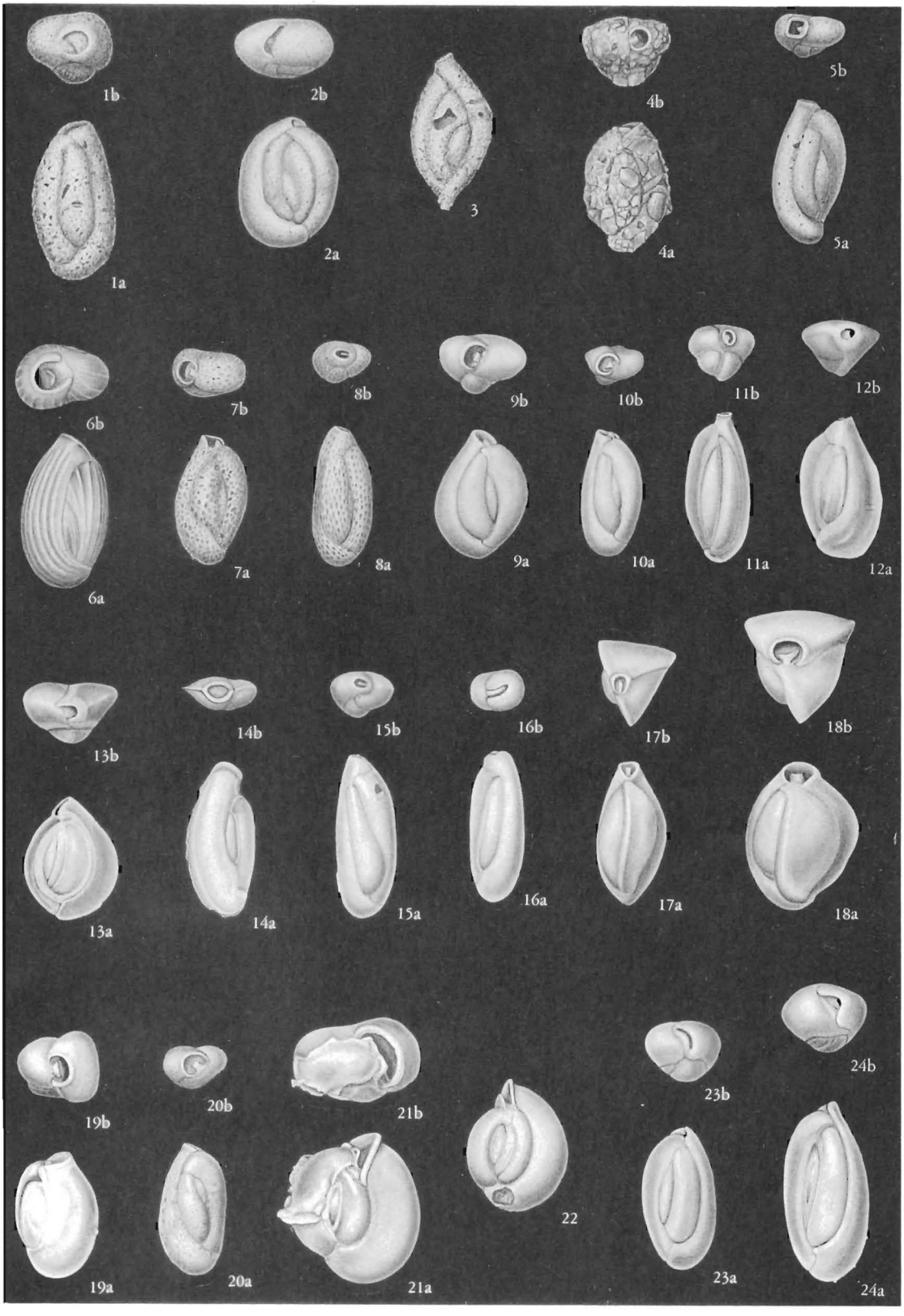
Palmerinella palmerae Bermudez
Elphidium trinitatense (Cushman and Bronnimann)
Quinqueloculina sp. B
Streblus beccarii (Linné) var. *sobrina* (Shupack)
Streblus beccarii (Linné) var. *tepida* (Cushman)

The almost complete absence of arenaceous species in this inner part of the river mouth appears to be due to the particularly difficult living conditions caused by the accumulation of residual oil in the sampled area. At station Br. 110 redeposited *Centropyxis* (*Cyclopyxis*) sp. occur rarely. At the outer edge of the Guaracara mud bank (station Br. 107), where the mud is not covered by tar, a subsequent collection showed the

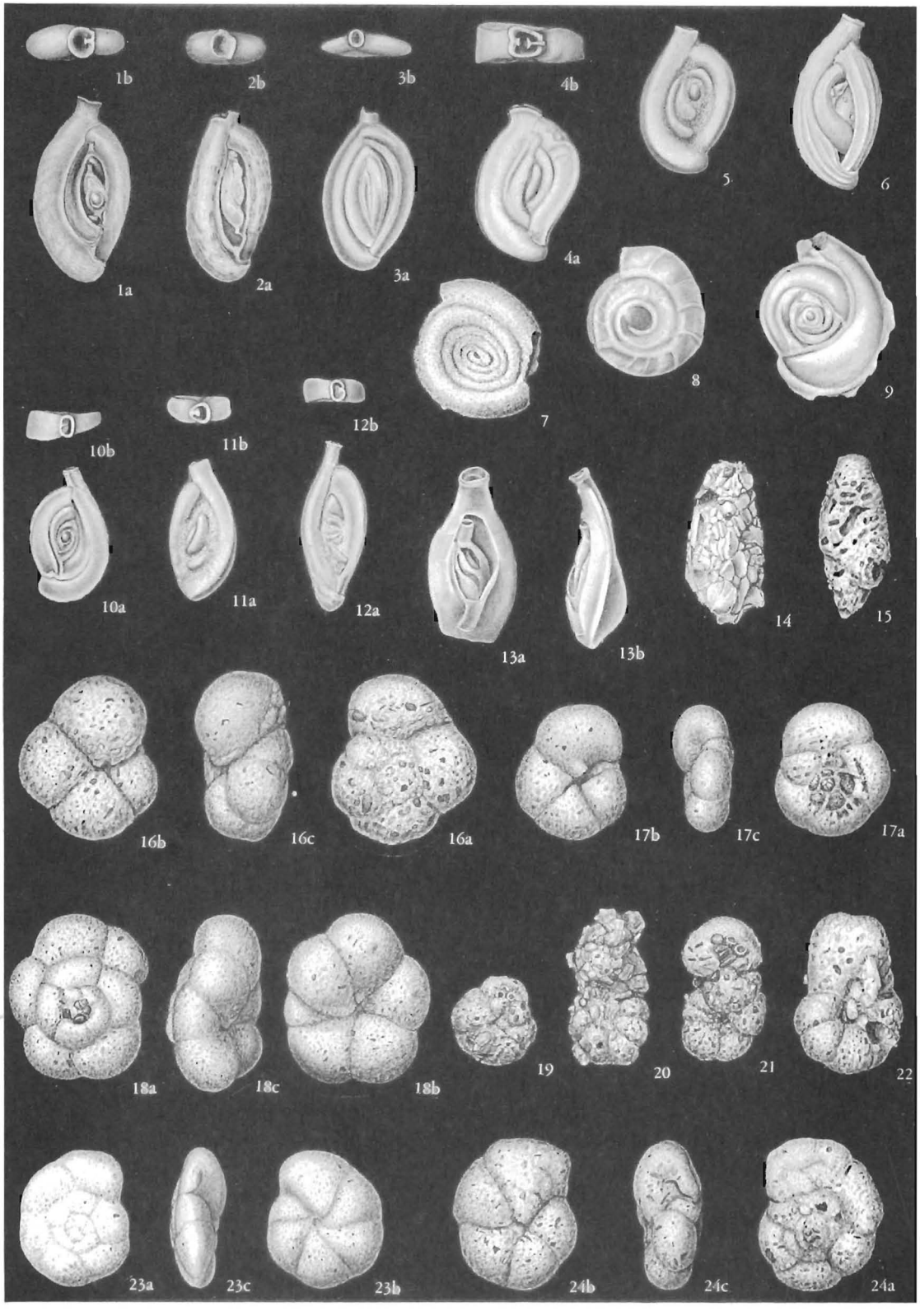
EXPLANATION OF PLATE 3

FORAMINIFERA (SILICINIDAE and MILIOLIDAE)

[*a*, Side views; *b*, apertural views]



Todd and Bronnimann: Gulf of Paria, Trinidad



Todd and Bronnimann: Gulf of Paria, Trinidad

arenaceous species typical of the nearshore zone to be well represented. Apart from the arenaceous components, the microfaunas of the St. Jean and the Guaracara estuaries are closely related.

Delta.—Stations Br. 121-126, situated at the southern edge of the Guaracara mud bank, yielded a mixed calcareous-arenaceous foraminiferal assemblage with abundant arenaceous individuals suggesting brackish water conditions. The fauna occurs in a fine, slightly silty mud, which seems to be preferred by *Ammobaculites* and *Haplophragmoides* to more sandy sediments. No Thecamoebina have been recorded from these stations. The microfauna is characteristic of the *Palmerinella-Arenoparrella* biotope of the lower part of the Guaracara and St. Jean estuaries but shows distinct affinities with the more calcareous fauna of the nearshore zone.

The following Foraminifera have been recorded at stations Br. 121-126 (see distribution chart, table 4), but are dominant at stations Br. 125 and 126 only:

Ammobaculites salsus Cushman and Bronnimann
A. salsus var. *distinctus* Cushman and Bronnimann
A. dilatatus Cushman and Bronnimann
Haplophragmoides wilberti Andersen
Palmerinella palmerae Bermudez
Streblus beccarii (Linné) var. *sobrina* (Shupack)
S. beccarii (Linné) var. *tepida* (Cushman)

Ammobaculites dilatatus Cushman and Bronnimann, which is diagnostic of the nearshore zone, appears here for the first time, indicating a more marine nature of this assemblage as compared with the biotopes at the mouths of the St. Jean Rivulet and the Guaracara River.

EXPLANATION OF PLATE 4

FORAMINIFERA (MILIOLIDAE, OPHTHALMIDIIDAE, and TROCHAMMINIDAE)

FIGURE — PAGE

1, 2. *Spiroloculina guppyi* Todd and Bronnimann, n. sp. 29
1, Holotype, Cushman Coll. No. 64789; 2, Paratype, Cushman Coll. No. 64790. × 60. Offshore zone. *a*, Side views; *b*, apertural views.

3. *Sigmoilina tenuis* (Czjzek) 29
Cushman Coll. No. 64793, × 90. Offshore zone. *a*, Side view; *b*, apertural view.

4. *Spiroloculina dentata* Cushman and Todd 29
Cushman Coll. No. 64786, × 30. Offshore zone. *a*, Side view; *b*, apertural view.

5. *Spiroloculina eximia* Cushman 29
Cushman Coll. No. 64787, × 60. Offshore zone.

6. *Spiroloculina grata* Terquem 29
Cushman Coll. No. 64788, × 110. Offshore zone.

7. *Cornuspira incerta* (d'Orbigny) 29
Cushman Coll. No. 64626, × 90. Tidal zone, Mangrove I.

8. *Cornuspira planorbis* Schultze 30
Cushman Coll. No. 64653, × 90. Nearshore zone.

9. *Ophthalmidium balkwilli* Macfadyen 30
Cushman Coll. No. 64795, × 125. Offshore zone.

10-12. *Spiroloculina anderseni* Todd and Bronnimann, n. sp. 28
10, Holotype, Cushman Coll. No. 64791, Offshore zone; 11, Plesiotype, Cushman Coll. No. 64652, Nearshore zone; 12, Paratype, Cushman Coll. No. 64792, Offshore zone. × 60. *a*, Side views; *b*, apertural views.

13. *Pyrgo nasutus* Cushman 29
Cushman Coll. No. 64794, × 90. Offshore zone. *a*, *b*, Side views 90° apart.

14. *Nouria polymorphinoides* Heron-Allen and Earland 30
Cushman Coll. No. 64797, × 38. Offshore zone.

15. *Nouria* sp. A 30
Cushman Coll. No. 64798, × 60. Offshore zone.

16. *Trochammina advena* Cushman 30
Cushman Coll. No. 64796, × 75. Offshore zone. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

17, 18. *Trochammina laevigata* Cushman and Bronnimann 30
17, Young form. Cushman Coll. No. 64615, × 90. Tidal zone, Mangrove II. 18, Adult, Cushman Coll. No. 64627, × 75. Tidal zone, Mangrove I. *a*, Dorsal views; *b*, ventral views; *c*, peripheral views.

19-22. *Trochamminita irregularis* Cushman and Bronnimann 30
19, Cushman Coll. No. 64616, × 30; 20, Cushman Coll. No. 64617, × 30; 21, Cushman Coll. No. 64618, × 45; 22, Cushman Coll. No. 64619, × 45. Tidal zone, Mangrove II.

23, 24. *Arenoparrella mexicana* (Kornfeld) 30
23, Cushman Coll. No. 64628, × 38. Tidal zone, Mangrove I. 24, Cushman Coll. No. 64620, × 60. Tidal zone, Mangrove II. *a*, Dorsal views; *b*, ventral views; *c*, peripheral views.

GUARACARA RIVER									*Streblus beccarii* var. *sobrina - tepida* biotope											
STATION Br.	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
FORAMINIFERA																				
Ammobaculites salsus																			●	●
Ammobaculites salsus var. *distinctus*																			●	●
Ammobaculites dilatatus																			●	●
Arenoparrella mexicana																			X	X
Elphidium salsum									X	X					X	X			X	
Elphidium trinitatense	O				X	X	X		X										X	
Haplophragmoides wilberti	X																		O	O
Palmerinella palmerae									X	X										●
Streblus beccarii var. *sobrina*	X			X		X	X		●	X					X	O		O		●
Streblus beccarii var. *tepida*				X	X	X	X		●	X					X	O		O		●
Quinqueloculina sp. B	X								●	X						X		X	X	
THECAMOEBINA																				
Centropyxis (*Cyclopyxis*) sp.				X																

X scarce O common ● abundant

Table 4. Distribution of Foraminifera and Thecamoebina in the mouth of Guaracara River.

As in the samples from the St. Jean Rivulet, fossil Foraminifera are in general abundant and may completely mask the Recent components. They are derived from the strata of Upper Cretaceous to Oligocene age cropping out in the areas in and south of the Central Range drained by the Guaracara River.

COMPARISONS OF GULF OF PARIA FAUNAS WITH OTHER FAUNAS

In table 5 are listed 33 publications on Foraminifera from various environments:

(a) Several ecologically similar to the Gulf of Paria environment from various parts of the world;

(b) Several geographically close to the Gulf of Paria;

(c) Several geographically remote from the Gulf of Paria (i.e. separated by continental and oceanic barriers) but having species in common with it.

Certain species were selected from the total of 210 for inclusion in this table, and these were grouped according to the three zones as recognized in our study.

The following species were omitted because they have not been recorded elsewhere than in the Gulf of Paria where they were originally described by Cushman and Bronnimann (1948a; 1948b):

Centropyxis (*Centropyxis*) *excentricus*
Centropyxis (*Cyclopyxis*) *salsus*
Alveolophragmium salsum
Ammobaculites directus[6]
A. diversus[6]
A. pseudocassis

6 Recently these species were provisionally identified in the Gulf of Mexico in an environment similar to that of the eastern Gulf of Paria (William R. Walton, written communication, July 23, 1956).

Haplophragmium salsum
Pseudoclavulina curta
Trochamminita irregularis
Elphidium kugleri
E. limosum
E. salsum
E. trinitatense
E. vadescens

In addition, numerous other species with limited recorded distributions, all species here described as new in the Gulf of Paria, all species designated by letters only, and all rare species were omitted from table 5.

The 81 species remaining, representing the major part of the fauna, are grouped as follows (besides the one form *Streblus beccarii* var. *tepida* that is found characteristically in all three zones):

(a) 16 species are characteristic of the tidal zone, of which 7 are in common with the nearshore zone;

(b) 40 species are characteristic of the nearshore zone, of which 7 are in common with the tidal zone and 18 more are in common with the offshore zone; and

(c) 49 species are characteristic of the offshore zone, of which 18 are in common with the nearshore zone.

Table 5 thus is a tabulation of the more abundant species found in each of the 3 zones and a compilation of some of the other occurrences of the species found in the Gulf of Paria.

The Foraminifera fauna reported from the Gulf of Paria, as discussed by Kruit (*in* van Andel and Postma, 1954, p. 117-134) and tabulated and illustrated by Key (idem, p. 207-217, pls. 1-3), includes species from the entire area extending from the coast of Venezuela eastward to Trinidad, and out southward through the Serpent's Mouth and northward through the Dragon's Mouths. Although encompassing a larger area, Kruit included relatively few forms for the purpose of his study, and based his recognition of facies on 30 selected species. The larger area studied by the Orinoco Shelf Expedition includes more normal marine environments, such as the area of the Dragon's Mouths, and to a lesser degree the Serpent's Mouth. In these areas were found several species not present in the area of our study. The following five species found were not observed in any of our material:

Amphistegina lessonii d'Orbigny
Bifarina advena Cushman
Eponides antillarum (d'Orbigny)
Höglundina elegans (d'Orbigny)
Cibicides corpulentus Phleger and Parker

These species are characteristic of higher and more stable salinities and greater depths than are to be found in the eastern part of the Gulf of Paria. It is likely that other physical and chemical (organic as well as inorganic) characteristics of sea water and bottom sediments, such as pH, Eh, and C/N ratio, act as differential screens keeping out the above species as well as others that are less tolerant of the various resulting physical conditions in the eastern Gulf of Paria.

ORIGIN OF THE FAUNAS

The faunas of the nearshore and offshore zones have about 25 percent of their combined number of species in common. As far as origin and development of the fauna are concerned, the two zones may be considered together.

The combined fauna of the nearshore and offshore zones is considered to be a mixture of an indigenous brackish-water fauna with a modified marine fauna derived from the surrounding marine environments. The modified marine fauna is dwarfed and fragile due to adverse conditions. Kruit (*in* van Andel and Postma, 1954, p. 131) has noted the occurrence in the shallow water of the Gulf of Paria of species known elsewhere from much deeper habitats. The currents flowing in through the two openings provide access to the gulf for any Foraminifera from surrounding areas that can tolerate the less favorable conditions there.

Inflowing surface-to-bottom currents enter the gulf through the Serpent's Mouth while only bottom currents enter underneath the outflowing surface currents at the Dragon's Mouths (see Postma, *in* van Andel and Postma, 1954, text figs. 18, 19). Kruit (idem, text fig. 64) gives a map showing the direction and limit of penetration of certain saline species into the gulf as based on sampling coverage of the area made by the Orinoco Shelf Expedition. The farthest penetration is shown by *Rotalia* (= *Streblus*) *beccarii*, *Uvigerina peregrina*, and *Quinqueloculina lamarckiana*. Our sampling coverage tends to confirm the general pattern indicated on this map, with the exception that *Streblus beccarii* is probably not an immigrant species but an indigenous one.

The fauna of the tidal zone is probably wholly indigenous. It is typical of other nearshore brackish water environments, such as some described from along the southwest coast of Texas (Parker, Phleger, and Peirson, 1953, text fig. 49), Mississippi Sound (Phleger, 1954, text fig. 4), Mason Inlet, North Carolina (Miller, 1953), and New York Bight (Ronai, 1955). Even from as remote an area as the North Sea, faunas reported from The Jade (Bartenstein, 1938) and Zuider Zee (Hofker, 1922) are similar to that of the mangrove swamps of the eastern Gulf of Paria. Similarity of faunas, including numerous instances of identical species, leads to speculation as to method of distribution of species between isolated brackish water areas across barriers of land or open ocean.

The tidal zone, however, has a number of species which thus far have not been recognized elsewhere

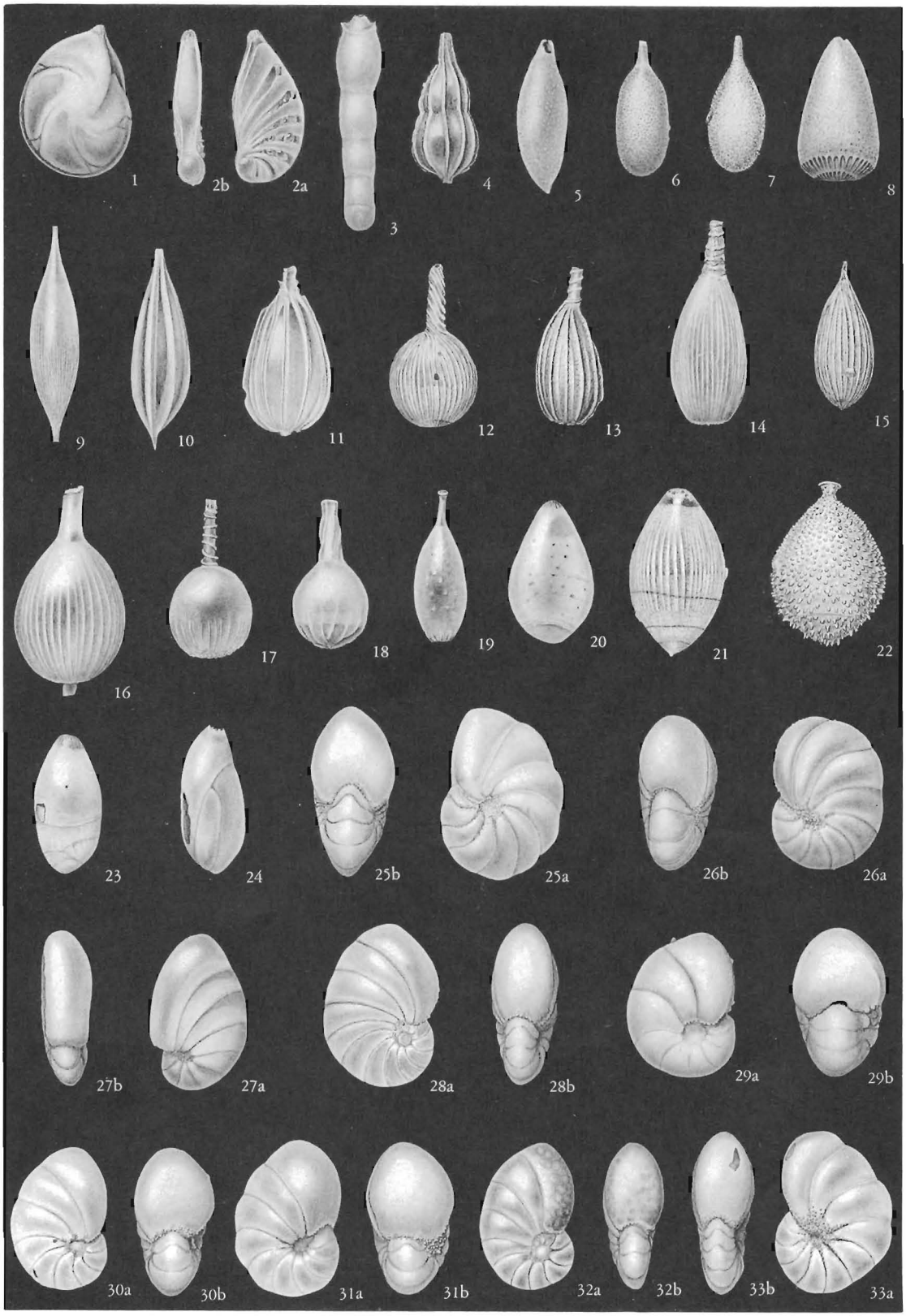
than in the Gulf of Paria where they were originally described by Cushman and Bronnimann (1948a, 1948b). These are

Centropyxis (Centropyxis) excentricus
Centropyxis (Cyclopyxis) salsus
Ammobaculites pseudocassis

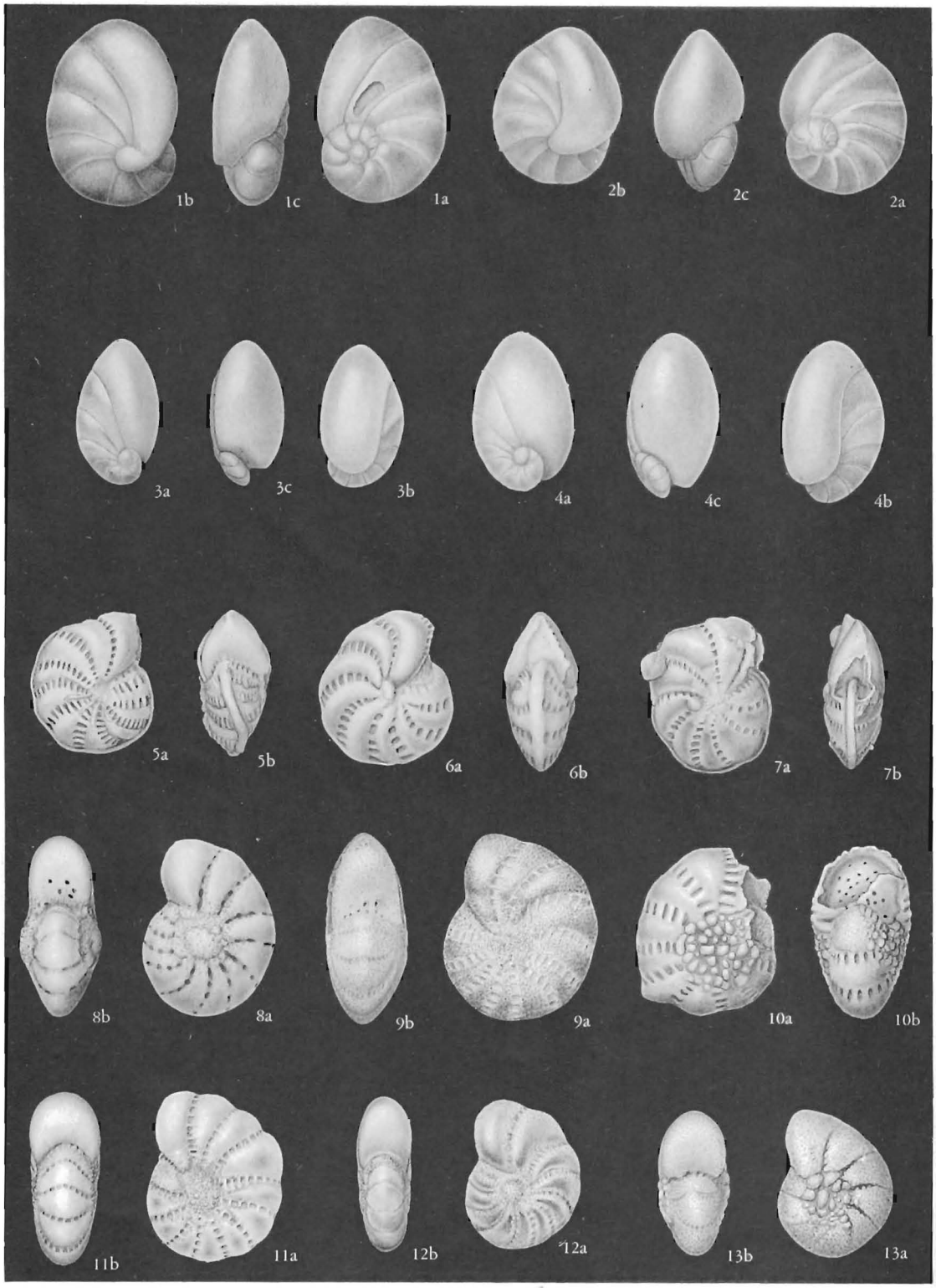
EXPLANATION OF PLATE 5

FORAMINIFERA (LAGENIDAE, POLYMORPHINIDAE, and NONIONIDAE)

[*a*, Side views; *b*, peripheral views—except as indicated]



Todd and Bronnimann: Gulf of Paria, Trinidad



Todd and Bronnimann: Gulf of Paria, Trinidad

Haplophragmium salsum
Trochamminita irregularis
Elphidium kugleri
E. limosum
E. salsum
E. vadescens

PHYSICAL CHARACTERISTICS OF THE SPECIMENS

As may be seen from magnifications of the illustrations given, most of the Gulf of Paria specimens are exceptionally small for Foraminifera, their maximum dimensions rarely reaching 0.4 mm. Certain species, mostly arenaceous forms—particularly species of *Haplophragmoides*, are exceptions to this general rule for the Gulf of Paria. The species involved are, in some instances, characteristically of a small size wherever they are found. In most instances, however, the species in the Gulf of Paria have average sizes only about half that of specimens of the same species found elsewhere. This apparent dwarfing does not apply to the few planktonic specimens found.

Another unusual feature of the Gulf of Paria fauna is the extreme fragility of the calcareous tests. In some instances no perfect specimens were obtained (see pl. 8, fig. 7; pl. 9, figs. 16-22; pl. 11, fig. 9). As is to be expected in the case of rotaliform species, the last-formed chambers are the most fragile and are often broken away. For many specimens even careful handling of the tests is too severe and the walls seem to disintegrate under the touch of a moistened sable brush.

Size as a physical characteristic of specimens is generally believed to have no specific importance but to be related indirectly to such factors of the physical environment as temperature, salinity, and food supply. Smaller than average size of specimens of any particular species may, therefore, be interpreted as indicative of less than optimum conditions of the particular environment in which the population is found. On the other hand, normal size of specimens of a particular species may indicate that the conditions under which the species lives are near or at optimum. For most of the Gulf of Paria species the conditions are probably less than optimum. For the exceptions noted above, such as the species of *Haplophragmoides* that are so abundant in the tidal zone, conditions are probably optimum.

SYSTEMATIC ZOOLOGY

Thecamoebina

No classification of the Thecamoebina is attempted. We have transferred directly to the Thecamoebina specific names originally given to two Gulf of Paria forms previously described as Foraminifera, realizing that these two forms may have already been described under other names and that the Gulf of Paria names may prove to be junior synonyms. We have followed in general the usage of Bolli and Saunders (1954), together with that of Leidy (1879).

We have recognized the following species:

Difflugia urceolata Carter (Plate 1, figure 1)

Difflugia pyriformis Perty (Plate 1, figure 2)

Difflugia capreolata Penard (Plate 1, figures 3, 4)

Pontigulasia compressa (Carter) (Plate 1, figure 5)

Centropyxis (Centropyxis) constrictus (Ehrenberg) (Plate 1, figures 6, 7)

EXPLANATION OF PLATE 6

FORAMINIFERA (NONIONIDAE and ELPHIDIIDAE)

[*a*, Side views; *b*, peripheral views—except as indicated]

FIGURE		PAGE
1, 2.	*Nonionella opima* Cushman 1, Cushman Coll. No. 64820, × 125; 2, Cushman Coll. No. 64821, × 90. Offshore zone. *a*, Dorsal views; *b*, ventral views; *c*, peripheral views.	32
3, 4.	*Nonionella turgida* (Williamson) 3, Cushman Coll. No. 64822; 4, Cushman Coll. No. 64823. × 90. Offshore zone. *a*, Dorsal views; *b*, ventral views; *c*, peripheral views.	32
5-7.	*Elphidium advenum* (Cushman) 5, Cushman Coll. No. 64849, × 60. Offshore zone. 6, Cushman Coll. No. 64719, × 90. Nearshore zone. 7, Cushman Coll. No. 64850, × 75. Offshore zone.	39
8, 9.	*Elphidium discoidale* (d'Orbigny) 8, Cushman Coll. No. 64720, × 75. Nearshore zone. 9, Cushman Coll. No. 64851, × 90. Offshore zone.	39
10.	*Elphidium incertum* (Williamson) var. *clavatum* Cushman Cushman Coll. No. 64724, × 75. Nearshore zone.	39
11, 12.	*Elphidium excavatum* (Terquem) 11, Cushman Coll. No. 64721, × 60; 12, Cushman Coll. No. 64722, × 90. Nearshore zone.	39
13.	*Elphidium limosum* (Cushman and Bronnimann) Cushman Coll. No. 64725, × 90. Nearshore zone.	39

Centropyxis (Centropyxis) excentricus (Cushman and Bronnimann) (Plate 1, figure 9)

Centropyxis (Centropyxis) sp. A (Plate 1, figure 12)

Centropyxis (Cyclopyxis) arenatus (Cushman) (Plate 1, figure 8)

Centropyxis (Cyclopyxis) salsus (Cushman and Bronnimann) (Plate 1, figures 10, 11)

Foraminifera

Family SACCAMMINIDAE

Genus **Psammosphaera** Schulze, 1875

Psammosphaera fusca Schulze

Plate 1, figure 13

Psammosphaera fusca Schulze. Brady, 1884, *Challenger* Rept., Zoology, v. 9, p. 249, pl. 18, figs. 1-8.

Genus **Sorosphaera Brady**, 1879

Sorosphaera? sp. A

Unidentified as to species, this form consists of an aggregate of various sized, spherical, thin-walled arenaceous chambers, with largest individual chamber about 0.1 mm. in diameter.

Genus **Saccammina** M. Sars, 1869

This genus includes species formerly placed in *Proteonina*, which genus was shown (Loeblich and Tappan, 1955b, p. 7, 8) to be a synonym of *Reophax*.

Saccammina atlantica (Cushman)

Plate 1, figure 14

Proteonina atlantica Cushman, 1944, Cushman Lab. Foram. Research Special Pub. 12, p. 5, pl. 1, fig. 4.

Saccammina difflugiformis (Brady)

Plate 1, figure 15

Reophax difflugiformis Brady, 1879, Quart. Jour. Micros. Sci., v. 19, p. 51, pl. 4, fig. 3.

Saccammina sphaerica M. Sars

Plate 1, figure 16

Saccammina sphaerica M. Sars. Brady (part) 1884, *Challenger* Rept., Zoology, v. 9, p. 253, pl. 18, figs. 11-15 (not figs. 16, 17).

Family HYPERAMMINIDAE

Genus **Hippocrepina** Parker, 1870

Hippocrepina? sp. A

These slender, arcuate, tapering, finely arenaceous tubes are open at both ends presumably due to breakage. Greatest diameter is 0.1 mm.

Family REOPHACIDAE

Genus **Reophax** Montfort, 1808

Reophax dentaliniformis Brady

Plate 1, figure 19

Reophax dentaliniformis Brady, 1884, *Challenger* Rept., Zoology, v. 9, p. 293, pl. 30, figs. 21, 22.

Reophax nana Rhumbler

Plate 1, figure 17

Reophax nana Rhumbler, 1911, Foram. Plankton-Exped., pt. 1, pl. 8, figs. 6-12; 1913, idem, pt. 2, p. 471.

Reophax scorpiurus Montfort

Plate 1, figure 18

Reophax scorpiurus Montfort, 1808, Conchyliologie systématique, v. 1, p. 331, 88th genre.

Family TOLYPAMMINIDAE

Genus **Involutina** Terquem, 1862

It was shown by Loeblich and Tappan (1954, p. 306-308) that the name *Ammodiscus* cannot be used for the planispiral agglutinated forms formerly placed in that genus, and that such forms should be called *Involutina*.

Involutina minima (Höglund)

Plate 1, figure 20

Ammodiscus minimus Höglund, 1947, Zool. Bidrag Uppsala, v. 26, p. 124, pl. 8, figs. 5, 10; text figs. 90, 105, 110.

A few minute specimens of this species described from Sweden were found. The test is gray and its surface roughened so that the sutures are obscured. Petrographic examination shows the grains to be very small.

Genus **Glomospira** Rzehak, 1888

Glomospira glomerata Höglund

Plate 1, figure 21

Glomospira glomerata Höglund, 1947, Zool. Bidrag Uppsala, v. 26, p. 130, pl. 3, figs. 8-10; text fig. 104.

Glomospira gordialis (Jones and Parker)

Plate 1, figures 22, 23

Glomospira gordialis (Jones and Parker). Cushman and McCulloch, 1939, Allan Hancock Pacific Exped., v. 6, no. 1, p. 70, pl. 5, figs. 5, 6.

Family LITUOLIDAE

Genus **Haplophragmoides** Cushman, 1910

Haplophragmoides canariense (d'Orbigny)

Plate 1, figure 27

Nonionina canariensis d'Orbigny, 1839 (*in* Barker-

WEBB and BERTHELOT), Histoire naturelle des Îles Canaries, v. 2, pt. 2, Foraminifères, p. 128, pl. 2, figs. 33, 34.

Haplophragmoides hancocki Cushman and McCulloch

Plate 2, figure 1

Haplophragmoides hancocki CUSHMAN and MCCULLOCH, 1939, Allan Hancock Pacific Exped., v. 6, no. 1, p. 79, pl. 6, figs. 5, 6.

This species was described from along the Pacific coasts of North and South America.

Haplophragmoides manilaense Andersen

Plate 1, figures 24-26

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

This species was described from brackish water environments of the Louisiana coast.

Haplophragmoides wilberti Andersen

Plate 1, figures 28, 29

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

This species was also described from brackish water environments of the Louisiana coast.

Haplophragmoides bonplandi Todd and Bronnimann, n. sp.

Plate 2, figure 2

Test rather small as compared with most species of the genus, compressed, periphery indented, particularly over the latter part of the test, umbilicus small and deep. Chambers few, inflated, 6 or 7 comprising a whorl, rapidly increasing in size and inflation as growth proceeds. Sutures straight, radial, deeply incised. Wall coarsely arenaceous but smoothly finished. Aperture a very low, elongate opening with a very slightly projecting rim formed by the base of the final chamber. Diameter 0.30-0.35 mm., thickness 0.15-0.18 mm.

Holotype (Cushman Coll. No. 64612) from the tidal zone, mangrove swamp at Four Roads, west of Port-of-Spain, northwest coast of Trinidad, B. W. I.

This species differs from *Haplophragmoides canariense* (d'Orbigny) in its relatively thicker test and inflated chambers rapidly increasing in size.

Genus **Alveolophragmium** Stschedrina, 1936

As pointed out by Loeblich and Tappan (1953, p. 28-29), this generic name replaces *Labrospira* Höglund, 1947, for those species that differ from *Haplophragmoides* in having an interio-areal aperture.

Alveolophragmium salsum (Cushman and Bronnimann)

Plate 2, figure 3

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

Genus **Ammoastuta** Cushman and Bronnimann, 1948

Ammoastuta inepta (Cushman and McCulloch)

Ammobaculites ineptus CUSHMAN and MCCULLOCH, 1939, Allan Hancock Pacific Exped., v. 6, no. 1, p. 89, pl. 7, fig. 6.

Ammoastuta salsa CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 17, pt. 3, p. 17, pl. 3, figs. 14-16.

This species has been reported from numerous widely separated localities: Trinidad, Panama, Ecuador, southwest Texas, Mississippi Sound, Long Island Sound, and Pleistocene deposits at Boston. Although occurring in marine deposits, the species probably originates in adjacent marshy or brackish habitats.

Genus **Ammobaculites** Cushman, 1910

Ammobaculites dilatatus Cushman and Bronnimann

Plate 2, figures 4, 5

Ammobaculites dilatatus CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 39, pl. 7, figs. 10, 11.

Ammobaculites directus Cushman and Bronnimann

Plate 2, figure 6

Ammobaculites directus CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 38, pl. 7, figs. 3, 4.

Ammobaculites diversus Cushman and Bronnimann

Ammobaculites diversus CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 38, pl. 7, figs. 5, 6.

Ammobaculites exiguus Cushman and Bronnimann

Plate 2, figure 7

Ammobaculites exiguus CUSHMAN AND BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 38, pl. 7, figs. 7, 8.

Ammobaculites exilis Cushman and Bronnimann

Ammobaculites exilis CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 39, pl. 7, fig. 9.

Ammobaculites pseudocassis Cushman and Bronnimann

Ammobaculites pseudocassis CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 39, pl. 7, fig. 12.

Ammobaculites salsus Cushman and Bronnimann

Plate 2, figure 8

Ammobaculites salsus CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 16, pl. 3, figs. 7-9.

Ammobaculites salsus var. **distinctus** Cushman and Bronnimann

Ammobaculites salsus var. *distinctus* CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 40, pl. 7, figs. 13, 14.

Ammobaculites salsus Cushman and Bronnimann variants

Plate 2, figures 9, 10

Such forms as the two illustrated appear to be related to *A. salsus* but are found more frequently in the nearshore and offshore zones.

Ammobaculites sp. A

Plate 2, figure 11

A small, compressed species with a close-coiled initial portion and wall composed of relatively large angular fragments, occurs in the nearshore zone.

Genus **Haplophragmium** Reuss, 1860

Haplophragmium salsum Cushman and Bronnimann

Plate 2, figure 12

Haplophragmium salsum CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 16, pl. 3, figs. 10-13.

Family TEXTULARIIDAE

Genus **Textularia** Defrance, 1824

Textularia agglutinans d'Orbigny

Plate 2, figure 13

Textularia agglutinans D'ORBIGNY, 1839 (*in* DE LA SAGRA), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 144, pl. 1, figs. 17, 18, 32-34.

Textularia candeiana d'Orbigny

Plate 2, figure 14

Textularia candeiana D'ORBIGNY, 1839 (*in* DE LA SAGRA), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 143, pl. 1, figs. 25-27.

Textularia cf. **T. earlandi** Parker

Plate 2, figure 22

Textularia elegans LACROIX, 1932 (not *Plecanium elegans* HANTKEN, 1868), Inst. Oceanographique Monaco, Bull. 591, p. 8, text figs. 4-6.

Textularia tenuissima EARLAND, 1933 (not *T. tenuissima* HÄUSLER, 1881), *Discovery* Repts., v. 7, p. 95, pl. 3, figs. 21-30.

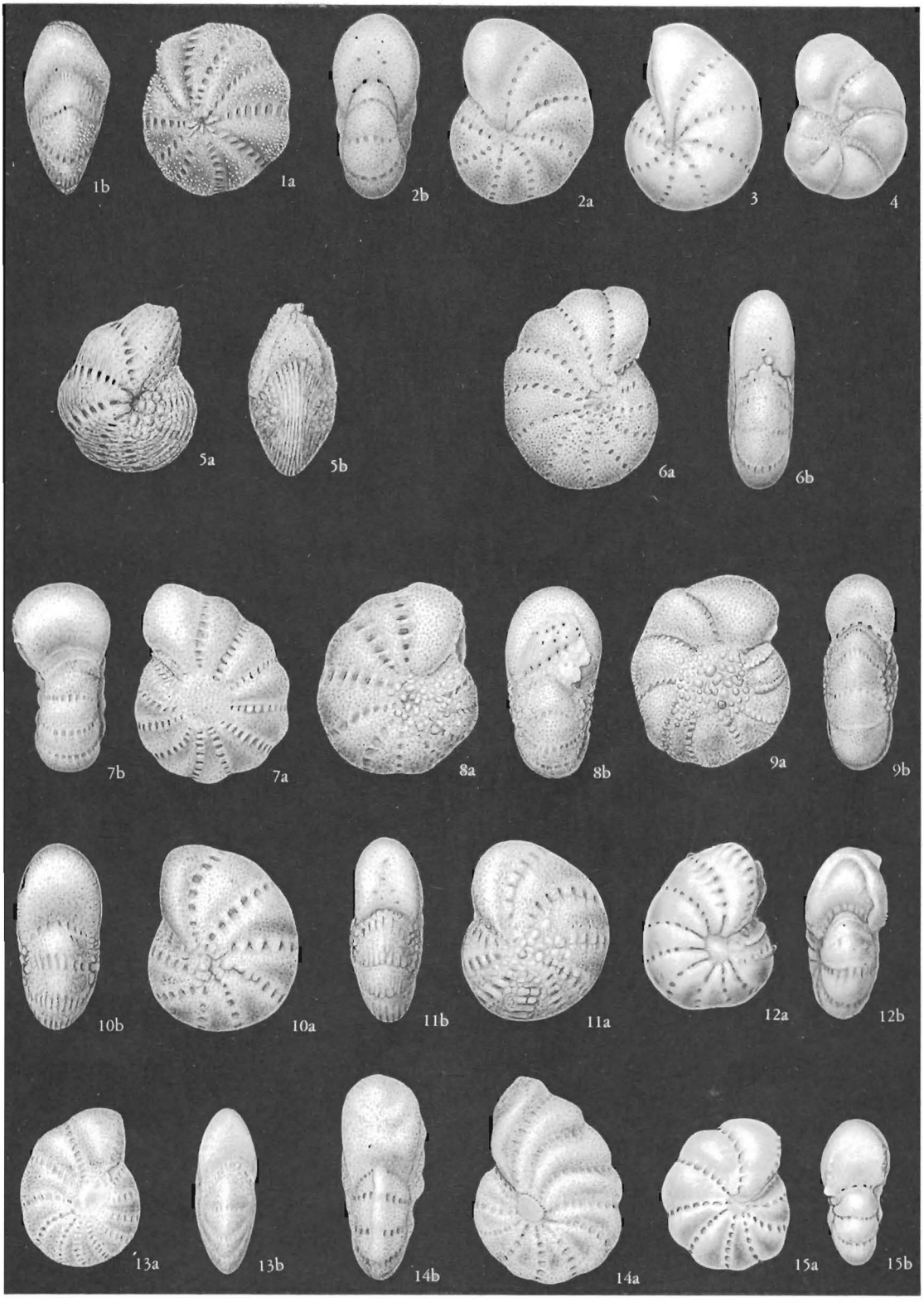
Textularia earlandi PARKER, 1952, Mus. Comp. Zoology Bull., v. 106, no. 10, p. 458 (footnote).—PHLEGER, 1952, Cushman Found. Foram. Research Contr., v. 3, pt. 2, p. 86, pl. 13, figs. 22, 23.—PARKER, 1954,

---

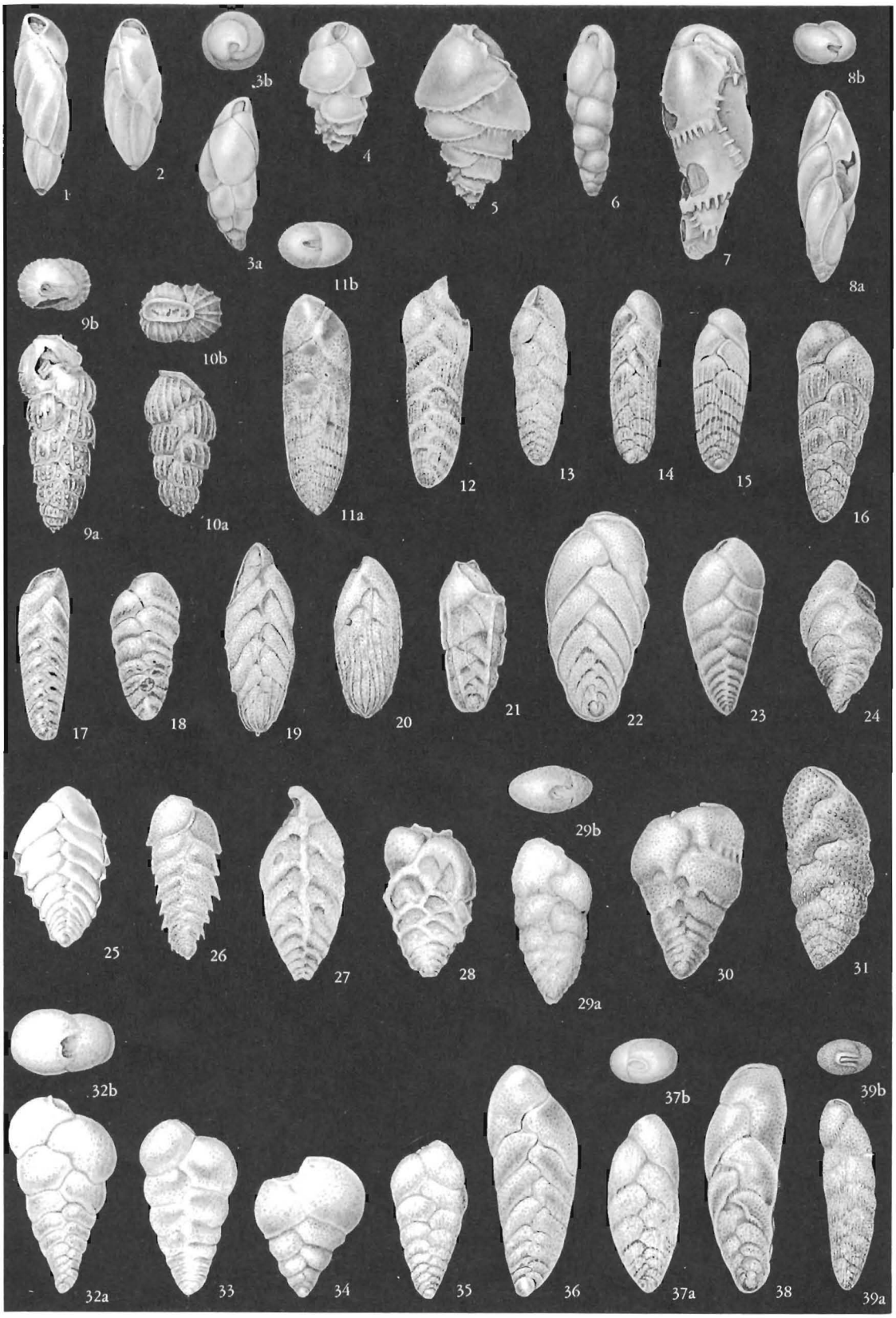
EXPLANATION OF PLATE 7

FORAMINIFERA (ELPHIDIIDAE)

[*a*, Side views; *b*, peripheral views]



Todd and Bronnimann: Gulf of Paria, Trinidad



Todd and Bronnimann: Gulf of Paria, Trinidad

EXPLANATION OF PLATE 8

FORAMINIFERA (BULIMINIDAE)

[*a*, Side views; *b*, apertural views]

FIGURE		PAGE
1, 2.	*Buliminella elegantissima* (d'Orbigny) 1, Cushman Coll. No. 64665, × 90; 2, Cushman Coll. No. 64666, × 125. Nearshore zone.	32
3.	*Buliminella subfusiformis* Cushman Cushman Coll. No. 64667, × 75. Nearshore zone.	32
4, 5.	*Bulimina marginata* d'Orbigny 4, Cushman Coll. No. 64825; 5, Cushman Coll. No. 64826. × 90. Offshore zone.	32
6.	*Bulimina* sp. A Cushman Coll. No. 64668, × 90. Nearshore zone.	33
7.	*Virgulina (Virgulinella) pertusa* Reuss Cushman Coll. No. 64827, × 75. Offshore zone.	33
8.	*Virgulina punctata* d'Orbigny Cushman Coll. No. 64828, × 75. Offshore zone.	33
9, 10.	*Bolivina pulchella* (d'Orbigny) var. *primitiva* Cushman 9, Cushman Coll. No. 64833, Offshore zone; 10, Cushman Coll. No. 64676, Nearshore zone. × 90.	34
11.	*Bolivina pseudopunctata* Höglund Cushman Coll. No. 64832, × 90. Offshore zone.	33
12-16.	*Bolivina striatula* Cushman 12, Cushman Coll. No. 64677, × 125. Nearshore zone. 13, Cushman Coll. No. 64678, × 75. Nearshore zone. 14, Cushman Coll. No. 64679, × 90. Nearshore zone. 15, Cushman Coll. No. 64836, × 75. Offshore zone. 16, Cushman Coll. No. 64680, × 75. Nearshore zone.	34
17.	*Bolivina hastata* Phleger and Parker Cushman Coll. No. 64670, × 90. Nearshore zone.	33
18.	*Bolivina lowmani* Phleger and Parker Cushman Coll. No. 64831, × 150. Offshore zone.	33
19, 20.	*Bolivina subaenariensis* Cushman 19, Cushman Coll. No. 64681; 20, Cushman Coll. No. 64682. × 75. Nearshore zone.	34
21.	*Bolivina tongi* Cushman Cushman Coll. No. 64684, × 90. Nearshore zone.	34
22, 23.	*Bolivina spathulata* (Williamson) 22, Cushman Coll. No. 64834; 23, Cushman Coll. No. 64835. × 90. Offshore zone.	34
24.	*Bolivina tortuosa* Brady Cushman Coll. No. 64685, × 90. Nearshore zone.	34
25.	*Bolivina barbata* Phleger and Parker Cushman Coll. No. 64829, × 105. Offshore zone.	33
26.	*Bolivina* cf. *B. difformis* (Williamson) Cushman Coll. No. 64830, × 75. Offshore zone.	33
27.	*Bolivina goësii* Cushman Cushman Coll. No. 64669, × 75. Nearshore zone.	33
28.	*Bolivina pseudoplicata* Heron-Allen and Earland Cushman Coll. No. 64675, × 125. Nearshore zone.	33
29.	*Bolivina subexcavata* Cushman and Wickenden Cushman Coll. No. 64683, × 90. Nearshore zone.	34
30.	*Bolivina plicatella* Cushman var. *mera* Cushman and Ponton Cushman Coll. No. 64674, × 125. Nearshore zone.	33
31.	*Bolivina variabilis* (Williamson) Cushman Coll. No. 64686, × 75. Nearshore zone.	35
32-34.	*Bolivina inflata* Heron-Allen and Earland 32, Cushman Coll. No. 64671; 33, Cushman Coll. No. 64672; 34, Cushman Coll. No. 64673. × 125. Nearshore zone.	33
35, 36.	*Bolivina* sp. A 35, Cushman Coll. No. 64687, Nearshore zone; 36, Cushman Coll. No. 64837, Offshore zone. × 125.	35
37.	*Loxostomum hiwanneense* Howe Cushman Coll. No. 64688, × 90. Nearshore zone.	35
38.	*Loxostomum mayori* (Cushman) Cushman Coll. No. 64838, × 60. Offshore zone.	35
39.	*Loxostomum porrectum* (Brady) Cushman Coll. No. 64839, × 38. Offshore zone.	35

Mus. Comp. Zoology Bull., v. 111, no. 10, p. 490, pl. 2, fig. 12.

Specimens close to this species with a very slender test occur abundantly in the offshore zone. Records of *T. earlandi* are from the Mediterranean, Antarctic, Arctic, southern New England, and Gulf of Mexico.

Textularia gramen d'Orbigny

Plate 2, figures 15-18

Textularia gramen d'Orbigny, 1846, Foraminifères fossiles du bassin tertiaire de Vienne, p. 248, pl. 15, figs. 4-6.

Textularia mayori Cushman

Plate 2, figure 19

Textularia mayori Cushman, 1922, Carnegie Inst. Washington Pub. 311, p. 23, pl. 2, fig. 3.

Textularia sp. A

Plate 2, figure 20

A small species with thin, smoothly finished wall is found in the offshore zone.

Textularia sp. B

Plate 2, figure 21

This species uses coarser grains than *T.* sp. A in constructing its test and the surface is rough.

Genus **Bigenerina** d'Orbigny, 1826

Bigenerina nodosaria d'Orbigny

Plate 2, figure 23

Bigenerina nodosaria d'Orbigny, 1826, Annales sci nat., tome 7, p. 261, pl. 11, figs. 9-12; Modèles no. 57.

Family VERNEUILINIDAE

Genus **Gaudryina** d'Orbigny, 1839

Gaudryina exilis Cushman and Bronnimann

Plate 2, figures 24, 25

Gaudryina exilis Cushman and Bronnimann, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 40, pl. 7, figs. 15, 16.

Genus **Pseudoclavulina** Cushman, 1936

Pseudoclavulina curta Cushman and Bronnimann

Pseudoclavulina curta Cushman and Bronnimann, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 41, pl. 7, figs. 19, 20.

Pseudoclavulina gracilis Cushman and Bronnimann

Pseudoclavulina gracilis Cushman and Bronnimann, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 2, p. 40, pl. 7, figs. 17, 18.

Family VALVULINIDAE

Genus **Eggerella** Cushman, 1933

Eggerella humboldti Todd and Bronnimann, n. sp.

Plate 2, figure 26

Test short, appearing to be a loose agglomeration of spherical chambers. Chambers few, very rapidly increasing in size, last three comprising most of the test, strongly inflated, nearly globular. Sutures consisting of deep incisions between the chambers. Wall coarsely arenaceous and rather roughly finished, usually orange-colored over the initial chambers. Aperture a narrow fissure-like opening at the bottom of the suture between the final chamber and the second from the last chamber. Length about 0.27 mm., breadth about 0.20 mm.

Holotype (Cushman Coll. No. 64641) from the nearshore zone (0-2 fms.), eastern Gulf of Paria, Trinidad, B. W. I.

This species differs from *Eggerella scabra* (Williamson) in its short, compact shape and fewer and more globular chambers.

Family SILICINIDAE

Genus **Miliammina** Heron-Allen and Earland, 1930

Miliammina fusca (Brady)

Plate 3, figure 1

Quinqueloculina fusca Brady, 1870, Annals and Mag. Nat. History, ser. 4, v. 6, p. 47, pl. 11, figs. 2, 3.

Miliammina fusca (Brady). Phleger and Walton, 1950, Am. Jour. Sci., v. 248, p. 280, pl. 1, fig. 19.

Miliammina pariaensis Todd and Bronnimann, n. sp.

Plate 3, figure 2

Test broadly oval and compressed, periphery rounded. Chamber arrangement changing from quinqueloculine to spiroloculine as growth proceeds, chambers much embracing so that the final two comprise most of the surface of the test, strongly curved at both ends. Sutures depressed but indistinct. Wall agglutinated, apparently of chitin with very fine-grained non-calcareous fragments, gray to orange in color, surface very smooth and polished. Aperture a very wide but low arched opening at the end of the final chamber, not projecting and without rim or tooth. Length 0.35-0.48 mm., breadth 0.28-0.35 mm., thickness about 0.15 mm.

Holotype (Cushman Coll. No. 64625) from the tidal zone, mangrove swamp between St. Mary's and California, west coast of Trinidad, B. W. I.

This species differs from *Miliammina fusca* (Brady) with which it occurs, in its compressed oval test and smooth, fine-grained wall lacking individual fragments of the size present in *M. fusca*.

Genus **Spirolocammina** Earland, 1934

Spirolocammina sp. A

Plate 3, figure 3

Very rare specimens of a planispirally coiled species, giving no reaction in acid and hence non-calcareous like *Miliammina*, were found in the offshore zone.

Family MILIOLIDAE

Genus **Quinqueloculina** d'Orbigny, 1826

Quinqueloculina agglutinans d'Orbigny

Plate 3, figure 4

Quinqueloculina agglutinans d'Orbigny, 1839 (*in* de la Sagra), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 195, pl. 12, figs. 11-13.

Quinqueloculina cultrata (Brady)

Plate 3, figure 14

Miliolina cultrata Brady, 1884, *Challenger* Rept., Zoology, v. 9, p. 161, pl. 5, figs. 1, 2.

Quinqueloculina lamarckiana d'Orbigny

Plate 3, figure 12

Quinqueloculina lamarckiana d'Orbigny, 1839 (*in* de la Sagra), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 189, pl. 11, figs. 14, 15.

Quinqueloculina poeyana d'Orbigny

Plate 3, figure 6

Quinqueloculina poeyana d'Orbigny, 1839 (*in* de la Sagra), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 191, pl. 11, figs. 25-27.

Quinqueloculina seminulum (Linné)

Plate 3, figures 9, 10

Quinqueloculina seminula (Linné). Cushman, 1929, Cushman Lab. Foram. Research Contr., v. 5, pt. 3, p. 59, pl. 9, figs. 16-18.

Quinqueloculina semireticulosa Cushman

Plate 3, figure 8

Quinqueloculina semireticulosa Cushman, 1932, U. S. Natl. Mus. Bull. 161, pt. 1, p. 27, pl. 7, fig. 2.

Quinqueloculina goësi Todd and Bronnimann, n. sp.

Plate 3, figure 11

Test small for the genus, triangular in section but with rounded angles, elongate, rounded at the base, apertural end slightly projecting. Chambers distinct, slender, quinqueloculine, not much embracing. Sutures depressed. Wall calcareous, smooth and polished, central portion of each chamber more white and opaque than the sides (i.e. close to the sutures), thus resulting in a faint longitudinal banding of light and dark parallel with the suture lines. Aperture circular, at the end of a short neck, without a tooth and without a lip. Length 0.30-0.40 mm., breadth 0.15-0.20 mm.

Holotype (Cushman Coll. No. 64645) from the nearshore zone (0-2 fms.), eastern Gulf of Paria, Trinidad, B. W. I.

This species differs from *Quinqueloculina seminulum* (Linné) in the light and dark longitudinal banding, in the projecting apertural neck, and in the less strongly embracing chambers and resulting greater depression of sutures.

Quinqueloculina sp. A

Plate 3, figure 7

The test of this species is agglutinated with the grains neatly fitted together, and the wall thin and rather smoothly finished. The test is soluble in acid, hence the agglutinated particles and probably also the cement are calcareous.

Quinqueloculina sp. B

Plate 3, figure 13

This species is quite smoothly triangular in section, the test translucent and smooth, and the aperture not protruding beyond the outline of the test.

Quinqueloculina sp. C

Plate 3, figure 5

This species has a thin, matte wall and the chambers are rounded in section and distinctly separated from one another.

Genus **Triloculina** d'Orbigny, 1826

Triloculina oblonga (Montagu)

Plate 3, figures 15, 16

Triloculina oblonga (Montagu). D'Orbigny, 1826, Annales sci. nat., tome 7, p. 300, Modèles no. 95; 1839 (*in* de la Sagra), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 175, pl. 10, figs. 3-5.

Triloculina tricarinata d'Orbigny

Plate 3, figure 17

Triloculina tricarinata d'Orbigny, 1826, Annales sci. nat., tome 7, p. 299, Modèles no. 94.

Triloculina trigonula (Lamarck)

Plate 3, figures 18, 19

Triloculina trigonula (Lamarck). D'Orbigny, 1826, Annales sci. nat., tome 7, p. 299, pl. 16, figs. 5-9, Modèles no. 93.

Triloculina sp. A

Plate 3, figure 20

This species may be the triloculine counterpart of *Quinqueloculina* sp. C.

Genus **Miliolinella** Wiesner, 1931

Miliolinella labiosa (d'Orbigny)

Plate 3, figures 21, 22

Triloculina labiosa d'Orbigny, 1839 (*in* de la Sagra), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminiferes, p. 178, pl. 10, figs. 12-14.

Miliolinella sp. A

Plate 3, figures 23, 24

This species differs from *M. labiosa* in being slender and compact and has a very low and hood-like aperture. The smooth wall is translucent in most specimens and the sutures are flush and hence indistinct.

Genus **Spiroloculina** d'Orbigny, 1826

Spiroloculina anderseni Todd and Bronnimann, n. sp.

Plate 4, figures 10-12

Test small for the genus, compressed, umbilicus slightly depressed, basal end bluntly pointed, apertural end with projecting neck, periphery squarely truncate with sharp angles that may be slightly limbate. Chambers few, very rapidly increasing in size and thickness as added, curved, slightly larger at the basal end of each chamber than at the apertural end. Sutures distinct, slightly limbate, not depressed. Wall calcareous, thin, somewhat translucent in the inter-sutural areas. Aperture circular, at the end of a short and slender neck, surrounded by a slightly flaring rim, and with a short simple tooth. Length 0.37-0.50 mm., breadth 0.18-0.25 mm., thickness about 0.10 mm.

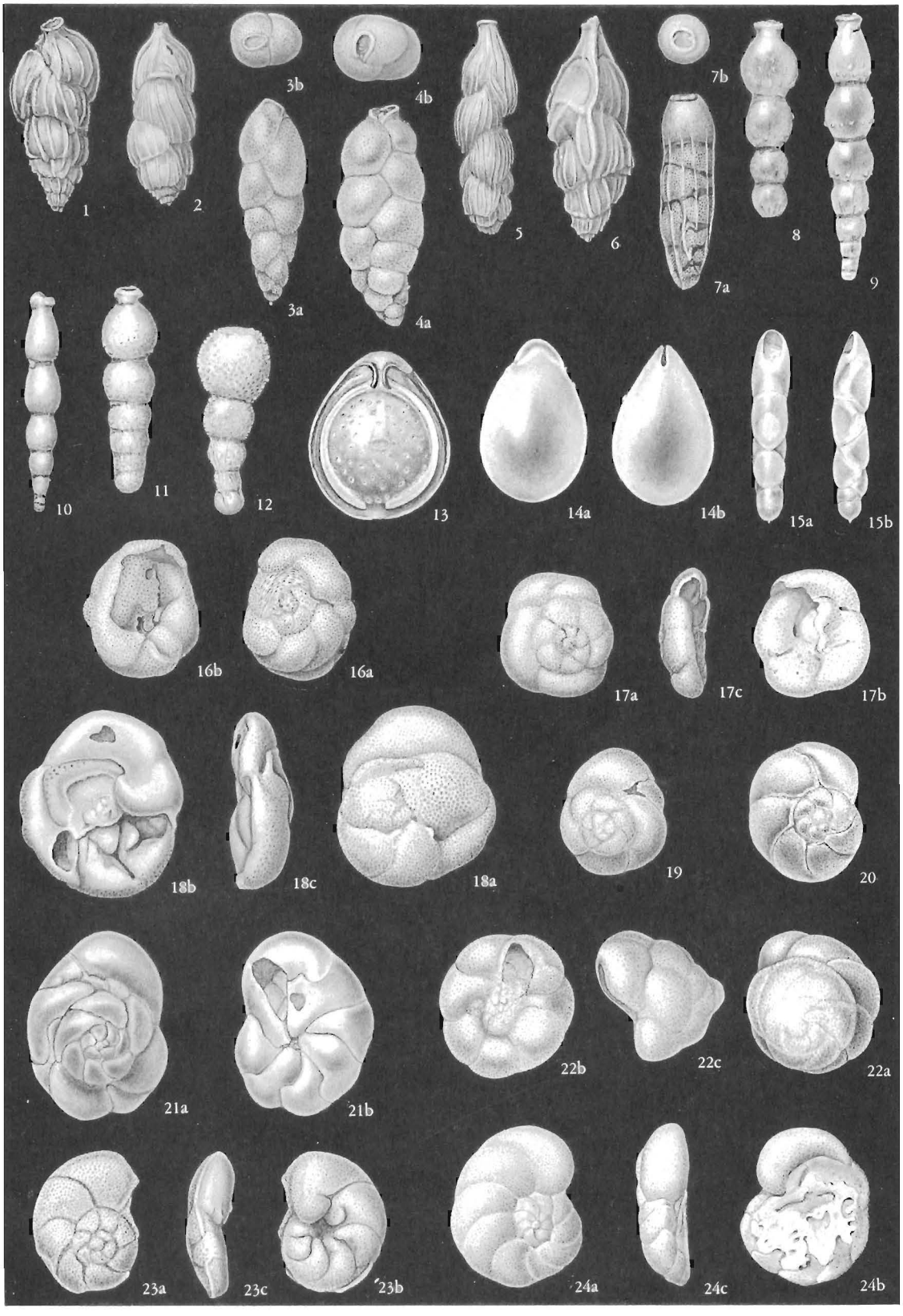
Holotype (Cushman Coll. No. 64791) from the offshore zone (2-18 fms.), eastern Gulf of Paria, Trinidad, B. W. I.

This species differs from *Spiroloculina eximia* Cushman in the squarely truncate periphery, less deeply depressed umbilicus, and somewhat translucent wall.

EXPLANATION OF PLATE 9

Foraminifera (Buliminidae, Ellipsoidinidae, and Discorbidae)

[*a*, Dorsal views; *b*, ventral views; *c*, peripheral views—except as indicated]



Todd and Bronnimann: Gulf of Paria, Trinidad

Todd and Bronnimann: Gulf of Paria, Trinidad

Spiroloculina dentata Cushman and Todd

Plate 4, figure 4

Spiroloculina dentata CUSHMAN and TODD, 1944, Cushman Lab. Foram. Research Special Pub. 11, p. 71, pl. 9, figs. 33, 34.

Spiroloculina eximia Cushman

Plate 4, figure 5

Spiroloculina eximia CUSHMAN, 1922, Carnegie Inst. Washington Pub. 311, p. 61, pl. 11, fig. 2.

Spiroloculina grata Terquem

Plate 4, figure 6

Spiroloculina grata TERQUEM, 1878, Soc. Géol. France Mém., ser. 3, v. 1, p. 55, pl. 5 (10), figs. 14, 15.

Spiroloculina guppyi Todd and Bronnimann, n. sp.

Plate 4, figures 1, 2

Test oval, compressed, periphery rounded, umbilicus open and depressed, basal end bluntly pointed, initial end bearing a projecting neck. Chambers distinct, rounded in section, rapidly increasing in size as added, each chamber increasing slightly in size from base to apertural end. Sutures distinctly incised. Wall calcareous, thin, translucent, surface slightly crinkled. Aperture circular with a slightly flaring lip and short simple tooth. Length about 0.50 mm., breadth about 0.25 mm., thickness about 0.10 mm.

Holotype (Cushman Coll. No. 64789) from the offshore zone (2-18 fms.), eastern Gulf of Paria, Trinidad, B. W. I.

This species differs from *Spiroloculina rugosa* Cushman and Todd, and especially from its variety *curvatura*, in having a much thinner and translucent wall, and in having a smaller, more compressed and more delicate test.

Genus **Sigmoilina** Schlumberger, 1887

Sigmoilina tenuis (Czjzek)

Plate 4, figure 3

Sigmoilina tenuis (CZJZEK). CUSHMAN, 1946, Cushman Lab. Foram. Research Contr., v. 22, pt. 2, p. 32, pl. 5, figs. 13-15.

Genus **Pyrgo** Defrance, 1824

Pyrgo nasutus Cushman

Plate 4, figure 13

Pyrgo nasutus CUSHMAN, 1935, Smithsonian Misc. Coll., v. 91, no. 21, p. 7, pl. 3, figs. 1-4.

Family OPHTHALMIDIIDAE

Genus **Cornuspira** Schultze, 1854

Cornuspira incerta (d'Orbigny)

Plate 4, figure 7

Operculina incerta D'ORBIGNY, 1839 (*in* DE LA SAGRA), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 49, pl. 6, figs. 16, 17.

D'Orbigny described this species from shore sands of Cuba and Martinique, stating the color to be yellow, the wall to be slightly translucent, and the size to be 0.1 mm. The original figure shows a speckled or mottled appearance, customarily used to denote an arenaceous test, but nothing in the description confirms its being arenaceous.

Heron-Allen and Earland (1932, p. 343), suspecting that the test was not agglutinated, examined d'Orbigny's specimens in Paris. They reported finding three specimens in one tube, all unmistakably fossil specimens of *Cornuspira*, two being *C. involvens* Reuss (one striated) and the third one a square-edged form suggesting *C. angigyra* Reuss. They, therefore, concluded that no true representatives of d'Orbigny's Recent Cuban species were still in existence.

Subsequently, but without reference to the earlier

EXPLANATION OF PLATE 10

FORAMINIFERA (ROTALIIDAE)

[*a*, Dorsal views; *b*, ventral views; *c*, peripheral views]

FIGURE		PAGE
1, 2.	*Streblus beccarii* (Linné) var. *sobrina* (Shupack) 1, Cushman Coll. No. 64711, Nearshore zone; 2, Cushman Coll. No. 64631, Tidal zone, Mangrove I. × 90.	38
3.	*Streblus beccarii* (Linné) variant Cushman Coll. No. 64717, × 90. Nearshore zone.	38
4.	*Streblus limnetes* Todd and Bronnimann, n. sp. Holotype, Cushman Coll. No. 64633, × 75. Tidal zone, Mangrove I.	38
5-11.	*Streblus beccarii* (Linné) var. *tepida* (Cushman) 5, Cushman Coll. No. 64712, × 90. Nearshore zone. 6, Cushman Coll. No. 64713, × 75. Nearshore zone. 7, Cushman Coll. No. 64714, × 90. Nearshore zone. 8, Cushman Coll. No. 64715, × 125. Nearshore zone. 9, Cushman Coll. No. 64632, × 125. Tidal zone, Mangrove I. 10, Cushman Coll. No. 64716, × 90. Nearshore zone. 11, Cushman Coll. No. 64846, × 90. Offshore zone.	38
12.	*Streblus pauciloculatus* (Phleger and Parker) Cushman Coll. No. 64847, × 125. Offshore zone.	38

observation of Heron-Allen and Earland, Loeblich and Tappan (1954, p. 308, text fig. 1) examined the three specimens in question, accepted them as syntypes of d'Orbigny's species from the Recent of Cuba, and designated one as lectotype and the other two as paratypes.

We prefer to reject, not the generic identification of the three specimens, but the identification of them as syntypes of d'Orbigny's Cuban species. Our reasons for this are the yellow color and small size mentioned in the original description as contrasted with the large size of the presumed syntypes. The diameter of the lectotype is nearly 14 times that of the original type. Further distinction seems to be shown by the rather large degree of involution of the presumed syntype as contrasted with the non-involute test of the minute species figured by d'Orbigny.

In the Gulf of Paria a few specimens, about 0.25 mm. in diameter, yellow in color, and having a thin wall with a matte surface, appear to belong in the species described by d'Orbigny. Petrographic examination of the test proves it to be not agglutinated.

Cornuspira planorbis Schultze

Plate 4, figure 8

Cornuspira planorbis SCHULTZE, 1854, Organismus Polythal., p. 40, pl. 2, fig. 21.

Genus **Ophthalmidium** Zwingli and Kübler, 1870

Ophthalmidium balkwilli Macfadyen

Plate 4, figure 9

Ophthalmidium carinatum BALKWILL and WRIGHT, 1885 (not KÜBLER and ZWINGLI, 1866), Royal Irish Acad. Trans., v. 28, Sci., p. 326, pl. 12, figs. 13-16.

Ophthalmidium balkwilli MACFADYEN, 1939, Royal Micros. Sci. Jour., ser. 3, v. 59, pt. 3, p. 166, text fig. 2.

This species was described and reported from Irish and English coasts.

Family TROCHAMMINIDAE

Genus **Trochammina** Parker and Jones, 1859

Trochammina advena Cushman

Plate 4, figure 16

Trochammina advena CUSHMAN, 1922, Carnegie Inst. Washington Pub. 311, p. 20, pl. 1, figs. 2-4.

Trochammina comprimata Cushman and Bronnimann

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

Trochammina laevigata Cushman and Bronnimann

Plate 4, figures 17, 18

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

Genus **Trochamminita** Cushman and Bronnimann, 1948

Trochamminita irregularis Cushman and Bronnimann

Plate 4, figures 19-22

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

Genus **Arenoparrella** Andersen, 1951

Arenoparrella mexicana (Kornfeld)

Plate 4, figures 23, 24

Trochammina inflata (MONTAGU) var. *mexicana* KORNFELD, 1931, Stanford Univ., Dept. Geology Contr., v. 1, no. 3, p. 86, pl. 13, fig. 5.

Genus **Nouria** Heron-Allen and Earland, 1914

Nouria polymorphinoides Heron-Allen and Earland

Plate 4, figure 14

Nouria polymorphinoides HERON-ALLEN and EARLAND, 1914, London Zool. Soc. Trans., v. 20, p. 376, pl. 37, figs. 1-15.

Nouria sp. A

Plate 4, figure 15

Specimens, differing from *N. polymorphinoides* in having a smaller and more compressed test with pointed initial end and in being composed of smaller arenaceous fragments, occur with it but are more abundant. The wall is very thin and easily broken. The species may be the same as an unnamed one reported from depths between 12 and 100 meters in the northeastern Gulf of Mexico (Parker, 1954, p. 504, pl. 5, fig. 20).

Family LAGENIDAE

Genus **Robulus** Montfort, 1808

Robulus cf. **R. cultratus** Montfort

Plate 5, figure 1

As is true of nearly all the species in the eastern Gulf of Paria, the specimens of *Robulus* are very minute (about 0.25 mm. in greatest dimension).

Genus Astacolus Montfort, 1808

Astacolus sp. A

Plate 5, figure 2

Rare specimens, ornamenred as in the illustration, occur in the offshore zone.

Genus **Dentalina** d'Orbigny, 1826

Dentalina? sp. A

Plate 5, figure 3

Rare fragmentary specimens, none showing the apertural end, may belong in *Dentalina*.

Genus **Nodosaria** Lamarck, 1812

Nodosaria catesbyi d'Orbigny

Plate 5, figure 4

Nodosaria catesbyi D'ORBIGNY, 1839 (*in* DE LA SAGRA), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 16, pl. 1, figs. 8-10.

Genus **Lagena** Walker and Jacob, 1798

Lagena chasteri Millett

Plate 5, figure 5

Lagena chasteri MILLETT, 1901, Royal Micros. Soc. Jour., p. 11, pl. 1, fig. 11.

Lagena clavata (d'Orbigny)

Plate 5, figure 9

Oolina clavata D'ORBIGNY, 1846, Foraminifères fossiles du bassin tertiaire de Vienne, p. 24, pl. 1, figs. 2, 3.

Lagena crenata Parker and Jones

Plate 5, figure 8

Lagena crenata PARKER and JONES, 1865, Philosophical Trans., p. 420, pl. 18, fig. 4.

Lagena elongata (Ehrenberg)

Lagena elongata (EHRENBERG). CUSHMAN and McCULLOCH, 1950, Allan Hancock Pacific Exped., v. 6, no. 6, p. 338, pl. 44, fig. 14.

Lagena filicosta Reuss

Plate 5, figure 11

Lagena filicosta REUSS, 1862, Akad. Wiss. Wien, Sitzungsber., v. 46, pt. 1, p. 328, pl. 4, figs. 50, 51.

Lagena gracilis Williamson

Plate 5, figure 10

Lagena gracilis WILLIAMSON, 1848, Annals and Mag. Nat. History, ser. 2, v. 1, p. 13, pl. 1, fig. 5.

Lagena hispidula Cushman

Plate 5, figures 6, 7

Lagena hispidula CUSHMAN, 1913, U. S. Natl. Mus. Bull. 71, pt. 3, p. 14, pl. 5, figs. 2, 3.

Lagena höglundi Todd and Bronnimann, n. sp.

Plate 5, figure 17

Test nearly spherical, slightly flattened at the base, slightly pointed at the top from which extends a long slender neck. Wall calcareous, thin, translucent, ornamented by about 15 very fine, sharp but low, widely spaced vertical costae over the lower third of the test, the basal ends of the costae extending downward as fine spines over the base of the test. Apertural neck long and slender from its base, ornamented throughout by a rather heavy spiral costa with widely spaced coils. Diameter 0.15-0.18 mm., height (exclusive of neck) 0.17-0.20 mm., maximum observed length of apertural neck 0.17 mm.

Holotype (Cushman Coll. No. 64807) from the offshore zone (2-18 fms.), eastern Gulf of Paria, Trinidad, B. W. I.

This species may be related to specimens commonly referred to *Lagena striata* (d'Orbigny) in the spiral costa around the apertural neck. It differs, however, in ornamentation of the body wall. In this feature it resembles specimens commonly referred to *L. perlucida* (Montagu). The present species is distinguishable from that species in its nearly spherical test which does not taper gradually into the apertural neck.

Lagena perlucida (Montagu)

Plate 5, figure 19

Lagena perlucida (MONTAGU). CUSHMAN AND McCULLOCH, 1950, Allan Hancock Pacific Exped., v. 6, no. 6, p. 342, pl. 46, figs. 1, 2.

Lagena semilineata Wright

Plate 5, figure 16

Lagena semilineata WRIGHT, 1886, Belfast Naturalists' Field Club Proc. 1884-5, app. 9, p. 320, pl. 26, fig. 7.

Lagena striata (d'Orbigny)

Plate 5, figures 12-15

Oolina striata D'ORBIGNY, 1839, Voyage dans l'Amérique méridionale, v. 5, pt. 5, Foraminifères, p. 21, pl. 5, fig. 12.

Lagena sp. A

Plate 5, figure 18

The single specimen figured seems distinct from any of the other species of *Lagena* found.

Genus **Rectoglandulina** Loeblich and Tappan, 1955

Rectoglandulina sp. A

Plate 5, figure 20

This generic name was recently proposed for some of the species formerly placed in the genus *Pseudoglandulina* Cushman (Loeblich and Tappan, 1955a, p. 1-4). A smooth walled, elongate oval form with indistinct sutures and slightly protruding radiate aperture but no internal tube, occurred in the offshore zone.

Family POLYMORPHINIDAE

Genus **Glandulina** d'Orbigny, 1826

Glandulina glans d'Orbigny

Plate 5, figure 21

Nodosaria (Glandulina) glans D'ORBIGNY, 1826, Annales sci. nat., tome 7, p. 252, Modèles no. 51.

Glandulina glans D'ORBIGNY. SELLI, 1947, Riv. italiana paleontologia, v. 53, p. 5, pl. 3, figs. 1-6.

Glandulina laevigata d'Orbigny

Plate 5, figure 23

Nodosaria (Glandulina) laevigata D'ORBIGNY, 1826, Annales sci. nat., tome 7, p. 252, pl. 10, figs. 1-3.

Glandulina? spinata Cushman

Plate 5, figure 22

Glandulina spinata CUSHMAN, 1935, Smithsonian Misc. Coll., v. 91, no. 21, p. 8, pl. 3, figs. 8, 9.

The generic assignment of this species is questioned because of the aperture being uvigerine instead of radiate. The species was described from northwest of Puerto Rico in 17 fathoms. Typical specimens are found in the offshore zone.

Genus **Laryngosigma** Loeblich and Tappan, 1953

Laryngosigma williamsoni (Terquem)

Plate 5, figure 24

Laryngosigma williamsoni (TERQUEM). LOEBLICH and TAPPAN, 1953, Smithsonian Misc. Coll., v. 121, no. 7, p. 84, pl. 16, fig. 1.

Family NONIONIDAE

Genus **Nonion** Montfort, 1808

Nonion boueanum (d'Orbigny)

Plate 5, figures 25, 26

Nonion boueanum (D'ORBIGNY). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 12, pl. 3, figs. 7, 8.

Nonion grateloupi (d'Orbigny)

Plate 5, figures 27, 28

Nonion grateloupi (D'ORBIGNY). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 21, pl. 6, figs. 1-7.

Nonion sp. A

Plate 5, figure 29

A stout, compact species with chambers very rapidly increasing in thickness occurs in the nearshore and offshore zones.

Genus **Nonionella** Cushman, 1926

Nonionella atlantica Cushman

Plate 5, figures 30, 31

Nonionella atlantica CUSHMAN, 1947, Cushman Lab. Foram. Research Contr., v. 23, pt. 4, p. 90, pl. 20, figs. 4, 5.

Nonionella auricula Heron-Allen and Earland

Plate 5, figure 32

Nonionella auricula HERON-ALLEN and EARLAND, 1930, Royal Micros. Soc. Jour., v. 50, p. 192, pl. 5, figs. 68-70.

Nonionella opima Cushman

Plate 6, figures 1, 2

Nonionella opima CUSHMAN, 1947, Cushman Lab. Foram. Research Contr., v. 23, pt. 4, p. 90, pl. 20, figs. 1-3.

Nonionella turgida (Williamson)

Plate 6, figures 3, 4

Nonionella turgida (WILLIAMSON). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 32, pl. 9, figs. 2, 3.

Nonionella sp. A

Plate 5, figure 33

Rare specimens of a compressed species suggest a slight degree of evolution on one side and are therefore placed in this genus although they show no ventral lobe.

Family BULIMINIDAE

Genus **Buliminella** Cushman, 1911

Buliminella elegantissima (d'Orbigny)

Plate 8, figures 1, 2

Bulimina elegantissima D'ORBIGNY, 1839, Voyage dans l'Amérique méridionale, v. 5, pt. 5, Foraminifères, p. 51, pl. 7, figs. 13, 14.

Buliminella subfusiformis Cushman

Plate 8, figure 3

Buliminella subfusiformis CUSHMAN, 1925, Cushman Lab. Foram. Research Contr., v. 1, pt. 2, p. 33, pl. 5, fig. 12.

Genus **Bulimina** d'Orbigny, 1826

Bulimina marginata d'Orbigny

Plate 8, figures 4, 5

Bulimina marginata D'ORBIGNY, 1826, Annales sci. nat., tome 7, p. 269, pl. 12, figs. 10-12.

Bulimina sp. A

Plate 8, figure 6

Rare specimens of a slender elongate species with a rather large aperture occur in the nearshore zone.

Genus **Virgulina** d'Orbigny, 1826

Virgulina (Virgulinella) pertusa Reuss

Plate 8, figure 7

Virgulina pertusa Reuss, 1860, Akad. Wiss. Wien, Sitzungsber., v. 42, p. 362, pl. 2, fig. 16.—Ruscelli, 1952, Riv. italiana paleontologia e stratigrafia, v. 58, no. 2, p. 46, pl. 2, fig. 11.

Virgulina (Virgulinella) pertusa Reuss. Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 31, pl. 5, figs. 6-9.—Bramlette (*in* Woodring and Bramlette), 1950 (1951), U. S. Geol. Survey Prof. Paper 222, p. 58, pl. 22, fig. 6.—Marks, 1952, Geologie en Mijnbouw, n. ser., no. 8, p. 6, pl. 1, figs. 15, 16.

Virgulinella pertusa (Reuss). Ten Dam and Reinhold, 1942, Meded. Geol. Stichting, ser. C-V, no. 2, p. 82, pl. 5, fig. 10.

This species was described from the Miocene of Germany and Pliocene of Belgium and has been recorded from the Miocene of Italy, Egypt, Algeria, and the Netherlands, and the Miocene and Pliocene of California. Two very similar (or possibly identical) species, *V. gunteri* Cushman and Ponton and *V. miocenica* Cushman and Ponton, were described and recorded from the Miocene of the southeastern United States (Florida, Maryland, Louisiana).

Because of the presence of sutural bridges, these three species are set apart from *Virgulina s.s.* as the subgenus *Virgulinella*. This appears to be the first record of this subgenus in the Recent. They are found fairly abundantly in the offshore zone and are nearly transparent and exceedingly fragile.

Through the courtesy of Miss Dora Gutierrez of San Marcos University, Lima, Peru, the senior author has seen Recent specimens of *Virgulinella* from two localities on the Pacific coast of Peru, as follows: 6 meters, near San Lorenzo Island, Callao; and 12 meters, Pucusana, south part of Lima. This subgenus may be looked for in additional Recent collections.

Virgulina punctata d'Orbigny

Plate 8, figure 8

Virgulina punctata d'Orbigny, 1839, (*in* de la Sagra), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 139, pl. 1, figs. 35, 36.

Genus **Bolivina** d'Orbigny, 1839

Bolivina barbata Phleger and Parker

Plate 8, figure 25

Bolivina barbata Phleger and Parker, 1951, Geol. Soc. America Mem. 46, pt. 2, p. 13, pl. 6, figs. 12, 13.

Bolivina cf. **B. difformis** (Williamson)

Plate 8, figure 26

Bolivina difformis (Williamson). Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 164, pl. 15, figs. 13-17.

Bolivina goësii Cushman

Plate 8, figure 27

Bolivina goësii Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 154, pl. 18, fig. 25.

Bolivina hastata Phleger and Parker

Plate 8, figure 17

Bolivina hastata Phleger and Parker, 1951, Geol. Soc. America Mem. 46, pt. 2, p. 13, pl. 6, figs. 18, 19.

Bolivina inflata Heron-Allen and Earland

Plate 8, figures 32-34

Bolivina inflata Heron-Allen and Earland, 1913, Royal Irish Acad. Proc., v. 31, pt. 64, p. 68, pl. 4, figs. 16-19.

Bolivina lowmani Phleger and Parker

Plate 8, figure 18

Bolivina lowmani Phleger and Parker, 1951, Geol. Soc. America Mem. 46, pt. 2, p. 13, pl. 6, figs. 20, 21.

Bolivina plicatella Cushman var. **mera** Cushman and Ponton

Plate 8, figure 30

Bolivina plicatella Cushman var. *mera* Cushman and Ponton, 1932, Florida Geol. Survey Bull. 9, p. 82, pl. 12, fig. 4.

Bolivina pseudoplicata Heron-Allen and Earland

Plate 8, figure 28

Bolivina pseudoplicata Heron-Allen and Earland, 1930, Royal Micros. Soc. Jour., v. 50, p. 81, pl. 3, figs. 36-40.

Bolivina pseudopunctata Höglund

Plate 8, figure 11

Bolivina pseudopunctata Höglund, 1947, Zool. Bidrag Uppsala, v. 26, p. 273, pl. 24, fig. 5; pl. 32, figs. 23, 24; text figs. 280, 281, 287.

Bolivina pulchella (d'Orbigny) var. **primitiva** Cushman

Plate 8, figures 9, 10

Bolivina pulchella (d'Orbigny) var. *primitiva* Cushman, 1930, Florida Geol. Survey Bull. 4, p. 47, pl. 8, fig. 12.

The typical form of this species is found in Recent West Indian material. This variety, described from the Miocene of Florida, is distinguished in having the initial triserial stage making up a larger proportion of the test than it does in the typical form. The Gulf of Paria specimens appear to belong to the variety, as do also other Recent specimens previously recorded from the Gulf of Mexico, Mississippi Sound, and the Texas coast.

Bolivina spathulata (Williamson)

Plate 8, figures 22, 23

Bolivina spathulata (Williamson). Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 162, pl. 15, figs. 20-24.

Bolivina striatula Cushman

Plate 8, figures 12-16

Bolivina striatula Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 154, pl. 18, figs. 30, 31.

Bolivina subaenariensis Cushman

Plate 8, figures 19, 20

Bolivina subaenariensis Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 155, pl. 18, figs. 26-28.

Bolivina subexcavata Cushman and Wickenden

Plate 8, figure 29

Bolivina subexcavata Cushman and Wickenden. Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 138, pl. 18, fig. 33.

Bolivina tongi Cushman

Plate 8, figure 21

Bolivina tongi Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 92, pl. 12, figs. 7, 8.

Although *Bolivina tongi* apparently has not previously been recorded from Recent sediments, specimens in the nearshore zone seem to belong in this species which is known from numerous localities in the area from Mexico and the Gulf Coast to the West Indies and Venezuela, in strata of Oligocene to Pliocene age.

Bolivina tortuosa Brady

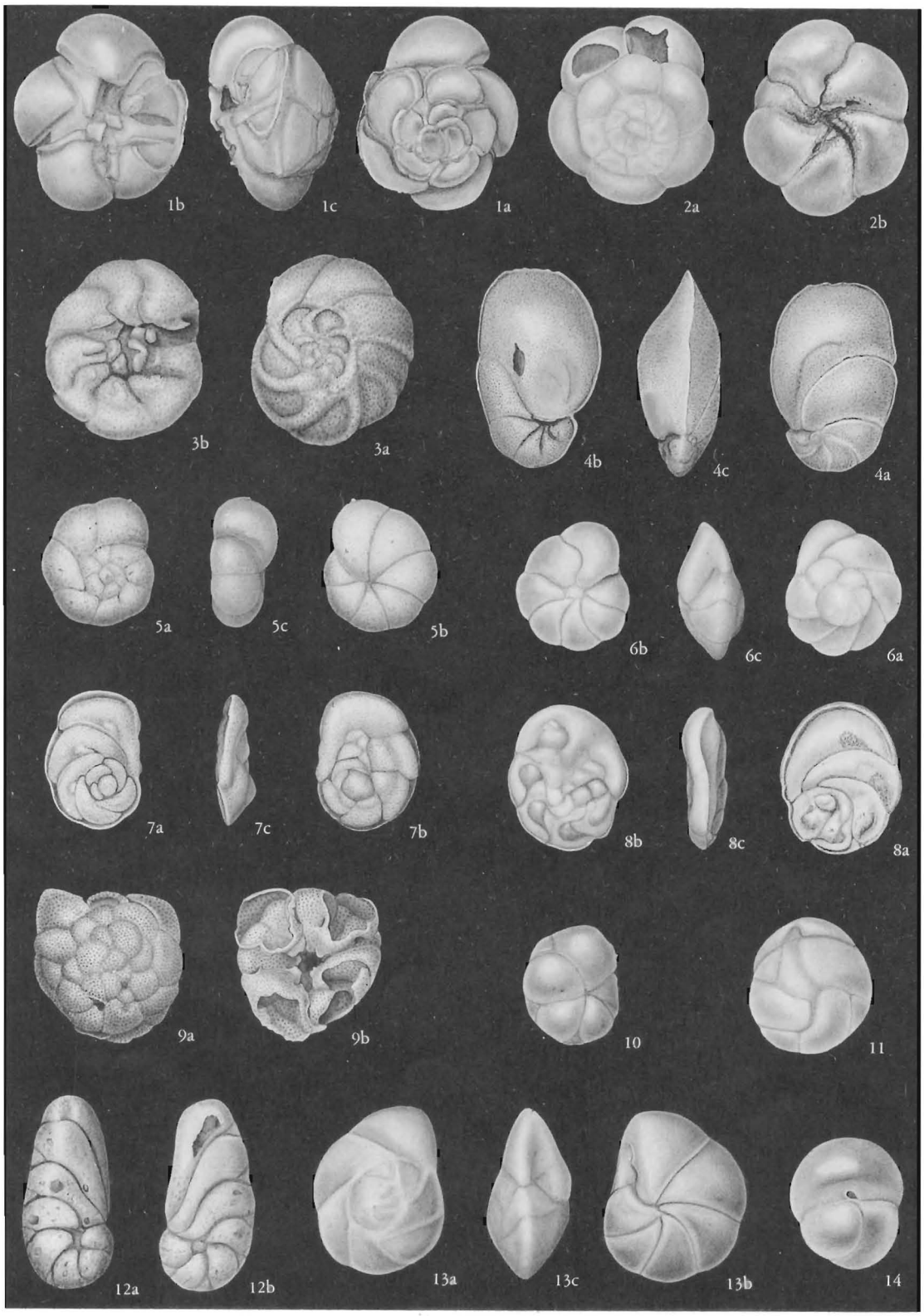
Plate 8, figure 24

Bolivina tortuosa Brady, 1884, *Challenger* Rept., Zoology, v. 9, p. 420, pl. 52, figs. 31-34.

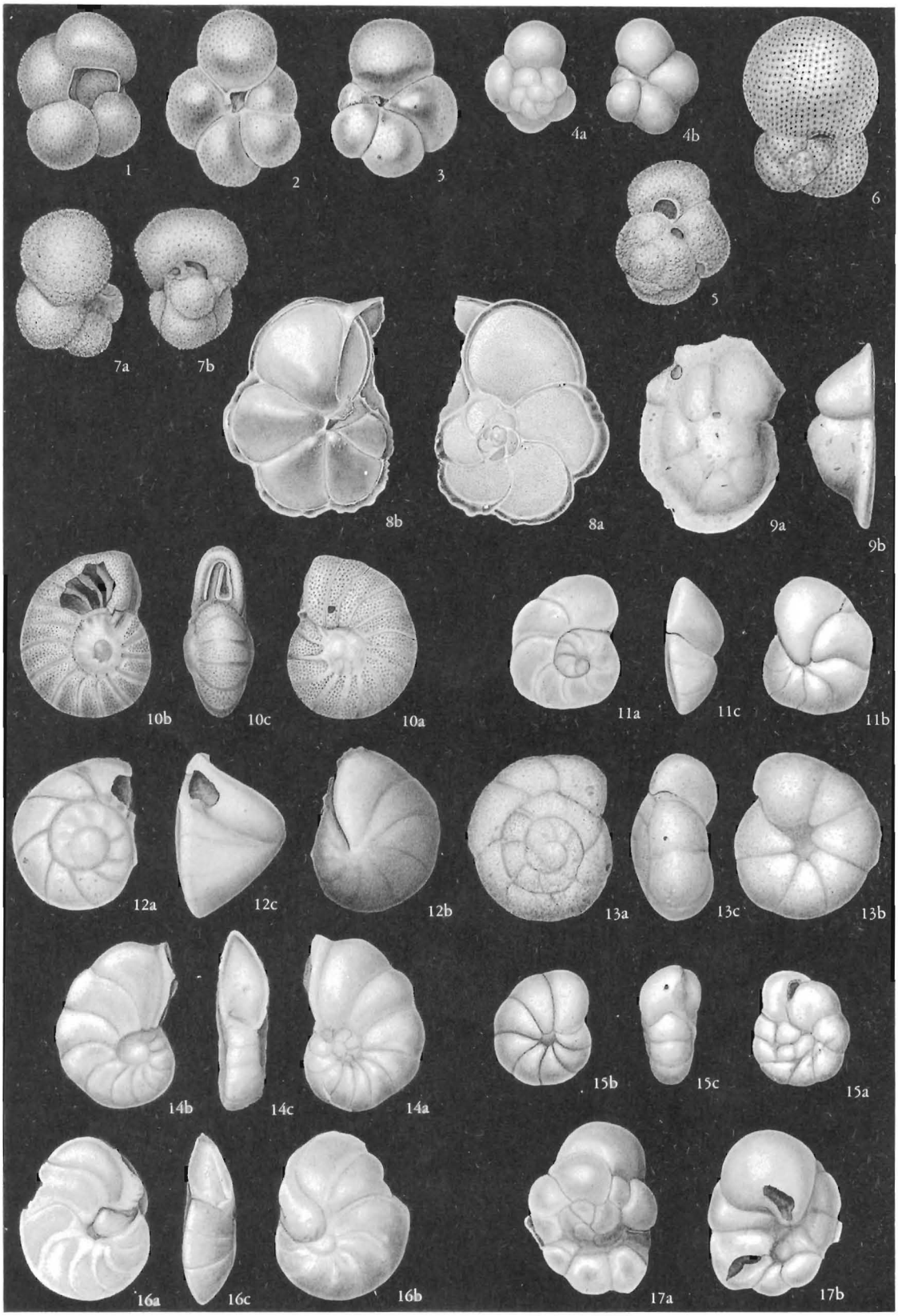
EXPLANATION OF PLATE 11

Foraminifera (Rotaliidae, Discorbidae, Cymbaloporidae, Cassidulinidae, and Chilostomellidae)

[*a*, Dorsal views; *b*, ventral views; *c*, peripheral views]



Todd and Bronnimann: Gulf of Paria, Trinidad



Todd and Bronnimann: Gulf of Paria, Trinidad

Bolivina variabilis (Williamson)

Plate 8, figure 31

Bolivina variabilis (Williamson). Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 158, pl. 16, figs. 6, 12-14.

Bolivina sp. A

Plate 8, figures 35, 36

Rare specimens in the nearshore and offshore zones are translucent, densely perforate, moderately compressed, and very faintly striated over the initial portion.

Genus **Loxostomum** Ehrenberg, 1854

Loxostomum hiwanneense Howe

Plate 8, figure 37

Loxostoma hiwanneense Howe, 1930, Jour. Paleontology, p. 329, pl. 27, fig. 7.

Rare specimens appear to be identical with this Oligocene species.

Loxostomum mayori (Cushman)

Plate 8, figure 38

Loxostoma mayori (Cushman). Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 195, pl. 22, figs. 16-21.

Loxostomum porrectum (Brady)

Plate 8, figure 39

Loxostoma porrectum (Brady). Cushman, 1937, Cushman Lab. Foram. Research Special Pub. 9, p. 190, pl. 22, figs. 7-10.

Genus **Uvigerina** d'Orbigny, 1826

Uvigerina peregrina var. **parvula** Cushman

Plate 9, figures 1, 2

Uvigerina peregrina var. *parvula* Cushman, 1923, U. S. Natl. Mus. Bull. 104, pt. 4, p. 168, pl. 42, fig. 11.

Genus **Hopkinsina** Howe and Wallace, 1933

Hopkinsina pacifica Cushman

Plate 9, figures 3, 4

Hopkinsina pacifica Cushman, 1933, Cushman Lab.

EXPLANATION OF PLATE 12

FORAMINIFERA (GLOBIGERINIDAE, GLOBOROTALIIDAE and ANOMALINIDAE)

[*a*, Dorsal views; *b*, ventral views; *c*, peripheral views]

Foram. Research Contr., v. 9, pt. 4, p. 86, pl. 8, fig. 16.

Hopkinsina pacifica var. *atlantica* CUSHMAN, 1944, Cushman Lab. Foram. Research Special Pub. 12, p. 30, pl. 4, fig. 1.

Hopkinsina pacifica atlantica CUSHMAN. PARKER, 1952, Mus. Comp. Zoology Bull., v. 106, no. 10, p. 451, pl. 4, figs. 14-16.

This species has been reported from shallow water in widely separated localities as follows: Tonga Islands, Japan, and along the southern coast of New England (Vineyard Sound, Buzzards Bay, Narragansett Bay, Gardiners Bay, and Long Island Sound). We prefer not to regard what slight differences there may be between the Atlantic and Pacific specimens as worthy of subspecific rank.

Genus **Angulogerina** Cushman, 1927

Angulogerina occidentalis (Cushman)

Plate 9, figures 5, 6

Angulogerina occidentalis (CUSHMAN). TODD (*in* CUSHMAN and MCCULLOCH), 1948, Allan Hancock Pacific Exped., v. 6, no. 5, p. 291, pl. 36, fig. 4.

Genus **Siphogenerina** Schlumberger, 1883

Siphogenerina raphana (Parker and Jones)

Plate 9, figure 7

Uvigerina (*Sagrina*) *raphanus* PARKER and JONES, 1865, Philosophical Trans., p. 364, pl. 18, figs. 16, 17.

Genus **Siphonodosaria** Silvestri, 1924

Siphonodosaria matanzana (Palmer and Bermudez)

Plate 9, figure 10

Ellipsonodosaria? matanzana PALMER and BERMUDEZ, 1936, Soc. cubana hist. nat. Mem., v. 10, no. 5, p. 298, pl. 18, fig. 12.

Rare specimens in the nearshore zone seem to be identical with this species described from the Oligocene of Cuba.

Siphonodosaria recta (Palmer and Bermudez)

Plate 9, figures 8, 9

Ellipsonodosaria recta PALMER and BERMUDEZ, 1936, Soc. cubana hist. nat. Mem., v. 10, no. 5, p. 297, pl. 18, figs. 6, 7.

Siphonodosaria sp. A

Plate 9, figure 11

The single specimen figured may represent an undescribed species.

Siphonodosaria? sp. B

Plate 9, figure 12

Rare specimens appear to belong to an undescribed species with a coarsely hispid wall. The chambers increase rapidly in size and inflation as added. The apertural end is broken on all specimens.

Genus **Fissurina** Reuss, 1850

Fissurina agassizi Todd and Bronnimann, n. sp.

Plate 9, figure 14

Test small for the genus, inflated and circular in section in the lower part, the upper part bluntly pointed and compressed. Wall calcareous, finely perforate, smooth, nearly opaque. Aperture a long and narrow slit extending from one side of the pinched-together apertural end across the top and down the other side in the plane of compression. No internal tube could be observed. Diameter of circular portion 0.13 mm., length of test 0.18-0.22 mm.

Holotype (Cushman Coll. No. 64843) from the offshore zone (2-18 fms.), eastern Gulf of Paria, Trinidad, B. W. I.

This species is close to *Fissurina laevigata* Reuss but is a more globular form with the compression not extending below the middle of the test. In addition, the present species has a much longer aperture that extends downward on each side of the apertural end.

Fissurina flintii (Cushman)

Plate 9, figure 13

Lagena orbignyana (SEGUENZA) var. *flintii* CUSHMAN, 1922, U. S. Geol. Survey Prof. Paper 129-F, p. 129, pl. 29, fig. 11.

This species described from the Oligocene of Mississippi occurs in the offshore zone in typical form, with the central transparent part of the chamber wall marked by large and widely spaced perforations.

Family ELLIPSOIDINIDAE

Genus **Pleurostomella** Reuss, 1860

Pleurostomella sp. A

Plate 9, figure 15

Rare specimens of a slender species were found in the nearshore zone.

Family DISCORBIDAE

Genus **Rosalina** d'Orbigny, 1826

In this genus, as typified by its genotype *Rosalina globularis* d'Orbigny, are included many of the species formerly placed in *Discorbis*.

Rosalina floridana (Cushman)

Plate 9, figures 16-21

Discorbis floridana CUSHMAN, 1922, Carnegie Inst. Washington Pub. 311, p. 39, pl. 5, figs. 11, 12.

Rosalina sagrai Todd and Bronnimann, n. sp.

Plate 9, figure 22

Test minute for the genus, close-coiled and high-spired, test composed of about 3 whorls, umbilicus slightly depressed, periphery rounded, not lobulate. Chambers numerous, about 7 comprising the last whorl, slightly inflated ventrally. Sutures indistinct, flush, curved and strongly oblique on the dorsal side, slightly indented ventrally. Wall calcareous, distinctly perforate, smooth, wall of the last-formed chambers translucent. Aperture a very small arched opening under the ventral edge of the final chamber. Diameter about 0.15 mm., height 0.12-0.15 mm.

Holotype (Cushman Coll. No. 64704) from the near-shore zone (0-2 fms.), eastern Gulf of Paria, Trinidad, B. W. I.

This minute species is distinguishable by its high-spired test. It differs from *Eponides tumidulus* (Brady) in the chambers being less inflated and in lacking the brown color of the early part of the test. *"Discorbis" bulbosa* Parker is similar but has fewer chambers per whorl and a larger aperture.

Genus **Discorbis** Lamarck, 1804

The nature of this genus, as typified by its genotype *D. vesicularis* Lamarck, needs clarification. Pending further study, two species are tentatively placed here.

Discorbis? aguayoi Bermudez

Plate 9, figure 24

Discorbis aguayoi Bermudez, 1935, Soc. cubana hist. nat. Mem., v. 9, p. 204, pl. 15, figs. 10-14.

Discorinopsis vadescens Cushman and Bronnimann, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 20, pl. 4, figs. 9, 10.

Discorinopsis is an arenaceous genus (Loeblich and Tappan, 1953, p. 117) and hence not available for this calcareous species. The spongy mass of shell material on the ventral surface suggests a relationship to the genus *Trichohyalus* (Loeblich and Tappan, 1953, p. 116) but comparison of types seems to eliminate this possibility. We prefer to retain this species questionably in *Discorbis*.

Besides occurring in the mangrove swamps, the species also is known from off the north coast of Cuba and in marshy areas in the vicinity of San Antonio Bay, Texas.

Discorbis? sp. A

Plate 9, figure 23

The single specimen figured is densely perforate dorsally, but the ventral surface is of relatively smooth, clear shell material. The inner ends of the later ventral sutures are irregularly curved and there are supplementary openings under the inner ends of the chambers.

Genus **Cancris** Montfort, 1808

Cancris sagra (d'Orbigny)

Plate 11, figure 4

Rotalina sagra d'Orbigny, 1839 (*in* de la Sagra), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 77, pl. 5, figs. 13-15.

Genus **Gyroidina** d'Orbigny, 1826

Gyroidina sp. A

Plate 11, figure 5

A minute species, as illustrated, occurs fairly commonly in the offshore zone.

Genus **Eponides** Montfort, 1808

Eponides? sp. A

Plate 11, figure 6

This minute rotaliform species has insufficient material to permit complete identification.

Genus **Heronallenia** Chapman and Parr, 1931

Heronallenia lingulata (Burrows and Holland)

Plate 11, figures 7, 8

Discorbina lingulata Burrows and Holland, 1896, (*in* Jones), Foraminifera of the Crag, pt. 3, p. 297, pl. 7, fig. 33.

Heronallenia lingulata (Burrows and Holland). Chapman, Parr, and Collins, 1934, Linnean Soc. Jour., Zoology, v. 38 (no. 262), p. 564, pl. 8, fig. 11.

This species was described from the Pliocene of England and has been recorded in the late Tertiary and Recent, particularly from Australia.

Family CYMBALOPORIDAE

Genus **Cymbaloporetta** Cushman, 1928

Cymbaloporetta bradyi (Cushman)

Plate 11, figure 9

Cymbalopora poeyi (d'Orbigny) var. *bradyi* Cushman, 1915, U. S. Natl. Mus. Bull. 71, p. 25, pl. 10, fig. 2; pl. 14, fig. 2.

Family ROTALIIDAE

Genus **Streblus** Fischer, 1817

Only one form, of those here referred to the genus *Streblus*, possesses a well developed umbilical plug. Because of the lack of this feature in the remaining species, their assignment to this genus may appear to

be questionable. They are, however, retained in *Streblus* because examination of several large series of *Streblus beccarii* (the genotype of the genus), from Rimini and from other localities, shows complete gradation from the small, thin-walled tests with few chambers and no umbilical plug to the typical, large, heavy-walled specimens with many chambers, limbate sutures, the umbilicus filled with an irregular mass of shell material, and with rough limbation and beading on the ventral side. An example of such gradation is illustrated by a series of specimens from Rimini by Cushman (1928, pl. 15), figure 3 being representative of the type of *Streblus* that is predominant in the Gulf of Paria. It seems likely that limiting ecological factors prevent the development of the large, heavy-walled specimens of *Streblus*, such as those illustrated in figures 6 and 7 in the above-mentioned series. That unusual ecological conditions do prevail is apparent from the dwarf size and fragile tests of many of the other species present.

Streblus advenus (Cushman)

Plate 11, figure 2

Discorbis advena CUSHMAN, 1922, Carnegie Inst. Washington Pub. 311, p. 40; 1931, U. S. Natl. Mus. Bull. 104, pt. 8, p. 13, pl. 2, fig. 8.

This species was described from and reported as common in the Tortugas region off Florida.

Streblus beccarii (Linné) var. **sobrina** (Shupack)

Plate 10, figures 1, 2

Rotalia beccarii (LINNÉ) var. *sobrina* SHUPACK, 1934, Am. Mus. Novitates, no. 737, p. 6, pl., fig. 4.

Streblus beccarii (Linné) var. **tepida** (Cushman)

Plate 10, figures 5-11

Rotalia beccarii (LINNÉ) var. *tepida* CUSHMAN, 1926, Carnegie Inst. Washington Pub. 344, p. 79, pl. 1.

This variety, showing a wide range of variation in size and shape, is the most abundant representative of the genus in the Gulf of Paria. It was described from shallow waters off Puerto Rico.

Streblus beccarii (Linné) variant

Plate 10, figure 3

Rare specimens, as illustrated, seem to be related to *Streblus beccarii* and may be intermediate between the varieties *sobrina* and *tepida*.

Streblus limnetes Todd and Brönnimann, n. sp.

Plate 10, figure 4

Test compressed, composed of about 2½ whorls, periphery rounded, little if at all lobulated; chambers few, 6 or 7 comprising the adult whorl, not inflated; sutures distinct, neither raised nor depressed except toward their inner ends on the ventral side where they become increasingly incised; wall calcareous, smooth, translucent, finely perforate; aperture a low, elongate, arched opening under the edge of the final chamber on the periphery, with supplementary openings along the ventral sutures near the umbilicus, under the edge of the chamber at the forward-bent section of the suture. Diameter 0.32-0.42 mm., thickness 0.12-0.15 mm.

Holotype (Cushman Coll. No. 64633) from the tidal zone, mangrove swamp between St. Mary's and California, west coast of Trinidad.

This species differs from *Streblus beccarii* (Linné) and its varieties in being more compressed, in having an entire and not lobulated periphery, in having fewer chambers, in the umbilical area lacking an umbilical pillar or pillars and being more nearly closed, and in the wall being thin, smooth, and translucent on both dorsal and ventral sides. The species somewhat resembles *Streblus flevensis* (Hofker) but is not rough over the inner ends of the chambers on the ventral side, nor does it have as much of an opening into the umbilical area as *S. flevensis*.

In the Gulf of Paria *S. limnetes*, n. sp., appears to be confined to the tidal zone, as it was found only in the mangrove swamps. The same form was found on the southern New England coast in Long Island Sound, Gardiners Bay, and Buzzards Bay, and called *Rotalia beccarii* (Linné) var. *sobrina* (Shupack) (Parker, 1952b, p. 457, pl. 5, fig. 7). It also occurs on the southwest coast of Texas, in San Antonio Bay and environs, where it was called "*Rotalia*" *beccarii* (Linné) variant C (Parker, Phleger, and Peirson, 1953, p. 13, pl. 4, figs. 29, 30). A very similar, perhaps identical, species is reported from Barnstable Marsh in Cape Cod Bay under the name of *Valvulineria* sp. (Phleger and Walton, 1950, p. 281, pl. 2, fig. 22).

The species is distinctive in its compressed and smoothly compact test and should prove to be a good indicator of swampy and marshy environments.

Streblus pauciloculatus (Phleger and Parker)

Plate 10, figure 12

"*Rotalia*" *pauciloculata* PHLEGER and PARKER, 1951, Geol. Soc. America Mem. 46, p. 23, pl. 12, figs. 8, 9. —PARKER, PHLEGER, and PEIRSON, 1953, Cushman Found. Foram. Research Special Pub. 2, p. 13, pl. 4, figs. 31, 37.

Streblus? sp. A

Plate 11, figure 3

This species is characteristically plano-convex with the dorsal side convex. The wall is densely perforated by rather coarse pores giving a granular appearance to the surface of the test. The dorsal sutures are limbate

and in some specimens the earlier ones are raised; the ventral sutures are incised. The umbilicus is occupied by one large or several small pillars. The generic assignment is questioned because of the peculiar appearance of the wall.

Genus **Rolshausenia** Bermudez, 1952

Rolshausenia rolshauseni (Cushman and Bermudez)

Plate 11, figure 1

Rotalia rolshauseni CUSHMAN and BERMUDEZ, 1946, Cushman Lab. Foram. Research Contr., v. 22, pt. 4, p. 119, pl. 19, figs. 11-13.

Family ELPHIDIIDAE

In the light of Wood's (1949, p. 249 and 251) studies of wall structure as observed in polarized light and Smout's (1955, p. 203) reclassification of the superfamily Rotaliidea, the family Elphidiidae is recognized as distinct from the family Nonionidae and shown to be related to the Rotaliidae.

Genus **Elphidium** Montfort, 1808

Elphidium advenum (Cushman)

Plate 6, figures 5-7

Elphidium advenum (CUSHMAN). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 60, pl. 16, figs. 31-35.

Elphidium discoidale (d'Orbigny)

Plate 6, figures 8, 9

Elphidium discoidale (D'ORBIGNY). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 56, pl. 15, figs. 5-7.

Elphidium excavatum (Terquem)

Plate 6, figures 11, 12

Elphidium excavatum (TERQUEM). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 58, pl. 16, figs. 7-12.

Elphidium hispidulum Cushman

Plate 7, figure 1

Elphidium hispidulum CUSHMAN, 1936, Cushman Lab. Foram. Research Contr., v. 12, pt. 4, p. 83, pl. 14, fig. 13.

Except in being slightly smaller, the rare specimens found in the nearshore zone appear to be identical with types of this species described from 4 to 14 fathoms in Albany Passage, Australia.

Elphidium incertum (Williamson) var. **clavatum** Cushman

Plate 6, figure 10

Elphidium incertum (WILLIAMSON) var. *clavatum* CUSHMAN. CUSHMAN, 1944, Cushman Lab. Foram. Research Special Publ. 12, p. 25, pl. 3, figs. 32, 33.—PARKER, 1952, Mus. Comp. Zoology Bull., v. 106, no. 9, p. 412, pl. 5, figs. 10, 11.

Elphidium kugleri (Cushman and Bronnimann)

Cribroelphidium kugleri CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 18, pl. 4, fig. 4.

Elphidium limosum (Cushman and Bronnimann)

Plate 6, figure 13

Cribroelphidium limosum CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 19, pl. 4, fig. 7.

Elphidium poeyanum (d'Orbigny)

Plate 7, figures 2-4

Elphidium poeyanum (D'ORBIGNY). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 54, pl. 14, figs. 25, 26.

Elphidium sagrum (d'Orbigny)

Plate 7, figure 5

Elphidium sagrum (D'ORBIGNY). CUSHMAN, 1939, U. S. Geol. Survey Prof. Paper 191, p. 55, pl. 15, figs. 1-3.

Elphidium salsum (Cushman and Bronnimann)

Cribroelphidium salsum CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 19, pl. 4, fig. 6.

Elphidium translucens Natland

Plate 7, figure 6

Elphidium translucens NATLAND, 1938, Scripps Inst. Oceanography Bull., tech. ser., v. 4, no. 5, p. 144, pl. 5, figs. 3, 4.

Elphidium trinitatense (Cushman and Bronnimann)

Plate 7, figure 12

Cribroelphidium trinitatensis CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 20, pl. 4, fig. 8.

Elphidium tumidum Natland

Plate 7, figures 7-9

Elphidium tumidum NATLAND, 1938, Scripps Inst. Oceanography Bull., tech. ser., v. 4, no. 5, p. 144, pl. 5, figs. 5, 6.

Elphidium vadescens (Cushman and Bronnimann)

Plate 7, figures 10, 11

Cribroelphidium vadescens CUSHMAN and BRONNI-

MANN, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 18, pl. 4, fig. 5.

Elphidium sp. A

Plate 7, figure 13

This is a compact, closely coiled biconvex species that shows no tendency toward inflation of chambers.

Elphidium sp. B

Plate 7, figure 14

This species is characterized by an umbilical knob on each side of the test, and by narrow, inflated, curved chambers.

Elphidium sp. C

Plate 7, figure 15

This species has a very thin, smooth, and translucent wall. The chambers are slightly inflated and the periphery is rounded.

Family CASSIDULINIDAE

Genus **Cassidulina** d'Orbigny, 1826

Cassidulina sp. A

Plate 11, figure 10

This very minute species (0.12 mm.) is compressed but has a rounded periphery.

Cassidulina sp. B

Plate 11, figure 11

This is another minute species (0.17 mm.), also compressed, but with an angular periphery.

Genus **Cassidulinoides** Cushman, 1927

Cassidulinoides sp. A

Plate 11, figure 12

The specimen figured is light brown and shows darker brown spots, as illustrated, but petrographic examination of it and a lighter colored specimen shows them to be not agglutinated.

Genus **Epistominella** Huszcima and Maruhasi, 1944

Epistominella sp. A

Plate 11, figure 13

The nature of the aperture places this species in *Epistominella*. Material is too rare and poorly preserved to permit further identification.

Family CHILOSTOMELLIDAE

Genus **Sphaeroidina** d'Orbigny, 1826

Sphaeroidina bulloides d'Orbigny

Plate 11, figure 14

Sphaeroidina bulloides D'ORBIGNY, 1826, Annales sci. nat., tome 7, p. 267, Modèles no. 65.

This species is not usually expected in such a shallow environment. The rare specimens are small (0.25 mm.) but otherwise typical.

Family GLOBIGERINIDAE

Species of this and the following family are planktonic forms, probably not indigenous to the Gulf of Paria but brought in through the Serpent's Mouth by currents that branch off from the North Equatorial Current to enter the Gulf of Paria.

Genus **Globigerina** d'Orbigny, 1826

Globigerina bulloides d'Orbigny

Plate 12, figure 1

Globigerina bulloides D'ORBIGNY, 1826, Annales sci. nat., tome 7, p. 277, Modèles nos. 17 (young) and 76 (adult).

Globigerina cf. **G. quinqueloba** Natland

Plate 12, figures 2, 3

Globigerina quinqueloba NATLAND, 1938, Scripps Inst. Oceanography Bull., tech. ser., v. 4, no. 5, p. 149, pl. 6, fig. 7.

Globigerina? sp. A

Plate 12, figure 4

These minute forms (0.15 mm.) have the shape but not the wall texture characteristic of *Globigerina*.

Genus **Globigerinoides** Cushman, 1927

Globigerinoides rubra (d'Orbigny)

Plate 12, figure 5

Globigerina rubra D'ORBIGNY, 1839 (*in* DE LA SAGRA), Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 82, pl. 4, figs. 12-14.

Globigerinoides sacculifera (Brady)

Plate 12, figure 6

Globigerina sacculifera BRADY, 1884, *Challenger* Rept., Zoology, v. 9, p. 604, pl. 80, figs. 11-17; pl. 82, fig. 4.

Genus **Globigerinella** Cushman, 1927

Globigerinella aequilateralis (Brady)

Plate 12, figure 7

Globigerina aequilateralis BRADY, 1884, *Challenger* Rept., Zoology, v. 9, p. 605, pl. 80, figs. 18-21.

Family GLOBOROTALIIDAE

Genus **Globorotalia** Cushman, 1927

Globorotalia menardii (d'Orbigny)

Plate 12, figure 8

Rotalia menardii D'ORBIGNY, 1826, Annales sci. nat., tome 7, p. 273, Modèles no. 10.

Family ANOMALINIDAE

Genus **Laticarinina** Galloway and Wissler, 1927

Laticarinina sp. A

Plate 12, figure 9

The rare specimens found all appear to be immature, and the peripheral keel, usually transparent, is opaque.

Genus **Palmerinella** Bermudez, 1934

Palmerinella palmerae Bermudez

Plate 12, figure 10

Palmerinella palmerae BERMUDEZ, 1934, Soc. cubana hist. nat. Mem., v. 8, no. 2, p. 84, text figs. 1-3.

Genus **Cibicides** Montfort, 1808

Cibicides lobatulus (Walker and Jacob)

Plate 12, figure 11

Only a single specimen referable to this common and widespread species was found. It is characterized by its flat dorsal side by which it was probably attached in life.

Cibicides refulgens Montfort

Plate 12, figure 12

Cibicides refulgens MONTFORT, 1808, Conchyliologie systématique, v. 1, p. 123, 31st genre.

Rare specimens of this high conical species were found.

Cibicides cf. **C. robertsonianus** (Brady)

Plate 12, figure 13

Truncatulina robertsoniana BRADY, 1884, *Challenger* Rept., Zoology, v. 9, p. 664, pl. 95, fig. 4.

A species of *Cibicides* with rounded periphery and both dorsal and ventral surfaces slightly bulging is somewhat similar to Brady's species, but has 7 instead of 13 chambers. The presence of coarse perforations on the dorsal side distinguishes this form from *Gyroidina*, which genus it superficially resembles.

Cibicides sp. A

Plate 12, figure 14

The single specimen figured appears to have been attached by its ventral side.

Cibicides? sp. B

Plate 12, figure 15

This single specimen is very small (0.15 mm.) and its generic identification remains in doubt.

Genus **Hanzawaia** Asano, 1944

Hanzawaia cf. **H. strattoni** (Applin)

Plate 12, figure 16

Truncatulina americana CUSHMAN var. *strattoni* APPLIN, 1925 (*in* APPLIN, ELLISOR, and KNIKER), Am. Assoc. Petroleum Geologists Bull., v. 9, no. 1, p. 99, pl. 3, fig. 3.

Hanzawaia strattoni (APPLIN). BANDY, 1954, U. S. Geol. Survey Prof. Paper 254-F, p. 136, pl. 31, fig. 4.

Genus **Cibicidella** Cushman, 1927

Cibicidella sp. A

Plate 12, figure 17

Rare specimens with very irregular shapes that are probably a result of attachment during life, are found in the nearshore zone.

Genus **Dyocibicides** Cushman and Valentine, 1930

Dyocibicides biserialis Cushman and Valentine

Dyocibicides biserialis CUSHMAN and VALENTINE, 1930, Stanford Univ., Dept. Geology Contr., v. 1, no. 1, p. 31, pl. 10, figs. 1, 2.

REFERENCES

ANDEL, TJ. VAN, and POSTMA, H., 1954, Recent sediments of the Gulf of Paria. Reports of the Orinoco Shelf Expedition (volume 1). Verh. K. Nederlandse Akad. Wetenschappen, Natuurk., ser. 1, v. 20, no. 5, p. 1-245, pls. 1-7.

BANDY, O. L., 1953, Ecology and paleoecology of some California Foraminifera. Pt. I, The frequency distribution of Recent Foraminifera off California. Jour. Paleontology, v. 27, no. 2, p. 161-182, pls. 21-25, text figs. 1-4, table 1.

——— 1954, Distribution of some shallow-water Foraminifera in the Gulf of Mexico. U. S. Geol. Survey Prof. Paper 254-F, p. 123-141, pls. 27-31, text figs. 5-13.

BARTENSTEIN, HELMUT, 1938, Die foraminiferen-fauna des Jade-Gebietes. 2, Foraminiferen der meerischen und brackischen Bezirke des Jade-Gebietes. Senckenbergiana, v. 20, p. 386-412, text figs. 1-15.

BERMUDEZ, P. J., 1935, Foraminíferos de la costa norte de Cuba. Soc. cubana hist. nat. Mem., v. 9, no. 3, p. 129-224, pls. 10-17, 3 text figs., map.

BOLLI, H. M., and SAUNDERS, J. B., 1954, Discussion of some Thecamoebina described erroneously as Foraminifera. Cushman Found. Foram. Research Contr., v. 5, pt. 2, p. 45-52, text figs. 1, 2.

CUSHMAN, J. A., 1921, Foraminifera from the north coast of Jamaica. U. S. Natl. Mus. Proc., v. 59, p. 47-82, pls. 11-19, text figs. 1-16.

——— 1922, Shallow-water Foraminifera of the Tortugas region. Carnegie Inst. Washington Pub. 311, v. 17, p. 1-85, pls. 1-14.

——— 1926, Recent Foraminifera from Porto Rico. Carnegie Inst. Washington Pub. 344, p. 75-84, pl. 1.

——— 1928, On *Rotalia beccarii* (Linné). Cushman Lab. Foram. Research Contr., v. 4, pt. 4, p. 103-107, pl. 15.

——— 1935, Fourteen new species of Foraminifera. Smithsonian Misc. Coll., v. 91, no. 31, p. 1-9, pls. 1-3.

——— 1944, Foraminifera from the shallow water of the New England coast. Cushman Lab. Foram. Research Special Pub. 12, p. 1-37, pls. 1-4.

CUSHMAN, J. A., and BRONNIMANN, PAUL, 1948a, Some new genera and species of Foraminifera from brackish water of Trinidad. Cushman Lab. Foram. Research Contr., v. 24, p. 15-21, pls. 3, 4.

——— 1948b, Additional new species of arenaceous Foraminifera from shallow waters of Trinidad. Cushman Lab. Foram. Research Contr., v. 24, p. 37-42, pls. 7, 8 (pt.).

CUSHMAN, J. A. and PARKER, F. L., 1931, Recent Foraminifera from the Atlantic coast of South America. U. S. Natl. Mus. Proc., v. 80, art. 3, p. 1-24, pls. 1-4.

GUPPY, R. J. L., 1900, On the Naparima Rocks, Trinidad. Geol. Mag., (n. ser)., dec. 4, v. 7, p. 322-325.

HADA, YOSHINE, 1931, Report of the biological survey of Mutsu Bay. 19. Notes on the Recent Foraminifera from Mutsu Bay. Tohoku Imp. Univ. Sci. Repts., 4th ser., Biol., v. 6, no. 1, p. 45-148, text figs. 1-95.

HERON-ALLEN, EDWARD, and EARLAND, ARTHUR, 1932, Foraminifera. Part 1, The ice-free area of the Falkland Islands and adjacent seas. *Discovery* Repts., v. 4, p. 291-460, pls. 6-17.

HILTERMANN, HEINRICH, 1949, Klassifikation der natürlichen Brackwässer. Erdöl und Kohle, Jahrg. 2, nr. 1, p. 4-8, text figs. 1-8, 1 chart.

HOFKER, JAN, 1922, De Protozoën: Flora en fauna der Zuiderzee, p. 127-183, text figs. 1-91.

HÖGLUND, HANS, 1947, Foraminifera in the Gullmar Fjord and the Skagerak. Zool. Bidrag fran Uppsala, Bd. 26, p. 1-328, 32 pls., 312 text figs., 2 maps, 7 tables.

KORNFELD, M. M., 1931, Recent littoral Foraminifera from Texas and Louisiana. Stanford Univ. Dept. Geology, Contr., v. 1, no. 3, p. 77-93, pls. 13-16.

LEIDY, JOSEPH, 1879, Fresh-water Rhizopods of North America. U. S. Geol. Survey Rept. of the Territories, v. 12, 324 p., 48 pls.

LOEBLICH, A. R. JR., and TAPPAN, HELEN, 1953, Studies of Arctic Foraminifera. Smithsonian Misc. Coll., v. 121, no. 7, p. 1-150, pls. 1-24, text fig. 1.

——— 1954, Emendation of the foraminiferal genera *Ammodiscus* Reuss, 1862, and *Involutina* Terquem, 1862. Washington Acad. Sci. Jour., v. 44, no. 10, p. 306-310, text figs. 1, 2.

——— 1955a, A revision of some glanduline Nodosariidae (Foraminifera). Smithsonian Misc. Coll., v. 126, no. 3, p. 1-9, pl. 1.

——— 1955b, Revision of some Recent foraminiferal genera. Smithsonian Misc. Coll., v. 128, no. 5, p. 1-37, pls. 1-4.

LOWMAN, S. W., 1949, Sedimentary facies in Gulf Coast. Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 1939-1997, text figs. 1-35.

MILLER, D. N. JR., 1953, Ecological study of the Foraminifera of Mason Inlet, North Carolina. Cushman Found. Foram. Research Contr., v. 4, pt. 2, p. 41-63, figs. 1-4, pls. 7-10, tables 1-3.

D'ORBIGNY, A. D., 1839a, Voyage dans l'Amérique Méridionale, Foraminifères. Paris and Strasbourg, tome 5, pt. 5, p. 1-86, 9 pls.

——— 1839b, Foraminifères, *in* Ramon de la Sagra, Histoire physique, politique et naturelle de l'Île de Cuba. Paris, p. 1-224, 12 pls.

PARKER, F. L., 1952a, Foraminifera species off Portsmouth, New Hampshire. Mus. Comp. Zoology Bull., v. 106, no. 9, p. 391-423, pls. 1-6.

——— 1952b, Foraminiferal distribution in the Long Island Sound-Buzzards Bay area. Mus. Comp. Zoology Bull., v. 106, no. 10, p. 425-473, pls. 1-5, text figs. 1-4.

——— 1954, Distribution of the Foraminifera in the northeastern Gulf of Mexico. Mus. Comp. Zoology Bull., v. 111, no. 10, p. 453-588, pls. 1-13.

PARKER, F. L., PHLEGER, F. B, and PEIRSON, J. F., 1953, Ecology of Foraminifera from San Antonio Bay and environs, southwest Texas. Cushman Found. Foram. Research Special Pub. 2, p. 1-72, pls. 1-4, text figs. 1-49.

PHLEGER, F. B, 1949, The Foraminifera. Papers from the Robert S. Peabody Found. for Archaeology, v. 4, no. 1, p. 99-108, pl. 14, tables 13, 14.

——— 1954, Ecology of Foraminifera and associated micro-organisms from Mississippi Sound and environs. Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 584-647, pls. 1-3, figs. 1-28, tables 1-11.

PHLEGER, F. B, and PARKER, F. L., 1951, Ecology of Foraminifera, northwest Gulf of Mexico. Geol. Soc. America Mem. 46, pt. 2, p. 1-64, pls. 1-20.

PHLEGER, F. B, and WALTON, W. R., 1950, Ecology of marsh and bay Foraminifera, Barnstable, Mass. Am. Jour. Sci., v. 248, no. 4, p. 274-294, pls. 1, 2, figs. 1, 2, tables 1-5.

POST, R. J., 1951, Foraminifera of the South Texas Coast. Inst. Marine Sci. Pub., v. 2, no. 1, p. 165-176, pl. 1, table 1.

RHUMBLER, LUDWIG, 1935, Rhizopoden der Kieler Bucht, gesammelt durch A. Remane. I Teil. Schr. Naturwiss. Ver. Schleswig-Holstein, Band 21, Heft 2, p. 143-194, pls. 1-9.

——— 1936, Foraminiferen der Kieler Bucht, gesammelt durch A. Remane. II Teil. (Ammodisculinidae bis einschl. Textulinidae). Kieler Meeresforschungen, v. 1, p. 179-242, text figs. 127-246.

RONAI, P. H., 1955, Brackish-water Foraminifera of the New York Bight. Cushman Found. Foram. Research Contr., v. 6, pt. 4, p. 140-149, pls. 20, 21.

ROTTGARDT, DIETRICH, 1952, Mikropaläontologisch wichtige Bestandteile recenter brackischer Sedimente an den Küsten Schleswig-Holsteins. Meyniana, Geol. Instit. Univ. Kiel, v. 1, p. 169-228, text figs. 1-21.

SAID, RUSHDI, 1951, Foraminifera of Narragansett Bay. Cushman Found. Foram. Research Contr., v. 2, p. 75-86, text figs. 1-4, tables 1, 2.

SMOUT, A. H., 1955, Reclassification of the Rotaliidea (Foraminifera) and two new Cretaceous forms resembling *Elphidium*. Washington Acad. Sci. Jour., v. 45, no. 7, p. 201-210, figs. 1-10.

SUTER, H. H., 1954, The general and economic geology of Trinidad, B. W. I. (reprinted with revisions). London, Her Majesty's Stationery Office, 134 p., 15 text figs., 7 pls.

WOOD, ALAN, 1949, The structure of the wall of the test in the Foraminifera: its value in classification. Geol. Soc. London Quart. Jour., v. 104, p. 229-255, pls. 13-15.

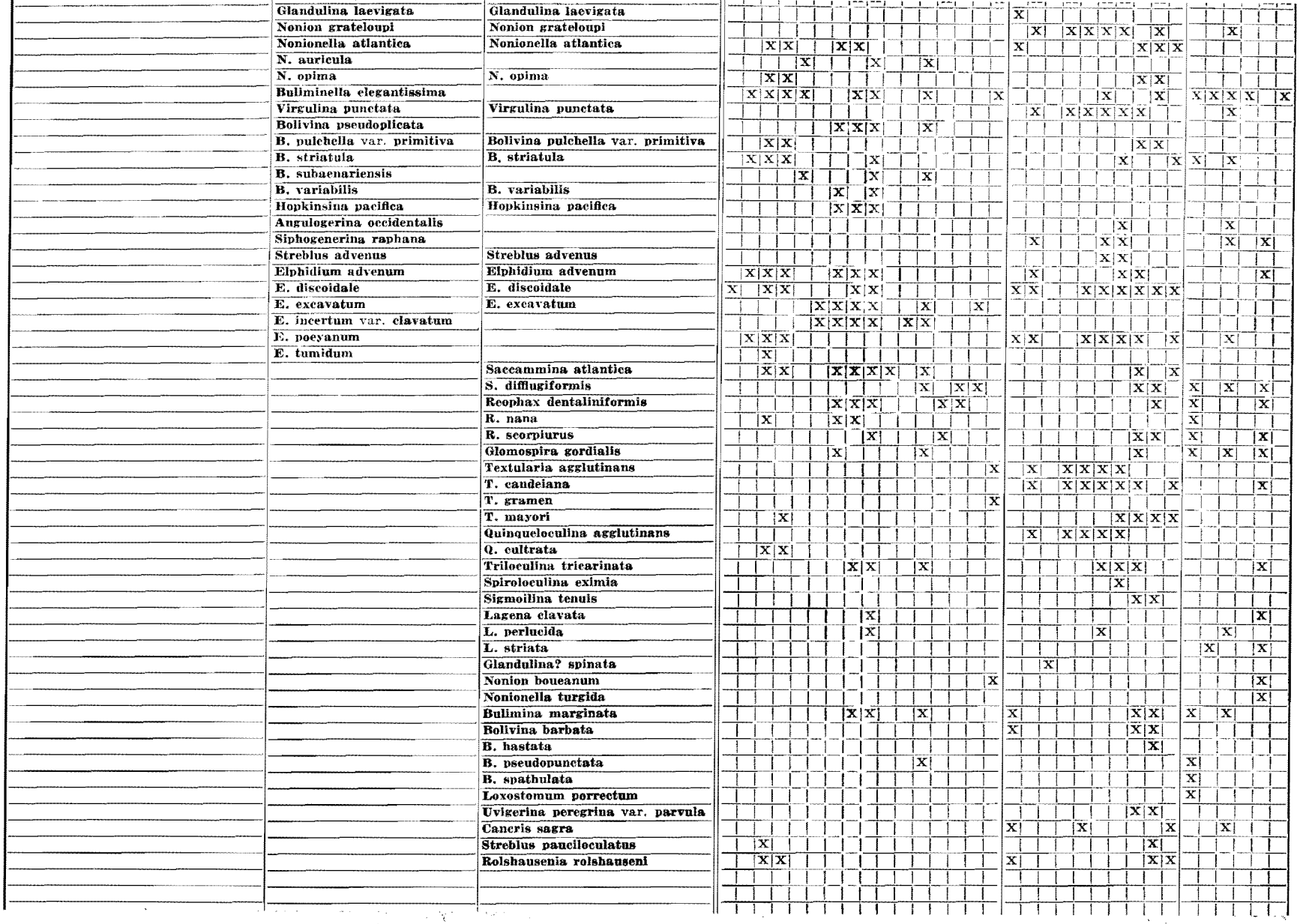
YOSHIDA, SABRO, 1954, Studies on the Foraminifera of brackish waters. III. The Foraminifera of Lake Saroma. Geol. and Mineralog. Inst., Tokyo Univ. Education, Mem. Vol. to Prof. Kiyosuke Kawada, p. 149-158, text figs. 1-4, 1 pl., tables 1-7.

Selected characteristic species of the eastern Gulf of Paria

Tidal zone (Mangrove I and Mangrove II)	Nearshore zone (0-2 fms.)	Offshore zone (2-18 fms.)
Difflugia urceolata		
Pontigulasia compressa		
Centropyxis (Centropyxis) constrictus		
Saccammina sphaerica		
Haplophragmoides canariense		
Ammoastuta inepta		
Ammobaculites salsus	**Ammobaculites salsus**	
A. salsus var. **distinctus**	**A. salsus** var. **distinctus**	
Miliammina fusca	**Miliammina fusca**	
Trochammina comprimata		
T. laevigata	**Trochammina laevigata**	
Arenoparrella mexicana		
Rosalina floridana	**Rosalina floridana**	
Discorbis? aguayoi		
Streblus beccarii var. **sobrina**	**Streblus beccarii** var. **sobrina**	
S. beccarii var. **tepida**	**S. beccarii** var. **tepida**	**Streblus beccarii** var. **tepida**
Palmerinella palmerae	**Palmerinella palmerae**	
	Psammosphaera fusca	
	Ammobaculites dilatatus	**Ammobaculites dilatatus**
	A. exiguus	
	A. exilis	**A. exilis**
	Gaudryina exilis	**Gaudryina exilis**
	Pseudoclavulina gracilis	
	Quinqueloculina poeyana	
	Q. seminulum	**Quinqueloculina seminulum**
	Triloculina oblonga	
	T. trigonula	**Triloculina trigonula**
	Cornuspira planorbis	
	Glandulina laevigata	**Glandulina laevigata**
	Nonion grateloupi	**Nonion grateloupi**
	Nonionella atlantica	**Nonionella atlantica**

Selected environments and references

Ecologically similar environments from various parts of the world																		Environments geographically close to Gulf of Paria									Environments geographically remote from Gulf of Paria					
Littoral zone, Texas and Louisiana (Kornfeld, 1931)	SW Texas coast (Post, 1951)	SW Texas coast (Parker, Phleger, and Peirson, 1953)	Mississippi Sound (Phleger, 1954)	Mason Inlet, North Carolina (Miller, 1953)	New York Bight (Ronai, 1955)	Long Island Sound (Parker, 1952b)	Narragansett Bay (Said, 1951)	New England (Cushman, 1944)	Barnstable, Massachusetts (Phleger and Walton, 1950)	Boston Basin (Phleger, 1949)	Portsmouth, New Hampshire (Parker, 1952a)	Kieler Bucht, Baltic Sea (Rhumbler, 1935; 1936)	Schleswig-Holstein (Rottgardt, 1952)	The Jade, North Sea (Bartenstein, 1938)	Zuider Zee (Hofker, 1922)	Gulf of Paria (van Andel and Postma, 1954)	Puerto Rico (Cushman, 1926)	Puerto Rico (Cushman, 1935)	Jamaica (Cushman, 1921)	Cuba (d'Orbigny, 1839b)	N coast of Cuba (Bermudez, 1935)	Dry Tortugas (Cushman, 1922)	NE Gulf of Mexico (Parker, 1954)	NW Gulf of Mexico (Phleger and Parker, 1951)	Gulf of Mexico (Bandy, 1954)	S Sweden (Höglund, 1947)	Off South America (d'Orbigny, 1839a)	Off South America (Cushman and Parker, 1931)	Off San Francisco (Bandy, 1953)	Mutsu Bay, Japan (Hada, 1931)	Saroma Lake, Japan (Yoshida, 1954)
		X	X			X							X		X																	
						X																										
		X				X					X				X																	
															X												X					
														X							X											
		X	X		X	X				X																					
Ammobaculites salsus		X	X																													
A. salsus var. distinctus	X																															
Miliammina fusca	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														X			
Trochammina comprimata		X	X																													
T. laevigata			X																													
Arenoparrella mexicana	X	X	X																													
Rosalina floridana		X	X																			X	X	X	X			X				
Discorbis? aguayoi		X																				X										
Streblus beccarii var. sobrina	X										X											X				X		X				
S. beccarii var. tepida	X	X	X	X	X	X	X	X							X	X	X	X					X	X	X			X				
Palmerinella palmerae			X																			X										
								X	X				X	X								X										
		X	X	X		X	X																									
		X	X			X	X																									
				X																												
		X	X																													
		X																														
		X		X														X		X	X	X	X								X	X
	X	X						X						X																		
		X	X		X										X		X	X		X	X	X	X			X						
							X	X					X			X	X			X		X	X		X					X	X	
																	X															
																		X		X	X	X	X		X							
		X	X			X	X										X								X							


Glandulina laevigata
Nonion grateloupi
Nonionella atlantica
N. auricula
N. opima
Buliminella elegantissima
Virgulina punctata
Bolivina pseudoplicata
B. pulchella var. primitiva
B. striatula
B. subaenariensis
B. variabilis
Hopkinsina pacifica
Angulogerina occidentalis
Siphogenerina raphana
Streblus advenus
Elphidium advenum
E. discoidale
E. excavatum
E. incertum var. clavatum
E. poeyanum
E. tumidum
Saccammina atlantica
S. difflugiformis
Reophax dentaliniformis
R. nana
R. scorpiurus
Glomospira gordialis
Textularia agglutinans
T. candeiana
T. gramen
T. mayori
Quinqueloculina agglutinans
Q. cultrata
Triloculina tricarinata
Spiroloculina eximia
Sigmoilina tenuis
Lagena clavata
L. perlucida
L. striata
Glandulina? spinata
Nonion boueanum
Nonionella turgida
Bulimina marginata
Bolivina barbata
B. hastata
B. pseudopunctata
B. spathulata
Loxostomum porrectum
Uvigerina peregrina var. parvula
Cancris sagra
Streblus pauciloculatus
Rolshausenia rolshauseni