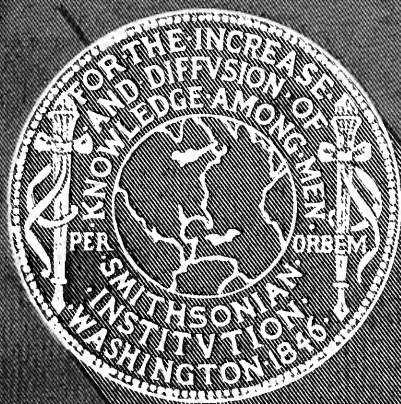


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SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM  
BULLETIN 161

THE FORAMINIFERA OF THE  
TROPICAL PACIFIC COLLECTIONS OF  
THE "ALBATROSS," 1899-1900

PART 1.—ASTRORRHIZIDAE TO TROCHAMMINIDAE

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## ADVERTISEMENT

The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

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The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

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The present volume forms No. 161 of the *Bulletin* series.

ALEXANDER WETMORE,

*Assistant Secretary, Smithsonian Institution.*

WASHINGTON, D. C., May 12, 1932.

# CONTENTS

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	Page
Introduction.....	1
Family Astrorhizidae.....	4
Genus <i>Rhabdammina</i> .....	4
<i>abyssorum</i> .....	4
Family Reophacidae.....	4
Genus <i>Reophae</i> .....	4
<i>agglutinatus</i> .....	4
Family Lituolidae.....	5
Genus <i>Haplophragmoides</i> .....	5
<i>trullissata</i> .....	5
Family Ammodiscidae.....	5
Genus <i>Ammodiscus</i> .....	5
<i>incertus</i> .....	5
Family Textulariidae.....	6
Subfamily Spiroplectammininae.....	6
Genus <i>Spiroplectammina</i> .....	6
<i>milletti</i> .....	7
Subfamily Textulariinae.....	7
Genus <i>Textularia</i> .....	7
<i>foliacea</i> .....	8
var. <i>oceanica</i> .....	8
<i>semialata</i> .....	9
<i>candeiana</i> .....	9
<i>agglutinans</i> .....	10
<i>conica</i> .....	11
<i>corrugata</i> .....	12
<i>albatrossi</i> .....	12
<i>concava</i> .....	13
Family Verneuillinidae.....	13
Genus <i>Gaudryina</i> .....	13
<i>bradyi</i> .....	13
<i>triangularis</i> var. <i>angulata</i> .....	14
<i>quadrangularis</i> .....	14
sp.(?).....	15
<i>rugulosa</i> .....	15
Genus <i>Clavulina</i> .....	16
<i>communis</i> .....	16
<i>pacifica</i> .....	16
<i>difformis</i> .....	17
Family Miliolidae.....	17
Genus <i>Quinqueloculina</i> .....	17
<i>anguina</i> var. <i>agglutinans</i> .....	18
<i>berthelotiana</i> .....	19
<i>bidentata</i> .....	20
<i>costata</i> .....	20
<i>crassa</i> var. <i>subcuneata</i> .....	21
<i>crenulata</i> .....	21
<i>funafutiensis</i> .....	22

## Family Miliolidae—Continued.

Genus *Quinqueloculina*—Continued.

	Page
<i>cf. gracilis</i> .....	23
<i>gualtieriana</i> .....	23
<i>lamarckiana</i> .....	24
<i>parkeri</i> .....	25
<i>polygona</i> .....	25
<i>samoensis</i> .....	26
<i>semireticulosa</i> .....	27
<i>striatula</i> .....	27
<i>sulcata</i> .....	28
Genus <i>Schlumbergerina</i> .....	29
<i>alveoliniformis</i> .....	29
Genus <i>Massilina</i> .....	30
<i>alveoliniformis</i> .....	30
<i>planata</i> .....	31
<i>inaequalis</i> .....	32
<i>australis</i> .....	32
<i>macilenta</i> .....	33
<i>crenata</i> .....	33
Genus <i>Spiroloculina</i> .....	34
<i>grateloupi</i> .....	34
var. <i>serrulata</i> .....	35
var. <i>acescata</i> .....	35
<i>antillarum</i> .....	36
var. <i>angulata</i> .....	37
var. <i>aequa</i> .....	38
var. <i>reticosa</i> .....	38
<i>caduca</i> .....	39
<i>planissima</i> var. <i>samoensis</i> .....	39
<i>eximia</i> .....	39
<i>clara</i> .....	40
<i>affixa</i> .....	41
sp.(?).....	42
Genus <i>Haverina</i> .....	42
<i>fragilissima</i> .....	42
<i>ornatissima</i> .....	43
<i>pacifica</i> .....	44
<i>bradyi</i> .....	44
Genus <i>Sigmoilina</i> .....	45
<i>edwardsi</i> .....	45
Genus <i>Articulina</i> .....	46
<i>lineata</i> .....	47
<i>sulcata</i> (?).....	47
Genus <i>Nubeculina</i> .....	48
<i>divaricata</i> .....	48
var. <i>advena</i> .....	49
<i>chapmani</i> .....	49
Genus <i>Triloculina</i> .....	50
<i>oblonga</i> .....	50
<i>circularis</i> .....	52
<i>labiosa</i> .....	53
var. <i>sparsicostata</i> .....	54



## Family Miliolidae—Continued.

Genus *Triloculina*—Continued.

	Page
<i>irregularis</i> .....	54
<i>oceanica</i> .....	54
var. <i>flintiana</i> .....	55
<i>fichteliana</i> .....	55
<i>spinata</i> .....	56
<i>trigonula</i> .....	56
<i>austriaca</i> .....	57
<i>affinis</i> .....	58
<i>tricarinata</i> .....	59
<i>bertheliniana</i> .....	60
<i>bicarinata</i> .....	60
sp. (?).....	61

Genus *Pyrgo*..... 61

*denticulata*..... 62

    var. *striolata*..... 63

*murrhina*..... 64

*globula*..... 65

*milletti*..... 66

## Family Ophthalmididae..... 67

## Subfamily Cornuspirinae..... 67

Genus *Cornuspira*..... 67

*invovens*..... 67

## Subfamily Nodobaculariinae..... 68

Genus *Nodobacularia*..... 68

*antillarum* var. *pacifica*..... 68

*milletti*..... 69

## Subfamily Ophthalmidinae..... 70

Genus *Spirophthalmidium*..... 70

*aculimargo*..... 70

Genus *Planispirina*..... 71

*exigua*..... 71

*auriculata*..... 72

Genus *Vertebralina*..... 72

*striata*..... 73

## Subfamily Nubeculariinae..... 74

Genus *Parrina*..... 74

*bradyi*..... 74

## Family Fischerinidae..... 75

Genus *Fischerina*..... 75

*pellucida*..... 75

*helix*..... 76

*involuta*..... 76

## Family Trochamminidae..... 77

## Subfamily Trochammininae..... 77

Genus *Trochammina*..... 77

*turbinata*..... 77

## Subfamily Globotextulariinae..... 77

Genus *Nouria*..... 77

*polymorphinoides*..... 78

## Explanation of plates..... 79

## Index..... 85

# ILLUSTRATIONS

## TEXT FIGURES

	Page
FIGURE 1. General route of the <i>Albatross</i> , 1899-1900.....	3

## PLATES

	Facing page
PLATE 1. Species of <i>Reophax</i> , <i>Haplophragmoides</i> , <i>Spiroplectammina</i> , and <i>Textularia</i> .....	84
2. Species of <i>Textularia</i> .....	84
3. Species of <i>Textularia</i> and <i>Gaudryina</i> .....	84
4. Species of <i>Gaudryina</i> and <i>Clavulina</i> .....	84
5-7. Species of <i>Quinqueloculina</i> .....	84
8. Species of <i>Schlumbergerina</i> , <i>Massilina</i> , and <i>Spiroloculina</i> .....	84
9. Species of <i>Spiroloculina</i> .....	84
10. Species of <i>Spiroloculina</i> and <i>Hauerina</i> .....	84
11. Species of <i>Articulina</i> , <i>Nubeculina</i> , <i>Sigmoilina</i> , and <i>Triloculina</i> ..	84
12, 13. Species of <i>Triloculina</i> .....	84
14, 15. Species of <i>Pyrgo</i> .....	84
16. Species of <i>Nodobacularia</i> , <i>Cornuspira</i> , <i>Spirothalmidium</i> , <i>Planispirina</i> , and <i>Vertebralina</i> .....	84
17. Species of <i>Parrina</i> , <i>Fischerina</i> , <i>Trochammina</i> , and <i>Nouria</i> .....	84

# THE FORAMINIFERA OF THE TROPICAL PACIFIC COLLECTIONS OF THE "ALBATROSS," 1899-1900

PART I.—ASTROBHZIDAE TO TROCHAMMINIDAE

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## INTRODUCTION

THIS PAPER is the first part of a work the intent of which is to describe and illustrate the foraminifera of the tropical Pacific collected by the United States Bureau of Fisheries steamer *Albatross*, together with certain other related material from shallow water of the same region. Parts 2 and 3 will take up in systematic order the rest of the families after the Trochamminidae.

Numerous papers deal with the shallow-water foraminifera of the Indo-Pacific, but from deep water few records are available for the general area except those from the *Challenger* expedition of 50 years ago.

Two previous bulletins of the United States National Museum, one on the foraminifera of the North Pacific Ocean (Bulletin 71, 1910-1917) and the other on the foraminifera of the Atlantic Ocean (Bulletin 104, 1918-1931), are general accounts, especially of the foraminifera dredged by the *Albatross*. These bulletins also include many of the species recorded from the same areas in other publications.

The collections of the *Albatross* made during the voyage from August 26, 1899, to February 21, 1900, form the basis of the present series. These were made largely in deep water, although many of them were in the immediate neighborhood of oceanic islands, particularly the Paumotu group. Shallow-water collections made from this same area have also come into my hands for study and greatly supplement the fauna obtained in the deeper-water dredgings. A few of the stations are in north latitude, especially those near the Marshall and Ladrone Islands. The fauna treated, however, is all more or less of a unit, and the fact that some forms come from north of the Equator and most of them from south does not interfere with the general unity of the paper.

Most of the papers published on the foraminifera of the Indo-Pacific region are cited in the synonymy under the various species, and in some of them species were figured and described that were not obtained in our collections. To have added all the other records from the general Indo-Pacific region would not only have greatly enlarged this work, but would have involved the addition of many species the types of which were not available for study. It has seemed best, therefore, to limit the scope of the work to the actual collections of the *Albatross* and to the other available shallow-water deposits from the same groups of islands.

Though the fauna as a whole is a unified one, nevertheless the study of the present collections shows that there are in the shallow water about various groups of oceanic islands of the South Pacific locally developed species that are strictly limited. The species of deeper water, however, have a wide distribution.

Furthermore, there are numerous species that occur definitely associated in other areas. For instance, many are widely distributed among the islands of the South Pacific that are known also from the West Indian region. Others are known from the Mediterranean and the Red Sea regions. A few of them are very closely related to species originally described from the warm-water facies of the Miocene or Pliocene of southern Europe.

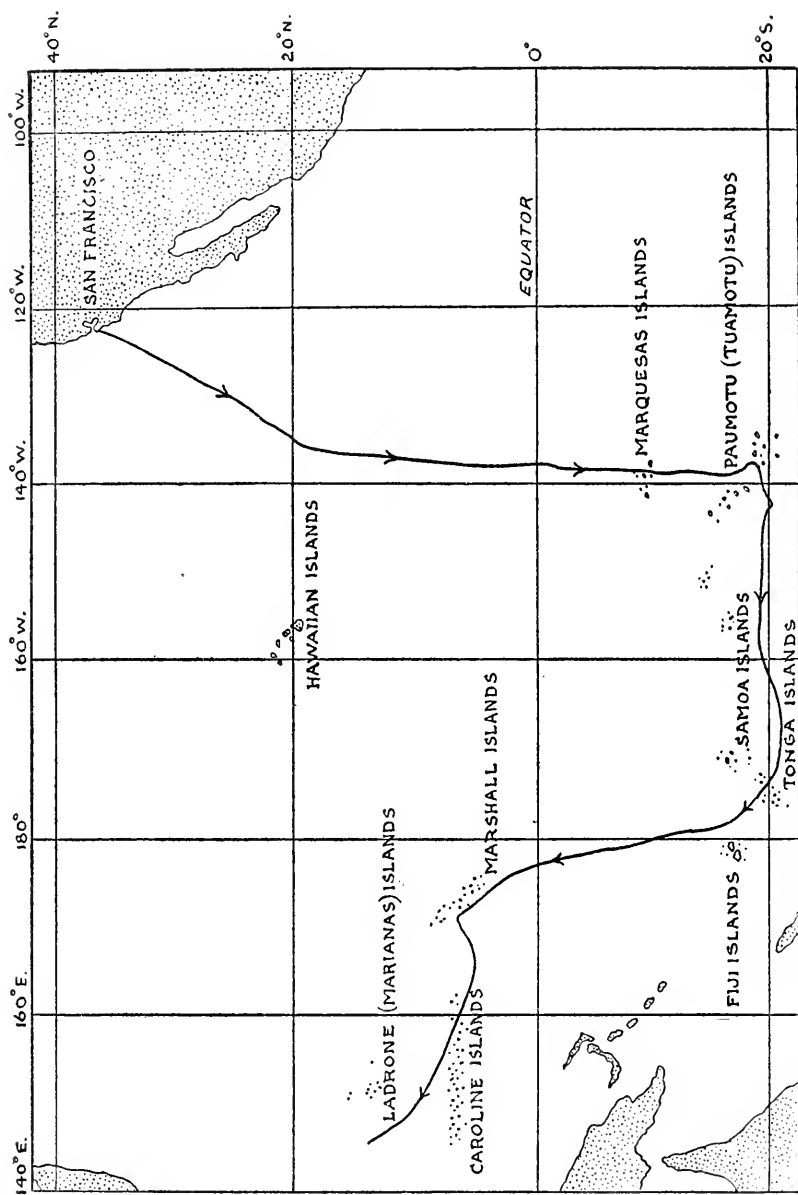
The accompanying map (fig. 1) shows the general path of the *Albatross* during this voyage, and for further details the reader is referred to the tables accompanying a number of the species. These give the depth, temperature, and other data regarding the samples from which the material was taken.

The plates are all from original drawings made from the collections by Miss Margaret S. Moore, and form perhaps the most useful part of the present work.

I wish to take this opportunity to express my great appreciation of the many kindnesses and the constant help that the United States National Museum and its staff have so constantly given me in the study of this and other material.

TABLE 1.—*Abbreviations used in the tables in this report to denote the character of the bottoms of the dredging stations*

Abbreviation	Meaning	Abbreviation	Meaning	Abbreviation	Meaning
br.....	brown.	lt.....	light.	pum.....	pumice.
brk.....	broken.	m.....	mud.	rd.....	red.
c.....	clay.	mang.....	manganese.	s.....	sand.
co.....	coral.	nod.....	nodules.	sh.....	shells.
crs.....	coarse.	oz.....	ooze.	vol.....	volcanic.
fne.....	fine.	part.....	particles.	wh.....	white.
glob.....	globigerina.	pter.....	pteropods.	yl.....	yellow.
gy.....	gray.				

FIGURE 1.—General route of the *Albatross*, 1899–1900

## Family ASTRORHIZIDAE

Genus RHABDAMMINA M. Sars, 1869

RHABDAMMINA ABYSSORUM M. Sars

There are a few very fragmentary specimens of a tubular form composed of rather coarse sand grains, firmly cemented. These strongly resemble broken portions of the arms of this species, and are placed here provisionally. They are the only records for this family in the material examined. They are from *Albatross* Station H3779, latitude 24° 45' N., longitude 130° 16' W., in 2,627 fathoms.

## Family REOPHACIDAE

Genus REOPHAX Montfort, 1808

REOPHAX AGGLUTINATUS Cushman

PLATE 1, FIGURES 1-3

*Reophax agglutinatus* CUSHMAN, Proc. U. S. Nat. Mus., vol. 44, p. 637, pl. 79, fig. 6, 1913; U. S. Nat. Mus. Bull. 104, pt. 2, p. 9, pl. 2, figs. 4, 5, 1920; U. S. Nat. Mus. Bull. 100, vol. 4, p. 73, pl. 14, figs. 2 a, b, 1921.

Test composed of a series of pyriform chambers with a thin chitinous lining and the exterior composed of tests of other foraminifera firmly cemented; aperture extended into a narrow, cylindrical neck.

There are in the *Albatross* collections a number of specimens, some of which are figured here. These are composed of young tests of nearly uniform size neatly cemented. A few of the specimens similar to that shown in Plate 1, Figure 1, are evidently the initial chambers of this form. Although the stations are somewhat widely distant from one another, the specimens are all very uniform in character. They have been referred to this species, which in other localities seems to lack the uniformity in the size of the tests that compose the wall.

TABLE 2.—*Reophax agglutinatus*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21972.....	1	H3809	Entrance to Avatoru Pass, Rabirola Atoll, 2.5 miles S.	Fathoms 645	° F. .....	fne. wh. co. s.....	Rare.
21973.....	1	H3893	East point Makemo, 75° N., 11 miles W.	1,221	26	glob. mang.....	Do.
21974.....	1	H3910	Southwest point Aki Aki, 1 mile E.	377	43	co. s.....	Do.
21975.....	2	H3919	{Lat. 19° 45' 30" S., long. 139° 54' W.	1,494	35.4	glob. mang.....	Do.
21976.....	2						

<sup>1</sup> Key to abbreviations is given in Table 1.

## Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES TRULLISSATA (H. B. Brady)

PLATE 1, FIGURES 4 a, b

- Trochammina trullissata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 56, pl. 5, figs. 10 a, b, 11, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 342, pl. 40, figs. 14-16 (not fig. 13), 1884.—HAEUSLER, Abh. Schweiz. Pal. Ges., vol. 17, p. 64, pl. 10, figs. 9, 11, 1890.—EGGER, Abh. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 265, pl. 5, figs. 25, 26 (?), 1893.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 18.—GOËS, Bull. Mus. Comp. Zool., vol. 29, p. 33, 1896.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 364.—BAGG, U. S. Geol. Surv. Bull. 514, p. 34, pl. 7, figs. 2a, b, 1912.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zoology, vol. 6, 113, 1922.
- Haplophragmoides trullissata*, CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 1, p. 100, figs. 148 a, b (in text), 1910.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, p. 1008, 1914.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 2, p. 43, pl. 9, fig. 5, 1920.

Test small, planispiral, composed of about three coils, not completely involute, the chambers of earlier coils visible at the center in the umbilical region, which is also depressed, periphery slightly lobulated; chambers numerous, 7 to 9 in the last-formed coil, subglobular; sutures distinct, slightly depressed; wall of fine sand grains with an excess of yellowish-brown or reddish-brown cement, smooth and polished; aperture a short narrow slit slightly above the base of the chamber; color yellowish brown or reddish brown. Diameter, 0.35 mm.; thickness, 0.1 mm.

There is a single very beautifully preserved specimen from *Albatross* Station H3779, latitude 24° 45' N., longitude 130° 16' W., in 2,627 fathoms. This is the only record for the species or for the family in the entire collection. The species is widely distributed in the deep water of both the Atlantic and Pacific.

## Family AMMODISCIDAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS INCERTUS (d'Orbigny)

There is a single very small specimen from *Albatross* Station D3837, latitude 16° 32' S., longitude 148° 40' W., in 2,363 fathoms. No other material was found in all the samples examined.

## Family TEXTULARIIDAE

## Subfamily SPIROPLECTAMMINAE

## Genus SPIROPLECTAMMINA Cushman, 1927

*Spiroplectammina* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, p. 23, 1927; Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 114, 1928.

*Textularia* (part) PARKER and JONES (not DeFrance), Philos. Trans., vol. 155, p. 370, 1865.

*Spiroplecta* H. B. BRADY (not Ehrenberg), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 376, 1884.

*Genoholotype*.—*Textularia agglutinans* var. *biformis* Parker and Jones.

Test free, early chambers planispiral in both microspheric and megalospheric forms, later ones biserial; wall arenaceous with a yellowish-brown cement; aperture in the planispiral portion at the base of the apertural face, in the biserial portion at the inner margin of the chamber. Carboniferous to Recent.

Out of all the *Textularia* group present in this collection from the Pacific only *milletti* seems to belong to this genus. At this time comment may be made on the relationships of this genus to *Textularia*. Doctor Lacroix has recently published a paper on the relationships of these, seeming to show that "*Spiroplecta wrightii*" is the same as "*Textularia sagittula*." He also comes to the conclusion that all species of *Textularia* have a spiral beginning, and that the chambers may have been displaced where they are not present. An examination of many species of this genus does not carry out this hypothesis. There are forms that have been placed under *Spiroplectammina* in which both the megalospheric and microspheric forms have planispirally coiled chambers in the end. These have been included under *Spiroplectammina*. There are, however, a great many species excellently preserved both in fossil and Recent material in which the megalospheric form does not show any trace of spiral beginnings. These seem to be distinct from the former group. It may be noted here also that certain of the species referred to *Textularia* evidently have their relationship with *Gaudryina*, and the microspheric form shows traces of a triserial beginning instead of a spiral one. From a strictly phylogenetic point of view, these should be distinguished from the other *Textularia* group having their beginning in a spiral form. By acceleration of development the triserial stage has become more and more restricted, and the biserial stage is taken on earlier and earlier. This process may continue until the relationship with *Gaudryina* is lost entirely, and there may be no possible way of distinguishing textularian forms developed from this source from those that have developed from spiral beginnings.



## SPIROPLECTAMMINA MILLETTI (Cushman)

## PLATE 1, FIGURES 5 a, b

*Textularia milletti* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 2, p. 133, figs. 18, 19 (in text), 1911.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zoology, vol. 6, p. 118, 1922.

Test compressed, somewhat longer than broad, composed of numerous broad, low chambers, the whole test rapidly increasing in width, especially in the earlier portion, end view narrow, periphery acute, each chamber with the outer margin thickened and coarsely arenaceous, the early portion concave and much less roughened, so that the surface of the test is composed of an alternating series of raised, rough ridges, and smoother depressions; sutures rather indistinct except for the depressions; wall coarsely arenaceous; aperture narrow at the inner margin of the last-formed chamber, with a slightly overhanging lip. Length, 0.8 mm.

This species, which has been recorded from a number of stations in the North Pacific and also by Heron-Allen and Earland from the Antarctic, seems to have a wide distribution in the Pacific region. It is nearest to a species described from the Atlantic as *Textularia mexicana*. The microspheric form shows distinct traces of coiling in the early chambers.

The species has been recorded by Hofker from the Zuider Zee, but from his figures his species from the Atlantic is not the same as this one, which is well developed in the Pacific.

## Subfamily TEXTULARIINAE

## Genus TEXTULARIA DeFrance, 1824

*Textularia* DEFRANCE, Dict. Sci. Nat., vol. 32, p. 177, 1824.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 144, 1928.

*Textularia* EHRENBERG, Abh. kais. Akad. Wiss. Berlin, 1839, p. 135.

*Plecanium* REUSS, Sitz. Akad. Wiss. Wien, vol. 44, p. 383, 1861 (1862) (genotype, by designation, *Textularia labiata* Reuss).

*Grammostomum* (part) of authors.

*Palaotextularia* SCHUBERT, Pal. Zeitschr., vol. 3, p. 183, 1920 (genotype, by designation, *Textularia jonesi* H. B. Brady).

*Genoholotype*.—*Textularia sagittula* DeFrance.

Test free, elongate, tapering, usually compressed with the zigzag line between the chambers on the middle of the flattened sides, early chambers in the microspheric form usually planispirally coiled, later biserial, chambers simple, not labyrinthic; wall arenaceous, the relative quantity of cement varying much; aperture, typically an arched slit at the inner margin of the chamber, occasionally in the apertural face.

Cambrian to Recent.

## TEXTULARIA FOLIACEA Heron-Allen and Earland

## PLATE 1, FIGURES 6-10

*Textularia foliacea* HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 628, pl. 47, figs. 17-20, 1915.—CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 117, pl. 19, figs. 7 *a*, *b*, 1921; Carnegie Inst. Washington Publ. 342, p. 14, pl. 2, figs. 2-4; pl. 3, fig. 1, 1924.

Test of medium size, much compressed, triangular, the outer apertural end broadly convex; chambers numerous, 9 to 11 on each side in the adult; sutures fairly distinct but only slightly depressed; surface roughly formed, of sand grains so cemented as to leave a characteristic, rough, somewhat flaky surface; aperture fairly large, curved, at the base of the last-formed chamber, with a slight lip. Length, 1 to 1.5 mm.

This species is one of the commonest in the shallow water of the general Indo-Pacific region. It is much compressed and has a characteristic size and shape in the adult specimens. When seen with other specimens in the sample it is usually much lighter in color. It is evidently most at home in shallow water of coral-reef regions, and while there are some records from deeper water they are mostly small specimens that may have been easily carried into deeper water. Previous records are by Heron-Allen and Earland from the Kerimba Archipelago, from Timor Sea, Java, 50 fathoms. I have recorded it from seven stations off the Philippines at depths ranging from 20 to 494 fathoms, and from shallow water about Samoa. In the present collections it has occurred at the following localities: Mokaujar Anchorage, Fiji; Viva Anchorage, Fiji, 3 fathoms; Levuka, Fiji, 12 fathoms; Nairai, Fiji, 12 fathoms and 24 fathoms; Vavau Anchorage, Tonga Islands; Rongelap Atoll, Marshall Islands; and from the Guam Anchorage, Ladrone (Marianas) Islands, 21 fathoms. At the last locality specimens are abundant, and the largest in size of any of the localities.

## TEXTULARIA FOLIACEA Heron-Allen and Earland OCEANICA, new variety

## PLATE 1, FIGURES 11, 12

Variety differing from the typical in the much thicker form and rougher appearance of the test. Length of holotype of variety, 2 mm.; width, 1.25 mm.; thickness, 1 mm.

*Holotype of variety*.—Cushman Coll. No. 14667, from Mokaujar Anchorage, Fiji.

This variety is much thicker than the typical, much rougher, and usually of a much darker color. The two occur together at some of the localities, but the variety seems to occur alone at certain others. The holotype is an exceptionally large, fine specimen, much larger

than the usual run of specimens in the collection. In the early stages the variety is usually distinguished by its greater thickness.

Besides the type locality the variety occurs at Levuka, Fiji, 12 fathoms; Nairai, Fiji, 12 fathoms; Vavau Anchorage, Tonga Islands; Rotonga, 7 fathoms; and Port Lotten, Kersail, Caroline Islands.

TEXTULARIA SEMIALATA Cushman

PLATE 2, FIGURES 1-3

*Textularia semialata* CUSHMAN, Proc. U. S. Nat. Mus., vol. 44, p. 634, pl. 80, figs. 6, 7, 1913; U. S. Nat. Mus. Bull. 100, vol. 4, p. 116, pl. 24, figs. 2, 3, 1921.

Test compressed, rather rapidly increasing in width, the periphery rounded, especially in the later chambers; chambers numerous, considerably overlapping so that all except the last two are much broader than high from the exterior; sutures distinct, nearly horizontal, depressed; wall finely arenaceous, very smoothly finished; aperture at the inner margin of the chamber with a distinct, overhanging lip. Length, 0.8 mm.; breadth, 0.55-0.7 mm.; thickness, 0.3-0.35 mm.

This species was originally described from the Philippines. Very typical specimens of the broad form occur at Mokaujar Anchorage, Fiji, and a single specimen, apparently the same, from *Albatross* Station H3901, in 1,620 fathoms, off Marokau Island, Paumotu (Tuamotu Archipelago).

TEXTULARIA CANDEIANA d'Orbigny

PLATE 2, FIGURES 4 a, b

*Textularia candeiana* d'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 143, pl. 1, figs. 25-27, 1839.—FORNASINI, Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. 10, p. 303, pl. 0, fig. 8, 1903.—CHAPMAN, Rep. Foram. Subantarctic Islands, New Zealand, p. 329, 1909.—CUSHMAN, U. S. Nat. Mus., Bull. 71, pt. 2, p. 12, figs. 14-17 (in text), 1911.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 627, pl. 47, figs. 10-16, 1915; Trans. Linn. Soc. London, vol. 11, ser. 2, p. 230, pl. 41, figs. 1, 2, 1916; Journ. Roy. Micr. Soc., 1916, p. 41.—CUSHMAN, Carnegie Inst. Washington Publ. 291, p. 32, 1922; Proc. U. S. Nat. Mus., vol. 59, p. 50, pl. 11, figs. 7, 8, 1921; U. S. Nat. Mus. Bull. 100, vol. 4, p. 109, 1921; Carnegie Inst. Washington Publ. 311, p. 32, pl. 2, fig. 2, 1922; U. S. Nat. Mus. Bull. 104, pt. 3, p. 8, pl. 1, figs. 1-3, 1922.—HERON-ALLEN and EARLAND, British Antarctic Expedition, Zoology, vol. 6, p. 119, 1922; Journ. Linn. Soc. Zool., vol. 35, p. 618, 1924.—HANZAWA, Jap. Journ. Geol. Pal., vol. 4, p. 38 (table), 1925 (1926).—CUSHMAN, Carnegie Inst. Washington Publ. 344, p. 76, 1926.

*Textularia sagittula* DEFRANCE var. *candeiana* MILLETT, Journ. Roy. Micr. Soc., 1899, p. 562, pl. 7, fig. 2.

Test elongate, club-shaped, the early portion narrow, much compressed, the edges almost carinate, tapering gradually to the rounded apex; chambers numerous, those of the early portion somewhat compressed, later ones enlarging very rapidly, and the final ones becoming much inflated; sutures of the later portion fairly distinct and considerably oblique, very slightly depressed; wall rather coarsely arenaceous especially in the early portion, often obscuring the sutures; aperture in a broad, shallow sinus at the base of the inner margin of the chamber. Length, up to 1 mm.; breadth, up to 0.6 mm.; thickness, 0.5 mm.

This species is common in the West Indian region, from which it was originally described by d'Orbigny. It occurs also in typical form in the Pacific. It may be distinguished from the following species (*agglutinans*) by the greater obliquity of the sutures and by the very rapid expansion of the chambers toward the apertural end together with the characteristic roughness of the surface of the early chambers. In the Pacific material examined this species and *T. agglutinans* occur together very rarely, the latter occurring in the Fiji collections but the former apparently absent.

Our records for *T. candeiana* include the following localities: Makemo Lagoon, Paumotus; Rangiroa; Rutavu; Port Lotten, Kersail, Caroline Islands; Rongelap Atoll, Marshall Islands; Guam Anchorage, Ladrone Islands, 21 fathoms; and the following *Albatross* stations: H3814, latitude 15° 14' 10" S., longitude 147° 51' 05" W., 391 fathoms off the Paumotus; H3855, off Apataki Island, Paumotus, 654 fathoms; H3889, off Taenge Atoll, Paumotus, 928 fathoms; and H3898, off Hikueru Atoll, Paumotus, 348 fathoms.

#### TEXTULARIA AGGLUTINANS d'Orbigny

#### PLATE 2, FIGURES 5-7

*Textularia agglutinans* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 136, pl. 1, figs. 17, 18, 32, 34, 1839.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, pl. 43, figs. 1 a, b (var. 2, 3), 1884.—GOËS, Bull. Mus. Comp. Zool., vol. 29, p. 41, 1896.—FLINT (part), Rep. U. S. Nat. Mus., 1897, p. 284, pl. 29, fig. 4, 1899.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 2, p. 9, figs. 10 a, b (in text), 1911; Proc. U. S. Nat. Mus., vol. 59, p. 49, pl. 11, figs. 1-3, 1921; U. S. Nat. Mus. Bull. 100, vol. 4, p. 106, pl. 20, fig. 8, 1921; Carnegie Inst. Washington Publ. 311, p. 22, pl. 1, fig. 6, 1922; U. S. Nat. Mus. Bull. 104, pt. 3, p. 7, pl. 1, figs. 4, 5, 1922; Carnegie Inst. Washington Publ. 344, p. 76, 1926.

Test elongate, tapering, very little compressed, periphery rounded, the increase in diameter from the initial end rather uniform; chambers inflated, increasing somewhat in height toward the apertural end rather uniformly; sutures distinct, depressed, usually about at

right angles to the long axis of the test; wall rather coarsely arenaceous, but smoothly finished; aperture an elongate slit in a well-marked depression of the inner border of the chamber. Length, 0.8–1 mm.; breadth, 0.5–0.6 mm.

This species was described by d'Orbigny from shore sands of Cuba, and it is a typical species of the general West Indian region, occurring in typical form at least as far back as the Miocene in Florida and probably in the West Indies. It is not so common in the Pacific but occurs widely distributed, especially in rather shallow water. It may be distinguished from *candeiana* by the horizontal sutures, the uniform tapering test, and the rather uniform shape of the chambers. In the Pacific collections it has occurred at *Albatross* Station H3961, off the south coast of Tarawa, Gilbert Islands, 413 fathoms. In the shallow water material it occurs off the Fiji Islands from Levuka, 12 fathoms, Mokaujar Anchorage. There are typical specimens also from Rongelap Atoll, Marshall Islands. It is much less common than *candeiana*.

TEXTULARIA CONICA d'Orbigny

PLATE 2, FIGURES 8–10; PLATE 3, FIGURES 1, 3

*Textularia conica* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 143, pl. 1, figs. 19, 20, 1839.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 365, pl. 43, figs. 13, 14; pl. 113, fig. 1, 1884.—Goës, Bull. Mus. Comp. Zool., vol. 29, p. 43, 1896.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, p. 50, pl. 11, figs. 4–6, 1921; U. S. Nat. Mus. Bull. 100, vol. 4, p. 123, pl. 25, figs. 2 a–c, 1921; Carnegie Inst. Washington Publ. 311, p. 24, pl. 2, fig. 4, 1922; U. S. Nat. Mus. Bull. 104, pt. 3, p. 22, pl. 5, figs. 5–7, 1922; Carnegie Inst. Washington Publ. 342, p. 15, pl. 1, fig. 6, 1924.

Test usually wider than high, triangular in front view, broadly oval in end view, slightly compressed, apex bluntly pointed; chambers comparatively few, distinct; sutures distinct, slightly depressed; wall arenaceous, smooth, or slightly roughened; aperture a narrow slit at the base of the inner margin of the last-formed chamber; color gray. Length, 0.55–0.7 mm.; breadth, 0.55–0.65 mm.; thickness, 0.4–0.5 mm.

D'Orbigny's original types of this species were from the West Indies in shallow water, where it is common and widely distributed. It has been recorded from many regions both as a Recent and fossil species, but an examination of the records where figures are given would show that these are not all one species. Various authors have referred the species to *Textularia abbreviata* d'Orbigny described by him from the Vienna Basin Miocene, but that species in its typical form is very different from the Recent West Indian one. The species occurs in our material from Rangiroa, Paumotu; Vavau Anchorage,

Tonga Islands; Mokaujar Anchorage, Fiji Islands; and from Rongelap Atoll, Marshall Islands. There is also a typical specimen from *Albatross* Station H3930, off Anu Anuraro Atoll, Paumotus, 438 fathoms, evidently a specimen carried out into deep water, as the station is only three-fourths of a mile offshore.

TEXTULARIA CORRUGATA Heron-Allen and Earland

PLATE 3, FIGURES 2, 4

*Textularia conica* D'ORBIGNY var. *corrugata* HERON-ALLEN and EARLAND, TRANS. Zool. Soc. London, vol. 20, p. 629, pl. 47, figs. 24-27, 1915.

Test short and broad, nearly as broad as long, oval in end view; chambers very distinct, much excavated toward the base, low and broad; sutures deep, usually curved upward in the middle, thence rather sharply downward toward the periphery; wall arenaceous, fine, of rounded particles with considerable cement giving it a smooth finish. Length and breadth, up to 1 mm.; thickness, 0.65-0.75 mm.

Heron-Allen and Earland described this species from Kerimba Archipelago off southeast Africa as a variety of *Textularia conica*. While the two forms occur together occasionally in our material they seem to be very distinct. This species is widely distributed, occurring off the Fiji Islands in 40 to 50 fathoms, off Rongelap Atoll, Marshall Islands, and Guam Anchorage, Ladrone Islands, in 21 fathoms.

TEXTULARIA ALBATROSSI Cushman

PLATE 3, FIGURES 5 a, b

*Textularia concava* FLINT (part) (not Karrer), Rep. U. S. Nat. Mus., 1897, p. 283, 1899.

*Textularia albatrossi* CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 14, pl. 2, figs. 5, 6, 1922.

Test elongate, much tapering, apical end bluntly pointed, apertural end broadly angled, in the later portion the breadth nearly equal to the thickness, concave at each side in the middle, periphery convex; chambers distinct, the last ones much inflated, low and broad, each with a reentrant portion near the central part at each side; sutures distinct, depressed; wall coarsely arenaceous, rather smoothly finished, especially in the later portion; aperture a long, narrow slit above the base of the chamber, with a slight lip; color gray. Length, 0.9 mm.; breadth, 0.55 mm.; thickness, 0.4 mm.

Previous records of this species are from the Atlantic, where it occurs at a depth of 382 fathoms in the western part of the Caribbean Sea. The single specimen figured here is the only one that occurs in our material, and is from *Albatross* Station H3858, Ngaruae Pass, Fakarava Atoll, Paumotus, in 599 fathoms.

## TEXTULARIA CONCAVA Karrer

## PLATE 3, FIGURES 6 a, b

Many forms have been referred to this species described by Karrer from the Miocene of Europe. Some of the specimens figured from the Mediterranean are very close to Karrer's original figure, and also some Recent Indo-Pacific shallow water specimens. The only specimen in the present collection that can be referred to Karrer's species is that figured, which is from *Albatross* Station H3815, latitude 15° 15' 15" S., longitude 147° 51' 35" W., in 524 fathoms

## Family VERNEUILINIDAE

## Genus GAUDRYINA d'Orbigny, 1839

*Gaudryina* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 109, 1839.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 126, 1928.

*Genotype*.—By designation, *Gaudryina rugosa* d'Orbigny.

Test in the early stages triserial, later biserial, transverse section angled or rounded; wall coarsely or finely arenaceous often with a large proportion of cement; aperture, typically a low opening at the base of the inner margin of the chamber, or in the wall of the apertural face. Lower Cretaceous to Recent.

There are a number of species in this Pacific material, and these show very little difference in the relative amount of the test made up by the triserial portion. As already noted under *Spiroplectammina*, textularian forms may easily be developed from *Gaudryina* and the triserial portion entirely crowded out. All stages in this process can be seen in various species of the genus.

## GAUDRYINA BRADYI Cushman

## PLATE 3, FIGURES 8, 9

- Gaudryina pupoides* H. B. BRADY (not *G. pupoides* d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 378, pl. 46, figs. 1-4, 1884.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, p. 219, pl. 43, figs. 7, 8, 1888.—WRIGHT, Ann. Mag. Nat. Hist., ser. 6, vol. 4, p. 448, 1889.—PEARCEY, Trans. Nat. Hist. Soc. Glasgow, vol. 2, p. 176, 1890.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, p. 471, 1891.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 20.—Goës, Bull. Mus. Comp. Zool., vol. 29, p. 40, 1896.—FLINT, Rep. U. S. Nat. Mus., 1897, p. 287, pl. 32, fig. 4, 1899.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 30, p. 403, 1910; Zool. Res. *Endeavour*, pt. 3, p. 310, 1912; vol. 3, pt. 1, p. 16, 1915.—SIDEBOTTOM, Journ. Roy. Micr. Soc., p. 23, 1918.
- Gaudryina bradyi* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 2, p. 67, figs. 107 a-c (in text), 1911.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, p. 1014, 1914.—CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 149, pl. 29, fig. 3, 1921; U. S. Nat. Mus. Bull. 104, pt. 3, p. 74, pl. 12, fig. 8, 1922.

Test stout, somewhat elongate, tapering slightly until near the initial end, where it tapers abruptly to the somewhat blunt end; triserial portion nearly circular in cross section, of few chambers, the later biserial portion making up about three-fourths of the test, slightly compressed; chambers overlapping and appearing crowded, broadly elliptical in cross section, inflated; sutures deep and distant, end strongly convex; wall of fine arenaceous or calcareous shell material, smooth; aperture oval, slightly back from the inner margin of the chamber and with the border raised somewhat and thickened; color light gray. Length, 0.38–1 mm.

Although this is a very widely distributed species, it is very rare in this collection. Single specimens, both of which are here figured, occurred at *Albatross* Stations H3818, latitude 15° 24' 10" S., longitude 147° 56' W., in 897 fathoms, and H3901, 8 miles off Marokau Islands, Paumotu, 1,620 fathoms.

**GAUDRYINA TRIANGULARIS** Cushman var. **ANGULATA** Cushman

PLATE 3, FIGURES 7 a, b

*Gaudryina triangularis* CUSHMAN var. *angulata* CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 22, 1924.

Variety differing from the typical in the later chambers, which are very angular, the opposite sides parallel, giving a peculiar appearance to the test, especially in end view. Length, 0.6 mm; breadth, 0.45 mm; thickness, 0.3 mm.

This variety, originally described from Samoa, occurs rarely in the Fiji Islands at Mokaujar Anchorage.

**GAUDRYINA QUADRANGULARIS** Bagg

PLATE 3, FIGURES 10, 11

*Gaudryina quadrangularis* BAGG, Proc. U. S. Nat. Mus., vol. 34, p. 133, pl. 5, fig. 1, 1908.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 2, p. 64, fig. 103 (in text), 1911; Proc. U. S. Nat. Mus., vol. 56, p. 604, 1919; U. S. Nat. Mus. Bull. 100, vol. 4, p. 147, pl. 29, fig. 2, 1921.

Test elongate, tapering abruptly at the initial end, composed of an early trihedral portion with acute angles made up of a triserial group of chambers, and a later more or less quadrangular portion composed of chambers biserially arranged; sutures often largely obscured by roughening of the surface; wall coarsely arenaceous and rather roughly cemented; aperture an elongate orifice between the inner border of the chamber and the adjacent wall of the preceding chamber, with, in end view, a sort of rounded lip above and a depression at either side; in side view the aperture is in a depression of the abruptly truncated end of the test. Length, up to 3 mm.



This species was originally described by Bagg from off the Hawaiian Islands. It is now known from numerous stations, especially from the Philippine region and in the North Atlantic. It has proved to be the most common species of the genus in these collections but occurs only in the *Albatross* material from comparatively deep water as follows: Station H3808, entrance to Avatoru Pass, Rāhīroa Atoll, Paumotu, 645 fathoms; H3810, same locality, 661 fathoms; H3959, Ngaruae Pass, Fakarava Atoll, 666 fathoms; H3860, off Fakarava, 602 fathoms; and H3954, off Nomuka Island, Cook Islands, 600 fathoms.

The specimens are uniform in showing the peculiar flaky roughness, especially over the earlier chambers, obscuring the sutures to a considerable degree.

**GAUDRYINA sp. (?)**

PLATE 4, FIGURES 2 *a*, *b*

The peculiar form figured here occurred in Makemo Lagoon, Paumotu. No other specimens were found with this to give the complete characters of the species.

**GAUDRYINA RUGULOSA, new species**

PLATE 4, FIGURES 1 *a*, *b*

Test large, stout, somewhat longer than broad, early triserial portion usually confined to the earliest stages, later becoming biserial for most of the growth, periphery broadly rounded; chambers fairly distinct, with the lower side much excavated, sometimes with one or more backwardly directed projections overlapping onto the preceding chamber; sutures distinct, depressed, nearly horizontal or somewhat upwardly curved in the middle; wall arenaceous, but with much cement rather smoothly finished; aperture a low opening at the inner margin of the last-formed chamber. Length, 2 mm.; breadth, 1.35 mm.; thickness, 0.75 mm.

*Holotype*.—Cushman Coll. No. 14698, from Alofi Niue.

This species has been often recorded from the Indo-Pacific as *Textularia rugosa* (Reuss). The early stages are, however, triserial, and the species should be placed in *Gaudryina*. This has been noted by Heron-Allen and Earland in their Kerimba paper, and shown by them in figures in that same paper (pl. 47, figs. 7-9).<sup>1</sup>

Though the species described by Reuss from the Tertiary from Gaas has apparently chambers that are excavated somewhat at the base, it is certainly not the same as this very large species, so

<sup>1</sup> The Foraminifera of the Kerimba Archipelago, Trans. Zool. Soc. London, vol. 20, pt. 2, pp. 543-794, pls. 40-53, 1915.

well developed in the Indo-Pacific in shallow water of coral reefs. Besides the type locality where the species is common and well developed, it has also occurred in the material from Guam Anchorage, Ladrone Islands, 21 fathoms. It occurs in the Philippines, where it is often common and grows to large size.

Genus *CLAVULINA* d'Orbigny, 1826

*Clavulina* d'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 268, 1826.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 3, p. 80, 1922; Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 127, 1928.

*Verneuilina* (part) of authors.

*Valulina* (part) of authors.

*Tritaxia* (part) of authors.

*Genotype*.—By designation, *Clavulina parisiensis* d'Orbigny.

Test elongate, cylindrical or angled, early portion consisting of chambers arranged triserially, in most species quickly followed by a uniserial series, but in some primitive species with a biserial stage between; wall arenaceous; aperture, in the early stages, a simple opening at or near the inner margin, later becoming terminal, often with a neck, in some species with an apertural tooth.

Cretaceous to Recent.

*CLAVULINA COMMUNIS* d'Orbigny

PLATE 4, FIGURES 3 a, b

There is a single large specimen figured here that may be referred to this species. It is from *Albatross* Station H3816, latitude 15° 16' 50'' S., longitude 147° 52' 30'' W., in 450 fathoms. The typical form of the species is often common in shallow water of the Mediterranean, and it is surprising that it has not occurred in many of the shallow-water Pacific samples included in this paper.

*CLAVULINA PACIFICA* Cushman

PLATE 4, FIGURES 4, 7, 9

*Clavulina angularis* H. B. BRADY (in part) (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 396, pl. 48, figs. 22-24, 1884.

*Clavulina pacifica* CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 22, pl. 6, figs. 7-11, 1924.

Test elongate, early portion triserial, short, trihedral; later portion uniserial, the sides parallel or nearly so, triangular in transverse section, the sides flat or somewhat convex; chambers fairly high; sutures distinct, depressed, curved; wall arenaceous, but very smoothly finished, last-formed chamber tapering toward the aper-

tural end, the whole rounded; aperture circular, with a fairly large tooth; color yellowish brown. Length, up to 1.5 mm.

This species was described from Samoa, where it occurred at several stations. The species has been usually recorded from the Pacific as *Clavulina angularis*. It is, however, a very different species from that of d'Orbigny and also from *C. tricarinata*, which is characteristic of the West Indian region. It is apparently not so common in the shallow water of the Pacific as the following species, *C. difformis* H. B. Brady. Typical specimens of *C. pacifica* were obtained from Rangiroa and from Makemo Lagoon, Paumotu Islands, specimens from both localities being figured here.

CLAVULINA DIFFORMIS H. B. Brady

PLATE 4, FIGURES 5, 6, 8, 10

*Clavulina angularis* D'OREIGNY var. *difformis* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 396, pl. 48, figs. 25-31, 1884.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 637, pl. 48, figs. 20-22, 1915.—CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 156, pl. 31, figs. 2 a, b, 1921.  
*Clavulina difformis* CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 23, pl. 6, figs. 5, 6, 1924.

Test elongate, somewhat tapering, usually polygonal, the sides concave, early triserial portion short, angles of the test sharp, slightly produced; chambers numerous, distinct, slightly inflated; sutures distinct, depressed, curved; wall arenaceous, rather roughly finished; aperture circular, with a distinct tooth, the last-formed chamber short and at the apertural end broadly truncate or even slightly depressed. Length, up to slightly more than 1 mm.

Brady described this as a variety of *Clavulina angularis*. It is, however, a distinct species developed in the Indo-Pacific region. The test is typically polygonal in end view, and the wall is very distinctly roughened, the chambers slightly inflated and often having distinct angular projections, which overlap the preceding chamber. Previous records include Nares Harbor, Admiralty Islands (Brady); Kerimba Archipelago, southeast coast of Africa (Heron-Allen and Earland); Apra Bay, Guam, and Samoa (Cushman). In the present collections typical specimens occurred at Guam Anchorage, Ladrone Islands, 21 fathoms; Mokaujar Anchorage, Fiji Islands, Vavau Anchorage, Tonga Islands; and Makemo Lagoon, Paumotu Archipelago.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny, 1826

*Quinqueloculina* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 301, 1826.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 42, 1917; Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 146, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 21, 1929.

*Serpula* (part) LINNAEUS, *Systema naturae*, ed. 10, p. 786, 1758.

*Adelosina* D'ORBIGNY, *Ann. Sci. Nat.*, vol. 7, p. 303, 1826 (genotype, by designation, *A. striata* d'Orbigny).

*Unitoculina* D'ORBIGNY, *Foram. Foss. Bass. Tert. Vienne*, p. 261, 1846 (genoholotype, *U. indica* d'Orbigny).

*Miliolina* (part) WILLIAMSON, *Rec. Foram. Great Britain*, p. 83, 1858 (and later authors).

*Genotype*.—By designation, *Serpula seminulum* Linnaeus.

Test with the coiling in five planes, the chambers half a coil in length and added successfully in planes  $144^\circ$  apart, five chambers completing a cycle, each chamber  $72^\circ$  from its adjacent one but  $144^\circ$  from the immediately preceding one; wall imperforate, calcareous, often with arenaceous material on the exterior and in deep or brackish water occasionally becoming siliceous; aperture usually with a simple tooth.

This is one of the common genera in the shallow water of the South Pacific represented by numerous species. In addition to those recorded here, there are probably several others in our material, but they are represented by either incomplete or insufficient specimens so that specific determination of them is not possible. Some of the species show considerable variation in shape of the chambers and the ornamentation from the young stages to the adult, and it is necessary to have rather full suites of specimens in order really to understand the complete developmental stages and the adult as well. In order to facilitate use of the species of the genus they are here arranged alphabetically.

QUINQUELOCULINA ANGUINA Terquem var. AGGLUTINANS (Wiesner)

PLATE 5, FIGURES 1 a-c

*Miliolina anguina* (TERQUEM) var. *agglutinans* WIESNER, in Heron-Allen and Earland, *Trans. Zool. Soc. London*, vol. 20, pt. 2, p. 575, 1915.—CUSHMAN, *Carnegie Inst. Washington Publ.* 342, p. 60, pl. 22, figs. 5, 6, 1924.

Test elongate, two or three times as long as broad, periphery rounded; chambers distinct, rounded in transverse section, the apertural end extended; sutures somewhat depressed; wall with the surface coarsely arenaceous and roughly finished; aperture with a cylindrical neck, and slight lip. Length, 0.5 mm.; breadth, 0.3 mm.; thickness, 0.2 mm.

This has proved to be a common form, well developed in our material. Previous records for the Pacific are from the Kerimba Archipelago off southeast Africa (Heron-Allen and Earland) and from Samoa (Cushman).

Specimens occurred in considerable numbers at the following localities: Mokaujar Anchorage, Fiji Islands; Levuka, Fiji, 12 fathoms; off Nairai, Fiji, 12 fathoms; Vavau Anchorage, Tonga

Islands, 18 fathoms; Rangiroa; Rotonga, 7 fathoms; Rongelap Atoll, Marshall Islands; and Guam Anchorage, Ladrones, 21 fathoms.

QUINQUELOCULINA BERTHELOTIANA d'Orbigny

PLATE 5, FIGURES 2-4

*Quinqueloculina berthelotiana* D'ORBIGNY, in Barker, Webb, and Berthelot, *Hist. Nat. Iles Canaries*, vol. 2, pt. 2, "Foraminifères," p. 142, pl. 3, figs. 25-27, 1839.

Test somewhat longer than broad, somewhat compressed; chambers distinct, polygonal in section, the periphery concave, and the

TABLE 3.—*Quinqueloculina berthelotiana*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21977.....	1	H3809	Entrance to Avatoru Pass, Raihira Atoll, 2.5 miles S.	<i>Fathoms</i> 645	<i>° F.</i> .....	fne. wh. co. s.....	Rare.
21978.....	4	H3815	Lat. 15° 15' S., long. 147° 51' 35" W.	524	.....	wh. co. s. brk. sh.	Few.
21979.....	3	H3827	Lat. 14° 53' 20" S., long. 148° 42' 30" W.	486	.....	crs. wh. co. s. vol. part.	Rare.
21980.....	1	H3834	West coast of Makatea Island, 1.3 miles E.	1,363	.....	wh. co. s. mang. nod.	Do.
21981.....	2	H3848	Village on west side Niau Atoll, ¾ mile E.	252	.....	co. s. glob. oz.....	Do.
21982.....	5	H3858	Ngaruae Pass, Fakarava Atoll, 28° S., 1 mile E.	599	.....	crs. co. s.....	Few.
21983.....	1	H3859	Ngaruae Pass, Fakarava Atoll, 35° S., 3.5 miles E.	666	.....	pter. oz. vol. part.	Rare.
21984.....	3	H3875	Southwest point Tahanae, about ½ mile offshore, 3 miles NE.	269	.....	crs. co. s.....	Do.
21985.....	1	H3876	Northwest entrance Makemo Lagoon, 1 mile SE.	467	.....	wh. co. s.....	Do.
21986.....	1	H3884	Northwest point Raroia, ½ mile SE.	508	40.2	crs. co. s. pter. oz.	Do.
21987.....	3	H3891	Lat. 16° 30' S., long. 143° 41' W.	540	39.7	co. s. pter. oz.....	Do.
21988.....	8	H3898	Northwest point Hikueru Atoll, ½ mile E.	345	43.8	co. s. brk. sh.....	C o m - mon.
21989.....	1	H3889	Northwest point Hikueru Atoll, 1.3 miles E.	798	37.8	co. s. pter. oz.....	Rare.
21990.....	1	H3905	Northwest point Hao Atoll, ½ mile SE.	425	42	crs. co. s.....	Do.
21991.....	8	H3910	Southwest point Aki Aki, 1 mile E.	377	43	co. s.....	C o m - mon.
21992.....	2	H3914	Northeast point Nukutavake, 1 mile S.	636	38.9	co. s.....	Rare.
21993.....	1	H3916	Pinaki Atoll, 1 mile E.....	486	41	crs. co. s. pter. oz.	Do.
21994.....	2	H3926	Midway between Nukutipipi and Anu Anurunga.	1,609	35.5	co. s. mang. glob.	Do.
21995.....	3	H3928	Anu Anurunga, 1 mile SE.....	659	38.5	co. s. brk. sh. pter. oz.	Do.
21996.....	4	H3930	Anu Anuraro Atoll, ¾ mile NW.	438	40.7	co. s.....	Few.
21997.....	1	H3931	Anu Anuraro Atoll, ½ mile SE.	405	42.5	co. s. pter. oz. mang. part.	Rare.
21998.....	6	H3935	Hereheretua Atoll, 1 mile W.....	594	39.5	crs. co. s.....	Few.

<sup>1</sup>Key to abbreviations is given in Table 1.

somewhat bluntly carinate edges of the test often becoming sinuous; sutures fairly distinct, only slightly if at all depressed; wall smooth or slightly roughened, with minute pits; aperture generally rounded at the end of a distinct neck, and with a single short tooth. Length, 0.6–0.75 mm.; breadth, 0.3–0.4 mm.; thickness, 0.15–0.2 mm.

Many different forms similar to those shown in our figures have been assigned numerous specific names. d'Orbigny's originals seem to be of the form that has polygonal chambers and a distinctly exerted neck. The degree of sinuosity of the edges of the chambers is very variable. Our specimens cover a wide range of territory including a number of *Albatross* stations, data for which are given in the accompanying table. From our other stations it occurs at Rangiroa; Rutavu; 40 to 50 fathoms off Fiji Islands; Makemo Lagoon; Hereheretue; Pinaki Atoll; Rongelap Atoll, Marshall Islands; Port Lotten, Kersail, Caroline Islands.

QUINQUELOCULINA BIDENTATA d'Orbigny

PLATE 5, FIGURE 5

*Quinqueloculina bidentata* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 197, pl. 12, figs. 18–20, 1839.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, p. 65, pl. 15, figs. 11, 12, 1921; Carnegie Inst. Washington Publ. 311, p. 54, 1922; Publ. 342, p. 59, pl. 22, figs. 1, 2, 1924.

Test somewhat longer than broad, periphery squarely truncate or somewhat concave; chambers fairly distinct, rounded or polygonal in transverse section; sutures somewhat obscure; wall composed on the exterior of rather coarse sand grains, but fairly smoothly finished; aperture somewhat extended with a slight lip and thin plate-like tooth, which extends out beyond the opening. Length, 1 mm.; breadth, 0.6 mm.

This species seems to be identical with that described by d'Orbigny from the West Indian region. I have already recorded it from Samoa. It is, however, not nearly so common in the region as are the other two arenaceous forms. Specimens occurred only off the Fiji Islands; Mokaujar Anchorage, Levuka, 12 fathoms; and Nairai Islands, 12 fathoms.

QUINQUELOCULINA COSTATA d'Orbigny

PLATE 5, FIGURES 6, 7

*Quinqueloculina costata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 301, No. 3, 1826.—TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 1, p. 63, pl. 6 (11), figs. 3 a–5 c, 1878.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 49, pl. 15, fig. 1, 1917; Carnegie Inst. Washington Publ. 311, p. 66, pl. 11, fig. 5, 1922; U. S. Nat. Mus. Bull. 104, pt. 6, p. 31, pl. 3, figs. 7 a–c, 1929.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, no. 1, p. 12, pl. 3, figs. 1 a–c, 1930.

*Miliolina costata* HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 579, pl. 44, figs. 9-12, 1915.

Test elongate, two to three times as long as broad, periphery usually rounded; chambers distinct, inflated; sutures somewhat depressed; wall ornamented by numerous fine longitudinal costae, often slightly oblique to the axis of the chamber; aperture at the end of a short neck, with a slight lip, and single short tooth. Length, 0.35-0.5 mm.; breadth, 0.15-0.25 mm.; thickness, 0.1-0.12 mm.

The types of d'Orbigny's species are from the Mediterranean. Forms such as those figured here occur rather abundantly in our material from Vavau Anchorage, Tonga Islands, from which the figured specimens came, and from the following Fiji Islands localities: 12 fathoms off Levuka; 3 fathoms, Viva Anchorage; Mokaujar Anchorage; and near Nairai. It was also common in 7 fathoms at Rotonga.

QUINQUELOCULINA CRASSA d'Orbigny var. SUBCUNEATA Cushman

PLATE 5, FIGURES 8 a-c

*Miliolina crassa* HERON-ALLEN and EARLAND (part) (not d'Orbigny), Trans. Zool. Soc. London, vol. 20, pt. 2, p. 572, pl. 42, fig. 41 (not 37-40), 1915.

*Quinqueloculina crassa* d'ORBIGNY var. *subcuneata* CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 423, pl. 89, figs. 4 a-c, 1921; Carnegie Inst. Washington Publ. 342, p. 62, pl. 23, fig. 7, 1924; U. S. Nat. Mus. Bull. 104, pt. 6, p. 30, pl. 5, figs. 1 a-c, 1929.

*Quinqueloculina crassa* CUSHMAN (not d'Orbigny), Carnegie Inst. Washington Publ. 344, p. 82, 1926.

Test similar to the typical form in ornamentation but short, and the chambers wedge-shaped, almost sharp at the peripheral angles.

This variety, originally described from the Philippines, occurs widely distributed in the Indo-Pacific and also extends into the Atlantic.

The form is not common in our material, but occurs rarely off Levuka, Fiji Islands, in 12 fathoms; Vavau Anchorage, Tonga Islands, 18 fathoms; off Rotonga, 7 fathoms; Port Lotten, Kersail, Caroline Islands; and Rongelap Atoll, Marshall Islands.

QUINQUELOCULINA CRENULATA, new species

PLATE 5, FIGURES 11 a-c

Test elongate, slender, about three times as long as broad; chambers distinct, not much inflated; sutures distinct; wall ornamented by numerous very coarse, obliquely curved, short costae, extending inward from the peripheral angle, and sloping toward the base of the chamber, six at the base of the last-formed chamber sometimes form-

ing reticulations; aperture with a prominent neck. Length, 0.55–0.75 mm.; breadth, 0.13–0.18 mm.; thickness, 0.08–0.12 mm.

*Holotype*.—U.S.N.M. No. 14615, from Port Lotten, Kersail, Caroline Islands.

This is a very peculiarly ornamented species, and it somewhat remotely resembles the form described and named by d'Orbigny in his Cuban papers as *Quinqueloculina tricarinata*. Our species is, however, apparently quite distinct from d'Orbigny's, and enough specimens were found at the type locality to show that the characters are fairly constant. It has not occurred, however, at any of the other stations.

QUINQUELOCULINA FUNAFUTIENSIS (Chapman)

PLATE 5, FIGURES 9, 10

*Miliolina funafutiensis* CHAPMAN, *Jourb. Linn. Soc. Zool.*, vol. 28, p. 178, pl. 19, fig. 6, 1901; *Proc. Zool. Soc. London*, vol. 1, p. 231, 1902.—HERON-ALLEN and EARLAND(?), *Trans. Zool. Soc. London*, vol. 20, pt. 2, p. 566, pl. 42, figs. 21, 22, 1915.

*Quinqueloculina funafutiensis* CUSHMAN, *Carnegie Inst. Washington Publ.* 311, p. 67, pl. 13, fig. 3, 1922; *U. S. Nat. Mus. Bull.* 104, pt. 6, p. 30, pl. 5, figs. 1 a-c, 1929.

Test somewhat longer than broad in end view, with the angles subacute or rounded, but generally triangular, occasionally with the angles keeled; chambers distinct, somewhat inflated; sutures slightly depressed; wall ornamented with numerous delicate costae which are rather strongly oblique to the periphery of the chamber; aperture at the end of a slight neck, rounded with a simple elongate tooth. Length, 0.3–0.5 mm.; breadth, 0.18–0.25 mm.; thickness, 0.12–0.2 mm.

Chapman originally described this species from the lagoon at Funafuti in the Pacific; it has since been recorded from the Ke-

TABLE 4.—*Quinqueloculina funafutiensis*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21970.....	1	H3849	Village on west side Niau Atoll, 1.75 miles NE.	Fathoms 491	° F. .....	co. s. pter oz....	Rare.
21971.....	1	H3866	Lat. 17° 17' S., long. 145° 45' 30'' W.	864	.....	glob. oz. mang..	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.



rimba Archipelago off southeast Africa by Heron-Allen and Earland, and I have had similar specimens from the Atlantic off the Tortugas, which show the oblique costae.

Our material in the present collections shows that the species is well distributed about the South Pacific Islands, occurring at Mokuaujar Anchorage, Fiji Islands; off Levuka, Fiji, in 12 fathoms; Vavau Anchorage, Tonga Islands; both in the lagoon and off the ished; aperture rounded or elliptical, with a distinct tooth, sometimes bifid at end. Length, 0.6 mm.; breadth, 0.35 mm.; thickness, 0.25 mm.

QUINQUELOCULINA cf. GRACILIS d'Orbigny

PLATE 5, FIGURE 12

Our figure shows a very elongate specimen, which has a tapering neck with a very distinct phialine lip and circular aperture. Such forms occur at Rangiroa and are somewhat like d'Orbigny's species, although they seem to be distinct. There are slight traces of longitudinal markings, and the wall is polished. Not enough specimens were obtained to be sure of the complete characters.

QUINQUELOCULINA GUALTIERIANA d'Orbigny

PLATE 6, FIGURES 1 a-c

*Quinqueloculina gualtieriana* D'ORBIGNY. in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 186, pl. 11, figs. 1-3, 1839.

Test slightly longer than broad, with the periphery sharply angled and the test tending to become more compressed as the later chambers are added; chambers distinct, slightly inflated, broadest toward the basal end, which projects somewhat beyond the general outline of the test; sutures very distinct, depressed; wall smooth and polished; aperture rounded or elliptical, with a distinct tooth, sometimes bifid at end. Length, 0.6 mm.; breadth, 0.35 mm.; thickness, 0.25 mm.

This species, described by d'Orbigny from the West Indian region, is present in very typical form in our South Pacific material. In a large series there are a few specimens that seem to show that this species is tending toward *Massilina*, as occasionally specimens are found in which the last-formed chambers are in a single plane. The whole test is much compressed, as shown in the original figures, and the step to *Massilina* would not be a very great one.

Our specimens are from off the Fiji Islands in 12 fathoms, Levuka; 3 fathoms, Viva Anchorage; in 7 fathoms off Rotonga; and most abundant at Vavau Anchorage, Tonga Islands.

## QUINQUELOCULINA LAMARCKIANA d'Orbigny

## PLATE 6. FIGURES 2 a-c

*Quinqueloculina lamarckiana* d'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 189, pl. 11, figs. 14, 15, 1839.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, p. 65, pl. 15, figs. 13, 15, 1921; Carnegie Inst. Washington Publ. 311, p. 64, 1922; Publ. 342, p. 63, 1924; Publ. 344, p. 81, 1926.—HOWE, Journ. Pal., vol. 2, p. 175 (list), 1928.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 26, pl. 2, figs. 6 a-c, 1929.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, no. 1, p. 10, pl. 1, figs. 9, 10, 1930.—CUSHMAN and MOYER, Contr. Cushman Lab. Foram. Res., vol. 6, p. 52, 1930.—CUSHMAN, Florida State Geol. Surv. Bull. 4, p. 20, pl. 2, figs. 3-5, 1930.

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

*Quinqueloculina cuvieriana* H. B. BRADY (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 162, pl. 5, figs. 12 a-c, 1884.

Test nearly as broad as long; chambers distinct; sutures slightly depressed; chambers generally triangular in transverse section, the angles subacute but not carinate; wall smooth and polished; apertural end of the chamber very slightly extended, forming an elliptical neck without a definite lip, but with a narrow elongate tooth. Maximum length, 1 mm.; breadth, 0.8 mm.; thickness, 0.5 mm.

This is a very widely distributed species occurring most commonly in tropical waters, although there are numerous records for it in comparatively deep water. Our specimens, in addition to the *Albatross* stations, data for which are given in the accompanying table, are from off Fiji Islands, 40 to 50 fathoms; off Nairai, Fiji, 12 to 24 fathoms; off Levuka, Fiji, 12 fathoms; and Viva Anchorage, Fiji, 3 fathoms. The species is common also at Vavau Anchorage, Tonga Islands, in 18 fathoms.

TABLE 5.—*Quinqueloculina lamarckiana*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21961.....	1	H3815	Lat. 15° 15' S., long. 147° 51' 35'' W.	524	°F.	wh. co. s. brk. sh.	Rare.
21962.....	1	H3827	Lat. 14° 53' 20'' S., long. 148° 42' 30'' W.	486		crs. wh. co. s. vol. part.	Do.
21963.....	1	H3873	Southwest point Tahanae, 68° N., 4 miles E.	966		glob. oz. mang..	Do.
21964.....	1	H3898	Northwest point Hikueru Atoll, ½ mile E.	348	43.8	co. s. brk. sh....	Do.
21965.....	1	H3914	Northeast point Nukutavake, 1 mile S.	636	38.9	co. s.....	Do.
21966.....	1	H3935	Hereheretue Atoll, 1 mile W....	594	39.5	crs. co. s.....	Do.
21967.....	2	H3936	Hereheretue Atoll, 0.3 mile E....	189	62.1	co. s. mang. part.	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

The species was originally described under the first two names by d'Orbigny from the West Indies, where it is well distributed. Many of the West Indian species occur in our Indo-Pacific material in rather typical form.

QUINQUELOCULINA PARKERI (H. B. Brady)

PLATE 6, FIGURES 3, 4

"*Quinqueloculina* with oblique ridges" PARKER, Trans. Micr. Soc. London, vol. 6, p. 53, pl. 5, fig. 10, 1858.

*Miliolina parkeri* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 46, 1881; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 177, pl. 7, fig. 14, 1884.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 11; Journ. Linn. Soc. Zool., vol. 28, p. 175, 1901; Proc. Zool. Soc. London, vol. 1, p. 231, 1902.—DAKIN, Rep. Pearl Oyster Fisheries Ceylon, p. 230, 1906.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 574, pl. 43, figs. 11, 12, 1915.

*Quinqueloculina parkeri* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 50, pl. 15, fig. 3, 1917; Carnegie Inst. Washington Publ. 213, p. 290, 1918; U. S. Nat. Mus. Bull. 100, vol. 4, p. 440, pl. 86, figs. 4 a-c, 1921; Carnegie Inst. Washington Publ. 342, p. 59, pl. 22, fig. 3, 1924.

Test about twice as long as broad, periphery subacute; chambers distinct; sutures depressed; surface marked by a series of transverse ridges and alternating excavations not involving the peripheral margin; aperture with a slight lip, rectangular, with a single tooth. Length, 1-1.65 mm.; breadth, 0.6-1 mm.; thickness, 0.4-0.6 mm.

This typically Indo-Pacific species, which from published records has a wide range, occurs rather sparingly in our collections, although it has occurred in few numbers at the following stations: Off the Fiji Islands in 12 fathoms at Levuka, and at Mokaujar Anchorage; in 18 fathoms, Vavau Anchorage, Tonga Islands; Makemo Lagoon, Paumotu Archipelago; Port Lotten, Kersail, Caroline Islands; and Guam Anchorage, Ladrone Islands, in 21 fathoms. Specimens from the last locality are the largest and best developed of all these, and the figured specimens are from there.

QUINQUELOCULINA POLYGONA d'Orbigny

PLATE 6, FIGURES 5, 6

*Quinqueloculina polygona* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 198, pl. 12, figs. 21-23, 1839.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, p. 66, pl. 16, figs. 3, 4, 1921; Carnegie Inst. Washington Publ. 311, p. 68, 1922; Publ. 344, p. 82, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 28, pl. 3, figs. 5 a-c, 1929.

Test two or three times as long as broad; chambers distinct, each end extended beyond the previous outline, polygonal in transverse section with the periphery either truncate and the angles somewhat rounded, or with definite projecting carinae at the angles; sutures

very distinct, usually slightly depressed; wall either smooth or more frequently with slight elongate pits covering much of the surface; aperture elongate, somewhat rectangular, but usually narrowest toward the base, toward each a simple narrow tooth extends into the opening. Length, 1–1.3 mm.; breadth, 0.4–0.5 mm.; thickness, 0.2–0.25 mm.

D'Orbigny described this species originally from the West Indies, from Jamaica and Cuba. The Indo-Pacific specimens seem to show a wide variation the extremes of which seem very distinct, but with a large series these distinctions are usually bridged.

It is one of the commonest species in our collections, occurring off Fiji Islands at Mokaujar Anchorage; 12 fathoms off Levuka; Vavau Anchorage, Tonga Islands; Rutavu; Makemo Lagoon; Pinaki; and beach off wharf Hereheretue. There are also specimens noted in the accompanying table from two *Albatross* stations.

TABLE 6.—*Quinqueloculina polygona*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21968.....	2	H3916	Pinaki Atoll, 1 mile E.....	Fathoms 486	° F. 41	crs. co. s. pter. oz	Rare.
21969.....	1	H3924	Nukutipipi Atoll, 1 mile NW...	649	39	co. s. brk. sh....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

QUINQUELOCULINA SAMOENSIS Cushman

PLATE 7, FIGURES 1 a–c

*Quinqueloculina samoensis* CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 59, pl. 21, figs. 4–7, 1924.

Test slightly longer than broad, periphery either squarish in the adult or with a blunt keel in the young, often sinuous; wall thick, with an encrusting of fine sand grains, initial end of the chamber extended and the apertural end elongated slightly into a cylindrical neck with a phialine lip and single tooth. Length, 0.65 mm.; breadth, 0.45 mm.; thickness, 0.3 mm.

This species, originally described from shallow water collections at Samoa, seems to be widely distributed in the collections examined, occurring at the following localities: Mokaujar Anchorage, Fiji; Levuka, Fiji, 12 fathoms; off Nairai, Fiji, 12–24 fathoms; inside the lagoon, Pinaki Atoll, Paumotu; off Rotonga, 7 fathoms; Vavau Anchorage, Tonga Islands, 18 fathoms; off Niau; Port Lotten, Kersail, Caroline Islands; and Guam Anchorage, Ladrone Islands, 21 fathoms.

There is considerable variation in the sinuous character of the chambers, but except for this variation the other characters seem to be generally constant. It may be easily distinguished from either of the other two arenaceous forms which are common in the region.

QUINQUELOCULINA SEMIRETICULOSA, new species

PLATE 7, FIGURES 2 a, b

Test small, two to three times as long as broad, periphery rounded, the basal end broadly rounded, the apertural end somewhat more contracted; chambers distinct, slightly inflated; sutures slightly depressed; wall beautifully ornamented by a somewhat reticulate pattern, the main elements of which are composed of oblique costae, somewhat irregularly sinuous, the depressed areas between broken up by transverse ridges into a series of elongate pits; aperture very slightly produced, occasionally with a very short neck, the aperture itself nearly circular with a very short, simple tooth. Length, 0.4–0.5 mm.; breadth, 0.2–0.25 mm.; thickness, 0.15–0.2 mm.

*Holotype*.—Cushman Coll. No. 14619, from Port Lotten, Kersail, Caroline Islands.

This seems to be a very beautifully ornamented, localized species, which was fairly common at the type locality but was not seen in any of the other collections.

QUINQUELOCULINA STRIATULA, new species

PLATE 7, FIGURES 3, 4

Test slightly longer than broad, the periphery of the chambers subacute; chambers triangular in section, distinct; sutures distinct, only slightly depressed; wall ornamented with numerous very fine, incised lines, slightly oblique to the periphery of the chamber, the peripheral angle of the chamber usually smooth; aperture large, broad, with a very slight lip, and a large, flat tooth nearly filling the aperture. Length, 0.6–0.8 mm.; breadth, 0.55–0.65 mm.; thickness, 0.35–0.4 mm.

*Holotype*.—Cushman Coll. No. 14780, from Mokaujar Anchorage, Fiji Islands.

This is abundant at the type locality, and also occurs about Fiji from Viva Anchorage, 3 fathoms; off Levuka, 12 fathoms; off Nairai, 12 fathoms. It is evidently widely distributed in the South Pacific, as we have less abundant specimens from Rotonga, 7 fathoms; Pinaki Islands; Makemo Lagoon; and Rongelap Atoll, Marshall Islands.

This is evidently the same as *Miliolina undulata* of Heron-Allen and Earland, not of d'Orbigny, figured in their Kerimba paper

(pl. 43, figs. 5-8).<sup>2</sup> A reference to the figures of *Quinqueloculina undulata* d'Orbigny given by Fornasini shows that the species has a rather narrow, elongate aperture, and a very narrow tooth. Specimens in my collection from Castel Arquato, Italy, one of the localities mentioned by d'Orbigny, are entirely identical with the original figures of d'Orbigny and show the same type of aperture and general characters of the test, the outer angles of which are not nearly so sharply formed as in our South Pacific species. The figures given by Heron-Allen and Earland show specimens with the same broad aperture and flat tooth that are seen throughout our series. They mention the close relation of their material to *Quinqueloculina nussdorfensis* d'Orbigny, but topotype material of that species compared with the figures shows that it has a narrow tooth and an elongate aperture, with the sides truncate. They also mention *Triloculina brongniartiana* d'Orbigny in this connection, but that species as developed in the West Indies is triloculine with a rounded periphery, and an exerted neck, making it a very different species from ours.

The material that I have referred to *Triloculina suborbicularis* d'Orbigny<sup>3</sup> is also possibly to be referred to this same species.

QUINQUELOCULINA SULCATA d'Orbigny

PLATE 7, FIGURES 5-8

*Quinqueloculina sulcata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 301, no. 17, 1826.—  
FORNASINI, Mem. Accad. Sci. Istit. Bologna, ser. 5<sup>a</sup>, vol. 8, p. 363, fig. 9 (in text), 1900.

Test elongate,  $2\frac{1}{2}$  to 3 times as long as broad, apertural end considerably extended out beyond the main body of the test; chambers distinct, elongate, in the early stages with a single angle at the periphery, later becoming truncate with two distinct angles, and in the adult typically with three raised costae; sutures fairly distinct, not much depressed; wall smooth except for the costae; both ends of the last-formed chamber extending beyond the previous chambers, the apertural end tapering with a rounded opening, a definite lip, and a simple tooth, which extends slightly beyond the rim of the aperture in side view. Maximum length, 1.75 mm.; breadth, 0.6 mm.; thickness, 0.3 mm.

D'Orbigny's original material of this species was from the Red Sea, an area that is closely associated in its fauna with that of the general Indo-Pacific region. Although this species was not really known until the publication of Fornasini's paper in 1900, it seems

<sup>2</sup> The Foraminifera of the Kerimba Archipelago, Trans. Zool. Soc. London, vol. 20, pt. 2, pp. 543-794, pls. 40-53, 1915.

<sup>3</sup> U. S. Nat. Mus. Bull. 71, pt. 6, pl. 21, fig. 3, 1917.

to fit this particular species much better than any of the earlier figures. The development as shown in our series of specimens is interesting. Though the neck remains of the same general character throughout and also the general form of the test, the form of the chambers changes greatly from the young to the adult condition, as already noted in the above description.

This is one of the largest species of the genus in the collection and is best developed in the collections from Guam Anchorage, Ladrone Islands, in 21 fathoms. It also occurs off the Fiji Islands at Mokaujar Anchorage and at Rangiroa. There are numerous specimens from various localities that are possibly the young of this species, but where no adults are present to check this they have not been included.

### Genus SCHLUMBERGERINA Munier-Chalmas, 1882

*Schlumbergerina* MUNIER-CHALMAS, Bull. Soc. Géol. France, ser. 3, vol. 10, p. 424, 1882.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 148, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 35, 1929.

*Miliolina* (part) of authors.

*Massilina* (part) of authors.

*Genoholotype*.—*Schlumbergerina areniphora* Munier-Chalmas.

Test typically quinqueloculine, the chambers narrowing so that frequently more than five chambers may be visible from the exterior; wall calcareous, imperforate, the exterior thickly coated with sand grains; aperture cribrate.

Late Tertiary and Recent.

The *Miliolina alveoliniformis* H. B. Brady described in 1879 is probably the same as Munier-Chalmas's species, and belongs here. This species is often abundant in shallow-water tropical collections, especially in the Indo-Pacific, but similar forms are also found in shallow warm water in the West Indian region.

### SCHLUMBERGERINA ALVEOLINIFORMIS (H. B. Brady)

#### PLATE 8. FIGURE 1

*Miliolina alveoliniformis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 268, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 181, pl. 8, figs. 15-20, 1884.—EGGER, Abh. Kön. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 232, pl. 2, figs. 17-19, 1893.—WOODWARD, The Observer, vol. 4, p. 76, 1893.—MILLET (in part), Journ. Roy. Micr. Soc., 1898, p. 510.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 28, p. 177, 1900; vol. 30, p. 398, 1910.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 581, 1915.

*Quinqueloculina alveoliniformis* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 43, 1917; U. S. Nat. Mus. Bull. 100, vol. 4, p. 443, 1921; Proc. U. S. Nat. Mus., vol. 59, p. 64, 1921; Carnegie Inst. Washington Publ. 311, p. 64, 1922; Publ. 342, p. 58, pl. 21, fig. 8, 1924; Publ. 344, p. 81, 1926.

*Schlumbergerina alveoliniformis* CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 36, 1929.

Test elongate, fusiform, composed of numerous chambers, long and narrow, five normally visible from the exterior in the early stages, more in the adult; wall in young specimens thin and porcelaneous, in adults covered with sand grains; aperture composed of numerous pores, or radiate, typically cribrate. Length, 1.5-2.2 mm.; breadth, 0.8-1 mm.

The species is abundant in the Fiji Islands at Mokuajar Anchorage, but it has not occurred in the other shallow-water collections. There is a specimen from *Albatross* Station H3875, half a mile off southwest point of Tahanae, Paumotu, in 269 fathoms. The bottom character at this station is given as coarse coral sand, and this is undoubtedly a specimen washed out from shallow water. It is surprising that this species did not occur at more localities, as it is widely distributed in the Indo-Pacific.

#### Genus MASSILINA Schlumberger, 1893

*Massilina* SCHLUMBERGER, Mém. Soc. Zool. France, vol. 6, p. 218, 1893.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 149, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 36, 1929.

*Quinqueloculina* (part) D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 303, 1826.  
*Miliolina* (part) of authors.

*Genotype*.—By designation, *Quinqueloculina secans* d'Orbigny.

Test with the early chambers quinqueloculine, later ones added on opposite sides in a single plane, the quinqueloculine stage present in both megalospheric and microspheric forms; aperture simple, with a bifid tooth.

Some of our specimens show very clearly the development of this genus from *Quinqueloculina*, the early stages being decidedly quinqueloculine, while the later ones progressively add the chambers more and more in a single plane. The genus may be distinguished from *Spiroloculina*, which has almost all the chambers in a single plane from the beginning, especially in the megalospheric form. In *Massilina* all the early chambers are quinqueloculine in both the microspheric and megalospheric forms. Species occur in which the exterior is arenaceous, but most of the species have lost that character and are entirely calcareous.

#### MASSILINA ALVEOLINIFORMIS Millett

##### PLATE 8, FIGURES 3 a, b

*Massilina alveoliniformis* MILLETT, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, figs. 5-7.—HERON-ALLEN and EARLAND, Trans. Zool. Soc., London, vol. 20, pt. 2, p. 584, pl. 45, fig. 15, 1915.—CUSHMAN, Carnegie Inst. Washington Publ. 311, p. 69, 1922; Publ. 342, p. 64, 1924; U. S. Nat. Mus. Bull. 104, pt. 6, p. 39, 1929.



*Spiroloculina asperula* H. B. BRADY (not Karrer), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 152, pl. 8, figs. 13, 14 (11?), 1884.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, p. 72, 1921.

*Massilina asperula* CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 447, 1921.

*Quinqueloculina variabilis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 301, No. 15, 1826.—FORNASINI, Mem. Accad. Sci. Istif. Bologna, ser. 6<sup>a</sup>, vol. 2, p. 65, pl. 3, figs. 6, 7, 1905.

Test much compressed, nearly circular; early chambers quinqueloculine, later ones in a single plane, periphery rounded, chambers distinct; wall of sand grains with a porcelaneous lining to the chambers; aperture very slightly exserted. Length, 1 mm.; breadth, 0.9 mm.; thickness, 0.25 mm.

This species, except for a very few records in the Tortugas region off Florida, is known only from the Indo-Pacific, but it is apparently widely distributed in that region. The only material we have in the present collection that can be referred to it is from off Levuka, Fiji Islands, 12 fathoms.

It may be noted here that the *Quinqueloculina variabilis* of d'Orbigny's 1826 paper, which came from Rawack, is probably the same as Millett's species. As the name *Quinqueloculina variabilis* d'Orbigny remained a *nomen nudum* until the publication of Fornasini in 1905, d'Orbigny's name can not be used for this species.

#### MASSILINA PLANATA, new species

##### PLATE 8, FIGURES 8 a, b

Test comparatively large, very much compressed, periphery subacute, both ends of the final chamber projecting beyond the body of the test; chambers distinct, much compressed, early ones entirely quinqueloculine, later ones in a single plane; sutures fairly distinct, but very slightly depressed; wall matte, smooth except for very fine elongate pits arranged generally in the long axis of the chamber; aperture elliptical, with a slight lip and an elongate simple tooth, slightly bifid at the tip. Length of holotype, 2 mm.; breadth, 1 mm.; thickness, 0.2 mm.

*Holotype*.—Cushman Coll. No. 14629, from Guam Anchorage, Ladrone Islands, 21 fathoms.

This is a large striking species that in our material occurred at the type locality only. It suggests rather strongly the specimens referred by Heron-Allen and Earland in their Kerimba Archipelago paper (pl. 41, figs. 1-5)<sup>4</sup> to *Spiroloculina planissima* (Lamarek). The early quinqueloculine chambers show that their species belongs to the genus *Massilina* and not to *Spiroloculina*, and its general character suggests that our species is to be found widely distributed in the Indo-Pacific region.

<sup>4</sup> The Foraminifera of the Kerimba Archipelago, Trans. Zool. Soc. London, vol. 20, pt. 2, pp. 543-794, pls. 40-53, 1915.

## MASSILINA INAEQUALIS Cushman

## PLATE 8, FIGURES 6, 7

*Massilina inaequalis* CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, p. 72, pl. 17, figs. 12, 13, 1921; U. S. Nat. Mus. Bull. 104, pt. 6, p. 38, pl. 7, figs. 6 a-c, 1929.

Test longer than broad, compressed, periphery squarely truncate; chambers elongate, of uniform width, quadrangular in transverse section; sutures distinct, very slightly depressed; wall smooth except for numerous fine, linear depressions breaking up the evenness of the surface; aperture rounded, with a slight lip and a definite linear tooth which is slightly bifid at the tip. Length, 1.3 mm.; breadth, 0.6 mm.; thickness, 0.18 mm.

This species was originally described from the north coast of Jamaica at Montego Bay, where it was fairly common. It has not been recorded elsewhere, but very typical specimens occur in our material from Vavau Anchorage, Tonga Islands, which seem to be absolutely identical with the Jamaican specimens.

## MASSILINA AUSTRALIS, new species

## PLATE 8, FIGURES 2 a, b

Test very much compressed, the earliest chambers quinqueloculine, later ones becoming planispiral, with slightly more than two chambers making up a coil, periphery subacute; chambers distinct, very slightly inflated; sutures fairly distinct, very slightly depressed between the last-formed chambers, but those of the earlier portion obscured; wall fairly thin, usually translucent, finely pitted; aperture elongate, narrow, with a slight lip, but no apertural tooth. Diameter, 0.8-1 mm.; thickness, 0.1 mm.

*Holotype*.—U.S.N.M. No. 14625, from Rotonga (= ? Rarotonga, Cook Islands), 7 fathoms.

This species is very common at the type locality. It is probably the same as that assigned by some authors to *Massilina secans* of d'Orbigny. That species, however, in its typical development has a very prominent quinqueloculine stage, and the later chambers have a definite elongate tooth in the aperture. Our series of specimens from the type locality shows that some of the last-formed chambers have a wrinkled appearance as if due to stages of growth of the chamber. The surface is dull and seems to be slightly pitted all over.

## MASSILINA MACILENTA (H. B. Brady)

## PLATE 8, FIGURES 4 a, b

*Mitlolina macilenta* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 167, pl. 7, figs. 5, 6, 1884.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 28, p. 399, 1902.

*Quinqueloculina macilenta* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 55, 1917.

(?) *Massilina macilenta* HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 583, pl. 45, figs. 13, 14, 1915.—CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 64, pl. 24, figs. 3, 4, 1924.

(?) *Massilina siccans* D'ORBIGNY var. *macilenta* MILLETT, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, fig. 4.

Test nearly circular, much compressed, periphery rounded, early chambers quinqueloculine, later ones spiroloculine; surface ornamented by obliquely longitudinal costae; apertural end with a flaring lip, aperture elongate. Length, 0.35 mm.; breadth, 0.3 mm.; thickness, 0.1 mm.

The records for this species show that it is rather definitely limited to the Indo-Pacific regions. It is a very distinctive, although small species, and shows little variation in its characters. Specimens are rare in our material, but represent the following localities: Off Fiji Islands in 12 fathoms, Levuka, and Mokuajar Anchorage; near Niau, and Vavau Anchorage, Tonga Islands, 18 fathoms.

## MASSILINA CRENATA (Karrer)

## PLATE 8, FIGURES 5 a, b

*Spiroloculina crenata* KARRER, Sitz. Akad. Wiss. Wien, vol. 57, p. 135, pl. 1, fig. 9, 1868.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 156, pl. 10, figs. 24-26, 1884.

*Massilina crenata* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 57, pl. 20, fig. 2, 1917; U. S. Nat. Mus. Bull. 100, vol. 4, p. 455, 1921; Carnegie Inst. Washington Publ. 311, p. 69, pl. 11, fig. 6, 1922; Publ. 342, p. 66, pl. 25, fig. 4, 1924; U. S. Nat. Mus. Bull. 104, pt. 6, p. 38, pl. 7, fig. 5, 1929.

Test in its early development quinqueloculine, adult chambers in a single plane, in front view subelliptical, nearly as broad as long, compressed; chambers long and narrow, margin crenulate, due to the regular contractions or plications of the chamber in the adult; aperture rounded. Length, 0.55 mm.; breadth, 0.35 mm.; thickness, 0.08 mm.

This is typically an Indo-Pacific species, but there are rare specimens from the West Indian region.

In the present collections the species has occurred at but two stations, at Rangiroa and at *Albatross* Station H3853, 28° south, 3.5 miles east of Ngaruae Pass, Fakarava Atoll, Paumotu. A specimen from the latter station is figured.

Genus *SPIROLOCULINA* d'Orbigny, 1826

- Spiroloculina* d'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 298, 1826.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 147, 1884.—CHAPMAN, The Foraminifera, p. 89, 1902.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 149, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 40, 1929.
- Miliola* (part) LAMARCK, Ann. Mus. d'Hist. Nat., vol. 5, p. 352, 1804 (and later authors).

*Genotype*.—By designation, *Spiroloculina depressa* d'Orbigny.

Test with the early chambers in the microspheric form quinqueloculine, the later ones in a single plane; chambers a half coil in length, in the megalospheric form all the chambers usually in one plane; apertural end usually with a neck and lip, simple, with a simple or bifid tooth.

Permian (?) Cretaceous to Recent.

This is a more specialized genus than *Massilina*, and the character of having chambers in a single plane is taken on very early even in the microspheric form. In the shallow-water material of the Pacific islands, specimens of this genus are often very abundant but belong to but few species.

**SPIROLOCULINA GRATELOUPI d'Orbigny**

## PLATE 8, FIGURES 9-11

- Spiroloculina grateloupi* d'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 298, 1826.—TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 1, p. 52, pl. 5, figs. 5, 6, 1878.—WIESNER, Arch. Prot., vol. 25, p. 208, 1912.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 31, pl. 4, figs. 4, 5, 1917; Proc. U. S. Nat. Mus., vol. 56, p. 634, 1919; U. S. Nat. Mus. Bull. 100, vol. 4, p. 396, pl. 78, figs. 4 *a*, *b*; pl. 100, fig. 3; figs. 17, 18 (in text), 1921; Carnegie Inst. Washington Publ. 311, p. 59, 1922; Publ. 342, p. 56, pl. 20, figs. 3, 4, 1924; Publ. 344, p. 80, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 40, pl. 8, figs. 1 *a*, *b*, 1929.
- Spiroloculina excavata* H. B. BRADY (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 151, pl. 9, figs. 5, 6, 1884.
- Spiroloculina impressa* H. B. BRADY (not Terquem), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 151, pl. 10, figs. 3, 4, 1884.
- Spiroloculina angulosa* d'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 298, 1826.—FORNASINI, Mem. Accad. Sci. Istit. Bologna, ser. 6<sup>a</sup>, vol. 1, p. 5, pl. 1, fig. 8, 1904.

Test elongate, broadest in the center, tapering toward either end; chambers rapidly thickening as added, in end view the periphery much the broadest portion of the test, central portion deeply excavated; periphery of the chambers in end view much convex, especially in the central portion, the edges broadly rounded; chambers evenly curved, the final chamber somewhat projecting, both at the base and at the apertural ends, the latter having a decided neck with a phialine lip; the aperture itself rounded and with either a single tooth with a bifid end, the two projections forming a concave extremity, or in some

cases a pair of such bifid teeth opposite one another; surface of the test dull, somewhat roughened. Length, 1.25 mm.; breadth, 0.6 mm.; thickness, 0.25 mm.

The typical form of the species is extremely common at some of the South Pacific stations, especially about the Fiji Islands, where it occurs off Levuka, 12 fathoms; Nairai, 12 fathoms; Viva Anchorage, 3 fathoms; and Mokaujar Anchorage; as well as at a station locality not given, but in 40 to 50 fathoms. Besides these Fiji stations it occurs at Vavau Anchorage, Tonga Islands; off Rotonga, 7 fathoms; at Port Lotten, Kersail, Caroline Islands; and at Guam Anchorage, Ladrone Islands, 21 fathoms. In the *Albatross* samples it occurs at Stations H3843, off Point Venus, Tahiti Island, 807 fathoms; H3930, off Anu Anuraro Atoll, Paumotu, 438 fathoms; and H3992, Schischmarev Pass, Marshall Islands, 482 fathoms.

TABLE 7.—*Spiroloculina grateloupi*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21954.....	1	H3843	Point Venus, Tahiti Island, 55° S., 3.8 miles E.	Fathoms 807	° F. .....	fine. vol. s. m.....	Rare.
21955.....	1	H3930	Anu Anuraro Atoll, 3/4 mile N.W.	438	40.7	co. s.....	Do.
21956.....	1	H3992	Schischmarev Pass, Wotje, Marshall Islands, 1 mfile N.	482	41.7	.....do.....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

**SPIROLOCULINA GRATELOUPI d'Orbigny SERRULATA, new variety**

PLATE 9, FIGURES 1 a, b

Variety differing from the typical in the peripheral margins which in the variety are beautifully serrate with a series of irregularly shaped teeth.

*Holotype of variety*.—Cushman Coll. No. 14748, from Viva Anchorage, Fiji Islands, in 3 fathoms.

The figured specimen shows the holotype, which has the teeth very well developed along the edges. There seem to be many gradations between this and the form in which these edges are only roughened. The variety was only found at the type locality, but there it is abundant.

**SPIROLOCULINA GRATELOUPI d'Orbigny ACESCATA, new variety**

PLATE 9, FIGURES 2 a, b

*Spiroloculina canaliculata* CUSHMAN (not d'Orbigny), Carnegie Inst. Washington Publ. 342, p. 57, pl. 21, fig. 1, 1924.

Variety with the test elongate, elliptical, much compressed, somewhat variably depressed in the middle; chambers distinct, earlier ones rectangular in transverse section, periphery truncate, the angles sharply keeled, later chambers much compressed with a single keel; sutures distinct, little depressed; wall smooth, glossy; apertural end extended into a cylindrical neck and a distinct phialine lip and tooth.

*Holotype of variety*.—Cushman Coll. No. 14747, from off Nairai, Fiji Islands, 24 fathoms.

This variety is very abundant at the type locality, and there are a few other records for it: Mokaujar Anchorage, Fiji; Levuka, Fiji. I have already noted this variety from Samoa. The young stages, which are found with the adults, are very similar to *Spiroloculina grateloupi*, but as the form develops toward its adult stage there is a very considerable compression of the test, and, in the adult, chambers are developed that are not only compressed but have a definite thin peripheral keel.

#### SPIROLOCULINA ANTILLARUM d'Orbigny

##### PLATE 9, FIGURES 3-5

*Spiroloculina antillarum* d'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 166, pl. 9, figs. 3, 4, 1839.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 155, pl. 10, figs. 21 *a*, *b*, 1884.—CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 407, pl. 81, figs. 4 *a*, *b*; pl. 83, fig. 4 (?), 1921; Proc. U. S. Nat. Mus., vol. 59, p. 63, pl. 14, figs. 14, 15, 1921; Carnegie Inst. Washington Publ. 311, p. 61, 1922; Publ. 342, p. 55, pl. 20, fig. 1, 1924; U. S. Nat. Mus. Bull. 104, pt. 6, p. 43, pl. 9, fig. 3, 1929.

Test elongate, elliptical; chambers nearly circular in cross section; surface ornamented by numerous longitudinal costae, often slightly oblique, both ends of the chamber projecting and the intermediate portions thus left either filled by a plate of clear material or occasionally open; apertural end projecting and forming a cylindrical neck with a slight lip and a single tooth, sometimes bifid at the tip. Length, 0.55-0.75 mm.; breadth, 0.35-0.4 mm.; thickness, 0.15-0.18 mm.

The original specimens of this species came from off the West Indies and were described by d'Orbigny in 1839. His species was allowed to lapse, and much of the material that should have been recorded as his species has been known under the name of *S. grata* Terquem, because of the adoption of that name by Brady in the *Challenger* report for this species of d'Orbigny. As a rule the typical form is more involute than the following variety (*angulata*), and in the Pacific at least it is much less common. The chambers

are circular in the transverse section in the typical form. Typical specimens occur at the following localities: Off Nairai, Fiji, 24 fathoms; Rutavu; Rangiroa; and at the following *Albatross* Stations: H3853, Pakaka entrance to Apataki Lagoon, Paumotus, 613 fathoms; H3910, 1 mile off southwest point of Aki Aki, Paumotus, 377 fathoms; H3916, 1 mile off Pinaki Atoll, Paumotus, 486 fathoms; H3983, half a mile off entrance of South Pass, Rongelap Atoll, Marshall Islands, 400 fathoms.

TABLE 8.—*Spiroloculina antillarum*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21957.....	1	H3853	Pakaka entrance to Apataki Lagoon, 50° N., 2 miles E.....	613	° F. 39.4	co. vol.....	Rare.
21958.....	1	H3910	Southwest point Aki Aki, 1 mile E.	377	43	co. s.....	Do.
21959.....	1	H3916	Pinaki Atoll, 1 mile E.....	486	41	crs. co. s. pter. oz.	Do.
21960.....	2	H3983	Entrance to South Pass, Rongelap, Marshall Islands, ½ mile N.	400	43.4	co. s.....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

## SPIROLOCULINA ANTILLARUM d'Orbigny var. ANGULATA Cushman

## PLATE 9, FIGURES 6-9

*Spiroloculina grata* H. B. BRADY (part) (not Terquem), Rep. Voy. *Challenger*, Zoology, vol. 9, pl. 10, figs. 22, 23, 1884.

*Spiroloculina grata* TERQUEM var. *angulata* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 36, pl. 7, fig. 5, 1917.

*Spiroloculina antillarum* d'ORBIGNY var. *angulata* CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 408, pl. 81, figs. 5 a, b, 1921; Carnegie Inst. Washington Publ. 311, p. 62, 1922; Publ. 342, p. 55, pl. 20, fig. 2, 1924; Publ. 344, p. 80, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 43, pl. 9, figs. 4 a, b, 1929.

Variety differing from the typical in the angular form of the chamber instead of cylindrical.

This variety is very much more abundant than the typical form and shows considerable variation, from specimens that are but slightly angled to those that are very much so. In some specimens there is a contortion of the chambers, and one is here figured (pl. 9, fig. 7) in which the chambers have become arranged three in a coil resembling *Flintina*. The distribution of the variety is given in the following table:

TABLE 9.—*Spiroloculina antillarum* var. *angulata*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21940.....	1	H3812	Entrance to Avatoru Pass, Rarhiroa Atoll, 7.5 miles S.	Fathoms 819	° F. -----	wh. co. s. glob. oz. vol. part.	Rare.
21941.....	2	H3814	Lat. 15° 14' 10" S., long. 147° 51' 5" W.	391	-----	wh. co. s. sh. glob.	Do.
21942.....	1	H3815	Lat. 15° 15' S., long. 147° 51' 35" W.	524	-----	wh. co. s. brk. sh.	Do.
21943.....	1	H3848	Village on west side of Niau Atoll, ¾ mile E.	252	-----	co. s. glob. oz...	Do.
21944.....	1	H3849	Village on west side of Niau Atoll, 1.75 miles NE.	491	-----	co. s. pter. oz...	Do.
21945.....	1	H3850	Niau Atoll, 3° S., 14 miles E....	677	-----	co. s. glob. oz...	Do.
21946.....	1	H3855	Northwest point Apataki, 1 mile SE.	654	38.8	crs. co. s.....	Do.
21947.....	2	H3857	Center Tikei Island, ½ mile E...	360	-----	.....do.....	Do.
21948.....	6	H3858	Ngaruae Pass, Fakarava Atoll, 28° S., 1 mile E.	599	-----	.....do.....	Few.
21949.....	1	H3860	Southwest end of Fakarava, 2 miles NE.	602	-----	co. s. pter. oz...	Rare.
21950.....	1	H3905	Northwest point Hao Atoll, ½ mile SE.	425	42	crs. co. s.....	Do.
21951.....	1	H3928	Anu Anurunga, 1 mile SE.....	659	38.5	co. s. brk. sh. pter. oz.	Do.
21952.....	2	H3930	Anu Anuraro Atoll, ¾ mile NW...	438	40.7	co. s.....	Do.
21953.....	1	H3931	Anu Anuraro Atoll, ½ mile SE...	405	42.5	co. s. pter. oz. mang. part.	Do.

<sup>1</sup>Key to abbreviations is given in Table 1.

SPIROLOCULINA ANTILLARUM d'Orbigny AEQUA, new variety

PLATE 9, FIGURES 13 a, b

Variety differing from the typical in the entirely smooth, polished surface.

*Holotype of variety*.—Cushman Coll. No. 14739, from the Inside Lagoon, Pinaki Atoll, Paumotu.

This is the only locality for this variety, but it is fairly common there.

SPIROLOCULINA ANTILLARUM d'Orbigny var. RETICOSA Chapman

PLATE 9, FIGURE 10

*Spiroloculina grata* TERQUEM var. *reticosa* CHAPMAN, Biol. Res. *Endavour*, vol. 3, pt. 1, p. 313, pl. 1, fig. 2, 1915.

*Spiroloculina antillea* D'ORBIGNY var. *reticosa* CUSHMAN, Proc. U. S. Nat. Mus., vol. 56, p. 635, 1919.

Variety differing from the typical in the ornamentation of the surface, which consists of deep elliptical pits, the long axis of the pits in the long axis of the chambers.



Chapman described this variety from "forty miles South of Cape Wiles," and I have had it from material off New Zealand. There is a single specimen from *Albatross* Station H3992, Schischmarev Pass, Marshall Islands, 482 fathoms, which seems to belong to this variety.

**SPIROLOCULINA CADUCA Cushman**

PLATE 9, FIGURES 11, 12

*Spiroloculina caduca* CUSHMAN, Carnegie Inst. Washington Publ. 311, p. 61, pl. 11, figs. 3, 4, 1922; U. S. Nat. Mus. Bull. 104, pt. 6, p. 42, pl. 9, figs. 1, 2, 1929.

Test broadly elliptical, much compressed, the apertural end extended; chambers of the adult with a sharp translucent keel, usually somewhat lobulated; sutures slightly depressed, surface of the chambers sometimes with irregular, raised costae, more or less oblique in position; aperture at the end of the cylindrical neck, rounded, with a simple tooth; surface smooth, shining, but the wall very thin and brittle. Length, 0.75 mm.; breadth, 0.45 mm.; thickness, 0.1 mm.

The only previous locality for this species is the Tortugas off Florida. It is interesting to find very typical specimens, two of which are here figured from Port Lotten, Kersail, Caroline Islands.

**SPIROLOCULINA PLANISSIMA (Lamarck) var. SAMOAENSIS Cushman**

PLATE 10, FIGURES 1 a, b

*Spiroloculina planissima* (LAMARCK) var. *samoensis* CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 58, pl. 21, figs. 9, 10, 1924.

Variety differing from the typical in the broader form and the ornamentation consisting of oblique costae running in part way from the border of the test.

This variety, described and figured from Samoa, occurs in very typical form at Vavau Anchorage, Tonga Islands. It apparently is the same as *S. striata* d'Orbigny, which was named by him in 1826, but not figured until Fornasini gave figures of those species described by d'Orbigny but not figured in the 1826 paper. Meanwhile other authors had used d'Orbigny's name of *striata*, so that this is not available for this form, which is probably somewhat widely distributed in the Indo-Pacific, d'Orbigny's species being from Rawack.

**SPIROLOCULINA EXIMIA Cushman**

PLATE 10, FIGURES 2, 3

*Spiroloculina eximia* CUSHMAN, Carnegie Inst. Washington Publ. 311, p. 61, pl. 11, fig. 2, 1922; Publ. 342, p. 56, pl. 21, fig. 2, 1924; U. S. Nat. Mus. Bull. 104, pt. 6, p. 42, pl. 8, figs. 7 a, b, 1929.

Test elongate, elliptical, periphery convex, the opposite faces concave, ends of the chamber projecting; sutures fairly distinct, the outer angle of each chamber projecting above the inner portion of the adjacent next-formed chamber; wall with a granular, dull surface; apertural end with a projecting cylindrical neck, circular, with a single, very thin, slightly bifid tooth. Length, 0.5–0.6 mm; breadth, 0.25–0.3 mm; thickness, 0.15–0.18 mm.

This species is not common, but it was found at a number of stations. It is easily distinguished by the partly rounded periphery of the chambers and by the projecting lateral margins originally described from the Tortugas. It has also been recorded at Samoa and in the present collections occurs off Levuka, Fiji, 12 fathoms; off Nairai, Fiji, 12 and 24 fathoms; Viva Anchorage, 3 fathoms; off Vavau Anchorage, Tonga Islands; and off Rutavu.

**SPIROLOCULINA CLARA, new species**

PLATE 10, FIGURES 4, 5

Test very much compressed, periphery truncate and concave, both ends somewhat prominently projecting; chambers numerous, narrow, the sides thickened and opaque, the central portion thin and translucent; sutures distinct, not much depressed, not limbate; wall smooth; aperture distinctly exerted, with a tooth or sometimes two opposite ones. Length, 0.5–0.7 mm.; breadth, 0.3–0.4 mm.; thickness, 0.1 mm.

*Holotype*.—Cushman Coll. No. 14781, from Rongelap Atoll, Marshall Islands.

This is probably the same as the form I have figured as "*Spiroloculina depressa* d'Orbigny."<sup>5</sup>

The species is abundant at the type locality, and is marked by the peculiar transparency of the middle portion of the chamber giving

TABLE 10.—*Spiroloculina clara*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21935-----	1	H3875	Southwest point Tabanae, about ½ mile offshore, 3 miles NE.	Fathoms 259	° F. -----	crs. co. s.-----	Rare.
21936-----	1	H3891	Lat. 16° 30' S., long. 143° 41' W..	540	29.7	co. s. pter. oz....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

<sup>5</sup> U. S. Nat. Mus. Bull. 71, pt. 6, pl. 3, figs. 6 a, b, 1917.

it a peculiar and distinct appearance. It also occurs at *Albatross* Stations H3875, one-half mile off southwest point of Tahanae, Paumotus, in 269 fathoms; and H3983, one-half mile off entrance to South Pass, Rongelap, in 400 fathoms. There is a single specimen that may belong here from Guam Anchorage, Ladrone Islands.

## SPIROLOCULINA AFFIXA Terquem

## PLATE 10, FIGURES 6, 7

*Spiroloculina affixa* TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 1, p. 55, pl. 5 (10), figs. 13 a-c, 1878.—HOWCHIN, Trans. Roy. Soc. South Australia, vol. 12, p. 2, 1889.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 30, p. 16, pl. 1, figs. 23-25, 1907.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 56, p. 635, 1919; U. S. Nat. Mus. Bull. 100, vol. 4, p. 410, pl. 83, figs. 2 a-c, 1921; Carnegie Inst. Washington Publ. 342, p. 57, pl. 21, fig. 3, 1924.

*Spiroloculina acutimargo* H. B. BRADY (in part), Rep. Voy. *Challenger*, Zoology, vol. 9, pl. 10, fig. 12, 1884 (not figs. 13-15).—SIDEBOTTOM (in part), Journ. Roy. Micr. Soc., 1918, p. 5.

*Spiroloculina inaequilateralis* SCHLUMBERGER, Mém. Soc. Zool. France, vol. 6, p. 201, pl. 4, figs. 84-86; fig. 3 (in text), 1893.—SIDEBOTTOM, Mem. Proc. Manchester Lit. and Philos. Soc., vol. 54, no. 16, p. 2, pl. 1, fig. 2, 1910.

Test elongate, fusiform, the sides very different from each other, one side flattened, the other deeply concave; chambers with definite sutures, which are flush with the surface; wall thin and smooth; peripheral face somewhat concave, peripheral margin somewhat carinate, apertural end subacute; aperture elliptical, compressed. Length, 0.3 mm.; breadth, 0.2 mm.; thickness, 0.1 mm.

There are single specimens, both of which are here figured, from *Albatross* Stations H3826, latitude 14° 56' S., longitude 148° 44' W., in 711 fathoms, off the Paumotus; and H3866, latitude 17° 17' S., longitude 145° 45' 30'' W., in 804 fathoms.

TABLE 11.—*Spiroloculina affixa*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21937.....	1	H3866	Lat. 17° 17' S., long. 145° 45' 30'' W.	Fathoms 804	° F. .....	glob. oz. mang..	Rare.
21938.....	1	H3829	Lat. 14° 56' S., long. 148° 48' W.	860	.....	wh. co. s. glob. vol. part.	Do.
21939.....	1	H3847	Lat. 16° 08' S., long. 146° 42' W.	609	39	glob. oz. ....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

## SPIROLOCULINA sp. (?)

## PLATE 10, FIGURE 8

There is a single small specimen here figured, rather thick but very short and nearly circular in outline. It is from *Albatross Station* H3876, 1 mile off northwest entrance to Makemo Lagoon, Paumotu. No other specimens were found to give further details as to the characters of this form.

## Genus HAUERINA d'Orbigny, 1839

*Hauerina* d'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," pp. xxxviii, xxxix, 1839.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 190, 1884.—CHAPMAN, The Foraminifera, p. 97, 1902.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 150, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 46, 1929.

*Genoholotype*.—*Hauerina compressa* d'Orbigny.

Test with the early chambers quinqueloculine, later ones more or less in one plane, making a half coil, later in some species gradually shortening so that more than two make up one coil; aperture cribrate.

Tertiary and Recent.

This genus has developed from a quinqueloculine ancestry adding the later chambers in a single plane and then reducing the length so that more than two chambers make a coil. With this change in structure is developed a strongly cribrate aperture.

Some of the species, especially *Hauerina ornatissima*, are very common in the shallow waters of the Indo-Pacific.

## HAUERINA FRAGILISSIMA (H. B. Brady)

## PLATE 10, FIGURE 9

*Spiroloculina fragilissima* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 149, pl. 9, figs. 12-14, 1884.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 28, p. 398, 1902.—DAKIN, Rep. Pearl Oyster Fisheries Ceylon, p. 230, 1906.

*Hauerina fragilissima* MILLETT, Journ. Roy. Micr. Soc., p. 610, pl. 13, figs. 8-10, 1898.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 587, pl. 46, figs. 1, 2, 1915.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 56, p. 638, 1919; Journ. Washington Acad. Sci., vol. 10, p. 200, 1920; U. S. Nat. Mus. Bull. 100, vol. 4, p. 451, 1921; U. S. Geol. Survey Prof. Paper 129-E, p. 103, pl. 27, fig. 3, 1922; Carnegie Inst. Washington Publ. 342, p. 68, pl. 25, figs. 2, 3, 1924.

Test much compressed, nearly circular; early chambers quinqueloculine, later ones, which make up the larger part of the adult test, spiroloculine; periphery rounded; sutures very slightly if at all depressed; wall very thin, opalescent; the sutures standing out as white opaque lines; aperture cribrate. Diameter, 0.6 mm.

There are numerous records for this species showing its wide distribution in the Indo-Pacific region from Kerimba Archipelago off southeast Africa to the Philippines and southward to Australia. Very similar specimens occur in the lower Oligocene, Byram marl. This is easily confused with the flattened forms of *Planispirina*, which often occur in the same locality. It may be noted here that the specimens referred to this species in United States National Museum Bulletin 71 (pt. 6, pl. 24, fig. 4, 1917) are not *Hauerina*, but should be placed in *Planispirina*.

## HAUERINA ORNATISSIMA (Karrer)

## PLATE 10, FIGURES 16, 17

*Quinqueloculina ornatissima* KARRER, Sitz. Akad. Wiss. Wien, vol. 58, p. 151, pl. 3, fig. 2, 1868.

*Hauerina ornatissima* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 192, pl. 7, figs. 15-22, 1884.—MILLETT, Journ. Roy. Micr. Soc., p. 610, 1898.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 28, p. 178, p. 207 (list), p. 399 (list), 1902.—FORNASINI, Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. 10, p. 27, 1902.—DAKIN, Rep. Pearl Oyster Fisheries Ceylon, vol. 5, p. 231, 1906.—RHUMBLEE, Zool. Jahrb., Abt. Syst., vol. 24, p. 53, 1906.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 590, 1915.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 63, pl. 23, figs. 1, 5, 1917; U. S. Geol. Survey Bull. 676, p. 26, pl. 6, fig. 5, 1918; U. S. Nat. Mus. Bull. 100, vol. 4, p. 452, 1921; Carnegie Inst. Washington Publ. 311, p. 72, 1922; Publ. 342, p. 67, pl. 24, figs. 7-9, 1924.—HERON-ALLEN and EARLAND, Journ. Linn. Soc. Zool., vol. 35, p. 609, 1924.—CUSHMAN, Carnegie Inst. Washington Publ. 344, p. 82, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 47, pl. 10, figs. 10-12, 1929.—HANZAWA, Jap. Journ. Geol. Pal., vol. 4, p. 37 (table), 1925 (1926).

Test compressed, early chambers milioline, later ones either embracing and extending in the center to cover the previously formed chambers or becoming elongate and more or less encircling the periphery; surface ornamented by strong transverse or radial ridges or crenulations crossed by numerous fine longitudinal striae; aperture consisting of numerous small pores in several linear series or scattered, the sieve plate thus formed extending the full height of the chamber. Diameter, up to 1.5 mm.

Although this species is typically an Indo-Pacific one, it occurs sparingly in the West Indian region, but specimens are never so well developed as in the Pacific and Indian Oceans. Forms referable to this species also occur in the Oligocene of the Gulf Coastal Plain of the United States. The types described by Karrer are from the Miocene of Europe.

In our collections the species is often abundant and occurs at the following localities: Levuka, Fiji, 12 fathoms; Mokaujar Anchorage, Fiji; Nairai Islands, Fiji, 12 fathoms; Rotonga, 7 fathoms; Makemo

Lagoon, Paumotus; Rangiroa; Port Lotten, Kersail, Caroline Islands; Rongelap Atoll, Marshall Islands; Guam Anchorage, Ladrone Islands, 21 fathoms; and the following two *Albatross* Stations: H3855, 1 mile off northwest point of Apataki, Paumotus, 654 fathoms; and H3967, one-half mile off Maraki Atoll, Marshall Islands, 431 fathoms.

HAUERINA PACIFICA Cushman

PLATE 10, FIGURES 10, 11

*Hauerina pacifica* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 64, pl. 21, fig. 2, 1917.

Test in the early stages quinqueloculine, with strongly angled chambers, in the adult with the chambers somewhat more inflated but carinate and irregularly coiled, more than two making up a coil; sutures fairly distinct in the early portion but not depressed, in the adult much more depressed; wall smooth, matte; aperture somewhat projecting with a slightly convex sieve plate, with numerous irregularly arranged pores. Length, 0.7 mm.

The types of this species are from off the Hawaiian Islands in shallow water ranging from 21 to 33 fathoms where it is common. In our material specimens occurred at Guam Anchorage, Ladrone Islands, 21 fathoms, and Mokaujar Anchorage, Fiji Islands.

HAUERINA BRADYI Cushman

PLATE 10, FIGURES 12-15

*Quinqueloculina ornatissima* KARRER, Sitz. Akad. Wiss. Wien, vol. 58, p. 151, pl. 3, fig. 2, 1868.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 244, pl. 3, figs. 9, 10, 23, 24, 1893.—MILLETT, Journ. Roy. Micr. Soc., 1898, p. 610, pl. 13, fig. 11.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 28, p. 399 (list), 1902.—RHUMBLER, Zool. Jahrb., Abt. Syst., vol. 24, p. 42, pl. 3, fig. 39, 1906.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 588, 1915; Journ. Linn. Soc. Zool., vol. 35, p. 609, 1924.

*Hauerina bradyi* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 62, pl. 23, fig. 2, 1917; Proc. U. S. Nat. Mus., vol. 59, p. 72, 1921; Carnegie Inst. Washington Publ. 311, p. 71, 1922; Publ. 344, p. 82, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 47, pl. 10, figs. 4-9, 1929.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, p. 14, pl. 3, figs. 7 a-c, 1930.

Test much compressed, the very earliest ones milioline, later ones becoming spiroloculine, and finally, in the last-formed coil, more than two chambers appear, usually three making up a complete coil; wall very finely striate-reticulate; periphery rounded or subcarinate; aperture a sieve plate the entire height of the chamber, curved, with numerous pores. Diameter, 1 mm.; thickness, 0.15 mm.

This is a widely distributed species in the Indo-Pacific. There is a very considerable degree of variation shown by the specimens we have. In the early stages the chambers are in a compact mass of

a generally quinqueloculine character; following these, chambers are developed that fail to make the usual half coil, after which, in the adult, chambers are developed generally in one plane but increasingly shorter so that three or four make up a complete coil. Some of the stages in this development are shown in the figures given here.

TABLE 12.—*Hauerina bradyi*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
				Fathoms	°F.		
22015.....	1	H3857	Center Tikei Island, ½ mile E.	360	-----	crs. co. s.....	Rare.
22016.....	1	H3910	Southwest point Aki Aki, 1 mile E.	377	43	co. s.....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

### Genus SIGMOILINA Schlumberger, 1887

*Sigmoilina* SCHLUMBERGER, Bull. Soc. Zool. France, vol. 12, p. 118, 1887.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 150, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 48, 1929.

*Spiroloculina* (part) COSTA (not d'Orbigny), Mem. Accad. Sci. Napoli, vol. 2, p. 126, 1855 (1857).

*Planispirina* (part) H. B. BRADY (not Seguenza), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 197, 1884.

*Genotype*.—By designation, *Planispirina sigmoidea* H. B. Brady.

Test with the early chambers quinqueloculine, later ones added in planes slightly more than 180° from one another, making a continuously revolving spiral, and in transverse section, producing a sigmoid appearance; aperture simple with a simple tooth; exterior very often with a superficial layer of arenaceous material.

Tertiary and Recent.

This genus very evidently developed from *Quinqueloculina* by the addition of chambers in planes of more than 180°, so that the resulting section is S-shaped.

The following species is the only one of this genus found in our South Pacific material.

#### SIGMOILINA EDWARDSI (Schlumberger)

##### PLATE 11, FIGURES 9 a-c

*Planispirina* (*Sigmoilina*) *edwardsi* SCHLUMBERGER, Bull. Soc. Zool. France, vol. 12, p. 483 (113), pl. 7, figs. 15-18; fig. 8 (in text), 1887.

*Sigmoilina edwardsi* HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 2, p. 584, pl. 45, figs. 19-21, 1915.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 9.—HERON-ALLEN and EARLAND, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 123; British Antarctic Exped., Zoology, vol. 6, p. 71, 1922; Trans. Zool. Soc. London, vol. 22, pt. 1, p. 69 (list), 1926.

Test slightly longer than broad, somewhat sigmoid in end view, the periphery subacute; chambers in the young fairly distinct, in the highly polished adult somewhat obscured; sutures flush with the surface, usually indistinct; wall smooth and usually highly polished; aperture rounded, sometimes with a very slight tooth. Length, 0.5–0.65 mm.; breadth, 0.4–0.45 mm.; thickness, 0.3–0.35 mm.

This species was found in the *Albatross* material only from deeper water and did not occur at any of the shallow stations. The data for its distribution are given in the accompanying table.

TABLE 13.—*Sigmoilina edwardsi*—material examined

U. S. N. M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
21999.....	1	H3819	Lat. 15° 25' S., long. 148° 08' W..	Fathoms 1,123	° F.	wh. co. s. glob. vol. part.	Rare.
22000.....	1	H3823	Lat. 15° 01' S., long. 148° 27' W..	782		wh. pter. oz. vol. part.	Do.
22001.....	2	H3824	Lat. 15° 00' 20'' S., long. 148° 30' W.	850		wh. glob. oz. mang. vol. part.	Do.
22002.....	1	H3826	Lat. 14° 56' S., long. 148° 44' W..	711		wh. pter. oz.....	Do.
22003.....	1	H3830	Lat. 15° 00' 30'' S., long. 148° 47' W.	1,257		wh. co. s. glob. vol. part.	Do.
22004.....	1	H3859	Ngaruae Pass, Fakarava Atoll, 35° S., 3.5 miles E.	666		pter. oz. vol. part.	Do
22005.....	1	H3866	Lat. 17° 17' S., long. 145° 45' 30'' W.	804		glob. oz. mang..	Do
22006.....	1	H3873	Southwest point Tahanae, 68° N., 4 miles E.	966		do.....	Do.
22007.....	5	H3878	Lat. 16° 13' S., long. 143° 48' W..	987		glob. pter. vol. part.	Few.
22008.....	1	H3896	Tekokoto Atoll, 1 mile E.....	617	38.4	co. s.....	Rare.
22998.....	1						
22010.....	1	H3904	Lat. 18° 07' S., long. 141° 26' W..	1,713		glob. oz.....	Do.
22011.....	1	H3913	Northeast end of Nukutavake, 6 miles E.	1,688	35.2	mang. glob.....	Do.
22013.....	2	H3937	Hereheretue Atoll, 5.3 miles SE.	1,688	35.3	lt. br. glob. oz. mang. part.	Do.
22014.....	1	H3977	Southeast point Elmore Atoll, 30° N., 9 miles W.	1,283	35.9	crs. glob. oz.....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

### Genus ARTICULINA d'Orbigny, 1826

*Articulina* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 300, 1826.—H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, p. 182, 1884.—CHAPMAN, The Foraminifera, p. 93, 1902.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 150, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 50, 1929.

*Nautilus* BATSCH (not Linnaeus), Conch. des Seesandes, p. 3, 1791.

*Veriebralina* (part) PARKER, JONES, and H. B. BRADY (not d'Orbigny), Ann. Mag. Nat. Hist., ser. 3, vol. 16, p. 22, 1865.



*Genoholotype*.—*Articulina nitida* d'Orbigny.

Test with the early chambers quinqueloculine or triloculine, later ones in a rectilinear series; aperture in the adult a rounded, usually elliptical opening, at the end of a short neck with a phialine lip.

Lower Eocene to Recent.

This genus has developed from a quinqueloculine ancestry by the addition of a uniserial stage, which is represented only by one or two chambers in some species, but in others these become numerous.

ARTICULINA LINEATA H. B. Brady

PLATE 11, FIGURES 1, 2

*Articulina lineata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 183, pl. 12, figs. 19–21, 1884.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 59, p. 73, pl. 18, fig. 6, 1921; Carnegie Inst. Washington Publ. 311, p. 70, pl. 12, fig. 4, 1922; U. S. Nat. Mus. Bull. 104, pt. 6, p. 52, pl. 11, figs. 8–10; pl. 12, fig. 1, 1929.

Test much compressed, even in the earlier portion, which is triloculine, the later portion consisting of one or two much compressed chambers in linear arrangement, periphery usually keeled; chambers distinct, with numerous fine longitudinal costae; wall translucent, of a bluish-white color; the aperture with a lip much thickened at the edge, but not everted and not extending out beyond the periphery of the chamber. Length, 0.8 mm.; breadth, 0.3–0.4 mm.; thickness, 0.12–0.15 mm.

Brady's specimens were from off Kandavu, Fiji Islands, 210 fathoms and 255 fathoms, and he also had it from Raine Island, Torres Strait, 155 fathoms. Brady also recorded the species from off the Bermudas in 435 fathoms, and according to Nuttall the figured specimens in the *Challenger* report are from this last locality.

I have recorded this species from the West Indian region, but a comparison of the Pacific and the Atlantic series of specimens seems to show that there are decided differences. If the two are found on further study to be different, the name *lineata* should be applied to the Atlantic form, as the figured specimens are the Atlantic ones. In the Pacific collections included in the present paper the most numerous are from Mokaujar Anchorage, where it is very common. Similar specimens have occurred also from Levuka, Fiji, in 12 fathoms, but specimens were not obtained from the other area from which material was examined.

ARTICULINA SULCATA Reuss(?)

PLATE 11, FIGURES 3, 4

Recent material from various regions has been referred to the above species. Specimens consist typically of a quinqueloculine early stage with one or two linear chambers with a decided neck and the surface

sharply costate. Such forms are widely distributed and seem never to have any considerable number of linear chambers. Reuss's types were from the Miocene of central Europe and should be compared with the various forms referred to this species from widely separated regions. These specimens figured are from Mokaujar Anchorage, Fiji, and the species occurred also at *Albatross* Station H3984, off entrance to South Pass, Rongelap, Marshall Islands, in 746 fathoms. This is marked as coarse coral sand and undoubtedly represents material carried out from shallow water.

TABLE 14.—*Articulina sulcata*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom	Occurrence
22017.....	1	H3885	Southwest point Takume Atoll, 1.5 miles NE.	Fathoms 572	° F. 38.7	crs. co. s.....	Rare.
22018.....	1	H3890	Lat. 16° 25' S., long. 143° 33' W..	1,108	36.1	glob. oz. mang..	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

#### Genus NUBECULINA Cushman, 1924

*Nubeculina* CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 52, 1924; CUSHMAN Lab. Foram. Res. Spec. Publ. No. 1, p. 151, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 55, 1929.

*Sagrina* (part) H. B. BRADY (not d'Orbigny), Quart. Journ. Micr. Sci., vol. 19, p. 276, 1879.

*Nubecularia* (part) H. B. BRADY (not DeFrance), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 133, 1884.

*Genoholotype*.—*Nubecularia divaricata* H. B. Brady.

Test elongate, uniserial; initial end coiled or milioline; chambers distinct, simple; wall imperforate, porcelaneous, with sand grains attached to the exterior; aperture at the end of an elongated tubular neck with an everted phialine lip, the apertural opening with a series of inwardly pointing teeth.

This genus is known only from the Indo-Pacific and is there represented by several forms. Three of these were found in the material recorded here. They occur in comparatively shallow water, and some of the forms reach a large size.

#### NUBECULINA DIVARICATA (H. B. Brady)

##### PLATE 11, FIGURES 5, 6

*Nubecularia divaricata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 136, pl. 76, figs. 11–16, 1884.—A. SILVESTRI, Atti Accad. Pont. Nuovi Lincei, vol. 50, p. 36, 1897.—MILLET, Journ. Roy. Micr. Soc., p. 261, pl. 5, fig. 4, 1898.

Test composed of subglobular chambers connected by slender cylindrical necks; the main body of the chambers with a calcareous base and the exterior composed of rather coarse calcareous fragments of various sorts; the apertural end of each chamber with an elongated tubular neck free from agglutinated material, with a definite lip and a series of platelike teeth inside the lip.

Brady described this species from the following three stations: Humboldt Bay, on the north coast of Papua, 37 fathoms; off Raine Island, Torres Strait, 155 fathoms; and off Tongatabu, Tonga Islands, 18 fathoms.

Although the species has been referred to by numerous authors, most of the specimens from the Indo-Pacific belong to the following variety, which has closely set chambers and a very short neck, and the teeth in the aperture are quite different. The only specimens we have that can be referred to Brady's species are fragments that are here figured from Nairai, Fiji. They show a characteristic, elongate, small neck and definite lip.

**NUBECULINA DIVARICATA (H. B. Brady) var. ADVENA Cushman**

PLATE 11, FIGURES 8 *a, b*

*Nubculina divaricata* (H. B. BRADY) var. *advena* CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 53, pl. 19, figs. 1-4, 1924.

Variety differing from the typical in the closely set chambers, which increase greatly in size and diameter as added; the aperture tubular, but short and stout with a definite everted phialine lip, and very coarse teeth in the opening.

Numerous figured specimens such as those of Sidebottom from the Mediterranean and Heron-Allen and Earland from the Kerimba Archipelago seem to belong to this variety rather than to the typical form. I had this variety in abundance from Samoa, where it reaches a size up to 2.5 mm.

In the present collections it has occurred in typical form from Mokaujar Anchorage, Fiji; off Levuka, Fiji, 12 fathoms; and off Nairai, Fiji, 24 fathoms; with somewhat less typical specimens from off Rotonga (= ? Rarotonga, Cook Islands), 7 fathoms.

**NUBECULINA CHAPMANI, new species**

PLATE 11, FIGURES 7 *a, b*

*Nubcularia divaricata* CHAPMAN (not H. B. Brady), Journ. Linn. Soc. Zool., vol. 28, p. 168, pl. 19, fig. 1, 1901.

Chambers somewhat irregularly pyriform, the wall with a calcareous base, and the exterior of rather fine fragmentary material; the apertural end with an elongate, rather stout, cylindrical neck, and

curved, enlarging toward the base, free from agglutinated material, the lip very thin, everted, either smooth or with very slight traces of teeth. Length, 0.8 mm.; diameter, 0.45 mm.

*Holotype*.—U.S.N.M. No. 22088, from *Albatross* Station H3898, one-third mile east of northwest point Hikueru Atoll, Paumotus.

Our figured specimen seems to be almost exactly identical with that figured by Chapman from the lagoon at Funafuti.

#### Genus TRILOCULINA d'Orbigny, 1826

*Triloculina* d'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 299, 1826.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 151, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 55, 1929.

*Miliola* (part) LAMARCK, Ann. Mus. d'Hist. Nat., vol. 5, p. 351, 1804.

*Miliolina* (part) WILLIAMSON, Rec. Foram. Great Britain, p. 83, 1858 (and later authors).

*Genotype*.—By designation, *Miliola trigonula* Lamarck.

Test with the early chambers quinqueloculine, at least in the microspheric form, later ones added in the planes  $120^\circ$  from one another, the third of each series added in the plane of the third preceding and covering it so that the surface of the test is composed of but three visible chambers, interior not labyrinthic; aperture simple, typically with a bifid tooth.

This genus is definitely derived from *Quinqueloculina* by the addition of chambers  $120^\circ$  apart and three making up a complete cycle, and the aperture typically with a bifid tooth. In the microspheric form all the stages are usually present, but in the megalospheric form the early quinqueloculine stages may be entirely skipped and the triloculine stage taken on at once.

In this genus there is a considerable degree of difference in the characters of the aperture. Some of the species have a large semi-circular aperture with a flattened tooth, which nearly fills the aperture, while other forms have a narrow aperture with a very narrow tooth typically bifid at the tip. So far as has been noted these two forms are not closely related, but they need further study. In the young stages of the microspheric form chambers are arranged in a quinqueloculine manner, and such specimens can only be determined as the young of *Triloculina* by comparison with the adult form that accompanies them.

#### TRILOCULINA OBLONGA (Montagu)

##### PLATE 11, FIGURES 10 a-c

*Vermiculium oblongum* MONTAGU, Test. Brit., p. 522, pl. 14, fig. 9, 1803.

*Triloculina oblonga* d'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 300, No. 16, 1826; Modèles, No. 95; in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 175, pl. 10, figs. 3-5, 1839.—H. B. BRADY, Trans. Linn. Soc. Zool.,

vol. 24, p. 472 (table), 1864; Nat. Hist. Trans. Northumberland and Durham, vol. 1, p. 93, 1865 (1867); Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 46, 1870.—TERQUEM, Essai Class. Anim. Dunkerque, p. 38, pl. 5, figs. 19 *a*, *b*, 1875.—J. WRIGHT, Proc. Belfast Nat. Field Club. Appendix, p. 103, 1876—77.—KIAER, Rep. Norwegian Fish. and Mar. Invest., vol. 1, no. 7, p. 26, 1900.—CUSHMAN, Contr. Can. Biol., p. 15, 1921 (1922); Carnegie Inst. Washington Publ. 311, p. 73, 1922; U. S. Nat. Mus. Bull. 104, pt. 6, p. 57, pl. 13, figs. 4, 5, 1929.—CUSHMAN and MOYER, Contr. Cushman Lab. Foram. Res., vol. 6, p. 52, 1930.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, No. 1, p. 16, pl. 4, figs. 5, 6, 1930.

*Miliolina oblonga* TERRIGI, Atti Accad. Pont. Nuovi Lincei, vol. 33, p. 173, pl. 1, fig. 2, 1880.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 160, pl. 5, figs. 4 *a*, *b*, 1884. (For further references to this species, see Cushman, U. S. Nat. Mus. Bull. 104, pt. 6, p. 57, 1929.)

Test elongate, the adult with three visible chambers, the last-formed chamber broadest near the initial end and longer than the preceding ones; test in end view triangular, the sides broadly curved and angles rounded; chambers inflated; sutures distinct, depressed; wall smooth and usually polished; aperture oval with the tooth simple or narrow, and bifid at the tip. Length, 0.7–1 mm.; breadth, 0.4–0.55 mm.; thickness, 0.25–0.35 mm.

TABLE 15.—*Triloculina oblonga*—material examined

U. S. N. M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22065.....	1	H3809	Entrance to Avatoru Pass, Rahoia Atoll, 2.5 miles S.	<i>Fathoms</i> 645	<i>° F.</i> .....	fne. wh. co. s.....	Rare.
22066.....	1	H3857	Center Tikei Island, ½ mile E...	360	.....	crs. co. s.....	Do.
22067.....	1	H3876	Northwest entrance to Makemo Lagoon, 1 mile SE.	467	.....	wh. co. s.....	Do.
22068.....	1	H3883	Northwest Pass Raroia, 5 miles SE.	1,385	35.7	gy. yl. glob. oz. mang. parts.	Do.
22069.....	1	H3884	Northwest point Raroia, ½ mile SE.	508	40.2	crs. co. s. pter. oz.	Do.
22070.....	1	H3898	Northwest point Hikueru Atoll, ½ mile E.	348	43.8	co. s. brk. sh.....	Do.
22071.....	1	H3924	Nukutipipi Atoll, 1 mile NW...	649	39.0	.....do.....	Do.
22072.....	1	H3936	Hereheretue Atoll, 0.3 mile E...	189	62.1	co. s. mang. part.	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

It is very evident that more than one species is included in the various references to Montagu's *oblonga*. The apertural features show specimens with an elongate, either simple or bifid tooth, together with a somewhat similar form with a flattened tooth nearly filling the aperture. In this South Pacific collection we have limited this species to those forms which have the narrow tooth.

Such specimens occur widely distributed and often are very abundant. They occur off Fiji in 40 to 50 fathoms; in 12 to 24 fathoms, off Nairai; in 3 fathoms, Viva Anchorage; 12 fathoms off Levuka; and Mokaujar Anchorage. From other areas the species occurs at Rangiroa; Rutavu; Rotonga; both off the island and from the lagoon at Niau; Port Lotten, Kersail, Caroline Islands; and in 21 fathoms, Guam Anchorage, Ladrone Islands. The data for the *Albatross* stations are given in the accompanying table.

## TRILOCULINA CIRCULARIS Bornemann

## PLATE 11, FIGURES 11 a-c

*Triloculina circularis* BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, p. 349, 1855.—REUSS, Sitz. Akad. Wiss. Wien, vol. 48, pt. 1, p. 41, 1863.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 67, pl. 25, fig. 4; pl. 26, fig. 1, 1917; Carnegie Inst. Washington Publ. 213, p. 290, 1918; Proc. U. S. Nat. Mus., vol. 56, p. 638, 1919; U. S. Nat. Mus. Bull. 100, vol. 4, p. 462, pl. 92, figs. 1, 2, 1921; Carnegie Inst. Washington Publ. 311, p. 74, 1922.—HOFKER, Flora en Fauna der Zuiderzee, Protozoa, p. 135, fig. 15 (in text), 1922.—CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 69, pl. 25, figs. 5, 6, 1924; Publ. 344, p. 82, 1926.—HOFKER, Zoology of the Faroes, vol. 2, pt. a, Foraminifera, p. 7, 1930.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, no. 1, p. 15, pl. 4, figs. 4 a-c, 1930. (For further references to this species, see Cushman, U. S. Nat. Mus. Bull. 104, pt. 6, p. 58, 1929.)

Test rounded, compressed, the periphery rounded, the three chambers making up the visible portion of the test, rounded, inflated; last-formed chamber strongly embracing; sutures distinct, depressed; wall smooth, polished; aperture, a narrow crescentiform slit with a large, flattened, semicircular tooth. Length, 0.4–1 mm.; breadth, 0.3–1 mm.; thickness, 0.2–0.35 mm.

This is one of the commonest species in warm shallow waters, and apparently has a very wide distribution. The general character of a large semicircular platelike tooth nearly filling the large opening is a constant one. The early quinqueloculine stages are usually found accompanying the adult triloculine ones, but are usually of much smaller size.

The accompanying table gives the distribution of this species as found in our collections at the *Albatross* stations. In addition it has occurred in shoal water inside the lagoon, Pinaki Atoll; Vavau Anchorage, Tonga Islands, 18 fathoms; and off Nairai, Fiji, in 24 fathoms.

TABLE 16.—*Triloculina circularis*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22049.....	1	H3813	Lat. 15° 13' 10" S., long. 147° 53' 10" W.	Fathoms 341	° F. -----	wh. co. s. glob. pter.	Rare.
22050.....	4	H3815	Lat. 15° 15' S., long. 147° 51' 35" W.	524	-----	wh. co. s. brk. sh.	Few.
22051.....	1	H3816	Lat. 15° 16' 50" S., long. 147° 52' 30" W.	450	-----	pter. oz. vol. part.	Rare.
22052.....	1	H3848	Village on west side of Niau Atoll, ¾ mile E.	252	-----	co. s. glob. oz.	Do.
22053.....	1	H3855	Northwest point Apataki, 1 mile SE.	654	38.8	crs. co. s.	Do.
22054.....	1	H3857	Center Tikei Island, ½ mile E.	360	-----	do.	Do.
22055.....	3	H3858	Ngarnaë Pass, Fakarava Atoll, 28° S., 1 mile E.	599	-----	do.	Do.
22056.....	3	H3910	Southwest point Aki Aki, 1 mile E.	377	43	co. s.	Do.
22057.....	4	H3916	Pinaki Atoll, 1 mile E.	486	41	crs. co. s. pter. oz.	Few.
22058.....	2	H3931	Anu Anuraro Atoll, ½ mile SE.	405	42.5	co. s. pter. oz. mang. part.	Rare.
22059.....	1	H3935	Hereheretue Atoll, 1 mile W.	594	39.5	crs. co. s.	Do.
22060.....	1	H3967	Monument, west shore of Maraki Atoll, 56° S., ½ mile E.	431	-----	-----	Do.
22061.....	1	Π3983	Entrance to South Pass, Rongelap, ½ mile N.	400	43.4	co. s.	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

### TRILOCULINA LABIOSA d'Orbigny

#### PLATE 11, FIGURES 12 a-c

*Triloculina labiosa* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba. "Foraminifères," p. 178, pl. 10, figs. 12-14, 1839.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 70, 1917; Proc. U. S. Nat. Mus., vol. 59, p. 70, pl. 16, figs. 13, 14, 1921; Carnegie Inst. Washington Publ. 311, p. 77, pl. 12, fig. 1, 1922; Publ. 344, p. 83, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 60, pl. 15, figs. 2, 3, 1929.

*Miliolina labiosa* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 170, pl. 6, figs. 3-5, 1884.

Test much broader than long, surface largely composed of the two last-formed chambers; chambers often somewhat irregular; periphery rounded; surface smooth, but dull; aperture crescentiform, with a somewhat triangular tooth, placed somewhat back from the aperture. Diameter, 0.5-0.65 mm.; thickness, 0.2-0.35 mm.

This somewhat irregular species, originally described by d'Orbigny from the West Indies occurs in these collections from Rangiroa; Rutavu; Hereheretue Island; off Fiji, 40 to 50 fathoms; at Mokaujar Anchorage, Fiji; and to the northward at Port Lotten, Kersail, Caroline Islands. At all these stations the material shows

some variations in the shape of the chambers, which are typically irregular, but the general characters of the aperture and arrangement of the chambers remain fairly constant.

**TRILOCULINA LABIOSA** d'Orbigny **SPARSICOSTATA**, new variety

PLATE 12, FIGURES 1 a-c

Variety differing from the typical in the ornamentation of the surface, which has a few, slightly developed, rounding costae with shallow depressions between.

*Holotype of variety*.—Cushman Coll. No. 14738, from beach off wharf, Hereheretue Island.

This variety is abundant at the type locality and occurs as well with the typical at Rutavu, and a single specimen was taken from *Albatross* Station H3924, 7 miles northwest of Nukutipipi Atoll, Paumotu.

**TRILOCULINA IRREGULARIS** (d'Orbigny)

PLATE 12, FIGURES 2 a-c

*Quinqueloculina irregularis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 302, No. 25, 1826.—FORNASINI, Mem. Accad. Sci. Istit. Bologna, ser. 6<sup>a</sup>, vol. 2, p. 67, pl. 3, fig. 14, 1905.

Test slightly longer than broad, nearly circular in side view, compressed, periphery truncate, with the angles produced into definite costae, apertural end slightly extended; chambers distinct; sutures distinct, but not depressed; wall matte, with slightly incised short lines; aperture elongate with a distinct, narrow tooth, with a bifid tip. Length, 0.8 mm.; breadth, 0.5 mm.; thickness, 0.3 mm.

The types of this species described by d'Orbigny are from the Mediterranean. Very similar specimens occur in considerable numbers in 40 to 50 fathoms off Fiji Islands. In its general characters it somewhat resembles the one here described as *Triloculina oceanica*, but the characters of the aperture are very distinctive, and the range of the form with a narrow aperture is very limited.

**TRILOCULINA OCEANICA**, new species

PLATE 12, FIGURES 3 a-c

Test about as long as broad, the periphery concave with very prominent angles to the chambers, which are acute; sutures distinct, slightly depressed; wall smooth except for the very coarse costae and angles of the chambers; aperture large, with a semicircular, flattened tooth nearly filling the opening. Length, 0.5–0.6 mm.; breadth, 0.45–0.5 mm.; thickness, 0.3–0.35 mm.



*Holotype*.—U.S.N.M. No. 22078, from *Albatross* Station H3935, 1 mile west of Hereheretue Atoll, Paumotus.

This species, with its large flat tooth and broad, semicircular opening with the acutely angled chambers, seems to be a distinct one in fairly deep water among the islands of the South Pacific. There are specimens from Pinaki Atoll and from the beach off the wharf at Hereheretue. It occurs also at a number of *Albatross* stations, the data for which are given in the accompanying table.

TABLE 17.—*Triloculina oceanica*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
				<i>Fathoms</i>	<i>° F.</i>		
22073.....	1	H3815	Lat. 15° 15' S., long. 147° 51' 35'' W.	524	-----	wh. co. s. brk. sh.	Rare.
22074.....	1	H3885	Southwest point Takume Atoll, 1.5 miles NE.	572	38.7	crs. co. s.-----	Do.
22075.....	1	H3891	Lat. 16° 30' S., long. 143° 41' W.	540	39.7	co. s. pter. oz.---	Do.
22076.....	1	H3905	Northwest point Hao Atoll, ½ mile SE.	425	42	crs. co. s.-----	Do.
22077.....	1	H3916	Pinaki Atoll, 1 mile E.-----	486	41	crs. co. s. pter. oz.	Do.
22078.....	1	H3935	Hereheretue Atoll, 1 mile W.---	594	39.5	crs. co. s.-----	Do.
22079.....	1	H3936	Hereheretue Atoll, 0.3 mile E.---	189	62.1	co. s. mang. part.	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

TRILOCULINA OCEANICA, new species, FLINTIANA, new variety

PLATE 12. FIGURES 4 a-c

Variety differing from the typical in the ornamentation of the surface, which consists of numerous additional fine costae, especially on the periphery, in addition to the angles of the chambers.

*Holotype of variety*.—U.S.N.M. No. 22089, from *Albatross* Station H3857, one-half mile east of Center Tikei Island, Paumotus.

This variety is evidently closely allied to the species, but seems to be worth a distinction from the smoother form.

TRILOCULINA FICHTLIANA d'Orbigny

PLATE 12, FIGURES 6 a-c

*Triloculina fichtliana* d'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba. "Foraminifères," p. 171, pl. 9, figs. 8-10, 1839.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 71, 1917; Proc. U. S. Nat. Mus., vol. 59, p. 70, pl. 17, figs. 1, 2, 1921; Carnegie Inst. Washington Publ. 311, p. 75, 1922; Publ. 344, p. 83, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 63, pl. 17, figs. 1 a-c, 1929.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, no. 1, p. 17, pl. 3, figs. 3 a-c, 1930.

Test subcircular in front view, somewhat compressed, periphery rounded; chambers distinct; sutures slightly depressed; wall ornamented by numerous longitudinal costae; aperture semicircular, with a slight tooth, which in side view projects beyond the outline of the aperture, and sometimes shows a distinct perforation. Diameter, 0.55-0.8 mm.; thickness, 0.4-0.45 mm.

This is one of the typical West Indian species described by d'Orbigny from Cuba and Jamaica. There are numerous records for it in the general West Indian region, and our material shows that it extends definitely into the Indo-Pacific, although much of the material that has been referred to this species is not the same as the species described by d'Orbigny. The only typical material we have is from Guam Anchorage, Ladrone Islands, 21 fathoms, one of which is here figured.

TRILOCULINA SPINATA, new species

PLATE 12, FIGURES 5 a-c

Test elongate, fusiform, periphery rounded, the basal end extending into a definite pointed spine, the apertural end extended into a long cylindrical neck; chambers distinct, somewhat inflated; sutures distinct, not depressed; wall smooth; aperture circular with a very slight lip and a very small simple tooth, which may or may not be present. Length, 0.6 mm.; breadth, 0.12 mm.; thickness, 0.1 mm.

*Holotype*.—Cushman Coll. No. 14633, from Rongelap Atoll, Marshall Islands.

This very distinctive species occurs only at the type locality, but a number of specimens were present to give the full characters of the species, which were very constant. The spine at the basal end is very well developed and is a rather unique feature in this group.

TRILOCULINA TRIGONULA (Lamarck)

PLATE 13, FIGURES 1 a, b

*Miliola trigonula* LAMARCK, Ann. Mus. d'Hist. Nat., vol. 5, p. 351, No. 3, 1804; vol. 9, pl. 17, fig. 4, 1807.

*Triloculina trigonula* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 299, No. 1, pl. 16, figs 5-9, 1826; Modèles No. 93, 1826.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 56, pl. 12, figs. 10, 11; pl. 13, figs. 1, 2, 1929.—CUSHMAN and VALENTINE, Contr. Dept. Geol. Stanford Univ., vol. 1, no. 1, p. 16, pl. 4, figs. 7 a-c, 1930.

*Millolina trigonula* WILLIAMSON, Rec. Foram. Great Britain, p. 84, pl. 7, figs. 180-182, 1858.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 164, pl. 3, figs. 14-16, 1884.

Test in the adult with three visible chambers, the angles rounded, the periphery broadly convex, whole test somewhat longer than

wide, in end view rounded, triangular, the sides convex; sutures distinct; wall smooth; aperture with a rather broad bifid tooth. Length, 0.5-0.85 mm.; diameter, 0.4-0.45 mm.

As noted previously in Bulletin 104, Lamarck's type of this species is from the Eocene of the Paris Basin, and before the application of this name can be very definitely and accurately used it would be necessary to make sections of microspheric specimens to determine the characters of the early stages. It has been the usual custom for authors to place under this species almost any of the triangular forms that have the edges rounded.

Such specimens as that figured here are fairly common in our material occurring off Fiji at Mokaujar Anchorage; 12 fathoms off Nairai; 12 fathoms off Levuka; and also from Makemo beach and Rutavu, as well as a specimen from *Albatross* Station H3936, 0.3 mile east of Hereheretue Atoll, Paumotu.

## TRILOCULINA AUSTRIACA d'Orbigny

## PLATE 13, FIGURES 2 a, b

*Triloculina austriaca* D'ORBIGNY, *Foram. Foss. Bass. Tert. Vienne*, p. 275, pl. 16, figs. 25-27, 1846.

Test slightly longer than broad, generally triangular in transverse section, the sides and periphery of the chambers rounded; chambers distinct, inflated, usually broader at the base than at the apertural end, giving an asymmetrical shape to the test in front and side views; sutures distinct, slightly depressed; wall smooth and polished, but often marked by very slight elongate pits; aperture either rounded or somewhat modified as shown in the accompanying figures, with an elongate tooth bifid at the tip, apertural lip thin and slightly everted. Length, 0.7 mm.; breadth, 0.45 mm.; thickness, 0.4 mm.

A number of the species described by d'Orbigny from the Miocene of the Vienna Basin are found still living in the Indo-Pacific region

TABLE 18.—*Triloculina austriaca*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22062-----	2	H3866	Lat. 17° 17' S., long. 145° 45' 30'' W.	Fathoms 804	° F.	glob. oz. mang.	Rare.
22063-----	1	H3910	Southwest point Aki Aki, 1 mile E.	377	43	co. s.-----	Do.
22064-----	1	H3916	Pinaki Atoll, 1 mile E.-----	486	41	crs. co. s. pter. oz.	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

as well as in the Mediterranean. Our material fits very well the form described by d'Orbigny, which we have from the type locality. It differs from *T. trigonula* in the side view on account of the greater inflation of the base, and the chamber is not symmetrical as it is in *T. trigonula*. The aperture also is distinctive. Those specimens that do not have a circular aperture have the sides toward the base with definite thin lobes, which are difficult to describe but which are shown in the accompanying figures.

So far as our material shows this species seems to have very definite and restricted distribution. It is abundant in the collections from the Paumotu Islands, occurring both inside the lagoon and off the island of Rongiroa; from the beach off wharf, Hereheretue; on the outer beach and in the lagoon at Pinaki Island.

Similar specimens occurred at a few *Albatross* stations, all also off the Paumotu Islands as shown in the accompanying table.

#### TRILOCULINA AFFINIS d'Orbigny

##### PLATE 13, FIGURES 4 a, b

*Triloculina affinis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 299, no. 2, 1826.—TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 2, p. 164, pl. xviii (xv), figs. 1 a-c, 1882.—FORNASINI, Mem. Acad. Sci. Istit. Bologna, ser. 6<sup>a</sup>, vol. 2, p. 59, pl. 1, fig. 1, 1905.

Test slightly longer than broad, triangular in transverse section, the angles subacute and the outer wall of the chamber decidedly convex; sutures distinct, slightly if at all depressed; wall smooth; aperture generally circular, with a distinctly bifid tooth. Length, 0.35–0.45 mm.; breadth, 0.35–0.4 mm.

The types of this species were from the Miocene of Dax in the Bordeaux region. Terquem records a somewhat similar form under this name, and Fornasini reproduced outline figures from d'Orbigny's plates. An examination of the Miocene material from the type locality of Dax shows that there are forms present there that strongly suggest that this species is closely related to the forms here called *Triloculina trigonula*. The outer periphery is distinctly convex, although the peripheral angles are often rather sharply formed.

Such specimens occurred at a number of stations as follows: Mokaujar Anchorage, Fiji; Viva Anchorage, 3 fathoms, Fiji; Levuka, 12 fathoms, Fiji; near Nairai, Fiji; Rotonga, 7 fathoms; Makemo Lagoon; and in 21 fathoms off Guam Anchorage, Ladrone Islands. It occurred also at several *Albatross* stations as noted in Table 19.

TABLE 19.—*Triloculina affinis*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22080.....	1	H3841	Point Venus, Tahiti Island, 32° S., 4.2 miles W.	Fathoms 775	° F. .....	crs. vol. s. mang. nod.	Rare.
22081.....	1	H3870	Village, point Anaa Atoll, 50° S., 5 miles W.	1,110	36	fne. co. s. pter. oz. glob.	Do.
22082.....	1	H3916	Pinaki Atoll, 1 mile E.....	486	41	crs. co. s. pter. oz.	Do.
22083.....	1	H3928	Anu Anurunga, 1 mile SE.....	659	38.5	co. s. brk. sh. pter. oz.	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

TRILOCULINA TRICARINATA d'Orbigny

PLATE 13, FIGURES 3 a, b

*Triloculina tricarinata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 299, no. 7, 1826; Modèles, no. 94, 1826.—H. B. BRADY, Trans. Linn. Soc. London, vol. 24, p. 446, pl. 48, fig. 3, 1864.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 56, pl. 13, figs. 3 a-c, 1929.

*Miliolina tricarinata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 165, pl. 3, figs. 17 a, b, 1884.

Test in the adult with three visible chambers, the angles of the chambers sharp, often almost carinate, whole test usually somewhat longer than wide, in end view triangular, the sides straight; sutures distinct; wall smooth, often polished; aperture with a narrow bifid tooth or variously angled in large specimens. Maximum length of our specimens, 0.6 mm.; diameter, 0.45 mm.

As noted previously, this species, also like *affinis*, needs definite sections to determine its early stages in relationships. I have included here only those specimens that have very sharp angles and the sides flat or slightly concave. There is apparently a difference in the distribution between this and *affinis*, our specimens being mostly from *Albatross* stations in deeper water, although rare specimens have occurred at Mokaujar Anchorage; Vavau Anchorage, Tonga, in 18 fathoms; and at Rongelap Atoll, Marshall Islands.

Although there are a great many references to this species, they are not given here, as so many things have been included under this name that probably are not strictly to be included under one species.

TABLE 20.—*Triloculina tricarinata*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22084.....	1	H3804	Entrance to Abii Lagoon, 2.5 miles SE.	Fathoms 1,208	° F. .....	lt. gy. oz. glob...	Rare.
22085.....	1	H3818	Lat. 15° 24' 10" S., long. 147° 56' W.	897	.....	glob. pter. vol. part.	Do.
22086.....	1	H3858	Ngaruae Pass, Fakarava Atoll, 28° S., 1 mile E.	599	.....	crs. co. s.....	Do.
22087.....	1	H3873	Southwest point Tabanae, 68° N., 4 miles E.	966	.....	glob. oz. mang..	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

TRILOCULINA BERTHELINIANA (H. B. Brady)

PLATE 13, FIGURE 5

*Miliolina bertheliniana* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 166, pl. 114, figs. 2 a, b, 1884.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 17, p. 563, pl. 41, figs. 32-35, 1915; Journ. Linn. Soc. Zool., vol. 35, p. 605, 1924.

*Miliolina tricarinata*, reticulated variety, MILLETT, Journ. Roy. Micr. Soc., 1898, p. 503, pl. 11, fig. 12.

*Miliolina tricarinata* var. *bertheliniana* CHAPMAN, Journ. Linn. Soc., Zool., vol. 28, p. 174, 1902.

*Triloculina bertheliniana* (H. B. BRADY), CUSHMAN, Carnegie Inst. Washington Publ. 213, p. 290, 1918; U. S. Nat. Mus. Bull. 100, vol. 4, p. 457, 1921.

Test slightly longer than broad, triangular in transverse section; wall ornamented with numerous, slightly elliptical pits evenly distributed over the surface of the test, forming a definite pattern. This is a distinctive Indo-Pacific species so far as the records show. It is already known from the following localities: Off Ascension Island, 7 fathoms; off Calpentyn, Ceylon, 2 fathoms; shore sands, Tamatavé, Madagascar; Port Elizabeth, Algoa Bay (H. B. Brady); Malay Archipelago, rare (Millett); Funafuti (Chapman); Kerimba Archipelago; Cebu in 45 to 120 fathoms; and Lord Howe Island (Heron-Allen and Earland); Binang Pool, Subin Bay; Tara Island; Sulu region off Jolo, off Tawi Tawi, near Basilan, China Sea, off southern Luzon, and between Burias and Luzon, also Murray Island, Australia (Cushman). Our only material of this species, which is very typical, is from Makemo Lagoon.

TRILOCULINA BICARINATA d'Orbigny

PLATE 13, FIGURES 6 a-c

*Triloculina bicarinata* D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 158, pl. 10, figs. 18-20, 1839.—CUSHMAN, Carnegie Inst. Washington Publ. 311, p. 76, pl. 12, fig. 7, 1922; Publ. 344, p. 83, 1926; U. S. Nat. Mus. Bull. 104, pt. 6, p. 66, pl. 17, fig. 5, 1929.

Test longer than broad, triloculine, typically with the chambers with a truncate periphery, the angles somewhat extended; chambers distinct; sutures somewhat depressed; surface ornamented by reticulations both on the sides and on the outer angles; aperture elongate, with a definite thin lip, slightly everted, tooth elongate, narrow, extending above the outline of the aperture. Length, 0.8–1 mm.; breadth, 0.7–0.9 mm.; thickness, 0.55–0.6 mm.

The reticulately ornamented species have been noted under many different names since the earliest ones given by d'Orbigny. D'Orbigny's *Triloculina reticulata* was not figured in the 1826 paper, and while it may apply to various forms with a rounded periphery such as those to which Brady assigned the name in the *Challenger* report, our specimens with definitely angled chambers are much closer to the West Indian species described by d'Orbigny in 1839 as *Triloculina bicarinata*.

Our specimens are all from Mokuajar Anchorage, Fiji, where this form is very abundant, but it was not found in any of the other stations. There is as usual a considerable degree of variation in size and arrangement of the reticulations, and in these Fiji specimens the peripheral face of the chambers is highly ornamented, while the sides are much less so.

TRILOCULINA sp. (?)

PLATE 13, FIGURES 7 a–c

There are in the collections certain forms similar to that here figured that are very difficult to place specifically. The species seems to be on the border line between *Triloculina* and *Quinqueloculina*, and it is figured here in order that attention may be called to this peculiar form.

Genus PYRGO Defrance, 1824

*Pyrgo* DEFANCE, Dict. Sci. Nat., vol. 32, p. 273, 1824.—CUSHMAN, Cushman Lab. Foram. Res. Special Publ. No. 1, p. 155, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 67, 1929.

*Miliola* (part) LAMARCK, Ann. Mus. d'Hist. Nat., vol. 5, p. 351, 1804.

*Biloculina* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 297, 1826 (*genotype*, by designation, *B. bulloides* d'Orbigny).

*Genoholotype*.—*Pyrgo laevis* Defrance.

In its microspheric form this genus shows all three stages—quinqueloculine, triloculine, and biloculine—but in the specimens with a small megalospheric proloculum acceleration takes place and the quinqueloculine stage is skipped, and in specimens with a very large proloculum the biloculine character is taken on at once and both the quinqueloculine and triloculine stages are skipped entirely.

A number of the species of this genus have become adapted to a cold, deep-water habitat, an unusual one for most of the genera of this family.

In the shallow water of the Pacific the genus is often very abundant, but is limited to a very few species.

PYRGO DENTICULATA (H. B. Brady)

PLATE 14, FIGURES 1-9

*Biloculina ringens* LAMARCK var. *denticulata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 143, pl. 3, figs. 4, 5, 1884.—WOODWARD, The Observer, vol. 4, p. 76, 1893.—MILLETT, Journ. Roy. Micr. Soc., 1898, p. 262.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 28, p. 398 (list), 1902.—DAKIN, Rep. Pearl Oyster Fish. Ceylon, pt. 5, p. 220, 1906.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 17, p. 551, pl. 40, figs. 11-13, 1915.

*Biloculina denticulata* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 80, pl. 33, fig. 1, 1917; U. S. Nat. Mus. Bull. 100, vol. 4, p. 476, pl. 98, figs. 3, *a*, *b*, 1921; Carnegie Inst. Washington Publ. 311, p. 78, 1922; Publ. 342, p. 70, 1924; Publ. 344, p. 83, 1926.—HANZAWA, Jap. Journ. Geol. Pal., vol. 4, p. 38, (table), 1925 (1926).

*Pyrgo denticulata* CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 69, pl. 18, figs. 3, 4, 1929.

Test elongate, roughly quadrangular in front view, in end view somewhat compressed, biconvex, apertural end broadly rounded, opposite end with a series of short, irregular teeth; wall smooth, usually polished; aperture very broad and narrow, extending nearly the whole width of the test, the ends somewhat expanded, with a long, narrow tooth, making the inner border of the aperture platelike, somewhat raised above the level of the surface to which it is attached, as is the whole border of the aperture. Length, 0.6-1 mm.; breadth, 0.45-0.9 mm.; thickness, 0.3-0.5 mm.

This is a typical species of the Indo-Pacific usually most abundant in coral reef regions. There are numerous records for it from shallow water in various parts of the Pacific from the Philippines to the Hawaiian Islands, southward through the various groups of islands, and westward to the coast of Africa. It also occurs in much less abundance and is less well developed in the Atlantic. It is by far the most common species of the genus in the material we have examined from the South Pacific. There is a great deal of variation in this species, and some of the various forms are figured here. The young stage is very close to *Pyrgo elongata* in many ways, and it is these small light forms that are most easily carried out into deep water by the current and are found at a number of *Albatross* stations a short distance away from these islands, as will be noted. The figures give these early stages, which may be compared with the adults. Not all



the specimens show the toothed character of the base, and this apparently is often lost in the largest, thin-walled specimens. Some of those with well-developed teeth are here figured as well as the smooth forms. In these collections the species occurs in typical form at the following localities: Mokaujar Anchorage, Fiji; Nairai, Fiji, 24 fathoms; Levuka, Fiji, 12 fathoms; Vavau Anchorage, Tonga Islands, 18 fathoms; Rongelap Atoll, Marshall Islands; Guam Anchorage, Ladrone Islands, 21 fathoms; Rutavu; and at the following *Albatross* Stations: H3857, one-half mile off Center Tikei Islands, 360 fathoms; H3858, Ngaruae Pass, Fakarava Atoll, 599 fathoms; H3916, 1 mile off Pinaki Atoll, 486 fathoms; H3935, 1 mile off Hereheretue Atoll, 594 fathoms; H3936, same locality, 189 fathoms; all off Paumotu Islands; and H3967, one-half mile off Maraki Atoll, Marshall Islands, 431 fathoms.

TABLE 21.—*Pyrgo denticulata*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22019-----	2	H3857	Center Tikei Island, ½ mile E.	360	° F.	crs. co. s.-----	Rare.
22020-----	1	H3858	Ngaruae Pass, Fakarava Atoll, 28° S., 1 mile E.	599	-----	do-----	Do.
22021-----	2	H3916	Pinaki Atoll, 1 mile E.-----	486	41	crs. co. s. pter. oz.	Do.
22022-----	1	H3935	Hereheretue Atoll, 1 mile W----	594	39.5	crs. co. s.-----	Do.
22023-----	1	H3936	Hereheretue Atoll, 0.3 mile E----	189	62.1	co. s. mang. part.	Do.
22024-----	1	H3967	Monument, west shore of Maraki Atoll, 56° S., ½ mile E., Marshall Islands.	431	-----	-----	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

**PYRGO DENTICULATA (H. B. Brady) var. STRIOLATA (H. B. Brady)**

PLATE 14, FIGURES 10, 11

*Biloculina ringens* (LAMARCK) var. *striolata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 143, pl. 3, figs. 7, 8, 1884.—CHAPMAN, Proc. Zool. Soc. London, p. 8, 1895.—MILLETT, Journ. Roy. Micr. Soc., p. 262, pl. 5, fig. 8, 1898.—DAKIN, Rep. Pearl Oyster Fisheries Ceylon, p. 228, 1906.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 551, 1915; Journ. Linn. Soc. Zool., vol. 35, p. 602, 1924.

*Biloculina denticulata* (H. B. BRADY) var. *striolata* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 80, pl. 33, figs. 2, 3, 1917; U. S. Nat. Mus. Bull. 100, vol. 4, p. 477, pl. 98, figs. 2 a-c, 1921; Carnegie Inst. Washington Publ. 311, p. 78, 1922; Publ. 342, p. 70, 1924.

*Pyrgo denticulata* (H. B. BRADY) var. *striolata* CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 69, pl. 18, figs. 5 a-c, 1929.

Variety differing from the typical in the addition of a surface ornamentation consisting of a series of costae on the lower half of the penultimate chamber, occasionally on the ultimate also.

The only specimens of the variety occur in material from Vavau Anchorage, Tonga Islands, 18 fathoms; and Mokaujar Anchorage, Fiji.

PYRGO MURRHINA (Schwager)

PLATE 15, FIGURES 1-3

*Bilocolina murrhina* SCHWAGER, *Novara-Expedition*, Geology, vol. 2, p. 203, pl. 4, figs. 15 *a-c*, 1866.—MUNIER-CHALMAS and SCHLUMBERGER, *Bull. Soc. Géol. France*, ser. 3, vol. 13, p. 283, figs. 9, 10 (in text); p. 290, figs. 15, 16 (in text), 1885.—SCHLUMBERGER, *Mém. Soc. Zool. France*, vol. 4, p. 165, pl. 9, figs. 52, 54; figs. 8, 9 (in text), 1891.—EGGER, *Abh. kön. bay. Akad. Wiss. München*, Cl. II, vol. 18, pl. 1, figs. 19, 20, 1893.—Goës, *Bull. Mus. Comp. Zool.*, vol. 29, p. 87, 1896.—SCHUBERT, *Abh. k. k. Reichs.*, vol. 20, p. 122, fig. 17 (in text), 1911.—PEARCEY, *Trans. Roy. Soc. Edinburgh*, vol. 49, p. 994, 1914.—CUSHMAN, *U. S. Nat. Mus. Bull.* 71, pt. 6, p. 19, fig. 25 (in text); p. 75, pl. 28, fig. 3; pl. 29, fig. 1, 1917; *U. S. Nat. Mus. Bull.* 100, vol. 4, p. 470, 1921; *Bull. Scripps Inst. Oceanogr.*, Tech. Ser., vol. 1, p. 140, 1927.

*Bilocolina depressa* D'ORBIGNY var. *murrhyna* H. B. BRADY, *Rep. Voy. Challenger*, Zoology, vol. 9, p. 146, pl. 2, figs. 10, 11, 1884.—J. WRIGHT, *Proc. Roy. Irish Acad.*, ser. 3, vol. 1, p. 462, 1891.—CHAPMAN, *Proc. Zool. Soc. London*, p. 7, 1895.—BAGG, *Proc. U. S. Nat. Mus.*, vol. 34, p. 117, 1908.—CHAPMAN, *Journ. Linn. Soc. Zool.*, vol. 30, p. 395, 1910; *Zool. Res. Endeavour*, pt. 3, p. 310, 1912; *Biol. Res. Endeavour*, vol. 3, pt. 1, p. 5, 1915.—SIDEBOTTOM, *Journ. Roy. Micr. Soc.*, 1918, p. 9.—HERON-ALLEN and EARLAND, *British Antarctic Expedition*, Zoology, vol. 6, p. 62, 1922.

*Pyrigo murrhina* CUSHMAN, *U. S. Nat. Mus. Bull.* 104, pt. 6, p. 71, 1929.

Test in front view, in young specimens, nearly circular, in adult specimens somewhat longer than broad, in end view ellipsoidal, with the borders extended and carinate, the carina interrupted at the point opposite the aperture, leaving a sinus, rather deep and often with a long spine at each angle in young specimens; in adults, sinus less deep, and the spines usually reduced or wanting; wall smooth; aperture in the young with a neck not exceeding the periphery of the test; in adults with a prominently exerted tubular neck with a bifid tooth partially filling the nearly circular opening. Diameter, up to 1.5 mm.; thickness, 0.5 mm.

This species is widely distributed in deep water in all the oceans and occurs in the Pliocene of the Indo-Pacific at the type locality, Kar Nikobar, and in the Pliocene of Fiji.

TABLE 22.—*Pyrgo murrhina*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22025	1	H3804	Entrance to Ahii Lagoon, 2.5 miles SE.	1,208	° F.	lt. gy. oz. glob...	Rare.
22026	1	H3809	Entrance to Avatoru Pass, Rapiroa Atoll, 2.5 miles S.	645		fne. wh. co. s.....	Do.
22027	1	H3820	Lat. 15° 25' 59" S., long. 148° 24' 25" W.	1,486		glob. oz. vol. part.	Do.
22028	1	H3825	Lat. 14° 58' 35" S., long. 148° 35' W.	844		wh. glob. oz. mang. vol. part.	Do.
22029	1	H3836	Lat. 16° 10' S., long. 148° 26' W.	2,238		vol. m. glob. mang. nod.	Do.
22030	1	H3841	Point Venus, Tahiti Island, 32° S., 4.2 miles W.	775		ers. vol. s. mang. nod.	Do.
22031	1	H3847	Lat. 16° 08' S., long. 146° 42' W.	609	39	glob. oz. ....	Do.
22032	1	H3855	Northwest point Apataki, 1 mile SE.	654	38.8	ers. co. s.....	Do.
22033	1	H3878	Lat. 16° 13' S., long. 143° 48' W.	987		glob. pter. vol. part.	Do.
22034	1	H3903	Lat. 18° 08' S., long. 141° 49' W.	2,187	35.2	vol. m. glob.....	Do.
22035	1	H3906	Tekokoto Atoll, 1 mile E.	617	38.4	co. s.....	Do.
22036	1	H3922	Lat. 20° 31' S., long. 142° W.	2,467	35	.....	Do.
22037	1	H3923	Nukutipipi Atoll, 5 miles NW.	2,315	35	rd. c. glob.....	Do.
22038	1	H3991	Lat. 9° 40' S., long. 169° 32' W.	1,583	35.5	glob. oz. ....	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

## PYRGO GLOBULA (Bornemann)

## PLATE 15, FIGURES 6-8

*Biloculina globulus* BORNEMANN, Zeitschr. deutsch. geol. Gesell., vol. 7, p. 349, pl. 19, fig. 3, 1855.—SCHLUMBERGER, Mém. Soc. Zool. France, vol. 4, p. 188, pl. 12, figs. 97-100; figs. 42-44 (in text), 1891.—CHAPMAN, Subantarctic Islands of New Zealand, p. 317, 1909.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 78, pl. 31, fig. 2, 1917; Bull. 100, vol. 4, p. 474, pl. 95, figs. 2 a, b, 1921.

Test in front view oval, in end view irregularly globular; chambers very tumid; suture slightly depressed, in side view the last-formed chamber at the aboral end somewhat curving out over the preceding chamber; wall smooth, white; aperture semicircular, with a simple flat tooth filling a large part of the opening. Length, about 1 mm.

Specimens that seem to be the same as the specimens described by Bornemann from the Oligocene of Europe, and recorded by Schlumberger from off the Azores, are found at numerous stations in the *Albatross* collections but not in the shallow-water samples. The typical form has a flat tooth largely filling the aperture. The specimens figured from the Philippines do not have this typical tooth but are otherwise similar.

TABLE 23.—*Pyrgo globula*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom <sup>1</sup>	Occurrence
22039.....	1	H3815	Lat. 15° 15' S., long. 147° 51' 35'' W.	Fathoms 524	° F.	wh. co. s. brk. sh.	Rare.
22040.....	1	H3825	Lat. 14° 58' 35'' S., long. 148° 35' W.	844		wh. glob. oz. mang. vol. part.	Do.
22041.....	1	H3828	Lat. 14° 51' 20'' S., long. 148° 51' 20'' W.	624		wh. co. s.....	Do.
22042.....	1	H3841	Point Venus, Tahiti Island, 32° S., 4.2 miles W.	775		crs. vol. s. mang. nod.	Do.
22043.....	1	H3853	Pakaka entrance to Apataki Lagoon, 50° N., 2 miles E.	613	39.4	co. vol.....	Do.
22044.....	1	H3857	Center Tikei Island, ½ mile E....	360		crs. co. s.....	Do.
22045.....	1	H3860	Southwest end of Fakarava, 2 miles NE.	602		co. s. pter. oz....	Do.
22046.....	1	H3876	Northwest entrance to Makemo Lagoon, 1 mile SE.	467		wh. co. s.....	Do.
22047.....	1	H3914	Northeast point Nukutavake, 1 mile S.	636	38.9	co. s.....	Do.
22048.....	1	H3954	West end of Nomuka Island, 33° N., 6 miles E.	600	39.2	co. s. pum. pter. oz.	Do.

<sup>1</sup> Key to abbreviations is given in Table 1.

## PYRGO MILLETTII (Cushman)

## PLATE 15, FIGURES 4, 5

*Miliolina durandii* MILETT (part), Journ. Roy. Micr. Soc., 1898, p. 268, pl. 6, figs. 8-10 (not fig. 7).—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 565, pl. 42, figs. 11-16, 1915.

*Bilocolina millettii* CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 81, pl. 34, figs. 4, 5, 1917; Carnegie Inst. Washington, Publ. 311, p. 77, 1922; Publ. 342, p. 71, 1924.

*Pyrgo millettii* CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 68, pl. 19, fig. 1, 1929.

Test in front view, broadly elliptical, in end view, compressed; chambers biconvex; the periphery with a definitely developed carina; wall smooth, except for occasional transverse ribs usually indistinct; aperture slightly produced, broadly elliptical, with a slightly thickened border joining the carina at its outer edge; the aperture with a small bifid tooth.

This is a typical Indo-Pacific species of wide distribution and apparently extends to the West Indies region, where it is known only from the Tortugas. In the Pacific it is recorded as follows: Malay Archipelago (Millett); Kerimba Archipelago, southeast Africa, Burma, Queensland, Java, Macassar, and Tahiti (Heron-Allen and

Earland); Hongkong Harbor, Philippines, and Samoa (Cushman). The only specimens found in all the samples examined in the present collections are from Levuka, Fiji, in 12 fathoms, but these are very typical.

### Family OPHTHALMIDIIDAE

Test calcareous, imperforate, early chambers at least planispiral, except in degenerate forms; wall without an arenaceous coating; aperture typically open, without a tooth.

#### Subfamily CORNUSPIRINAE

Test made up of a proloculum and an elongate, planispiral, tubular second chamber.

#### Genus CORNUSPIRA Schultze, 1854

*Cornuspira* SCHULTZE, Organismus Polythal., p. 40, 1854.—H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, p. 198, 1884.—CHAPMAN, The Foraminifera, p. 99, 1902.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 160, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 78, 1929.

*Orbis* (part) PHILIPPI, Enum. Moll. Siciliae, vol. 2, p. 147, 1844.

*Operculina* (part) CZJZEK, Haidinger's Nat. Abh., vol. 2, p. 146, 1848.

*Spirillina* (part) WILLIAMSON, Rec. Foram. Great Britain, p. 91, 1858.

*Genotype*.—By designation, *Cornuspira planorbis* Schultze.

Test consisting of a proloculum followed by a long planispirally coiled second chamber, rounded or complanate; wall calcareous, imperforate; aperture formed by the open end of the chamber, sometimes constricted and with a thickened lip.

This genus is represented in the South Pacific by but a single species in our collections.

#### CORNUSPIRA INVOLVENS Reuss

##### PLATE 16, FIGURES 2 a, b

For complete references to this species see Cushman, U. S. Nat. Mus. Bull. 104, pt. 6, pp. 80-81, 1929.

Test nearly circular in side view, consisting of a proloculum and a long closely coiled, planispiral second chamber of nearly equal diameter throughout, slightly involute; suture distinct, somewhat depressed; wall smooth and polished, occasionally showing slight lines of growth; aperture nearly the size of the open end of the tube. Diameter of our South Pacific specimen, not exceeding 0.35 mm.

This is a common and widely distributed species, but in our material never reaches any considerable size. Specimens are common off Fiji near Nairai, 12 and 24 fathoms; off Levuka, 12 fathoms; off

Vavau Anchorage, 3 fathoms; and Mokaujar Anchorage. Specimens are also common off Niau and in Niau Lagoon; Vavau Anchorage, Tonga Islands, 18 fathoms; Rotonga, 7 fathoms; Rongelap Atoll, Marshall Islands; Port Lotten, Kersail, Caroline Islands; and Guam Anchorage, Ladrone Islands, 21 fathoms.

### Subfamily NODOBACULARIINAE

#### Genus NODOBACULARIA Rhumbler, 1895

*Nodobacularia* RHUMBLER, Nachr. Ges. Wiss. Göttingen, 1895, p. 87.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 164, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 86, 1929.

*Nubecularia* (part) JONES and PARKER (not DeFrance), Quart. Journ. Geol. Soc., vol. 16, p. 455, 1860.

*Genoholotype*.—*Nubecularia tibia* Jones and Parker.

Test with a globular proloculum followed by a planispiral tubular second chamber, the adult chambers in a rectilinear series; aperture simple, with a lip.

Lias to Recent.

This genus was apparently developed early in the history of the family, and species and specimens are common in the Jurassic. There are few living species.

The early stages in most specimens are very delicate, and easily broken away so that the majority of specimens have only the later heavy-walled chambers present. In some specimens there is only the proloculum and a second coiled chamber before the rectilinear series is taken on. In others there are two or three coiled chambers usually making up a half coil or less, but the proloculum is always evident. This is a typically tropical shallow-water genus. Owing to the early chambers being usually lacking, it is difficult to place some of the early described species, such as, for example, the forms usually referred to *Articulina conico-articulata*. The original figure given by Batsch does not have the early chambers, and it is very difficult to be sure of his species.

NODOBACULARIA ANTILLARUM Cushman PACIFICA, new variety

#### PLATE 16, FIGURES 1 a-c

Test slender, elongate, often slightly curved; the early chambers gradually increasing in length as added, somewhat pyriform, slightly wider toward the base; sutures distinct, much depressed; wall ornamented by numerous, usually 13 to 15, sharp, raised, longitudinal costæ; apertural end slightly contracted, and then expanded into a very definite lip, which is smooth. Length, 2.2 mm.; breadth, 0.2 mm.

*Holotype of variety*.—Cushman Coll. No. 14741, from Mokuajar Anchorage, Fiji.

This variety has also occurred off Levuka, Fiji, in 12 fathoms, and off Nairai, Fiji, 12 fathoms. Somewhat less typical specimens, but probably belonging to this same variety, occurred off Rotonga, 7 fathoms, and at Vavau Anchorage, Tonga Islands, 18 fathoms.

It is close to the species I have described as *Nodobacularia antillarum* from the West Indian region. The Pacific specimens, however, uniformly have more and sharper costae, and the earliest chambers are more compressed and smaller in comparison with the adult chambers.

NODOBACULARIA MILLETTI, new species

PLATE 16, FIGURES 3, 4

*Articulina conico-articulata* MILLETT (not Batsch), Journ. Roy. Micr. Soc., 1898, p. 511, pl. 12, figs. 9, 10.

Test with the early chambers planispiral, the later ones rectilinear and rapidly increasing in size as added, adult chambers very strongly pyriform, greatest breadth at the base, and thence rather rapidly contracting toward the apertural end, which is expanded into a broad smooth lip; sutures distinct; wall ornamented by a few, 12 to 18 usually, high, thin, platelike costae, which terminate in spines at the basal end, those of the later chambers often bifurcating; aperture elliptical, with a very broad lip. Length, 1.5 mm.; breadth, 0.5 mm.; thickness, 0.35 mm.

*Holotype*.—Cushman Coll. No. 14743, from Mokuajar Anchorage, Fiji.

This is probably the same form as that described and figured by Millett in the above reference from the Malay Archipelago. His specimens, however, show a much larger proloculum, and the coiled chambers show practically no compression, while in our specimens from Fiji there is a strongly compressed young stage. Later chambers, however, seem to be very close to ours. It may be that his specimens are the megalospheric form, while ours are microspheric. This is a fine distinctive species, beautifully ornamented, and so far as the material we have shows, has only occurred off Fiji at Mokuajar Anchorage, and off Levuka in 12 fathoms. It is common at the type locality.

In the early stages there may be developed short chambers of one-third of a coil in length, which begin to take on the characteristic costæ ornamentation before the adult uniserial stage is developed.

## Subfamily OPHTHALMIDIINAE

## Genus SPIROPTHALMIDIUM Cushman, 1927

*Spiroptthalmidium* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, p. 37, 1927; Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 165, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 90, 1929.

*Spiroloculina* (part) H. B. BRADY (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 154, 1884.

*Genoholotype*.—*Spiroloculina acutimargo* H. B. Brady (part).

Test similar to *Ophthalmidium*, but accelerated, the stage having two chambers in a coil quickly reached; plate between the chambers usually present; aperture simple, without teeth.

There is a single species of this genus occurring in our material.

## SPIROPTHALMIDIUM ACUTIMARGO (H. B. Brady)

## PLATE 16, FIGURES 5 a, b

*Spiroloculina acutimargo* H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 154, pl. 10, fig. 13 (not figs. 12, 14, 15), 1884.—BALKWILL and J. WRIGHT, Trans. Roy. Irish Acad., vol. 28, Sci., p. 323, 1885.—SIDALL, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 72 (list).—HALKYARD, Trans. Manchester Micr. Soc., 1889, p. 59.—CHASTER, 1st Rep. Southport Soc. Nat. Sci., 1890-91, p. 55, 1892.—J. WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, p. 463, 1891.—MILLETT, Journ. Roy. Micr. Soc., 1898, p. 264.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 23, p. 172, 1901.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, no. 5, p. 6, 1904.—EARLAND, Journ. Quekett Micr. Club, ser. 2, vol. 9, p. 192, 1905.—BAGG, Proc. U. S. Nat. Mus., vol. 34, p. 119, 1908.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 30, p. 396, 1910.—HERON-ALLEN and EARLAND, Proc. Roy. Irish Acad., vol. 31, pt. 64, p. 24, pl. 1, fig. 8, 1913.—CHAPMAN, Biol. Res. *Endavour*, vol. 3, pt. 1, p. 6, 1915.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 17, p. 557, 1915; Trans. Linn. Soc. London, ser. 2, vol. 11, p. 208, 1916.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 31, pl. 5, fig. 1, 1917.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 5.—CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 398, 1921; Carnegie Inst. Washington Publ. 342, p. 56, 1924.

*Spiroptthalmidium acutimargo* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, p. 37, pl. 8, fig. 5, 1927; Cushman Lab. Foram. Res. Special Publ. No. 1, pl. 20, fig. 7; pl. 21, fig. 5, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 90, pl. 22, fig. 1, 1929.

Test oval, much compressed, planispiral throughout, peripheral margin carinate; development consisting of a proloculum followed by several coils of an undivided second tubular chamber, then by chambers a half coil in length separated by a wide flange; wall smooth; aperture rounded, without a tooth. Length, 0.5 mm.; breadth, 0.3 mm.; thickness, 0.05 mm.

The only specimens of this species are from three *Albatross* stations as given in Table 24. All the specimens are very typical.



TABLE 24.—*Spirothalmidium acutimargo*—material examined

U.S.N.M. No.	Number of specimens	Albatross station	Locality	Depth	Bottom temperature	Character of bottom	Occurrence
22090.....	2	H3829	Lat. 14° 56' S., long. 148° 48' W..	Fathoms 860	° F. -----	wh. co. s. glob. vol. part.	Rare.
22091.....	1	H3830	Lat. 15° 00' 30'' S., long. 148° 47' W.	1,257	-----	do-----	Do.
22092.....	1	H3873	Southwest point of Tahanae, 68° N., 4 miles E.	966	-----	glob. oz. mang--	Do.

## Genus PLANISPIRINA Seguenza, 1880

*Planispirina* SEGUENZA, Atti R. Accad. Lincei, ser. 3, vol. 6, p. 310, 1880.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 193 (in part), 1884.—CHAPMAN, The Foraminifera, p. 98, 1902.—CUSHMAN, Cushman Lab. Forum. Res. Spec. Publ. No. 1, p. 166, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 93, 1929.

*Genotype*.—By designation, *Planispirina communis* Seguenza.

Test in the early stages like *Cornuspira*, later divided into chambers, several to a coil; aperture simple, without a tooth.

There are two species of this genus in our Pacific material, only one of which is at all common.

## PLANISPIRINA EXIGUA (H. B. Brady)

## PLATE 16, FIGURES 7 a, b

*Hauerina exigua* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 53, 1879.

*Planispirina exigua* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 196, pl. 12, figs. 1-4; text-fig. 5b, 1884.—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, p. 216, pl. 40, fig. 4, 1888.—HOWCHIN, Trans. Proc. Roy. Soc. South Australia, vol. 12, p. 5, 1889.—EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 245, pl. 3, figs. 11, 12, 1893.—WOODWARD, The Observer, vol. 4, p. 77, 1893.—MILLETT, Journ. Roy. Micr. Soc., p. 611, pl. 13, fig. 13, 1898.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 30, p. 21, pl. 2, fig. 43, 1907; Subantarctic Islands of New Zealand, p. 323, 1909.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 590, 1915.—CHAPMAN, Biol. Res. *Endeavour*, vol. 3, pt. 1, p. 11, 1915.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 9, fig. 7 (in text), 1917.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., p. 133, 1924.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 94, 1929.

Test much compressed, planispiral, the early whorls undivided, later ones showing usually two or three chambers to the coil, rather indistinct except when the specimens are wet; sutures rather indistinct except those of the last-formed coil; wall fairly smooth, usually opaque; aperture a narrow elongate opening without a definite tooth. Diameter, 0.3 mm.; thickness, 0.03-0.05 mm.

This is a small easily overlooked species occurring in its typical form rather widely distributed in the Indo-Pacific, although there are records from other regions. I have in the present collections very typical specimens from 12 fathoms off Levuka, Fiji, where it is fairly common, and from near Nairai, Fiji. A single specimen also occurred at *Albatross* Station H3812, 7½ miles south of entrance, Avatoru Pass, Rāhīroa Atoll, Paumotu.

PLANISPIRINA AURICULATA Egger

PLATE 16, FIGURES 6 a-c

*Planispirina auriculata* EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 245, pl. 3, figs. 13-15, 1893.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 590, pl. 46, figs. 3-7, 1915.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 10.—CUSHMAN, Carnegie Inst. Washington Publ. 311, p. 62, pl. 10, fig. 8, 1922.—HERON-ALLEN and EARLAND, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 123; Journ. Linn. Soc. Zool., vol. 35, p. 609, 1924.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 93, pl. 22, fig. 3, 1929.—CUSHMAN and PARKER, Proc. U. S. Nat. Mus., vol. 80, art. 3, p. 6, pl. 2, fig. 3, 1931.

Test minute, generally oval in outline, biconvex, consisting of a few milioline chambers, the apertural end somewhat extended, turned so that the aperture is entirely at one side of the test; aperture elliptical or rounded, with a broad, flaring lip; sutures fairly distinct, not depressed; wall translucent; color, bluish white. Length, 0.3 mm.; breadth, 0.15 mm.; thickness, 0.05 mm.

The only specimens we have are a few from Port Lotten, Kersail, Caroline Islands.

This minute species is, like the preceding, very easily overlooked on account of its small size. From the records, however, it has a wide distribution in both the Atlantic and Pacific. It is easily distinguished by the large aperture in proportion to the size of the test, and the flaring lip.

Genus VERTEBRALINA d'Orbigny, 1826

*Vertebralina* d'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 283, 1826.—H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, p. 1884.—CHAPMAN, The Foraminifera, p. 97, 1902.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 168, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 95, 1929.

*Genoholotype*.—*Vertebralina striata* d'Orbigny.

Test with the early chambers planispiral, later ones in a rectilinear series; aperture simple, a long narrow slit either at the outer end of the chamber or somewhat laterally placed, typically with a definite lip. Eocene to Recent.

In the present collection the genus is represented only by the following species, *striata*.

## VERTEBRALINA STRIATA d'Orbigny

## PLATE 16, FIGURES 8-10

*Vertebralina striata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 283, No. 1, Modèles, No. 81, 1826.—WILLIAMSON, Rec. Foram. Great Britain, p. 90, pl. 7, figs. 196a, b (=197, 198), 1858.—W. B. CARPENTER, PARKER, and JONES, Introd. Foram., p. 72, pl. 5, figs. 17-25, 1862.—PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, p. 32, pl. 1, fig. 1, 1865; ser. 4, vol. 8, p. 239, pl. 8, fig. 27, 1871.—SCHWAGER, Boll. R. Com. Geol. Ital., vol. 8, p. 27, pl., fig. 106, 1877.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 187, pl. 12, figs. 14-16, 1884.—A. SILVESTRI, Atti Accad. Sci. Acireale, vol. 7, p. 22, 1896.—MILLETT, Journ. Roy. Micr. Soc., p. 607, pl. 13, fig. 1, 1898.—SIDE-BOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, no. 5, p. 18, 1904.—DAKIN, Rep. Pearl Oyster Fish. Ceylon, p. 231, 1906.—CHAPMAN, Journ. Quekett Micr. Club, ser. 2, vol. 10, p. 125, 1907.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, no. 16, p. 6, 1910.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., p. 305, 1911; Trans. Zool. Soc. London, vol. 20, p. 587, 1915.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 38, pl. 22, figs. 3, 4, 1917.—MARTINOTTI, Atti Soc. Ital. Sci. Nat., vol. 59, p. 327, fig. 170 (in text), 1920.—CUSHMAN, U. S. Nat. Mus. Bull. 100, vol. 4, p. 414, 1921.—HERON-ALLEN and EARLAND, Bull. Soc. Sci. Hist. Nat. Corse, 1922, p. 123.—CUSHMAN, Carnegie Inst. Washington Publ. 342, p. 58, 1924; U. S. Nat. Mus. Bull. 104, pt. 6, p. 96, pl. 22, figs. 6a, b, 1929.

Test much compressed, early portion close coiled, later uncoiling in a series of low, broad, uniserial chambers; sutures distinct, depressed; surface ornamented by fine longitudinal striae; aperture elongate, irregular, the lip on one side being shorter than on the other, making the aperture really on the ventral side of the test, lip smooth, ends rounded and not projecting. Length, 0.6-1.2 mm.; breadth, 0.5-0.7 mm.; thickness, 0.2-0.25 mm.

This is a common species in the material, rather widely distributed, and while it varies somewhat in form, because the early stages are close coiled and the later ones somewhat uncoiled, nevertheless the ornamentation, which is very constant, will serve to distinguish the species from any other of those allied to it. There are occasional specimens that tend toward *V. reticulosa* Cushman described from the Philippines, but none of them has these characters very strongly developed. D'Orbigny's model of this species shows a much uncoiled specimen with the sides in the adult nearly parallel. Such specimens are not common, but are occasionally found in large series of specimens. Most of those found are usually in the early coiled stages. There are specimens in the present collection from Mokuaujar Anchorage, Fiji; Levuka, Fiji, 12 fathoms; Viva Anchorage, Fiji, 3 fathoms; and off Nairai, Fiji, 12 fathoms. Specimens also occur off Vavau Anchorage, Tonga Islands; off Rotonga (= ?Rarotonga); and Guam Anchorage, Ladrone Islands, in 21 fathoms.

## Subfamily NUBECULARIINAE

## Genus PARRINA Cushman, 1931

*Parrina* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 7, p. 20, 1931.

*Silvestria* SCHUBERT, Pal. Zeitschr., vol. 3, p. 166, 1920.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 169, 1928.

*Nubecularia* (part) of authors.

*Genoholotype*.—*Nubecularia inflata* H. B. Brady (not Terquem) = *N. bradyi* Millett.

Test with the early chambers where visible irregularly coiled, later chambers inflated and very irregular, sometimes coiled, sometimes in an irregular linear arrangement; wall calcareous, imperforate; aperture variable in shape, often rounded, and irregularly placed.

Recent.

This genus is represented in the Indo-Pacific in shallow water of coral reef regions by the following species, *bradyi*.

## PARRINA BRADYI (Millett)

## PLATE 17, FIGURES 1-4

*Nubecularia inflata* H. B. BRADY (not Terquem), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 135, pl. 1, figs. 5-8, 1884.—A. SILVESTRI, Atti Accad. Sci. Acireale, vol. 7, p. 30, 1895-96; Mem. Accad. Pont. Nuovi Lincei, vol. 50, p. 35, 1897.—BAGG, Proc. U. S. Nat. Mus., vol. 34, p. 116, 1908.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 6, p. 98, 1929.

*Nubecularia bradyi* MILLETT, Journ. Roy. Micr. Soc., 1898, p. 261, pl. 5, figs. 6a, b.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 28, p. 169, pl. 19, fig. 3, 1900.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 48, no. 5, p. 3, 1904.—RIUMBLER, Zool. Jahrb., Abt. Syst., vol. 24, p. 40, pl. 2, figs. 17-19, 1906.—CHAPMAN, Journ. Quekett Micr. Club, ser. 2, vol. 10, p. 119, 1907.—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, no. 16, p. 2, 1910.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1911, p. 300.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, p. 993, 1914.—CHAPMAN, Victorian Nat., vol. 32, p. 49, fig. 1 (in text), 1915.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 550, pl. 40, figs. 8-10, 1915.—CUSHMAN, U. S. Nat. Mus. Bull. 71, pt. 6, p. 41, pl. 8, figs. 4, 5, 1917; Proc. U. S. Nat. Mus., vol. 56, p. 636, 1919.—HERON-ALLEN and EARLAND, British Antarctic Expedition, Zoology, vol. 6, p. 60, 1922; Journ. Linn. Soc. Zool., vol. 35, p. 601, 1924; Trans. Zool. Soc. London, vol. 22, pt. 1, p. 68 (list), 1926.

*Silvestria bradyi* SCHUBERT, Pal. Zeitschr., vol. 3, p. 166, 1920.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, pl. 53, figs. 11-13, 1928.

*Parrina bradyi* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 7, p. 20, 1931.

Test very irregular in form, the early portion often showing signs of coiling but early becoming irregular in form and shape; chambers inflated, globular, irregularly arranged, either in a loose coil or in a more or less linear series; wall smooth, calcareous, imperforate, polished; aperture rounded, or very irregular in form and irregularly placed. Diameter of test, up to 1 mm.

This species seems to be widely distributed in warm coral reef areas, especially in the Mediterranean and the Indo-Pacific. It is an extremely variable form, and assumes many shapes.

Our specimens are all from comparatively shallow waters, except for one station off Fiji in 21 fathoms or less. They include the following stations: Off Nairai, Fiji, 12 fathoms; off Levuka, Fiji, 12 fathoms; off Fiji, 40-50 fathoms; Rangiroa; off Niau; Makemo Lagoon; beach off wharf, Hereheretue Island; Rutavu; Vavau Anchorage, Tonga Islands, 18 fathoms; Port Lotten, Kersail, Caroline Islands; and Guam Anchorage, Ladrone Islands, in 21 fathoms.

### Family FISCHERINIDAE

Test coiled, earlier ones somewhat planispiral, later ones trochoid, all coils visible from the dorsal side, only the last-formed one from the ventral side; chambers distinct but not inflated, usually four or five making up the last-formed coil; wall calcareous, imperforate; aperture rounded, formed by the open end of the last-formed chamber.

This family is represented by the single genus *Fischerina*, which is commonest in the warm waters of the Tropics. The family is closely related to and derived from the family Ophthalmididae. It is a direct derivative of the genus *Cornuspira*, assumes a trochoid form, and is divided into chambers.

#### Genus FISCHERINA Terquem, 1878

*Fischerina* TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 1, p. 80, 1878.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 1, p. 170, 1928; U. S. Nat. Mus. Bull. 104, pt. 6, p. 100, 1929.

*Genoholotype*.—*Fischerina rhodiensis* Terquem.

Test coiled in a low conical spiral; chambers few in each coil, all visible from the dorsal side, only those of the last-formed coil from the ventral side; wall calcareous, imperforate; aperture formed by the open end of the last-formed chamber, simple.

The species of this genus are mostly confined to shallow warm water of the Tropics.

Our material has yielded three species of this genus, all of them apparently different from the West Indian one.

#### FISCHERINA PELLUCIDA Millett

##### PLATE 17, FIGURES 7 a-c

*Fischerina pellucida* MILLETT, Journ. Roy. Micr. Soc., 1898, p. 611, pl. 13, figs. 14, 15.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, p. 591, 1915.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 56, p. 636, 1919; Carnegie Inst. Washington Publ. 342, p. 53, pl. 19, fig. 9, 1924.—HERON-ALLEN and EARLAND, Journ. Linn. Soc. Zool., vol. 35, p. 610, 1924.

Test forming a very low, compressed, trochoid spiral of only about  $1\frac{1}{2}$  to 2 whorls, the earliest portion in the microspheric form with the chamber following the proloculum, making about one complete coil, followed by an adult whorl, in which there are from 5 to 6 chambers on the dorsal side, the coils very slightly if at all overlapping, on the ventral side the central portion slightly umbilicate, the last-formed whorl making up most of the surface on the ventral side, periphery broadly rounded; wall thin, translucent, bluish white; aperture circular, formed by the open end of the last-formed chamber. Diameter, 0.25 mm.; thickness, 0.05–0.07 mm.

Millett's types of this species are from the Malay Archipelago, and there are records for it, references to which are given above, from the Kerimba Archipelago (Heron-Allen and Earland); off New Zealand, off Samoa (Cushman); Lord Howe Island (Heron-Allen and Earland). Rather typical specimens occurred in our material from Port Lotten, Kersail, Caroline Islands, and from Guam Anchorage, Ladrone Islands, in 21 fathoms.

**FISCHERINA HELIX** Heron-Allen and Earland

PLATE 17, FIGURES 5 a-c

*Fischerina helix* HERON-ALLEN and EARLAND, TRANS. Zool. Soc. London, vol. 20, pt. 17, p. 591, pl. 46, figs. 10–14, 1915; British Antarctic Expedition, Zoology, vol. 6, p. 73, 1922.

Test forming a definite trochoid spiral of 4 or 5 volutions, periphery broadly rounded, whorls with about 3 or 4 chambers to each; sutures flush with the surface except the spiral suture, which is somewhat depressed; wall very thin, fragile, opalescent; aperture formed by the open end of the last-formed chamber. Diameter, 0.25–0.3 mm.; height, 0.18–0.2 mm.

Heron-Allen and Earland described this species from the Kerimba Archipelago off southeast Africa, and also recorded it from a dredging off the Poor Knights Islands, New Zealand. The only material I have had in these present collections is 40 to 50 fathoms off Fiji.

**FISCHERINA INVOLUTA**, new species

PLATE 17, FIGURES 6 a-c

Test nearly planispiral and almost completely involute on both sides; chambers somewhat indistinct, three or four in the final whorl; sutures sigmoid on the ventral side, on the dorsal side radial, flush with the surface; wall very thin, fragile; aperture semicircular, formed by the open end of the last-formed chamber. Diameter, 0.3–0.35 mm.; thickness, 0.2 mm.

*Holotype*.—U.S.N.M. No. 14626, from Rangiroa.

This species differs from the other known ones of the genus in having the whorls almost completely involute, especially in the later development. A few specimens seem to show that the earliest chambers are more open. The ventral side seems to be almost completely involute with a very slight umbilical depression, the dorsal side flattened or slightly convex. As far as our material shows, this is the commonest species of the genus in the South Pacific. It is abundant at the type locality, and also occurs at Rutavu; Makemo Lagoon, Paumotus; inside lagoon, Pinaki Atoll; beach off wharf, Hereheretue; and from *Albatross* Station H3933, latitude 20° 02' S., longitude 144° 28' W., Paumotus.

## Family TROCHAMMINIDAE

### Subfamily TROCHAMMININAE

#### Genus TROCHAMMINA Parker and Jones, 1860

##### TROCHAMMINA TURBINATA (H. B. Brady)

##### PLATE 17, FIGURES 8 a, b

*Haplophragmium turbinatum* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 50, 1881; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 312, pl. 35, figs. 9a-c, 1884.

*Trochammina turbinatum* EIMER and FICKERT, Zeitschr. Wiss. Zool., vol. 65, p. 695, 1889.—CUSHMAN, U. S. Nat. Mus. Bull. 104, pt. 2, p. 81, pl. 17, fig. 2, 1920; Bull. Scripps Inst. Oceanogr., Tech. Ser., vol. 1, no. 10, p. 142, 1927.—CUSHMAN and MOYER, Contr. Cushman Lab. Foram. Res., vol. 6, p. 53, pl. 7, fig. 10, 1930.

Test spiral, early portion regular, low spired, last-formed whorl in the adult often becoming oblique; chambers 5 to 8 in the last whorl, umbilicate; wall arenaceous, usually smoothly finished, cement yellowish brown; aperture a narrow slit at the base of the ventral side of the chamber. Diameter, 0.35 mm.; thickness, 0.18 mm.

The only specimens of this species are from *Albatross* Station H3973, latitude 5° 20' S., longitude 169° 43' W., in 2,411 fathoms.

### Subfamily GLOBOTEXTULARIINAE

#### Genus NOURIA Heron-Allen and Earland, 1914

*Nouria* HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 12, p. 375, 1914.—CUSHMAN, Smithsonian Misc. Coll., vol. 77, no. 4, p. 30, 1925; Cushman Lab. Foram. Res. Spec. Publ. no. 1, p. 174, 1928.

*Genotype*.—By designation, *Nouria polymorphinoides* Heron-Allen and Earland.

Test free, of several chambers, irregularly arranged; wall arenaeous; aperture simple, terminal.

Recent.

There is a single species present in the collections.

NOURIA POLYMORPHINOIDES Heron-Allen and Earland

PLATE 17, FIGURES 9 *a*, *b*

*Nouria polymorphinoides* HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, pt. 12, p. 376, pl. 37, figs. 1-14, 1914; pt. 17, p. 615, 1915.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 56, p. 601, pl. 75, figs. 4, 5, 1919.—HERON-ALLEN and EARLAND, British Antarctic Expedition, Zoology, vol. 6, p. 103, 1922.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, p. 189, 1927; Bull. Scripps Inst. Oceanogr., Tech. Ser., vol. 1, p. 142, 1927.

This species has now been recorded from several widely distributed stations in the Indo-Pacific region from the east coast of Africa, the western coast of America, and from off New Zealand. The record given by Heron-Allen and Earland from the Eocene of Biarritz<sup>6</sup> seems from the figures to be a different thing. The Indo-Pacific material is definite in its general characters. Our specimens are from Mokaujar Anchorage, Fiji, in comparatively shallow water. They often have sponge spicules incorporated in the test as well as other fragments of various sorts. These are usually neatly cemented, and there are traces of sutures in most of the specimens.

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<sup>6</sup> Halkyard, Mem. Proc. Manchester Lit. Philos. Soc., vol. 62, pt. 2, pl. 1, figs. 6, 7, 1918 (1919).



## EXPLANATION OF PLATES

### PLATE 1

- FIGURES 1-3. *Reophax agglutinatus* Cushman.  $\times 70$ . Fig. 1, Young specimen. *Albatross* H3910. Fig. 2. *Albatross* H3919. Fig. 3, Specimen broken, showing interior, *Albatross* H3779.
- 4 a, b. *Haplophragmoides trullissata* (H. B. Brady).  $\times 70$ . a, Side view; b, peripheral view. *Albatross* H3779.
- 5 a, b. *Spiroplectammina milletti* (Cushman).  $\times 40$ . a, Front view; b, apertural view. *Albatross* H3959.
- 6-10. *Textularia foliacea* Heron-Allen and Earland.  $\times 40$ . Fig. 6, Vavau Anchorage, Tonga Islands. Fig. 7, a, Front view; b, side view. Levuka, Fiji. Fig. 8, a, Front view; b, apertural view. Mokaujar Anchorage, Fiji. Fig. 9, a, Front view; b, side view. Rongelap Atoll, Marshall Islands. Fig. 10, Mokaujar Anchorage, Fiji.
- 11, 12. *Textularia foliacea* Heron-Allen and Earland *occantica*, new variety. Fig. 11, Holotype,  $\times 30$ . a, Front view; b, side view. Mokaujar Anchorage, Fiji. Fig. 12, Young stage.  $\times 40$ . Rotonga.

### PLATE 2

- FIGURES 1-3. *Textularia semialata* Cushman.  $\times 40$ . a, Front view; b, apertural view. Mokaujar Anchorage, Fiji.
- 4 a, b. *Textularia candeiana* d'Orbigny.  $\times 40$ . a, Front view; b, apertural view. Makemo Lagoon, Paumotu Islands.
- 5-7. *Textularia agglutinans* d'Orbigny.  $\times 55$ . Fig. 5, Rongelap Atoll, Marshall Islands. Fig. 6, a, Front view; b, apertural view. Levuka, Fiji. Fig. 7, *Albatross* H3961.
- 8-10. *Textularia conica* d'Orbigny.  $\times 55$ . a, a, Front view; b, b, b, apertural views. Figs. 8, 10, Mokaujar Anchorage, Fiji. Fig. 9, Vavau Anchorage, Tonga Islands.

### PLATE 3

- FIGURES 1, 3. *Textularia conica* d'Orbigny.  $\times 55$ . a, Front view; b, apertural view. Rongelap Atoll, Marshall Islands.
- 2, 4. *Textularia corrugata* Heron-Allen and Earland.  $\times 40$ . a, Front view; b, apertural view. Off Fiji, 40-50 fathoms.
- 5 a, b. *Textularia albatrossi* Cushman.  $\times 40$ . a, Front view; b, apertural view. *Albatross* H3858.
- 6 a, b. *Textularia concava* Karrer.  $\times 55$ . a, Front view; b, apertural view. *Albatross* H3815.
- 7 a, b. *Gaudryina triangularis* Cushman var. *angulata* Cushman.  $\times 55$ . a, Front view; b, apertural view. Mokaujar Anchorage, Fiji.
- 8, 9. *Gaudryina bradyi* Cushman.  $\times 55$ . a, a, Front views; b, b, apertural views. Fig. 8, *Albatross* H3818. Fig. 9, *Albatross* H3901.
- 10, 11. *Gaudryina quadrangularis* Bagg.  $\times 40$ . a, a, Front views; b, b, apertural views. *Albatross* H3959.

## PLATE 4

- FIGURES 1 *a, b*. *Gaudryina rugulosa*, new species.  $\times 25$ . *a*, Front view; *b*, apertural view. Alofi Niue.
- 2 *a, b*. *Gaudryina* sp. (?).  $\times 55$ . *a*, Front view; *b*, apertural view. Makemo Lagoon, Paumotu Islands.
- 3 *a, b*. *Clavulina communis* d'Orbigny,  $\times 25$ . *a*, Front view; *b*, apertural view. Albatross H3816.
- 4 *a, b*. *Clavulina pacifica* Cushman.  $\times 30$ . *a*, Front view; *b*, apertural view. Makemo Lagoon, Paumotu Islands.
- 5, 6. *Clavulina difformis* H. B. Brady.  $\times 25$ . *a, a*, Front views; *b, b*, apertural views. Fig. 5, Guam Anchorage, Ladrone Islands. Fig. 6, Mokaujar Anchorage, Fiji.
- 7 *a, b*. *Clavulina pacifica* Cushman.  $\times 30$ . *a*, Front view; *b*, apertural view. Rangiroa.
- 8 *a, b*. *Clavulina difformis* H. B. Brady.  $\times 25$ . *a*, Front view; *b*, apertural view. Vavau Anchorage, Tonga Islands.
- 9 *a, b*. *Clavulina pacifica* Cushman.  $\times 30$ . *a*, Front view; *b*, apertural view. Rangiroa.
- 10 *a, b*. *Clavulina difformis* H. B. Brady. *a*, Front view; *b*, apertural view. Guam Anchorage, Ladrone Islands.

## PLATE 5

- FIGURES 1 *a-c*. *Quinqueloculina anguina* Terquem var. *agglutinans* (Wiesner).  $\times 55$ . *a, b*, Opposite sides; *c*, apertural view. From off Nairai, Fiji.
- 2-4. *Quinqueloculina berthelotiana* d'Orbigny.  $\times 55$ . Figs. 2, 4, From Rangiroa. Fig. 3, *a, b*, Opposite sides; *c*, apertural view. From Hereheretue Island.
5. *Quinqueloculina bidentata* d'Orbigny.  $\times 40$ . Off Levuka, Fiji.
- 6, 7. *Quinqueloculina costata* d'Orbigny.  $\times 55$ . *a, a, b*, Opposite sides; *c, c*, apertural views. Vavau Anchorage, Tonga Islands.
- 8 *a-c*. *Quinqueloculina crassa* d'Orbigny var. *subcuneata* Cushman.  $\times 55$ . *a, b*, Opposite sides; *c*, apertural view. Rongelap Atoll, Marshall Islands.
- 9, 10. *Quinqueloculina funafutiensis* (Chapman).  $\times 70$ . Fig. 9, Mokaujar Anchorage, Fiji. Fig. 10, *a, b*, Opposite sides; *c*, apertural view. Off Niau, Paumotu Islands.
- 11 *a-c*. *Quinqueloculina crenulata*, new species.  $\times 55$ . *a, b*, Opposite sides; *c*, apertural view. From Port Lotten, Kersail, Caroline Islands.
12. *Quinqueloculina* cf. *gracilis* d'Orbigny.  $\times 40$ . Rangiroa.

## PLATE 6

- FIGURES 1 *a-c*. *Quinqueloculina gualtieriana* d'Orbigny.  $\times 55$ . *a, b*, Opposite sides; *c*, apertural view. Vavau Anchorage, Tonga Islands.
- 2 *a-c*. *Quinqueloculina lamarckiana* d'Orbigny.  $\times 40$ . *a, b*, Opposite sides; *c*, apertural view. Off Levuka, Fiji.
- 3, 4. *Quinqueloculina parkeri* (H. B. Brady).  $\times 30$ . Fig. 3, *a, b*, Opposite sides. From Guam Anchorage, Ladrone Islands.
- 5, 6. *Quinqueloculina polygona* d'Orbigny,  $\times 40$ . *a, a, b*, Opposite sides; *c, c*, apertural views. Fig. 5, Rotonga. Fig. 6, Off Levuka, Fiji.

## PLATE 7

- FIGURES 1 *a-c*. *Quinqueloculina samoensis* Cushman.  $\times 40$ . *a, b*, Opposite sides; *c*, apertural view. Off Levuka, Fiji.
- 2 *a, b*. *Quinqueloculina semireticulosa*, new species.  $\times 55$ . *a*, Front view; *b*, apertural view. Port Lotten, Kersail, Caroline Islands.
- 3, 4. *Quinqueloculina striatula*, new species.  $\times 40$ . Fig. 3, Holotype. *a, b*, Opposite sides; *c*, apertural view. Mokaujar Anchorage, Fiji.
- 5-8. *Quinqueloculina sulcata* d'Orbigny.  $\times 40$ . Figs. 5, 8, Off Fiji, 40-50 fathoms. *8a, b*, Opposite sides; *c*, apertural view. Figs. 6, 7, Mokaujar Anchorage, Fiji. *7a, b*, Opposite sides; *c*, apertural view.

## PLATE 8

- FIGURE 1. *Schlumbergerina alveoliniformis* (H. B. Brady).  $\times 25$ . Mokaujar Anchorage, Fiji.
- 2 *a, b*. *Massilina australis*, new species.  $\times 40$ . *a*, Front view; *b*, apertural view. Rotonga.
- 3 *a, b*. *Massilina alveoliniformis* Millett.  $\times 40$ . *a*, Front view; *b*, apertural view. Off Levuka, Fiji.
- 4 *a, b*. *Massilina macilenta* (H. B. Brady).  $\times 55$ . *a*, Front view; *b*, apertural view. Off Levuka, Fiji.
- 5 *a, b*. *Massilina crenata* (Karrer).  $\times 55$ . *a*, Front view; *b*, apertural view. Albatross H3858.
- 6, 7. *Massilina inaequalis* Cushman.  $\times 40$ . Fig. 6, From Viva Anchorage, Fiji. Fig. 7, *a*, Front view; *b*, apertural view. Vavau Anchorage, Tonga Islands.
- 8 *a, b*. *Massilina planata*, new species.  $\times 25$ . *a*, Front view; *b*, apertural view. From Guam Anchorage, Ladrone Islands.
- 9-11. *Spiroloculina grateloupi* d'Orbigny.  $\times 40$ . Fig. 9, *a*, Front view; *b*, apertural view. Mokaujar Anchorage, Fiji. Fig. 10, Viva Anchorage, Fiji. Fig. 11, Albatross H3930.

## PLATE 9

- FIGURES 1 *a, b*. *Spiroloculina grateloupi* d'Orbigny *serrulata*, new variety.  $\times 55$ . *a*, Front view; *b*, apertural view. Viva Anchorage, Fiji.
- 2 *a, b*. *Spiroloculina grateloupi* d'Orbigny *acescata*, new variety.  $\times 40$ . *a*, Front view; *b*, apertural view. Off Nairai, Fiji.
- 3-5. *Spiroloculina antillarum* d'Orbigny.  $\times 50$ . Fig. 3, *a*, Front view; *b*, apertural view. Rangiroa. Fig. 4, Albatross H3853. Fig. 5, Albatross H3910.
- 6-9. *Spiroloculina antillarum* d'Orbigny var. *angulata* Cushman.  $\times 50$ . Fig. 6, *a*, Front view; *b*, apertural view. Guam Anchorage, Ladrone Islands. Fig. 7, Deformed, triserial form. Niau Lagoon, Paumatus. Figs. 8, 9, Off Fiji, 40-50 fathoms.
10. *Spiroloculina antillarum* d'Orbigny var. *reticosa* Chapman.  $\times 60$ . Albatross H3992.
- 11, 12. *Spiroloculina cauduca* Cushman.  $\times 50$ . Fig. 12, *a*, Front view; *b*, apertural view. Port Lotten, Kersail, Caroline Islands.
- 13 *a, b*. *Spiroloculina antillarum* d'Orbigny *aequa*, new variety.  $\times 50$ , *a*, Front view; *b*, apertural view. Inside Lagoon, Pinaki Atoll, Paumotu Islands.

## PLATE 10

- FIGURES 1 *a, b*. *Spiroloculina planissima* (Lamarek) var. *samoensis* Cushman.  $\times 50$ . *a*, Front view; *b*, apertural view. Vavau Anchorage, Tonga Islands.
- 2, 3. *Spiroloculina eximia* Cushman.  $\times 55$ . Fig. 2, *a*, Front view; *b*, apertural view. Levuka, Fiji. Fig. 3, Viva Anchorage, Fiji.
- 4, 5. *Spiroloculina clara*, new species.  $\times 55$ . Fig. 4, Holotype. *a*, Front view; *b*, apertural view. Rongelap Atoll, Marshall Islands.
- 6, 7. *Spiroloculina affixa* Terquem.  $\times 75$ . Fig. 6, *a, b*, Opposite sides; *c*, apertural view. Albatross H3826. Fig. 7, Albatross H3866.
8. *Spiroloculina* sp. (?).  $\times 75$ . Albatross H3876.
9. *Hauerina fragilissima* (H. B. Brady).  $\times 40$ . Levuka, Fiji.
- 10, 11. *Hauerina pacifica* Cushman.  $\times 40$ . Fig. 10, Guam Anchorage, Ladrone Islands. Fig. 11, Mokaujar Anchorage, Fiji.
- 12-15. *Hauerina bradyi* Cushman.  $\times 55$ . Figs. 12, 13, Young microspheric stages. Vavau Anchorage, Tonga Islands. Fig. 14, Young megalospheric form. Levuka, Fiji. Fig. 15, Adult specimen. Hereheretue Island.
- 16, 17. *Hauerina ornatusissima* (Karrer).  $\times 40$ . Levuka, Fiji. Fig. 16, Adult. Fig. 17, Early stage.

## PLATE 11

- FIGURES 1, 2. *Articulina lineata* H. B. Brady.  $\times 40$ . Fig. 1, Adult specimen. Fig. 2, Early stage. *a*, Front view; *b*, apertural view. Mokaujar Anchorage, Fiji.
- 3, 4. *Articulina sulcata* Reuss (?).  $\times 40$ . Mokaujar Anchorage, Fiji. Fig. 3, *a*, Front view; *b*, apertural view.
- 5, 6. *Nubeculina divaricata* (H. B. Brady).  $\times 40$ . Near Nairai, Fiji.
- 7 *a, b*. *Nubeculina chapmani*, new species.  $\times 40$ . *a*, Front view; *b*, apertural view. Albatross H3898.
- 8 *a, b*. *Nubeculina divaricata* (H. B. Brady) var. *advena* Cushman.  $\times 40$ . *a*, Front view; *b*, apertural view. Mokaujar Anchorage, Fiji.
- 9 *a-c*. *Sigmoilina edwardsi* (Schlumberger).  $\times 55$ . *a, b*, Opposite sides; *c*, apertural view. Albatross H3878.
- 10 *a-c*. *Triloculina oblonga* (Montagu).  $\times 40$ . *a, b*, Opposite sides; *c*, apertural view. Off Nairai, Fiji.
- 11 *a-c*. *Triloculina circularis* Bornemann.  $\times 75$ . *a, b*, Opposite sides; *c*, apertural view. Vavau Anchorage, Tonga Islands.
- 12 *a-c*. *Triloculina labiosa* d'Orbigny.  $\times 75$ . *a, b*, Opposite sides; *c*, apertural view. Rangiroa.

## PLATE 12

- FIGURES 1 *a-c*. *Triloculina labiosa* d'Orbigny *sparsicostata*, new variety.  $\times 55$ . *a, b*, Opposite sides; *c*, apertural view. Off Hereheretue Island.
- 2 *a-c*. *Triloculina irregularis* (d'Orbigny).  $\times 40$ . *a, b*, Opposite sides; *c*, apertural view. 40-50 fathoms, off Fiji.

- 3 a-c. *Triloculina oceanica*, new species.  $\times 50$ . a, b, Opposite sides; c, apertural view. Albatross H3935.
- 4 a-c. *Triloculina oceanica flintiana*, new species and variety.  $\times 50$ . a, b, Opposite sides; c, apertural view. Albatross H3857.
- 5 a-c. *Triloculina spinata*, new species.  $\times 55$ . a, b, Opposite sides; c, apertural view. Rongelap Atoll, Marshall Islands.
- 6 a-c. *Triloculina fichteliana* d'Orbigny.  $\times 40$ . a, b, Opposite sides; c, apertural view. Guam Anchorage, Ladrone Islands.

## PLATE 13

- FIGURES 1 a, b. *Triloculina trigonula* (Lamarek)  $\times 55$ . a, Front view; b, apertural view. Mokaujar Anchorage, Fiji.
- 2 a, b. *Triloculina austriaca* d'Orbigny.  $\times 40$ . a, Front view; b, apertural view. Rangiroa.
- 3 a, b. *Triloculina tricarinata* d'Orbigny.  $\times 55$ . a, Front view; b, apertural view. Viva Anchorage, Fiji.
- 4 a, b. *Triloculina affinis* d'Orbigny.  $\times 55$ . a, Front view; b, apertural view. Nairai, Fiji.
5. *Triloculina bertheliniana* (H. B. Brady).  $\times 55$ . Makemo Lagoon, Paumotu Islands.
- 6 a-c. *Triloculina bicarinata* d'Orbigny.  $\times 40$ . a, b, Opposite sides; c, apertural view. Mokaujar Anchorage, Fiji.
- 7 a-c. *Triloculina* sp. (?)  $\times 40$ . a, b, Opposite sides; c, apertural view. Rotonga.

## PLATE 14

- FIGURES 1-9. *Pyrgo denticulata* (H. B. Brady).  $\times 40$ . Figs. 1-3, a, a, c, Front views; b, b, b, apertural views. Mokaujar Anchorage, Fiji. Figs. 4, 5, a, a, Front views; b, b, apertural views. Guam Anchorage, Ladrone Islands. Fig. 6, a, Front view; b, apertural view. Rongelap Atoll, Marshall Islands. Fig. 7, a, Front view; b, apertural view. Albatross H3858. Figs. 8, 9, Levuka, Fiji.
- 10, 11. *Pyrgo denticulata* (H. B. Brady) var. *striolata* (H. B. Brady).  $\times 40$ . Fig. 10, a, b, Opposite sides; c, apertural view. Mokaujar Anchorage, Fiji.

## PLATE 15

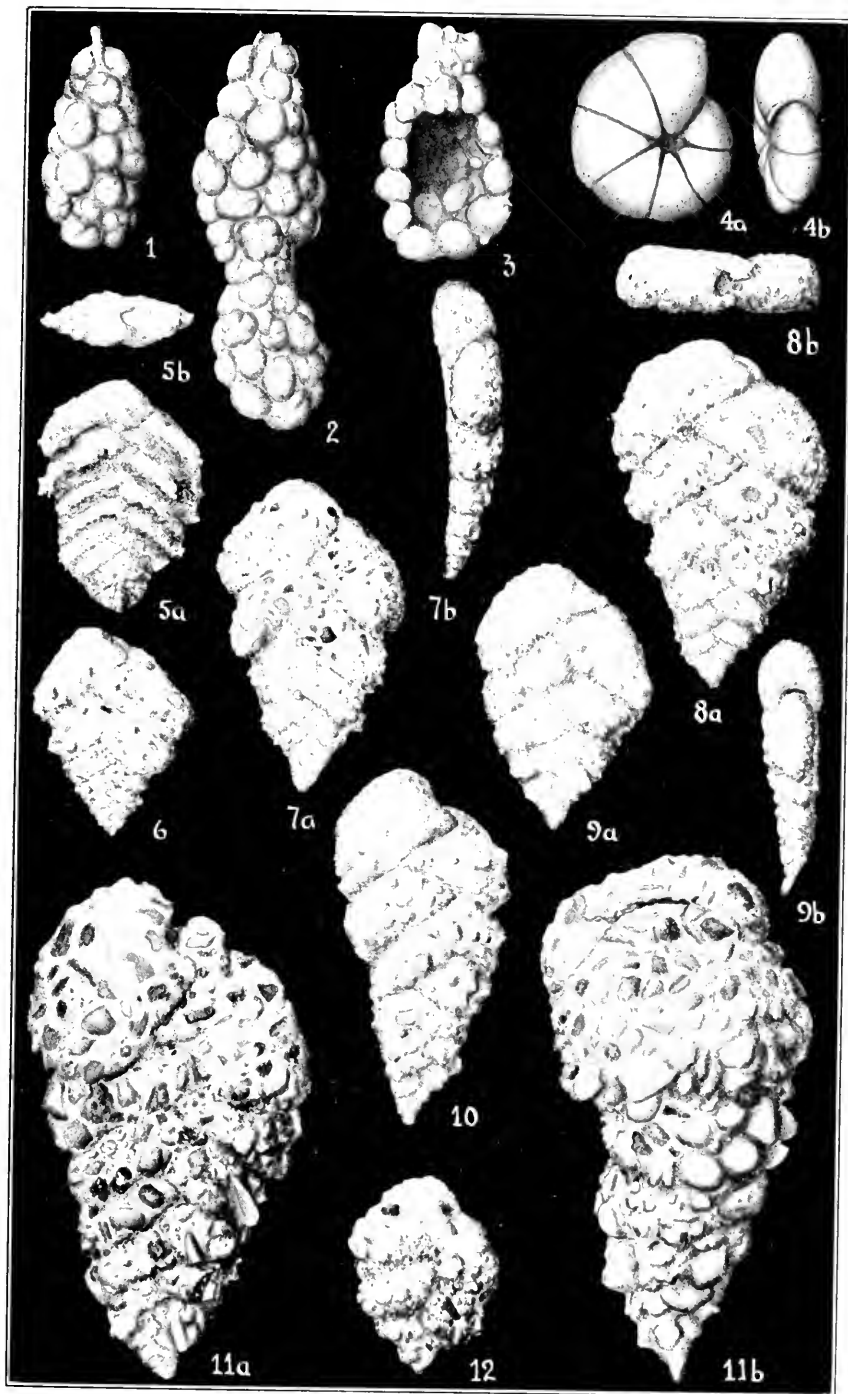
- FIGURES 1-3. *Pyrgo murrhina* (Schwager).  $\times 40$ . a, a, a, Front views; b, b, b, apertural views. Fig. 1, Albatross H3820. Fig. 2, Albatross H3878. Fig. 3, Albatross H3841.
- 4, 5. *Pyrgo millettii* (Cushman).  $\times 40$ . Fig. 4, a, Front view; b, apertural view. Levuka, Fiji.
- 6-8. *Pyrgo globula* (Bornemann).  $\times 40$ . a, a, a, Front views; b, b, b, apertural views. Figs. 6, 8, Albatross H3841. Fig. 7, Albatross H3815.

## PLATE 16

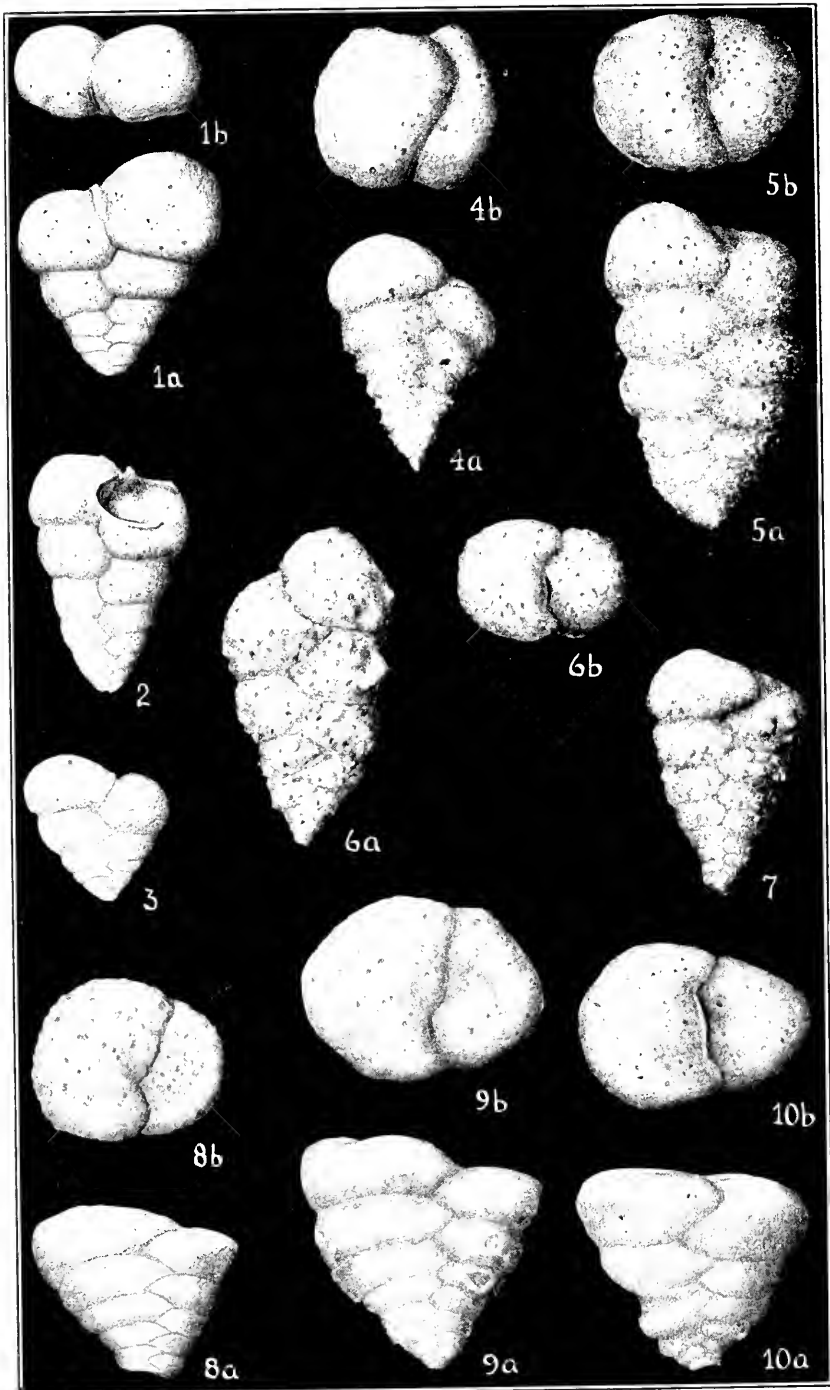
- FIGURES 1 *a-c*. *Nodobacularia antillarum* Cushman *pacifica*, new variety. *a*, Front view; *b*, apertural view,  $\times 40$ ; *c*, early portion,  $\times 75$ . Mokaujar Anchorage, Fiji.
- 2 *a, b*. *Cornuspira involvens* Reuss.  $\times 75$ . *a*, Front view; *b*, peripheral view. Levuka, Fiji.
- 3, 4. *Nodobacularia milletti*, new species. Fig. 3, Holotype. *a*, Front view; *b*, apertural view,  $\times 40$ ; *c*, early portion,  $\times 75$ . Fig. 4, Paratype. *a*, Front view,  $\times 40$ ; *b*, early portion,  $\times 75$ . Mokaujar Anchorage, Fiji.
- 5 *a, b*. *Spirothamidium acutimargo* (H. B. Brady).  $\times 75$ . *a*, Front view; *b*, apertural view. Albatross H3829.
- 6 *a-c*. *Planispirina auriculata* Egger.  $\times 75$ . *a, b*, Opposite sides; *c*, apertural view. Port Lotten, Kersail, Caroline Islands.
- 7 *a, b*. *Planispirina exigua* (H. B. Brady).  $\times 75$ . *a*, Front view; *b*, apertural view. Levuka, Fiji.
- 8-10. *Vertebralina striata* d'Orbigny.  $\times 40$ . Fig. 8, *a*, Front view; *b*, apertural view. Fig. 10, Young specimen. Mokaujar Anchorage, Fiji. Fig. 9, Coarsely ornamented form. Levuka, Fiji.

## PLATE 17

- FIGURES 1-4. *Parrina bradyi* (Millett).  $\times 55$ . Figs. 1, 2, 4, Hereheretue Island. Fig. 3, 40-50 fathoms, off Fiji.
- 5 *a-c*. *Fischerina helix* Heron-Allen and Earland.  $\times 75$ . *a*, Dorsal view; *b*, ventral view; *c*, peripheral view. Hereheretue Island.
- 6 *a-c*. *Fischerina involuta*, new species.  $\times 75$ . *a*, Dorsal view; *b*, ventral view; *c*, peripheral view. Rangiroa.
- 7 *a-c*. *Fischerina pellucida* Millett.  $\times 75$ . *a*, Dorsal view; *b*, ventral view; *c*, peripheral view. Port Lotten, Kersail, Caroline Islands.
- 8 *a, b*. *Trochammina turbinata* (H. B. Brady).  $\times 75$ . *a*, Front view; *b*, apertural view. Albatross H3973.
- 9 *a, b*. *Nouria polymorphinoides* Heron-Allen and Earland.  $\times 30$ . *a*, Front view; *b*, side view. Mokaujar Anchorage, Fiji.

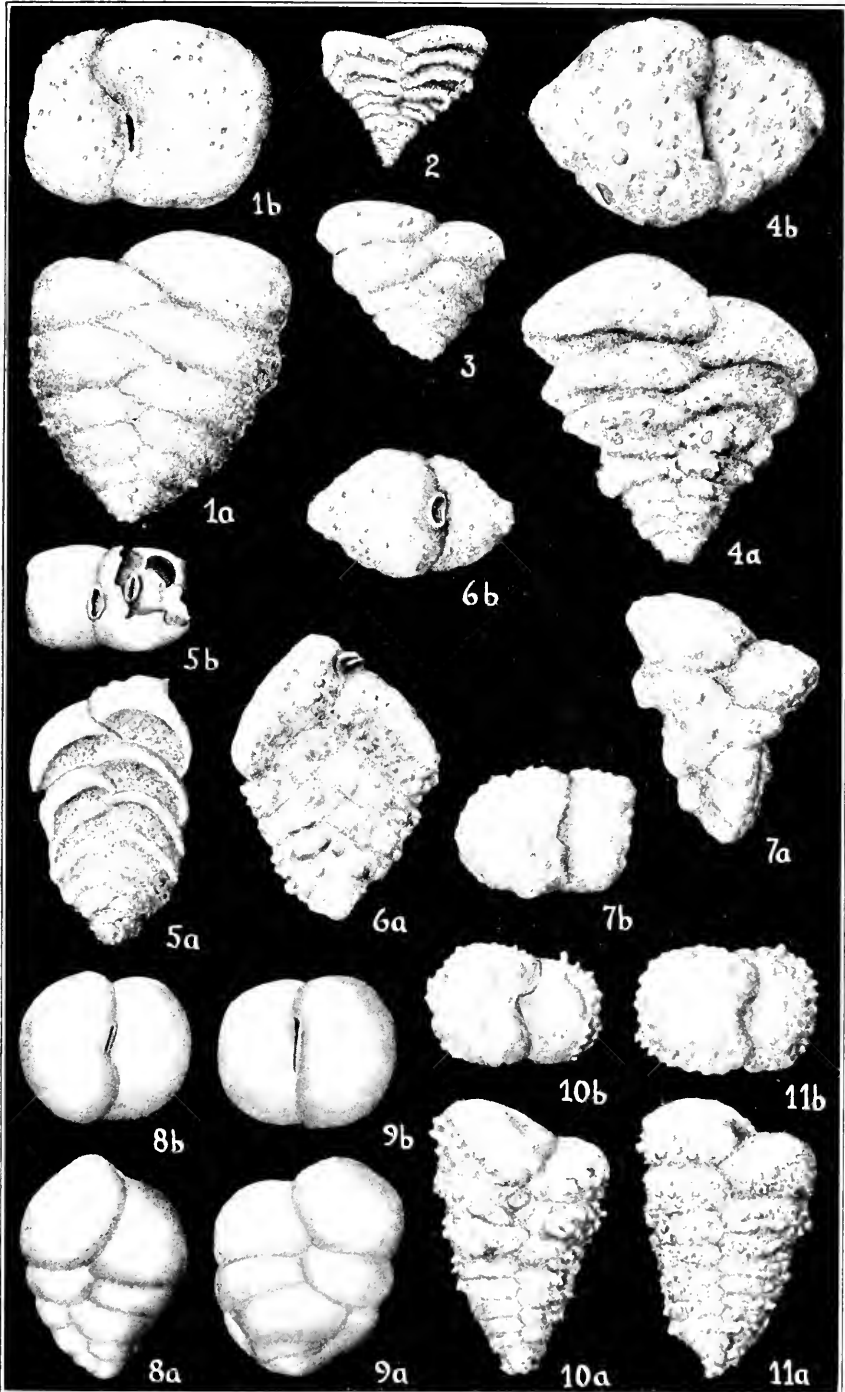


TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE, SEE PAGE 79.

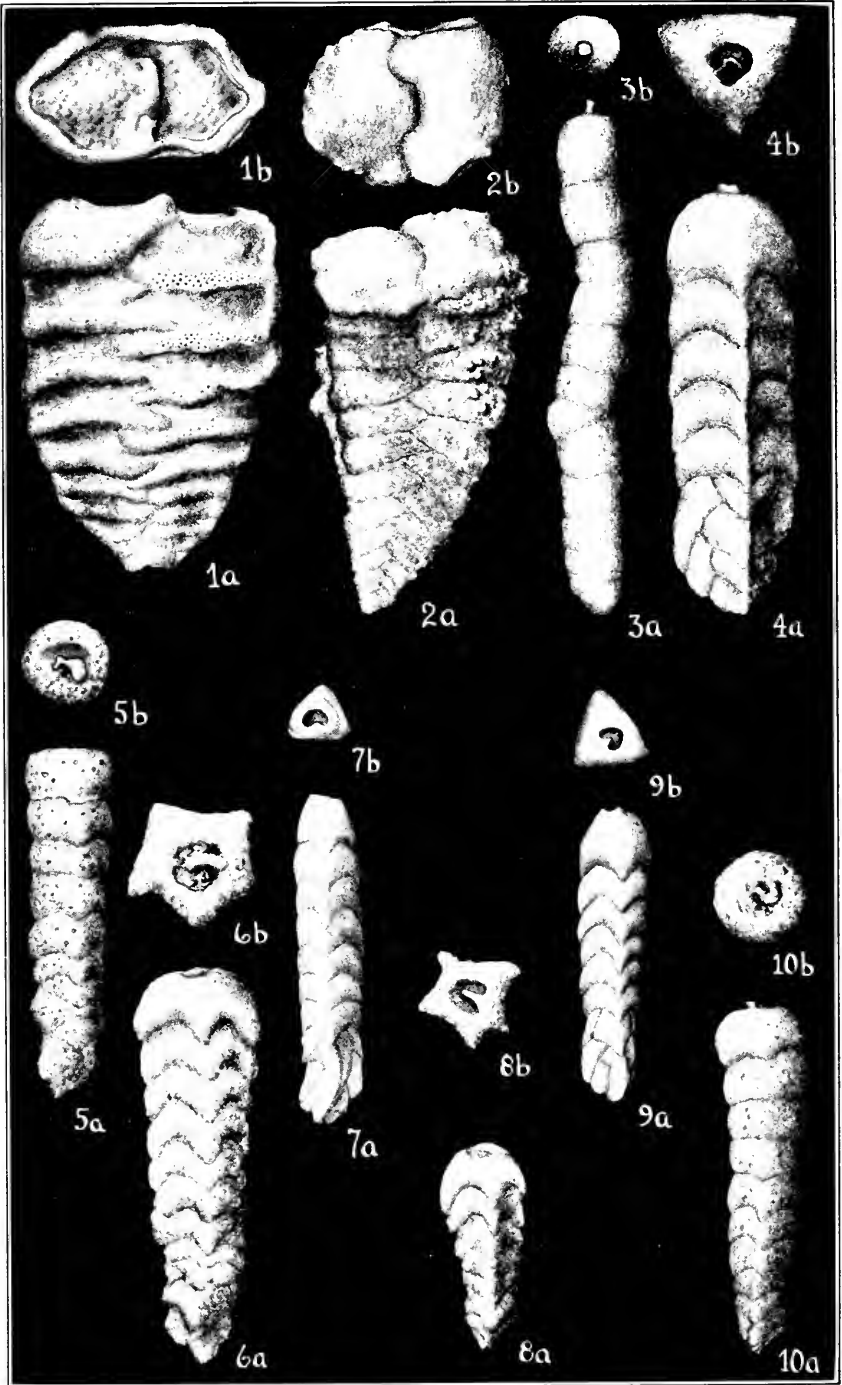


TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 79.

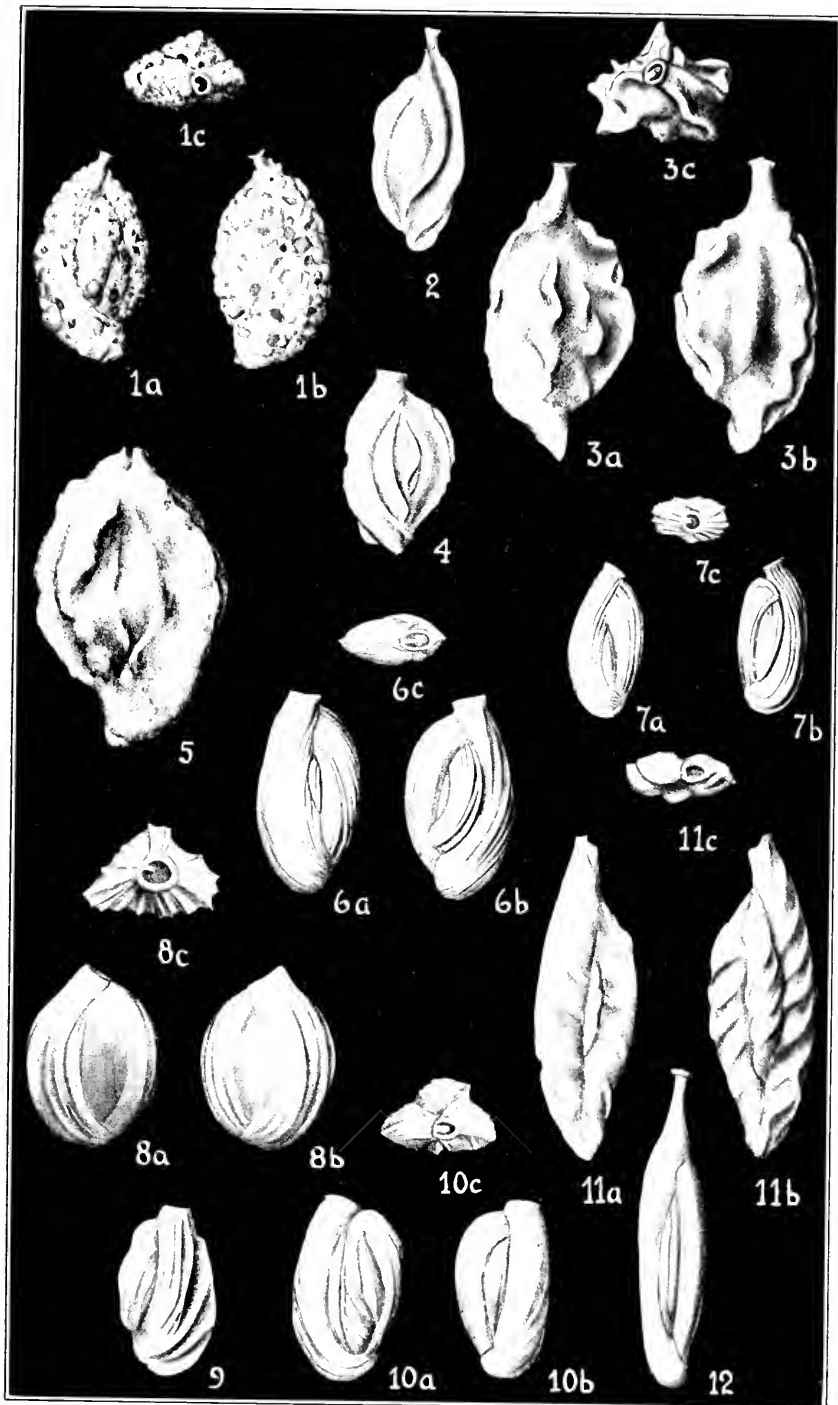




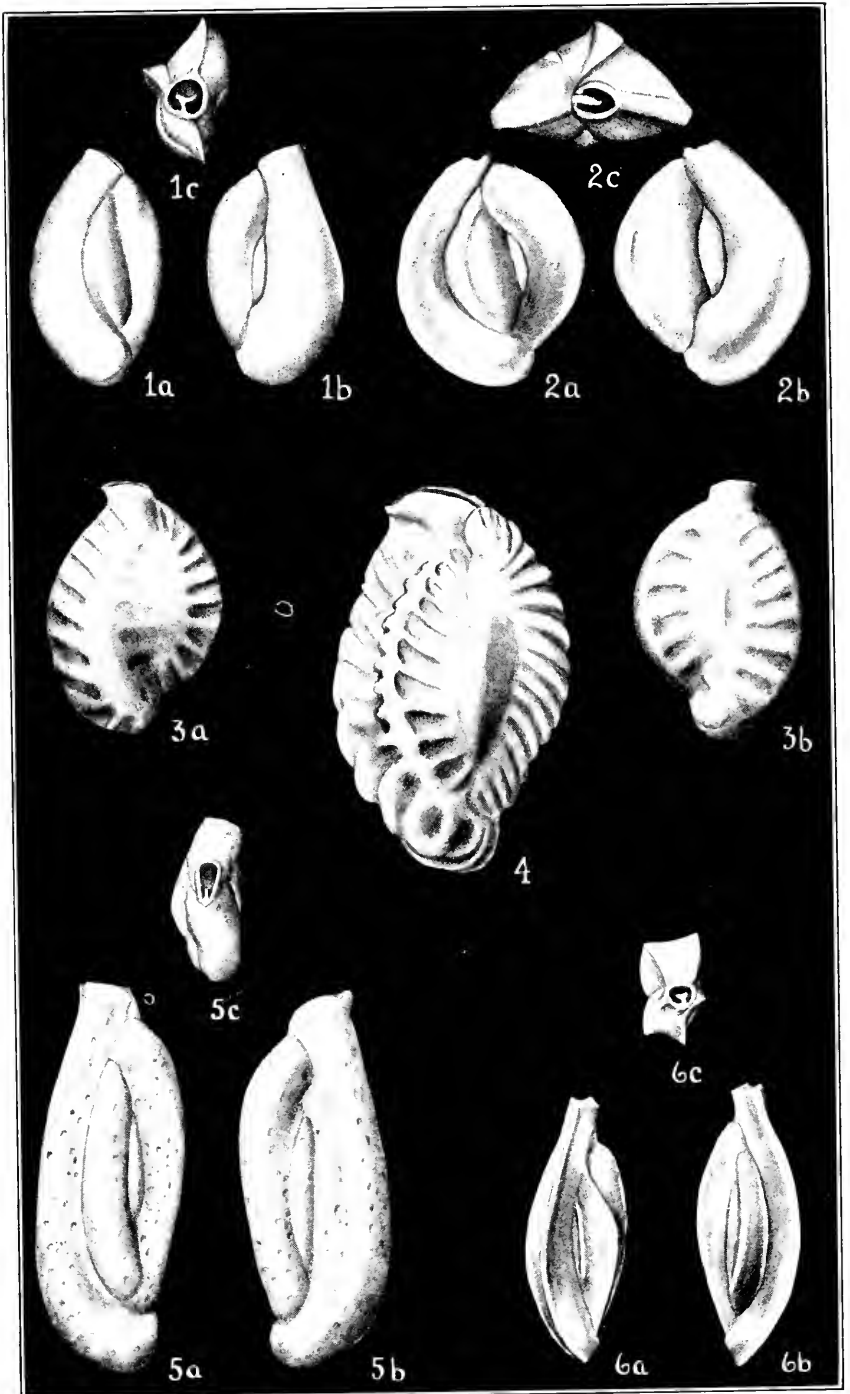
TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 29



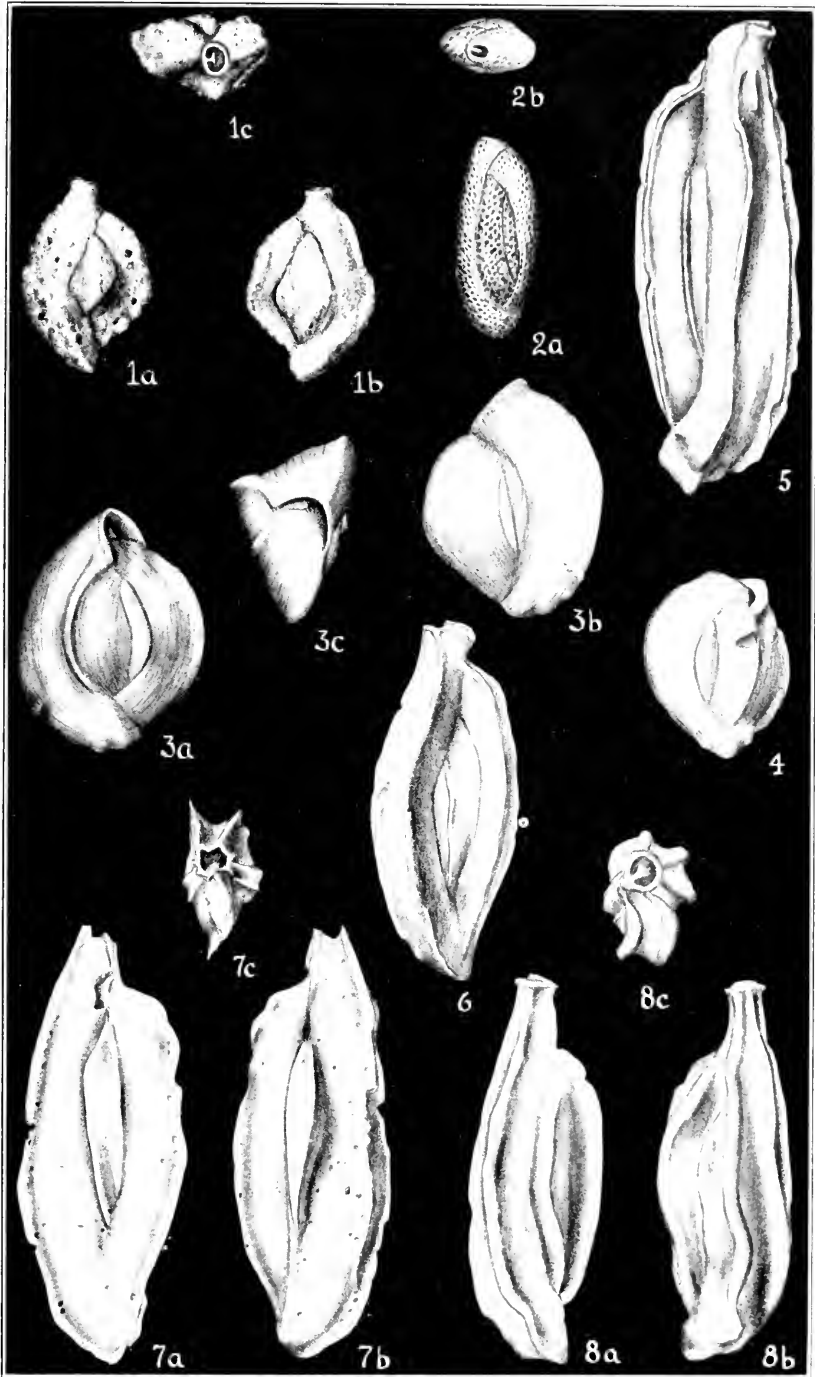
TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 80.



TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 80.

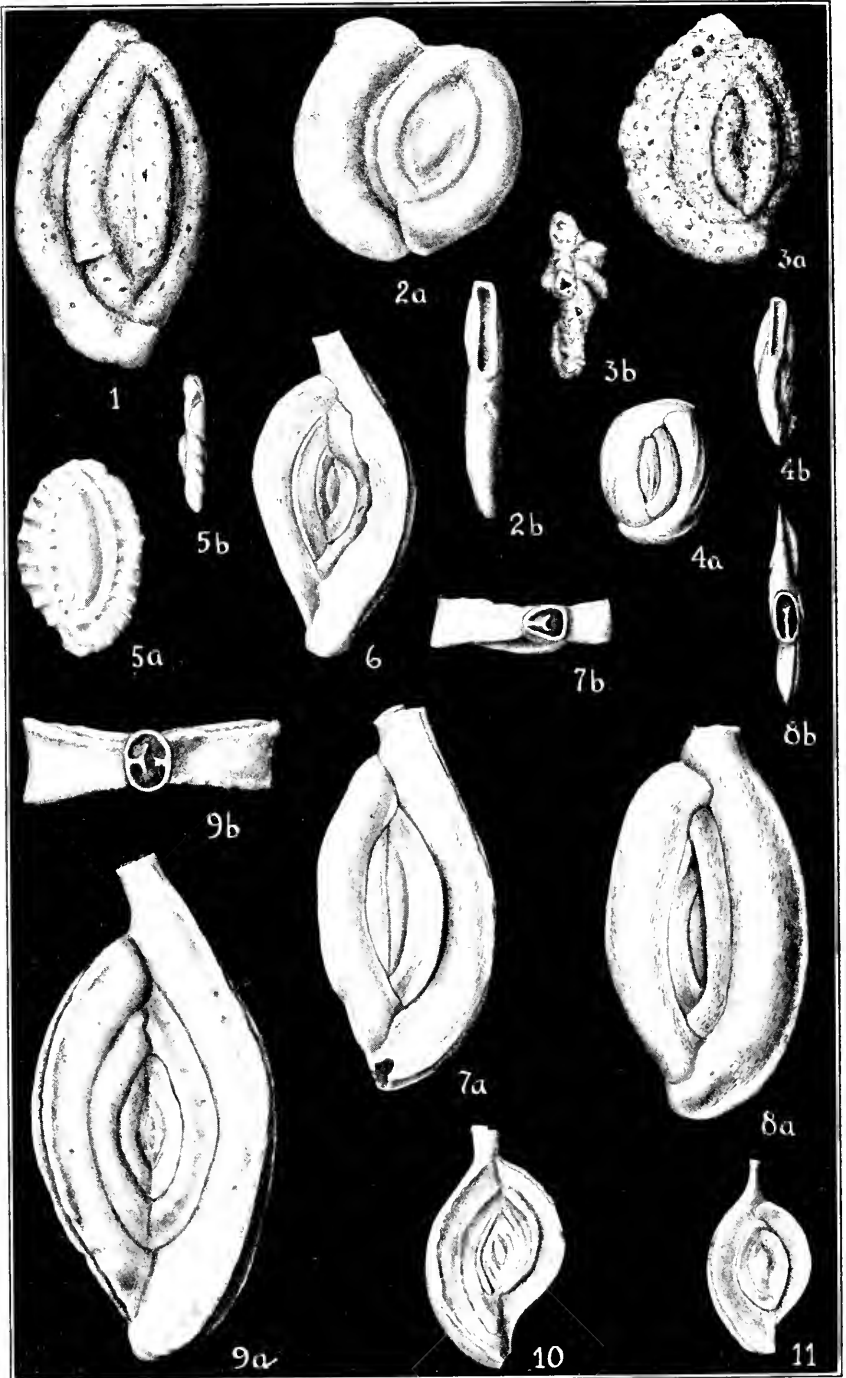


TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 80

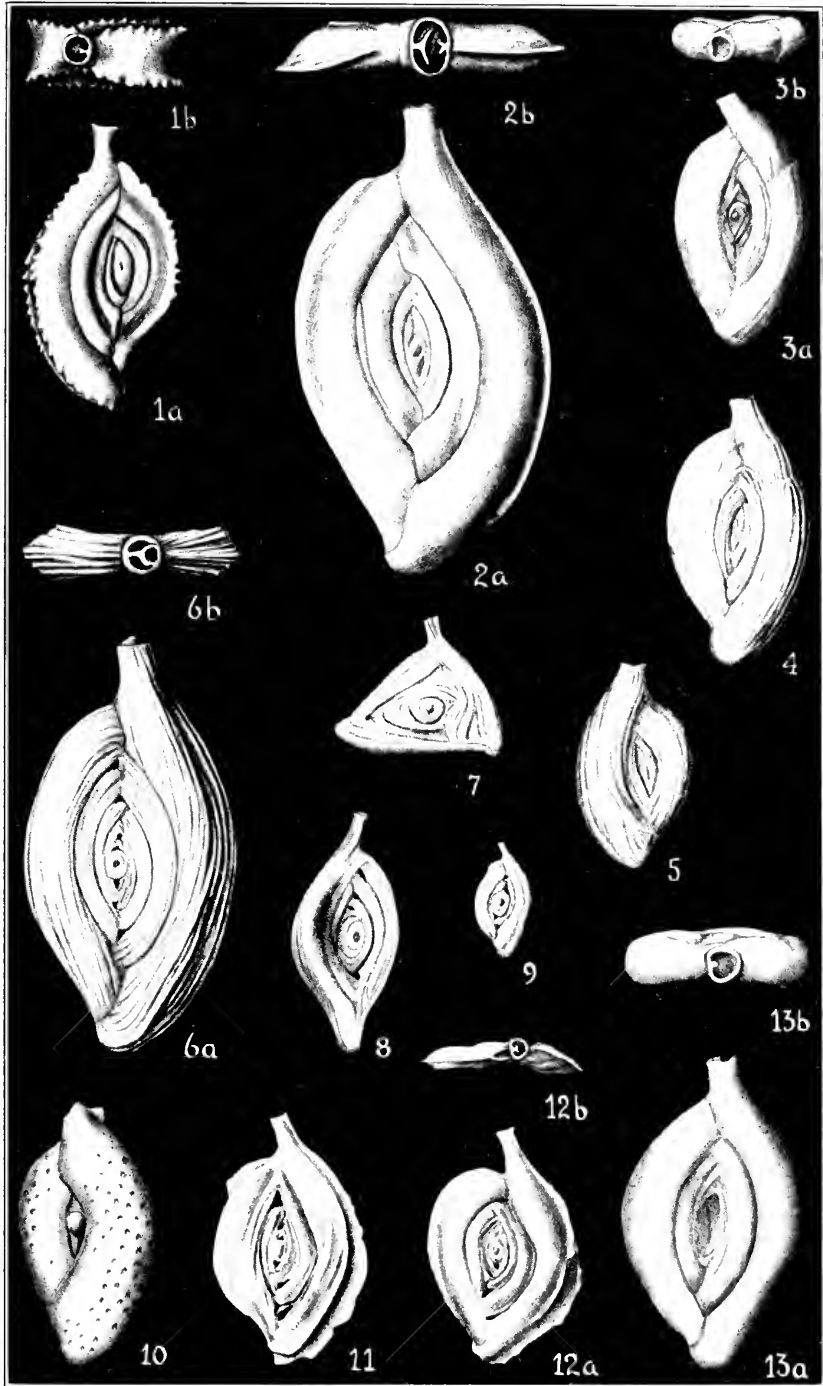


TROPICAL PACIFIC FORAMINIFERA

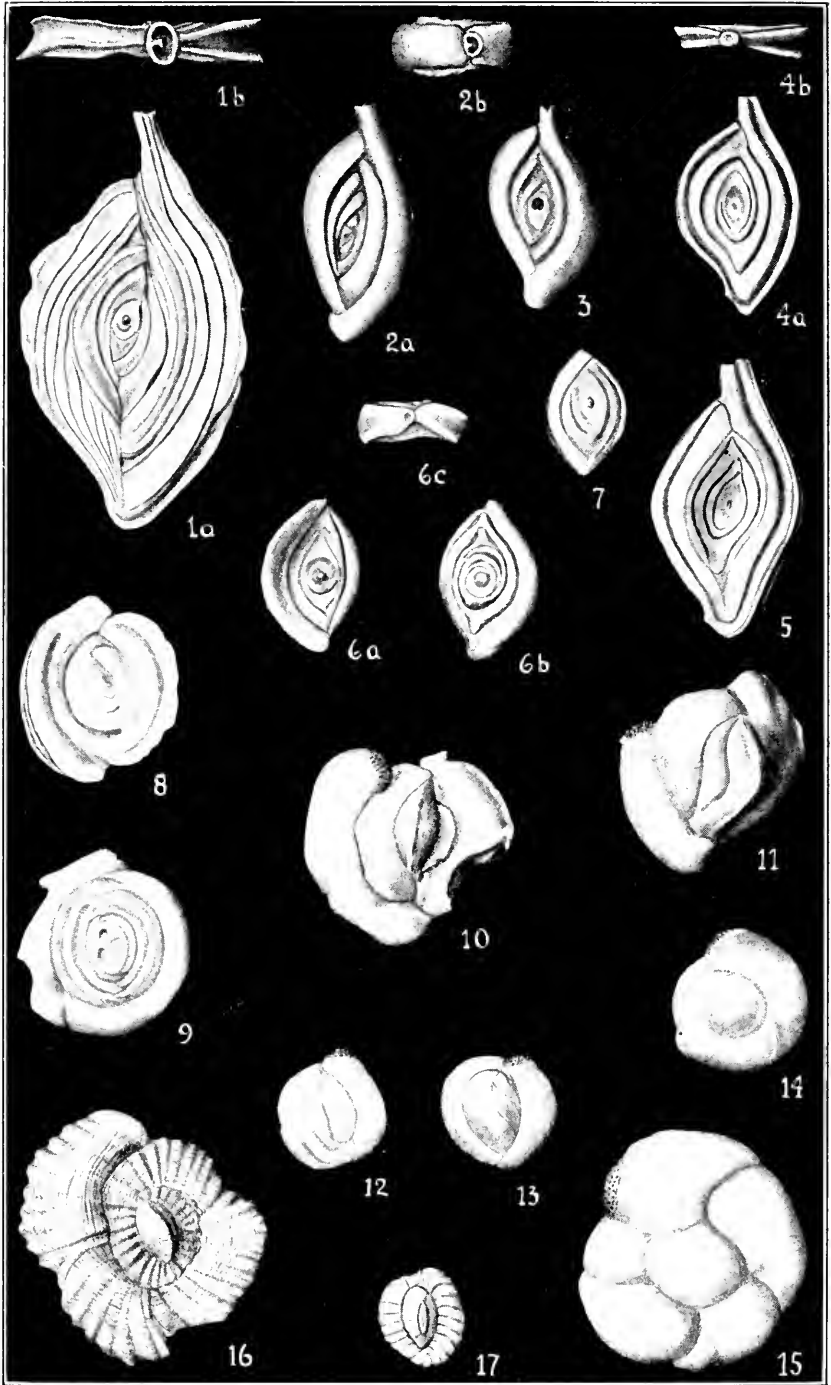
FOR EXPLANATION OF PLATE SEE PAGE 81



TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 81.

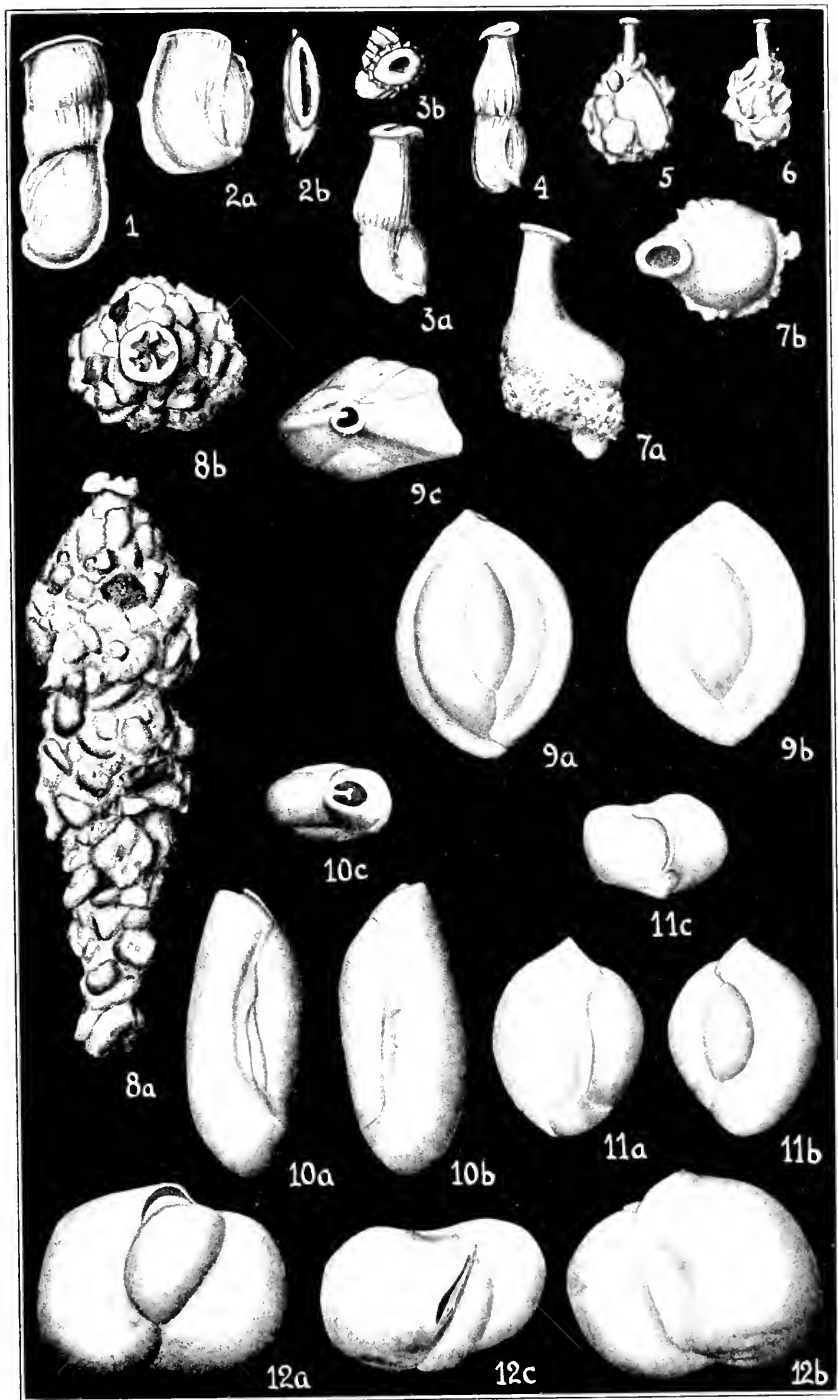


TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 81

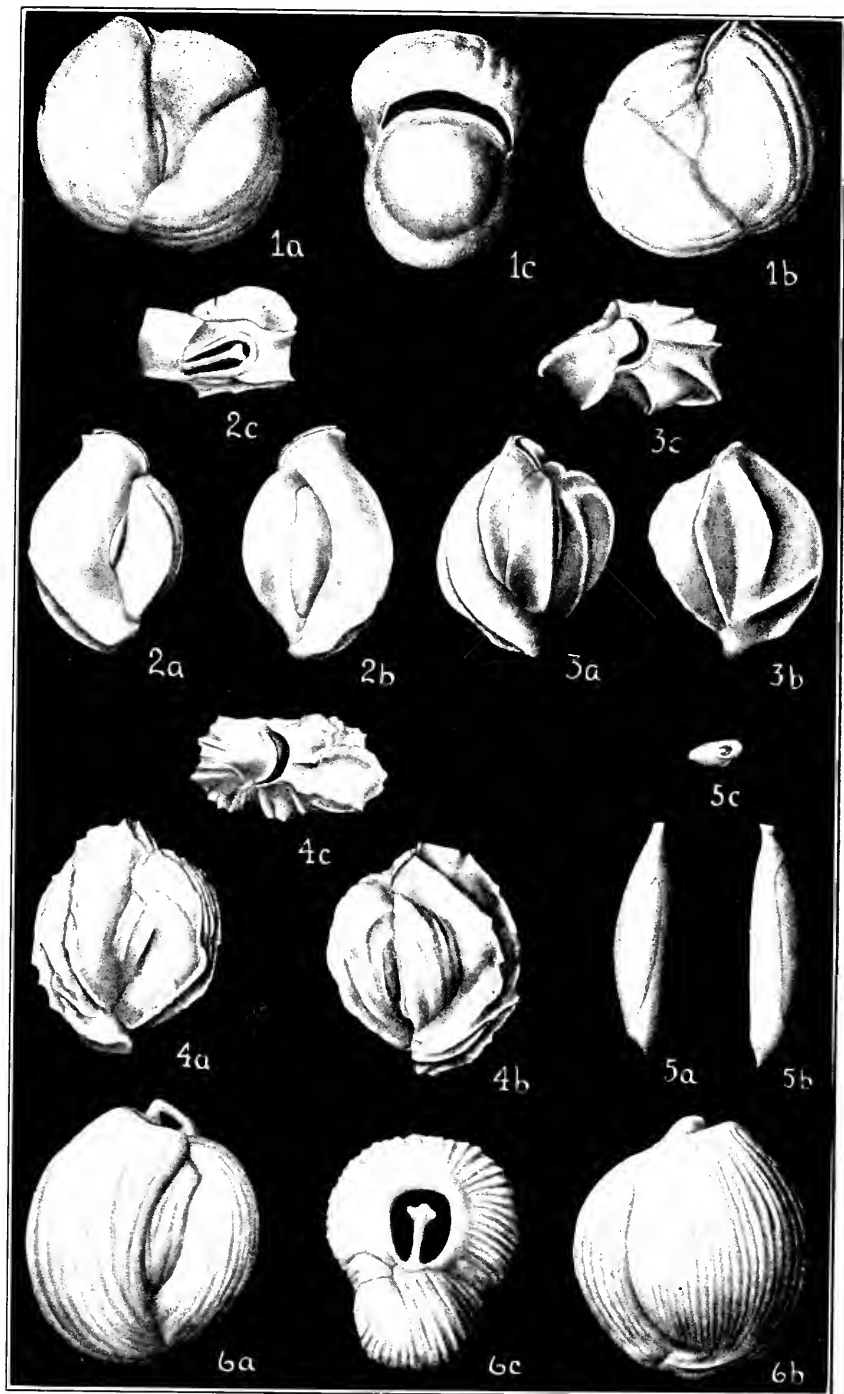


TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 82.



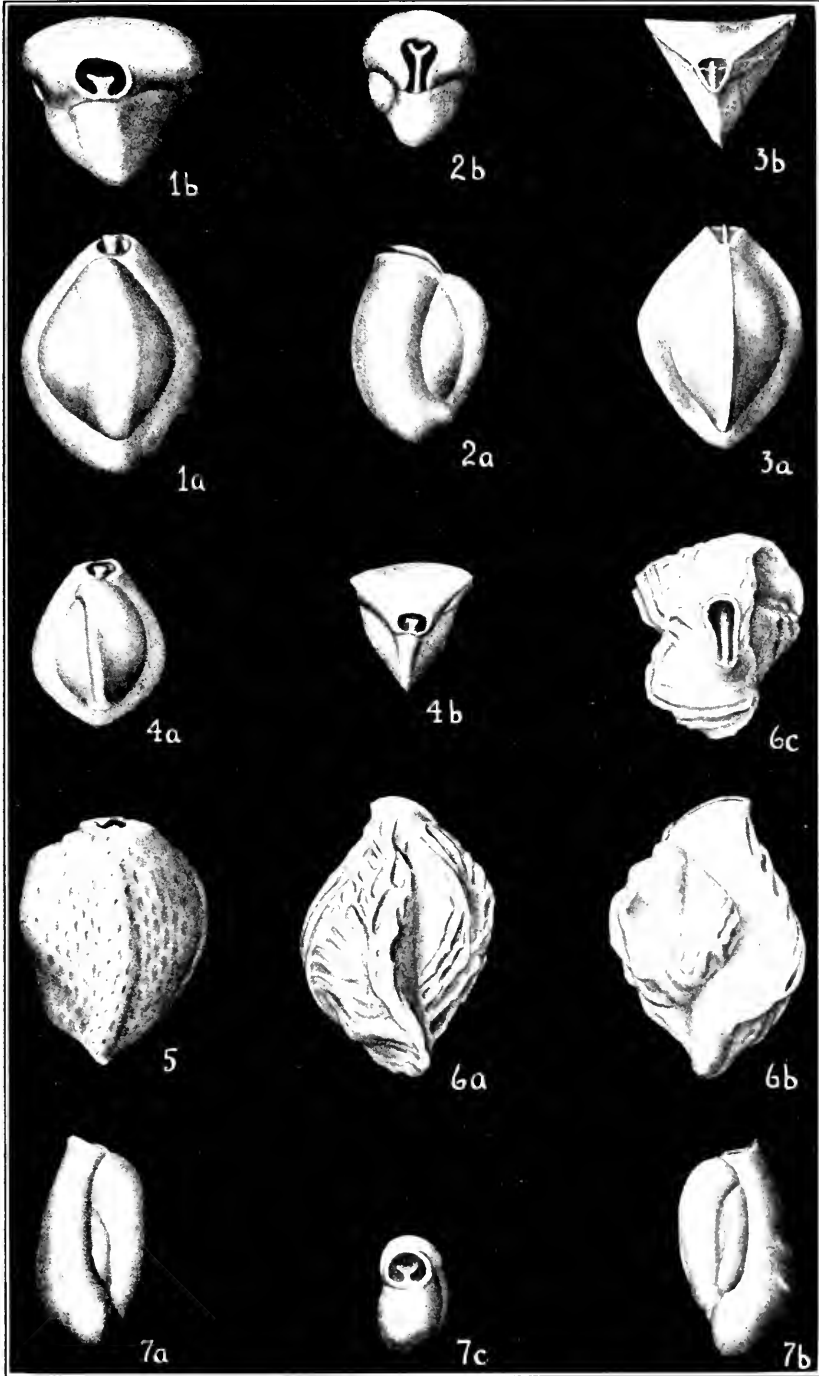


TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE, SEE PAGE 80.

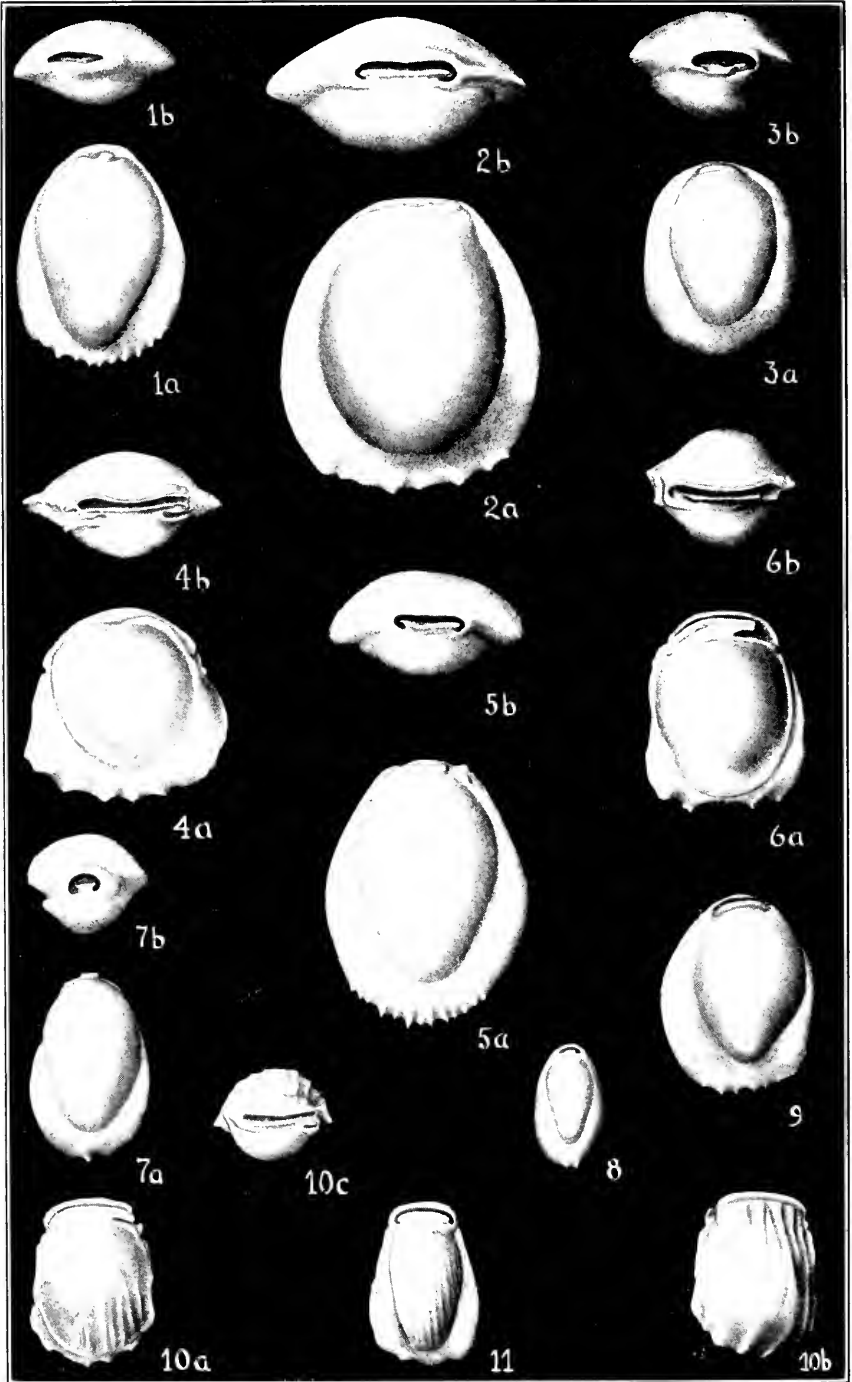


TROPICAL PACIFIC FORAMINIFERA

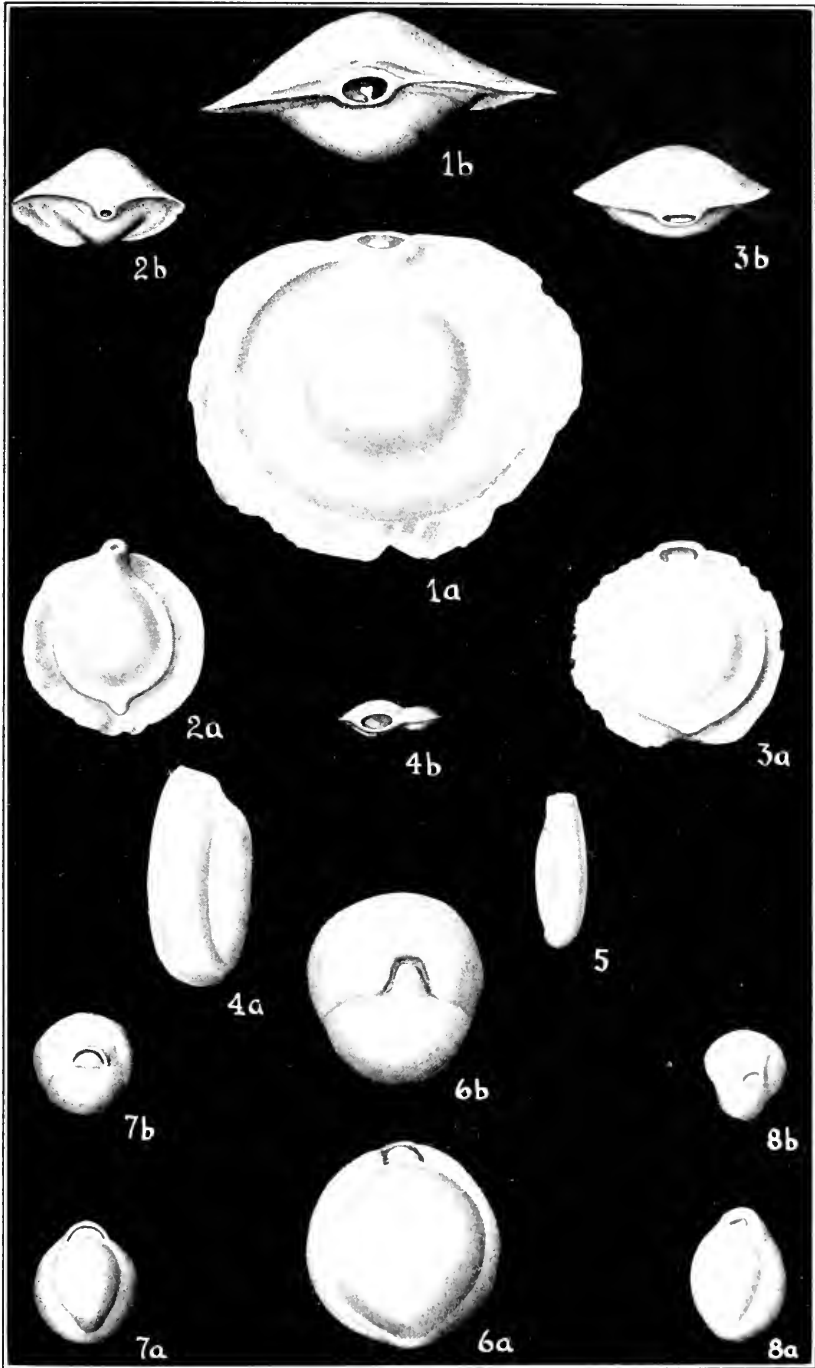
FOR EXPLANATION OF PLATE SEE PAGES 82, 83.



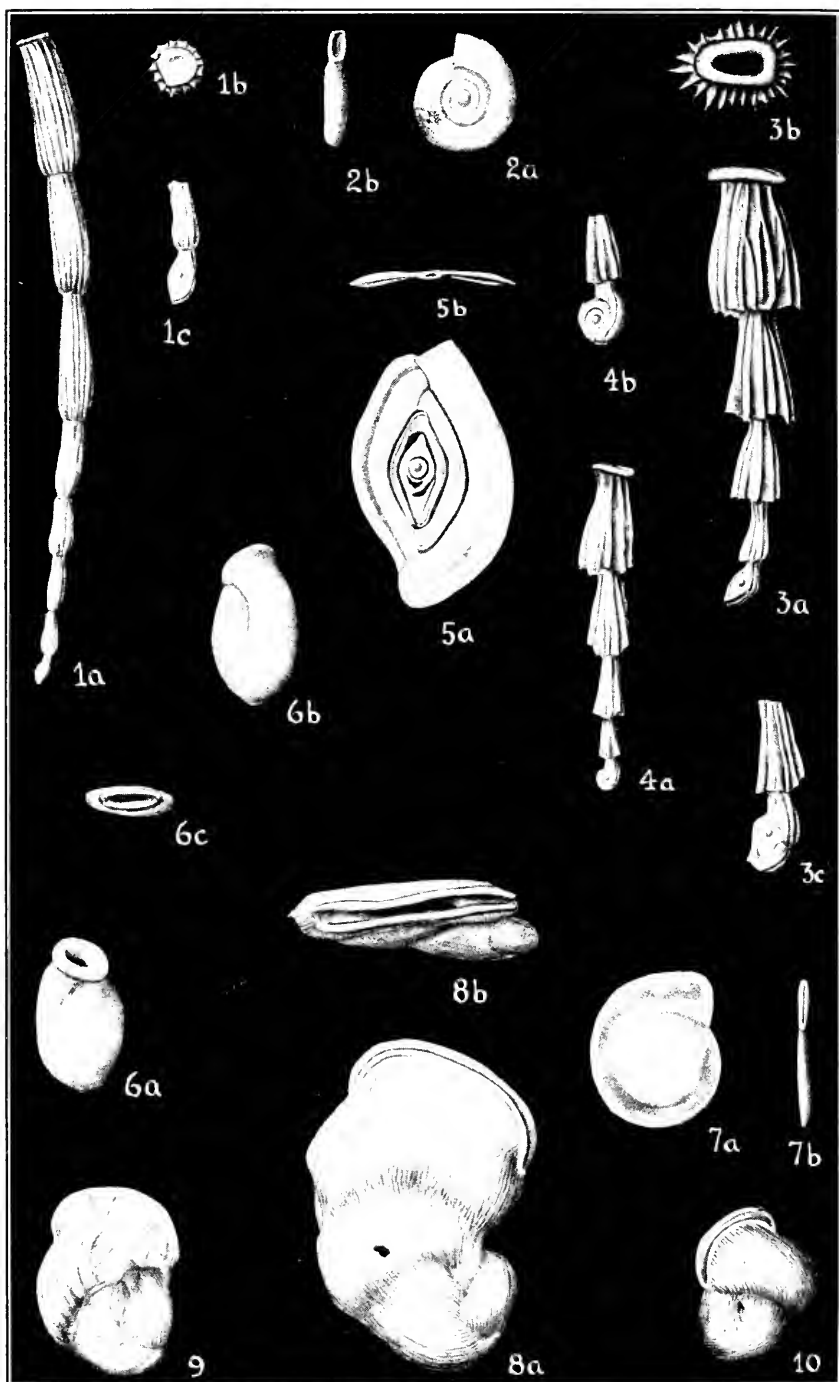
TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 81



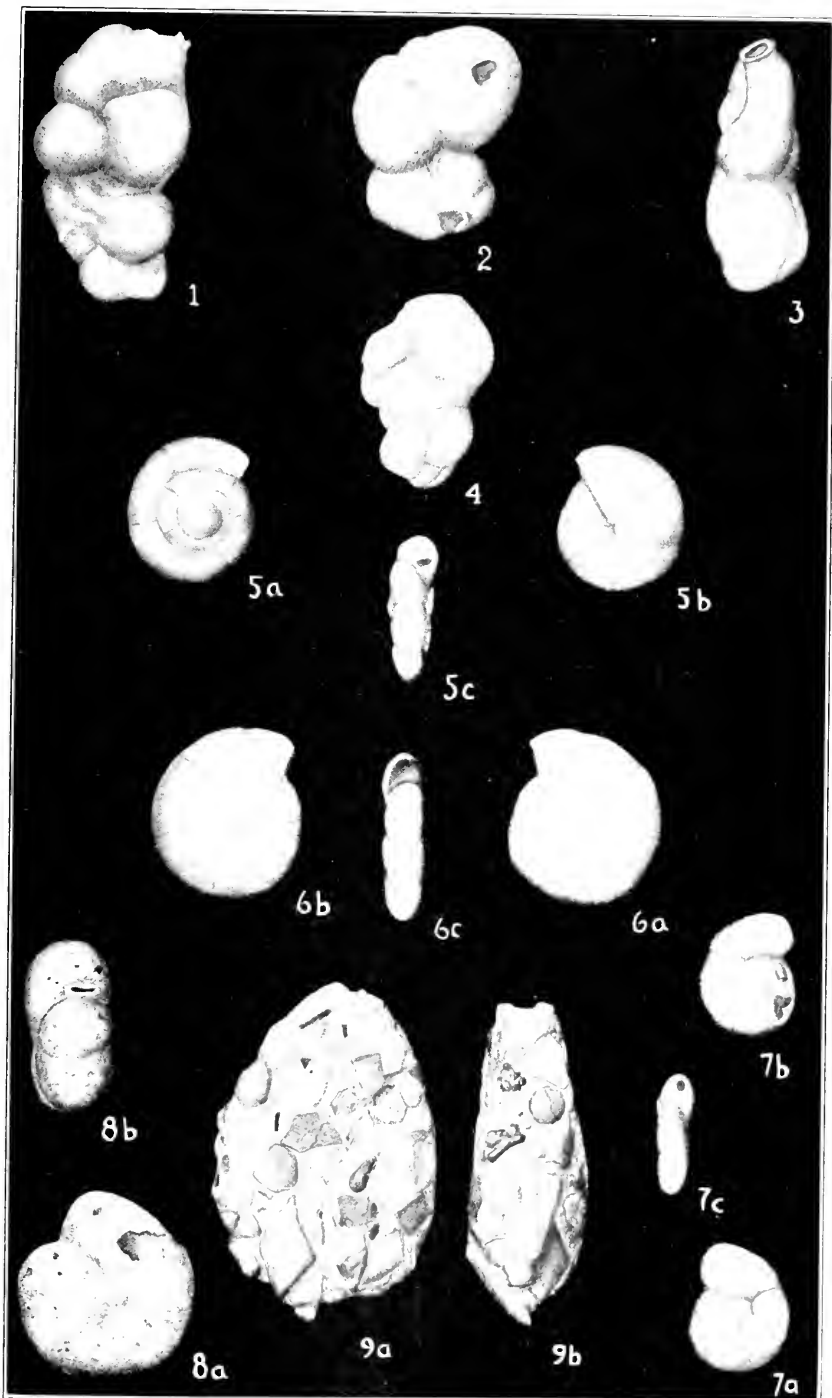
TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 83.



TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE 151, PAGE 83.



TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE SEE PAGE 84.



TROPICAL PACIFIC FORAMINIFERA  
FOR EXPLANATION OF PLATE 11, FIG. 81





## INDEX

- abbreviata, Textularia, 11.  
 abyssorum, Rhabdammina, 4.  
 acescata, Spiroloculina grateloupi, 35.  
 acutimargo, Spiroloculina, 41, 70.  
     Spiroptbalmidium, 70.  
 Adelosina, 18.  
     striata, 18.  
 advena, Nubeculina divaricata, 49.  
 aequa, Spiroloculina antillarum, 38.  
 affinis, Triloculina, 58, 59.  
 affixa, Spiroloculina, 41.  
 agglutinans biformis, Textularia, 6.  
 agglutinans, Miliolina anguina, 18.  
     Quinqueloculina anguina, 18.  
     Textularia, 10.  
 agglutinatus, Reophax, 4.  
 albatrossi, Textularia, 12.  
 alveoliniformis, Massilina, 30.  
     Miliolina, 29.  
     Quinqueloculina, 29.  
     Schlumbergerina, 29.  
 Ammodiscidae, 5.  
 Ammodiscus incertus, 5.  
 anguina agglutinans, Miliolina, 18.  
     Quinqueloculina, 18.  
 angularis, Clavulina, 16, 17.  
 angularis difformis, Clavulina, 17.  
 angulata, Gaudryina triangularis, 14.  
     Spiroloculina antillarum, 36, 37.  
     Spiroloculina grata, 37.  
 angulosa, Spiroloculina, 34.  
 antillarum aequa, Spiroloculina, 38.  
     angulata, Spiroloculina, 36, 37.  
     pacifica, Nodobaculalia, 68.  
     reticosa, Spiroloculina, 38.  
 antillarum, Nodobaculalia, 69.  
     Spiroloculina, 36.  
 antillea reticosa, Spiroloculina, 38.  
 areniphora, Schlumbergerina, 29.  
 Articulina, 46.  
     conico-articulata, 68, 69.  
     lineata, 47.  
     nitida, 47.  
     sulcata, 47.  
 asperula, Massilina, 31.  
     Spiroloculina, 31.  
 Astrorrhizidae, 4.  
 auberiana, Quinqueloculina, 24.  
 auriculata, Planispirina, 72.  
 australis, Massilina, 32.  
 austriaca, Triloculina, 57.  
  
 bertheliniana, Miliolina, 60.  
     Miliolina tricarinata, 60.  
     Triloculina, 60.  
 berthelotiana, Quinqueloculina, 19.  
 bicarinata, Triloculina, 60, 61.  
 bidentata, Quinqueloculina, 20.  
 biformis, Textularia agglutinans, 6.  
  
 Biloculina, 61.  
     bulloides, 61.  
     denticulata, 62.  
     denticulata striolata, 63.  
     depressa murrhyna, 64.  
     globulus, 65.  
     millettii, 66.  
     murrhyna, 64.  
     ringens denticulata, 62.  
     ringens striolata, 63.  
 bradyi, Gaudryina, 13.  
     Hauerina, 44.  
     Nubecularia, 74.  
     Parrina, 74.  
     Silvestria, 74.  
 brongniartiana, Triloculina, 28.  
 bulloides, Biloculina, 61.  
  
 caedua, Spiroloculina, 39.  
 canaliculata, Spiroloculina, 35.  
 candeiana, Textularia, 9, 10, 11.  
     Textularia sagittula, 9.  
 chapmani, Nubeculina, 49.  
 circularis, Triloculina, 52.  
 clara, Spiroloculina, 40.  
 Clavulina, 16.  
     angularis, 16, 17.  
     angularis difformis, 17.  
     communis, 16.  
     difformis, 17.  
     pacifica, 16, 17.  
     parisiensis, 16.  
     tricarinata, 17.  
 communis, Clavulina, 16.  
     Planispirina, 71.  
 compressa, Hauerina, 42.  
 concava, Textularia, 12, 13.  
 conica corrugata, Textularia, 12.  
 conica, Textularia, 11, 12.  
 conico-articulata, Articulina, 68, 69.  
 Cornuspira, 67, 71.  
     invovens, 67.  
     planorbis, 67.  
 Cornuspirinae, 67.  
 corrugata, Textularia, 12.  
     Textularia conica, 12.  
 costata, Miliolina, 21.  
     Quinqueloculina, 20.  
 crassa, Miliolina, 21.  
     Quinqueloculina, 21.  
 crassa subeuncata, Quinqueloculina, 21.  
 crenata, Massilina, 33.  
     Spiroloculina, 33.  
 crenulata, Quinqueloculina, 21.  
 cuvieriana, Quinqueloculina, 24.  
  
 denticulata, Biloculina, 62.  
     Biloculina ringens, 62.  
     Pyrgo, 62.

- denticulata striolata*, Biloculina, 63.  
*striolata*, Pyrgo, 63.  
*depressa murrhyna*, Biloculina, 64.  
*depressa*, Spiroloculina, 34, 40.  
*difformis*, Clavulina, 17.  
*Clavulina angularis*, 17.  
*divaricata advena*, Nubeculina, 49.  
*divaricata*, Nubeculina, 48, 49.  
*Nubeculina*, 48.  
*durandii*, Miliolina, 66.  
  
*edwardsi*, Planispirina (Sigmoidina), 45.  
*Sigmoidina*, 45.  
*elongata*, Pyrgo, 62.  
*excavata*, Spiroloculina, 34.  
*exigua*, Hauerina, 71.  
*Planispirina*, 71.  
*eximia*, Spiroloculina, 39.  
  
*fichteliana*, Triloculina, 55.  
*Fischerina*, 75.  
*helix*, 76.  
*involuta*, 76.  
*pellucida*, 75.  
*rhodiensis*, 75.  
*Fischerinidae*, 75.  
*flintiana*, Triloculina oceanica, 55.  
*Flintina*, 37.  
*foliacea oceanica*, Textularia, 8.  
*foliacea*, Textularia, 8.  
*fragilissima*, Hauerina, 42.  
*Spiroloculina*, 42.  
*funafutiensis*, Miliolina, 22.  
*Quinqueloculina*, 22.  
  
*Gaudryina*, 6, 13, 15.  
*bradyi*, 13.  
*pupoides*, 13.  
*quadrangularis*, 14.  
*rugosa*, 13.  
*rugulosa*, 15.  
*sp. (?)*, 15.  
*triangularis angulata*, 14.  
*Globotextulariinae*, 77.  
*globula*, Pyrgo, 65.  
*globulus*, Biloculina, 65.  
*gracilis*, Quinqueloculina cf., 23.  
*Grammostomum*, 7.  
*grata angulata*, Spiroloculina, 37.  
*reticosa*, Spiroloculina, 38.  
*grata*, Spiroloculina, 36, 37.  
*grateloupi acescata*, Spiroloculina, 35.  
*serrulata*, Spiroloculina, 35.  
*grateloupi*, Spiroloculina, 34, 36.  
*gualtieriana*, Quinqueloculina, 23.  
  
*Haplophragmium turbinatum*, 77.  
*Haplophragmoides trullissata*, 5.  
*Hauerina*, 42, 43.  
*bradyi*, 44.  
*compressa*, 42.  
*exigua*, 71.  
*fragilissima*, 42.  
*ornatissima*, 42, 43.  
*pacifica*, 44.  
*helix*, Fischerina, 76.  
  
*impresa*, Spiroloculina, 34.  
*inaequilateralis*, Spiroloculina, 41.  
*inaequalis*, Massilina, 32.  
*incertus*, Ammodiscus, 5.  
*indica*, Uniloculina, 18.  
*inflata*, Nubecularia, 74.  
*involuta*, Fischerina, 76.  
*involveus*, Cornuspira, 67.  
*irregularis*, Quinqueloculina, 54.  
*Triloculina*, 54.  
  
*Jonesi*, Textularia, 7.  
  
*labiata*, Textularia, 7.  
*labiosa*, Miliolina, 53.  
*Triloculina*, 53.  
*labiosa sparsicostata*, Triloculina, 54.  
*laevis*, Pyrgo, 61.  
*lamarekiana*, Quinqueloculina, 24.  
*lineata*, Articulina, 47.  
*Lituolidae*, 5.  
  
*macilenta*, Massilina, 33.  
*Massilina secans*, 33.  
*Miliolina*, 33.  
*Quinqueloculina*, 33.  
*Massilina*, 23, 29, 30, 31, 34.  
*alveoliniformis*, 30.  
*asperula*, 31.  
*australis*, 32.  
*crenata*, 33.  
*inaequalis*, 32.  
*macilenta*, 33.  
*planata*, 31.  
*secans*, 32.  
*secans macilenta*, 33.  
*mexicana*, Textularia, 7.  
*Miliola*, 34, 50, 61.  
*trigonula*, 50, 56.  
*Miliolidae*, 17.  
*Miloholina*, 18, 29, 30, 50.  
*alveoliniformis*, 29.  
*anguina agglutinans*, 18.  
*bertheliniana*, 60.  
*costata*, 21.  
*crassa*, 21.  
*durandii*, 66.  
*funafutiensis*, 22.  
*labiosa*, 53.  
*macilenta*, 33.  
*oblonga*, 51.  
*parkeri*, 25.  
*tricarinata*, 59, 60.  
*tricarinata bertheliniana*, 60.  
*trigonula*, 56.  
*undulata*, 27.  
  
*milletti*, Nodobacularia, 69.  
*Spiroplectamina*, 6, 7.  
*Textularia*, 7.  
*milletti*, Biloculina, 66.  
*Pyrgo*, 66.  
*murrhyna*, Biloculina, 64.  
*Pyrgo*, 64.  
*murrhyna*, Biloculina depressa, 64.  
  
*Nautilus*, 46.  
*nitida*, Articulina, 47.

- Nodobaculalaria, 68.  
   antillarum, 69.  
   antillarum pacifica, 68.  
   milletti, 69.
- Nodobaculariinae, 68.
- Nouria, 77.  
   polymorphinoides, 77, 78.
- Nubecularia, 48, 68, 74.  
   bradyi, 74.  
   divaricata, 48, 49.  
   inflata, 74.  
   tibia, 68.
- Nubeculariinae, 74.
- Nubeculina, 48.  
   chapmani, 49.  
   divaricata, 48.  
   divaricata advena, 49.
- nussdorffensis, Quinqueloculina, 28.
- oblonga, Miliolina, 51.  
   Triloculina, 50.
- oblongum, Vermiculum, 50.
- oceanica flintiana, Triloculina, 55.
- oceanica, Textularia foliacea, 8.  
   Triloculina, 54.
- Operculina, 67.
- Ophthalmidiidae, 67.
- Ophthalmidiinae, 70.
- Ophthalmidium, 70.
- Orbis, 67.
- ornatissima, Hauerina, 42, 43.  
   Quinqueloculina, 43, 44.
- pacifica, Clavulina, 16, 17.  
   Hauerina, 44.  
   Nodobaculalaria antillarum, 68.
- Palaeotextularia, 7.
- parisiensis, Clavulina, 16.
- parkeri, Miliolina, 25.  
   Quinqueloculina, 25.
- Parrina, 74.  
   bradyi, 74.
- pellucida, Fischerina, 75.
- planata, Massilina, 31.
- Planispirina, 43, 45, 71.  
   auriculata, 72.  
   communis, 71.  
   exigua, 71.  
   sigmoidea, 45.  
   (Sigmoilina) edwardsi, 45.
- planissima samoensis, Spiroloculina, 39.
- planissima, Spiroloculina, 31.
- planorbis, Cornuspira, 67.
- Plecanium, 7.
- polygona, Quinqueloculina, 25.
- polymorphinoides, Nouria, 77, 78.
- pupoides, Gaudryina, 13.
- Pyrgo, 61.  
   denticulata, 62.  
   denticulata striolata, 63.  
   elongata, 62.  
   globula, 65.  
   laevis, 61.  
   milletti, 66.  
   murrhina, 64.
- quadrangularis, Gaudryina, 14.
- Quinqueloculina, 17, 25, 30, 45, 50, 61.  
   alveoliniformis, 29.  
   anguina agglutinans, 18.  
   auberiana, 24.  
   berthelotiana, 19.  
   bidentata, 20.  
   costata, 20.  
   crassa, 21.  
   crassa subcuneata, 21.  
   crenulata, 21.  
   cuvieriana, 24.  
   funafutiensis, 22.  
   cf. gracilis, 23.  
   gualteriana, 23.  
   irregularis, 54.  
   lamarckiana, 24.  
   macilenta, 33.  
   nussdorffensis, 28.  
   ornatissima, 43, 44.  
   parkeri, 25.  
   polygona, 25.  
   samoensis, 26.  
   secans, 30.  
   semireticulosa, 27.  
   striatula, 27.  
   sulcata, 28.  
   tricarinata, 22.  
   undulata, 28.  
   variabilis, 31.
- Reophaeidae, 4.
- Reophax agglutinatus, 4.
- reticosa, Spiroloculina antillarum, 28.  
   Spiroloculina antillea, 38.  
   Spiroloculina grata, 38.
- reticulata, Triloculina, 61.
- reticulosa, Vertebralina, 73.
- Rhabdammina abyssorum, 4.
- rhodiensis, Fischerina, 75.
- ringens denticulata, Biloculina, 62.  
   striolata, Biloculina, 63.
- rugosa, Gaudryina, 13.  
   Textularia, 15.
- rugulosa, Gaudryina, 15.
- sagittula candeiana, Textularia, 9.
- sagittula, Textularia, 6, 7.
- Sagrina, 48.
- samoensis, Quinqueloculina, 26.  
   Spiroloculina planissima, 39.
- Schlumbergerina, 29.  
   alveoliniformis, 29.  
   areniphora, 29.
- secans macilenta, Massilina, 33.
- secans, Massilina, 32.  
   Quinqueloculina, 30.
- semilata, Textularia, 9.
- seminulum, Serpula, 18.
- semireticulosa, Quinqueloculina, 27.
- Serpula, 18.  
   seminulum, 18.
- serrulata, Spiroloculina grateloupi, 35.
- sigmoidea, Planispirina, 45.
- Sigmoilina, 45.  
   edwardsi, 45.  
   (Sigmoilina) edwardsi, Planispirina, 45.

- Silvestria*, 74.  
   *bradyi*, 74.  
*sparsicostata*, *Triloculina labiosa*, 54.  
*spinata*, *Triloculina*, 56.  
*Spirillina*, 67.  
*Spiroloculina*, 30, 31, 34, 45, 70.  
   *acutimargo*, 41, 70.  
   *affixa*, 41.  
   *angulosa*, 31.  
   *antillarum*, 36.  
   *antillarum aequa*, 38.  
   *antillarum angulata*, 36.  
   *antillarum reticosa*, 38.  
   *antillea reticosa*, 38.  
   *asperula*, 31.  
   *caduca*, 39.  
   *cauliculata*, 35.  
   *clara*, 40.  
   *crenata*, 33.  
   *depressa*, 34, 40.  
   *excavata*, 34.  
   *eximia*, 39.  
   *fragilissima*, 42.  
   *grata*, 36, 37.  
   *grata angulata*, 37.  
   *grata reticosa*, 38.  
   *grateloupi*, 34, 36.  
   *grateloupi acescata*, 35.  
   *grateloupi serrulata*, 35.  
   *impressa*, 34.  
   *inaequilateralis*, 41.  
   *planissima*, 31.  
   *planissima samoensis*, 39.  
   *sp. (?)*, 42.  
   *striata*, 39.  
*Spiroplecta*, 6.  
   *wrightii*, 6.  
*Spiroplectamina*, 6, 13.  
   *milletti*, 6, 7.  
*Spiroplectamininae*, 6.  
*Spiroptalmidium*, 70.  
   *acutimargo*, 70.  
*striata*, *Adelosina*, 18.  
*Spiroloculina*, 39.  
   *Vertebralina*, 72, 73.  
*striatula*, *Quinqueloculina*, 27.  
*striolata*, *Biloculina denticulata*, 63.  
   *Biloculina ringens*, 63.  
   *Pyrgo denticulata*, 63.  
   *subcuneata*, *Quinqueloculina crassa*, 21.  
*suborbicularis*, *Triloculina*, 28.  
*sulcata*, *Articulina*, 47.  
   *Quinqueloculina*, 28.  
  
*Textilaria*, 7.  
   *labiata*, 7.  
*Textularia*, 6, 7.  
   *abbreviata*, 11.  
   *agglutinans*, 10.  
   *agglutinans biformis*, 6.  
   *albatrossi*, 12.  
   *candeiana*, 9, 10, 11.  
   *concava*, 12, 13.  
   *conica*, 11, 12.  
   *conica corrugata*, 12.  
   *corrugata*, 12.  
  
*Textularia foliacea*, 8.  
   *foliacea oceanica*, 8.  
   *jonesi*, 7.  
   *mexicana*, 7.  
   *milletti*, 7.  
   *rugosa*, 15.  
   *sagittula*, 6, 7.  
   *sagittula candeiana*, 9.  
   *senialata*, 9.  
*Textulariidae*, 6.  
*Textulariinae*, 7.  
*tibia*, *Nubecularia*, 68.  
*triangularis angulata*, *Gaudryina*, 14.  
*tricarinata bertheliniana*, *Miliolina*, 60.  
*tricarinata*, *Clavulina*, 17.  
   *Miliolina*, 59, 60.  
   *Quinqueloculina*, 22.  
   *Triloculina*, 59.  
*trigonula*, *Miliola*, 50, 56.  
   *Miliolina*, 56.  
   *Triloculina*, 56, 58.  
*Triloculina*, 50, 61.  
   *affinis*, 58, 59.  
   *austriaca*, 57.  
   *bertheliniana*, 60.  
   *bicarinata*, 60, 61.  
   *brongniartiana*, 28.  
   *circularis*, 52.  
   *fichteliana*, 55.  
   *irregularis*, 54.  
   *labiosa*, 53.  
   *labiosa sparsicostata*, 54.  
   *oblonga*, 50.  
   *oceanica*, 54.  
   *oceanica flintiana*, 55.  
   *reticulata*, 61.  
   *sp. (?)*, 61.  
   *spinata*, 56.  
   *suborbicularis*, 28.  
   *tricarinata*, 59.  
   *trigonula*, 56, 58.  
*Tritaxia*, 16.  
*Trochammina trullissata*, 5.  
   *turbinata*, 77.  
*Trochamminidae*, 77.  
*Trochammininae*, 77.  
*trullissata*, *Haplophragmoides*, 5.  
   *Trochammina*, 5.  
*turbinata*, *Trochammina*, 77.  
*turbinatum*, *Haplophragmium*, 77.  
  
*undulata*, *Miliolina*, 27.  
   *Quinqueloculina*, 28.  
*Uniloculina*, 18.  
   *indica*, 18.  
  
*Valvulina*, 16.  
*variabilis*, *Quinqueloculina*, 31.  
*Verniculum oblongum*, 50.  
*Verneuilina*, 16.  
*Verneuilinidae*, 13.  
*Vertebralina*, 46, 72.  
   *reticulosa*, 73.  
   *striata*, 72, 73.  
  
*wrightii*, *Spiroplecta*, 6.













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