

# Recent Foraminifera of the Marshall Islands

Bikini and Nearby Atolls, Part 2, Oceanography (Biologic)

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GEOLOGICAL SURVEY PROFESSIONAL PAPER 260-H



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In the distribution tables (1-5) *italic numbers* indicate abundance of the species in percentages of the Foraminifera present in the sample. Arabic numbers indicate actual count of specimens.



# Recent Foraminifera of the Marshall Islands

*By* JOSEPH A. CUSHMAN, RUTH TODD, *and* RITA J. POST

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# BIKINI AND NEARBY ATOLLS, MARSHALL ISLANDS

## RECENT FORAMINIFERA OF THE MARSHALL ISLANDS

By Joseph A. Cushman,<sup>1</sup> Ruth Todd, and Rita J. Post

### ABSTRACT

This paper records 331 species and varieties, most of which are formally described and illustrated, from 195 samples from the lagoons and outer slopes of the Marshall Islands: Rongerik, Rongelap, Bikini and Eniwetok. Seventeen species and two varieties are new and 33 are undeterminable specifically. The samples range in depth from the beach to 835 fathoms on Sylvania Guyot adjoining Bikini Atoll. Tables showing the distribution and abundance (as percentage of the total) of all the species in each sample are included. Species are listed according to their ecologic significance or lack of it. Depth, and access to the open ocean, appear to be the chief ecologic factors affecting distribution and abundance.

### INTRODUCTION

A series of bottom foraminiferal samples from four coral atolls at the northwestern end of the Marshall group in the south Pacific has been studied both as to the total fauna present and as to the relative abundance of the species at various depths and positions within the lagoon and on the outer slopes of the atoll.

The samples available give a rather complete picture of the foraminiferal faunas present in the waters of and surrounding the atolls. The faunas may be divided as follows: reef flat and lagoon beach fauna, lagoon and shallow outer slope fauna, and deep-water fauna (chiefly a planktonic fauna with the addition of rare benthonic species). In each case the faunas may intergrade, or dominant species from either of the first two may work down the slope into the second or third and obscure its normal appearance.

Generally speaking, the faunas here studied are characteristic of the tropical Pacific. About 84 percent of the species are identified with known species from the tropical Pacific. About 6 percent of the species and varieties found seem to be new to science, and 10 percent are undeterminable specifically and may also be new. The faunas of the four atolls do not differ significantly

among themselves, but there are notable differences between these atolls and certain other Pacific islands; for example, the absence of *Baculogypsina* and various medium to large species of *Rotalia*, such as *R. calcar* (D'Orbigny), and the great variety of the miliolids.

The percentages recorded in the distribution table were estimated by means of a picking tray divided into segments to facilitate the counting of all specimens in a unit area of a thinly scattered sample. Depending upon the variety of forms present, fifty to several hundred specimens were counted in each sample. In the original picking of the samples the species were picked quantitatively up to 25 specimens. Beyond that point, percentages were estimated, but where the percentages are low the estimates are very rough.

In most cases the samples were treated with carbon tetrachloride to separate the smaller species from the larger and heavier tests of *Calcarina*, *Amphistegina*, *Heterostegina*, *Marginopora*, etc., and from the fragments of coral, shell, and *Halimeda*, but both fractions were studied.

The most abundant single species in nearly all the lagoon samples (exclusive of beach samples) is *Amphistegina madagascariensis* D'Orbigny, but its varying percentages are not so much significant of changes in its abundance as a reflection of the richness or barrenness of the accompanying fauna.

We appreciate the many helpful suggestions received during discussions of our work with Miss Frances L. Parker of Scripps Institution of Oceanography, Dr. W. Storrs Cole of Cornell University, Drs. Harry S. Ladd and Joshua I. Tracey of the U. S. Geological Survey and Dr. Kenneth O. Emery of the University of Southern California.

### GENERAL FEATURES

#### FAUNA OF REEF FLATS

The fauna of the reef flat, represented by seven samples from Bikini, is characterized by large percentages of *Calcarina spengleri* (Gmelin), *Marginopora vertebralis* Blainville, *Homotrema rubrum* (Lamarck),

<sup>1</sup> Dr. Cushman died during the progress of work on this fauna. It was therefore brought to completion by the two junior authors. The samples from Rongerik Atoll had been studied and the species identified and described by Dr. Cushman, and the work on Eniwetok Atoll begun, before his death. The work on the other two atolls was done largely by the other authors. The tables showing distribution and abundance were prepared by the junior authors. Responsibility for the descriptions of the various new species and varieties is indicated in each case.

*Miniacina miniacea* (Pallas), and *Carpenteria proteiformis* Goës together with much smaller percentages of *Amphistegina madagascariensis* D'Orbigny. In addition there are some thirty other species which comprise a very small percentage of the total fauna and these are found mainly in pools on the reef flat. Local variations such as channels or pools where the water would be swift-moving or quiet affect the concentration of the species on the reef flat. A few specimens of planktonic forms brought in by the surf are found on the reef flat.

The fauna of the beaches is almost entirely a transported one and consists mainly of much-worn specimens of *Calcarina spengleri* (Gmelin). The percentage of *C. spengleri* (Gmelin) on the beaches varies from place to place and in some places there is a considerable percentage of worn specimens of *Amphistegina madagascariensis* D'Orbigny and *Marginopora vertebralis* Blainville.

#### FAUNA OF LAGOONS

The fauna of the lagoons was studied in 13 samples from Rongerik ranging in depth from 74 to 150 feet, 12 samples from Rongelap ranging in depth from 60 to 192 feet, 58 samples from Bikini ranging in depth from 11 to 188 feet, and 45 samples from Eniwetok ranging in depth from 54 to 204 feet.

In the lagoon fauna as a whole, the dominant species is *Amphistegina madagascariensis* D'Orbigny. Next in abundance in the lagoons is *Heterostegina suborbicularis* D'Orbigny, which in a few places is more abundant than *Amphistegina*. The dominance of *Heterostegina suborbicularis* D'Orbigny over *Amphistegina madagascariensis* D'Orbigny is probably related to bottom conditions. (See Meyers, 1943, p. 29.) Furthermore, the distribution of these two common species may be affected by additional unknown factors.

Leaving out of consideration the dominant one or several species, the remaining lagoon fauna may be rich in one or another of the *Reussella-Bolivina*, *Textularia*, milioid, peneroplid, or globigerinid groups. The reasons for these variations are also obscure but probably bottom conditions have a very important part in determining what foraminiferal species are to be found. Many factors other than depth affect these faunas, which are not entirely life associations.

Other species found in considerable abundance in the lagoons are *Calcarina hispida* H. B. Brady, *Marginopora vertebralis* Blainville, *Homotrema rubrum* (Lamarek), and *Miniacina miniacea* (Pallas). Certain samples, the shallower ones and those close to the reef, have rather large percentages of worn specimens of *Calcarina spengleri* (Gmelin) which appear to have been transported down into the lagoon from the reef flat. In general, the percentage of *C. spengleri* (Gmelin)

decreases with depth and that of *C. hispida* H. B. Brady increases.

The seven species mentioned above are as follows:

*Heterostegina suborbicularis* D'Orbigny  
*Marginopora vertebralis* Blainville  
*Amphistegina madagascariensis* D'Orbigny  
*Calcarina hispida* H. B. Brady  
*spengleri* (Gmelin)  
*Homotrema rubrum* (Lamarek)  
*Miniacina miniacea* (Pallas)

These species may comprise from 50 to 75 percent of the total lagoon fauna. The remaining percentage is made up of about 185 other species, many of which are common and about 60 of which are very rare.

The following species are restricted to the lagoons (or with very rare occurrences outside):

#### Family Miliolidae

*Quinqueloculina anguina* var. *arenata* Said  
*Spiroloculina clara* var. *lirata* Cushman, n. var.  
*foveolata* Egger  
*Hauerina serrata* Cushman, n. sp.  
*Triloculina* sp. A

#### Family Ophthalmidiidae

*Nubecularia lacunensis* Chapman

#### Family Peneroplidae

*Monalysidium politum* Chapman

#### Family Buliminidae

*Buliminella milletti* Cushman  
*Bulimina fijiensis* Cushman  
*Reussella* sp. A

#### Family Rotaliidae

*Spirillina decorata* H. B. Brady  
*vivipara* var. *revertens* Rhumbler  
*Patellinella inconspicua* (H. B. Brady)  
*Discorbis subbertheloti* Cushman  
*Rotalia* cf. *R. beccarii* var. *tepida* Cushman  
*Epistomaroides polystomelloides* (Parker and Jones)  
*Siphonina tubulosa* Cushman

#### Family Pegidiidae?

*Rugidia?* *spinosa* Cushman, n. sp.

#### Family Globigerinidae?

*Globigerina?* sp.

#### Family Planorbulinidae

*Gypsina plana* (Carter)

One core, Bikini 218, taken inside Bikini lagoon about 3 miles southwest of Bikini Island, and 2½ miles from the reef at its nearest place, was available for study. The sample showed a distinct difference in the composition of the fauna from top to bottom of the 16-inch core. The abundance of *Globigerinoides conglobata* (H. B. Brady) at the bottom of the core indicates that conditions had been different, resulting in a greater concentration of planktonic species and those characteristic of the outer slope. This might have been due to the proximity of a gap in the reef at the time of deposition of that part of the core, or to a change in the currents within the lagoon. At present, the pass nearest to the

location of the core is about 6 miles to the south. The presence in considerable numbers at the bottom of the core of *Globigerinoides conglobata* (H. B. Brady) is significant in view of the fact that the species is not found, except very rarely, in any other of the lagoon samples, and occurs in abundance only in the deeper samples of the outer slopes and guyot. The presence of a considerable percentage of *Calcarina spengleri* (Gmelin) at the bottom of the core is consistent with other lagoon samples, however.

The two commonest pelagic species, *Globigerinoides rubra* (D'Orbigny) and *G. sacculifera* (H. B. Brady), are found almost throughout all the lagoons but are less abundant and less well developed there, as if those in the lagoons were all young specimens. The reasons for this are obscure. They may become more apparent as more is learned of the life history and the food supply of planktonic Foraminifera.

#### FAUNA OF OUTER SLOPES

The samples from the outer slopes of the atolls do not differ greatly in percentage composition from those inside the lagoons. They are, however, characterized by the appearance, as rare specimens, of various deep-water species that occur in greater abundance at greater depths. *Cycloclypeus carpenteri* H. B. Brady is characteristic of the outer slopes of Bikini Atoll from 58 to 240 fathoms and was not found, except very rarely, at greater depths, such as on the guyot.

The following species occur only on the outer slopes of the atolls:

*Siphotextularia crispata* (H. B. Brady)  
*Gaudryina* (*Siphogaudryina*) *siphonifera* (H. B. Brady)  
*Cycloclypeus carpenteri* H. B. Brady  
*Discorbis tuberculata* (Chapman)  
*Cassidulina pacifica* Cushman

#### FAUNA OF DEEP WATER

The deep-water fauna is represented by 13 bottom samples on the outer slopes of Bikini Atoll from 55 to 710 fathoms, 21 samples from Sylvania Guyot adjoining Bikini Atoll from 410 to 835 fathoms, and five samples from 24 to 500 fathoms on the outer slope of Eniwetok Atoll. The percentage composition of this fauna is entirely different from that of the reef flat or the lagoons. In the samples from the deeper locations, various species of the planktonic families Globigerinidae and Globorotaliidae together comprise 50 percent to 98 percent of the total foraminiferal fauna. In the samples from the shallower locations the next most abundant species are *Amphistegina madagascariensis* D'Orbigny and *Amphistegina radiata* (Fichtel and Moll) and its varieties. In addition to these there are about

215 other species which are mostly rare and together form a relatively small proportion of the deep water fauna. Representatives of the families Lagenidae, Polymorphinidae, Ellipsoidinidae, Cassidulinidae and Chilostomellidae are found almost exclusively in the deeper-water fauna.

The following species are restricted to the outer slopes of the atolls and to the guyot, with rare occurrences inside the lagoons in a few cases:

- Family Textulariidae  
*Textularia kerimbaensis* Said  
*milletti* Cushman  
*senialata* Cushman  
*Bigenerina* sp.
- Family Verneulinidae  
*Gaudryina triangularis* var. *angulata* Cushman  
*trullissata* Todd, n. sp.  
(*Siphogaudryina*) *transversaria* (H. B. Brady)
- Family Valvulinidae  
*Karrerella bradyi* (Cushman)
- Family Miliolidae  
*Quinqueloculina bradyana* Cushman  
*Spiroloculina circularis* Chapman  
*Pyrgo lucernula* (Schwager)  
*murrhina* (Schwager)
- Family Lagenidae  
*Robulus calcar* (Linné)  
*gibbus* (D'Orbigny)  
*limbosus* (Reuss)  
*nigriseptus* (Koch)  
sp. A  
sp. B  
sp. C  
sp. D  
*Astacolus bradyi* (Cushman)  
*planulata* (Galloway and Wissler)  
*Dentalina* cf. *D. filiformis* (D'Orbigny)  
*Nodosaria pauciloculata* Cushman  
sp. B  
sp. C  
*Fronidularia* sp. A of Boomgaard  
*Lagena acuticosta* Reuss  
*gracilis* Williamson
- Family Polymorphinidae  
*Dimorphina tuberosa* D'Orbigny  
*Polymorphinella pacifica* Cushman and Hanzawa
- Family Nonionidae  
*Nonion pacificum* (Cushman)  
*Astrononion tumidum* Cushman and Edwards
- Family Buliminidae  
*Fissurina* sp. B  
*Bolivina abbreviata* Heron-Allen and Earland  
*nitida* H. B. Brady  
*robusta* H. B. Brady  
*Bitubulogenerina* sp.  
*Uvigerina ampullacea* H. B. Brady  
*proboscidea* Schwager  
*proboscidea* var. *vadescens* Cushman  
*Siphogenerina dimorpha* var. *pacifica* Cushman  
*Angulogerina albatrossi* var. *ornata* Cushman  
*Trifarina bradyi* Cushman

## Family Rotaliidae

- Gyroidina soldanii* D'Orbigny  
*Eponides tenera* (H. B. Brady)  
*Höglundina elegans* (D'Orbigny)  
*Mississippina concentrica* (Parker and Jones)  
*Baggina philippinensis* (Cushman)  
*philippinensis* var. *pilulifera* Cushman and Todd

## Family Amphisteginidae

- Amphistegina radiata* (Fichtel and Moll)  
*radiata* var. *papillosa* Said  
*radiata* var. *venosa* (Fichtel and Moll)  
*radiata* (Fichtel and Moll) var.

## Family Cassidulinidae

- Cassidulina angulosa* Cushman  
*costatula* Cushman  
*delicata* Cushman  
*elegans* Sidebottom  
*marshallana* Todd, n. sp.  
*patula* Cushman  
 cf. *C. spinifera* Cushman and Jarvis  
*subglobosa* H. B. Brady  
*subglobosa* H. B. Brady var.  
*Ehrenbergina pacifica* Cushman

## Family Chilostomellidae

- Pullenia salisburyi* R. E. and K. C. Stewart  
*Sphaeroidina bulloides* D'Orbigny  
*compacta* Cushman and Todd

## Family Globigerinidae

- Globigerina* cf. *G. conglomerata* Schwager  
*subcretacea* Lomnicki  
*Globigerinella aequilateralis* (H. B. Brady)  
*Hastigerinella digitata* Rhumbler  
*Orbulina universa* D'Orbigny  
*Pulleniatina obliquiloculata* (Parker and Jones)  
*Sphaeroidinella dehiscens* (Parker and Jones)  
*Candeina nitida* D'Orbigny

## Family Globorotaliidae

- Globorotalia crassa* (D'Orbigny)  
 cf. *G. hirsuta* (D'Orbigny)  
*menardii* (D'Orbigny)  
*truncatulinoides* (D'Orbigny)  
*tumida* (H. B. Brady)

## Family Anomalinidae

- Anomalina polymorpha* Costa  
*Planulina ariminensis* D'Orbigny  
*Cibicides cicatricosus* (Schwager)  
*Cibicidina* sp.

## SYLVANIA GUYOT CORE

One of the cores from Sylvania Guyot, Bikini 1176, 7 inches long, taken at a depth of 720 fathoms, contains a few species which suggest Tertiary age. These are

- Gümbelina? marshallana* Todd, n. sp.  
*Pavonina triformis* Parr  
*Parafissurina* sp.  
*Pleurostomella bolivinooides* Schubert  
*Osangularia bengalensis* (Schwager)

The evidence is not conclusive and needs further support from additional samples.

The position of the core in which these fossil species

were found is at the inner part of the neck connecting Sylvania Guyot to the base of the atoll slope. (See figure in chapter A of the present report.) Such a position, about 4300 feet below the top of the atoll would be favorable for the accumulation of any Tertiary or older material that might be exposed on the atoll slope above. Evidence from the well drilled to a depth of about 2500 feet on Bikini and which penetrated beds thought to be Oligocene, indicates the probable existence of lower Tertiary beds as much as 1800 feet higher than the elevation of the core, Bikini 1176. Thus there is a possibility that the origin of these Tertiary species is an exposure somewhere on the atoll slope above, which sheds debris down onto the more gradual slope below.

Only one of the species listed above, *Favonina triformis* Parr, was found in the material from the Bikini well at depths of 925-935½ feet and 1167-1177½ feet.

## SPECIES RESTRICTED TO GUYOT

The following species are restricted to the guyot:

- Family Textulariidae  
*Siphotextularia* cf. *S. concava* (Karrer)
- Family Verneuilinidae  
*Gaudryina flintii* Cushman
- Family Valvulinidae  
*Schenckiella primaeva* (Cushman)
- Family Miliolidae  
*Triloculina* sp. B
- Family Lagenidae  
*Nodosaria* sp. A
- Family Nonionidae  
*Nonion pompilioides* (Fichtel and Moll)
- Family Heterohelicidae  
*Gümbelina? marshallana* Todd, n. sp.  
*Bolivinita quadrilatera* (Schwager)
- Family Buliminidae  
*Robertina subcylindrica* (H. B. Brady)  
*translucens* Cushman and Parker  
*Bulimina aculeata* D'Orbigny  
*affinis* D'Orbigny  
*costata* D'Orbigny  
*rostrata* H. B. Brady  
*Fissurina* sp. C  
*Loxostomum karrerianum* (H. B. Brady)  
*Rectobolivina bifrons* (H. B. Brady)  
*Uvigerina* cf. *U. peregrina* Cushman  
*porrecta* var. *fimbriata* Sidebottom  
*Siphonodosaria abyssorum* (H. B. Brady)  
*lepidula* (Schwager)
- Family Rotaliidae  
*Osangularia bengalensis* (Schwager)
- Family Cassidulinidae  
*Cassidulina gemma* Todd, n. sp.  
*Cassidulinoides* sp.  
*Ehrenbergina reticulata* Cushman
- Family Chilostomellidae  
*Pullenia bulloides* (D'Orbigny)
- Family Globorotaliidae  
*Globorotalia menardii* var. *fimbriata* (H. B. Brady)

## NONDIAGNOSTIC SPECIES

The following species are not very diagnostic because of their widespread distribution. However, those preceded by (\*) are very rare or absent on the guyot, and those preceded by (\*\*) are less abundant inside the lagoon.

## Family Hyperamminidae

\**Sagenina frondescens* (H. B. Brady)

## Family Textulariidae

*Textularia agglutinans* D'Orbigny

*candeiana* D'Orbigny

*conica* D'Orbigny

*dupla* Todd, n. sp.

\**foliacea* Heron-Allen and Earland

*foliacea* var. *oceanica* Cushman

## Family Verneuilinidae

*Gaudryina* (*Siphogaudryina*) *rugulosa* Cushman

## Family Valvulinidae

*Valvulina davidiana* Chapman

## Family Miliolidae

*Quinqueloculina bidentata* D'Orbigny

*crassa* var. *subcuneata* Cushman

*distorqueata* Cushman, n. sp.

cf. *Q. ferussacii* D'Orbigny

*neostriatula* Thalmann

*parkeri* (H. B. Brady)

cf. *Q. seminulum* (Linné)

*sulcata* D'Orbigny

*Miliolinella australis* (Parr)

*Triloculinella labiosa* (D'Orbigny)

*Spiroloculina angulata* Cushman

*clara* Cushman

*communis* Cushman and Todd

*corrugata* Cushman and Todd

*marshallana* Todd, n. sp.

*Articulina pacifica* Cushman

*Hauerina bradyi* Cushman

*diversa* Cushman

*involuta* Cushman

*milletti* Cushman, n. sp.

*Schlumbergerina alveoliniformis* (H. B. Brady)

*Triloculina* cf. *T. bassensis* Parr

cf. *T. bicarinata* D'Orbigny

*bikiniensis* Todd, n. sp.

*earlandi* Cushman, n. sp.

*involuta* Todd, n. sp.

*irregularis* (D'Orbigny)

*kerimbatica* (Heron-Allen and Earland)

*marshallana* Todd, n. sp.

cf. *T. oblonga* (Montagu)

*spinata* Cushman

*subplanciana* Cushman, n. sp.

*terquemiana* (H. B. Brady)

*tricarinata* D'Orbigny

*trigonula* (Lamarek)

*Pyrgo denticulata* (H. B. Brady)

*denticulata* var. *striolata* (H. B. Brady)

sp.

## Family Ophthalmidiidae

*Cornuspira planorbis* Schultze

*Parrina bradyi* (Millet)

## Family Nonionidae

*Nonionella translucens* Cushman

sp. B

*Elphidium advenum* (Cushman)

*advenum* var. *dispar* Cushman, n. var.

*jenseni* (Cushman)

*simplex* Cushman

## Family Camerinidae

*Operculina ammonoides* (Gronovius)

\**Heterostegina suborbicularis* D'Orbigny

## Family Peneroplidae

*Spirolina acicularis* (Batsch)

*arietina* (Batsch)

*Sorites marginalis* (Lamarek)

\**Marginopora vertebralis* Blainville

## Family Heterohelicidae

*Bolivina folia* (Parker and Jones)

*folia* var. *ornata* Cushman

## Family Buliminidae

*Fissurina circularis* Todd, n. sp.

*formosa* (Schwager)

*lacunata* (Burrows and Holland)

*milletti* Todd, n. sp.

*Bolivina compacta* Sidebottom

*pseudopygmaea* Cushman

*rhomboidalis* (Millet)

*striatula* Cushman

*subexcavata* Cushman and Wickenden

*tortuosa* H. B. Brady

*Loxostomum convallarium* (Millet)

*limbatum* (H. B. Brady)

*Reussella simplex* (Cushman)

*Mimosina pacifica* Cushman

*Uvigerina porrecta* H. B. Brady

*Siphogenerina raphana* (Parker and Jones)

## Family Rotaliidae

\**Discorbis concinna* (H. B. Brady)

*crustata* Cushman

\**micens* Cushman

*opima* Cushman

\**patelliformis* (H. B. Brady)

\**rugosa* (D'Orbigny)

\**Poroeponides cribroripandus* Asano and Uchio

\**Siphoninoides echinata* (H. B. Brady)

## Family Pegidiidae

*Rugidia corticata* (Heron-Allen and Earland)

## Family Amphisteginidae

*Amphistegina madagascariensis* D'Orbigny

## Family Calcarinidae

*Calcarina hispida* H. B. Brady

## Family Cymbaloporidae

*Cymbaloporeta bradyi* (Cushman)

*squammosa* (D'Orbigny)

*Tretomphalus planus* Cushman

## Family Cassidulinidae

*Epistominella tubulifera* (Heron-Allen and Earland)

sp.

*Cassidulina minuta* Cushman

## Family Globigerinidae

*Globigerina bulloides* D'Orbigny

*Globigerinoides conglobata* (H. B. Brady)

\*\**rubra* (D'Orbigny)

\*\**sacculifera* (H. B. Brady)



## Family Anomalinidae

- Anomalina* cf. *A. glabrata* Cushman  
 \**Anomalinella rostrata* (H. B. Brady)  
*Cibicides lobatulus* (Walker and Jacob)  
*mayori* (Cushman)  
 cf. *C. pseudoungerianus* (Cushman)  
*Cibicidella variabilis* (D'Orbigny)

## Family Planorbulinidae

- \**Planorbulina acervalis* H. B. Brady  
 \**Acerulina inhaerens* Schultze  
 \**Gypsina globula* (Reuss)  
 \**vesicularis* (Parker and Jones)

## Family Homotremidae

- \**Homotrema rubrum* (Lamarek)  
 \**Miniacina miniacina* (Pallas)

The following species are too rare to be of value as indicators of ecologic conditions:

## Family Saccamminidae

- Proteonina* sp.

## Family Ammodiscidae

- Ammodiscus incertus* (D'Orbigny)

## Family Verneuilinidae

- Gaudryina* cf. *G. pauperata* Earland

## Family Valvulinidae

- Clavulina angularis* D'Orbigny  
*pacifica* Cushman

## Family Miliolidae

- Quinqueloculina parkeri* (H. B. Brady) var.  
 cf. *Q. samoensis* Cushman  
*Miliolinella oceanica* (Cushman)  
*oceanica* var. *flintiana* (Cushman)  
*Massilina planata* Cushman  
*Spiroloculina acescata* Cushman  
*aequa* Cushman  
*mayori* Cushman  
 sp. A  
 sp. B

- Sigmoilina edwardsi* (Schlumberger)

- Articulina elongata* Cushman  
*Tubinella funalis* (H. B. Brady)  
*Pyrgo milletti* (Cushman)

## Family Ophthalmidiidae

- Vertebralina striata* D'Orbigny  
*Planispirina exigua* (H. B. Brady)  
*Wiesnerella auriculata* (Egger)

## Family Trochamminidae

- Trochammina* cf. *T. rotaliformis* J. Wright  
*Rotaliammina mayori* Cushman  
*Carterina spiculotesta* (Carter)  
*Nouria polymorphinoides* Heron-Allen and Earland

## Family Lagenidae (except as indicators of outer slopes and deep water)

- Lagena globosa* (Montagu)  
*spiralis* H. B. Brady  
*striato-punctata* Parker and Jones  
*williamsoni* (Alcock)

## Family Polymorphinidae

- Sigmomorphina semitecta* var. *terquemiana* (Fornasini)

## Family Nonionidae

- Nonionella* sp. A  
*Elphidium milletti* (Heron-Allen and Earland)

## Family Peneroplidae

- Peneroplis* sp.

## Family Alveolinellidae

- Nealveolina pulchra* (D'Orbigny)

## Family Buliminidae

- Buliminella elegantissima* (D'Orbigny)  
*Buliminoides williamsoniana* (H. B. Brady)  
*Pseudobulimina* sp.  
*Oolina squamosa* (Montagu)  
*Fissurina auriculata* var. *costata* (H. B. Brady)  
*radiato-marginata* (Parker and Jones)  
 sp. A

- Virgulina earlandi* Cushman

- Bolivina globulosa* Cushman  
*oceanica* Cushman  
*subreticulata* Parr  
*subtenuis* Cushman

- Loxostomum mayori* (Cushman)

- Bifarinella mackinnonii* (Millett)

- Reussella* sp. B

- Pavonina triformis* Parr

- Chrysalidinella fijiensis* Cushman

## Family Ellipsoidinidae

- Pleurostomella bolivinoidea* Schubert  
*Parafissurina* sp.

## Family Rotaliidae

- Spirillina decorata* var. of Sidebottom  
*inaequalis* H. B. Brady  
*tuberculato-limbata* Chapman  
*vivipara* var. *densepunctata* Cushman  
*Conicospirillina semi-involuta* Cushman  
 sp.

- Patellina advena* Cushman

- advena* var. *altiformis* Cushman

- Patellinella fijiensis* Cushman

- jugosa* (H. B. Brady)

- Discorbis frustata* Cushman

- Lamarckina scabra* (H. B. Brady)

- Heronallenia* sp.

- Paumotua terebra* (Cushman)

## Family Pegidiidae

- Pegidia dubia* (D'Orbigny)

- Sphaeridia papillata* Heron-Allen and Earland

## Family Cymbaloporidae

- Pyropilus rotundatus* Cushman

## Family Cassidulinidae

- Ceratobulimina pacifica* Cushman and Harris  
*Epistominella* cf. *E. obtusa* (Burrows and Holland)  
*pulchra* (Cushman)

## Family Chilostomellidae

- Chilostomella oolina* Schwager

## Family Globigerinidae

- Globigerinoides elongata* (D'Orbigny)  
*sacculifera* var. *fistulosa* (Schubert)

## Family Anomalinidae

- Laticarinina pauperata* (Parker and Jones)

## Family Planorbulinidae

- Planorbulinella larvata* (Parker and Jones)

## Family Rupertiidae

- Rupertia stabilis* Wallich  
*Carpenteria* sp.

NOTES ON DISTRIBUTION BY FAMILIES

Textulariidae and other arenaceous groups are present at all the atolls, less abundantly in deeper water and with certain species being very abundant in the lagoons. Miliolidae and Ophthalmitidae are present and abundant at all the atolls, but are rare in deeper water. Lagenidae and Polymorphinidae are not present in Rongerik lagoon. These groups are not found abundantly anywhere in the Marshall Islands, but their frequency is greater at the deeper locations. Nonionidae are present at all the atolls. Camerinidae are present at all the atolls, comprising a considerable percentage of the lagoon fauna, but are rare in deeper water. Peneroplidae are present at all the atolls, rare in deeper water. One species, *Marginopora vertebralis* Blainville, comprises a considerable percentage of the reef fauna. Heterohelicidae and Ellipsoidinidae are found only very rarely. Buliminidae occur rarely at all the atolls, with fewer numbers but a greater variety of genera and species in deeper water. Rotaliidae are present at all the atolls but are rare. Amphisteginidae are present in large numbers at all the atolls, decreasing in numbers but increasing in variety of forms with depth on the outer slopes of the atolls. Calcarinidae are present at all the atolls. The two species found in this family are apparently restricted in their habitats, although the one reef-dwelling species, *Calcarina spengleri* (Gmelin), is found washed out great distances, both into the lagoons and down the outer slopes of the atolls. The other species, *C. hispida* H. B. Brady, flourishes within the lagoon at about 10 fathoms and deeper as well as in deep water on the outer slopes of the atolls. Cymbaloporidae are found equally in the lagoons and in the deeper water surrounding the atolls. Cassidulinidae and Chilostomellidae are found almost exclusively in the deep water on the outer slopes surrounding the atolls. There is only one notable exception, *Cassidulina minuta* Cushman, which is found as frequently inside the lagoons as out. Globigerinidae and Globorotaliidae are found most abundantly in the oozes from the deepest samples. These planktonic forms are also found inside the lagoons but in much smaller numbers. Anomalinidae and Planorbulinidae occur at all the atolls, but more rarely in deeper water. Homotremidae are found most abundantly in the shallower parts of the lagoons and very rarely in deep water.

Three generalized diagrams show the differences in percentage composition of the three types of environment. Figure 116 represents the composition of a

typical beach sample, figure 117 that of a typical lagoon sample, and figure 118 that of a typical deep-water sample.

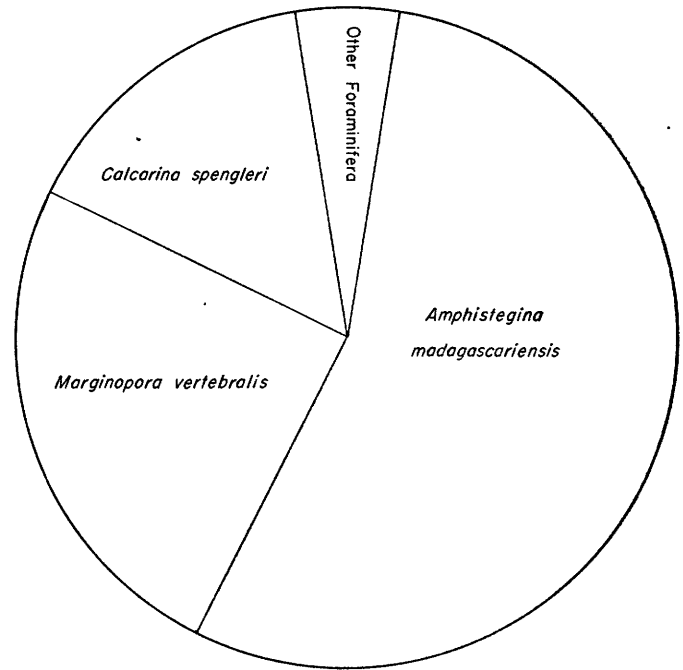


FIGURE 116.—Composition of typical beach sample

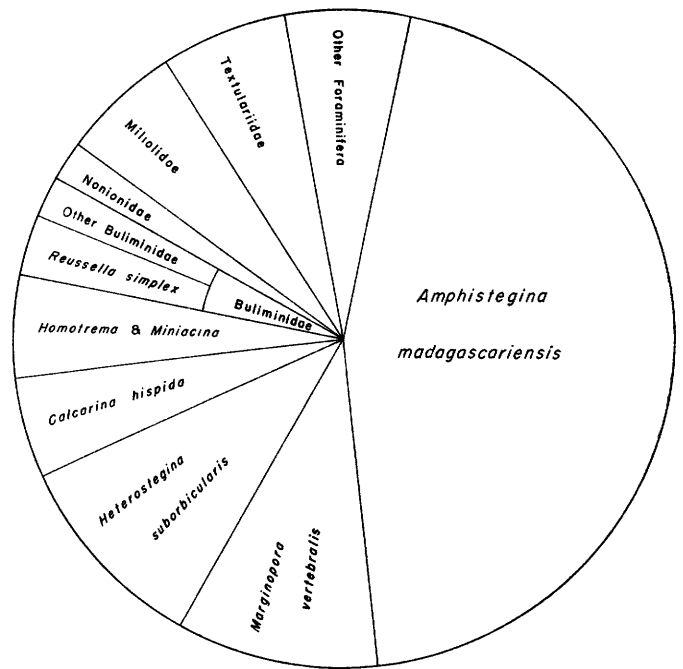


FIGURE 117.—Composition of typical lagoon sample

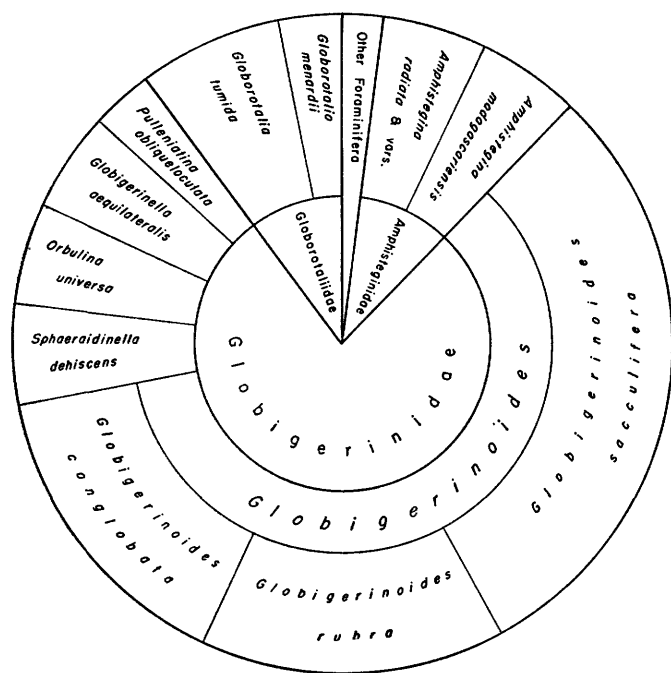


FIGURE 118.—Composition of typical deep-water sample

LOCALITIES AND DEPTHS OF SAMPLES

The samples examined in the course of this study were obtained from the localities and depths indicated below.

RONGERIK LAGOON

Sample	Depth (feet)	Latitude (N.)	Longitude (E.)
99	+3	11°23'10''	167°21'54''
102	+3	23'56''	29'00''
80	-74	23'02''	26'53''
56	-76	23'30''	27'40''
54	-85	23'35''	28'35''
91	-95	21'20''	23'06''
3	-101	22'34''	22'40''
31	-102	21'36''	25'44''
51	-111	22'32''	28'48''
12	-120	21'02''	24'05''
21	-127	21'55''	24'52''
70	-130	19'08''	26'36''
57	-138	22'57''	27'39''
18	-150	21'00''	24'48''
79	-150	22'36''	26'55''

RONGELAP ATOLL

Sample	Depth (fathoms)	Latitude (N.)	Longitude (E.)
<i>Inside lagoon:</i>			
B-74	Beach sandstone, lagoon beach, west end of Tufa Island.		
6	+½	11°13'43''	166°53'50''
483	-10	14'19''	38'17''
111	-13	25'00''	167°01'48''
348	-14	10'12''	166°50'20''
484	-16	14'18''	38'30''
71	-18	20'25''	55'00''
480	-20	14'08''	39'00''
76	-22	22'24''	57'02''
183	-24	11'30''	48'48''
133	-26	23'30''	56'21''
272	-28	20'13''	40'46''
30	-30	16'34''	51'48''
171	-32	14'32''	48'46''
<i>Outside lagoon:</i>			
468	-21	11°27'20''	166°43'43''
463	-32	27'37''	54'26''
456	-40	22'57''	167°01'18''
462	-49	26'42''	166°58'23''

BIKINI ATOLL

Sample	Depth (feet)	Latitude (N.)	Longitude (E.)
<i>Beach samples:</i>			
B-1	Beach rock, east center, Bikini Island.		
B-20	Sand from lagoon beach, north end, Bikini Island.		
B-58	Polished beach sandstone, lagoon side of sand bar, at west end of Uorikku Island, Bikini.		
B-105	Sand from "old reef zone" near middle of Bikini Island.		
734	Latitude 11°36'45'' N., Longitude 165°32'59'' E.		
<i>Reef flat samples:</i>			
B-23	Sand from reef flat, northwest end of Bikini Island (Traverse 28).		
B-52	Channel bottom, 6 feet, algal nodules from pools, Oruk Island, Bikini.		
B-72	Edge of pothole in reef, 100 yards from edge of reef, ¼ mile northwest of Beacon San, Bikini Island (Traverse 26).		
B-107	From a piece of living <i>Lithothamnion</i> , from landward edge of algal flat, 1 mile north of south end of Bikini Island.		
B-132	Sand scraped from surface of reef flat, from rock flat zone (Traverse 5), about ¼ mile north of Enyu Island, Bikini.		
B-135	Sand from inside edge of reef flat in shallow tidal pool, half way between Bikini and Aomoen Islands (Traverse 26).		
B-305	Picked from small cavities in surface reef rock, sea reef northeast of Bikini Island, 1,400 feet out from shore in 1 foot of water at low tide.		
<i>From inside of lagoon:</i>			
37	-11	11°36'45''	165°32'55''
33	-22	36'13''	32'42''
34	-35	36'12''	32'40''

Sample	Depth (feet)	Latitude (N.)	Longitude (E.)
<i>From inside of lagoon:</i>			
B-307	-35	From coral knoll in lagoon, top of knoll 35 feet under water, 1 mile north of Eninman Island, Bikini.	
473	-38	11°40'03''	165°21'27''
96	-46	36'59''	32'05''
149	-57	35'47''	32'13''
559	-64	33'58''	13'10''
190	-69	36'19''	31'40''
B-45	-72	Off Bikini Island about 1½ miles.	
B-46	-72	Off Bikini Island about 1½ miles.	
76	-85	11°36'16''	165°31'28''
401	-90	33'08''	16'14''
366	-97	34'00''	14'03''
384	-101	40'18''	15'22''
567	-104	34'58''	13'55''
938	-104	31'16''	27'27''
402	-105	32'40''	16'14''
356	-118	37'15''	13'34''
177	-119	36'37''	30'34''
569	-123	35'13''	14'12''
1052	-125	30'33''	29'18''
1055	-128	35'09''	24'32''
1012	-130	31'33''	19'33''
165	-132	36'29''	29'56''
1022	-134	31'30''	25'10''
576	-140	35'40''	15'25''
933	-145	30'52''	31'02''
460	-147	33'47''	21'27''
413	-148	35'05''	17'42''
444	-148	35'25''	22'57''
1116	-149	39'56''	23'50''
1056	-154	34'55''	19'56''
546	-155	35'08''	29'57''
1117	-157	39'18''	23'14''
580. 1	-158	35'37''	16'40''
423	-159	36'54''	17'42''
431	-160	40'24''	17'41''
573	-160	35'35''	14'44''
582	-160	35'30''	16'58''
218(0''-4'')	-161	35'23''	30'44''
218(12''-16'')			
1010	-163	32'24''	18'08''
1028	-164	34'38''	28'47''
1143	-165	35'25''	17'28''
326	-165	33'27''	24'48''
377	-171	37'14''	14'52''
482	-172	35'17''	20'20''
478	-176	37'52''	20'04''
462	-178	35'00''	21'22''
292	-179	33'45''	27'26''
443	-179	36'27''	22'39''
947	-179	33'47''	28'18''
245	-180	35'08''	27'50''
591	-180?	35'32''	18'02''
593	-180?	35'32''	18'26''
311	-184	35'19''	26'05''
445	-188	34'57''	22'48''

Sample	Depth (fathoms)	Latitude (N.)	Longitude (E.)
<i>From outer slopes:</i>			
<i>Dredge samples:</i>			
1478	-13-8	11°31'52''	165°32'53''
1493	-21-25	29'26''	32'00''
1461	-44-25	38'26''	31'43''
1458	-48-33	29'06''	20'52''
1460	-91-58	38'27''	31'46''
<i>Bottom samples:</i>			
815	-55	11°34'44''	165°33'40''
812	-80	29'31''	32'19''
817	-114	35'06''	33'34''
814	-136	29'18''	30'59''
816	-219	35'53''	33'30''
1173(0''-1'')	-240	40'40''	14'05''
1173(1''-3'')			
1173(3''-5'')			
1173(5''-7'')			
1173(7''-9'')			
819	-315	35'53''	33'30''
818	-500	35'42''	33'52''
830	-710	50'30''	164°56'00''
<i>Guyot samples:</i>			
1174(1''-2'')	-410	11°41'00''	165°14'01''
1174(4''-6'')			
1174(6''-8'')			
1174(8''-10'')			
1174(10''-14'')			
1175	-592	42'33''	12'45''
1175(0''-1'')	-592	42'33''	12'45''
1175(1''-2'')			
1175(2''-3'')			
1175(3''-4'')			
1175(4''-5'')			
1176(0''-1'')	-720	44'47''	09'56''
1176(1''-2'')			
1176(2''-3'')			
1176(5''-7'')			
1169	-710	48'00''	01'52''
1170(0''-1'')	-680	48'20''	01'27''
1170(1''-2'')			
1170(2''-4'')			
1170(4''-6'')			
1172	-835	47'35''	164°59'20''

ENIWETOK LAGOON

Sample	Depth (fathoms)	Latitude (N.)	Longitude (E.)
10	+0.5	11°21'15''	162°12'30''
11	+ .5	32'53''	21'35''
120	+ .5	33'30''	21'35''
231	-9	20'33''	15'50''
336	-10	30'57''	22'00''
332	-12	31'42''	21'17''
286	-16	22'13''	12'28''
287	-18	22'20''	12'33''
288	-20	22'29''	12'41''
289	-22	22'38''	12'50''
290	-22	22'49''	12'59''
293	-23	23'24''	13'30''

Sample	Depth (fathoms)	Latitude (N.)	Longitude (E.)
329	-23	31'40''	20'53''
218	-24		
291	-24	22'59''	13'08''
292	-24	23'11''	13'19''
296	-24	24'16''	14'10''
145	-24	27'19''	16'25''
326	-24	31'15''	20'27''
328	-24	31'29''	20'41''
295	-26	24'02''	14'00''
298	-26	24'41''	14'28''
321	-26	30'16''	19'35''
323	-26	30'36''	19'54''
299	-27	24'54''	14'39''
305	-27	26'37''	15'46''
325	-27	31'03''	20'16''
310	-28	27'55''	17'13''
317	-28	29'08''	18'33''
318	-28	29'28''	18'53''
320	-28	29'57''	19'18''
324	-28	30'51''	20'05''
300	-29	25'07''	14'50''
301	-29	25'29''	15'08''
302	-30	25'41''	15'15''
307	-30	27'07''	16'10''
312	-30	28'18''	17'37''
313	-30	28'30''	17'49''
314	-30	28'38''	18'00''
316	-30	28'59''	18'23''
322	-30	30'23''	19'45''
151	-30	27'55''	15'58''
303	-31	25'55''	15'20''
304	-32	26'08''	15'28''
306	-32	26'49''	15'55''
311	-32	28'05''	17'23''
183	-34	33'26''	15'30''
49	-34	32'00''	17'47''

## OUTER SLOPES OF ENIWETOK ATOLL

Sample	Depth (fathoms)	Latitude (N.)	Longitude (E.)
118	-24	11°20'06''	162°16'19''
117	-88	19'43''	16'24''
116	-173	19'35''	16'37''
115	-214	19'30''	16'40''
119	-500	18'52''	15'24''

## SYSTEMATIC DESCRIPTIONS

## Family SACCAMMINIDAE

## Genus PROTEONINA Williamson, 1858

## Proteonina sp.

## Plate 83, figure 1

A few specimens occur singly or very rarely in several samples at Bikini, Eniwetok, and Rongelap. The test is large, elongate, compressed, and smooth on the surface, being composed of large, flat fragments, sometimes tests of other Foraminifera, and considerable cement. There is a distinct, slender neck. The specimens from

Rongelap are composed of somewhat smaller fragments than those from Eniwetok. The one from Bikini is rough on the surface and may be different.

The species does not seem to have been previously described, but present material is inadequate for description. The species shows a definite selective power in choosing large, flat fragments for the construction of its test. In this it may be compared to *P. micacea* Cushman (1918, p. 49, pl. 19, figs. 6, 7) but the present species has a much smoother surface and regular shape.

## Family HYPERAMMINIDAE

## Genus SAGENINA Chapman, 1900

*Sagenina frondescens* (H. B. Brady)

*Sagenella frondescens* Brady, Quart. Jour. Micros. Sci., v. 19, p. 41, pl. 5, fig. 1, 1879; *Challenger* Rept., Zoology, v. 9, p. 278, pl. 28, figs. 14, 15, 1884.

*Sagenina frondescens* Chapman, Linnean Soc. Jour., Zoology, v. 28, p. 4, pl. 1, figs. 1, 2; pl. 2, figs. 1, 2, 1899.

Cushman, U. S. Natl. Mus. Bull. 100, v. 4, p. 60, pl. 9, fig. 1; pl. 14, fig. 1, 1921.

The species is found in abundance attached to *Halimeda* fronds at Bikini 1493 dredged on the outer slopes of Bikini at 125 to 150 feet. It also occurs attached to large specimens of *Cycloclypeus carpenteri* H. B. Brady obtained by dredging on the outer slopes of Bikini from 800 to 580 feet.

## Family AMMODISCIDAE

## Genus AMMODISCUS Reuss, 1861

*Ammodiscus incertus* (D'Orbigny)

*Operculina incerta* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 49, pl. 6, figs. 16, 17, 1839.

*Ammodiscus incertus* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 330, pl. 38, figs. 1-3, 1884.

Cushman, U. S. Natl. Mus. Bull. 104, pt. 1, p. 9, pl. 39, 1918; Bull. 100, v. 4, p. 62, pl. 5, figs. 1, 2, 1921.

A single megalospheric specimen was found at Bik 1176 (5-7').

## Family TEXTULARIIDAE

## Genus TEXTULARIA DeFrance, 1824

*Textularia agglutinans* D'Orbigny

## Plate 83, figure 2

*Textularia agglutinans* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 144, pl. 1, figs. 17, 18, 32-34, 1839.

This species was described from shore sands of Cuba and is a common species in the warmer, shallow waters of both the Atlantic and Pacific. The specimens in the present material have more chambers and a more rapid increase in thickness than the typical form.

*Textularia candeiiana* D'Orbigny

Plate 83, figure 3

*Textularia candeiiana* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 143, pl. 1, figs. 25-27, 1839.

The types of this species are from the Atlantic in the West Indian region but it has been recorded from shallow, warm waters of the Pacific and in some localities in deeper water.

Comparison between *T. candeiiana* and *T. agglutinans* shows the following points of distinction: *T. candeiiana* is more inflated and globular toward the later chambers and has a more tapering form, with very indistinct early chambers. *T. agglutinans* is of more even width and thickness nearly throughout and the chambers are higher and more distinct in the early part.

*Textularia conica* D'Orbigny

Plate 83, figure 4

*Textularia conica* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 143, pl. 1, figs. 19, 20, 1839.

This is evidently a species of shallow, warm waters. It is distinguished by its concave and nearly circular apertural face.

*Textularia dupla* Todd, n. sp.

Plate 83, figure 6

Test compressed, about as broad as or broader than long, triangular in side view, apertural faces flattened or slightly concave, except convex in the young stages, periphery subacute, irregularly serrate; chambers indistinct, low, broad, much overlapping, later ones becoming slightly inflated; sutures indistinct in the early part, later becoming depressed, nearly horizontal; wall thin, finely granular, somewhat rough on the surface; aperture a low, arched slit at the base of the last-formed chamber bordered by an inconspicuous rim. Length 0.42 to 0.60 mm, breadth 0.40 to 0.80 mm, thickness 0.25 to 0.45 mm.

Holotype (USNM 548609) from Bikini lagoon, 179 feet, 11°33'45" N., 165°27'26" E. (Bik 292).

This species resembles *T. semialata* Cushman but differs in its much broader form, its rougher surface, and the apertural end depressed instead of inflated. It also somewhat resembles *T. abbreviata* D'Orbigny (1846, p. 249, pl. 15, figs. 7-12) but differs in its more numerous, lower, and broader chambers, in the test increasing steadily in breadth as growth proceeds, and in the very fine texture of its wall.

*Textularia foliacea* Heron-Allen and Earland

Plate 83, figure 7

*Textularia foliacea* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, pt. 2, p. 628, pl. 47, figs. 17-20, 1915.

This is a common species in shallow water of the Indo-Pacific area and has been widely recorded in coral-reef regions.

*Textularia foliacea* var. *oceanica* Cushman

Plate 83, figure 8

*Textularia foliacea* Heron-Allen and Earland, var. *oceanica* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 8, pl. 1, figs. 11, 12, 1932.

This variety differs from the typical form in being thicker and narrower, with higher chambers, and in having a rougher surface. It is considerably more abundant in the Marshall Islands than the typical form.

*Textularia kerimbaensis* Said

Plate 83, figure 11

*Textularia conica* D'Orbigny var. *corrugata* Heron-Allen and Earland (not *T. corrugata* Costa), Zool. Soc. London Trans., v. 20, p. 629, pl. 47, figs. 24-27, 1915.

*Textularia corrugata* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 12, pl. 3, figs. 2, 4, 1932.

*Textularia kerimbaensis* Said, Cushman Lab. Forum. Research Special Pub. 26, p. 6, pl. 1, fig. 8, 1949.

Rare specimens were found in three Bikini samples. The species is distinguished by its broad, low chambers and deeply incised sutures.

*Textularia milletti* Cushman

*Textularia milletti* Cushman, U. S. Natl. Mus. Bull. 71, pt. 2, p. 13, text figs. 18, 19, 1911.

*Spiroplectammina milletti* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 7, pl. 1, fig. 5, 1932.

Test compressed, wedge-shaped, periphery of early portion acute in edge view, broadly rounded in side view; later portion very slightly tapering and gradually increasing in thickness to the truncate apertural end; chambers indistinct, low, broad, slightly curved; sutures distinct except in some specimens where they are obscured by the coarse texture of the wall surface, depressed and slightly curved; wall arenaceous, in most specimens very roughly finished; aperture a low, short opening in a reentrant at the base of the apertural face. Length about 1.2 mm, breadth about 0.75 mm, thickness about 0.50 mm.

The above description applies to specimens from Bikini and Eniwetok that have been compared and seem to be identical with types and other specimens of this species from deep water (323 to 891 fathoms) from several localities in the Pacific.

In the Marshall Islands, this species is found commonly at four Bikini stations between 592 and 720 fathoms and at Eni 119 in 500 fathoms.

In the distribution chart this species was not distinguished from *Textularia foliacea* Heron-Allen and Earland, and the two were therefore plotted as one species. Actually, the deepest occurrence of *T. foliacea* is 136 fathoms at Bik 814 on the outer slope of the atoll.

The two species are, however, distinguishable both on the basis of shape of the test and surface of the wall, as follows: *T. foliacea* has a thicker, less wedge-shaped test than *T. milletti*, tapering gradually from the initial end, with fewer and higher chambers showing indentation along the periphery. *T. milletti* has a much rougher finish than *T. foliacea*.

The restricted occurrence of *T. milletti* to deep water, as well as that of *T. foliacea* to shallow water, makes these two species of value as ecologic indicators.

**Textularia semialata Cushman**

Plate 83, figure 5

*Textularia semialata* Cushman, U. S. Natl. Mus. Proc., v. 44, p. 634, pl. 80, figs. 6, 7, 1913; Bull. 100, v. 4, p. 116, pl. 24, figs. 2, 3, 1921; Bull. 161, pt. 1, p. 9, pl. 2, figs. 1-3, 1932.

Test compressed throughout, rapidly broadening, triangular in side view, periphery slightly indented, subacute on the earlier chambers, later becoming rounded; chambers much overlapping thus appearing very narrow on the surface, later chambers lightly inflated; but distinctly granular, very smoothly finished; aperture an arched opening at the base of the last formed chamber, with a distinct overhanging lip.

This species, originally described from the Philippines and known from the Tropical Pacific occurs in several samples at Bikini and Rongelap. It is distinctive in its overhanging apertural lip and its very thin, smooth wall.

**Genus SIPHOTEXTULARIA Finlay, 1939**

*Siphotextularia* cf. *S. concava* (Karrer)

Plate 83, figure 9

*Plecanium concavum* Karrer, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber., Band 58, pt. 1, p. 129, pl. 1, fig. 3, 1868.

A very few specimens from two stations at Bikini seem very close to this species described from the Miocene of Hungary and widely recorded in the Recent seas.

*Siphotextularia crispata* (H. B. Brady)

Plate 83, figure 10

*Textularia crispata* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 359, pl. 113, fig. 2, 1884.

Test elongate, quadrangular in section with the sides slightly concave, compressed, plane of the test twisted

through about 90°, initial end acute, apertural end rounded, periphery truncate with acute and limbate angles, periphery serrate in side view, especially along the later chambers; chambers rather indistinct, not inflated but on the contrary appearing somewhat collapsed; sutures rather distinct, curved, limbate and slightly raised; wall very thin, translucent in the middle of the chambers, very finely granular, smoothly finished; aperture terminal, a narrow slit placed at an angle to the suture which separates the apertural faces of the two last-formed chambers, surrounded by a slight, raised rim. Length 0.52 to 0.72 mm; breadth 0.30 to 0.40 mm; thickness 0.17 to 0.25 mm.

Topotypes of Brady's species from 155 fathoms, off Raine Island, Torres Strait, indicate this species belongs in *Siphotextularia*.

It differs from *S. concava* (Karrer) in its twisted test, its less distinctly concave faces, and its very delicate, translucent wall.

**Genus BIGENERINA D'Orbigny, 182°**

*Bigenerina* sp.

Plate 83, figure 12

A few specimens of this genus were found in one Eniwetok and two Bikini samples, all from deep water. They seem to be different from any described species but are too rare to warrant description. The textularian portion is relatively broad and rather strongly compressed, and the chambers of the uniserial portion are indistinct and tend to decrease in diameter with growth. The aperture is protuding and surrounded by a raised rim.

**Family VERNEUILINIDAE**

**Genus GAUDRYINA D'Orbigny, 1839**

*Gaudryina flintii* Cushman

*Gaudryina subrotundata* Flint (not *G. subrotundata* Schwager), U. S. Natl. Mus. Rept. for 1897, p. 287, pl. 3, fig. 1, 1899.  
*Gaudryina rugosa* Goës (not *G. rugosa* D'Orbigny), Mus. Comp. Zool. Bull., v. 29, p. 39, 1896.  
*Gaudryina flintii* Cushman, U. S. Natl. Mus. Bull. 71, pt. 2, p. 63, text figs. 102a-c, 1911; Cushman Lab. Focam. Research Special Pub. 7, p. 62, pl. 10, figs. 18-20, 1937.

This large, deep-water species occurs rarely in the guyot samples.

*Gaudryina* cf. *G. pauperata* Earland

Plate 83, figure 13

*Gaudryina pauperata* Earland, *Discovery* Repts., v. 10, p. 121, pl. 5, figs. 47-49, 1934.

A few specimens occurring rarely in several samples from Eniwetok are somewhat similar to this minute species described from the Antarctic. They are slightly

larger, 0.28 to 0.32 mm in length, are composed of very coarse fragments for the size of the test, the axis of the test is usually slightly curved, and the last two chambers are distinctly inflated.

**Gaudryina triangularis var. angulata Cushman**

Plate 83, figure 14

*Gaudryina triangularis* Cushman var. *angulata* Cushman, Carnegie Inst. Washington Pub. 342, p. 22, 1924; Bernice P. Bishop Mus., Bull. 27, p. 125, 1925 (1926); U. S. Natl. Mus. Bull. 161, pt. 1, p. 14, pl. 3, figs. 7a, b, 1932; Cushman Lab. Foram. Research Special Pub. 7, p. 66, pl. 10, figs. 14a, b, 1937.

Although specimens exhibit considerable variation in shape, the variety is distinguished by its square end view and its rough and coarse surface. It occurs at Eniwetok, Bikini, and Rongelap.

**Gaudryina trullissata Todd, n. sp.**

Plate 83, figure 15

Test small for the genus, tapering, and wedge-shaped initial end acute, triserial portion almost indistinguishable in some specimens, apertural end truncate, periphery broadly rounded in end view, irregularly serrate in side view; chambers indistinct in the early portion, low and broad in the later portion, projecting laterally outward; sutures indistinct except toward the periphery and in the later portion where they are deeply depressed; wall formed of very coarse, ill-sorted fragments, very roughly finished; aperture a narrow, low, arched opening at the base of the apertural face of the last-formed chamber, with a slight rim. Length 0.50 to 0.60 mm, breadth 0.25 to 0.35 mm; thickness 0.20 to 0.25 mm.

Holotype (USNM 548622) from Bikini atoll, 55 fathoms, 11°34'44" N., 165°33'40" E. (Bik 815).

This species differs from *G. quadrangularis* Bagge (1908, p. 133, pl. 5, fig. 1) in its very much smaller size, greater compression and less distinct triserial portion.

**Subgenus SIPHOGAUDRYINA Cushman, 1935**

**Gaudryina (Siphogaudryina) rugulosa Cushman**

Plate 82, figure 1

*Gaudryina rugulosa* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 15, pl. 4, figs. 1a, b, 1932.

*Gaudryina (Siphogaudryina) rugulosa* Cushman, Cushman Lab. Foram. Research Special Pub. 7, p. 84, pl. 12, figs. 11, 12, 1937.

*Textularia rugosa* H. B. Brady (not Reuss), *Challenger* Rept., Zoology, v. 9, p. 363, pl. 42, figs. 23, 24, 1884.

In our specimens the periphery is acute throughout and the lobes are very prominent. This species seems closely related to *G. (S.) rhodiensis* Cushman

(1936, p. 12, pl. 2, figs. 9a, b) from the Pliocene of the Isle of Rhodes but that species is less broadly tapering.

**Gaudryina (Siphogaudryina) siphonifera (H. B. Brady)**

Plate 83, figure 17

*Textularia siphonifera* H. B. Brady, *Quart. Jour. Micros. Sci.*, v. 21, p. 53, 1881; *Challenger* Rept., Zoology, v. 9, p. 362, pl. 42, figs. 25-29, 1884.

*Gaudryina siphonifera* Cushman, Cushman Lab. Foram. Research Contr., v. 4, p. 109, pl. 16, figs. 1-5, 1928.

*Gaudryina (Siphogaudryina) siphonifera* Cushman, Cushman Lab. Foram. Research Special Pub. 7, p. 83, pl. 12, figs. 9, 10, 1937.

This species is common in the Rongelap samples, but no specimens were found at any of the other islands. Some specimens are well enough preserved to show the closed ends of the tubes.

**Gaudryina (Siphogaudryina) transversaria (H. B. Brady)**

Plate 83, figure 16

*Textularia transversaria* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 359, pl. 113, figs. 3-5, 1884.

*Gaudryina (Siphogaudryina) transversaria* Said, Cushman Lab. Foram. Research Special Pub. 26, p. 8, pl. 1, fig. 12, 1949.

Test small for the genus, strongly compressed, triserial portion very small and inconspicuous, rapidly increasing in width in the early part, later part of equal width or slightly decreasing, periphery irregularly serrate in side view, narrowly truncate in end view due to the broken-off peripheral extensions of the chambers; chambers numerous, indistinct in the early part, low, broad, not inflated; sutures indistinct in the early part, later ones horizontal, straight, slightly depressed; wall very thin usually translucent in the central part of the chambers, very finely granular, very smoothly finished; aperture a narrow, low, arched opening at the base of the apertural face of the last-formed chamber. Length 0.35 to 0.55 mm, breadth 0.20 to 0.27 mm, thickness 0.07 to 0.10 mm.

The species occurs rarely at Bikini and more commonly at Rongelap.

**Family VALVULINIDAE**

**Genus VALVULINA D'Orbigny, 1826**

**Valvulina davidiana Chapman**

Plate 82, figure 2

*Valvulina davidiana* Chapman, *Linnean Soc. Jour., Zoology*, v. 28, p. 9, pl. 1, fig. 4; p. 207 (list), 1900; idem, p. 382, 386 (lists), 1902.

Cushman, Cushman Lab. Foram. Research Special Pub. 8, p. 11, pl. 2, figs. 6, 7, 1937.

Test triangular, chambers triserially arranged and forming a more or less equilateral cone; aperture situated in a subrescentic



depression, with a tooth-like valve projecting across, and sometimes a secondary one nearly meeting from the opposite side. Texture somewhat coarsely arenaceous, composed of calcareous particles; colour white to pale cream. Length  $\frac{1}{2}$  inch (1 mm.).—Chapman, 1900.

The few records for this species are from shallow warm water of the Pacific including the lagoon of Rongelap Atoll, Marshall Ids.

Genus **CLAVULINA** D'Orbigny, 1826

*Clavulina angularis* D'Orbigny

Plate 83, figure 18

*Clavulina angularis* D'Orbigny, Annales sci. nat., v. 7, p. 268, pl. 12, fig. 7, 1826.  
Cushman, Cushman Lab. Foram. Research Special Pub. 8, p. 19, pl. 2, figs. 29–33, 1937.

Test elongate, sides nearly parallel in the adult, earlier portion triserial, later uniserial, triangular in transverse section, except for last-formed portion, which is rounded; chambers distinct, not inflated except the final one or two; sutures distinct, slightly depressed, especially toward the apertural end; wall arenaceous, rather roughly finished; aperture terminal, rounded, with a distinct, valvular tooth.

The species occurs rarely at Eniwetok and Rongelap.

*Clavulina pacifica* Cushman

Plate 83, figure 19

*Clavulina pacifica* Cushman, Carnegie Inst. Washington Pub. 342, p. 22, pl. 6, figs. 7–11, 1924; U. S. Natl. Mus. Bull. 161, pt. 1, p. 16, pl. 4, figs. 4, 7, 9, 1932.  
*Clavulina angularis* H. B. Brady (part, not D'Orbigny), Challenger Rept., Zoology, v. 9, p. 396, pl. 48, figs. 22–24, 1884.

This Indo-Pacific species has a rather wide distribution. One specimen from Rongerik and a single fragment from Bikini seem to belong to this species. The texture of the wall is much smoother and the sutures not so deeply excavated as in *C. angularis* D'Orbigny.

Genus **KARRERIELLA** Cushman, 1933

*Karreriella bradyi* (Cushman)

Plate 83, figure 20

*Gaudryina pupoides* H. B. Brady (not D'Orbigny), Challenger Rept., Zoology, v. 9, p. 378, pl. 46, figs. 1–4, 1884.  
*Gaudryina bradyi* Cushman, U. S. Natl. Mus. Bull. 71, pt. 2, p. 67, figs. 107a–c (in text), 1911.  
*Karreriella bradyi* Cushman, Cushman Lab. Foram. Research Special Pub. 8, p. 135, pl. 16, figs. 6–11, 1937.

A few specimens from Bikini seem to belong to this species, which is widely known in Recent seas and as a fossil in the late Tertiary.

Genus **SCHENCKIELLA** Thalmann, 1942

*Schenckiella primaeva* (Cushman)

*Clavulina primaeva* Cushman, U. S. Natl. Mus. Proc., v. 44, p. 635, pl. 80, figs. 4, 5, 1913; idem, Bull. 100, v. 4, p. 158, pl. 30, figs. 2, 3, 5–7, 1921.  
*Listerella primaeva* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 36, pl. 4, figs. 5a, b, 1937; idem, Special Pub. 8, p. 153, pl. 17, figs. 24–28, 1937.  
*Schenckiella primaeva* Cushman, Cushman Lab. Foram. Research Special Pub. 8A, p. 53, 1947.

This species described from deep water off Borneo occurs fairly commonly in the guyot samples.

Family **MILIOLIDAE**

Genus **QUINQUELOCULINA** D'Orbigny, 1826

*Quinqueloculina anguina* var. *arenata* Said

Plate 83, figure 21

*Miliolina anguina* (Terquem) var. *agglutinans* Wiesner (not *Quinqueloculina agglutinans* D'Orbigny), in Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, p. 575, 1915.  
*Quinqueloculina anguina* Terquem var. *agglutinans* Cushman, Carnegie Inst. Washington Pub. 342, p. 60, pl. 22, figs. 5, 6, 1924; U. S. Natl. Mus. Bull. 161, pt. 1, p. 18 pl. 5, figs. 1a–c, 1932.  
*Quinqueloculina anguina* Terquem var. *arenata* Said, Cushman Lab. Foram. Research Special Pub. 26, p. 9, pl. 1, fig. 25.

From the records this is evidently a common species in warm, shallow waters of the Indo-Pacific area. Some of our specimens are not very noticeably arenaceous, probably because only fine sediment was available for test building.

*Quinqueloculina bidentata* D'Orbigny

Plate 83, figure 31

*Quinqueloculina bidentata* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'Ile de Cuba, Foraminifères, p. 197, pl. 12, figs. 18–20, 1839.

This species was described from shore sands of Cuba. The Pacific specimens seem to be enough like the Atlantic ones to be included under this name. The apertural tooth is not bidentate, as shown in the type figure, but platelike. In our series of specimens there is great variation in size and also in the sharpness of the peripheral angles. In some specimens the periphery is almost smoothly rounded.

Some specimens with a short-necked, compressed, and flaring aperture are included here but may be distinct. They seem to be smaller, thinner-walled, more compressed, and have a pebbly surface.

*Quinqueloculina bradyana* Cushman

Plate 83, figure 26

*Miliolina undosa* H. B. Brady (not *Quinqueloculina undosa* Karrer), Challenger Rept., Zoology, v. 9, p. 176, pl. 6, figs. 6–8, 1884.  
*Quinqueloculina bradyana* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 52, pl. 18, figs. 2a–c, 1917.

A very few specimens similar to that figured were found at Bikini and Rongelap.

*Quinqueloculina crassa* var. *subcuneata* Cushman

Plate 83, figure 22

*Miliolina crassa* Heron-Allen and Earland (part, not D'Orbigny), Zool. Soc. London Trans., v. 20, pt. 2, p. 572, pl. 42, fig. 41 (not figs. 37-40), 1915.

*Quinqueloculina crassa* D'Orbigny var. *subcuneata* Cushman, U. S. Natl. Mus. Bull. 100, v. 4, p. 423, pl. 89, figs. 4a-c, 1921; idem, Bull. 161, pt. 1, p. 21, pl. 5, figs. 8a-c, 1932.

Numerous specimens in our material seem identical with this variety which is widely distributed, particularly in the Indo-Pacific region. There is considerable variation in strength of the ornamentation. The wall is more highly polished than in *Q. neostriatula* Thalmann and the costae are raised. In *Q. neostriatula* the wall is finely roughened, although shining, and the ornamentation consists of fine, incised striae.

*Quinqueloculina distortata* Cushman, n. sp.

Plate 83, figure 27

Test nearly as broad as long, initial end bluntly pointed, apertural end with a short, slender neck, periphery acute or slightly keeled, irregularly curved; chambers much compressed, distinct, enlarging rather rapidly as added, distorted in shape; sutures indistinct except for the keel of the preceding chamber; wall slightly roughened, with the sinuous keel of previous chambers making an irregular raised pattern; aperture small, rounded, at the end of a short and very slender neck, with a slight lip, usually without a definite apertural tooth. Length 0.65 to 0.80 mm, breadth 0.45 to 0.65 mm.

Holotype, USNM 548545, from Rongerik lagoon, 150 feet, 11°22'36" N., 167°26'55" E. (Rik 79).

This species is very common in certain samples from all the islands. They somewhat resemble forms referred to *Quinqueloculina berthelotiana* D'Orbigny (Cushman, 1932, p. 19, pl. 5, figs. 2-4), but have a much more irregular form of the chambers which are sub-acute or keeled. This species differs from *Q. samoensis* Cushman in its higher, sharper keels which make the test appear more twisted.

*Quinqueloculina* cf. *Q. ferussacii* D'Orbigny

Plate 83, figure 30

A few specimens of moderate size and closely approaching the triloculine stage are questionably assigned to this species. They are elongate, with a moderately prominent neck, but without a lip, compressed, and are rather irregularly and variably ornamented with two or more costae on the periphery. The surface of the wall is matte rather than polished.

This form is found only at Bikini and Eniwetok.

*Quinqueloculina neostriatula* Thalmann

Plate 83, figure 28

*Quinqueloculina striatula* Cushman (not Deshayes, 1831) U. S. Natl. Mus. Bull. 161, pt. 1, p. 27, pl. 7, figs. 3, 4, 1932.

*Quinqueloculina neostriatula* Thalmann, Cushman Found. Foram. Research Contr., v. 1, p. 45, 1950.

The types of this species are from Mokaujar Anchorage, Fiji Islands, and it seems to be widely distributed in shallow, warm waters of the South Pacific.

The ornamentation consists of fine incised lines, not costae, and the angles of the chambers are sharp. The aperture is a hood-like opening, not terminal and circular with a neck, although some specimens do have a neck.

*Quinqueloculina parkeri* (H. B. Brady)

Plate 83, figure 23

"*Quinqueloculina* with oblique ridges" Parker, Trans. Micros. Soc. London, v. 6, p. 57, pl. 5, fig. 10, 1858.

*Miliolina parkeri* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 46, 1881; *Challenger* Rept., Zoology, v. 9, p. 177, pl. 7, fig. 14, 1884.

*Quinqueloculina parkeri* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 50, pl. 15, fig. 3, 1917; idem, Bull. 161, pt. 1, p. 25, pl. 6, figs. 3, 4, 1932.

This is a species of warm, shallow waters of the Indo-Pacific area. It is found rarely at all the atolls.

*Quinqueloculina parkeri* (H. B. Brady) var.

Plate 83, figure 24

A few specimens from all the islands differ from the typical form in the ornamentation being less distinct and consisting of fewer, coarser ridges, usually present only on the central part of the test.

*Quinqueloculina* cf. *Q. samoensis* Cushman

Plate 83, figure 25

*Quinqueloculina samoensis* Cushman, Carnegie Inst. Washington Pub. 342, p. 59, pl. 21, figs. 4-7, 1924; U. S. Natl. Mus. Bull. 161, pt. 1, p. 26, pl. 7, figs. 1a-c, 1932.

A few specimens from Eniwetok seem close to this species described from 17 fathoms at Samoa. They are slightly smaller and most of them do not have as elongate an apertural neck.

*Quinqueloculina* cf. *Q. seminulum* (Linné)

Plate 83, figure 29

A very few small specimens from all the islands similar to that figured, are referred to this widely recorded species. The wall is smooth and polished. They seem to be too large to be the nepionic or quinqueloculine stage of *Triloculina* cf. *oblonga* (Montagu), although otherwise they resemble that species.

**Quinqueloculina sulcata D'Orbigny**

Plate 84, figures 1, 2

*Quinqueloculina sulcata* D'Orbigny, Annales sci. nat., v. 7, p. 301, no. 17, 1826.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 28, pl. 7, figs. 5-8, 1932.

The types of this species are from the Red Sea and it is recorded from a number of localities in warm, shallow waters about certain Pacific Islands.

The texture of the wall and the height and straightness of the ridges vary considerably. A group of specimens from Eniwetok are much more flattened than the more typical forms, but for the present are included in this species.

**Genus MILIOLINELLA Wiesner, 1931***Miliolinella australis* (Parr)

Plate 84, figures 3, 4

*Quinqueloculina australis* Parr, Royal Soc. Victoria Proc., v. 44, p. 7, pl. 1, fig. 8, 1932.

Test small for the genus, nearly circular, compressed, periphery subacute; chambers strongly curved, not inflated; sutures indistinct, curved, slightly depressed; wall thin, translucent in the middle portions of the chambers, surface very finely marked with faint, incised, longitudinal lines; aperture a high, arched opening with a slight lip, nearly closed by a projecting plate in front of the opening. Length and breadth both about 0.30 mm; thickness 0.15 to 0.20 mm.

This species was described from 7 miles east of Cape Pillar, Tasmania, in 100 fathoms and has been recorded from other localities off Australia.

A few specimens are considerably larger than the average but these appear to be the same, as they have the typical wall texture which is a good distinguishing feature of this species. The projecting plate in front of the aperture is frequently broken away but when present, the test shows in side view a rather deep slot between the aperture and the plate.

*Miliolinella oceanica* (Cushman)*Triloculina oceanica* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 54, pl. 12, figs. 3a-c, 1932.

A few typical specimens of this species which apparently belongs in *Miliolinella* were found in two Bikini samples.

*Miliolinella oceanica* (Cushman), var. *flintiana* (Cushman)*Triloculina oceanica* Cushman, var. *flintiana* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 55, pl. 12, figs. 4a-c, 1932.

A single specimen was found in Rongerik sample 54.

**Genus TRILOCULINELLA Riccio, 1950***Triloculinella labiosa* (D'Orbigny)

Plate 84, figures 5, 6

*Triloculina labiosa* D'Orbigny, in De la Sagra Histoire physique' politique et naturelle de l'Ile de Cuba, Foraminifères, p. 178, pl. 10, figs. 12-14, 1839.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 53, pl. 11, figs. 12a-c, 1932.

*Miliolina labiosa* H. B. Brady, Challenger Rept., Zoology, v. 9, p. 170, pl. 6, figs. 3-5, 1884.

Numerous specimens are found in most of the samples. This genus bears the same relationship to *Miliolinella* as *Triloculina* does to *Quinqueloculina*.

**Genus MASSILINA Schlumberger, 1893***Massilina planata* Cushman

Plate 84, figure 16

*Massilina planata* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 31, pl. 8, figs. 8a, b, 1932.

A few typical specimens were found at Eniwetok, Bikini, and Rongelap.

**Genus SPIROLOCULINA D'Orbigny, 1826***Spiroloculina acescata* Cushman*Spiroloculina grateloupi* D'Orbigny, var. *acescata* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 35, pl. 9, fig. 2, 1932.*Spiroloculina acescata* Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 58, pl. 8, figs. 11, 12, 1944.*Spiroloculina planissima* Heron-Allen and Earland (not Lamarek), Zool. Soc. London Trans., v. 20, p. 556, pl. 41, figs. 1-5, 1915.

A single specimen of this species known from the Fiji Islands was found at Eniwetok 310.

*Spiroloculina aequa* Cushman*Spiroloculina antillarum* D'Orbigny, var. *aequa* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 38, pl. 9, fig. 13, 1932.*Spiroloculina aequa* Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 59, pl. 8, figs. 13-15, 1944.

A few typical specimens of this species described from inside the lagoon, Pinaki Atoll, Paumotu Ids., were found at Rongelap 111.

*Spiroloculina angulata* Cushman

Plate 84, figures 11, 12

*Spiroloculina grata* Terquem, var. *angulata* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 36, pl. 7, fig. 5, 1917.*Spiroloculina antillarum* D'Orbigny, var. *angulata* Cushman (part), U. S. Natl. Mus. Bull. 100, v. 4, p. 408, pl. 81, fig. 5, 1921; idem, Bull. 161, pt. 1, p. 37, pl. 9, figs. 6-9, 1932.*Spiroloculina angulata* Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 50, pl. 7, figs. 18-22, 1944.*Spiroloculina grata* H. B. Brady (not Terquem), Challenger Rept., Zoology, v. 9, p. 155, pl. 10, figs. 16, 17, 22, 23, 1884.

The types of this species are from off Cebu, Philippine

Islands. It is widely distributed in shallow, warm water of the Indo-Pacific.

The larger forms normally have a prominent ridge along the center of the periphery while the smaller ones have a flat and truncate periphery, and usually less distinct ornamentation. Both forms are figured. We believe the larger forms are microspheric and the much more abundant smaller ones are megalospheric.

*Spiroloculina circularis* Chapman

Plate 84, figure 7

*Spiroloculina dorsata* Reuss, var. *circularis* Chapman, Biol. Results *Endeavour*, v. 3, pt. 1, p. 7, pl. 1, fig. 1, 1915.

*Spiroloculina circularis* Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 49, pl. 7, figs. 15, 16, 1944.

A very few specimens of this species were found in three of the deep Bikini samples. It is a very small form, nearly circular in outline except for the basal and apertural ends of the last chamber which are protruding. The test is composed of very few chambers, rapidly increasing in size and thickness at the periphery which is truncate and bluntly keeled. The apertural neck is much contracted and has a slight phialine lip.

*Spiroloculina clara* Cushman

Plate 84, figure 9

*Spiroloculina clara* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 40, pl. 10, figs. 4, 5, 1932.

The types of this species were from Rongelap Atoll, and it has been found at other localities in the Pacific. It is the most abundant and widespread species of this genus in the Marshall Islands.

*Spiroloculina clara* var. *lirata* Cushman, n. var.

Plate 84, figure 10

Variety differing from the typical form in the adult having an expanded periphery with raised ridges and the entire surface of the chambers more or less costate longitudinally.

Holotype, USNM 548477, from Rongerik lagoon, 102 feet, 11°21'36" N., 167°25'44" E. (Rik 31).

*Spiroloculina communis* Cushman and Todd

Plate 84, figure 13

*Spiroloculina communis* Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 63, pl. 9, figs. 4, 5, 7, 8, 1944.

*Spiroloculina excavata* H. B. Brady (not D'Orbigny), *Challenger* Rept., Zoology, v. 9, p. 151, pl. 9, figs. 5, 6, 1884.

*Spiroloculina impressa* H. B. Brady (not Terquem), *idem*, p. 151, pl. 10, figs. 3, 4, 1884.

*Spiroloculina grateloupi* Cushman (not D'Orbigny), U. S. Natl. Mus. Bull. 161, pt. 1, p. 34, pl. 8, figs. 10, 11 (not fig. 9), 1932.

A few specimens occur at Eniwetok, Bikini, and

Rongelap. They are rather rough-surfaced and not as large as the types.

*Spiroloculina corrugata* Cushman and Todd

Plate 84, figures 17, 18

*Spiroloculina corrugata* Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 61, pl. 8, figs. 22-25, 1944.

*Spiroloculina antillarum* Cushman (not D'Orbigny) (part), U. S. Natl. Mus. Bull. 161, pt. 1, p. 36 (not pl. 9, figs. 3-5), 1932.

The types of this species are from the Philippine region, 50 fathoms, off San Andreas Island, between Marinduque and Luzon. It is a variable species and widely distributed in the Indo-Pacific area.

In our specimens there is a variation from forms with cylindrical chambers and a very narrow test, to those with a broader test having flattened chambers, fainter costae, and a translucent wall. Both forms are figured.

*Spiroloculina foveolata* Egger

Plate 84, figure 14

*Spiroloculina foveolata* Egger, K. Bayer Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, Band 18, p. 224, pl. 1, figs. 33, 34, 1893.

Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 48, pl. 7, figs. 7-12, 1944.

The types of this species are from off Mauritius and it seems to have a wide range in the Indo-Pacific region. Rare specimens were found at Rongerik and Rongelap.

*Spiroloculina marshallana* Todd, n. sp.

Plate 84, figure 8

Test compressed throughout, slightly longer than broad, only slightly depressed in the middle, periphery squarely truncate or slightly convex or concave with thickened edges; chambers numerous, distinct, quadrangular in section, of uniform width, increasing slowly in size in the early stages, later more rapidly, basal and apertural ends about equally protruding; sutures distinct, slightly depressed; wall smooth, polished, somewhat translucent along the middle of the chambers; aperture small, quadrangular, nearly filled by a tooth. Length 0.75 to 0.92 mm; breadth 0.50 to 0.72 mm; thickness 0.10 to 0.13 mm.

Holotype, USNM 548615, from Bikini atoll, 136 fathoms, 11°29'18" N., 165°30'59" E. (Bik 814).

This species differs from *S. clara* Cushman in its larger size and more nearly circular shape and its less distinctly translucent wall. It differs from *S. regularis* Cushman and Todd (1944, p. 51, pl. 7, figs. 26, 27) in its flatter form and protruding apical and apertural ends.

Specimens were found at all four islands but they were fairly common only at Bikini.

**Spiroloculina mayori Cushman**

Plate 84, figure 15

*Spiroloculina mayori* Cushman, Carnegie Inst. Washington Pub. 342, p. 56, pl. 20, figs. 5, 6, 1924.

Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 11, p. 56, pl. 8, figs. 1-6, 1944.

The types of this species are from 25 fathoms, off Utilei Reef, Pago Pago harbor, Samoa. The species is apparently limited to shallow, warm waters of the Pacific. A few young specimens were found at Eniwetok and Bikini.

**Spiroloculina sp. A**

Plate 84, figures 21, 22

A very few specimens of a distinctive but apparently undescribed form occur in several Rongelap samples and single specimens were found at Rongerik 51 and Eniwetok 119. They are characterized by their broad, keel-shaped chambers which are very strongly embracing leaving only a relatively small depressed area in the middle of the test, and by their elongate and much contracted apertural neck. The wall is thick, procelaneous and polished; in some specimens, apparently immature forms, the periphery is truncate rather than acute, and several specimens, one of which is figured, show the one type of periphery on one side and the other type on the other side. In having this broad truncate periphery in the young form the species resembles *S. mayori* Cushman. Adult forms are somewhat similar to *S. cushmani* Hada (1931, p. 83, text fig. 36) but are more strongly compressed, and have an elongate apertural neck while *S. cushmani* has none.

**Spiroloculina sp. B**

Plate 84, figure 19

The single specimen figured seems to represent an undescribed species. It is unique in its slender and tubular apertural neck.

**Genus SIGMOILINA Schlumberger, 1887****Sigmoidina edwardsi (Schlumberger)**

Plate 84, figure 20

*Planispirina (Sigmoidina) edwardsi* Schlumberger, Soc. zool. France Bull., v. 12, p. 483 (113), pl. 7, figs. 15-18; text fig. 8, 1887.

*Sigmoidina edwardsi* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, p. 584, pl. 45, figs. 19-21, 1915.

A very few rather small specimens were found in two Rongelap samples.

**Genus ARTICULINA D'Orbigny, 1829****Articulina elongata Cushman**

*Articulina elongata* Cushman, Cushman Lab. Foram. Research Special Pub. 10, p. 16, pl. 4, figs. 7-9, 1944.

A fragment of a specimen showing a series of six uniserial chambers with the later chambers characteristically overhanging the earlier ones, was found at Rongelap 468. A few fragments were found at Eniwetok.

**Articulina pacifica Cushman**

Plate 84, figure 25

*Articulina pacifica* Cushman, Cushman Lab. Foram. Research Special Pub. 10, p. 17, pl. 4, figs. 14-18, 1944.

The types of this species are from Mokuaujar Anchor age, Fiji. It is evidently a species of the warmer waters of the Indo-Pacific and occurs fairly commonly at all the atolls. In the second, or possibly third, uniserial chamber, the chamber is broad and flattened and the lip much recurved, suggesting *A. mucronata* (D'Orbigny) (1839a, p. 52, pl. 7, figs. 16-19).

**Genus TUBINELLA Rhumbler, 1907****Tubinella funalis (H. B. Brady)**

Plate 84, figure 24

*Articulina funalis* H. B. Brady, Challenger Rept., Zoology, v. 9, p. 185, pl. 13, figs. 6-11, 1884.

*Tubinella funalis* Rhumbler, Jahrb. Zool., Abt. Syst., Band 24, p. 26, pl. 2, fig. 3, 1906; Foram. Plankton-Exped., pt. 1, pl. 2, figs. 22, 23, 1911; pt. 2, p. 384, 1913.

The records indicate that this is a very widely distributed species. Only a single specimen was found at Rongerik 51.

**Genus HAUERINA D'Orbigny, 1836****Hauerina bradyi Cushman**

Plate 84, figure 32

*Hauerina bradyi* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 62 (not pl. 23, fig. 2), 1917; Cushman Lab. Foram. Research Contr., v. 22, p. 11, pl. 2, figs. 14, 20, 21, 1946.

*Hauerina compressa* H. B. Brady (not D'Orbigny), Challenger Rept., Zoology, v. 9, p. 190, pl. 11, figs. 12, 13, 1884.

The species is characterized by having a definite, elongated quinqueloculine stage in the middle, then a spiroloculine stage for several whorls, and in the adult having about 2½ chambers per whorl. The wall, especially of the later chambers, is usually translucent and bluish. The test is almost completely evolute.

This species apparently has a fairly wide range in the Indo-Pacific region. It is much less common in the Marshall Islands than *H. diversa* Cushman.

***Hauerina diversa* Cushman**

Plate 84, figures 30, 31

*Hauerina diversa* Cushman, Cushman Lab. Foram. Research Contr., v. 22, pt. 1, p. 11, pl. 2, figs. 16-19, 1946.*Hauerina bradyi* Cushman (not Cushman, 1917), U. S. Natl. Mus. Bull. 161, pt. 1, p. 44, pl. 10, figs. 12-15, 1932.

The types of this species are from shallow water off the beach at Hereheretue, Paumotu Islands, and it is also recorded from 12 fathoms, Levuka, Fiji, and in 18 fathoms, Vavau Anchorage, Tonga Islands. It occurs commonly at all the atolls of the Marshall Islands.

This species differs from *H. bradyi* Cushman in being thicker and in having 3 to 5 chambers in the adult whorl; an inconspicuous and not raised, early quinqueloculine stage; and the test strongly involute with the last chambers consequently broad. The wall is usually not translucent, but may be. The earlier apertures are apparent as markings on the wall like retral processes along the sutures. The test tends to become uncoiled (see fig. 31) thus suggesting the Eocene genus *Raadshocvenia* van den Bold (1946, p. 123) but these do not have labyrinthic chambers.

***Hauerina involuta* Cushman**

Plate 84, figures 28, 29

*Hauerina involuta* Cushman, Cushman Lab. Foram. Research Contr., v. 22, p. 13, pl. 2, figs. 25-28, 1946.*Hauerina ornatissima* H. B. Brady (part) (not Karrer), *Challenger* Rept., Zoology, v. 9, p. 192, pl. 7, figs. 15-17 (not figs. 18-22), 1884.

Cushman (part), U. S. Natl. Mus. Bull. 161, pt. 1, p. 43 (not pl. 10, figs. 16, 17), 1932.

The types of this species are from Rongelap Atoll, and it is evidently a common species in warm, shallow waters of the Pacific.

A very few small specimens from Eniwetok and Rongelap included here are much compressed and not involute, and somewhat resemble *H. speciosa* (Karrer) (1868, p. 135, pl. 1, fig. 8) from the Miocene of Europe. They are probably different but are inadequate for further identification.

***Hauerina milletti* Cushman, n. sp.**

Plate 84, figure 23

*Miliolina circularis* Bornemann var. *sublineata* Millett (not H. B. Brady) Royal Micros. Soc. Jour., p. 501, pl. 11, figs. 4a, b, 1898.

Test in the adult stage rounded in front view and broadly elliptical in edge view, periphery broadly rounded; chambers distinct, strongly inflated, in the earlier stages with several making up the surface but in the adult becoming involute and usually but three making up the entire surface; sutures distinct, depressed; wall thin, translucent, with very fine, numerous longitudinal costae; aperture with a finely perforate,

cribrate plate. Length 0.45 to 0.50 mm, diameter 0.40 to 0.45 mm, thickness 0.25 to 0.28 mm.

Holotype, USNM 548501, from Rongerik lagoon, 111 feet, 11°22'32" N., 167°28'48" E. (Rik 51).

This is the same as the form recorded and figured by Millett in the above reference from the Malay Archipelago. It differs from Brady's variety in the more irregular shape, and the cribrate aperture places it in the genus *Hauerina*.

***Hauerina serrata* Cushman, n. sp.**

Plate 84, figures 26, 27

Test much compressed, early quinqueloculine stage with strongly raised chambers, in the adult with the periphery very prominently wavy and serrate; chambers distinct, compressed in the adult, two forming the entire periphery, basal end projecting into a triangular lobe; sutures distinct, depressed; wall slightly granular; aperture slightly projecting, cribrate. Length 0.60 to 0.70 mm, breadth 0.45 to 0.55 mm.

Holotype, USNM 548764, from Eniwetok lagoon, 26 fathoms, 11°30'16" N., 162°19'35" E. (Eni 321).

This species differs from *H. pacifica* Cushman in the more regular form with two chambers making up the adult whorl and in the coarsely serrate periphery in the adult. Specimens occur at a number of stations in the vicinity of Eniwetok Atoll and also, but less commonly, at the other three islands.

**Genus SCHLUMBERGERINA Munier-Chalmas, 1882*****Schlumbergerina alveoliniformis* (H. B. Brady)**

Plate 85, figure 1

*Miliolina alveoliniformis* H. B. Brady, Quart. Jour. Micros. Sci., vol. 19, p. 54, 1879; *Challenger* Rept., Zoology, v. 9, p. 181, pl. 8, figs. 15-20, 1884.*Schlumbergerina alveoliniformis* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 29, pl. 8, fig. 1, 1932.

A few specimens from a number of Rongelap samples seem to belong to this species. They are somewhat shorter and broader than Brady's type figures and the young forms show considerable variation in shape. Most of the specimens appear worn and the cribrate apertural plate is absent in many of them. Rare specimens also occur at the other atolls.

**Genus TRILOCULINA D'Orbigny, 1826*****Triloculina* cf. *T. bassensis* Parr**

Plate 85, figure 14

*Triloculina bassensis* Parr, Royal Soc. Victoria Proc., v. 56 (n. ser.), pt. 2, p. 198, pl. 8, figs. 7a-c, 1945.

A few specimens from all the atolls seem close to this species described from shore sands at Barwon Heads, Victoria, Australia. They were compared with a type received from Mr. Parr and some differ in having

a slightly rougher surface but otherwise seem very close. They are characterized by the elongate arched aperture which is slightly grooved at the outer end, and by the wall covered by a pattern of very fine, incised longitudinal lines. In a few cases the wall is slightly crinkled transversely.

*Triloculina* cf. *T. bicarinata* D'Orbigny

Plate 85, figure 2

*Triloculina bicarinata* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, p. 180, pl. 10, figs. 18-20, 1839.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 60, pl. 13, figs. 6a-c, 1932.

The figured specimen is similar to that figured from the Pacific, Mokaujar Anchorage, Fiji, but differs in not having the sharply angled periphery. It is probably distinct from the Atlantic species. The ornamentation is of a coarser texture in the Pacific specimens and tends to include elongate and irregular ridges.

*Triloculina bikiniensis* Todd, n. sp.

Plate 85, figure 19

Test only slightly longer than broad, apical end rounded, apertural end not projecting, periphery acute; chambers curved, not inflated; sutures indistinct, not depressed; wall smooth, highly polished, somewhat translucent; aperture large, without a neck or lip, with an elongate tooth, slightly broadened or bifid at the tip. Length 0.40 to 0.48 mm, breadth 0.30 to 0.37 mm.

Holotype, USNM 548598, from Bikini lagoon, 119 feet, 11°36'37" N., 165°30'34" E. (Bik 177).

This species seems to be distinct from any known species but is very close to *Quinqueloculina auberiana* D'Orbigny (1839, p. 193, pl. 12, figs. 1-3) described from the West Indies, differing from that species (which generically is very close to *Triloculina*) in its less sharply acute periphery and its different apertural tooth.

It occurs at Bikini, Rongelap and Rongerik.

*Triloculina earlandi* Cushman, n. sp.

Plate 85, figure 3

*Miliolina terquemiana* Heron-Allen and Earland (part) (not H. B. Brady), Zool. Soc. London Trans., v. 20, p. 563, pl. 41, figs. 26-28 (not figs. 29-31), 1915.

Test elongate, greatest breadth usually below the middle, triangular in end view, initial end rounded. apertural end tapering, periphery of the last-formed chamber broad, slightly convex and with distinct angles; chambers distinct, three visible in the adult, the last formed one making up a large proportion of the surface; sutures distinct, slightly depressed, the last-formed one usually slightly sinuous; wall ornamented by very fine longitudinal costae, often very slightly

oblique; aperture circular, at the end of a slight neck, with a small, often slightly bifid tooth. Length 0.45 to 0.50 mm, breadth 0.20 to 0.25 mm.

Holotype, USNM 548502, from Rongerik lagoon, 111 feet, 11°22'32" N., 167°28'48" E. (Rik 51).

This abundant species in this material is apparently identical with the form noted above from the Kerimba Archipelago. It differs from *Triloculina terquemiana* (H. B. Brady) in the more elongate form, slightly twisted chambers, distinct neck and rounded aperture with a bifid tooth.

*Triloculina involuta* Todd, n. sp.

Plate 85, figure 4

Test of medium size for the genus, about twice as long as broad, compressed, nearly involute so that the last two chambers comprise most of the surface, basal end projecting and rounded, apertural end projecting in a short, thick, cylindrical neck, periphery broadly rounded; chambers curved, slightly inflated and strongly embracing the previous ones, very rapidly increasing in size as added; sutures indistinct, slightly depressed, either straight or irregular due to irregular overlapping of last chamber; wall dull-surfaced, ornamented by numerous, closely spaced costae, variable in strength, intercalating and tending to be slightly tangential, high and sharp when well preserved, best developed on the peripheral part of each chamber, extending onto the neck and curving around the basal end; aperture a large, circular, slightly flaring opening surrounded by a slightly thickened and polished rim, with a short bifid tooth. Length 1.10 to 1.50 mm, breadth 0.60 to 0.90 mm, thickness 0.37 to 0.62 mm.

Holotype, USNM 548742, from Eniwetok atoll, 24 fathoms, 11°20'06" N., 162°16'19" E. (Eni 118).

This species differs from *T. linneiana* D'Orbigny (1839a, p. 172, pl. 9, figs. 11-13) in its ornamentation, the costae being more closely spaced and less regular in pattern, and in its more strongly embracing chambers resulting in a nearly involute form. It also resembles *T. planiciana* D'Orbigny (1839a, p. 173, pl. 9, figs. 17-19) but is much more strongly ornamented.

The generic position of adult forms of this species seems to be transitional between *Triloculina* and *Flintia* but as the young clearly show the triloculine, not biloculine, stage, the species is placed in *Triloculina*.

*Triloculina irregularis* (D'Orbigny)

Plate 85, figure 12

*Quinqueloculina irregularis* D'Orbigny, Annales sci. nat., tome 7, p. 302, no. 25, 1826.

Fornasini, Accad. sci. Ist. Bologna Mem., ser. 6, v. 2, p. 67, pl. 3, fig. 14, 1905.

*Triloculina irregularis* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 54, pl. 12, figs. 2a-c, 1932.







This species occurs fairly commonly at a few stations. The periphery is broadly truncate and keeled and the aperture is compressed and flaring and does not extend out beyond the outline of the test.

*Triloculina kerimbatica* (Heron-Allen and Earland)

Plate 85, figures 10, 11

*Miliolina kerimbatica* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, pt. 2, p. 574, pl. 43, figs. 13-23, 1915

*Quinqueloculina kerimbatica* Cushman, Carnegie Inst. Washington Pub. 342, p. 60, pl. 22, fig. 9, 1924.

*Miliolina parkeri* Millett (not H. B. Brady), Royal Micros. Soc. Jour., 1898, p. 507, pl. 12, figs. 4a, b.

Test free, quinqueloculine. The walls of the chambers thick, irregularly furrowed in all directions with broad, deeply gouged-out channels, running obliquely and irregularly across the face of each chamber and generally connecting with a deeper straight furrow excavated down the peripheral edge. This straight peripheral furrow, when exposed on an earlier chamber in the center of the test by the quinqueloculine arrangement of the shell, affords a very striking appearance by contrast with the transverse furrows on the surface of the surrounding chambers. Aperture large and furnished with a prominent tooth. The oral end is usually but slightly produced, but in some individuals the aperture is situated on a produced neck. The ridges between the furrows are flat on the top, *i. e.*, the furrows are cleanly gouged out of the shell substance.—Heron-Allen and Earland, 1915.

The above is the original description of this species the types of which are from the Kerimba Archipelago. It has been recorded from a number of localities in the Indo-Pacific. Our specimens, although they vary somewhat, are much more uniformly ornamented than the series of figures given by Heron-Allen and Earland. The species appears to be closely related to that referred to *T. cf. bicarinata* D'Orbigny but the ornamentation consists of more definite wavy ridges than of a series of pits. The nepionic stages are quinqueloculine but the adults would indicate that the species should be placed in *Triloculina*.

*Triloculina marshallana* Todd, n. sp.

Plate 85, figure 13

Test elongate-triangular, tricarinate, irregular in shape, apertural end more acute than apical end, periphery bluntly angled; chambers distinct, moderately inflated, each chamber as added projecting out with an angular face beyond the previous ones; sutures distinct, depressed; wall with a fine matte surface, glistening; aperture large, projecting, at the end of a short, broad neck, with an elongate tooth, bifid at the tip, surrounded by a slight lip above which the tooth is usually visible in side view. Length 0.50 to 0.65 mm, breadth 0.30 to 0.37 mm.

Holotype, USNM 548594, from Rongelap lagoon, 10 fathoms, 11°14'19" N., 166°38'17" E. (Rap 483).

This species is characterized by its irregular and

angular appearance due to the chambers projecting out beyond the earlier formed ones. It differs from *T. trigonula* (Lamarck) in its more elongate form and irregular shape and its projecting apertural neck.

*Triloculina cf. T. oblonga* (Montagu)

Plate 85, figures 5-7

*Vermiculum oblongum* Montagu, Testacea Britannica, p. 522, pl. 14, fig. 9, 1803.

*Triloculina oblonga* D'Orbigny, Annales sci. nat., tome 7, p. 300, no. 16, Modèles, no. 95, 1826.

Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 3d ser., v. 16, p. 34, pl. 1, fig. 9, 1865.

*Miliolina oblonga* H. B. Brady, Challenger Rept. Zoology, v. 9, p. 160, pl. 5, figs. 4a, b, 1884.

Numerous specimens from all the atolls are tentatively referred to this species. They vary considerably in proportionate breadth, most of them being slenderer than the typical form which was described from off the British Isles. Except for their triloculine form, some are close to the specimens here referred to *Quinqueloculina cf. seminulum* (Linné) and it may be that these two groups belong together, the ones referred to *Quinqueloculina* being the microspheric forms, and the ones referred to *Triloculina* the megalospheric forms. The slenderer forms are close to *Quinqueloculina bosciiana* D'Orbigny (1839a, p. 191, pl. 11, figs. 22-24) described from the West Indies but are larger and triloculine rather than quinqueloculine.

*Triloculina spinata* Cushman

Plate 85, figure 8

*Triloculina spinata* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 56, pl. 12, fig. 5, 1932.

This small, slender species is distinguished by the spine on the apical end and its elongate apertural neck. It was described from Rongelap Atoll and also occurs rarely in the present material from Eniwetok and Rongerik.

*Triloculina subplanciana* Cushman, n. sp.

Plate 85, figure 17

Test elongate, about 2½ times as long as broad, periphery subacute, initial end rounded, apertural end with a short neck; chambers distinct, slightly inflated, increasing rapidly in size as added; sutures distinct, very slightly depressed; wall thin, translucent, smooth or very finely costate; aperture terminal, with a short neck and phialine lip and a short tooth sometimes slightly expanded at the top. Length 0.45 to 0.53 mm, diameter 0.20 to 0.23 mm.

Holotype, USNM 548540, from Rongerik lagoon, 85 feet, 11°23'35" N., 167°28'35" E. (Rik 54).

This species differs from *Triloculina planciana*

D'Orbigny (1839a, p. 173, pl. 9, figs. 17-19) in the more compressed test, subacute periphery, and definitely projecting neck with a rounded lip and a short tooth. The wall is usually thin, showing the earlier chambers.

*Triloculina terquemiana* (H. B. Brady)

Plate 85, figure 9

*Miliolina terquemiana* Brady, *Challenger* Rept., Zoology, v. 9, p. 166, pl. 114, figs. 1a, b, 1884.

Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, p. 563, pl. 41, figs. 29-31 (not figs. 26-28), 1915.

*Triloculina terquemiana* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 72, pl. 27, figs. 2a, b, 1917.

This species, described from shallow sediments of Ceylon and Madagascar, occurs rarely at a few stations.

In its surface it resembles *Quinqueloculina neostriatula* Thalmann but differs in its triloculine shape, larger size, and its aperture, which is entirely terminal whereas that of *Quinqueloculina neostriatula* is hoodlike.

*Triloculina tricarinata* D'Orbigny

Plate 85, figures 15, 16

*Triloculina tricarinata* D'Orbigny, *Annales sci. nat.*, v. 7, p. 299, no. 7; *Modèles*, no. 94, 1826.

Parker, Jones, and H. B. Brady, *Annals and Mag. Nat. History*, 3d ser., v. 16, p. 34, pl. 1, fig. 8, 1865.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 59, pl. 13, figs. 3a, b, 1932.

*Miliolina tricarinata* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 165, pl. 3, figs. 17a, b, 1884.

There are many records for this species but apparently not all referring to the same form, and no attempt is made to include them. Triangular forms with sharp angles are here included under this name.

*Triloculina trigonula* (Lamarck)

Plate 85, figure 18

*Miliolina trigonula* Lamarck, *Annales Muséum*, tome 5, p. 351, no. 3, 1804; v. 9, pl. 17, fig. 4, 1807.

*Triloculina trigonula* D'Orbigny, *Annales sci. nat.*, tome 7, p. 299, no. 1, pl. 16, figs. 5-9; *Modèles*, no. 93, 1826.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 56, pl. 13, figs. 1a, b, 1932.

*Miliolina trigonula* Williamson, *Recent Foraminifera of Great Britain*, p. 84, pl. 7, figs. 180-182, 1858.

H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 164, pl. 3, figs. 14-16, 1884.

A few specimens of a triangular form with rounded angles are placed in this species.

*Triloculina* sp. A

Plate 85, figure 20

Test elongate, compressed,  $2\frac{1}{2}$  to 3 times as long as broad, periphery acute; chambers not inflated, of about equal breadth throughout, curved at basal end; sutures indistinct; wall having a rather coarse matte surface occasionally with slight keels on the periphery; aperture

elongate, compressed, surrounded by a narrow lip, filled by an elongate tooth. Length 1.00 to 1.25 mm, breadth 0.25 to 0.45 mm.

This species occurs in some numbers at Eniwetok. It is distinguished by its elongate and compressed form.

*Triloculina* sp. B

Plate 85, figure 21

Test elongate, triangular in section, 2 to  $2\frac{1}{2}$  times as long as broad, peripheral angles acute but rounded, apical end bluntly pointed, apertural end obliquely truncate so aperture is visible in side view; chambers not inflated; sutures indistinct, slightly depressed; wall smooth, polished; aperture circular, without any thickened rim or lip, partially filled by delicate bifid U-shaped tooth which extends across about one-third the diameter of the opening. Length 0.55 to 0.78 mm, breadth 0.22 to 0.38 mm.

The species was found only in the deeper waters outside Bikini Atoll.

Genus PYRGO Defrance, 1824

*Pyrgo denticulata* (H. B. Brady)

Plate 85, figure 22

*Biloculina ringens* Lamarck var. *denticulata* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 143, pl. 3, figs. 4, 5, 1884.

*Biloculina denticulata* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 80, pl. 33, fig. 1, 1917.

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

This is a species typical of coral reef regions, especially in the Pacific. There is considerable variation in the development of the basal spines. It is common in the Marshall Islands material, occurring in numerous samples.

*Pyrgo denticulata* var. *striolata* (H. B. Brady)

Plate 85, figure 23

*Biloculina ringens* Lamarck var. *striolata* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 143, pl. 3, figs. 7, 8, 1884.

*Biloculina denticulata* (H. B. Brady) var. *striolata* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 80, pl. 33, figs. 2, 3, 1917.

*Pyrgo denticulata* (H. B. Brady) var. *striolata* Cushman, U. S. Natl. Mus. Bull. 104, pt. 6, p. 69, pl. 18, figs. 5a-c, 1929; idem, Bull. 161, pt. 1, p. 63, pl. 14, figs. 10, 11, 1932.

Specimens occur in a number of samples but are not abundant. The specimens show the typical striae in varying degree.

*Pyrgo lucernula* (Schwager)

Plate 85, figure 24

*Biloculina lucernula* Schwager, *Novara-Exped.*, Geol. Theil, Band. 2, p. 202, pl. 4, figs. 14, 17, 1866.

*Pyrgo lucernula* Thalmann, *Eclogae geol. Helvetiae*, v. 25, pp. 295, 296, 1932.

*Biloculina bulloides* H. B. Brady (not D'Orbigny), *Challenger* Rept., Zoology, v. 9, p. 142, pl. 2, figs. 5, 6, 1884.

Flint, U. S. Natl. Mus. Rept. for 1897, p. 293, pl. 38, fig. 5, 1899.

This species, described from the Pliocene of Kar Nicobar, occurs rarely in a number of samples at Bikini and in one sample from Eniwetok. Specimens vary considerably in shape but are characterized by a protruding apertural neck.

*Pyrgo millettii* (Cushman)

Plate 85, figure 25

*Biloculina millettii* Cushman, U. S. Natl. Mus. Bull. 71, pt. 6, p. 81, pl. 34, figs. 4, 5, 1917.

*Pyrgo millettii* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 66, pl. 15, figs. 4, 5, 1932.

*Miliolina durrandii* Millett (part), Royal Micros. Soc. Jour., 1898, p. 268, pl. 6, figs. 8-10 (not fig. 7).

Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, p. 565, pl. 42, figs. 11-16, 1915.

A very few specimens, all immature and in the triloculine stage, occur at Eniwetok and Bikini. This is a unique species in that its compression is at right angles to the usual plane of compression in this genus.

*Pyrgo murrhina* (Schwager)

*Biloculina murrhina* Schwager, *Novara-Expéd.*, Geol. Theil, Band 2, p. 203, pl. 4, fig. 15, 1866.

*Pyrgo murrhina* Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 64, pl. 15, figs. 1-3, 1932.

A few specimens from Bikini, circular, and keeled around the periphery, seem to belong to this species described from the Pliocene of Kar Nicobar and widely recorded in Recent seas.

*Pyrgo* sp.

Plate 85, figure 26

A few specimens similar to that figured have a roughly quadrangular test, with sutures not depressed and chambers not inflated nor angular along the periphery. They are somewhat similar to *P. elongata*, (D'Orbigny) (Parker, Jones, and Brady, 1871, p. 247, pl. 8, fig. 6) but have an elongate, slitlike aperture.

Family OPTHALMIDIIDAE

Genus CORNUSPIRA Schultze, 1854

*Cornuspira planorbis* Schultze

Plate 85, figure 27

*Cornuspira planorbis* Schultze, *Organismus Pclythal.*, p. 40, pl. 2, fig. 21, 1854.

*Cornuspira involvens* Cushman (not Reuss), U. S. Natl. Mus. Bull. 161, pt. 1, p. 67, pl. 16, figs. 2a, b, 1932.

The species occurs rarely in the Marshall Islands.

Genus VERTEBRALINA D'Orbigny, 1826

*Vertebralina striata* D'Orbigny

*Vertebralina striata* D'Orbigny, *Annales sci. nat.*, tome 7, p. 283, no. 1; Modèles, no. 81, 1re livraison, 1826.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 73, pl. 16, figs. 8-10, 1932.

Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 20, pt. 3, p. 74, pl. 12, figs. 7-11, 1944.

A few nepionic specimens, some fragmentary, were found at Bikini and Rongelap.

Genus PLANISPIRINA Seguenza, 1880

*Planispirina exigua* (H. B. Brady)

Plate 85, figure 28

*Hauerina exigua* H. B. Brady, *Quart. Jour. Micros. Sci.*, v. 19, p. 53, 1879.

*Planispirina exigua* H. B. Brady, *Challenger Rept.*, Zoology, v. 9, p. 196, pl. 12, figs. 1-4; woodcut, fig. 5b, 1884.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 71, pl. 16, figs. 7a, b, 1932.

Rare specimens were found at Eniwetok 329 and a single specimen at Rongelap 480.

Genus WIESNERELLA Cushman, 1933

*Wiesnerella auriculata* (Egger)

Plate 85, figure 30

*Planispirina auriculata* Egger, *K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, Band 18*, p. 245, pl. 3, figs. 13-15, 1893.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 72, pl. 16, figs. 6a-c, 1932.

*Wiesnerella auriculata* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 33, pl. 3, figs. 7-9, 1933.

This species has a wide distribution in the Atlantic and Pacific. Typical specimens occur rarely in several samples from Eniwetok, Bikini, and Rongelap.

Genus NUBECULARIA Defrance, 1825

*Nubecularia lacunensis* Chapman

Plate 85, figure 29

*Nubecularia lacunensis* Chapman, *Linnean Soc. Jour., Zoology*, v. 28, p. 169, pl. 19, fig. 2; p. 206 (list), 1900; v. 28, p. 381, 386, 1902.

Test porcellaneous, opaque or translucent, apparently attached by flat or concave surface, periphery acute and irregular; first few chambers coiled, later ones irregularly spreading.

A few specimens were found at all the islands.

Genus **PARRINA** Cushman, 1931**Parrina bradyi** (Millett)

Plate 85, figures 31-34

*Nubecularia bradyi* Millett, Royal Micros. Soc. Jour., 1898' p. 261, pl. 5, figs. 6a, b.

*Silvestria bradyi* Schubert, Palaeont. Zeitschr., Band 3, p. 166, 1920.

*Parrina bradyi* Cushman, Cushman Lab. Foram. Research Contr., v. 7, p. 20, 1931; U. S. Natl. Mus. Bull. 161, pt. 1, p. 74, pl. 17, figs. 1-4, 1932.

*Nubecularia inflata* H. B. Brady (not Terquem), *Challenger* Rept., Zoology, v. 9, p. 135, pl. 1, figs. 5-8, 1884.

It is highly variable in shape, and some immature specimens resemble *Miliolinella labiosa* (D'Orbigny). This species is widely distributed in warm, shallow waters of the Mediterranean and about the islands of the Indo-Pacific.

Family **TROCHAMMINIDAE**Genus **TROCHAMMINA** Parker and Jones, 1859**Trochammina** cf. **T. rotaliformis** J. Wright

Plate 85, figure 35

*Trochammina rotaliformis* J. Wright Heron-Allen and Earland, Royal Irish Acad. Proc., v. 31, pt. 64, p. 52, pl. 3, figs. 11-13, 1913.

A few specimens from Eniwetok, Bikini, and Rongelap are similar to this species. They are small and rounded, with indistinct chambers and sutures, and 3 or 4 chambers in the last whorl.

Genus **ROTALIAMMINA** Cushman, 1924**Rotaliammina mayori** Cushman

Plate 85, figure 36

*Rotaliammina mayori* Cushman, Carnegie Inst. Washington Pub. 342, p. 11, pl. 1, figs. 4, 5, 1924.

Typical specimens of this species, described from shallow water of Samoa, occurs at Rongelap 468. This is an attached form and from the dorsal side appears to be a *Trochammina* surrounded by a thin flange of lighter colored material.

From the ventral side it is apparent that no ventral wall to the chambers exists, but the septal partitions indicate the chamber divisions.

Genus **CARTERINA** H. B. Brady, 1884**Carterina spiculotesta** (Carter)

Plate 85, figure 37

*Rotalia spiculotesta* Carter, Annals and Mag. Nat. History, 4th ser., v. 20, p. 470, pl. 16, figs. 1-3, 1877.

*Carterina spiculotesta* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 346, pl. 41, figs. 7-10, 1884.

A single specimen was found in Bikini sample 814. The thin wall is very distinctive in being formed of a

single layer of elongate sponge spicules very neatly cemented together.

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

*Nouria polymorphinoides* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, pt. 12, p. 376, pl. 37, figs. 1-14, 1914. Cushman, U. S. Natl. Mus. Bull. 161, pt. 1, p. 78, pl. 17, fig. 9, 1932.

Test longer than broad, somewhat compressed, periphery rounded; chambers few, tending to be biserial in adult, irregular; sutures slightly depressed; wall arenaceous, composed of sand grains of various sizes rather neatly cemented; aperture simple, terminal. Maximum length 1.5 mm.

The types of this species are from the Kerimba Archipelago. It has been widely recorded in the Pacific. Very rare specimens were found in the Marshall Islands.

Family **LAGENIDAE**

The occurrence of species of this family in the Marshall Islands is of particular interest because, unlike the other families, this family is very restricted in its distribution. None were found at Rongerik, and only a few at Eniwetok and Rongelap. The family is fairly well represented at Bikini by a large number of species, but not in abundance. The presence of species of the Lagenidae seems to be indicative of moderate to great depth and open-sea conditions.

Genus **ROBULUS** Montfort, 1808**Robulus calcar** (Linné)

Plate 86, figure 4

*Robulus calcar* (Linnaeus) Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 7, pl. 2, figs. 3a, b, 1933.

A few small, apparently young, specimens were found at several Bikini stations.

**Robulus gibbus** (D'Orbigny)

Plate 86, figure 2

*Cristellaria gibba* D'Orbigny, Annales sci. nat., v. 7, p. 292, no. 17, 1826; D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'Ile de Cuba, Foraminifères, p. 40, pl. 7, figs. 20, 21, 1839.

Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 4th ser., v. 8, v. 253, 1871.

H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 546, pl. 69, figs. 8, 9, 1884.

*Robulus gibbus* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 6, pl. 2, figs. 2, 6, 7, 1933.

A few specimens, similar to that figured, occur at several Bikini stations. They are compact, relatively thick forms, with a blunt periphery, and the chambers and sutures are rather indistinct.

**Robulus limbosus (Reuss)**

Plate 86, figure 1

*Robulina limbosa* Reuss, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber., Band 48, pt. 1, p. 55, pl. 6, fig. 69, 1863.

*Robulus limbosus* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 3, pl. 1, figs. 4-6; pl. 2, figs. 5a, b, 1933.

Cushman and McCulloch, Allan Hancock Pacific Exped., v. 6, no. 6, p. 297, pl. 38, fig. 8; pl. 39, figs. 1-4, 1950.

Specimens with few chambers (5 to 7), a keeled periphery, prominent umbones, and tangential slightly curved and limbate sutures are placed in this species. They occur rarely at a few Bikini stations.

**Robulus nigriseptus (Koch)**

Plate 86, figure 3

*Cristellaria nigrisepta* Koch, Schweizer. palaeont. Gesell. Ber., Band 19, no. 3, p. 740, fig. 14 (in text), 1926.

*Robulus nigriseptus* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 5, pl. 1, figs. 9a, b, 1933.

A very few specimens from two Bikini stations and one Rongelap station seem to be the same as those recorded from the Tropical Pacific. They differ, however, from the type of *R. nigriseptus* in having a blunt, not keeled, periphery. They are also like *R. clericii* (Fornasini) (1895, text fig.) described from the Pliocene of Italy but the characteristic curvature at the inner ends of the sutures is not as strongly developed as in that species.

**Robulus sp. A**

Plate 86, figure 6

Specimens with numerous chambers (8 to 10), strongly curved sutures, acute or slightly keeled periphery, and clear umbones occur rarely in several Bikini samples. They seem to be identical with the species referred to *R. expansus* (Cushman) var. *planulatus* (Cushman) (1933, p. 8, pl. 2, figs. 4a, b) but comparison with the holotype of that variety shows they are distinct in being much smaller, biconvex and not compressed, and lacking any surface ornamentation.

This species resembles specimens referred to *R. vortex* (Fichtel and Moll) (Cushman, 1933, p. 5, pl. 2, figs. 1a, b) and *R. orbicularis* (D'Orbigny) (Cushman and McCulloch, 1950, p. 296, pl. 38, figs. 4-7), but differs in the clear umbones and somewhat less strongly curved sutures.

**Robulus sp. B**

Plate 86, figure 5

This compressed species occurs rather commonly at Bikini 1174 (1-2'') and more rarely at Bikini 1174. The umbones are clear, giving the effect of a slightly evolute test. Seven or eight chambers comprise the last whorl and the sutures are strongly curved. The periphery is acute and slightly keeled.

**Robulus sp. C**

Plate 86, figure 8

A few specimens from Bikini and Rongelap, similar to that figured, are inadequate for description. They are distinctly keeled and the curved sutures are limbate with the middle portion of each suture raised as a ridge of clear shell material.

**Robulus sp. D**

Plate 82, figure 3

This large species is represented by only three specimens from three Bikini stations, but is figured for future reference. Six chambers comprise the last whorl, and around the periphery the large radiate apertures, belonging to each previous chamber, are visible.

**Genus ASTACOLUS Montfort, 1808*****Astacolus bradyi* (Cushman)**

Plate 86, figure 9

*Cristellaria bradyi* Cushman, U. S. Natl. Mus. Proc., v. 51, p. 659, 1917; idem, Bull. 100, v. 4, p. 243, pl. 48, figs. 1a, b, 1921.

*Cristellaria costata* H. B. Brady (in part?), *Challenger* Rept., Zoology, v. 9, p. 555, pl. 71, fig. 8, 1884.

Two nepionic specimens were found at Bikini.

***Astacolus planulata* Galloway and Wissler**

Plate 86, figure 7

*Astacolus planulatus* Galloway and Wissler, Jour. Paleontology, v. 1, p. 46, pl. 8, fig. 5, 1927.

*Planularia planulata* Cushman and Gray, Cushman Lab. Foram. Research Special Pub. 19, p. 12, pl. 2, fig. 18, 1946.

Cushman and McCulloch, Allan Hancock Pacific Exped., v. 6, no. 6, p. 303, pl. 40, figs. 1-5, 1950.

Specimens were rare at a few stations at Bikini. The one figured shows more of a coiled stage than most of the others.

**Genus DENTALINA D'Orbigny, 1826*****Dentalina* cf. *D. filiformis* (D'Orbigny)**

Plate 86, figure 10

*Nodosaria filiformis* D'Orbigny, H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 500, pl. 63, figs. 3-5.

Very rare specimens from several Bikini stations are referred here with some question. They are slender, have an initial spine, and oblique sutures.

**Genus NODOSARIA Lamarck, 1812*****Nodosaria pauciloculata* Cushman**

Plate 86, figure 14

*Nodosaria pauciloculata* Cushman, U. S. Natl. Mus. Proc., v. 51, p. 655, 1917.

A few two-chambered specimens from Eniwetok and Bikini seem to be the young of this species.

**Nodosaria sp. A**

Plate 86, figure 11

Rare specimens, mostly fragmentary, represent a slender species with slightly inflated chambers, transverse sutures, and granular wall.

**Nodosaria sp. B**

Plate 86, figure 12

Rare specimens, similar to that figured, are inadequate for description.

**Nodosaria sp. C**

Plate 86, figure 13

This form may be an anomalous kind of *Lagena* and is recorded here for future reference. The ornamentation resembles that of *N. prava* Cushman (1933, p. 14, pl. 4, figs. 1-4) but the much greater constriction between the chambers and the transverse rings distinguish it from that species.

**Genus FRONDICULARIA DeFrance, 1824****Frondicularia sp. A of Boomgaard**

Plate 86, figure 15

*Frondicularia* sp. A Boomgaard, Thesis Univ. Utrecht, p. 84, pl. 11, fig. 1, 1949.

Three single specimens, from Bikini 814, Bikini 817, and Eniwetok 117, seem very close to a specimen described and figured from late Tertiary sediments from a well at Bodjonegoro, Java. The present specimens are larger in size and number of chambers, but otherwise seem to be the same.

**Genus LAGENA Walker and Jacob, 1798****Lagena acuticosta Reuss**

Plate 86, figure 16

*Lagena acuticosta* Reuss, Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 34, pl. 8, figs. 9, 10, 12, 1933.

This species occurs rarely at Bikini.

**Lagena globosa (Montagu)**

Plate 86, figure 17

*Lagena globosa* (Montagu), Cushman, U. S. Natl. Mus. Bull. 104, pt. 4, p. 20, pl. 4, figs. 1, 2, 1923.

Single specimens were found at a few stations at Bikini, Eniwetok, and Rongelap.

**Lagena gracilis Williamson**

Plate 86, figure 18

*Lagena gracilis* Williamson, Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 33, pl. 8, figs. 5-7, 1933.

This species occurs rarely at several Bikini stations.

**Lagena spiralis H. B. Brady**

Plate 86, figure 19

*Lagena spiralis* H. B. Brady, Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 30, pl. 7, figs. 15, 16, 1933.

This is known as a species of the Indo-Pacific, occurring in shoal water. It occurs in typical form in the Eniwetok samples but is rare.

**Lagena striato-punctata Parker and Jones**

*Lagena striato-punctata* Parker and Jones, Cushman, U. S. Natl. Mus. Bull. 104, pt. 4, p. 55, pl. 10, fig. 10, 1923.

Very rare and very small specimens from Bikini and Eniwetok have the ornamented costae characteristic of this species.

**Lagena williamsoni (Alcock)**

Plate 86, figure 20

*Lagena williamsoni* (Alcock), Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 34, pl. 8, fig. 8, 1933.

Single specimens were found at Bikini and Eniwetok.

**Family POLYMORPHINIDAE****Genus DIMORPHINA D'Orbigny, 1826****Dimorphina tuberosa D'Orbigny**

Plate 86, figures 21, 22

*Dimorphina tuberosa* D'Orbigny, Annales sci. nat., tome 7, p. 264, no. 1; Modèles, no. 60, iii<sup>e</sup> livraison, 1826.

Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 3d ser., v. 16, p. 28, pl. 2, fig. 53, 1865.

Common specimens from several Bikini samples seem to belong in this species described from the Mediterranean. Only one specimen shows the polyserial arrangement of the early chambers. In all the other specimens the test is uniserial throughout.

**Genus SIGMOMORPHINA Cushman and Ozawa, 1928****Sigmomorphina semitecta (Reuss), var. terquemiana (Fornasini)**

*Sigmomorphina semitecta* (Reuss), var. *terquemiana* (Fornasini), Cushman and Ozawa, U. S. Natl. Mus. Proc., v. 77, art. 6, p. 129, pl. 33, figs. 4, 5; pl. 34, figs. 2, 3; pl. 35, fig. 1, 1930.

Specimens occur rarely at Bikini.

**Genus POLYMORPHINELLA Cushman and Hanzawa, 1936****Polymorphinella pacifica Cushman and Hanzawa**

Plate 86, figures 23, 24

*Polymorphinella pacifica* Cushman and Hanzawa, Cushman Lab. Foram. Research Contr., v. 12, pt. 2, p. 47, 1936.

*Cristellaria schloenbachi* Reuss, anomalous specimen, H. B. Brady, Challenger Rept., Zoology, v. 9, pl. 67, fig. 8, 1884.

A few specimens from several Bikini stations apparently belong in this species which was named from

a specimen figured by Brady in the *Challenger* Report from Torres Strait. Two specimens are figured to show the two extremes of form. The species is only slightly biserial in the initial part and so may appear to be an anomalous form of *Astacolus*.

**Family NONIONIDAE**

**Genus NONION Montfort, 1808**

***Nonion pacificum* (Cushman)**

Plate 86, figure 25

*Nonionina umbilicatula* (Montagu) var. *pacificum* Cushman, Carnegie Inst. Washington Pub. 342, p. 48, pl. 16, fig. 3, 1924.

*Nonion umbilicatum* (Montagu) var. *pacificum* Cushman, Scripps Inst. Oceanography Bull., Tech. ser., v. 1, no. 10, p. 149, pl. 2, fig. 5, 1927.

*Nonion pacificum* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 44, pl. 10, figs. 9a, b, 1933; B. P. Bishop Mus. Bull. 119, p. 120, pl. 14, figs. 7a, b, 1934; U. S. Geol. Survey Prof. Paper 191, p. 25, pl. 6, fig. 25, 1939.

Cushman and Todd, Cushman Lab. Foram. Research Special Pub. 15, p. 36, pl. 5, fig. 26, 1945.

Typical specimens occur at Bikini. They are very coarsely perforate, similar to *N. pompilioides*, but differ in being more compressed and not having limbate sutures.

***Nonion pompilioides* (Fichtel and Moll)**

Plate 86, figure 26

"*Nautilus melo*" Soldani, Testaceographica, p. 38, pl. 8, figs. zz, A, B, C, 1798.

*Nautilus pompilioides* Fichtel and Moll, Testacea microscopica, p. 31, pl. 2, figs. a-c, 1798.

*Nonionina pompilioides* D'Orbigny, Annales sci. nat., tome 7, p. 294, no. 15, 1826.

H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 727, pl. 109, figs. 10, 11, 1884.

*Nonion pompilioides* Cushman, U. S. Natl. Mus. Bull. 104, pt. 7, p. 4, pl. 1, figs. 7-11; pl. 2, figs. 1, 2, 1929; U. S. Geol. Survey Prof. Paper 191, p. 19, pl. 5, figs. 9-12, 1939.

This species is common in several Bikini samples. It is known from the later Tertiary of southern Europe and is widely distributed in Recent seas.

**Genus ASTRONONION Cushman and Edwards, 1937**

***Astrononion tumidum* Cushman and Edwards**

Plate 86, figure 27

*Astrononion tumidum* Cushman and Edwards, Cushman Lab. Foram. Research Contr., v. 13, p. 33, pl. 3, fig. 17, 1937.

Cushman, U. S. Geol. Survey Prof. Paper 191, p. 37, pl. 10, fig. 11, 1939.

*Nonionina stelligera* (part) H. B. Brady (not D'Orbigny), *Challenger* Rept., Zoology, v. 9, p. 728, pl. 109, fig. 5, 1884.

This species, named from the South Atlantic, occurs rarely at Bikini and Eniwetok.

**Genus NONIONELLA Cushman, 1926**

***Nonionella translucens* Cushman**

Plate 86, figure 29

*Nonionella translucens* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 45, pl. 11, figs. 2a-c, 1933; U. S. Geol. Survey Prof. Paper 191, p. 34, pl. 9, figs. 13a-c, 1939.

The types of this species are from a depth of 12 fathoms off Levuka, Fiji. It is apparently a species of the Pacific but not confined to shallow waters.

***Nonionella* sp. A**

*Nonionella* sp. Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 46, pl. 11, fig. 3, 1933.

A very few specimens from Bikini and Eniwetok seem to be the same as the specimen recorded in the above reference from 860 fathoms, in the tropical Pacific.

***Nonionella* sp. B**

Plate 86, figure 28

Test small, elongate, strongly compressed, periphery rounded; chambers about 10 in the last whorl, rapidly increasing in height as added, not inflated; sutures distinct, not depressed, slightly curved at the outer ends especially of the later ones; wall thin, transparent; aperture indistinct. Length 0.25 to 0.35 mm, breadth 0.17 to 0.20 mm, thickness 0.05 mm.

This species seems to be distinct but is inadequate for complete description. It resembles *N. japonica* (Asano), var. *mexicana* Cushman and McCulloch (1940, p. 160, pl. 17, figs. 10a-c) in its strongly compressed form but has fewer chambers and is somewhat larger. It also somewhat resembles *N. limbato-striata* Cushman (1934, p. 121, pl. 14, figs. 10a-c) from the Neogene of Fiji but is a narrower and more elongate form.

**Genus ELPHIDIUM Montfort, 1808**

***Elphidium advenum* (Cushman)**

Plate 86, figure 30

*Polystomella advena* Cushman, Carnegie Inst. Washington Pub. 311, p. 56, pl. 9, figs. 11, 12, 1922.

*Elphidium advenum* Cushman, U. S. Natl. Mus. Bull. 104, pt. 7, p. 25, pl. 10, figs. 1, 2, 1930; idem, Bull. 161, pt. 2, p. 50, pl. 12, figs. 1-3, 1933; U. S. Geol. Survey Prof. Paper 191, p. 60, pl. 16, figs. 31-35, 1939.

This widely distributed species in the Atlantic and Pacific occurs at all four atolls, but less commonly than the variety *dispar*. The occurrence of these two forms may be of significance, as the typical form is common at Bikini and very rare at Eniwetok while the variety is abundant at Eniwetok and was not found at all at Bikini.

**Elphidium advenum var. dispar** Cushman, n. var.

Plate 86, figure 31

Variety differing from the typical form in having the umbonal region slightly depressed, with the boss very much reduced or wanting, and in having the retral processes comprising a larger proportion of the surface of the test with the intervening chamber ridges slightly raised. Diameter 0.40 to 0.45 mm, thickness 0.20 to 0.25 mm.

Holotype of variety (USNM 548508) from Rongerik lagoon, 111 feet, 11°22'32" N., 167°28'48" E. (Rik 51).

This is the most common form of the genus in this material. It seems related to *E. advenum* (Cushman) in number and curvature of chambers, but may be a distinct species. It differs from *E. fimbriatum* (Cushman) (1918, p. 20, pl. 8, fig. 5) in its more numerous and more strongly curved chambers, and its depressed umbonal region.

**Elphidium jenseni** (Cushman)

Plate 86, figure 32

*Polystomella jenseni* Cushman, Carnegie Inst. Washington Pub. 342, p. 49, pl. 16, figs. 4 (?), 6, 1924.

*Elphidium jenseni* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 48, pl. 11, figs. 6, 7, 1933; U. S. Geol. Survey Prof. Paper 191, p. 62, pl. 17, figs. 14, 15, 1939.

*Polystomella macella* (Fichtel and Moll), var. Jensen, Linnean Soc. New South Wales Proc., v. 29, p. 817, pl. 23, fig. 4, 1904 (1905).

From the records this is a species of rather shallow warm water of the South Pacific. It is found mostly in water of less than 25 fathoms but may be carried into deeper water by currents. It may be confused with *E. advenum* var. *dispar* but is much more strongly compressed throughout.

**Elphidium milletti** (Heron-Allen and Earland)

*Polystomella verriculata* Millett (not H. B. Brady), Royal Micros. Soc. Jour., 1904, p. 604, pl. 11, fig. 3.

*Polystomella milletti* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, p. 735, pl. 53, figs. 38-42, 1915.

*Elphidium milletti* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 49, pl. 11, figs. 8a, b, 1933; U. S. Geol. Survey Prof. Paper 191, p. 58, pl. 16, figs. 20-22, 1939.

A single typical specimen was found at 3 to 5 inches in the core at Bikini 1173.

**Elphidium simplex** Cushman

Plate 86, figure 33

*Elphidium simplex* Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 52, pl. 12, figs. 8, 9, 1933; U. S. Geol. Survey Prof. Paper 191, p. 62, pl. 17, fig. 10, 1939.

The types of this species are from Vavau Anchorage, Tonga Islands. It is recorded rather widely in the Pacific.

## Family CAMERINIDAE

## Genus OPERCULINA D'Orbigny, 1826

*Operculina ammonoides* (Gronovius)

Plate 87, figure 1

*Nautilus ammonoides* Gronovius, Zoophylacium Gronovianum etc., p. 282, pl. 19, figs. 5, 6, 1781.

Linné, Systema naturae Linnaei, Ed. 13 (Gmelin's), p. 3370, 1788.

*Operculina ammonoides* Parker and Jones, Introd. Foram., Appendix, p. 310, 1862.

H. B. Brady, Challenger Rept., Zoology, v. 9, p. 745, pl. 112, figs. 1, 2, 1884; Royal Micros. Soc. Jour., 1887, p. 926.

*Operculina gaimardi* D'Orbigny, Annales sci. nat., tome 7, p. 281, no. 5, 1826.

Fornasini, Soc. geol. italiana Boll., v. 22, fasc. 3, p. 2 (396), pl. 14, fig. 4, 1903.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 55, pl. 13, 1933.

*Operculina granulosa* (Leymerie) (?), Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 56, pls. 14, 15; pl. 16, figs. 1-3, 1933.

Numerous specimens, mostly worn, occur at Eniwetok, Bikini, and Rongerik. Some specimens are ornamented by bosses along the early suture lines and the umbonal areas are somewhat raised.

## Genus HETEROSTEGINA D'Orbigny, 1826

*Heterostegina suborbicularis* D'Orbigny

Plate 82, figures 7, 8; plate 87, figure 2

*Heterostegina suborbicularis* D'Orbigny, Annales sci. nat., tome 7, p. 305, no. 1, 1826.

Fornasini, Soc. geol. italiana Boll., v. 22, fasc. 3, p. 2 (396), pl. 14, figs. 5-7, 1903.

Hofker, Siboga-Exped., Mon. 4, p. 70, pl. 35; pl. 36, figs. 3, 6-12, 1927; Resultats Sci. Voyage Indes Orientales Neerlandaises, v. 2, fasc. 1, p. 6, pl. 1, figs. 11, 12, 1930; Vidensk. Medd. fra Dansk naturh. Foren., v. 93, 1932, p. 153, 1933.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 58, pl. 17, figs. 6a, b, 1933.

*Heterostegina curva* Moebius, Foraminiferen von Mauritius, p. 105, pl. 13, figs. 1-6, 1880.

Egger, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, Band 18, p. 434, pl. 20, figs. 26-33, 1893.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 59, pl. 17, figs. 1-5, 1933.

Test large, lenticular in edge view, rapidly flaring in side view, central portion much thickened, peripheral portion thin, periphery rounded; chambers distinct in some specimens, indistinct in others, becoming more indistinct toward the middle portion on account of the thickening of the test, divided into chamberlets progressively from the peripheral end of each chamber; sutures very strongly curved and becoming sigmoid at their inner ends, slightly limbate, becoming indistinct toward the central part of the test; wall smooth except for slightly raised and limbate sutures.

The largest specimen observed in the present material is 14 mm in diameter. Several specimens show







evidence of breaking and then regrowth with larger chambers.

It is difficult to separate the two forms called *H. suborbicularis* and *H. curva* as their distinction seems to be an arbitrary rather than a natural one. It is, therefore, believed that only one species of *Heterostegina* is represented in the present material.

The types of *H. suborbicularis* were from the Hawaiian Islands. The very thick umbonate forms with a more opaque wall have been included under this specific name.

The types of *H. curva* were from off Mauritius. The flatter forms with the chambers visible to the center of the test have been assigned to this species.

It is possible that some forms we have included here are the same as forms referred to *Heterostegina depressa* D'Orbigny (Cushman, 1933, p. 57, pl. 16, figs. 5-9 (not fig. 4) but these do not appear to be typical of *H. depressa* according to the type figure.

Genus **CYCLOCLYPEUS** W. B. Carpenter, 1856

*Cycloclypeus carpenteri* H. B. Brady

Plate 82, figure 9

*Cycloclypeus* W. B. Carpenter, Philosophical Trans., v. 146, p. 555, pl. 30, figs. 1, 3, 1856; Introd. Foraminifera, p. 292, pl. 19, figs. 2-7, 1862.

Tan, Wetenschappelijke Mededeelingen no. 19, Dienst Mijnbouw Nederlandsch-Indie, p. 81, 82, 1932.

*Cycloclypeus carpenteri* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 67, 1881; *Challenger* Rept., Zoology, v. 9, p. 751, 1884.

Chapman, Linnean Soc. Jour., Zoology, v. 28, p. 22, pl. 2, figs. 6, 7; pl. 3, figs. 1-5, 1900.

Hofker, *Siboga-Exped.*, Mon. 4, p. 71, pl. 24, fig. 1; pl. 37; pl. 38, figs. 1-9, 12, 13, 1927.

*Cycloclypeus guembelianus* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 66, 1881; *Challenger* Rept., Zoology, v. 9, p. 751, pl. 111, figs. 8a, b (young form), 1884.

Hanzawa, Short Papers Instit. Geol. Pal., Tohoku Univ., Sendai, no. 3, p. 1, pls. 1, 2, text figs. 1-10, 1951.

This species, described from off the coast of Borneo and off Fiji, occurs rarely in several deep-water samples at Bikini and Rongelap, and very abundantly in a dredging from off Bikini. The microspheric and megalospheric forms of the species are quite distinct in size and appearance; the megalospheric ones having been described as *C. guembelianus*. The megalospheric specimens are 15 to 18 mm. in diameter, papillate along the sutures, and rather translucent except in the central thickened portion. The microspheric specimens are much larger, up to 48 mm in diameter, smooth, thick-walled and not translucent, with the chambers less

distinctly visible, and the periphery often slightly ruffled.

In a sample dredged from 800 to 580 feet, off Bikini, 11°38'33" N., 165°31'18" E., abundant specimens of both forms were obtained. Some of this material preserved in neutralized formalin was tested for protoplasm by the rose bengal test and gave a positive reaction. The megalospheric forms showed the protoplasm present in the central, thickened portion only. The test was not conclusive for the microspheric forms inasmuch as the surface of the shell substance, even in obviously dead specimens, appeared to take the stain in varying degrees.

Examination by Dr. Margaret Jepps (1953, p. 1114), including decalcification of additional preserved material from the same dredging sample, disclosed the internal structure and canal system of the shells as well as proved the existence of multinuclear protoplasm within a microspheric specimen.

All the large, microspheric specimens obtained were found to bear various types of attached organisms: bryozoans, worm tubes, and Foraminifera; and a few specimens showed pin-prick holes, the results of the activity of the boring sponge *Cliona* (Chapman, 1900, p. 24).

Among the Foraminifera found attached to *Cycloclypeus* is an unidentified form that leaves shallow pits from 0.5 to 2 mm in diameter thickly scattered over the surface. A few pits were worn deeply enough into the shell substance as to give access to the interior of the chambers of the *Cycloclypeus*. Eight specimens of these pitting organisms were found attached to the surface of one specimen, but, although the results of their activities could be observed on several of the larger microspheric individuals, no more specimens were seen. The test is irregular in outline, flat with a thin wall on the attached side, convex but flattened on the exposed side. The exposed surface is smooth, granular, and ornamented with a few glassy papillae apparently without any definite pattern. The wall is calcareous and appears to be finely perforate. Internally the test consists of a large central chamber surrounded by two or more crescent-shaped chambers. No aperture was observed. Sutures between the chambers are not obvious from the exposed surface of the test but may be seen when the test is moistened. The affinities of this form are not revealed by the available material. Further material may show its family and generic relationships and whether it feeds upon other Foraminifera.

## Family PENEROPLIDAE

## Genus PENEROPLIS Montfort, 1808

*Peneroplis* sp.

Plate 87, figure 3

A few specimens from Rongelap appear to represent an undescribed species. The test is strongly compressed, slightly umbilicate; the chambers 9 to 11 in the last whorl; the wall translucent and finely pitted; the apertures multiple on the face of the last-formed chamber.

## Genus SPIROLINA Lamarck, 1804

*Spirolina acicularis* (Batsch)

Plate 87, figure 6

*Nautilus (Lituus) acicularis* Batsch, Conch. Seesandes, p. 4, pl. 6, fig. 16, 1791.

*Spirolina acicularis* Cushman, U. S. Natl. Mus. Bull. 104, pt. 7, p. 42, pl. 15, figs. 1-3, 1930; idem, Bull. 161, pt. 2, p. 63, pl. 19, figs. 6, 7, 1933.

Very rare, small specimens, may be referred to this species which has been recorded from various localities in shallow water of the Pacific Islands and the Tropical Atlantic. The types are from the Mediterranean. One fragmentary specimen shows as many as 20 uniserial chambers.

*Spirolina arietina* (Batsch)

Plate 87, figures 4, 5

*Nautilus (Lituus) arietinus*, Batsch (in part), Conch. Seesandes, p. 4, pl. 6, fig. 15c, 1791.

*Peneroplis arietinus* Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 3rd ser. v. 16, p. 26, pl. 1, fig. 18, 1865. H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 204, pl. 13, figs. 18, 19, 22, 1884.

*Spirolina arietina* Cushman, U. S. Natl. Mus. Bull. 104, pt. 7, p. 43, pl. 15, figs. 4, 5, 1930; idem, Bull. 161, pt. 2, p. 62, pl. 19, figs. 4, 5, 1933.

This is a widely distributed species in the warm shallow waters of tropical seas. It is common in this material.

## Genus MONALYSIDIUM Chapman, 1900

*Monalysidium politum* Chapman

Plate 87, figure 7

*Peneroplis (Monalysidium) polita* Chapman, Linnean Soc. Jour., Zoology, v. 28, p. 4, pl. 1, fig. 5 (?), 1900.

*Monalysidium politum* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, p. 603, fig. 43G (in text), 1915.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 63, pl. 19, figs. 8, 9, 1933.

Very rare specimens in this material are referred to this widely recorded species. They are all fragmentary.

Some show faint striae as the fragments of *Spirolina acicularis* do, but in this species the chambers are more distinctly separated by incised sutures.

## Genus SORITES Ehrenberg, 1840

*Sorites marginalis* (Lamarck)

Plate 82, figure 4

*Orbulites marginalis* Lamarck, Syst. Anim. sans Vert., tome 2, p. 196, no. 1, 1816.

*Orbitolites marginalis* W. B. Carpenter, Philosophical Trans., v. 174, p. 560, fig. 1 (in text), 1883; *Challenger* Rept., Zoology, v. 7, "Orbitolites," p. 20, pl. 3, figs. 1-7; pl. 4, figs. 1-5, 1883. H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 214, pl. 15, figs. 1-5, 1884.

*Sorites marginalis* Cushman, U. S. Natl. Mus. Bull. 104, pt. 7, p. 49, pl. 18, figs. 1-4, 1930.

This species is not common in this material and is mostly represented by immature specimens.

## Genus MARGINOPORA Blainville, 1830

*Marginopora vertebralis* Blainville

Plate 82, figures 5, 6

*Marginopora vertebralis* Blainville, Manuel d'Actinologie ou de Zoophytologie, p. 412, pl. 69, fig. 6, 1834.

Van der Vlerk, Wetenschappelijke Mededeelingen, no. 1, p. 11, pl. 4, figs. 14, 15, 1924.

Hofker, *Siboga*-Exped., Mon. 4a, p. 160, pl. 57, figs. 1, 2; pl. 61, figs. 4, 5, 11; pl. 62 figs. 1-9, 11, 12, 1930.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 67, pl. 19, figs. 11, 12, 1933.

*Amphisorus hemprichii* Ehrenberg, Akad. Wiss. Berlin Abhandl., 1838, p. 134, pl. 3, fig. 3, 1840.

We are following W. Storrs Cole in placing together *Amphisorus* and *Marginopora*, considering the former as immature specimens of the latter. The thicker, more robust specimens with depressed centers are very abundant in very shallow water and on the reef flats. They are evidently strong enough to resist wave action to some extent. The thinner, two-chambers-thick specimens with more translucent walls, those formerly referred to *Amphisorus*, are found with the thicker ones and, in addition, occur in deeper water.

## Family ALVEOLINELLIDAE

## Genus NEOALVEOLINA Silvestri, 1928

*Neoalveolina pulchra* (D'Orbigny)

Plate 87, figure 8

*Alveolina pulchra* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'Ile de Cuba, Foraminifères, p. 70, pl. 8, figs. 19, 20, 1839.

*Neoalveolina pulchra* Reichel, Soc. Pal. Suisse Mem., v. 58, p. 95, 1937.

Rare specimens occur at all the atolls.

## Family HETEROHELICIDAE

## Genus GÜMBELINA Egger, 1899

*Gümbelina?* *marshallana* Todd, n. sp.

Plate 87, figure 9

Test small, slender, somewhat compressed, periphery rounded, very slightly indented; chambers few, distinct, 6 to 8 pairs comprising the test, rapidly increasing in size as added; sutures distinct, depressed; wall finely perforate; aperture a high, narrow, slit extending from the suture into the face of the last-formed chamber. Length 0.23 to 0.30 mm, breadth 0.13 to 0.15 mm, thickness 0.07 to 0.10 mm.

Holotype (USNM 548727) from core on Sylvania Guyot, bottom of the core at 5 to 7 inches, 720 fathoms, 11°44'47" N., 165°09'56" E. (Bik 1176(5''-7'')).

This species closely resembles *G. cubensis* Palmer (1934, p. 74, text figs. 1-6) from the Oligocene of Cuba and adjacent areas but differs in its slenderer test, slightly less inflated chambers, and its high aperture, elongated in the plane of the test.

This genus has not previously been known from sediments younger than Oligocene. This form is questionably placed in this genus because of the type of aperture which resembles that characteristic of *Bolivina*, although it is not unknown in the genus *Gümbelina*.

This species may have its origin in fossil, rather than Recent, sediments in a manner suggested in the discussion of the unique faunal composition of the core, Bikini 1176, whereby a submarine outcrop of Tertiary sediments higher on the atoll slope might have shed debris down the slope of the atoll.

## Genus BOLIVINITA Cushman, 1927

*Bolivinita quadrilatera* (Schwager)

*Textularia quadrilatera* Schwager, *Novara-Exped.*, Geol. Theil, Band 2, p. 253, pl. 7, fig. 103, 1866.

H. B. Brady, *Challenger Rept.*, Zoology, v. 9, p. 358, pl. 42, figs. 8-12, 1884.

*Bolivinita quadrilatera* Cushman, B. P. Bishop Mus. Bull. 119, p. 121, pl. 14, figs. 12a, b, 1934; U. S. Natl. Mus. Bull. 161, pt. 3, p. 2, pl. 1, 1942.

A few specimens, some as long as 1.15 mm, occur in three deep-water samples off Bikini.

## Genus BOLIVINELLA Cushman, 1927

*Bolivinella folia* (Parker and Jones)

Plate 87, figures 10, 11

*Textularia folia* Parker and Jones, *Philosophical Trans.*, v. 155, p. 370, 420, pl. 18, fig. 19, 1865.

H. B. Brady (in part), *Challenger Rept.*, Zoology, v. 9, p. 357, pl. 42, figs. 3-5 (not 1, 2), 1884.

*Bolivinella folia* Cushman Lab. Foram. Research Contr., v. 2, pt. 4, p. 79, 1927; U. S. Natl. Mus. Bull. 161, pt. 3, p. 3, pl. 2, figs. 1-4, 6, 1942.

This is a characteristic species of warm shallow waters of the Pacific.

*Bolivinella folia* var. *ornata* Cushman

Plate 87, figures 12, 13

*Bolivinella folia* (Parker and Jones) var. *ornata* Cushman, Cushman Lab. Foram. Research Contr., v. 5, p. 32, pl. 5, figs. 3, 4, 1929; U. S. Natl. Mus. Bull. 161, pt. 3, p. 5, pl. 2, figs. 5, 8, 1942.

The types of this variety were from shore sand of Hardwicke Bay, Australia, and the only other recorded occurrence is from 12 fathoms, off Levuka, Fiji. It is of interest that it has been found in a number of samples in this material.

In addition to the peripheral spines this variety differs in being thicker in the middle, while the typical form is equally compressed throughout.

## Family BULIMINIDAE

## Genus BULIMINELLA Cushman, 1911

*Buliminella elegantissima* (D'Orbigny)

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

*Buliminella elegantissima* Cushman and Parker, U. S. Geol. Survey Prof. Paper 210-D, p. 67, pl. 17, figs. 10-12, 1947.

A single small but typical specimen of this cosmopolitan species was found at Eniwetok 329.

*Buliminella milletti* Cushman

Plate 87, figures 14, 15

*Buliminella milletti* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 78, pl. 8, figs. 5, 6, 1933; U. S. Natl. Mus. Bull. 161, pt. 3, p. 7, pl. 3, figs. 1-4, 1942.

The types of this species are from Mokaujar Anchorage, Fiji, and it is recorded from numerous stations in shallow warm waters of the Pacific and also in the Mediterranean and the West Indian region of the Atlantic. A few of the specimens have a pointed initial end resembling *B. madagascariensis* (D'Orbigny), var. *spicata* Cushman and Parker (1947, p. 64, pl. 16, fig. 20) but not the distinct basal spine characteristic of that variety. With these are very rare specimens that tend toward *B. parallela* Cushman and Parker (1947, p. 69, pl. 17, fig. 22) but not enough to separate them definitely.

## Genus BULIMINOIDES Cushman, 1911

*Buliminoides williamsoniana* (H. B. Brady)

Plate 87, figures 16, 17

*Bulimina williamsoniana* H. B. Brady, *Quart. Jour. Microsc. Sci.*, v. 21, p. 56, 1881; *Challenger Rept.*, Zoology, v. 9, p. 408, pl. 51, figs. 16, 17, 1884.

*Buliminoides williamsoniana* Cushman, U. S. Natl. Mus. Bull. 71, pt. 2, p. 90, fig. 144 (in text), 1911; idem, Bull. 161, pt. 3, p. 8, pl. 3, figs. 7-9, 1942.

This is a widely distributed species in the Indo-

Pacific region and occurs also in the West Indian region of the Atlantic.

Genus **ROBERTINA** D'Orbigny, 1846

*Robertina subcylindrica* (H. B. Brady)

Plate 87, figure 18

*Bulimina subcylindrica* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 56, 1881; *Challenger* Rept., Zoology, v. 9, p. 404, pl. 50, figs. 16a, b, 1884.

*Robertina subcylindrica* Cushman and Parker, Cushman Lab. Foram. Research Contr., v. 12, p. 95, pl. 16, figs. 10a, b, 1936.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 9, pl. 3, fig. 14, 1942.

This species occurs rarely in the core at Bikini 1176.

*Robertina translucens* Cushman and Parker

Plate 87, figure 19

*Robertina translucens* Cushman and Parker, Cushman Lab. Foram. Research Contr., v. 12, p. 99, pl. 16, figs. 8a, b, 1936; U. S. Geol. Survey Prof. Paper 210-D, p. 75, pl. 18, figs. 15a, b, 1947.

Two typical specimens were found at Bikini 1174.

Genus **PSEUDOBULIMINA** Earland, 1934

*Pseudobulimina* sp.

Plate 87, figure 20

A few specimens from Bikini and Rongelap, insufficient for complete description, seem to represent an undescribed species. The specimens are quite strongly compressed and broader in proportion to length than those referred to *Pseudobulimina convoluta* (Williamson) (Said, 1949, p. 26, pl. 4, fig. 4), although the available specimens show a considerable degree of variation in shape.

Genus **BULIMINA** D'Orbigny, 1826

*Bulimina aculeata* D'Orbigny

Plate 87, figure 21

*Bulimina aculeata* D'Orbigny, Annales sci. nat., tome 7, p. 269, no. 7, 1826.

Cushman and Parker, U. S. Geol. Survey Prof. Paper 210-D, p. 120, pl. 28, figs. 8-11, 1947.

This widely distributed species occurs at several of the deep-water Bikini stations.

*Bulimina affinis* D'Orbigny

Plate 87, figure 22

*Bulimina affinis* D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'Île de Cuba, Foraminifères, tome 6, p. 105, pl. 2, figs. 25, 26, 1839.

Cushman and Parker, U. S. Geol. Survey Prof. Paper 210-D, p. 122, pl. 28, figs. 23-25, 1947.

A few specimens were found in the core at Bikini 1176.

*Bulimina costata* D'Orbigny

Plate 87, figure 23

*Bulimina costata* D'Orbigny, Annales sci. nat., tome 7, p. 269, no. 1, 1826.

Cushman and Parker, U. S. Geol. Survey Prof. Paper 210-D, p. 115, pl. 27, figs. 2, 3, 1947.

This thin-walled, coarsely punctate species occurs in several deep-water samples at Bikini. The present specimens have been compared with specimens from the Pliocene of Italy and resemble them closely.

*Bulimina fijiensis* Cushman

Plate 87, figure 25

*Bulimina fijiensis* Cushman Lab. Foram. Research Contr., v. 9, p. 79, pl. 8, figs. 7a-c, 1933; U. S. Natl. Mus. Bull. 161, pt. 3, p. 11, pl. 3, figs. 10, 11, 1942.

The types are from 12 fathoms, Nairai, Fiji, and it is also recorded from 12 fathoms, Levuka, Fiji, and from Zanzibar. It occurs commonly at all four atolls.

*Bulimina rostrata* H. B. Brady

Plate 87, figure 24

*Bulimina rostrata* H. B. Brady, *Challenger*, Rept., Zoology, v. 9, p. 408, pl. 51, figs. 14, 15, 1884.

This species, described from 428 fathoms off the Ki Islands, occurs at several deep-water stations at Bikini.

Genus **OOLINA** D'Orbigny, 1839

*Oolina squamosa* (Montagu)

Plate 87, figure 26

*Vermiculum squamosum* Montagu, Testacea Britannica, p. 526 pl. 14, fig. 2, 1803.

*Entosolenia squamosa* Williamson, Annals and Mag. Nat. History, 2d ser., v. 1, p. 18, pl. 2, fig. 19, 1848; Recent Foraminifera of Great Britain, p. 12, pl. 1, fig. 29, 1858.

Rare but characteristic specimens of this widely known species were found at Bikini and Rongelap. With these was found a single specimen of *O. catenulata* (Williamson) (1848, p. 19, pl. 2, fig. 20) which differs in that the cells of the reticulate ornamentation are arranged in longitudinal columns whereas in *O. squamosa* no alignment of the cells is noticeable.

Genus **FISSURINA** Reuss, 1850

*Fissurina auriculata* (H. B. Brady) var. *costata* (H. B. Brady)

*Lagena auriculata* var. *costata* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 61, 1881; *Challenger* Rept., Zoology, v. 9, p. 487, pl. 60, fig. 38, 1884.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 23, pl. 6, fig. 2, 1933.

A single specimen from Bikini 1175 at 592 fathoms is the same as specimens from deep water in the Tropical Pacific.

*Fissurina circularis* Todd, n. sp.

Plate 87, figure 27

*Lagena marginata* Cushman (part) (not Montagu), U. S. Natl. Mus. Bull. 161, pt. 2, p. 17, pl. 4, figs. 11, 14; pl. 5, figs. 4, 6, 8, 9 (not pl. 4, figs. 9, 12, 15, 16; pl. 5, fig. 2), 1933.

Test small for the genus, compressed, very slightly longer than broad, apertural end not extending out from the circular outline of the test, periphery acute, sometimes slightly keeled; wall thin, transparent in the central portion, with an opaque band around the periphery giving the appearance of a broad keel, sometimes both sides of the test are ornamented by faint ridges of shell material just inside and parallel to the periphery; aperture an elongate slit, without a lip, connecting with the interior by an elongate tube extending half or more of the length of the test. Diameter 0.25 to 0.30 mm, thickness 0.12 mm.

Holotype (USNM 548767) from Eniwetok lagoon, 24 fathoms, 11°31'15" N., 162°20'27" E. (Eni 326).

This species differs from *F. marginata* (Walker and Boys) (1784, p. 2, pl. 1, fig. 7) in its circular form and its aperture not projecting out from the outline of the test. It is fairly widespread in the Marshall Islands material.

*Fissurina formosa* (Schwager)

Plate 87, figure 31

*Lagena formosa* Schwager (in part), *Novara-Exped.*, Geol. Theil, v. 2, p. 206, pl. 4, figs. 19a, 19d (not 19b, 19c), 1866.

H. B. Brady, *Challenger Rept.*, Zoology, v. 9, p. 480, pl. 60, figs. 10, 18-20, 1884.

*Entosolenia formosa* Cushman, *Foraminifera*, 4th Ed., Key, pl. 21, fig. 22, 1948.

A few specimens showing considerable variation in shape and size, occur rather rarely at Rongerik, Bikini, and Eniwetok.

*Fissurina lacunata* (Burrows and Holland)

Plate 87, figure 28

*Lagena lacunata* Burrows and Holland, (in Jones), *Paleont. Soc.*, 1895, pt. 205, pl. 7, fig. 12.

*Lagena orbignyana* var. *lacunata* Sidebottom, *Manchester Lit. Philos. Soc. Mem. and Proc.*, v. 54, no. 16, p. 19, pl. 2, fig. 14, 1910.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 27, pl. 7, figs. 1-5, 8, 1933.

*Fissurina lacunata* Parr, *Royal Soc. Victoria Proc.*, v. 56 (n. ser.), pt. 2, p. 203, 1945.

*Lagena castrensis* H. B. Brady (not Schwager), *Challenger Rept.*, Zoology, v. 9, p. 485, pl. 60, figs. 1, 2, 1884.

*Lagena orbignyana* var. *castrensis* Millett, *Royal Micros. Soc. Jour.*, 1901, p. 626, pl. 14, fig. 20.

This small species, triple-keeled on the periphery and with the body of the test having a reticulate ornamentation, occurs rarely at all four atolls. It has a more definite neck than *F. orbignyana* (Seguenza) (1862, p.

66, pl. 2, figs. 25, 26) and so seems to be more than variety distinct from that species.

*Fissurina milletti* Todd, n. sp.

Plate 87, figure 30

*Lagena marginato-perforata* Millett (not Seguenza), *Royal Micros. Soc. Jour.*, 1901, p. 621, pl. 14, fig. 4.

Cushman (part), U. S. Natl. Mus. Bull. 161, pt. 2, p. 19, pl. 5, figs. 1a, b; pl. 6, figs. 1a, b (not pl. 4, figs. 13a, b), 1933.

Test small for the genus, compressed, about twice as long as broad, basal end rounded, apertural end extended into a short neck with everted lip, periphery with a thickened, blunt keel; wall thin, transparent, ornamented thickly and evenly by small pits which appear opaque on the clear wall; aperture compressed, surrounded by a thickened rim, connecting with the interior by means of a tube extending about one quarter the length of the test. Length 0.25 mm, breadth 0.13 mm, thickness 0.10 mm.

Holotype (USNM 548743) from Eniwetok atoll, 500 fathoms, 11°18'52" N., 162°15'24" E. (Eni 119).

This species differs from *F. marginato-perforata* (Seguenza) (1880, p. 332, pl. 17, fig. 34) in the finer texture of its ornamentation, its narrow, blunt peripheral keel and its short neck with backwardly curved lip. It appears to be the same as the specimens referred to in the above synonymy; Millett's record being from the Malay Archipelago and the other from various localities in the Tropical Pacific. In the present material it occurs at numerous stations but is nowhere common. It shows remarkably little variation.

It somewhat resembles *F. perforata* (Moebius, 1880, p. 90, pl. 8, fig. 6) from off Mauritius but that species lacks the definite neck that is characteristic of *F. milletti*, n. sp.

*Fissurina radiato-marginata* (Parker and Jones)

Plate 87, figure 29

*Lagena radiato-marginata* Parker and Jones, *Philosophical Trans.*, v. 155, p. 355, pl. 18, fig. 3, 1865.

H. B. Brady, *Challenger Rept.*, Zoology, v. 9, p. 481, pl. 61, figs. 8, 9, 1884.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 2, p. 31, pl. 7, figs. 17, 18, 1933.

*Fissurina radiato-marginata* Parr, *Royal Soc. Victoria Proc.*, v. 58 (n. ser.), pts. 1-2, p. 122, pl. 6, fig. 11, 1945 (1947).

This species, described from Australian coral-reefs and recorded from various localities in the Pacific, is represented by two specimens from Bikini 218 core (12-16").

*Fissurina* sp. A

Plate 87, figure 32

Test very small, inflated, globular with a projecting apertural neck, periphery with 3 very slight keels, cen-

tral body of test translucent so that the internal tube is visible. Length 0.18 mm, breadth 0.15 mm, thickness 0.10 mm.

This small species seems to be undescribed. It occurs fairly commonly at Eniwetok and is found rarely at Rongelap and Rongerik.

*Fissurina* sp. B

Plate 87, figure 33

*Lagena orbignyana* Cushman (not Seguenza), U. S. Natl. Mus. Bull. 161, pt. 2, p. 26, pl. 6, figs. 7, 8, 11, 1933.

A species with a broad peripheral keel and secondary keels on either side, and a projecting apertural neck, is represented by a few specimens at Bikini and Eniwetok. It seems to be different from typical *F. orbignyana* (Seguenza) (1862, p. 66, pl. 2, figs. 25, 26) in its very broad keels and projecting neck.

*Fissurina* sp. C

Plate 87, figure 34

A species with thickened base showing numerous keels and a compressed and pointed apertural end, similar to the specimen figured, occurs rarely at Bikini and Eniwetok.

*Fissurina* spp.

In addition to those here recorded, there are several other species of *Fissurina*, represented by too few or poor specimens to describe.

Genus *VIRGULINA* D'Orbigny, 1826

*Virgulina earlandi* Cushman

Plate 87, figure 35

*Virgulina earlandi* Cushman, Cushman Lab. Foram. Research Special Pub. 6, p. 49, pl. 7, figs. 8a-c, 1936; idem, Special Pub. 9, p. 30, pl. 4, figs. 27, 28, 1937.

*Virgulina schreibersiana* Millett (not Czjzek), Royal Micros. Soc. Jour., 1900, p. 280, pl. 11, figs. 13a, b.

Heron-Allen and Earland, Zool. Soc. London Trans, v. 20, p. 642, pl. 49, figs. 1-12, 1915.

This species, described from the Kerimba Archipelago occurs rarely. Most of the specimens are young and are slenderer than paratypes with which they have been compared.

Genus *BOLIVINA* D'Orbigny, 1839

*Bolivina abbreviata* Heron-Allen and Earland

Plate 87, figure 36

*Bolivina limbata* H. B. Brady var. *abbreviata* Heron-Allen and Earland, Linnean Soc. Jour., Zoology, v. 35, p. 622, pl. 36, figs. 25-27, 1924.

*Bolivina abbreviata* Cushman, Cushman Lab. Foram. Research Special Pub. 9, p. 143, pl. 18, figs. 34, 35, 1937; U. S. Natl. Mus. Bull. 161, pt. 3, p. 33, pl. 9, fig. 5, 1942.

A few specimens were found at Bikini.

*Bolivina compacta* Sidebottom

Plate 87, figure 37

*Bolivina robusta* H. B. Brady var. *compacta* Sidebottom, Manchester Lit. Philos. Soc. Mem. and Proc., v. 49, no. 5, p. 15, pl. 3, fig. 7, 1905.

*Bolivina compacta* Cushman, U. S. Natl. Mus. Bull. 71, pt. 2, p. 36, fig. 58, 1911; U. S. Natl. Mus. Bull. 161, pt. 3, p. 20, pl. 7, figs 2, 3, 1942.

This is apparently a widely distributed species and has been recorded from many localities in the warm, shallow waters of the Pacific.

*Bolivina globulosa* Cushman

*Bolivina globulosa* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 80, pl. 8, figs. 9a, b, 1933.

A single specimen of this species described from 2883 fathoms and recorded from other deep water samples from the tropical Pacific, was found at Bikini 1175 (0-1'').

The measurements as originally given are in error. The holotype measures 0.30 mm in length and 0.13 mm in breadth. The present specimen is slightly larger; 0.48 mm long and 0.21 mm wide, but shows the same highly polished wall surface.

*Bolivina nitida* H. B. Brady

Plate 87, figure 38

*Bolivina nitida* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 420, pl. 52, fig. 30a, b, 1884.

Cushman, Cushman Lab. Foram. Research Special Pub. 9, p. 136, pl. 17, figs. 25a, b, 1937; U. S. Natl. Mus. Bull. 161, pt. 3, p. 25, pl. 7, figs. 5a, b, 1942.

This species known from medium to deep-water samples in the Pacific occurs rarely but in typical form at Bikini and Rongelap.

*Bolivina oceanica* Cushman

*Bolivina oceanica* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 81, pl. 8, figs. 10a, b, 1933; idem, Special Pub. 9, p. 147, pl. 19, figs. 31a, b, 1937; U. S. Natl. Mus. Bull. 161, pt. 3, p. 24, pl. 7, figs. 4a, b, 1942.

Single specimens from two samples, Rongerik 13 and 54, resemble this species but may not belong here. The species is recorded from numerous Pacific stations but all in comparatively deep water.

*Bolivina pseudopygmaea* Cushman

Plate 87, figure 39

*Bolivina pseudopygmaea* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 79, pl. 8, figs. 8a, b, 1933; idem, Special Pub. 9, p. 147, pl. 19, figs. 32a, b, 1937; U. S. Natl. Mus. Bull. 161, pt. 3, p. 29, pl. 8, figs. 6a, b, 1942.

The types and all other records for this species are from the vicinity of the Marshall Islands. Therefore

it is not surprising to find typical specimens in abundance in this material.

***Bolivina rhomboidalis* (Millett)**

Plate 87, figures 41, 42

*Textularia rhomboidalis* Millett, Royal Micros. Soc. Jour., 1899, p. 559, pl. 7, figs. 4a, b.

*Bolivina rhomboidalis* Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 19, pl. 6, figs. 7, 8, 1942.

The types of this species are from the Malay Archipelago. It is widely distributed in rather warm, shallow waters.

***Bolivina robusta* H. B. Brady**

Plate 87, figure 40

*Bolivina robusta* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 57, 1881; *Challenger Rept.*, Zoology, v. 9, p. 421, pl. 53, figs. 7-9, 1884.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 17, pl. 6, figs. 2a, b, 1942.

This species described from the Ki Islands and Fiji occurs at Bikini and Eniwetok in typical form except lacking the basal spine. Specimens are distinctive in their crenulated sutures.

***Bolivina striatula* Cushman**

Plate 87, figure 43

*Bolivina striatula* Cushman, Carnegie Inst. Washington Pub. 311, p. 27, pl. 3, fig. 10, 1922; U. S. Natl. Mus. Bull. 161, pt. 3, p. 30, pl. 9, fig. 1, 1942.

This species has a very wide distribution. Specimens referred to it are quite abundant in the present material.

***Bolivina subexcavata* Cushman and Wickenden**

Plate 87, figure 44

*Bolivina subexcavata* Cushman and Wickenden, U. S. Natl. Mus. Proc., v. 75, art. 9, p. 9, pl. 4, figs. 4a, b, 1929.

The types of this species were from off Juan Fernandez. Specimens from several samples have been compared with the types and seem identical.

***Bolivina subreticulata* Parr**

*Bolivina subreticulata* Parr, Royal Soc. Victoria Proc., v. 44, p. 12, pl. 1, figs. 21a, b, 1932.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 31, pl. 9, fig. 2, 1942.

Two specimens from Bikini 1175 core at 1 to 2 inches have been compared with topotypes of this species from 155 fathoms, off Raine Island, and seem to be the same. In ornamentation they are similar to *B. robusta* H. B. Brady but are shorter and broader, and have more strongly raised costae.

***Bolivina subtenuis* Cushman**

*Bolivina subtenuis* Cushman, Cushman Lab. Forum. Research Special Pub. 6, p. 57, pl. 8, fig. 10, 1936; idem, Special Pub. 9, p. 148, pl. 19, figs. 33, 34, 1937; U. S. Natl. Mus. Bull. 161, pt. 3, p. 29, pl. 8, fig. 5, 1942.

*Bolivina tenuis* H. B. Brady (not Marsson), *Challenger Rept.*, Zoology, v. 9, p. 419, pl. 52, fig. 29, 1884.

A single specimen of this rare species, known from Fiji and Samoa, was found at Rongelap 183, at 24 fms.

***Bolivina tortuosa* H. B. Brady**

Plate 87, figures 45-47

*Bolivina tortuosa* H. B. Brady (part), Quart. Jour. Micros. Sci., v. 21, p. 27, 1881; *Challenger Rept.*, Zoology, v. 9, p. 420, pl. 52, figs. 31, 32 (not 33, 34), 1884.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 20, pl. 7, figs. 1a, b, 1942.

The types of this species are from 17 fathoms off the Admiralty Islands. It is very widely recorded both living and fossil. It is especially abundant in rather warm, shallow waters, and is abundant in our material. The species is characterized by rather coarse perforations which appear white against the translucent wall, and some specimens showing these perforations are placed here even though not strongly twisted.

**Genus LOXOSTOMUM Ehrenberg, 1854**

***Loxostomum convallarium* (Millett)**

Plate 88, figures 4, 5

*Bolivina convallaria* Millett, Royal Micros. Soc. Jour., 1900, p. 544, pl. 4, fig. 6.

*Loxostoma convallarium* Cushman, Cushman Lab. Forum. Research Special Pub. 9, p. 191, pl. 22, figs. 11-13, 1937; U. S. Natl. Mus. Bull. 161, pt. 3, p. 37, pl. 10, fig. 6, 1942.

This is evidently a Pacific species. It is rather common at Eniwetok.

***Loxostomum karrerianum* (H. B. Brady)**

Plate 88, figure 6

*Bolivina karreriana* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 28, 1881; *Challenger Rept.*, Zoology, v. 9, p. 424, pl. 53, figs. 19-21, 1884.

*Loxostoma karrerianum* Cushman, Cushman Lab. Forum. Research Special Pub. 9, p. 184, pl. 21, figs. 17a, b, 1937.

A few typical specimens were found in two deep-water samples, Bikini 1174 and 1175.

***Loxostomum limbatum* (H. B. Brady)**

Plate 88, figure 7

*Bolivina limbata* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 27, 1881; *Challenger Rept.*, Zoology, v. 9, p. 419, pl. 52, figs. 26-28, 1884.

*Loxostoma limbatum* Cushman, Cushman Lab. Forum. Research Special Pub. 9, p. 186, pl. 21, figs. 26-29, 1937; U. S. Natl. Mus. Bull. 161, pt. 3, p. 35, pl. 10, figs. 1a, b, 1942.

The types of this species are from off the Hawaiian Islands. It has a very wide distribution particularly in warm, shallow waters.



**Loxostomum mayori** (Cushman)

Plate 88, figure 8

*Bolivina mayori* Cushman, Carnegie Inst. Washington Pub. 311, p. 27, pl. 3, figs. 5, 6, 1922.*Loxostomum mayori* Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 38, pl. 11, figs. 1, 2, 1942.

A few specimens of this widely distributed species were found at Eniwetok and Rongerik. In the coarsely perforated test they are similar to *L. limbatum* but differ in the sutures not being limbate and the whole test being much slenderer.

**Genus BIFARINELLA** Cushman and Hanzawa, 1936**Bifarinnella mackinnonii** (Millett)

Plate 88, figure 9

*Bifarinnella mackinnonii* Millett, Royal Micros. Soc. Jour., 1900, p. 281, pl. 2, figs. 15a, b.

Cushman, Cushman Lab. Foram. Research Special Pub. 9, p. 200, pl. 23, figs. 6, 7, 1937.

The genus *Bifarinnella*, known from a single species described from the late Tertiary of the Ryukyu Islands and found in deep water of the Red Sea, is represented by a different species in the Marshall Islands. Only three specimens were found but they seem to be referable to the form described from the Malay Archipelago at 14 fms. They differ from *B. ryukyuensis* Cushman and Hanzawa (1936, p. 46, pl. 8, figs. 7, 8) in the much slenderer test lacking the coarse papillate and spinose ornamentation. The available specimens indicate that the present species holds its stage of oblique sutures much longer and the test axis continues to be twisted throughout growth.

**Genus RECTOBOLIVINA** Cushman, 1927**Rectobolivina bifrons** (H. B. Brady)*Sagrina bifrons* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 64, 1881; *Challenger Rept.*, Zoology, v. 9, p. 582, pl. 75, figs. 18-20, 1884.*Siphogenerina (Sagrina) bifrons* Egger, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, Band 18, p. 317, pl. 9, figs. 25, 26, 29, 1893.*Siphogenerina bifrons* Cushman, U. S. Natl. Mus. Bull. 71, pt. 3, p. 105, pl. 45, figs. 1, 2, 5-7, 1913.*Rectobolivina bifrons* Cushman, Cushman Lab. Foram. Research Contr., v. 3, p. 68, 1927; *idem*, Special Pub. 9, p. 204, pl. 23, figs. 13, 14, 1937.

A few specimens were found in Bikini core 1175 at 1 to 2 inches and 2 to 3 inches.

**Genus BITUBULOGENERINA** Howe, 1934**Bitubulogenerina** sp.

Plate 88, figure 11

Test small, compressed, attenuated, periphery strongly indented; chambers few, not inflated, basal

portion flaring outward from the test and strongly undercut with the result that the test resembles a stalk surrounded by a spiral fringe; wall thin, translucent; aperture large, terminal, rounded, with a slight lip. Length 0.25 to 0.32 mm, breadth 0.12 to 0.15 mm.

This seems to be the first record of this genus in the Recent although certain species having terminal apertures but described as *Bolivina* may belong here. The present specimens may possibly be young forms of a *Bifarinnella*, but in the material available, no indication of uniserial development can be noticed. This species differs from early stages of *Bifarinnella fimbriata* (Millett) (Cushman, 1937, p. 200, pl. 23, fig. 4) in the chambers being much more attenuated.

**Genus REUSSELLA** Galloway, 1933**Reussella simplex** (Cushman)

Plate 88, figures 1, 2

*Trimosina simplex* Cushman, Washington Acad. Sci. Jour., v. 19, p. 158, figs. 2a, b (in text), 1929; U. S. Natl. Mus. Bull. 161, pt. 3, p. 44, pl. 12, figs. 7a, b, 1942.*Reussella simplex* Cushman, Cushman Lab. Foram. Research Contr., v. 21, p. 40, pl. 7, figs. 5a, b, 1945.

This species is known only from the Indo-Pacific area. It is very abundant in this material.

**Reussella** sp. A

Plate 88, figure 3

Rare specimens from a number of Eniwetok stations and one Rongerik station differ from *R. simplex* in their smaller, slenderer, and less regular tests and the wall which is rather granular on the surface instead of smooth, translucent, and ornamented by coarse perforations as in *R. simplex*. They closely resemble young specimens of *R. spinulosa*, var. *atlantica* Cushman (1947, p. 91, pl. 20, figs. 6, 7) described from off Florida.

**Reussella** sp. B

Rare specimens from Bikini core 1175 at 3 to 4 inches differ from *R. simplex* (Cushman) in having a few heavy, blunt spines projecting outward, nearly horizontally, from the three peripheral angles.

**Genus MIMOSINA** Millett, 1900**Mimosina pacifica** Cushman*Mimosina pacifica* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 77, pl. 8, figs. 3a, b, 1933; U. S. Natl. Mus. Bull. 161, pt. 3, p. 45, pl. 12, figs. 8a, b, 1942.

This species was described from material collected in 12 fathoms off Levuka, Fiji. The other records are from Mokaujar Anchorage, Fiji, and Pongelap Atoll, Marshall Islands. It is fairly common, occurring at all four atolls.







## Genus PAVONINA D'Orbigny, 1826

*Pavonina triformis* Parr

Plate 88, figure 10

*Pavonina triformis* Parr, Royal Soc. Victoria Proc., v. 45, p. 29, pl. 7, figs. 1-3, 1933.

*Pavonina flabelliformis* Howchin (not D'Orbigny), Royal Soc. South Australia Trans. and Proc., v. 12, p. 7, 1889.

Heron-Allen and Earland, Royal Micros. Soc. Jour., 1924, p. 141, pl. 8, fig. 22.

A single specimen from 5 to 7 inches in Bikini core 1176 seems referable to this species described and known from the Miocene and Oligocene of Australia. It has a more prominently projecting initial part than the Recent *P. flabelliformis* D'Orbigny (1826, p. 260, pl. 10, figs. 10-12), including at the beginning a triserial, then a biserial stage. Preservation of the surface of the test is not good but the wall is finely beaded except over the initial part where it is irregularly costate.

## Genus CHRYSALIDINELLA Schubert, 1907

*Chrysalidinella fijiensis* Cushman

Plate 88, figure 12

*Chrysalidinella fijiensis* Cushman, Cushman Lab. Foram. Research Contr., v. 21, p. 53, pl. 8, figs. 24a, b, 1945.

*Chrysalidinella dimorpha* Cushman (not H. B. Brady), Washington Acad. Sci. Jour., v. 19, p. 159, fig. 3 (in text), 1929; U. S. Natl. Mus. Bull. 161, pt. 3, p. 46, pl. 13, fig. 1, 1942.

A single specimen from Rongerik 31 is typical but no other specimens were found. It was described from 40 to 50 fathoms, off Fiji.

## Genus UVIGERINA D'Orbigny, 1826

*Uvigerina ampullacea* H. B. Brady

Plate 88, figure 19

*Uvigerina asperula* var. *ampullacea* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 579, pl. 75, figs. 10, 11, 1884.

*Uvigerina ampullacea* Egger, K. Bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, Band 18, p. 313, pl. 9, fig. 37, 1893.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 46, pl. 13, figs. 2-6, 1942.

This species occurs in a few deep-water samples at Bikini. It is characterized by a compact, rounded initial portion and a slender, attenuated apertural end. The species was described from Ascension Island and has been widely recorded in both the Atlantic and Pacific, and in the later Tertiary as well.

*Uvigerina* cf. *U. peregrina* Cushman

Plate 88, figure 13

*Uvigerina peregrina* Cushman, U. S. Natl. Mus. Bull. 104, pt. 4, p. 166, pl. 42, figs. 7-10, 1923.

Abundant specimens from Bikini 1174 seem closer to this western Atlantic species than to any other. They are not well preserved, as the ornamentation is ob-

scured by fine sediment, but otherwise they seem very close.

*Uvigerina porrecta* H. B. Brady

Plate 88, figures 14, 15

*Uvigerina porrecta* H. B. Brady, Quart. Jour. Micros. Sci., v. 19, p. 60, pl. 8, figs. 15, 16, 1879; *Challenger* Rept., Zoology, v. 9, p. 577, pl. 74, figs. 21-23, 1884.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 48, pl. 13, figs. 7, 8, 1942.

Typical specimens occur at all four atolls. This species was described from Torres Strait and has been widely recorded in the Pacific.

*Uvigerina porrecta* var. *fimbriata* Sidebottom

Plate 88, figure 16

*Uvigerina porrecta* H. B. Brady var. *fimbriata* Sidebottom, Royal Micros. Soc. Jour., 1918, p. 147, pl. 5, fig. 23.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 49, pl. 13, figs. 9, 10, 1942.

A single specimen of this form was found at Rongelap 463. The wall is covered by rather coarse spines throughout. The variety is unique in its extreme attenuation.

*Uvigerina proboscidea* Schwager

Plate 88, figure 18

*Uvigerina proboscidea* Schwager, *Novara-Exped.*, Geol. Theil, Band 2, p. 250, pl. 7, fig. 96, 1866.

Cushman, U. S. Natl. Mus. Bull. 161, pt. 3, p. 49, pl. 14, figs. 1-4, 1942.

This species described from the Pliocene of Far Nicobar occurs commonly in the deeper-water samples of Bikini and rarely at Eniwetok. In ornamentation it is similar to *U. ampullacea* H. B. Brady, but differs in shape of test, being more robust and compact, and not attenuated toward the apertural end.

*Uvigerina proboscidea* var. *vadescens* Cushman

Plate 88, figure 17

*Uvigerina proboscidea* Schwager var. *vadescens* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 85, pl. 8, figs. 14, 15, 1933; U. S. Natl. Mus. Bull. 161, pt. 3, p. 50, pl. 14, figs. 5-9, 1942.

This variety occurs in a number of deep-water samples at Bikini and Eniwetok, but is abundant at only a few stations. It was described from 21 fathoms, Guam Anchorage, Ladrone Islands.

## Genus SIPHOGENERINA Schlumberger, 1883

*Siphogenerina dimorpha* var. *pacifica* Cushman

Plate 88, figure 22

*Siphogenerina dimorpha* (Parker and Jones) var. *pacifica* Cushman, U. S. Natl. Mus. Proc., v. 67, art. 25, p. 13, pl. 2, fig. 9; pl. 3, figs. 6a, b, 1926; idem, Bull. 161, pt. 3, p. 53, pl. 15, fig. 4, 1942.

*Sagrina dimorpha* H. B. Brady (part), *Challenger* Rept., Zoology, v. 9, p. 582, pl. 76, figs. 1-3, 1884.

Single typical specimens were found at Bikini 1175

and Eniwetok 119. This small species is characterized by its cancellated wall and the depressions along the base of the chambers at the sutures.

*Siphogenerina raphana* (Parker and Jones)

Plate 88, figures 23, 24

*Uvigerina* (*Sagrina*) *raphanus* Parker and Jones, Philosophical Trans., v. 155, p. 364, pl. 18, figs. 16, 17, 1865.

*Sagrina raphanus* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 585, pl. 75, figs. 21-24, 1884.

*Siphogenerina* (*Sagrina*) *raphanus* Egger, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, Band 18, p. 317, pl. 9, fig. 36, 1893.

*Siphogenerina raphanus* Cushman, U. S. Natl. Mus. Proc., v. 67, art. 25, p. 4, pl. 1, figs. 1-4; pl. 2, figs. 1-3, 10; pl. 5, figs. 1, 2, 1926; idem, Bull. 161, pt. 3, p. 55, pl. 15, figs. 6-9, 1942.

*Siphogenerina raphanus* (Parker and Jones) var. *costulata* Cushman, idem, Proc., v. 51, p. 662, 1917; idem, Bull. 100, v. 4, p. 281, pl. 56, fig. 6, 1921.

*Siphogenerina costata* Schlumberger, Feuille Jeun. Nat., ann. 13, p. 118, fig. B, 1883.

This species is recorded from numerous localities in fairly shallow warm water. The figured specimens illustrate the difference between microspheric and megalospheric forms.

Genus *SIPHONODOSARIA* A. Silvestri, 1924

*Siphonodosaria abyssorum* (H. B. Brady)

Plate 88, figure 26

*Nodosaria abyssorum* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 63, 1881.

*Nodosaria* (?) *abyssorum* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 504, pl. 63, figs. 8, 9, 1884.

This species was described from 1825 fathoms in the South Pacific, southwest of Juan Fernandez. A few typical specimens occur in the core at Bikini 1176.

*Siphonodosaria lepidula* (Schwager)

Plate 88, figures 27, 28

*Nodosaria lepidula* Schwager, *Novara*-Exped., Geol. Theil, v. 2, p. 210, pl. 5, figs. 27, 28, 1866.

*Siphonodosaria lepidula* van der Sluis and de Vletter, Ned. Akad. Wetenschappen Proc., v. 45, p. 1014 (list), 1942.

This species described from the Pliocene of Kar Nicobar also occurs in the core at Bikini 1176, and is fairly common. Two specimens are figured to show the variation in ornamentation.

Genus *ANGULOGERINA* Cushman, 1927

*Angulogerina albatrossi* var. *ornata* Cushman

Plate 88, figure 20

*Angulogerina albatrossi* Cushman var. *ornata* Cushman, Cushman Lab. Foram. Research Contr., v. 8, p. 45, pl. 6, figs. 13, 14, 1932; U. S. Natl. Mus. Bull. 161, pt. 3, p. 57, pl. 15, figs. 10, 11, 1942.

Rare specimens from Bikini and Eniwetok are referred to this variety, although differing somewhat in having

an elongated apertural neck and rather prominent trilateral keels extending up onto the neck.

Genus *TRIFARINA* Cushman, 1927

*Trifarina bradyi* Cushman

Plate 88, figure 21

*Trifarina bradyi* Cushman, U. S. Natl. Mus. Bull. 104, pt. 4, p. 99, pl. 22, figs. 3-9, 1923; idem, Bull. 161, pt. 3, p. 59, pl. 15, figs. 13a, b, 1942.

*Rhabdognium tricarinatum* H. B. Brady (not *Vaginulina tricarinata* D'Orbigny), *Challenger* Rept., Zoology, v. 9, p. 525, pl. 67, figs. 1-3, 1884.

*Triplasia tricarinata* Cushman (not *Vaginulina tricarinata* D'Orbigny), U. S. Natl. Mus. Bull. 71, pt. 3, p. 62, pl. 39, fig. 2, 1913.

This cosmopolitan species occurs rarely at Bikini and Eniwetok. Specimens are shorter and proportionately broader than the types.

Family *ELLIPSOIDINIDAE*

Genus *PLEUROSTOMELLA* Reuss, 1860

*Pleurostomella bolivinoides* Schubert

Plate 88, figure 29

*Pleurostomella bolivinoides* Schubert, Geol. Reichsanstalt Abh., v. 20, pt. 4, p. 58, figs. 4a, b (in text), 1911.

Thalmann, *Eclogae geol. Helvetiae*, v. 30, p. 337, pl. 21, figs. 1a, b, 1937.

*Pleurostomella* sp. nov. Schubert, Geol. Reichsanstalt Abh., Band 20, pt. 4, p. 57, figs. 4a, b (in text), 1911.

*Pleurostomella schuberti* Cushman and Harris, Cushman Lab. Foram. Research Contr., v. 3, p. 133, pl. 25, figs. 29a, b, 1927.

A single typical specimen was found at 5-7'' in the core at Bikini 1176. The species was described from late Tertiary sediments in the Bismarck Archipelago and recorded from 375 fathoms in the Philippines.

Genus *PARAFISSURINA* Parr, 1947

*Parafissurina* sp.

Plate 88, figure 25

A single specimen belonging in this genus was found at the bottom of the core at Bikini 1176. It is somewhat similar to figures of *P. ventricosa* (Silvestri) (1903, p. 10, text figs. 6a-e) from the Miocene of Italy.

Family *ROTALIIDAE*

Genus *SPIRILLINA* Ehrenberg, 1843

*Spirillina decorata* H. B. Brady

Plate 88, figures 32, 33

*Spirillina decorata* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 633, pl. 85, figs. 22-25, 1884.

Test with the dorsal side flattened or slightly concave, ventral side convex, periphery acute; chamber with the coils increasing very gradually in width as added, slightly involute on the ventral side; suture distinct, depressed on the ventral side; wall on the dorsal side with fine, generally radiate markings, more

definite and coarser on the ventral side, and somewhat depressed; aperture at the end of the tubular chamber. Diameter of present specimens up to 0.35 mm.

A few specimens may be referred to this decidedly variable species.

***Spirillina decorata* H. B. Brady var. of Sidebottom**

Plate 88, figure 35

*Spirillina decorata* H. B. Brady var. Sidebottom, Manchester Lit. Philos. Soc. Mem. and Proc., v. 52, no. 13, p. 8, pl. 2, figs. 6a, b, 1908.

A very few specimens from Rongelap and Bikini resemble the form recorded by Sidebottom from the Island of Delos. The wall is radially ornamented, like *S. decorata*, but the peripheral spines vary from small and numerous, as in the specimen figured by Sidebottom, to fewer and more prominent, as in the specimen figured here.

***Spirillina inaequalis* H. B. Brady**

Plate 88, figures 36, 37

*Spirillina inaequalis* H. B. Brady, Quart Jour. Micros. Sci., v. 19, p. 278, pl. 8, figs. 25a, b, 1879; *Challenger* Rept., Zoology, v. 9, p. 631, pl. 85, figs. 8-11, 1884.

Specimens of this widely distributed Indo-Pacific species are very rare in these collections.

***Spirillina tuberculato-limbata* Chapman**

Plate 88, figure 34

*Spirillina tuberculato-limbata* Chapman, Linnean Soc. Jour., Zoology, v. 28, p. 11, pl. 1, figs. 8a-c, 1899.

Two specimens, from Bikini 819 and Eniwetok 298, were found of this species described from the Funafuti borings. On one side the suture is obscured by the papillate ornamentation and on the other side the suture is strongly limbate.

***Spirillina vivipara* var. *densepunctata* Cushman**

Plate 88, figure 31

*Spirillina vivipara* Ehrenberg var. *densepunctata* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 4, pl. 1, figs. 5a, b, 1931.

This variety differs from the typical form in the broader coils that are ornamented by very numerous, fine, and evenly spaced perforations. Diameter 0.28 to 0.35 mm.

The types of this variety are from 7 feet, Largo Shoal, San Juan Harbor, Puerto Rico, and it is also recorded from Rio de Janeiro Harbor, Brazil. Rare specimens from Rongerik Atoll seem identical.

***Spirillina vivipara* var. *revertens* Rhumbler**

Plate 88, figure 30

*Spirillina vivipara* Ehrenberg var. *revertens* Rhumbler, Jahrb. Zool., Abt. Syst., Band 24, p. 32, pl. 2, figs. 8-10, 1906; Foram. Plankton-Exped., pt. 1, pl. 5, fig. 8; pl. 6, figs. 7-10, 1911; idem, pt. 2, p. 430, 1913.

Variety differing from the typical in a thicker test and in having the last portion of the final whorl slightly bent under on the ventral side.

The types of this variety are from off Laysan, Chatham Islands. It is recorded from a number of localities in the Pacific but is very rare in our material.

**Genus CONICOSPIRILLINA Cushman, 1927**

***Conicospirillina semi-involuta* Cushman**

Plate 88, figure 38

*Conicospirillina semi-involuta* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 86, pl. 8, figs. 19a-c, 1933.

A single specimen of this species described from 40 to 50 fathoms off Fiji was found at Sta. 51, 111 feet, in the lagoon at Rongerik.

***Conicospirillina* sp.**

Plate 88, figure 39

Very rare specimens represent a small, low, scalelike species of *Conicospirillina*. The wall is thin and transparent and the spiral suture indistinct. The periphery is acute and the ventral side depressed in the middle.

**Genus PATELLINA Williamson, 1858**

***Patellina advena* Cushman**

*Patellina advena* Cushman, U. S. Geol. Survey Prof. Paper 129-F, p. 135, pl. 31, fig. 9, 1922.

Test plano-convex, variable in relative height, the earliest portion of one or more undivided tubular whorls of greatest extent in the microspheric form, later portion composed of chambers spirally arranged, the length of the earliest chambers often more than a half whorl but in the adult usually reduced to a half whorl in length, the latest portion in gerontic specimens sometimes showing a tendency to become undivided and tubular; chambers partially divided by numerous internal septa, visible from the exterior and forming a radiating pattern; ventral side with numerous radiating lines; wall calcareous, fairly thin, finely perforate; aperture on the ventral side near the middle, a rounded opening into the ventral face. Diameter of present specimens up to 0.23 mm.

This species occurs in both the Atlantic and Pacific. It is very rare in the present material from Bikini and Rongerik.

***Patellina advena* var. *altiformis* Cushman**

Plate 89, figure 1

*Patellina advena* Cushman var. *altiformis* Cushman, Cushman Lab. Foram. Research, Contr., v. 9, p. 87, pl. 9, figs. 8a, b, 1933.

Variety differing from the typical form in the very high, pointed conical test.

The types of the variety are from 40 to 50 fathoms off Fiji, the only previous record. It is interesting to find a single specimen at Rongelap 463.

Genus *PATELLINELLA* Cushman, 1928

*Patellinella fijiana* Cushman

Plate 89, figure 2

*Patellinella fijiana* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 87, pl. 9, figs. 7a, b, 1933.

The types of this species are from off Nairai, Fiji. Single specimens were found at Bikini 818 and Rongelap 462. The species is characterized by its spinose wall, except over the ventral surface of the last two chambers, where it is smooth and polished.

*Patellinella inconspicua* (H. B. Brady)

Plate 89, figure 4

*Textularia inconspicua* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 357, pl. 42, figs. 6a-c, 1884.

*Patellinella inconspicua* Cushman, Cushman Lab. Foram. Research Contr., v. 4, p. 5, pl. 1, figs. 8a-c, 1928.

Test small, conical but somewhat compressed laterally, earliest stage with a short, spiral chamber in the microspheric form, remainder of the test with two chambers making up each whorl, periphery rounded, ventral face concave; chambers distinct but not inflated, increasing rather rapidly but evenly in size as added; sutures distinct, not depressed; wall smooth; aperture a semi-elliptical depression at the inner border of the ventral face of the last-formed chamber. Height up to 0.23 mm, breadth 0.20 mm, thickness 0.15 mm.

The records for this species are from the Pacific and Australian regions. It is rare in the material from Rongerik, Eniwetok and Rongelap but occurs in several samples.

*Patellinella jugosa* (H. B. Brady)

Plate 89, figure 3

*Textularia jugosa* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 358, pl. 42, figs. 7a,b, 1884.

*Textularia inconspicua* H. B. Brady var. *jugosa* Millett, Royal Micros. Soc. Jour., 1898, p. 558, pl. 7, figs. 2a,b.

A single specimen from Rongerik 12 in 120 feet is the only one found. It is not entirely typical but is like others found in the Fiji and Caroline Islands. With more material it may prove to be a new species.

Genus *DISCORBIS* Lamarck, 1804

*Discorbis concinna* (H. B. Brady)

Plate 89, figures 12, 13

*Discorbina concinna* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 646, pl. 90, figs. 7, 8, 1884.

*Discorbis concinna* Cushman, U. S. Natl. Mus. Bull. 71, pt. 5, p. 16, pl. 5, fig. 3, 1915; idem, Bull. 104, pt. 8, p. 21, 1931.

Test small, plano-convex, dorsal side rather evenly

convex, ventral side flattened or somewhat concave, periphery subacute but not keeled, two or more whorls in the adult; chambers few, about four in the adult whorl, slightly inflated, the final one making up nearly one-half of the periphery; sutures distinct, slightly depressed, very strongly curved; wall smooth, distinctly perforate; aperture ventral, beneath a distinct lip-like projection of the ventral border of the last-formed chamber. Diameter 0.25 to 0.35 mm.

This is apparently an Indo-Pacific species from the records. Specimens are fairly common in some of the samples. They are characterized by a circular test with narrow arcuate chambers, and the wall sometimes polished.

*Discorbis crustata* Cushman

Plate 89, figure 6

*Discorbis crustata* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 88, pl. 9, figs. 4a-c, 1933.

This species described from 24 fathoms, Nairai, Fiji, occurs in typical form, but rarely, at all four atolls. It is distinctive in its polished wall.

*Discorbis frustata* Cushman

Plate 89, figure 5

*Discorbis frustata* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 88, pl. 9, figs. 2a-c, 1933.

The types are from off Fiji in 40 to 50 fathoms, the only previous record. It is extremely rare, occurring only at Rongerik 51 and 80.

*Discorbis micens* Cushman

Plate 89, figures 8, 9

*Discorbis micens* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 89, pl. 9, figs. 5a-c, 1933.

The types are from off the Paumotu Islands in 675 fathoms and it has not been recorded from shallow water. A number of specimens with a rounded periphery seem to be very close to this species. As compared with *D. concinna* (H. B. Brady) this species has an elongate test, with only four chambers in the last whorl, and the last chamber is easily discernible.

*Discorbis opima* Cushman

Plate 89, figures 10, 11

*Discorbis opima* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 88, pl. 9, figs. 3a-c, 1933.

The types are from 24 fathoms, off Nairai, Fiji. It is a common species in the Pacific and occurs in a number of samples from all the atolls. It is characterized by a rounded periphery, very coarse perforations, and limbate dorsal sutures.

**Discorbis patelliformis (H. B. Brady)**

Plate 89, figure 7

*Discorbina patelliformis* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 647, pl. 88, figs. 3a-c; pl. 89, figs. 1a-c, 1884.*Discorbis patelliformis* Cushman, U. S. Natl. Mus. Bull. 71, pt. 5, p. 17, pl. 5, figs. 5a-c, 1915.

Fairly common specimens of this high-spined species occur at all four atolls. They vary considerably in height and acuteness of the spire but exhibit the radial ornamentation of the ventral side typical of this species.

**Discorbis rugosa (D'Orbigny)**

Plate 89, figure 14

*Rosalina rugosa* D'Orbigny, Voyage dans l'Amérique méridionale, tome 5, pt. 5, Foraminifères, p. 42, pl. 2, figs. 12-14, 1839.*Discorbina rugosa* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 652, pl. 87, figs. 3a-c; pl. 91, figs. 4a-c, 1884.

A few specimens, mostly immature, of this widely recorded species were found at all four atolls. They are large and are distinguished by their very coarsely perforate wall and chambers which are flat on the dorsal surface and inflated ventrally.

**Discorbis subbertheloti Cushman**

Plate 89, figure 15

*Discorbis bertheloti* H. B. Brady (part) (not D'Orbigny), *Challenger* Rept., Zoology, v. 9, p. 650, pl. 89, figs. 10a, b, 1884.*Discorbis subbertheloti* Cushman, Carnegie Inst. Washington Pub. 342, p. 33, pl. 10, fig. 1, 1924.

Test attached, plano-convex, early chambers in a low spire, composed of about two and a half whorls, periphery subacute to rounded; chambers distinct, four to five in the adult whorl, slightly if at all inflated, increasing rapidly in size as added, slightly keeled on the ventral side; sutures distinct, very slightly depressed strongly curved both on the dorsal and ventral sides; wall thin, very finely but distinctly perforate; aperture a curved slit on the ventral margin of the last-formed chamber. Diameter about 0.45 mm.

The types of this species are from rather shallow water off Samoa. It is evidently a species of comparatively warm, shallow waters. Specimens referable to it occurred in a number of the samples. It is characterized by very fine perforations, and a flattened dorsal surface.

**Discorbis tubero capitata (Chapman)**

Plate 89, figure 16

*Discorbina tubero capitata* Chapman, Linnean Soc. Jour., Zoology, v. 28, p. 11, pl. 1, figs. 9a-c, 1899.*Discorbis tubero capitata* Chapman, Annals and Mag. Nat. History, 11th ser., v. 11, p. 100 (list), 1944.

This species occurs fairly commonly at Rongelap. It was described from Funafuti Atoll and recorded as

better developed on the outer part of the reef than in the lagoon. It was also found in the Funafuti boring.

**Genus LAMARCKINA Berthelin, 1881****Lamarckina scabra (H. B. Brady)**

Plate 89, figure 17

*Pulvinulina oblonga* var. *scabra* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 689, pl. 106, figs. 8a-c, 1884.*Lamarckina scabra* Cushman, Cushman Lab. Foram. Research Contr., v. 2, pt. 1, p. 13, 1926.

A single specimen was found at Bikini 1175 ± 592 fathoms. The species was described from 155 fathoms in Torres Strait.

**Genus HERONALLENIA Chapman and Parr, 1931****Heronallenia sp. ●**

Plate 89, figure 18

An apparently undescribed species of *Heronallenia* is represented by a very few specimens from Eniwetok, Bikini and Rongelap. It is small, 0.25 to 0.30 mm, compressed, and slightly arched with the dorsal side convex and the ventral side concave; the periphery is subacute. The chambers are few and rapidly increase in size as added. The sutures are distinct and curved on the dorsal side. The wall is thin, translucent, finely punctate on the dorsal side, and ornamented by fine lines radiating out from the umbilicus on the ventral side. It is distinctive in its few chambers very rapidly increasing in size.

**Genus GYROIDINA D'Orbigny, 1826****Gyroidina soldanii D'Orbigny**

Plate 89, figure 19

*Gyroidina soldanii* D'Orbigny, Annales sci. nat., tome 7, p. 278, no. 5; Modèles, no. 36, ii<sup>e</sup> livraison, 1826.

Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 3d ser., v. 16, p. 25, pl. 3, fig. 86, 1865; idem, 4th ser., v. 8, p. 176, pl. 12, fig. 151, 1871.

Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 38, pl. 8, figs. 3-8, 1931.

*Rotalia soldanii* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 706, pl. 107, figs. 6, 7, 1884.

Specimens from Bikini and Eniwetok have been compared with topotypes from Rimini, Italy, and seem identical.

**Genus EPONIDES Montfort, 1808****Eponides tenera (H. B. Brady)**

Plate 89, figure 20

*Truncatulina tenera* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 665, pl. 95, figs. 11a-c, 1884.*Eponides tenera* Cushman, Scripps Inst. Oceanography Bull., Tech. ser., v. 1, no. 10, p. 163, pl. 5, figs. 6, 7, 1927.

Typical specimens were found in several Bikini

samples and at Eniwetok 119. The species was described from the west coast of Patagonia.

**Genus OSANGULARIA Brotzen, 1940**

*Osangularia bengalensis* (Schwager)

Plate 89, figure 21

*Anomalina bengalensis* Schwager, *Novara-Exped.*, Geol. Theil, Band 2, p. 259, pl. 7, fig. 111, 1866.

*Parrella bengalensis* Finlay, Royal Soc. New Zealand Trans., v. 68, p. 523, 1939.

Single typical specimens of this species described from the Pliocene of Kar Nicobar were found in Bikini core 1176, at a depth of 1 to 2 inches in the core, and at Bikini 1172.

**Genus ROTALIA Lamarck, 1804**

*Rotalia* cf. *R. beccarii* var. *tepida* Cushman

Plate 89, figure 22

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

Fairly common specimens from Eniwetok, Rongelap, and Rongerik seem very close to, if not identical with this variety known from warm, shallow waters of the West Indian region. Most of the Pacific specimens have 6 rather than 7 chambers in the last whorl.

**Genus HÖGLUNDINA Brotzen, 1948**

*Höglundina elegans* (D'Orbigny)

Plate 89, figure 23

*Epistomina elegans* (D'Orbigny) Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 65, pl. 13, figs. 6a-c, 1931.

A few well-developed and typical specimens occur at several deep-water stations at Bikini and at Eniwetok 119, at 500 fathoms.

**Genus POROEPONIDES Cushman, 1944**

*Poroeponides cribrorrepandus* Asano and Uchio

Plate 89, figures 24, 25

*Poroeponides cribrorrepandus* Asano and Uchio, in Asano, Illustrated Catalogue of Japanese Tertiary Smaller Foraminifera, pt. 14, Rotaliidae, p. 18, figs. 134, 135, 1951.

*Eponides repanda* Cushman and Kellett (not Fichtel and Moll), U. S. Natl. Mus. Proc., v. 75, art. 25, p. 11, pl. 4, figs. 7a-c, 1929.

Test large, biconvex, ventral side more strongly so than the dorsal, periphery slightly lobulate, limbate, blunt; chambers distinct, 6 to 9 in the last-formed whorl, gradually increasing in size as added, later ones very slightly inflated; sutures distinct, limbate, oblique on the dorsal side, radial on the ventral side, last one or two ventral sutures depressed instead of limbate; wall very finely perforate, usually roughened in front

of the aperture; apertures of two kinds, a low, arched opening under the edge of the last-formed chamber, extending from the periphery to the umbilicus, and a series of evenly spaced pores over the apertural face. Diameter 1.00 to 1.50 mm, thickness 0.55 to 0.85 mm.

This species differs from *P. lateralis* (Terquem) in its more regular form with chambers not becoming long and arcuate, and in being more strongly convex on the ventral than on the dorsal side. In its general shape and limbate sutures it rather closely resembles specimens in the Cushman Collection referred to *Eponides repandus* (Fichtel and Moll) from the Bay of Naples, Italy (Cushman Coll. 12844). One of these shows a single supplementary pore on the apertural face. It is our opinion that the genus *Poroeponides*, being based upon a character that may be found in varying degrees even within a single species, is therefore inadequate as a genus. However, until more is learned of the cause of development of supplementary apertural pores, we are continuing to use *Poroeponides* for those forms that differ from *Eponides* in the presence of supplementary pores on the apertural face.

There seem to be two forms of this species, both of which are figured. The larger form is more regular in outline with a small apertural face and consequently fewer pores. The smaller form tends to be irregular in shape with a large flaring apertural face and more supplementary pores. The two forms seem to grade into one another.

**Genus EPISTOMAROIDES Uchio, 1952**

*Epistomaroides polystomelloides* (Parker and Jones)

Plate 89, figure 26

*Discorbina polystomelloides* Parker and Jones, Philos. Trans., 1865, p. 421, pl. 19, fig. 8.

H. B. Brady, *Challenger Rept.*, Zoology, v. 9, p. 652, pl. 91, fig. 1, 1884.

*Epistomaroides polystomelloides* Uchio, Japanese Jour. Geol. Geogr., v. 22, p. 158, pl. 7, figs. 1-3, 1952.

A few specimens from Rongelap, Bikini, and Rongerik, and more abundant ones from Eniwetok seem to be the same as this Indo-Pacific species.

**Genus MISSISSIPPINA Howe, 1930**

*Mississippina concentrica* (Parker and Jones)

Plate 89, figure 27

*Pulvinulina concentrica* Parker and Jones, Ms., in H. B. Brady, Linnean Soc. London Trans., v. 24, p. 470, pl. 48, figs. 14a, b, 1864.

H. B. Brady, *Challenger Rept.*, Zoology, v. 9, p. 686, pl. 105, figs. 1a-c, 1884.

*Eponides concentrica* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 43, pl. 9, figs. 4, 5, 1931.

Colom, Inst. Español Oceanografía, Notas y Resúmenes, ser. 2, no. 108, p. 39, pl. 7, figs. 136, 137, 194.



*Mississippiina concentrica* Chapman, Royal Soc. South Australia Trans., v. 65, p. 174, 1941.

Said, Cushman Lab. Foram. Research Special Pub. 26, p. 37, pl. 4, fig. 1, 1949.

Rare specimens were found in the following deep-water samples: Bikini 814, 817, 818, and Rongelap 456. The species was recorded by H. B. Brady from various, mostly deep-water, samples in the Atlantic, Mediterranean and South Pacific.

**Genus PAUMOTUA Loeblich, 1952**

***Paumotua terebra* (Cushman)**

Plate 89, figure 28

*Eponides terebra* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 89, pl. 10, figs. 1a-c, 1933.

*Paumotua terebra* Loeblich, Washington Acad. Sci. Jour., v. 42, No. 6, p. 193, fig. 1, 1952.

Three specimens were found at Bikini 817 in 114 fathoms. The present specimens show an opaque band close inside the periphery on the ventral side, and the ventral openings, although not as numerous or regular as in the holotype, are distributed along this band. The Bikini specimens are more strongly compressed than the types from Anu Anuraro Atoll, Paumotu Islands, 405 fathoms.

**Genus SIPHONINA Reuss, 1849**

***Siphonina tubulosa* Cushman**

Plate 89, figures 29, 30

*Siphonina tubulosa* Cushman, Carnegie Inst. Washington Pub. 342, p. 40, pl. 13, figs. 1, 2, 1924; U. S. Natl. Mus. Proc., v. 72, art. 20, p. 10, pl. 1, figs. 3, 5, 1927.

*Truncatulina reticulata* H. B. Brady (part) (not Czjzek), Challenger Rept., Zoology, v. 9, p. 669, pl. 96, figs. 5-7 (not fig. 8), 1884.

Test compressed, keeled, the last-formed whorl consisting of three or four chambers; sutures slightly depressed; wall with numerous, short, tubular projections and the periphery with a border of longer projections of varying length; aperture somewhat compressed with a short, tubular neck and widely flaring lip. Maximum diameter 0.50 mm, usually less.

The types are from off Samoa. Rare specimens occur in our material.

**Genus SIPHONINOIDES Cushman, 1927**

***Siphoninoides echinata* (H. B. Brady)**

Plate 89, figures 31, 32

*Planorbulina echinata* H. B. Brady, Quart. Jour. Micros. Sci., v. 19, p. 283, pl. 8, figs. 31a-c, 1879.

*Truncatulina echinata* H. B. Brady, Challenger Rept., Zoology, v. 9, p. 670, pl. 96, figs. 9-14, 1884.

*Siphonina echinata* Cushman, U. S. Natl. Mus. Bull. 71, pt. 5, p. 42, pl. 18, figs. 1-4, 1915.

*Siphoninoides echinata* Cushman, Cushman Lab. Foram. Research Contr., v. 3, p. 77, pl. 16, figs. 12a-c, 1927; U. S. Natl. Mus. Proc., v. 72, art. 20, p. 13, pl. 4, figs. 7, 8, 1927.

Test nearly spherical, composed of about two irregular whorls, the last-formed one consisting of about four chambers; wall coarsely punctate, thick, smooth except for a few blunt, spinose projections; aperture a short tube with a circular opening and slight lip. Diameter up to 0.40 mm.

This is a widely distributed species in the Indo-Pacific region and occurs also in the Atlantic. It occurred in a number of the samples but only rarely.

**Genus BAGGINA Cushman, 1926**

***Baggina philippinensis* (Cushman)**

*Pulvinulina hauerii* H. B. Brady (part) (not D'Orbigny), Challenger Rept., Zoology, v. 9, p. 690, pl. 106, fig. 7 (not fig. 6), 1884.

*Pulvinulina philippinensis* Cushman, U. S. Natl. Mus. Bull. 100, v. 4, p. 331, pl. 58, fig. 2, 1921.

*Baggina philippinensis* LeRoy, Colorado School of Mines Quart., v. 36, no. 1, p. 84, pl. 6, figs. 36, 37, 1941.

Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 20, p. 104, pl. 17, figs. 1-3, 1944.

*Discorbis allomorphinoides* Cushman (not Reuss), U. S. Natl. Mus. Bull. 100, v. 4, p. 306, pl. 58, fig. 1, 1921.

A single typical specimen was found at Bikini 1174 (1''-2'').

***Baggina philippinensis* var. *pilulifera* Cushman and Todd**

Plate 89, figure 33

*Baggina philippinensis* (Cushman) var. *pilulifera* Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 20, p. 105, pl. 17, figs. 4a-c, 1944.

A specimen from Bikini 815 in 55 fathoms seems identical with this variety in having a series of knobs of clear shell material in front of the aperture. The only other record for this form was from Recent dredgings, 12½ miles east of Cape Byron, Australia.

**Family PEGIDIIDAE**

**Genus PEGIDIA Heron-Allen and Earland, 1928**

***Pegidia dubia* (D'Orbigny)**

*Rotalia dubia* D'Orbigny, Annales sci. nat., v. 7, p. 274, no. 34, 1826.

Fornasini, Accad. sci. Ist. Bologna Mem., ser. 6, v. 5, p. 46, pl. 1, figs. 14, 14a, b, 1908.

*Pegidia dubia* Heron-Allen and Earland, Royal Micros. Soc. Jour., 1928, p. 290, pl. 1, figs. 8-15.

A single typical specimen was found at Bikini 1461, dredged at 44 to 25 fathoms on the outer slope of Bikini Atoll. This species was described from Mauritius and recorded as rare from the Kerimba Archipelago, the Java Sea, and the Philippines.

Genus *SPHAERIDIA* Heron-Allen and Earland, 1928*Sphaeridia papillata* Heron-Allen and Earland

*Sphaeridia papillata* Heron-Allen and Earland, Royal Micros. Soc. Jour., 1928, p. 294, pls. 2, 3, figs. 27-37.

A single specimen was found in Bikini lagoon at 105 feet. It is known from the Kerimba Archipelago and Mauritius.

Genus *RUGIDIA* Heron-Allen and Earland, 1928*Rugidia corticata* (Heron-Allen and Earland)

Plate 89, figure 34

*Sphaeroidina corticata* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, pt. 17, p. 681, pl. 51, figs. 14-18, 1915.  
*Rugidia corticata* Heron-Allen and Earland, Royal Micros. Soc. Jour., 1928, p. 289, pl. 1, figs. 5-7.

Test irregular in shape, one side flattened, the other strongly convex, composed in the adult of three or four visible, subglobular chambers; wall thick, coarsely punctate, covered with irregular cortications giving a rough appearance; apertures along the sutures on the convex side. Diameter up to 0.25 mm.

This species is known only from the Indo-Pacific region. Specimens from several samples seem like the figures of this species except that almost all have but three chambers.

*Rugidia? spinosa* Cushman, n. sp.

Plate 89, figures 35-37

Test small, irregular in shape, one side formed of the last two chambers, strongly convex, the other side usually somewhat angled; chambers in the adult globular, increasing very rapidly in size as added; sutures of the later portion depressed; wall of the pointed portion with irregular raised areas generally elongate toward the point of the test, in the globular chambers irregular in shape; aperture a very small, rounded opening near the inner margin of the chamber. Diameter up to 0.30 mm.

Holotype (USNM 548542) from Rongerik lagoon, 85 feet, 11°23'35" N., 167°28'35" E. (Rik 54).

This species is a puzzling one and is referred to this genus with considerable question. It differs from *R. corticata* (Heron-Allen and Earland) in the pointed early chambers, different surface ornamentation and the very small rounded apertures.

## Family AMPHISTEGINIDAE

## Genus AMPHISTEGINA D'Orbigny, 1826

*Amphistegina madagascariensis* D'Orbigny

Plate 90, figures 1, 2

*Amphistegina madagascariensis* D'Orbigny, Annales sci. nat., tome 7, p. 304, no. 5, 1826.

Fornasini, Accad. sci. Ist. Bologna Rend., v. 7, p. 3, pl. 2, figs. 5a-c, 1903.

Cushman, Carnegie Inst. Washington Pub. 342, p. 49, pl. 17, fig. 3, 1924.

*Amphistegina lessonii* D'Orbigny var. *madagascariensis* Cushman, U. S. Natl. Mus. Bull. 100, v. 4, p. 372, 1921.

Test large, slightly carinate, strongly but unequally biconvex, umbonal region of the ventral side very convex, of clear shell material; chambers fairly distinct, few in number, not inflated; sutures strongly curved, often slightly angular in the middle, usually flush with the surface; wall smooth except on the ventral side near the aperture where it is spinose; aperture on the ventral side of the last-formed chamber. Diameter up to 1.65 mm.

The types of this species were from off Madagascar. It is very abundant in the present collections. It has probably been referred to many times as *A. lessonii* D'Orbigny (1826, p. 304, pl. 17, figs. 1-4) which, however, is a thinner form with more numerous chambers per whorl. It is a species of the shallow, warm waters of the Indo-Pacific. In the Marshall Islands it occurs abundantly in the lagoons and down to moderate depths on the outer slopes of the reefs, comprising in some samples as much as 80 percent of the foraminifera present. In the deep-water samples the species is present but much less abundantly and the specimens are very much smaller.

*Amphistegina radiata* (Fichtel and Moll)

Plate 90, figure 3

*Nautilus radiatus* Fichtel and Moll, Testacea microscopica, p. 58, pl. 8, figs. a-d, 1798.

*Amphistegina radiata* Said, Cushman Lab. Foram. Research Special Pub. 26, p. 38, pl. 4, fig. 10, 1949.

Typical specimens of this species described from the Red Sea were found in deep waters off Bikini and Eniwetok.

*Amphistegina radiata* var. *papillosa* Said

Plate 90, figures 5, 6

*Amphistegina radiata* (Fichtel and Moll) var. *papillosa* Said, Cushman Lab. Foram. Research Special Pub. 26, p. 39, pl. 4, fig. 12, 1949.

*Amphistegina radiata* Cushman (part) (not Fichtel and Moll), Carnegie Inst. Washington Pub. 342, p. 49, pl. 17, fig. 2 (not fig. 1), 1924.

Hofker, Resultats Sci. Voyage Indes Orientales Neerlandaises, tome 2, fasc. 1, p. 6, pl. 1, figs. 8-10, 1930.

*Amphistegina lessonii* Dakin (not D'Orbigny), Ceylon Pearl Oyster Fish. Rept., v. 5, p. 240, pl. 1, fig. 13, 1906.

Variety differing from the typical form in its ornamentation, which consists of 2 or more rows of papillae between adjacent sutures on both sides of the test. Some papillae are joined together into short raised ridges. The present specimens include both planoconvex and biconvex forms. Diameter as much as 1.00 mm, thickness as much as 0.50 mm.







With a large series of specimens it is possible to find almost every gradation between the typical form and this papillose variety. Nevertheless, the ornamental form seems worthy of distinction and so arbitrary limits have been set. In the Marshall Islands the variety is much more abundant than the typical form.

*Amphistegina radiata* var. *venosa* (Fichtel and Moll)

Plate 90, figure 7

*Nautilus venosus* Fichtel and Moll, *Testacea microscopica*, p. 59, pl. 8, figs. e-h, 1798.

*Amphistegina radiata* (Fichtel and Moll) var. *venosa* Said, Cushman Lab. Foram. Research Special Pub. 26, p. 39, pl. 4, fig. 11, 1949.

This smooth, unornamented variety, having fewer chambers than the typical form, is found rarely at Bikini.

*Amphistegina radiata* (Fichtel and Moll) var.

Plate 90, figure 4

Rare specimens from Eniwetok, Bikini and Rongelap are distinct from *A. radiata* in having a large strongly raised knob of clear shell material on the ventral side.

Family CALCARINIDAE

Genus CALCARINA D'Orbigny, 1826

*Calcarina hispida* H. B. Brady

Plate 90, figures 9-12

*Calcarina hispida* H. B. Brady, *Quart. Jour. Micros. Sci.*, v. 16, p. 406, 1876; *Challenger Rept.*, Zoology, v. 9, p. 713, pl. 108, figs. 8, 9, 1884.

*Calcarina quoyi* D'Orbigny, *Annales sci. nat.*, tome 7, p. 276, no. 6, 1826, *nomen nudum*.

Fornasini, *Accad. sci. Ist. Bologna Mem.*, ser. 6, v. 5, p. 45, pl. 3, figs. 8, 9, 1908.

*Calcarina* hispid variety, Carpenter, Parker and Jones, *Introd. Foram.*, p. 218, pl. 14, figs. 6, 7, 1862.

Test small for the genus, compressed, dorsal surface slightly convex, ventral umbilicus slightly depressed, periphery rounded, slightly lobulated; chambers indistinct except the last few, narrow, inflated; sutures obscured except on the ventral side where they are radial and depressed; wall finely perforate, thickly covered by short coarse blunt spines throughout, except over the last one or two chambers, and by polished tubercles of shell material more thickly distributed at the middle of both dorsal and ventral sides, ornamented along the periphery by numerous (6 to 15 or more) large slender tapering spines which are themselves channeled and spinose, the large spines usually not much diverging from the plane of the test; aperture not observed. Diameter, exclusive of spines, 0.50 to 1.00 mm, thickness 0.35 to 0.45 mm.

This species is very well developed in the Marshall

Islands samples and specimens do not appear worn. The species occurs fairly abundantly in the lagoon and at moderate depths on the outer slopes of the reefs. Its ecologic range appears to be entirely different from that of *C. spengleri* (Gmelin). These two species should prove useful in paleoecologic studies.

*Calcarina hispida* was found in material from the top of a coral knoll in Bikini Lagoon (B307) at a depth of only 35 feet. It would thus appear that depth is of less importance as a factor in determining whether the species will live in a certain location than is relation to the reef and to accumulation of detritus from above.

*Calcarina spengleri* (Gmelin)

{[Plate 82, figures 10, 11; plate 92, figures 1-7

"Ammonshorn" Spengler, *Dansk. Skr.*, Band 1, p. 373, pl. 2, figs. 9a-c, 1781.

*Nautilus spengleri* Gmelin, *Systema naturae Linnaei*, Ed. 13, p. 3371, 1788.

Fichtel and Moll, *Testacea microscopica*, p. 84, pl. 14, figs. g-i; pl. 15, figs. a-h, 1798.

*Calcarina spengleri* D'Orbigny, *Annales sci. nat.*, tome 7, p. 276, no. 4, 1826.

Carpenter, Parker and Jones, *Introd. Foram.*, p. 216, pl. 14, figs. 1-5, 8-10; figs. 33-35 (in text), 1862.

H. B. Brady, *Challenger Rept.*, Zoology, v. 9, p. 712, pl. 108, figs. 5, 7, 1884.

Hofker, *Siboga-Exped.*, Mon. 4, p. 45, pl. 21, figs. 3-6, 8-10; pl. 22, 1927; *Resultats Sci. Voyage Indes Orientales Neerlandaises*, tome 2, fasc. 1, p. 8, pl. 3, figs. 1-8, 1930.

*Calcarina defrancii* H. B. Brady (not D'Orbigny), *Challenger Rept.*, Zoology, v. 9, p. 714, pl. 108, figs. 6a-c, 1884.

Test large, lenticular, biconvex; chambers numerous, narrow, inflated, all except the last few on the ventral side obscured by the supplementary skeleton; sutures radial, depressed, observable only between the last few chambers on the ventral side; wall of the chambers coarsely perforate, thin, fragile, quickly covered during development of the test by a heavy supplementary skeleton, the surface of which is thickly covered by highly polished tubercles, the test ornamented by long, coarse spines varying in number from 6 to 30 or more, usually most abundant along the periphery, sometimes bifurcating at their ends, the spines themselves smooth but longitudinally channeled; aperture not observed and it is believed that the coarsely perforate wall of the last several chambers serves as the aperture. Diameter, exclusive of spines, 1.00 to 2.00 mm, thickness 0.60 to 1.25 mm.

In the Marshall Islands this species is found at two different locations and in two correspondingly different states of preservation: 1, on the reef flat in a fresh unworn condition with the shell wall white and the spines more or less complete; and 2, on the lagoon beaches where the specimens are spineless, being worn almost beyond recognition, and the shell wall is light

orange-colored. This species apparently lives only on the reef flat, a fact pointed out by Dr. Joshua I. Tracey, Jr., who found specimens in abundance, together with *Marginopora vertebralis* Blainville, both species rather firmly settled into but not attached to the small cavities on the surface and underneath the beach rocks on the reef flats around the outer sides of the islands and reefs of Bikini Atoll. The species occurs even more abundantly in a layer of velvety algae on the bare reef flat, particularly on the outer edge of the flat.

The spines of *C. spengleri* are well adapted for enabling the test to cling in the cavities and also for holding the body of the test away from actual contact with rock or other specimens and thus allowing free access of the ocean water to all parts of the animal. The degree of development of spines is probably related to the conditions under which the animal lives, especially turbidity of the water, and is not a specific character, as had previously been believed (see Cushman, p. 367, 1919).

Two specimens from Bikini and one from Eniwetok similar to that figured, pl. 82, fig. 11, represent an extreme development of arborescent spines. A somewhat similar form was described as "*Calcarina hispida* Brady var. *pulchella* Chapman" (1900a, p. 15, pl. 1, fig. 10) from Funafuti Atoll, but the present specimens seem, in the surface texture of the wall, closer to *Calcarina spengleri* and the spines are even more numerous and project from the dorsal and ventral as well as the peripheral areas.

This species is one of the most abundant in the Marshall Islands, comprising as much as 95 to 98 percent of the Foraminifera in some of the lagoon beach sands. It is washed out into the lagoon in small numbers, and is carried out onto the outer slopes of the atolls. It occurs rarely in the moderately deep samples on the outer slopes of the reefs, but is never found in the deep bottom samples of the adjacent guyot.

#### Family CYMBALOPORIDAE

##### Genus CYMBALOPORETTA Cushman, 1928

###### *Cymbaloporetta bradyi* (Cushman)

Plate 90, figures 13, 14

*Cymbalopora poeyi* (D'Orbigny) var. H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 637, pl. 102, figs. 14a-d, 1884.

*Cymbalopora poeyi* Rhumbler (not D'Orbigny), *Jahrb. Zool., Abt. Syst.*, Band 24, p. 71, pl. 15, figs. 59a, b, 1906.

*Cymbalopora poeyi* (D'Orbigny) var. *bradyi* Cushman, U. S. Natl. Mus. Bull. 71, pt. 5, p. 25, pl. 10, figs. 2a-c; pl. 14, figs. 2a-c, 1915.

*Cymbalopora bradyi* Cushman, Carnegie Inst. Washington Pub. 342, p. 34, pl. 10, figs. 2-4, 1924.

*Cymbaloporetta bradyi* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 85, 1931.

Test with the chambers in a very flattened, irregular

spire, numerous, with as many as ten or more in the last-formed whorl visible on the ventral side; sutures distinct and slightly depressed on the dorsal side, ventrally deeply depressed and nearly radial; wall rather coarsely perforate. Diameter up to 0.90 mm.

This species is common in the Indo-Pacific region but less so in the Atlantic. It is somewhat variable in the amount of flattening of the spire and in the number of chambers. It is common in the Marshall Islands.

##### *Cymbaloporetta squamosa* (D'Orbigny)

Plate 90, figures 15, 16

*Rotalia squamosa* D'Orbigny, *Annales sci. nat.*, tome 7, p. 272, no. 8, 1826.

*Rosalina squamosa* D'Orbigny (in De la Sagra), *Histoire physique, politique et naturelle de l'Ile de Cuba*, Foraminifères, p. 91, pl. 3, figs. 12-14, 1839.

*Cymbalopora squamosa* Cushman, Carnegie Inst. Washington Pub. 311, p. 41, pl. 6, figs. 4-6, 1922.

*Cymbaloporetta squamosa* Cushman, Cushman Lab. Foram. Research Contr., vol. 4, p. 7, 1928; U. S. Natl. Mus. Bull. 104, pt. 8, p. 83, pl. 16, fig. 4, 1931.

*Rosalina poeyi* D'Orbigny (in De la Sagra), *Histoire physique, politique et naturelle de l'Ile de Cuba*, Foraminifères, p. 92, pl. 3, figs. 18-20, 1839.

*Cymbalopora poeyi* Carpenter, Parker, and Jones, *Introd. Foram.*, p. 215, pl. 13, figs. 10-12, 1862.

*Discorbina poeyi* Goës, *K. svenska vetensk. akad. Handl.*, Band 19, no. 4, p. 107, pl. 8, figs. 264, 265, 1882.

This species is much higher spired than *C. bradyi* and has fewer chambers visible on the ventral side.

##### Genus PYROPILUS Cushman, 1934

###### *Pyropilus rotundatus* Cushman

Plate 90, figure 8

*Pyropilus rotundatus* Cushman, Cushman Lab. Foram. Research Contr., v. 10, p. 100, pl. 13, figs. 1, 2, 1934.

The types are from off Rangiroa in the Pacific and it has not been recorded elsewhere. It is interesting to find rare but typical specimens in the material from Rongerik, Eniwetok and Rongelap in the shallow water of the lagoons.

##### Genus TRETOMPHALUS Moebius, 1880

###### *Tretomphalus planus* Cushman

Plate 90, figures 17, 18

*Tretomphalus bulloides* (D'Orbigny) var. *planus* Cushman, Carnegie Inst. Washington Pub. 342, p. 36, pl. 10, fig. 8, 1924.

*Tretomphalus planus* Cushman, Cushman Lab. Foram. Research Contr., v. 10, p. 94, pl. 11, figs. 11a-c; pl. 12, figs. 18-22, 1934.

Martin W. Johnson (1949, pp. 238, 241, 243) found *T. planus* occurring abundantly as plankton inside Bikini lagoon but not outside to the east and north.

In the bottom sediments, specimens were found at Rongelap, Bikini, and Eniwetok, most commonly at the

latter atoll. Relatively few specimens showing the spherical float-chamber were found.

Family CASSIDULINIDAE

Genus CERATOBULIMINA Toulou, 1915

*Ceratobulimina pacifica* Cushman and Harris

*Ceratobulimina pacifica* Cushman and Harris, Cushman Lab. Foram. Research Contr., v. 3, p. 176, pl. 29, figs. 9a-c, 1927.

A single specimen, probably immature, was found in Bikini core 1176 at 2 to 3 inches. The species was described from the Philippines in 494 fathoms.

Genus EPISTOMINELLA Husezima and Maruhasi, 1944

*Epistominella* cf. *E. obtusa* (Burrows and Holland)

Plate 90, figure 19

*Pulvinulina exigua* H. B. Brady var. *obtusa* Burrows and Holland, Geol. Assoc. Proc., v. 15, p. 49, pl. 2, fig. 25, 1897.

A single specimen from Bikini 1174 (1-2'') seems close to this Eocene species and is figured for future reference. It also somewhat resembles one of the specimens included as *Pulvinulina exigua* H. B. Brady (1884, p. 696, pl. 103, fig. 14 (not fig. 13)), but is not the same as that species, which is convex on the dorsal side and nearly flat on the ventral, whereas the opposite is true of the present specimen.

*Epistominella pulchra* (Cushman)

*Pulvinulinella pulchra* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 92, pl. 9, figs. 10a-c, 1933.

A single specimen apparently identical with this species described from near Nairai, Fiji, was found at Eniwetok 321.

*Epistominella tubulifera* (Heron-Allen and Earland)

Plate 90, figure 20

*Truncatulina tubulifera* Heron-Allen and Earland, Zool. Soc. London Trans., v. 20, p. 710, pl. 52, figs. 37-40, 1915.

Cushman, Carnegie Inst. Washington Pub. 342, p. 38, pl. 11, fig. 8, 1924.

Test small, biconvex, the ventral side much more convex than the dorsal, periphery acute, serrate; chambers fairly distinct on the dorsal side, much more so on the ventral side, six to eight in the adult whorl, increasing gradually in size as added, the peripheral edge fringed and serrate; sutures on the dorsal side indistinct except last two or three which are depressed, very oblique and curved, on the ventral side distinct, slightly depressed, strongly curved; wall on the ventral side smooth, on the dorsal side with a thickened fringe along the outer margin and in the adult with spinose projections both near the periphery and in the middle of each chamber, some of the projections open at their ends; aperture elongate, at the basal margin of the last-

formed chamber on the ventral side and extending into the ventral face more or less parallel to the periphery. Diameter 0.38 to 0.47 mm, thickness 0.20 to 0.25 mm.

This species was described from the general Indo-Pacific region and is present in the Marshall Islands. It occurs at all the atolls, rarely in the lagoons and more abundantly in the deeper waters on the outer slopes of the atolls.

*Epistominella* sp.

Plate 90, figure 21

Rare specimens from Eniwetok, Bikini, and Rongelap seem to belong in this genus but are insufficient for complete description. They are small (about 0.35 mm) and smoothly rounded in outline as well as on the periphery. The chambers are not inflated and the sutures are indistinct. The wall is smooth and polished but coarsely and conspicuously perforate. The aperture under the ventral edge of the last-formed chamber, appears to extend from the umbilicus to the periphery with a looplike extension parallel to and just ventral to the periphery.

In its coarsely perforate wall this species suggests *E. pulchra* (Cushman) but is not the same, as in that species the perforations are in definite rows, outlining chamber edges and sutures, and the periphery is acute.

Genus CASSIDULINA D'Orbigny, 1826

*Cassidulina angulosa* Cushman

Plate 90, figure 22

*Cassidulina angulosa* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 93, pl. 10, figs. 6a, b, 1933.

Rare specimens from deep-water samples at Bikini and Eniwetok are identical with this species described from 468 fathoms in the Marshall Islands.

*Cassidulina costatula* Cushman

Plate 90, figure 24

*Cassidulina costatula* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 94, pl. 10, figs. 7a, b, 1933.

This species described from 594 fathoms in the Paumotu Islands, occurs fairly commonly at Bikini and rarely at Eniwetok. It is similar to *C. decorata* Sidelbottom (1910b, p. 107, pl. 4, fig. 2) described from the southwest Pacific but is not as smoothly globular as that species.

*Cassidulina delicata* Cushman

Plate 90, figure 25

*Cassidulina delicata* Cushman, Scripps Inst. Oceanography Bull., Tech. Ser., v. 1, no. 10, p. 168, pl. 6, fig. 5, 1927.

Fairly common specimens from Bikini and from Eniwetok 119 are referred to this species described from the west coast of America. Although larger, they seem

to be the same in having a very elongate, curved aperture and the alternating chambers occupying only a very small space between the main series on each side.

*Cassidulina elegans* Sidebottom

Plate 90, figure 23

*Cassidulina elegans* Sidebottom, Quekett Micros. Club Jour., ser. 2, v. 11, p. 106, pl. 4, figs. 1a-c, 1910.

Very rare specimens from four deep-water samples off Bikini seem to be the same as Sidebottom's species described from 1050 fathoms in the southwest Pacific. The angulation of the chambers in the present specimens is even stronger than shown in Sidebottom's figure. This species is also related to *C. alternans* Yabe and Hanzawa (1926, p. 53, text figs. a, b) described from south of the Riukiu Islands, but comparison with a specimen of that species shows they are not the same.

*Cassidulina gemma* Todd, n. sp.

Plate 90, figures 26, 27

Test of medium size, outline lobulated; chambers distinct, inflated, about six pairs forming the last whorl; sutures distinct, limbate, depressed, especially the later ones; wall thin, translucent, conspicuously perforate; aperture an elongate loop-shaped opening extending into the concave face of the last-formed chamber, surrounded by a slight, raised lip, in the early stages nearly circular instead of elongate. Length 0.35 to 0.45 mm, breadth 0.25 to 0.35 mm, thickness 0.25 to 0.35 mm.

Holotype (USNM 548668) from Sylvania guyot, 835 fathoms, 11°47'35" N., 164°59'20" E. (Bik 1172).

This species differs from *C. subglobosa* H. B. Brady in its inflated chambers and consequently lobulated test and in its translucent and distinctly perforate wall.

It occurs commonly at Bikini 1172 and a single specimen was found at Bikini 1175.

*Cassidulina marshallana* Todd, n. sp.

Plate 90, figures 28, 29

Test nearly spherical, very slightly compressed; chambers not inflated, 4 or 5 pairs forming the last whorl, very slowly increasing in size as added; sutures indistinct, flush; wall thick, opaque, smooth, polished, very finely perforate; aperture a long, much curved slit in the ventral face of the last-formed chamber, wall below aperture concave with sharp, outward flaring edge, and wall above smoothly rounded and bent inward. Diameter 0.55 to 1.10 mm.

Holotype (USNM 548685) from core on Sylvania guyot, at 1 to 2 inches in the core, 410 fathoms, 11°41'00" N., 165°14'01" E. (Bik 1174 (1''-2'')).

This species differs from *C. subglobosa* H. B. Brady in its more smoothly rounded test and the very long aperture which is curved downward almost into a semicircle. In its aperture this species somewhat suggests *C. caudriae* Cushman and Stainforth (1945, p. 64, pl. 12, figs. 2, 3). In some specimens the aperture gives the impression of being a large arched opening nearly filled by a large platelike tooth, but with proper lighting it can be seen that only one end of the long arched opening actually joins the suture, although the opposite end nearly does.

This species was found at Bikini 1174 (1-2) and Eniwetok 119 only.

*Cassidulina minuta* Cushman

Plate 90, figure 35

*Cassidulina minuta* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 92, pl. 10, figs. 3a-c, 1933.

The types of this species are from off the Paumotu Islands at 844 fathoms. This is by far the most abundant species of the genus in the present material, and unlike the other species of the genus is not restricted to the deep-water samples.

*Cassidulina pacifica* Cushman

*Cassidulina calabra* H. B. Brady (not Seguenza), *Challenger* Rept., Zoology, v. 9, p. 431, pl. 113, figs. 8a-c, 1884.

*Cassidulina pacifica* Cushman, Cushman Lab. Foram. Research Contr., v. 1, pt. 3, p. 53, pl. 9, figs. 14-16, 1925.

Very rare specimens from two Rongelap samples are referred to this small globular species, the types of which are from Torres Strait.

*Cassidulina patula* Cushman

*Cassidulina patula* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 92, pl. 10, figs. 2a-c, 1933.

Very rare specimens from several deep-water samples at Bikini and Eniwetok belong to this species described from 486 fathoms in the Paumotu Islands. They are distinctive in their few chambers and distinctly perforate wall.

*Cassidulina* cf. *C. spinifera* Cushman and Jarvis

Plate 90, figure 34

*Cassidulina spinifera* Cushman and Jarvis, Cushman Lab. Foram. Research Contr., v. 5, p. 17, pl. 3, figs. 1a, b, 1929.

A single specimen from Bikini 1170 is interesting in its close relationship to this species known from the Oligocene of Trinidad. It is figured for future reference.

**Cassidulina subglobosa** H. B. Brady

Plate 90, figures 30-32

*Cassidulina subglobosa* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 60, 1881; *Challenger* Rept., Zoology, v. 9, p. 430, pl. 54, figs. 17a-c, 1884.

Specimens referable to Brady's species occur rather commonly in a number of Bikini samples and at Eniwetok 119 and 116, all deep-water samples. Specimens vary considerably in size and inflation of the chambers and several are figured to illustrate this.

**Cassidulina subglobosa** H. B. Brady var.

Plate 90, figure 33

A few specimens, similar to that figured, from Bikini 1174 (1-2) and 1175 and Eniwetok 119 show a pattern of straight grooves radiating out in all directions from the aperture.

**Genus CASSIDULINOIDES** Cushman, 1927**Cassidulinoides** sp.

A small, compact and compressed form, with a translucent wall appears to belong in this genus but is different from *C. bradyi* (Norman) (H. B. Brady, 1884, p. 431, pl. 54, figs. 6-10) in being less elongate and having fewer uncoiled chambers. It is similar to the form referred to *C. bradyi* (Norman) from fairly deep water (90 to 300 meters) of the Atlantic continental shelf, off the northeastern United States (Parker, 1948, p. 224, 237, pl. 3, fig. 12).

**Genus EHRENBURGINA** Reuss, 1850**Ehrenbergina pacifica** Cushman

Plate 90, figure 36

*Ehrenbergina serrata* H. B. Brady (part) (not Reuss), *Challenger* Rept., Zoology, v. 9, pl. 55, figs. 6, 7, 4 (?) (not figs. 2, 3, 5 (?)), 1884.

*Ehrenbergina pacifica* Cushman, U. S. Natl. Mus. Proc., v. 70, art. 16, p. 5, pl. 2, figs. 2a-c, 1927.

This species, the types of which are from off the Ki Islands, in 129 fathoms, occurs fairly commonly at Bikini and in two Eniwetok samples. The wall is smooth and polished and the peripheral angles and spines project outward nearly horizontally.

**Ehrenbergina reticulata** Cushman

Plate 90, figure 37

*Ehrenbergina reticulata* Cushman, Cushman Lab. Foram. Research Contr., v. 9, p. 94, pl. 10, figs. 9a, b, 1933.

Rare specimens from Bikini 1175 and 1176 (5''-7'') are identical with this species described from 1937 fathoms, off the Cook Islands. In the figured specimen the last-formed chamber is without surface ornamentation but is densely perforate.

**Family CHILOSTOMELLIDAE****Genus CHILOSTOMELLA** Reuss, 1850**Chilostomella oolina** Schwager

*Chilostomella oolina* Schwager, R. com. geol. Italia Boll. v. 9, p. 527, pl. 1, fig. 16, 1878.

Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 25, p. 91, pl. 15, figs. 23, 24, 1949.

A single specimen was found in Bikini 1175 (0-1).

**Genus PULLENIA** Parker and Jones, 1862**Pullenia bulloides** (D'Orbigny)

*Nonionina bulloides* D'Orbigny, Annales sci. nat., tome 7, p. 293, 1826; Foraminifères fossiles du bassin tertiaire de Vienne, p. 107, pl. 5, figs. 9, 10, 1846.

*Pullenia bulloides* Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 19, p. 13, pl. 2, figs. 15-18, 1943.

Very rare specimens from Bikini may be referred to this widely recorded species.

**Pullenia salisburyi** R. E. and K. C. Stewart

Plate 90, figure 38

*Pullenia salisburyi* R. E. and K. C. Stewart, Jour. Paleontology, v. 4, p. 72, pl. 8, figs. 2a, b, 1930.

This species described from the Pliocene of California and known from the Miocene to the Recent is more common in the Marshall Islands than is *P. bulloides* (D'Orbigny). Specimens vary considerably in relative thickness.

**Genus SPHAEROIDINA** D'Orbigny, 1826**Sphaeroidina bulloides** D'Orbigny

Plate 90, figure 39

*Sphaeroidina bulloides* D'Orbigny, Annales sci. nat., tome 7, p. 267, no. 1; Modèles, no. 65, 1826.

Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 25, p. 13, pl. 3, figs. 8-11, 1949.

A few specimens from several of the deep Bikini and Eniwetok samples are referred to this widely recorded species. They are very thin walled and translucent and smaller than topotypes of *S. bulloides* from the Adriatic, but otherwise seem very similar.

**Sphaeroidina compacta** Cushman and Todd

*Sphaeroidina compacta* Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 25, p. 19, pl. 4, figs. 14a, b, 1949.

*Sphaeroidina bulloides* Cushman (not D'Orbigny), U. S. Natl. Mus. Bull. 71, pt. 4, p. 18, pl. 12, figs. 1a, b, 1914.

Two rather typical specimens of this species described from the Yucatan Channel between the Gulf of Mexico and the Caribbean Sea and also known from the Pacific near Guam, were found in the sample from Bikini 1174 (1''-2'').



## Family GLOBIGERINIDAE

## Genus GLOBIGERINA D'Orbigny, 1826

*Globigerina bulloides* D'Orbigny

Plate 91, figure 2

*Globigerina bulloides* D'Orbigny, Annales sci. nat., tome 7, p. 277, no. 1; Modèles, jeune, n° 17, i<sup>re</sup> livr., et adulte, iv<sup>e</sup> n° 76, 1826; (in Barker-Webb and Berthelot), Histoire naturelle des Iles Canaries, tome 2, pt. 2, Foraminifères, p. 132, pl. 2, figs. 1-3, 28, 1839.

Williamson, Recent Foraminifera of Great Britain, p. 56, pl. 5, figs. 116-118, 1858.

Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 3d ser., v. 16, pp. 21, 31, pl. 2, figs. 55, 56, 1865.

Cushman, Cushman Lab. Foram. Research Contr., v. 17, p. 38, pl. 10, figs. 1-13, 1941.

A few specimens, mostly smaller than topotypes from Rimini on the Adriatic, are very similar to this widely distributed species. They are distinguished by a rather finely spinose wall and by having four chambers, rapidly increasing in size, in the last whorl.

*Globigerina* cf. *G. conglomerata* Schwager

Plate 91, figure 4

*Globigerina conglomerata* Schwager, Novara-Exped., Geol. Theil, v. 2, p. 255, pl. 7, fig. 113, 1866.

In the deeper samples at Bikini a rather small, compact form, showing 4 chambers in the last whorl, and having a smooth, polished, but conspicuously punctate wall is somewhat similar to this species described from the Pliocene of Kar Nicobar and widely recorded in Recent seas.

*Globigerina subcretacea* Lomnicki

Plate 91, figure 1

*Globigerina subcretacea* Lomnicki, Akad. Umiej. Krakowie, Czesk II, p. 57, 1901.

*Globigerina subcretacea* Chapman, Linnean Soc. Jour., Zoology, v. 28, p. 404 (list); p. 410, pl. 36, figs. 16a, b, 1902.

*Globigerina cretacea* H. B. Brady (part) (not D'Orbigny), Challenger Rept., Zoology, v. 9, p. 596, pl. 82, figs. 10a-c (not figs. 11a-c), 1884.

Test large, compact, somewhat compressed, spire low or depressed, periphery indented; chambers inflated, six or seven comprising the adult whorl, not much increasing in size as added, the last chamber in some instances slightly smaller than previous ones; sutures distinct, incised; wall rather thick for the genus, smooth-surfaced and covered with closely spaced fine pits with a pore at the bottom of each pit, the pits showing no particular arrangement; aperture small, semicircular, slightly rimmed, under the ventral edge of the last-formed chamber about half way between the periphery and the umbilicus. Diameter up to 0.70 mm.

The species is based upon Brady's figure 10 on plate 82 for which the same new name, *subcretacea*, was pro-

posed independently and nearly simultaneously by two authors: Lomnicki (1901) and Chapman (1902). Brady's figure 10, mentioned above, is of a specimen from 580 fathoms off the Ki Islands. The specimen figured by Chapman is from deep dredgings around Funafuti.

This species occurs abundantly in the deep-water Bikini samples and was found rarely at Eniwetok and Rongelap.

*Globigerina?* sp.

Plate 91, figure 3

A few specimens of a very minute form, about 0.22 mm in greatest diameter, with 5 or 6 chambers in the last whorl, and a nearly smooth but distinctly perforate wall, occur in some numbers. A specimen is here figured for future reference.

As it occurs fairly commonly inside the lagoon at Rongerik, it does not seem likely that it is an oceanic form and its reference to *Globigerina* is doubtful.

## Genus GLOBIGERINOIDES Cushman, 1927

*Globigerinoides*<sup>2</sup> *conglobata* (H. B. Brady)

Plate 91, figure 12

*Globigerina conglobata* H. B. Brady, Quart. Jour. Micros. Sci., v. 19, p. 72, 1879; Challenger Rept., Zoology, v. 9, p. 603, pl. 80, figs. 1-5; pl. 82, fig. 5, 1884.

*Globigerinoides conglobata* Cushman, Am. Jour. Sci., v. 239, pl. 2, fig. 2, 1941.

This species occurs abundantly at the deep-water stations at Bikini, Eniwetok, and Rongelap.

At Bikini, it is not known inside the lagoon except in the core at 218. It occurs commonly at the bottom of the core, 12 to 16 inches, but only a single specimen was found at the top of the core. This would suggest that 218 was open to oceanic waters when the sediments at 12 to 16 inches below the surface of the core were deposited.

*Globigerinoides elongata* (D'Orbigny)

Plate 91, figure 5

*Globigerina elongata* D'Orbigny, Annales sci. nat., tome 7, p. 277, no. 4, 1826.

Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 4th ser., v. 8, p. 175, pl. 11, fig. 129, 1871.

Fornasini, Accad. sci. Ist. Bologna Mem., ser. 5, v. 7, p. 11, pl. 3, figs. 8-10, 1899.

*Globigerinoides elongata* Cushman, Cushman Lab. Foram. Research Contr., v. 17, p. 40, pl. 10, figs. 20-23; pl. 11, figs. 3a-c, 1941.

A single specimen, here figured, is very similar to this species described from the Adriatic at Rimini and the

<sup>2</sup> Regarding gender of *Globigerinoides*, I prefer to follow the recommendation of Roland W. Brown that a generic name ending in *-oides*, an adjectival suffix meaning like, takes its gender from the gender of the generic name on which it is based. Thus *Globigerinoides*, like *Globigerina*, is feminine; *Ammodiscoides*, like *Ammodiscus*, is masculine; and *Haplophragmoides*, like *Haplophragmium*, is neuter. R. Todd.

Pliocene of Castel Arquato, Italy. It is unique in its very high spire and belongs in *Globigerinoides* as it has supplementary apertures.

***Globigerinoides rubra* (D'Orbigny)**

Plate 91, figure 6

*Globigerina rubra* D'Orbigny (in De la Sagra), Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 82, pl. 4, figs. 12-14, 1839.

*Globigerinoides rubra* Cushman, Am. Jour. Sci., v. 239, pl. 2, fig. 3, 1941; Cushman Lab. Forum. Research Contr., v. 21, p. 75, pl. 12, figs. 6-9, 1945.

This species was found at all four atolls. Only a few of the specimens, generally the smallest, show the red color.

***Globigerinoides sacculifera* (H. B. Brady)**

Plate 91, figure 7

*Globigerina sacculifera* H. B. Brady, Quart. Jour. Micros. Sci., v. 19, p. 73, 1879; *Challenger* Rept., Zoology, v. 9, p. 604, pl. 80, figs. 11-17; pl. 82, fig. 4, 1884.

*Globigerinoides sacculifera* Cushman, Am. Jour. Sci., v. 239, pl. 3, fig. 1, 1941.

This species and *G. rubra* (D'Orbigny) include the bulk of the specimens of the Globigerinidae in the Marshall Islands. Both species occur more or less abundantly at all four atolls, even inside the lagoons. However, specimens from inside the lagoons are notably smaller than normal size.

***Globigerinoides sacculifera* var. *fistulosa* (Schubert)**

Plate 91, figure 13

*Globigerina fistulosa* Schubert, K. k. geol. Reichsanstalt Verh., no. 14, p. 324 (7), fig. 2 (in text), 1910; K. k. geol. Reichsanstalt Abh., Band 20, pt. 4, p. 100, figs. 13a-c (in text), 1911.

*Globigerinoides sacculifera* (H. B. Brady) var. *fistulosa* Cushman, Cushman Lab. Forum. Research Special Pub. 5, pl. 34, figs. 6a-c, 1933.

A few specimens were found in the core at Bikini 1176. The variety was described from *Globigerina* marls of New Guinea, and recorded from the Pliocene of Java. The figured specimen represents an extreme development of the fistulose processes on the later chambers.

**Genus *Globigerinella* Cushman, 1927**

***Globigerinella aequilateralis* (H. B. Brady)**

Plate 91, figure 8

*Globigerina aequilateralis* H. B. Brady, Quart. Jour. Micros. Sci., v. 19, p. 71, 1879; *Challenger* Rept., Zoology, v. 9, p. 605, pl. 80, figs. 18-21, 1884.

*Globigerinella aequilateralis* Cushman, Am. Jour. Sci., v. 239, pl. 2, fig. 1, 1941.

This species occurs commonly in several of the deep-water samples at Bikini and Eniwetok.

**Genus *HASTIGERINELLA* Cushman, 1927**

***Hastigerinella digitata* (Rhumbler)**

Plate 91, figures 9, 10

*Hastigerina digitata* Rhumbler, Foram. Plankton-Exped., v. 3, pt. 1, pl. 37, figs. 9a, b, 1911.

*Hastigerinella digitata* Wiesner, Deutsche Süd-Polar Exped., Band 20, Zoology, p. 135, pl. 22, figs. 264-266, 1931.

A few specimens, mostly small and immature, were found at Eniwetok and Bikini. Young specimens differ from *Globigerinella aequilateralis* (H. B. Brady) in the chambers being more rapidly enlarging and rather attenuated and the aperture not extending over onto the dorsal side as in *Globigerinella*. The texture of the wall surface in both species is very similar.

**Genus *ORBULINA* D'Orbigny, 1839**

***Orbulina universa* D'Orbigny**

*Orbulina universa* D'Orbigny (in Barker-Webb and Berthelot), Histoire naturelle des îles Canaries, tome 2, pt. 2, Foraminifères, p. 123, pl. 1, fig. 1, 1839; (in De la Sagra), Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 3, pl. 1, fig. 1, 1839.

Cushman, Am. Jour. Sci., v. 239, pl. 4, fig. 2, 1941.

*Orbulina universa* occurs abundantly in most of the deep-water Bikini samples and rarely at Eniwetok and Rongelap, but no specimens were found from inside Rongerik lagoon. The occurrence of this and other pelagic species seems to depend more on exposed position than depth of the sample.

**Genus *PULLENIATINA* Cushman, 1927**

***Pulleniatina obliquiloculata* (Parker and Jones)**

Plate 91, figure 11

*Pullenia obliquiloculata* Parker and Jones, Philos. Trans., v. 155, p. 368, pl. 19, figs. 4a, b, 1865.

H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 618, pl. 84, figs. 16-20, 1884.

*Pulleniatina obliquiloculata* Cushman, Am. Jour. Sci., v. 239, pl. 4, fig. 3, 1941.

This planktonic species has a similar distribution in the deeper-water samples of Bikini and Eniwetok.

**Genus *SPHAEROIDINELLA* Cushman, 1927**

***Sphaeroidinella dehiscens* (Parker and Jones)**

Plate 91, figure 14

*Sphaeroidina dehiscens* Parker and Jones, Philos. Trans., v. 155, p. 369, pl. 19, figs. 5a-c, 1865.

H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 621, pl. 84, figs. 8-11, 1884.

*Sphaeroidinella dehiscens* Cushman, Am. Jour. Sci., v. 239, pl. 5, fig. 1, 1941.

This species is well developed and abundant in most of the deep-water samples from Bikini and Eniwetok.

## Genus CANDEINA D'Orbigny, 1839

*Candeina nitida* D'Orbigny

Plate 91, figure 15

*Candeina nitida* D'Orbigny (in De la Sagra), Histoire physique, politique et naturelle de l'Ile de Cuba, Foraminifères, p. 108, pl. 2, figs. 27, 28, 1839.

H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 622, pl. 82, figs. 13-20, 1884.

Cushman, *Am. Jour. Sci.* v. 239, pl. 1, fig. 1, 1941.

This cosmopolitan species occurs in the deep-water Bikini and Eniwetok samples.

## Family GLOBOROTALIIDAE

## Genus GLOBOROTALIA Cushman, 1927

*Globorotalia crassa* (D'Orbigny)

Plate 91, figure 16

*Pulvinulina crassa* D'Orbigny, sp. H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 694, pl. 103, figs. 11, 12, 1884.

*Globorotalia crassa* Heron-Allen and Earland, *Discovery* Repts., v. 4, p. 428, 1932.

This form, which is midway between *G. truncatulinoides* (D'Orbigny) and *G. cf. G. hirsuta* (D'Orbigny), occurs rarely at Bikini and Eniwetok. It is less thick and has blunter angles at the periphery and along the face of the last-formed chamber than *G. truncatulinoides*, and is a thicker, more compact form than *G. cf. G. hirsuta*.

*Globorotalia cf. G. hirsuta* (D'Orbigny)

Plate 91, figure 17

*Rotalina hirsuta* D'Orbigny (in Barker-Webb and Berthelot), Histoire naturelle des Iles Canaries, tome 2, pt. 2, Foraminifères, p. 131, pl. 1, figs. 37-39, 1839.

*Globorotalia hirsuta* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 99, pl. 17, figs. 6a-c, 1931.

Specimens resembling this species described from the Canary Islands, but differing in being considerably more inflated ventrally, occur rarely in several Bikini samples and one Eniwetok sample. The ventral side, particularly the earlier chambers, shows a coarsely hispid surface.

*Globorotalia menardii* (D'Orbigny)

Plate 91, figure 19

*Rotalia menardii* D'Orbigny, *Annales sci. nat.*, tome 7, p. 273, no. 26; *Modèles*, no. 10, 1<sup>re</sup> livraison, 1826.

Parker, Jones, and H. B. Brady, *Annals and Mag. Nat. History*, 3d ser., v. 16, p. 20, pl. 3, fig. 81, 1865.

*Pulvinulina menardii* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 690, pl. 103, figs. 1, 2, 1884.

Flint, U. S. Natl. Mus. Rept. for 1897, p. 329, pl. 73, fig. 3, 1899.

*Globorotalia menardii* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 91, pl. 17, figs. 1a-c, 1931; *Am. Jour. Sci.*, v. 239, pl. 3, fig. 2, 1941.

This species occurs at most stations with *G. tumida* (H. B. Brady) from which it differs in its less inflated

test and clear or translucent wall without the heavy beading characteristic of the latter species.

*Globorotalia menardii* var. *fimbriata* (H. B. Brady)

Plate 91, figure 20

*Pulvinulina menardii* var. *fimbriata* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 691, pl. 103, figs. 3a, b, 1884.

*Globorotalia menardii* (D'Orbigny) var. *fimbriata* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 94, pl. 17, figs. 2a, b, 1931.

Only three specimens from Bikini 1175 are referable to this variety which has a fringed and spinose periphery.

*Globorotalia truncatulinoides* (D'Orbigny)

Plate 91, figure 18

*Rotalina truncatulinoides* D'Orbigny (in Barker-Webb and Berthelot), Histoire naturelle des Iles Canaries, tome 2, pt. 2, Foraminifères, p. 132, pl. 2, figs. 25-27, 1839.

*Globorotalia truncatulinoides* Cushman and Wickenden, U. S. Natl. Mus. Proc., v. 75, art. 9, p. 14, pl. 6, figs. 3a-c, 1929. Cushman, *Am. Jour. Sci.*, v. 239, pl. 4, fig. 1, 1941.

This species occurs commonly in a few deep-water samples from Bikini and Eniwetok.

*Globorotalia tumida* (H. B. Brady)

Plate 91, figure 21

*Pulvinulina tumida* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 692, pl. 103, figs. 4-6, 1884.

*Globorotalia tumida* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 95, pl. 17, figs. 3a-c, 1931; *Am. Jour. Sci.*, v. 239, pl. 3, fig. 3, 1941.

This widely distributed species occurs abundantly in a few of the deeper-water samples from Bikini, and more rarely at Eniwetok and Rongelap.

## Family ANOMALINIDAE

## Genus ANOMALINA D'Orbigny, 1826

*Anomalina cf. A. glabrata* Cushman

Plate 91, figure 23

*Anomalina glabrata* Cushman, *Carnegie Inst. Washington Pub.* 342, p. 39, pl. 12, figs. 5-7, 1924.

A few specimens from numerous samples from all the atolls seem close to this species known from the South Pacific but these specimens are somewhat larger than the types and more coarsely punctate.

*Anomalina polymorpha* Costa

Plate 91, figure 22

*Anomalina polymorpha* Costa, *Accad. pontaniana Atti*, v. 7, pt. 2, p. 252, pl. 21, figs. 7-9, 1856.

A few specimens of this distinctive species described from the Pliocene of Italy and known from Recent seas, were found in Bikini core 1174, more abundant at the base than at the top, and a single specimen from Bikini 1175.







Genus *PLANULINA* D'Orbigny, 1826*Planulina ariminensis* D'Orbigny

*Planulina ariminensis* D'Orbigny, Annales sci. nat., tome 7, p. 280, no. 1, pl. 5 (14), figs. 1-3 bis., Modèles, no. 49, ii<sup>e</sup> livr., 1826.

*Anomalina ariminensis* H. B. Brady, Challenger Rept., Zoology, v. 9, p. 674, pl. 93, figs. 10, 11, 1884.

A few well-preserved specimens occur in the guyot samples. The species was described from the Adriatic Sea and is known from the late Tertiary of the Mediterranean. It is widely recorded in Recent seas.

Genus *LATICARININA* Galloway and Wissler, 1927*Laticarinina pauperata* (Parker and Jones)

*Pulvinulina repanda* var. *menardii*, subvar. *pauperata* Parker and Jones, Philosophical Trans., v. 155, p. 395, pl. 16, figs. 50, 51, 1865.

*Pulvinulina pauperata* H. B. Brady, Challenger Rept., Zoology, v. 9, p. 696, pl. 104, figs. 3-11, 1884.

*Laticarinina pauperata* Cushman and Todd, Cushman Lab. Foram. Research Contr., v. 18, p. 15, pl. 4, figs. 1-6, 1942.

A single nepionic individual was found at Bikini 1170.

Genus *ANOMALINELLA* Cushman, 1927*Anomalinella rostrata* (H. B. Brady)

Plate 91, figure 24

*Truncatulina rostrata* H. B. Brady, Quart. Jour. Micros. Sci., v. 21, p. 65, 1881; Challenger Rept., Zoology, v. 9, p. 668, pl. 94, figs. 6a-c, 1884.

*Anomalinella rostrata* Cushman, Cushman Lab. Foram. Research Contr., v. 3, p. 93, 1927; idem, Special Pub. 1, p. 322, pl. 50, fig. 1, 1928.

Test bilaterally symmetrical, involute, last-formed whorl consisting of about ten chambers, periphery keeled; chambers of uniform shape, increasing very slowly and evenly in size as added; sutures distinct, limbate, slightly curved; wall very coarsely perforate; aperture on ventral margin of last-formed chamber between periphery and umbilical area with a supplementary aperture just below peripheral margin, elongate, and parallel to axis of coiling. Length up to 1 mm.

This is a rather common species in the Indo-Pacific region and occurs in a number of the samples.

Genus *CIBICIDES* Montfort, 1808*Cibicides cicatricosus* (Schwager)

Plate 91, figures 25, 26

*Anomalina cicatricosa* Schwager, Novara-Exped., Geol. Theil, Band 2, p. 260, pl. 7, figs. 108, 4, 1866.

Cushman, Geol. Soc. Japan Jour., v. 46, no. 546, p. 153 (43), pl. 10 (6), figs. 19 a-c, 1939.

*Cibicides cicatricosus* Thalman, Eclogae geol. Helvetiae, tome 25, p. 309, 1932.

*Truncatulina akneriana* H. B. Brady (not D'Orbigny), Challenger Rept., Zoology, v. 9, p. 663, pl. 94, figs. 8a-c, 1884.

In a few deep-water samples from Eniwetok and Bikini, this species, described from the Pliocene of Kar Nicobar, occurs fairly commonly. It is a distinctly perforate species. About 10 chambers comprise the last-formed whorl, the dorsal side is only slightly evolute and the earlier whorls largely obscured by shell material, the sutures are limbate and distinct, and the aperture extends slightly over onto the dorsal side. In adult tests the wall is about equally perforate on both dorsal and ventral sides, but in young specimens the ventral side, or the early chambers on the ventral side, are almost free of the coarse perforations.

*Cibicides lobatulus* (Walker and Jacob)

Plate 91, figures 27, 28

*Nautilus lobatulus* Walker and Jacob, Adams Essays, Kammacher's ed., p. 642, pl. 14, fig. 36, 1798.

*Truncatulina lobatula* D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 168, pl. 9, figs. 18-23, 1846.

*Cibicides lobatulus* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 118, pl. 21, figs. 3a-c, 1931.

*Truncatulina lobata* D'Orbigny (in Barker-Webb and Berthelot), Histoire naturelle des Iles Canaries, tome 2, pt. 2, Foraminifères, p. 134, pl. 2, figs. 22-24, 1839.

This cosmopolitan species is found at Bikini, Eniwetok, and Rongelap, more abundantly at the deeper stations. It shows much variation and occurs in two forms, examples of each of which are figured. The difference in these two forms seems to be due to the attachment of the one (fig. 27) resulting in a flat or concave dorsal surface and consequently an acute periphery, while the other (fig. 28) shows no evidence of having been attached and the chambers on the dorsal side are slightly inflated, and the periphery smoothly rounded. This second, rounded form seems to be limited to the deeper-water samples and to be found only among the larger specimens while those showing evidence of attachment are found in either deep or shallow-water samples. Young specimens almost all show evidence of attachment. Both kinds show the closely spaced, coarse perforations on both dorsal and ventral surfaces, typical of the species.

*Cibicides mayori* (Cushman)

Plate 91, figures 29, 30

*Truncatulina mayori* Cushman, Carnegie Inst. Washington Pub. 342, p. 39, pl. 12, figs. 3, 4, 1924.

Test attached, flattened, planoconvex or with dorsal side slightly concave, not completely involute ventrally thus leaving a small knob of shell material in the center of the convex ventral side, periphery very irregular, with a very thin, fringe-like, sometimes serrate keel; chambers indistinct, numerous, 5 to 10 in the last whorl, later ones irregular in size and shape, very slightly inflated; sutures indistinct, limbate and curved.

slightly depressed on the ventral side; wall thin, smooth, perforations very coarse, less closely spaced on the ventral side than on the dorsal; aperture an elongate, very low and inconspicuous slit extending from near the umbo on the ventral side to the periphery and slightly over onto the dorsal side. Diameter 0.50 to 0.75 mm, thickness 0.15 to 0.20 mm.

Specimens from Bikini, Eniwetok and Rongelap have been compared with the types of this species from off Samoa, in 17, 18, and 25 fathoms, and seem to be the same, although they exhibit considerable variation. The Marshall Islands specimens have more chambers to the last whorl, as many as 10, and only a few specimens have the perforations on the dorsal surface which, as shown by reexamination of the holotype, do not extend entirely through the test, but only into the previous chambers. These perforations seem to be the unclosed dorsal portions of earlier apertures.

*Cibicides* cf. *C. pseudoungerianus* (Cushman)

Plate 91, figure 31

*Truncatulina pseudoungeriana* Cushman, U. S. Geol. Survey Prof. Paper 129-E, p. 97, pl. 20, fig. 9, 1922.

*Cibicides pseudoungeriana* Cushman, U. S. Natl. Mus. Bull. 104, pt. 8, p. 123, pl. 22, figs. 3-7, 1931; Am. Jour. Sci., v. 239, p. 138, pl. 5, figs. 16-19, 1941.

A few specimens seem closely related to this species described from the Oligocene of Mississippi and widely recorded, fossil and Recent. They are smaller than the types and have 13 or 14 chambers in the last whorl. They have a more prominent umbilical boss on the ventral side than do the types, and the difference in coarseness of perforations between the ventral and dorsal sides is very striking.

Genus *CIBICIDINA* Bandy, 1949

*Cibicidina* sp.

Plate 91, figure 32

A very few specimens from four Bikini deep-water samples, similar to that figured, seem to be undescribed. The species resembles *C. mississippiensis* (Cushman) (1935, p. 54, pl. 22, figs. 3a-c) in general structure. The chambers are very strongly inflated ventrally and the dorsal side is slightly concave and only very slightly evolute. The wall is distinctly perforate.

Genus *CIBICIDELLA* Cushman, 1927

*Cibicidella variabilis* (D'Orbigny)

Plate 82, figure 13

*Truncatulina variabilis* D'Orbigny, Annales sci. nat., vol. 7, p. 279, No. 8, 1826; (in Barker-Webb and Berthelot), Histoire naturelle des Iles Canaries, tome 2, pt. 2, Foraminifères, p. 135, pl. 2, fig. 29, 1839.

Parker, Jones, and H. B. Brady, Annals and Mag. Nat. History, 4th ser., v. 8, p. 177, pl. 12, fig. 138, 1871.

*Cibicidella variabilis* Cushman, Cushman Lab. Foram. Research Contr., v. 3, p. 93, 1927; idem, Special Pub. 1, p. 323, pl. 50, figs. 5-7; pl. 51, fig. 5, 1928; U. S. Natl. Mus. Bull. 104, pt. 8, p. 127, pl. 24, fig. 3, 1931.

This is a highly variable species, the early stages like *Cibicides* but the later chambers taking many different shapes, probably partly due to the surface to which it is attached. It is very widely recorded and more than one species may be included.

Family *PLANORBULINIDAE*

Genus *PLANORBULINA* D'Orbigny, 1827

*Planorbulina acervalis* H. B. Brady

Plate 82, figure 14; plate 91, figures 34-36

*Planorbulina acervalis* H. B. Brady, Challenger Rept., Zoology, v. 9, p. 657, pl. 92, fig. 4, 1884.

Numerous specimens from all four atolls are referred to this species. It is evidently very variable and has been confused with *Acervulina inhaerens* Schultze. The two are very difficult to separate in some instances, and it is difficult to place the references with any degree of consistency. Usually it is possible to distinguish the initial few chambers in a regular coil on the dorsal side before the chambers assume their irregular manner of growth.

Genus *PLANORBULINELLA* Cushman, 1927

*Planorbulinella larvata* (Parker and Jones)

*Planorbulina larvata* Parker and Jones, Philos. Trans., v. 155, p. 380, pl. 19, fig. 3, 1865.

H. B. Brady, Challenger Rept., Zoology, v. 9, p. 658, pl. 92, figs. 5, 6, 1884.

*Planorbulinella larvata* Cushman, Cushman Lab. Foram. Research Special Pub. 4, pl. 29, figs. 5a, b, 1933; idem, Special Pub. 5, pl. 37, figs. 3a, b, 1933.

This usually common species is noteworthy because of its rarity in the Marshall Islands. Only a single specimen, from Bikini core 1176 at 2 to 3 inches, was found.

Genus *ACERVULINA* Schultze, 1854

*Acervulina inhaerens* Schultze

Plate 91, figures 37, 38

*Acervulina inhaerens* Schultze, Organismus Polythal., 1854, p. 68, pl. 6, fig. 12.

Bronn, Klassen und Ordnungen Thier-Reichs, Band 1, p. 72, pl. 6, fig. 17, 1859.

*Gypsina inhaerens* H. B. Brady, Challenger Rept., Zoology, v. 9, p. 718, pl. 102, figs. 1-6, 1884.

From an examination of the records of this species it seems that more than one species is recorded under this name. Specimens referred to it here are common in many of the samples and it is evidently a species of rather warm, shallow water.



The separation between this species and *Planorbulina acervalis* is hard to make. In this species the later chambers are more piled up on top of the earlier chambers and in some cases the species is very distinctive in having a radial pattern of sutures on the ventral side. It has very small chambers, not inflated, and not as coarsely perforate as in *Planorbulina acervalis*.

Genus **GYPSSINA** Carter, 1877

*Gypsina globula* (Reuss)

Plate 91, figure 39

*Cerriopora globulus* Reuss, Haidinger's Naturwiss. Abh., Band 2, p. 33, pl. 5, fig. 7, 1847.

*Gypsina globulus* H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 717, pl. 101, fig. 8, 1884.

A few specimens may be placed under this name. When well preserved they are generally spherical in shape, although a number of immature ones have a flat surface on one side. The individual chambers are usually smaller than in *G. vesicularis*, resulting in a finer textured surface.

*Gypsina plana* (Carter)

Plate 93, figure 1

*Polytrema planum* Carter, *Annals and Mag. Nat. History*, 4th ser., v. 17, p. 211, pl. 13, figs. 18, 19, 1876.

Chapman, *Linnean Soc. Jour., Zoology*, v. 28, p. 209 (list); p. 201, pl. 20, figs. 6, 7, 1900; *Annals and Mag. Nat. History*, 7th ser., v. 7, p. 82, 1901; *Linnean Soc. Jour., Zoology*, v. 28, p. 396, pl. 35, figs. 2, 4; p. 407 (list), 1902.

*Gypsina inhaerens* Schultze var. *plana* Yabe and Hanzawa, *Tohoku Imp. Univ. Sci. Repts., 2nd ser., Geol.*, v. 11, p. 179, pl. 2, fig. 6, 1929; v. 14, p. 37, pl. 1, fig. 6; pl. 5, fig. 7; pl. 9, fig. 12; pl. 10, fig. 8, 1930.

*Acervulina inhaerens* Schultze var. *plana* Hanzawa, *idem*, v. 12, p. 156, pl. 3, fig. 4, 1931.

*Acervulina inhaerens* Schultze var. *plana* Carter var. Chapman, *Annals and Mag. Nat. History*, 11th ser., v. 11, p. 101 (list), 1944.

Rather large masses of this encrusting form are found attached to coral at a relatively shallow depth, 14 fathoms, in Bikini Lagoon, and as a cementing coating on *Halimeda* segments at Bikini 788 also in the lagoon. It differs from *Miniacina miniacea* in consisting of a smooth, very fine textured coating over a large area rather than a more local development with branches extending upward from the surface. In cut section (pl. 93, fig. 1b) the structure is identical with that observed in cut sections of free specimens of *Gypsina*.

This species has been reported in Tertiary material. Chapman (1944) reported it as "one of the chief agents in binding together the loose reef material" in the Funafuti boring.

*Gypsina vesicularis* (Parker and Jones)

Plate 82, figure 12

*Orbitolina vesicularis* Parker and Jones, *Annals and Mag. Nat. History*, 3d ser., v. 6, p. 31, no. 5, 1860.

*Gypsina vesicularis* Carter, *idem*, 4th ser., v. 20, p. 173, 1877. H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 718, pl. 101, figs. 9-12, 1884.

This species was found at all four atolls. Specimens are much larger and coarser textured than *G. globula* and are disc-shaped, usually thickened in the center.

Family **RUPERTIIDAE**

Genus **RUPERTIA** Wallich, 1877

*Rupertia stabilis* Wallich

Plate 91, figure 33

*Rupertia stabilis* Wallich, *Annals and Mag. Nat. History*, 4th ser., v. 19, pp. 501-504, pl. 20, 1877.

A single young specimen, here figured, was found at Rongelap 456.

Genus **CARPENTERIA** Gray, 1858

*Carpenteria proteiformis* Goës?

*Carpenteria balaniformis* Gray var. *proteiformis* Goës, *K. svenska vetensk. akad. Handl.*, Band 19, no. 4, p. 94, pl. 6, figs. 208-214; pl. 7, figs. 215-219, 1882.

*Carpenteria proteiformis* Brady, *Challenger* Rept., Zoology, v. 9, p. 679, pl. 97, figs. 8-14, 1884.

Specimens consisting of an irregularly growing series of thick-walled, coarsely perforate chambers are found fairly abundantly in a few samples. They are mostly light to dark red or orange.

*Carpenteria* sp.

Plate 82, figure 15

The specimen figured was the only one of this sort found. It may belong in *C. monticularis* Carter (1877, p. 211, pl. 13, figs. 9-12) which is known from the Pacific.

Family **HOMOTREMIDAE**

Genus **HOMOTREMA** Hickson, 1911

*Homotrema rubrum* (Lamarck)

Plate 82, figure 17; plate 92, figure 8; plate 93, figure 2

*Millepora rubra* Lamarck, *Histoire naturelle des Animaux sans Vertèbres*, tome 2, p. 202, 1816.

*Polytrema rubra* Dujardin, *Histoire naturelle des Zoophytes*, 1841, p. 259.

Carpenter, Parker, and Jones, *Introd. Foram.*, p. 235, pl. 13, figs. 18-20, 1862.

- Homotrema rubrum* Hickson, Linnean Soc. London Trans., Zoology, ser. 2, v. 14, pp. 445, 454, pl. 30, fig. 2; pl. 31, fig. 9; pl. 32, figs. 19, 22, 28, 1911.
- Cushman, Carnegie Inst. Washington Pub. 311, p. 53, pl. 14, figs. 6-8, 1922.
- Hofker, *Siboga-Exped.*, Mon. 4, p. 31, pl. 13, figs. 8, 9; pl. 14, figs. 12-20; pl. 15, 1927.
- Chapman and Parr, Royal Soc. Victoria Proc., v. 43, pt. 2, p. 238, pl. 9, figs. 9, 10, 1931.
- Emiliani, Cushman Found. Foram. Research Contr., v. 2, pp. 143-146, pls. 15, 16, 1951.

This is a species of shallow, warm waters, attached to shell or *Halimeda* or coral fragments. In our samples it is mostly represented by fragments evidently taken into deeper water by wave and current action. A few well-preserved specimens were found attached inside cavities. In these specimens (see plate 92, fig. 8, and plate 93, fig. 2) sponge spicules may be observed protruding from the high conical apertures.

#### Genus *MINIACINA* Galloway, 1933

##### *Miniacina miniacea* (Pallas)

Plate 82, figure 16

- Millepora miniacea* Pallas, Elenchus Zoophytorum, p. 251, The Hague, 1766.
- Esper, Die Pflanzenthiere, Theil 1, p. 225, pl. 17, figs. 1-4, 1791.
- Polytrema miniacea* Carter, Annals and Mag. Nat. History, 4th ser., v. 17, p. 185, pl. 13, figs. 1-6, 1876.
- Moebius, Foraminiferen von Mauritius, p. 85, pl. 7, figs. 1-17, 1880.
- H. B. Brady, *Challenger* Rept., Zoology, v. 9, p. 721, pl. 100, figs. 5-9; pl. 101, fig. 1, 1884.
- Chapman, Linnean Soc. Jour., Zoology, v. 28, p. 16, pl. 4, fig. 7, 1899.
- Hickson, Linnean Soc. London Trans., Zoology, ser. 2, v. 14, p. 453, pl. 30, fig. 1; pl. 31, fig. 8, 1911.
- Heron-Allen and Earland, Soc. Sci. Hist. Nat. Corse Bull., p. 139, pl. 2, figs. 40-49, 1922.
- Hofker, *Siboga-Exped.*, Mon. 4, p. 27, pl. 12; pl. 13, figs. 1-7; pl. 14, figs. 1-11, 1927.
- Miniacina miniacea* Cushman, Cushman Lab. Foram. Research Special Pub. 5, pl. 37, figs. 33-36, 1933.
- Colom, Inst. Español Oceanografía, Notas y Resúmenes, ser. 2, no. 108, p. 45, pl. 11, figs. 218, 220-222, 1942.

This species, red in color, occurs at all four atolls and is distinguished from *Homotrema rubrum* (Lamarck) by having fine perforations throughout, whereas in *Homotrema* the walls between the foramina are solid and thus appear glossy. Also, *M. miniacea* is a slenderer and more branching form. Numerous fragments show the enlarged disclike area by which the specimens are attached.

Some specimens lack the red color and may belong to the variety *alba* (Carter) (1877, p. 213, pl. 13, fig. 14).

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   *echinata* ..... 361  
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*Tubinella fumalis* ..... 324, 336, tab. 1, pl. 84  
*tubulifera, Epistominella* ..... 323, 355, tab. 4, pl. 90  
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   *schreibersiana* ..... 352  
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PLATES 82-93

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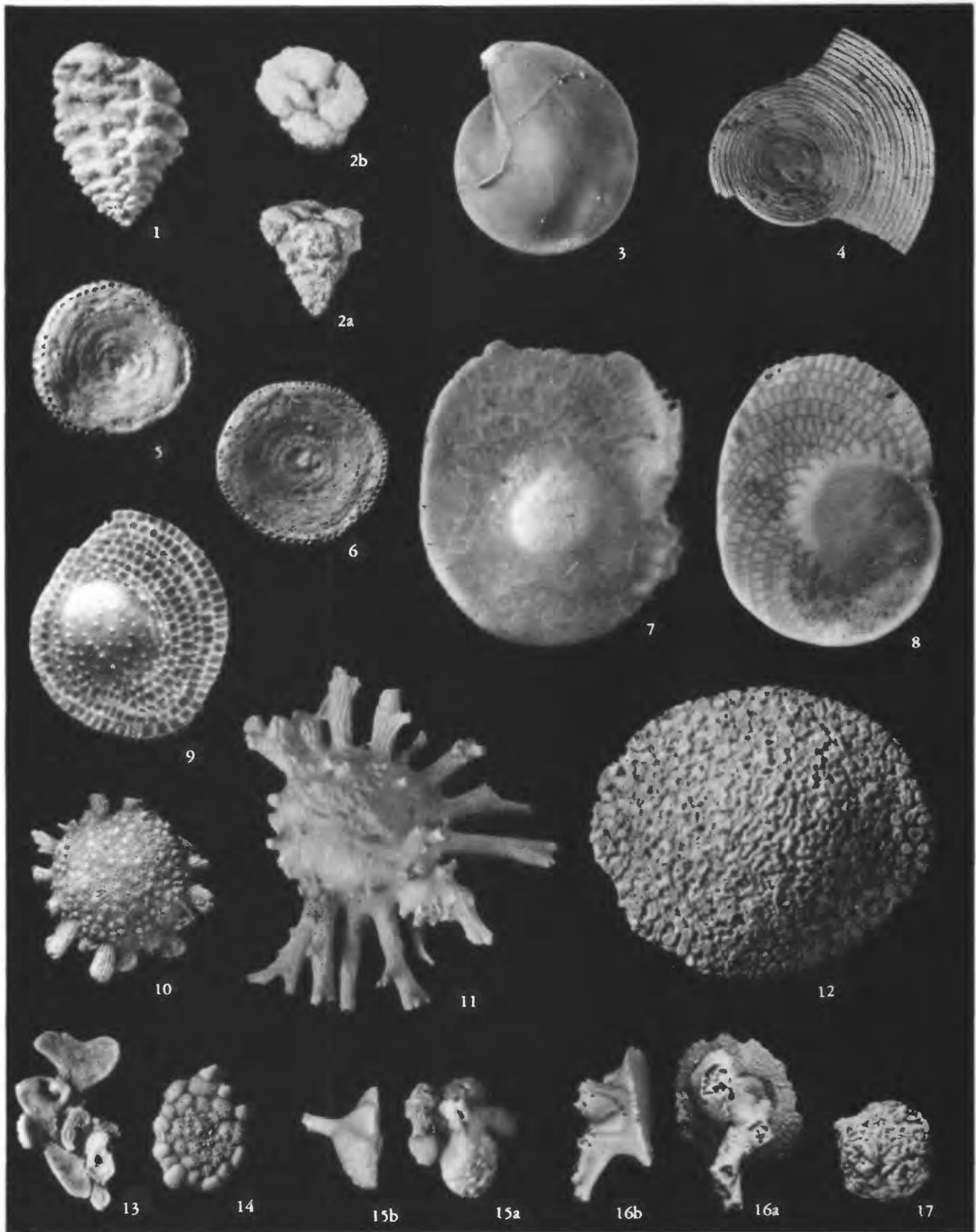
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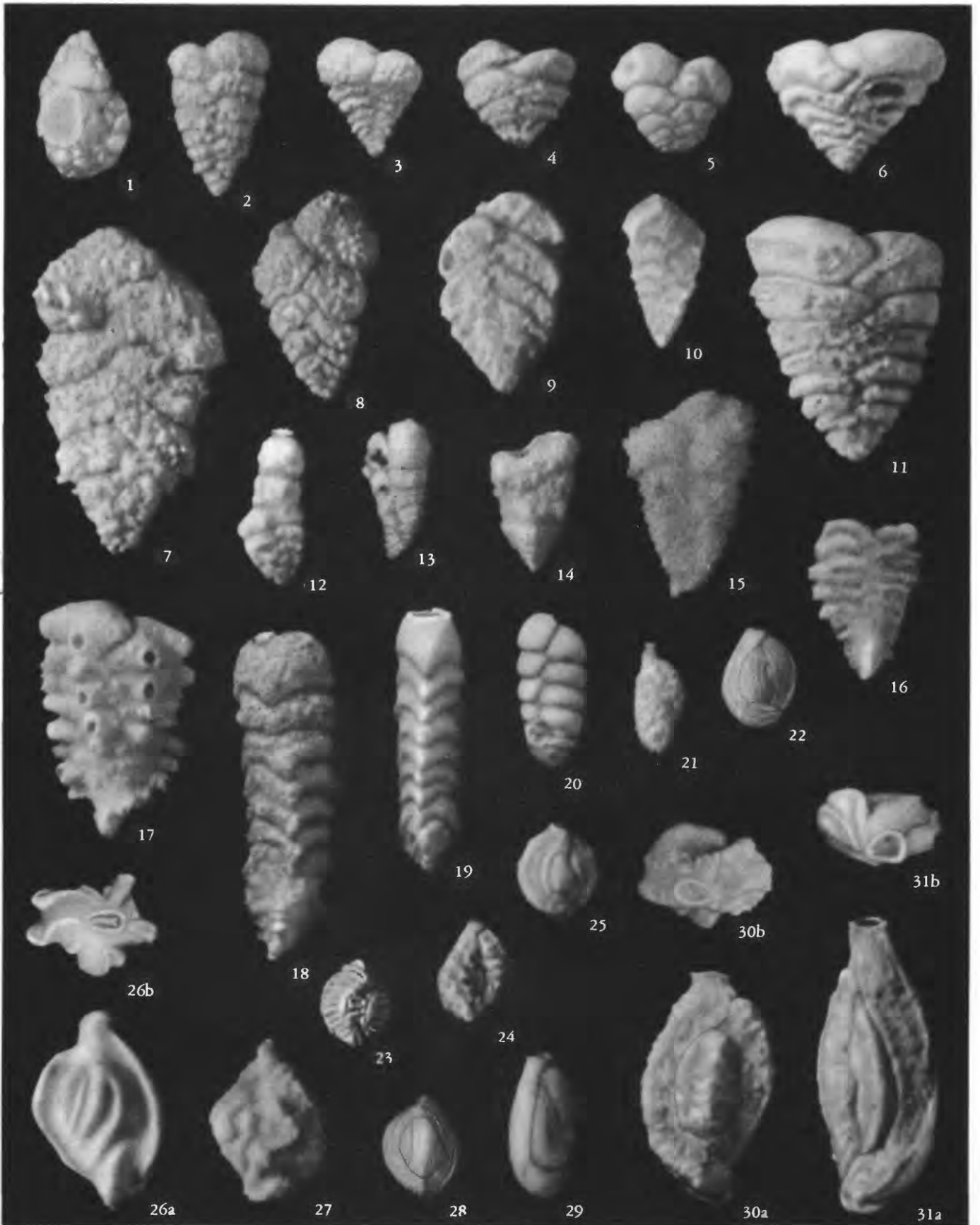
PLATE 82

[All figures  $\times 15$ ]

- FIGURE 1. *Gaudryina (Siphogaudryina) rugulosa* Cushman (p. 331).  
USNM 548610; Bikini 292.
2. *Valvulina davidiana* Chapman (p. 331).  
USNM 548487; Rongerik 51; *a*, Side view; *b*, top view.
3. *Robulus* sp. D. (p. 343).  
USNM 548619; Bikini 814.
4. *Sorites marginalis* (Lamarck) (p. 348).  
USNM 548472; Rongerik 21.
- 5, 6. *Marginopora vertebralis* Blainville. (p. 348).  
5, USNM 548558; Rongerik 99. 6, USNM 548550; Rongerik 79.
- 7, 8. *Heterostegina suborbicularis* D'Orbigny (p. 346).  
7, USNM 548746; 8, USNM 548747; Eniwetok 145.
9. *Cycloclypeus carpenteri* H. B. Brady (p. 347).  
USNM 548632; Bikini 817; Megalospheric specimen.
- 10, 11. *Calcarina spengleri* (Gmelin) (p. 363).  
10, USNM 548559; Rongerik 99. 11, USNM 548611; Bikini 304; Specimen showing development of arborescent spines.
12. *Gypsina vesicularis* (Parker and Jones) (p. 373).  
USNM 548752; Eniwetok 291.
13. *Cibicidella variabilis* (D'Orbigny) (p. 372).  
USNM 548536; Rongerik 51.
14. *Planorbulina acervalis* H. B. Brady (p. 372).  
USNM 548537; Rongerik 51.
15. *Carpenteria* sp. (p. 373).  
USNM 548554; Rongerik 80; *a*, Top view; *b*, side view.
16. *Miniacina miniacea* (Pallas) (p. 374).  
USNM 548755; Eniwetok 306; *a*, Top view; *b*, side view.
17. *Homotrema rubrum* (Lamarck) (p. 373).  
USNM 548737; Eniwetok 11; Eroded fragment of an attached specimen.



MISCELLANEOUS LARGE SPECIMENS OF FORAMINIFERA



SACCAMMINIDAE, TEXTULARIIDAE, VERNEULINIDAE, VALVULINIDAE, MILIOLIDAE

PLATE 83

[All figures  $\times 40$ , except as indicated]

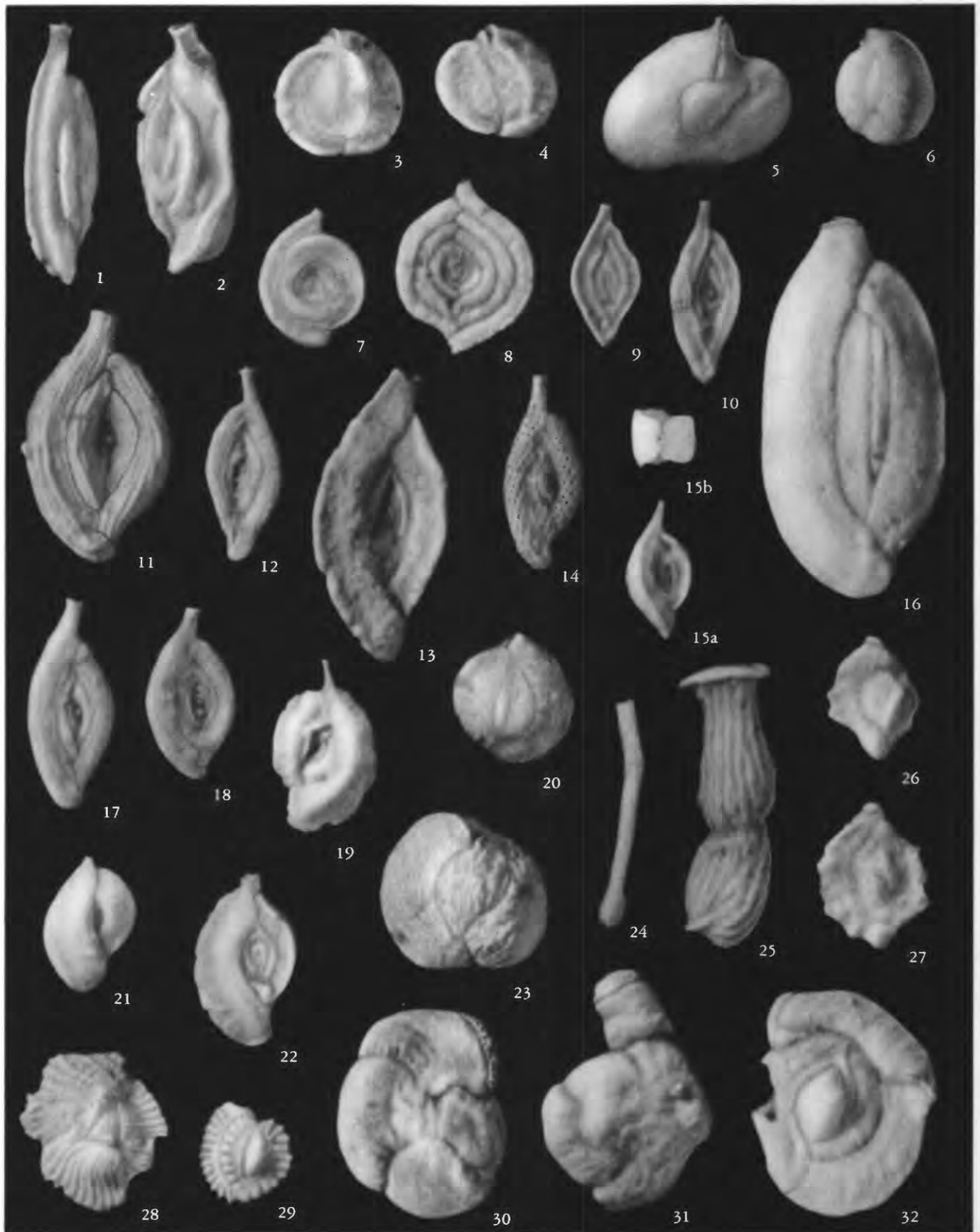
- FIGURE 1. *Proteonina* sp. (p. 328).  
 USNM 548745; Eniwetok 145.
2. *Textularia agglutinans* D'Orbigny (p. 328).  
 USNM 548483; Rongerik 51.
  3. *Textularia candeiana* D'Orbigny (p. 329).  
 USNM 548484; Rongerik 51.
  4. *Textularia conica* D'Orbigny (p. 329).  
 USNM 548555; Rongerik 91.
  5. *Textularia semialata* Cushman (p. 330).  
 USNM 548583; Rongelap 468.
  6. *Textularia dupla* Todd, n. sp. (p. 329).  
 Holotype, USNM 548609; Bikini 292.
  7. *Textularia foliacea* Heron-Allen and Earland (p. 329).  
 USNM 548485; Rongerik 51.
  8. *Textularia foliacea* var. *oceanica* Cushman (p. 329).  
 USNM 548486; Rongerik 51.
  9. *Siphotextularia* cf. *S. concava* (Karrer) (p. 330).  
 USNM 548672; Bikini 1174 (1-2'').
  10. *Siphotextularia crispata* (H. B. Brady) (p. 330).  
 USNM 548568; Rongelap 456.
  11. *Textularia kerimbaensis* Said (p. 329).  
 USNM 548629; Bikini 817.
  12. *Bigenerina* sp. (p. 330).  
 USNM 548671; Bikini 1174 (1-2'').
  13. *Gaudryina* cf. *G. pauperata* Earland (p. 330).  
 USNM 548748,  $\times 80$ ; Eniwetok 218.
  14. *Gaudryina triangularis* var. *angulata* Cushman (p. 331).  
 USNM 548649; Bikini 819.
  15. *Gaudryina trullissata* Todd, n. sp. (p. 331).  
 Holotype, USNM 548622,  $\times 80$ ; Bikini 815.
  16. *Gaudryina* (*Siphogaudryina*) *transversaria* (H. B. Brady) (p. 331).  
 USNM 548612,  $\times 80$ ; Rongelap 463.
  17. *Gaudryina* (*Siphogaudryina*) *siphonifera* (H. B. Brady) (p. 331).  
 USNM 548576; Rongelap 463.
  18. *Clavulina angularis* D'Orbigny (p. 332).  
 USNM 548591; Rongelap 483.
  19. *Clavulina pacifica* Cushman (p. 332).  
 USNM 548488; Rongerik 51.
  20. *Karrieriella bradyi* (Cushman) (p. 332).  
 USNM 548698; Bikini 1175.
  21. *Quinqueloculina anguina* var. *arenata* Said (p. 332).  
 USNM 548489; Rongerik 51.
  22. *Quinqueloculina crassa* var. *subcuneata* Cushman (p. 333).  
 USNM 548470; Rongerik 18.
  23. *Quinqueloculina parkeri* (H. B. Brady) (p. 333).  
 USNM 548491,  $\times 15$ ; Rongerik 51.
  24. *Quinqueloculina parkeri* (H. B. Brady) var. (p. 333).  
 USNM 548492,  $\times 15$ ; Rongerik 51.
  25. *Quinqueloculina* cf. *Q. samoensis* Cushman (p. 333).  
 USNM 548757; Eniwetok 310.
  26. *Quinqueloculina bradyana* Cushman (p. 332).  
 USNM 548614; Bikini 814; a, Side view; b, apertural view
  27. *Quinqueloculina distorta* Cushman, n. sp. (p. 333).  
 Holotype, USNM 548545; Rongerik 79.
  28. *Quinqueloculina neostriatula* Thalmann (p. 333).  
 USNM 548464; Rongerik 3.
  29. *Quinqueloculina* cf. *Q. seminulum* (Linné) (p. 333).  
 USNM 548562; Rongelap 111.
  30. *Quinqueloculina* cf. *Q. ferussacii* D'Orbigny (p. 333).  
 USNM 548599; Bikini 190; a, Side view; b, apertural view
  31. *Quinqueloculina bidentata* D'Orbigny (p. 332).  
 USNM 548490; Rongerik 51; a, Side view; b, apertural view.



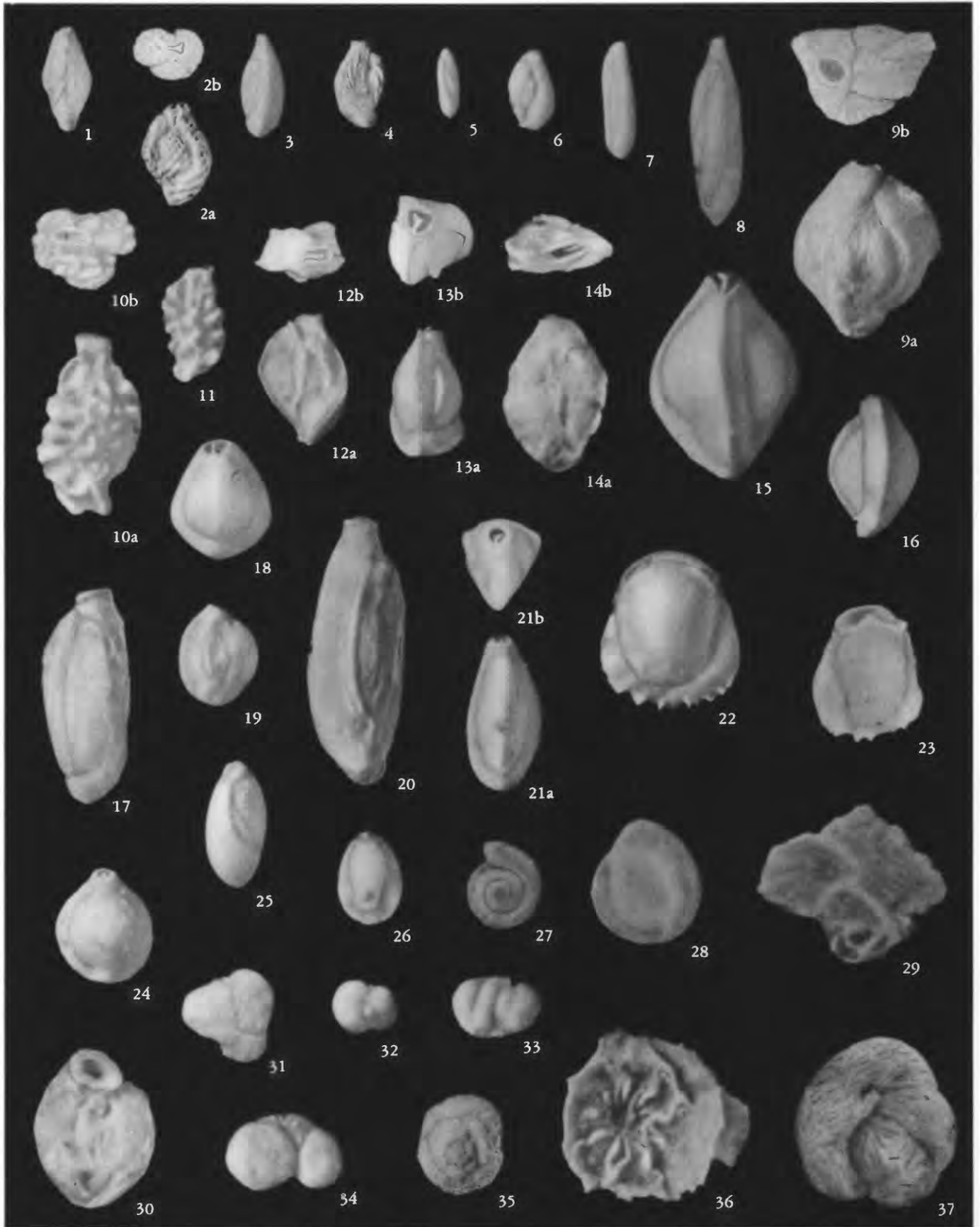
## PLATE 84

[All figures  $\times 40$ , except as indicated]

- FIGURES 1, 2. *Quinqueloculina sulcata* D'Orbigny (p. 334).  
 USNM 548493; Rongerik 51.
- 3, 4. *Miliolinella australis* (Parr) (p. 334).  
 3, USNM 548476,  $\times 80$ ; Rongerik 31. 4, USNM 548577,  $\times 80$ ; Rongelap 463.
- 5, 6. *Triloculinella labiosa* (D'Orbigny) (p. 334).  
 5, USNM 548761,  $\times 80$ ; Eniwetok 317. 6, USNM 548494,  $\times 80$ ; Rongerik 51; Young specimen.
7. *Spiroloculina circularis* Chapman (p. 335)  
 USNM 548650;  $\times 80$ ; Bikini 819.
8. *Spiroloculina marshallana* Todd, n. sp. (p. 335).  
 Holotype, USNM 548615; Bikini 814.
9. *Spiroloculina clara* Cushman (p. 335).  
 USNM 548496, Rongerik 51.
10. *Spiroloculina clara* var. *lirata* Cushman, n. var. (p. 335).  
 Holotype, USNM 548477; Rongerik 31.
- 11, 12. *Spiroloculina angulata* Cushman (p. 334).  
 USNM 548495; Rongerik 51.
13. *Spiroloculina communis* Cushman and Todd (p. 335).  
 USNM 548738, Eniwetok 116.
14. *Spiroloculina foveolata* Egger (p. 335).  
 USNM 548497; Rongerik 51.
15. *Spiroloculina mayori* Cushman (p. 336).  
 USNM 548613; Bikini 1028; a, Front view; b, end view.
16. *Massilina planata* Cushman (p. 334).  
 USNM 548762; Eniwetok 317.
- 17, 18. *Spiroloculina corrugata* Cushman and Todd (p. 335).  
 17, USNM 548739; Eniwetok 116. 18, USNM 548758; Eniwetok 310.
19. *Spiroloculina* sp. B. (p. 336).  
 USNM 548478; Rongerik 31.
20. *Sigmoilina edwardsi* (Schlumberger) (p. 336).  
 USNM 548602,  $\times 80$ ; Bikini 218 (12-16'').
- 21, 22. *Spiroloculina* sp. A. (p. 336).  
 21, USNM 548584; Rongelap 468. 22, USNM 548592; Rongelap 483.
23. *Hauerina milletti* Cushman, n. sp. (p. 337).  
 Holotype, USNM 548501; Rongerik 51.
24. *Tubinella funalis* (H. B. Brady) (p. 336).  
 USNM 548498,  $\times 80$ ; Rongerik 51.
25. *Articulina pacifica* Cushman (p. 336).  
 USNM 548546,  $\times 80$ ; Rongerik 79.
- 26, 27. *Hauerina serrata* Cushman, n. sp. (p. 337).  
 26, Paratype, USNM 548765; 27 Holotype, USNM 548764; Eniwetok 321.
- 28, 29. *Hauerina involuta* Cushman (p. 337).  
 USNM 548500; Rongerik 51.
- 30, 31. *Hauerina diversa* Cushman (p. 337).  
 30, USNM 548499; Rongerik 51. 31, USNM 548593; Rongelap 483.
32. *Hauerina bradyi* Cushman (p. 336).  
 USNM 548760; Eniwetok 314.



MILIOLIDAE



MILIOLIDAE, OPTHALMIDIIDAE, TROCHAMMINIDAE

## PLATE 85

[All figures  $\times 40$ , except as indicated]

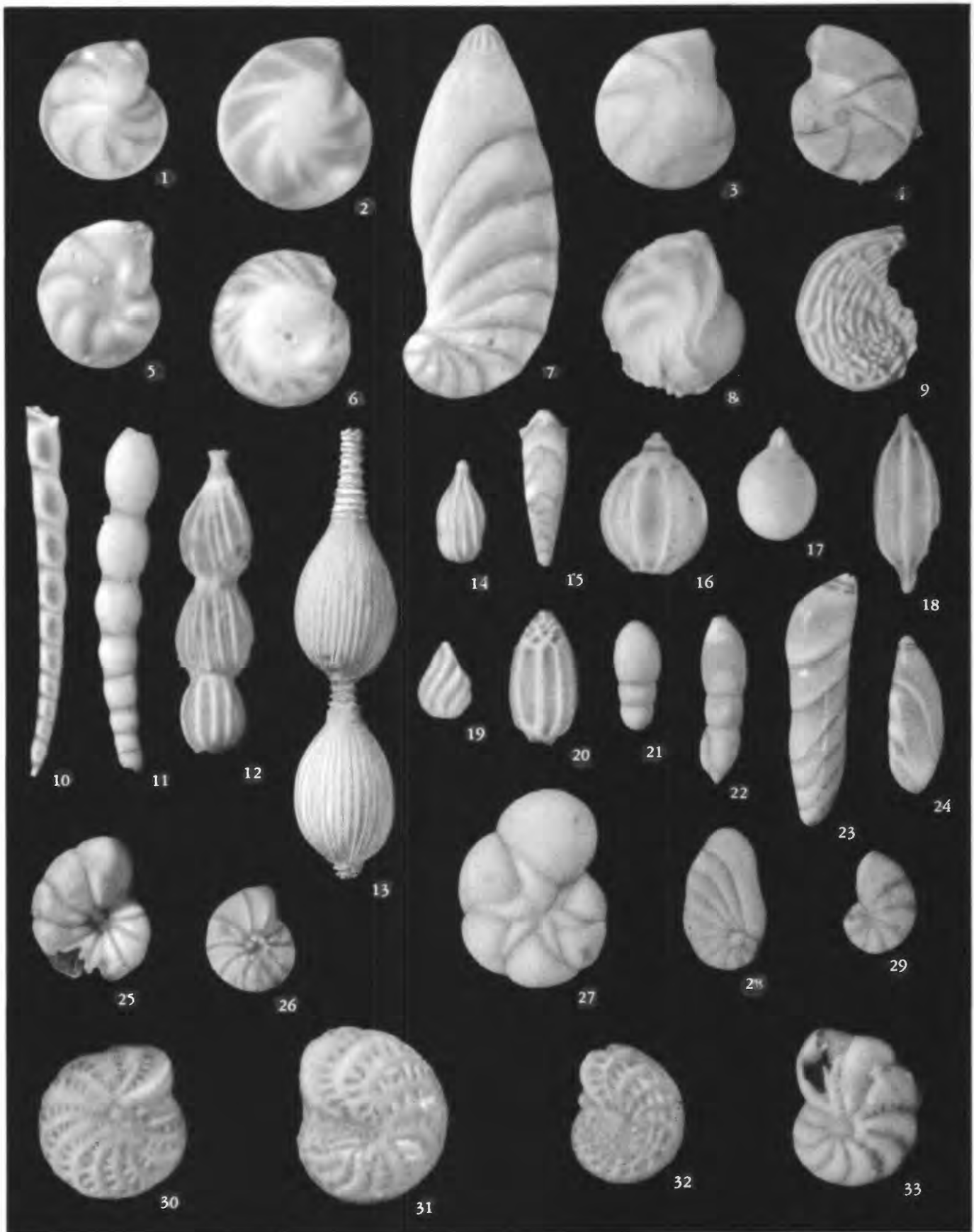
- FIGURE 1.** *Schlumbergerina alveoliniformis* (H. B. Brady) (p. 337).  
 USNM 548569,  $\times 15$ ; Rongelap 456.
2. *Triloculina* cf. *T. bicarinata* D'Orbigny (p. 338).  
 USNM 548556,  $\times 15$ ; Rongerik 99; *a*, Side view; *b*, apertural view.
3. *Triloculina earlandi* Cushman, n. sp. (p. 338).  
 Holotype, USNM 548502; Rongerik 51.
4. *Triloculina involuta* Todd, n. sp. (p. 338).  
 Holotype, USNM 548742,  $\times 15$ ; Eniwetok 118.
- 5-7. *Triloculina* cf. *T. oblonga* (Montagu) (p. 339).  
 USNM 548504; Rongerik 51.
8. *Triloculina spinata* Cushman (p. 339).  
 USNM 548595,  $\times 80$ ; Rongelap 483.
9. *Triloculina terquemiana* (H. B. Brady) (p. 340).  
 USNM 548557; Rongerik 99; *a*, Side view; *b*, apertural view.
- 10, 11. *Triloculina kerimbatica* (Heron-Allen and Earland) (p. 339).  
 10, USNM 548585; Rongelap 468; *a*, Side view; *b*, apertural view.  
 11, USNM 548503; Rongerik 51.
12. *Triloculina irregularis* (D'Orbigny) (p. 338).  
 USNM 548596; Bikini 37; *a*, Side view; *b*, apertural view.
13. *Triloculina marshallana* Todd, n. sp. (p. 339).  
 Holotype, USNM 548594; Rongelap 483; *a*, Side view; *b*, apertural view.
14. *Triloculina* cf. *T. bassensis* Parr. (p. 337).  
 USNM 548597; Bikini 177; *a*, Side view; *b*, apertural view.
- 15, 16. *Triloculina tricarinata* D'Orbigny (p. 340).  
 USNM 548505; Rongerik 51.
17. *Triloculina subplanciana* Cushman, n. sp. (p. 339).  
 Holotype, USNM 548540,  $\times 80$ ; Rongerik 54.
18. *Triloculina trigonula* (Lamarck) (p. 340).  
 USNM 548628; Bikini 816.
19. *Triloculina bikiniensis* Todd, n. sp. (p. 338).  
 Holotype, USNM 548598; Bikini 177.
20. *Triloculina* sp. A. (p. 340).  
 USNM 548756; Eniwetok 307.
21. *Triloculina* sp. B. (p. 340).  
 USNM 548635; Bikini 818; *a*, Side view; *b*, apertural view.
22. *Pyrgo denticulata* (H. B. Brady) (p. 340).  
 USNM 548506; Rongerik 51.
23. *Pyrgo denticulata* var. *striolata* (H. B. Brady) (p. 340).  
 USNM 548507,  $\times 50$ ; Rongerik 51.
24. *Pyrgo lucernula* (Schwager) (p. 340).  
 USNM 548659; Bikini 1170.
25. *Pyrgo millettii* (Cushman), juv. (p. 341).  
 USNM 548616; Bikini 814.
26. *Pyrgo* sp. (p. 341).  
 USNM 548617; Bikini 814.
27. *Cornuspira planorbis* Schultze (p. 341).  
 USNM 548471,  $\times 80$ ; Rongerik 21.
28. *Planispirina exigua* (H. B. Brady) (p. 341).  
 USNM 548769,  $\times 80$ ; Eniwetok 329.
29. *Nubecularia lacunensis* Chapman (p. 341).  
 USNM 548544,  $\times 80$ ; Rongerik 56.
30. *Wiesnerella auriculata* (Egger) (p. 341).  
 USNM 548754,  $\times 80$ ; Eniwetok 304.
- 31-34. *Parrina bradyi* (Millett) (p. 342).  
 USNM 548547; Rongerik 79.
35. *Trochammina* cf. *T. rotaliformis* J. Wright (p. 342).  
 USNM 548749,  $\times 80$ ; Eniwetok 218.
36. *Rotaliammina mayori* Cushman (p. 342).  
 USNM 548586,  $\times 80$ ; Rongelap 468; Ventral view, showing chamber walls.
37. *Carterina spiculotesta* (Carter) (p. 342).  
 USNM 548618,  $\times 80$ ; Bikini 814.



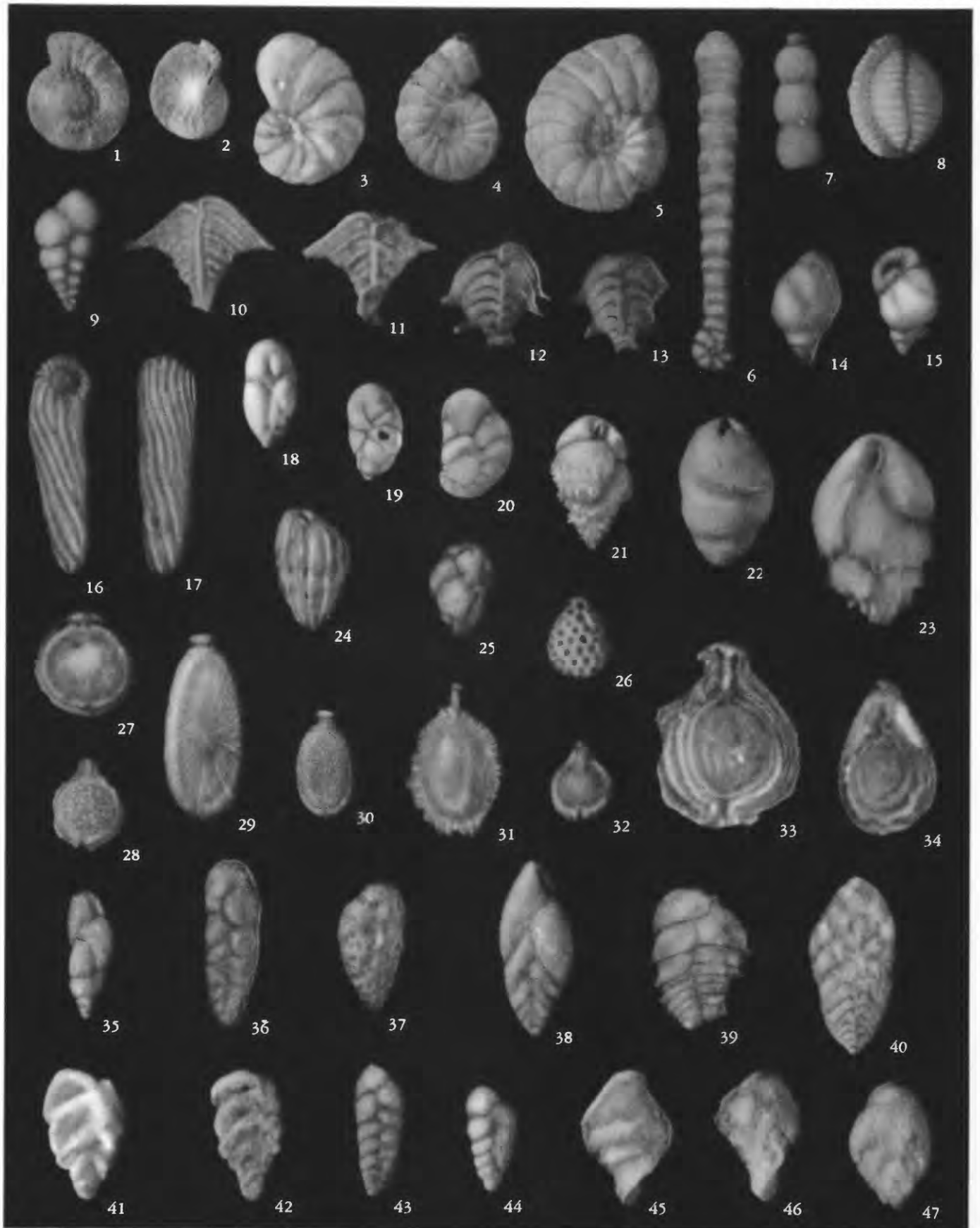
## PLATE 86

[All figures  $\times 40$ , except as indicated]

- FIGURE 1.** *Robulus limbosus* (Reuss) (p. 343).  
USNM 548699; Bikini 1175.
2. *Robulus gibbus* (D'Orbigny) (p. 342).  
USNM 548630; Bikini 817.
3. *Robulus nigriseptus* (Koch) (p. 343).  
USNM 548673; Bikini 1174 (1-2'').
4. *Robulus calcar* (Linné) (p. 342).  
USNM 548636,  $\times 80$ ; Bikini 818.
5. *Robulus* sp. B. (p. 343).  
USNM 548674; Bikini 1174 (1-2'').
6. *Robulus* sp. A. (p. 343).  
USNM 548651; Bikini 819.
7. *Astaculus planulata* Galloway and Wissler (p. 343).  
USNM 548676; Bikini 1174 (1-2'').
8. *Robulus* sp. C. (p. 343).  
USNM 548675; Bikini 1174 (1-2'').
9. *Astaculus bradyi* (Cushman), juv. (p. 343).  
USNM 548652; Bikini 819.
10. *Dentalina* cf. *D. filiformis* (D'Orbigny) p. 343).  
USNM 548653; Bikini 819.
11. *Nodosaria* sp. A. (p. 344).  
USNM 548717; Bikini 1176 (1-2'').
12. *Nodosaria* sp. B. (p. 344).  
USNM 548677; Bikini 1174 (1-2'').
13. *Nodosaria* sp. C. (p. 344).  
USNM 548678; Bikini 1174 (1-2'').
14. *Nodosaria pauciloculata* Cushman, juv. (p. 343).  
USNM 548740; Eniwetok 117.
15. *Frondicularia* sp. A of Boomgaard (p. 344).  
USNM 548631; Bikini 817.
16. *Lagena acuticosta* Reuss (p. 344).  
USNM 548718,  $\times 80$ ; Bikini 1176 (1-2'').
17. *Lagena globosa* (Montagu) (p. 344).  
USNM 548719,  $\times 80$ ; Bikini 1176 (1-2'').
18. *Lagena gracilis* Williamson (p. 344).  
USNM 548637,  $\times 80$ ; Bikini 818.
19. *Lagena spiralis* H. B. Brady (p. 344).  
USNM 548759,  $\times 80$ ; Eniwetok 312.
20. *Lagena williamsoni* (Alcock) (p. 344).  
USNM 548700,  $\times 80$ ; Bikini 1175.
- 21, 22. *Dimorphina tuberosa* D'Orbigny (p. 344).  
USNM 548679; Bikini 1174 (1-2'').
- 23, 24. *Polymorphinella pacifica* Cushman and Hanzawa (p. 344).  
USNM 548680; Bikini 1174 (1-2'').
25. *Nonion pacificum* (Cushman) (p. 345).  
USNM 548638; Bikini 818.
26. *Nonion pompilioides* (Fichtel and Moll) (p. 345).  
USNM 548701; Bikini 1175.
27. *Astrononion tumidum* Cushman and Edwards (p. 345).  
USNM 548639,  $\times 80$ ; Bikini 818.
28. *Nonionella* sp. B. (p. 345).  
USNM 548563,  $\times 80$ ; Rongelap 111.
29. *Nonionella translucens* Cushman (p. 345).  
USNM 548552,  $\times 80$ ; Rongerik 80.
30. *Elphidium advenum* (Cushman) (p. 345).  
USNM 548553,  $\times 80$ ; Rongerik 80.
31. *Elphidium advenum* var. *dispar* Cushman, n. var. (p. 346).  
Holotype, USNM 548508,  $\times 80$ ; Rongerik 51.
32. *Elphidium jenseni* (Cushman) (p. 346).  
USNM 548509,  $\times 80$ ; Rongerik 51.
33. *Elphidium simplex* Cushman (p. 346).  
USNM 548510,  $\times 80$ ; Rongerik 51.



LAGENIDAE, POLYMORPHINIDAE, NONIONIDAE



CAMERINIDAE, PENEROPLIDAE, ALVEOLINELLIDAE, HETEROHELICIDAE, BULIMINIDAE

## PLATE 87

[All figures  $\times 80$ , except as indicated]

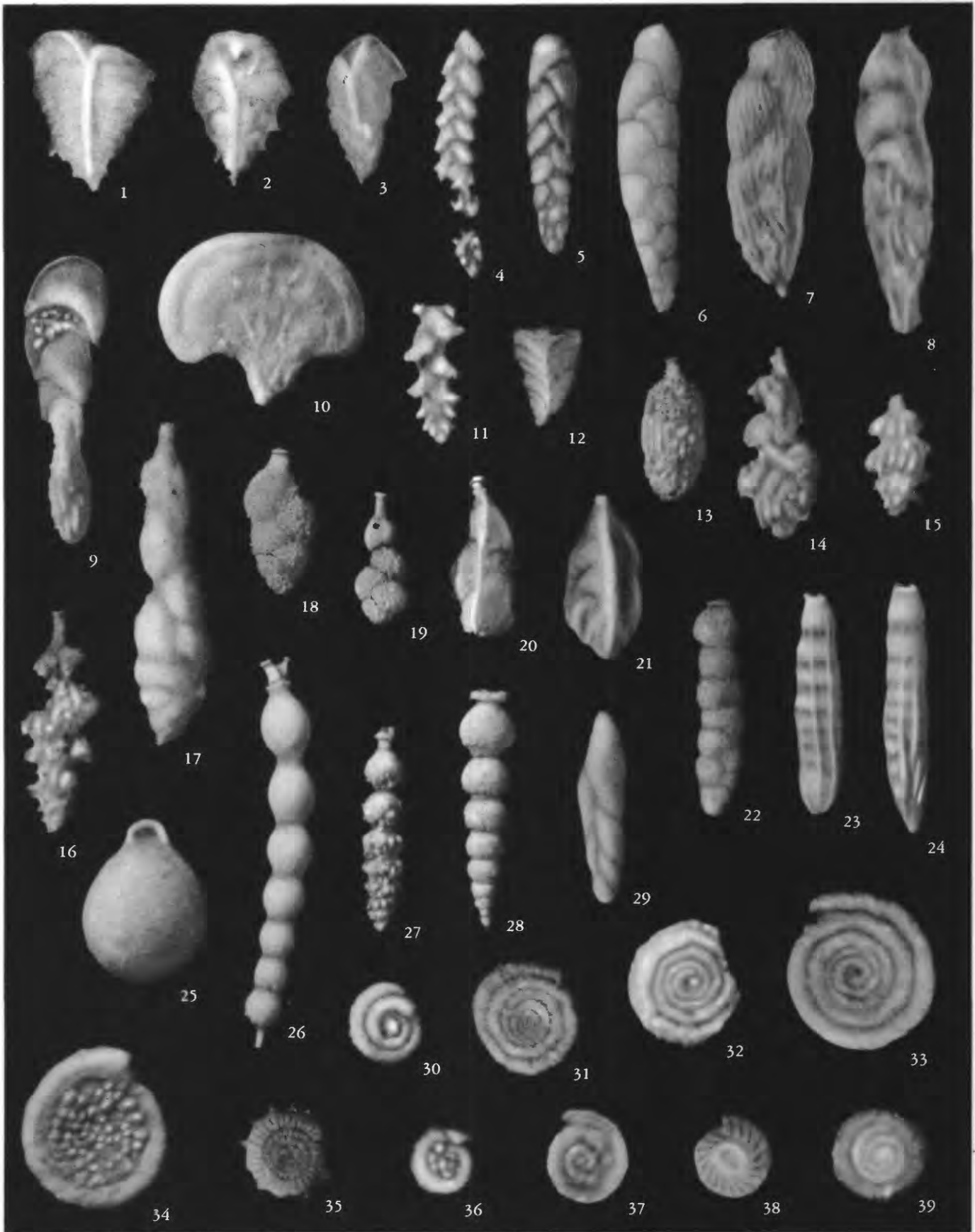
- FIGURE 1. *Operculina ammonoides* (Gronovius). USNM 548770,  $\times 15$ ; Eniwetok 329. (p. 346).
2. *Heterostegina suborbicularis* D'Orbigny. USNM 548548,  $\times 15$ ; Rongerik 79. (p. 346).
3. *Peneroplis* sp. USNM 548564,  $\times 40$ ; Rongelap 111. (p. 348).
- 4, 5. *Spirolina arietina* (Batsch). USNM 548511,  $\times 40$ ; Rongerik 51. (p. 348).
6. *Spirolina acicularis* (Batsch). USNM 548565; Rongelap 111. (p. 348).
7. *Monalysidium politum* Chapman. USNM 548549; Rongerik 79. (p. 348).
8. *Neoaebolina pulchra* (D'Orbigny). USNM 548570,  $\times 40$ ; Rongelap 456. (p. 348).
9. *Gämbelina? marshallana* Todd, n. sp. Holotype, USNM 548727; Bikini 1176 (5-7''). (p. 349).
- 10, 11. *Bolivinella folia* (Parker and Jones). USNM 548512; Rongerik 51. (p. 349).
- 12, 13. *Bolivinella folia* var. *ornata* Cushman. USNM 548513; Rongerik 51. (p. 349).
- 14, 15. *Buliminella milletti* Cushman. USNM 548514; Rongerik 51. (p. 349).
- 16, 17. *Buliminoides williamsoniana* (H. B. Brady). USNM 548515; Rongerik 51. (p. 349).
18. *Robertina subcylindrica* (H. B. Brady). USNM 548728,  $\times 40$ ; Bikini 1176 (5-7''). (p. 350).
19. *Robertina translucens* Cushman and Parker. USNM 548690,  $\times 40$ ; Bikini 1174 (10-14''). (p. 350).
20. *Pseudobulimina* sp. USNM 548578,  $\times 40$ ; Rongelap 463. (p. 350).
21. *Bulimina aculeata* D'Orbigny. USNM 548702,  $\times 40$ ; Bikini 1175. (p. 350).
22. *Bulimina affinis* D'Orbigny. USNM 548729,  $\times 15$ ; Bikini 1176 (5-7''). (p. 350).
23. *Bulimina costata* D'Orbigny. USNM 548703; Bikini 1175. (p. 350).
24. *Bulimina rostrata* H. B. Brady. USNM 548704; Bikini 1175. (p. 350).
25. *Bulimina fijiensis* Cushman. USNM 548473; Rongerik 21. (p. 350).
26. *Oolina squamosa* (Montagu). USNM 548579; Rongelap 463. (p. 350).
27. *Fissurina circularis* Todd, n. sp. Holotype, USNM 548767; Eniwetok 326. (p. 351).
28. *Fissurina lacunata* (Burrows and Holland). USNM 548654; Bikini 819. (p. 351).
29. *Fissurina radiato-marginata* (Parker and Jones). USNM 548604; Bikini 218 (12-16''). (p. 351).
30. *Fissurina milletti* Todd, n. sp. Holotype, USNM 548743; Eniwetok 119. (p. 351).
31. *Fissurina formosa* (Schwager). USNM 548603; Bikini 218 (12-16''). (p. 351).
32. *Fissurina* sp. A. USNM 548763; Eniwetok 318. (p. 351).
33. *Fissurina* sp. B. USNM 548655; Bikini 819. (p. 352).
34. *Fissurina* sp. C. USNM 548705; Bikini 1175. (p. 352).
35. *Virgulina earlandi* Cushman. USNM 548605; Bikini 218 (12-16''). (p. 352).
36. *Bolivina abbreviata* Heron-Allen and Earland. USNM 548720; Bikini 1176 (1-2''). (p. 352).
37. *Bolivina compacta* Sidebottom. USNM 548706; Bikini 1175. (p. 352).
38. *Bolivina nitida* H. B. Brady. USNM 548640; Bikini 818. (p. 352).
39. *Bolivina pseudopygmaea* Cushman. USNM 548479; Rongerik 31. (p. 352).
40. *Bolivina robusta* H. B. Brady. USNM 548707; Bikini 1175. (p. 353).
- 41, 42. *Bolivina rhomboidalis* (Millett). USNM 548516; Rongerik 51. (p. 353).
43. *Bolivina striatula* Cushman. USNM 548768; Eniwetok 326. (p. 353).
44. *Bolivina subexcavata* Cushman and Wickenden. USNM 548517; Rongerik 51. (p. 353).
- 45-47. *Bolivina tortuosa* H. B. Brady. 45, 46, USNM 548518; 47, USNM 548519; Rongerik 51. (p. 353).



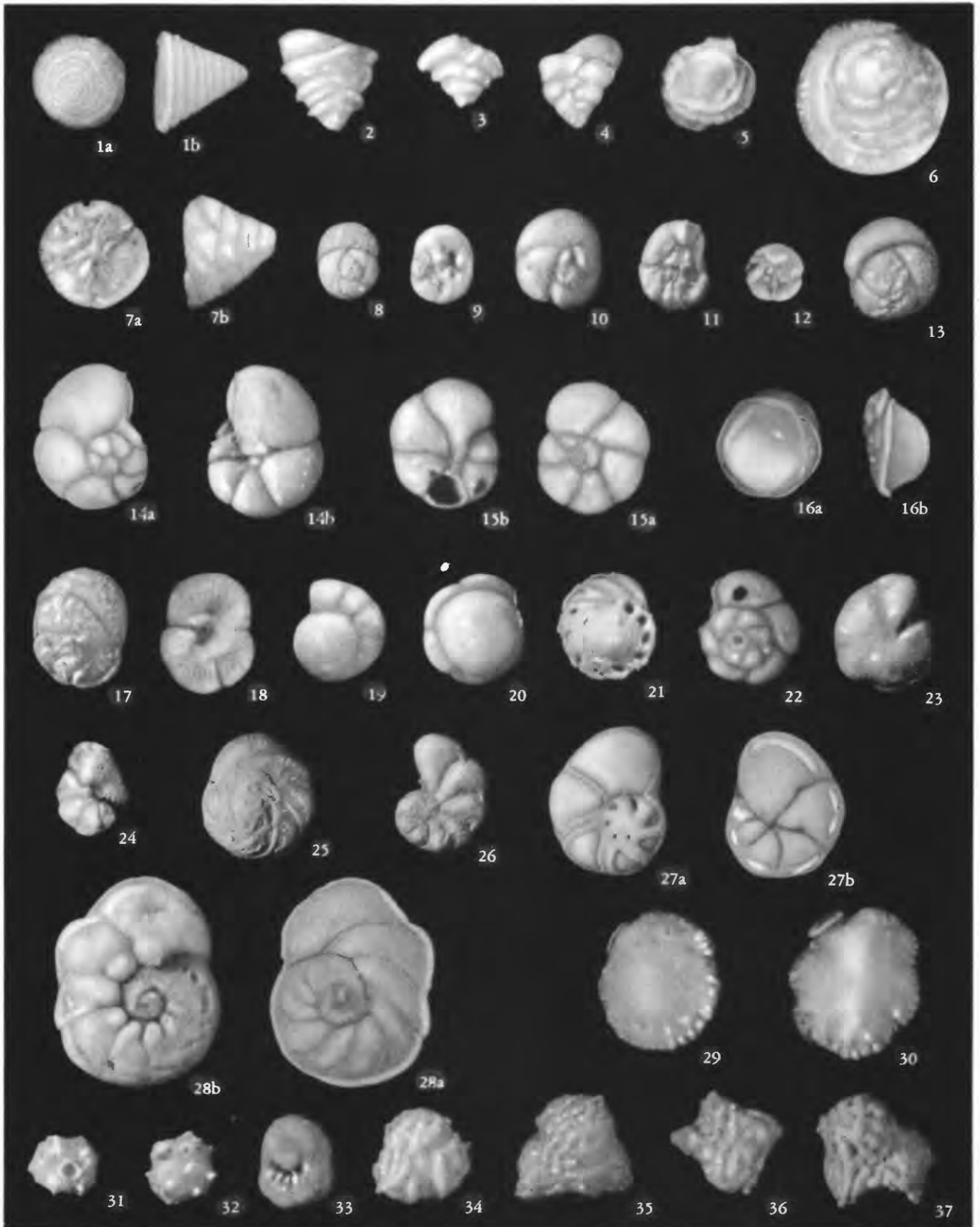
PLATE 88

[All figures  $\times 80$ , except as indicated]

- FIGURES 1, 2. *Reussella simplex* (Cushman) (p. 354).  
 USNM 548522; Rongerik 51.
3. *Reussella* sp. A. (p. 354).  
 USNM 548753; Eniwetok 301.
- 4, 5. *Loxostomum convallarium* (Millett) (p. 353).  
 4, USNM 548520; Rongerik 51. 5, USNM 548567; Rongelap 133.
6. *Loxostomum karrerianum* (H. B. Brady) (p. 353).  
 USNM 548691; Bikini 1174 (10-14'').
7. *Loxostomum limbatum* (H. B. Brady) (p. 353).  
 USNM 548521; Rongerik 51.
8. *Loxostomum mayori* (Cushman) (p. 354).  
 USNM 548766; Eniwetok 321.
9. *Bifarinella mackinnonii* (Millett) (p. 354).  
 USNM 548571,  $\times 40$ ; Rongelap 456.
10. *Pavonina triformis* Parr (p. 355).  
 USNM 548730,  $\times 40$ ; Bikini 1176 (5-7'').
11. *Bitubulogenerina* sp. (p. 354).  
 USNM 548587; Rongelap 468.
12. *Chrysalidinella fijiensis* Cushman (p. 355).  
 USNM 548480,  $\times 40$ ; Rongerik 31.
13. *Uvigerina* cf. *U. peregrina* Cushman (p. 355).  
 USNM 548692,  $\times 40$ ; Bikini 1174 (10-14'').
- 14, 15. *Uvigerina porrecta* H. B. Brady (p. 355).  
 USNM 548641; Bikini 818.
16. *Uvigerina porrecta* var. *fimbriata* Sidebottom (p. 355).  
 USNM 548580; Rongelap 463.
17. *Uvigerina proboscidea* var. *vadescens* Cushman (p. 355).  
 USNM 548681; Bikini 1174 (1-2'').
18. *Uvigerina proboscidea* Schwager (p. 355).  
 USNM 548660,  $\times 40$ ; Bikini 1170.
19. *Uvigerina ampullacea* H. B. Brady (p. 355).  
 USNM 548731,  $\times 40$ ; Bikini 1176 (5-7'').
20. *Angulogenerina albatrossi* var. *ornata* Cushman (p. 356).  
 USNM 548656,  $\times 40$ ; Bikini 819.
21. *Trifarina bradyi* Cushman (p. 356).  
 USNM 548623; Bikini 815.
22. *Siphogenerina dimorpha* var. *pacifica* Cushman (p. 355).  
 USNM 548708; Bikini 1175.
- 23, 24. *Siphogenerina raphana* (Parker and Jones) (p. 356).  
 USNM 548620,  $\times 40$ ; Bikini 814; 23, Megalospheric specimen; 24, microspheric specimen.
25. *Parafissurina* sp. (p. 356).  
 USNM 548734; Bikini 1176 (5-7'').
26. *Siphonodosaria abyssorum* (H. B. Brady) (p. 356).  
 USNM 548732,  $\times 40$ ; Bikini 1176 (5-7'').
- 27, 28. *Siphonodosaria lepidula* (Schwager) (p. 356).  
 USNM 548721,  $\times 40$ ; Bikini 1176 (1-2'').
29. *Pleurostomella bolivinoides* Schubert (p. 356).  
 USNM 548733; Bikini 1176 (5-7'').
30. *Spirillina vivipara* var. *revertens* Rhumbler (p. 357).  
 USNM 548468; Rongerik 12.
31. *Spirillina vivipara* var. *densepunctata* Cushman (p. 357).  
 USNM 548551; Rongerik 79.
- 32, 33. *Spirillina decorata* H. B. Brady (p. 356).  
 USNM 548465; Rongerik 3.
34. *Spirillina tuberculato-limbata* Chapman (p. 357).  
 USNM 548657; Bikini 819.
35. *Spirillina decorata* H. B. Brady var. of Sidebottom (p. 357).  
 USNM 548581; Rongelap 463.
- 36, 37. *Spirillina inaequalis* H. B. Brady (p. 357).  
 USNM 548523; Rongerik 51.
38. *Conicospirillina semi-involuta* Cushman (p. 357).  
 USNM 548524; Rongerik 51.
39. *Conicospirillina* sp. (p. 357).  
 USNM 548606; Bikini 218 (12-16'').



BULIMINIDAE, ELLIPSOIDINIDAE, ROTALIIDAE



ROTALIIDAE, PEGIDIIDAE

PLATE 89

[All figures  $\times 80$ , except as indicated]

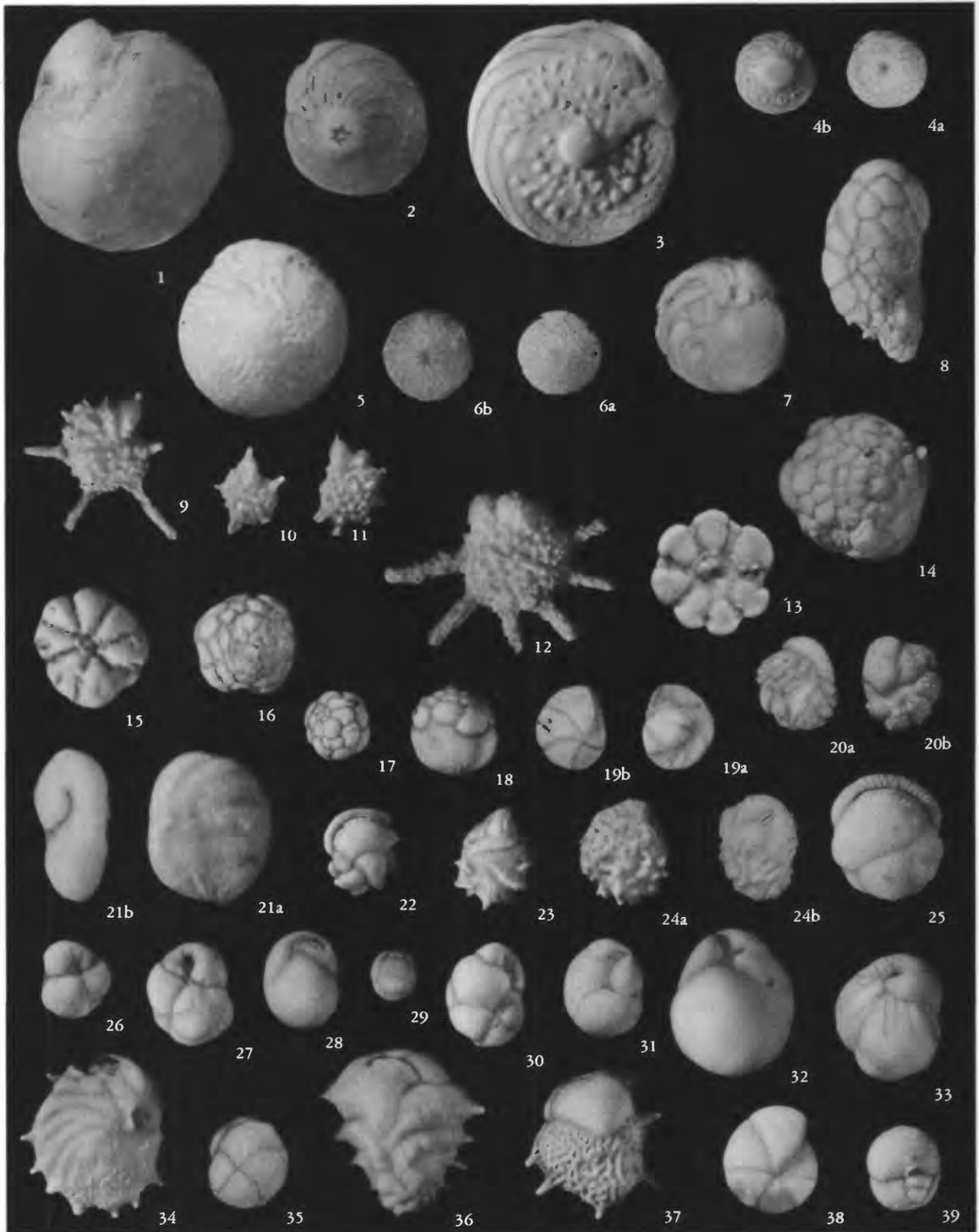
- FIGURE 1. *Patellina advena* var. *altiformis* Cushman (p. 357).  
 USNM 548582; Rongelap 463; *a*, Dorsal view; *b*, side view.
2. *Patellinella fijiana* Cushman (p. 358).  
 USNM 548642; Bikini 818.
3. *Patellinella jugosa* (H. B. Brady) (p. 358).  
 USNM 548469; Rongerik 12.
4. *Patellinella inconspicua* (H. B. Brady) (p. 358).  
 USNM 548541; Rongerik 54.
5. *Discorbis frustata* Cushman (p. 358).  
 USNM 548526; Rongerik 51.
6. *Discorbis crustata* Cushman (p. 358).  
 USNM 548588; Rongelap 468.
7. *Discorbis patelliformis* (H. B. Brady) (p. 359).  
 USNM 548529; Rongerik 51; *a*, Ventral view; *b*, side view.
- 8, 9. *Discorbis micens* Cushman (p. 358).  
 USNM 548527,  $\times 40$ ; Rongerik 51; 8, Dorsal view; 9, ventral view.
- 10, 11. *Discorbis opima* Cushman (p. 358).  
 USNM 548528,  $\times 40$ ; Rongerik 51; 10, Dorsal view; 11, ventral view.
- 12, 13. *Discorbis concinna* (H. B. Brady) (p. 358).  
 USNM 548525,  $\times 40$ ; Rongerik 51; 12, Ventral view; 13, dorsal view.
14. *Discorbis rugosa* (D'Orbigny) (p. 359).  
 USNM 548624,  $\times 40$ ; Bikini 815; *a*, Dorsal view; *b*, ventral view.
15. *Discorbis subbertheloti* Cushman (p. 359).  
 USNM 548643; Bikini 818; *a*, Dorsal view; *b*, ventral view.
16. *Discorbis tuberculata* (Chapman) (p. 359).  
 USNM 548574,  $\times 40$ ; Rongelap 462; *a*, Dorsal view; *b*, side view.
17. *Lamarckina scabra* (H. B. Brady) (p. 359).  
 USNM 548709,  $\times 40$ ; Bikini 1175.
18. *Heronallenia* sp. (p. 359).  
 USNM 548607; Bikini 218 (12-16'').
19. *Gyroidina soldanii* D'Orbigny (p. 359).  
 USNM 548693,  $\times 40$ ; Bikini 1174 (10-14'').
20. *Eponides tenera* (H. B. Brady) (p. 359).  
 USNM 548682,  $\times 40$ ; Bikini 1174 (1-2'').
21. *Osangularia bengalensis* (Schwager) (p. 360).  
 USNM 548722,  $\times 40$ ; Bikini 1176 (1-2'').
22. *Rotalia* cf. *R. beccarii* var. *tepida* Cushman (p. 360).  
 USNM 548600; Bikini 218.
23. *Höglundina elegans* (D'Orbigny) (p. 360).  
 USNM 548694,  $\times 15$ ; Bikini 1174 (10-14'').
- 24, 25. *Poroponides cribrorepandus* Asano and Uchio (p. 360).  
 24, USNM 548590,  $\times 15$ ; Ventral view; 25, USNM 548589,  $\times 15$ ; Dorsal view; Rongelap 468.
26. *Epistomaroides polystomelloides* (Parker and Jones) (p. 360).  
 USNM 548566,  $\times 15$ ; Rongelap 111.
27. *Mississippina concentrica* (Parker and Jones) (p. 360).  
 USNM 548621,  $\times 40$ ; Bikini 814; *a*, Dorsal view; *b*, ventral view.
28. *Paumotua terebra* (Cushman) (p. 361).  
 USNM 548633,  $\times 40$ ; Bikini 817; *a*, Dorsal view, *b*, ventral view.
- 29, 30. *Siphonina tubulosa* Cushman (p. 361).  
 USNM 548530; Rongerik 51; 29, Dorsal view; 30, ventral view.
- 31, 32. *Siphoninoides echinata* (H. B. Brady) (p. 361).  
 USNM 548474,  $\times 40$ ; Rongerik 21.
33. *Baggina philippinensis* var. *pilulifera* Cushman and Todd (p. 361).  
 USNM 548625,  $\times 15$ ; Bikini 815.
34. *Rugidia corticata* (Heron-Allen and Earland) (p. 362).  
 USNM 548475; Rongerik 21.
- 35-37. *Rugidia? spinosa* Cushman, n. sp. (p. 362).  
 35, 36, Paratypes, USNM 548543; 37, Holotype, USNM 548542; Rongerik 54.



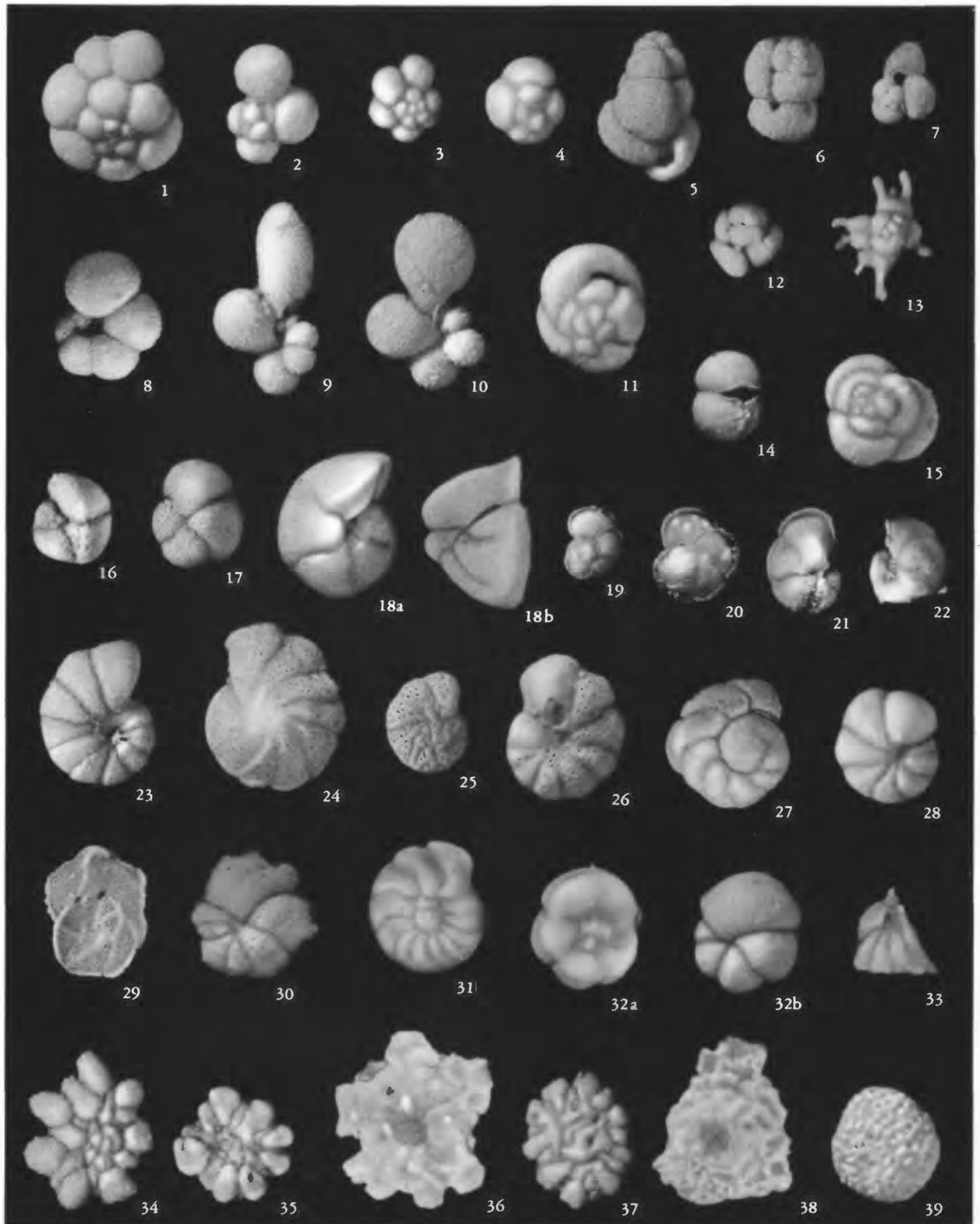
## PLATE 90

[All figures  $\times 40$ , except as indicated]

- FIGURES 1, 2. *Amphistegina madagascariensis* D'Orbigny (p. 362).  
 USNM 548531; Rongerik 51; 1, Ventral view; 2, dorsal view.
3. *Amphistegina radiata* (Fichtel and Moll) (p. 362).  
 USNM 548741; Eniwetok 117.
4. *Amphistegina radiata* (Fichtel and Moll) var. (p. 363).  
 USNM 548572,  $\times 15$ ; Rongelap 456; a, Dorsal view; b, ventral view.
- 5, 6. *Amphistegina radiata* var. *papillosa* Said (p. 362).  
 5, USNM 548634; Bikini 817. 6, USNM 548575,  $\times 15$ ; Rongelap 462; a, Dorsal view; b, ventral view.
7. *Amphistegina radiata* var. *venosa* (Fichtel and Moll) (p. 363).  
 USNM 548644; Bikini 818.
8. *Pyropilus rotundatus* Cushman (p. 364).  
 USNM 548560; Rongerik 99.
- 9-12. *Calcarina hispida* H. B. Brady (p. 363).  
 USNM 548532; Rongerik 51; 9, 10, Ventral views; 11, 12, dorsal views. 10, 11, Young specimens.
- 13, 14. *Cymbaloporeta bradyi* (Cushman) (p. 364).  
 USNM 548533; Rongerik 51; 13, Ventral view; 14, dorsal view.
- 15, 16. *Cymbaloporeta squamosa* (D'Orbigny) (p. 364).  
 USNM 548534; Rongerik 51; 15, Ventral view; 16, dorsal view.
- 17, 18. *Tretomphalus planus* Cushman (p. 364).  
 USNM 548751; Eniwetok 290; 17, Dorsal view; 18, side view.
19. *Epistominella* cf. *E. obtusa* (Burrows and Holland) (p. 365).  
 USNM 548683; Bikini 1174 (1-2''); a, Dorsal view; b, ventral view.
20. *Epistominella tubulifera* (Heron-Allen and Earland) (p. 365).  
 USNM 548744; Eniwetok 119; a, Dorsal view; b, ventral view.
21. *Epistominella* sp. (p. 365).  
 USNM 548645,  $\times 80$ ; Bikini 818; a, Dorsal view; b, peripheral view.
22. *Cassidulina angulosa* Cushman (p. 365).  
 USNM 548726; Bikini 1175.
23. *Cassidulina elegans* Sidebottom (p. 366).  
 USNM 548646; Bikini 818.
24. *Cassidulina costatula* Cushman (p. 365).  
 USNM 548684; Bikini 1174 (1-2''); a, Side view; b, peripheral view.
25. *Cassidulina delicata* Cushman (p. 365).  
 USNM 548710; Bikini 1175.
- 26, 27. *Cassidulina gemma* Todd, n. sp. (p. 366).  
 26, Paratype, USNM 548669; 27, Holotype, USNM 548668; Bikini 1172.
- 28, 29. *Cassidulina marshallana* Todd, n. sp. (p. 366).  
 28, Holotype, USNM 548685,  $\times 15$ ; 29, Paratype, USNM 548686,  $\times 15$ ; Bikini 1174 (1-2'').
- 30-32. *Cassidulina subglobosa* H. B. Brady (p. 367).  
 USNM 548687; Bikini 1174 (1-2'').
33. *Cassidulina subglobosa* H. B. Brady var. (p. 367).  
 USNM 548711; Bikini 1175.
34. *Cassidulina* cf. *C. spinifera* Cushman and Jarvis (p. 366).  
 USNM 548661; Bikini 1170.
35. *Cassidulina minuta* Cushman (p. 366).  
 USNM 548466,  $\times 80$ ; Rongerik 3.
36. *Ehrenbergina pacifica* Cushman (p. 367).  
 USNM 548712,  $\times 80$ ; Bikini 1175.
37. *Ehrenbergina reticulata* Cushman (p. 367).  
 USNM 548735; Bikini 1176 (5-7'').
38. *Pullenia salisburyi* R. E. and K. C. Stewart (p. 367).  
 USNM 548713; Bikini 1175.
39. *Sphaeroidina bulloides* D'Orbigny (p. 367).  
 USNM 548695; Bikini 1174 (10-14'').



AMPHISTEGINIDAE, CALCARINIDAE, CYMBALOPORIDAE, CASSIDULINIDAE, CHILOSTOMELLIDAE



GLOBIGERINIDAE, GLOBOROTALIIDAE, ANOMALINIDAE, PLANORBULINIDAE, RUPERTIIDAE

## PLATE 91

[All figures  $\times 40$ , except as indicated]

- FIGURE 1.** *Globigerina subcretacea* Lomnicki (p. 368).  
USNM 548662; Bikini 1170.
2. *Globigerina bulloides* D'Orbigny (p. 368).  
USNM 548723; Bikini 1176 (1-2'').
3. *Globigerina?* sp. (p. 368).  
USNM 548750,  $\times 80$ ; Eniwetok 288.
4. *Globigerina* cf. *G. conglomerata* Schwager (p. 368).  
USNM 548724; Bikini 1176 (1-2'').
5. *Globigerinoides elongata* (D'Orbigny) (p. 368).  
USNM 548664; Bikini 1170.
6. *Globigerinoides rubra* (D'Orbigny) (p. 369).  
USNM 548658; Bikini 819.
7. *Globigerinoides sacculifera* (H. B. Brady) (p. 369).  
USNM 548626,  $\times 15$ ; Bikini 815.
8. *Globigerinella aequilateralis* (H. B. Brady) (p. 369).  
USNM 548647; Bikini 818.
- 9, 10. *Hastigerinella digitata* (Rhumbler) (p. 369).  
USNM 548601; Bikini 218.
11. *Pulleniatina obliquiloculata* (Parker and Jones) (p. 369).  
USNM 548714; Bikini 1175.
12. *Globigerinoides conglobata* (H. B. Brady) (p. 368).  
USNM 548663,  $\times 15$ ; Bikini 1170.
13. *Globigerinoides sacculifera* var. *fistulosa* (Schubert) (p. 369).  
USNM 548736,  $\times 15$ ; Bikini 1176 (5-7'').
14. *Sphaeroidinella dehiscens* (Parker and Jones) (p. 369).  
USNM 548648,  $\times 15$ ; Bikini 818.
15. *Candeina nitida* D'Orbigny (p. 370).  
USNM 548725; Bikini 1176 (1-2'').
16. *Globorotalia crassa* (D'Orbigny) (p. 370).  
USNM 548670; Bikini 1172.
17. *Globorotalia* cf. *G. hirsuta* (D'Orbigny) (p. 370).  
USNM 548665; Bikini 1170.
18. *Globorotalia truncatulinoidea* (D'Orbigny) (p. 370).  
USNM 548666; Bikini 1170; a, Ventral view; b, side view.
19. *Globorotalia menardii* (D'Orbigny) (p. 370).  
USNM 548715,  $\times 15$ ; Bikini 1175.
20. *Globorotalia menardii* var. *fimbriata* (H. B. Brady) (p. 370).  
USNM 548716,  $\times 15$ ; Bikini 1175.
21. *Globorotalia tumida* (H. B. Brady) (p. 370).  
USNM 548667,  $\times 15$ ; Bikini 1170.
22. *Anomalina polymorpha* Costa (p. 370).  
USNM 548696,  $\times 15$ ; Bikini 1174 (10-14'').
23. *Anomalina* cf. *A. glabrata* Cushman (p. 370).  
USNM 548481; Rongerik 31.
24. *Anomalinella rostrata* (H. B. Brady) (p. 371).  
USNM 548535; Rongerik 51.
- 25, 26. *Cibicides cicatricosus* (Schwager) (p. 371).  
USNM 548697; Bikini 1174 (10-14'').
- 27, 28. *Cibicides lobatulus* (Walker and Jacob) (p. 371).  
USNM 548627; Bikini 815; 27, Dorsal view; 28, ventral view.
- 29, 30. *Cibicides mayori* (Cushman) (p. 371).  
29, USNM 548561; Rongelap 71; Dorsal view. 30, USNM 548608; Bikini 218 (12-16''); Ventral view.
31. *Cibicides* cf. *C. pseudoungerianus* (Cushman) (p. 372).  
USNM 548688, Bikini 1174 (1-2'').
32. *Cibicidina* sp. (p. 372).  
USNM 548689; Bikini 1174 (1-2''); a, Dorsal view; b, ventral view.
33. *Rupertia stabilis* Wallich (p. 373).  
USNM 548573; Rongelap 456.
- 34-36. *Planorbulina acervalis* H. B. Brady (p. 372).  
USNM 548538; Rongerik 51. 34, 35, Ventral views,  $\times 40$ ; 36, dorsal view,  $\times 50$ . Note that specimens 34 and 36 were attached by the dorsal sides, while specimen 35 appears to have been attached by the ventral side.
- 37, 38. *Acervulina inhaerens* Schultze (p. 372).  
USNM 548482; Rongerik 31. 37, Ventral view,  $\times 40$ ; 38, dorsal view,  $\times 50$ .
39. *Gypsina globula* (Reuss) (p. 373).  
USNM 548539; Rongerik 51.



PLATE 92

[All figures  $\times 20$ ]

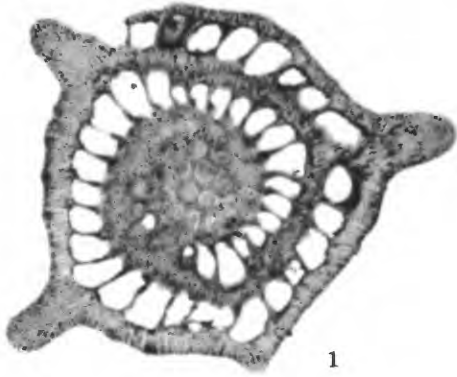
FIGURES 1-7. *Calcarina spengleri* (Gmelin) (p. 363).

Free specimens sectioned and photographed by W. Storrs Cole. 1, 3-6, Horizontal sections; 2, 7, vertical sections.

1, 2, From reef off village of Odomari, Okinawa Shima, Ryukyu Islands. 3-7, From Arno Atoll, Marshall Islands.

8. *Homotrema rubrum* (Lamarck) (p. 373).

USNM 548772; Bikini 314. Specimen encrusting a cavity made by a boring organism in algal material. Siliceous sponge spicules protrude from the apertures.



1



2



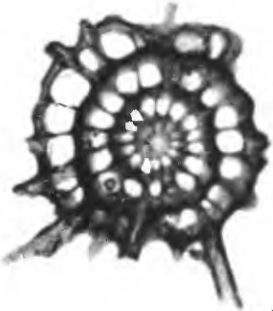
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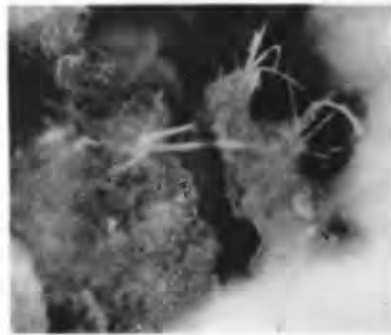
5



6



7



8

CALCARINIDAE AND HOMOTREMIDAE



HOMOTREMIDAE

PLATE 93

[Both figures  $\times 14\frac{1}{2}$ ]

FIGURE 1. *Gypsina plana* (Carter) (p. 373).

USNM 548771; Bikini 788, Bikini Lagoon. Encrustation on *Halimeda* segments showing cellular structure in the cut section and the indistinct honeycomb pattern of areolae on the surface. *a*, *Halimeda* in cut section; *b*, cellular structure of *Gypsina plana* in cut section; *c*, surface of *Gypsina plana*.

2. *Homotrema rubrum* (Lamarck) (p. 373).

USNM 548772; Bikini 314. Three specimens, at *a*, *b*, and *c*, encrusting a cavity in algal material. Specimen *a* is white, *b* is pink, and *c* is red. Siliceous sponge spicules protrude from the high, conical apertural areas. Surface areolae are best shown on specimen *c* between the apertural cones.





