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Common Living Benthic Foraminifera in Māmala Bay, Hawai'i, with Descriptions of Two New Species

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ABSTRACT

Foraminifera species in Māmala Bay, O'ahu, were chosen for study if their tests occurred in large numbers and if individuals were found alive. One hundred ten foraminifers were found to be common to abundant. Many of the animals treated occur on specific substrates and in different depth zones from 0 to 500 m. Two new species, *Alabamina resigae* and *Cassidulina radiata,* are described.

INTRODUCTION

More than 1,000 species of Foraminifera have been reported in Hawai'i. Brady (1884), in his systematic account of the species collected by the *Challenger* expedition, was the first to illustrate many of the species found in Hawaiian waters. Later, Bagg (1908) and Cushman (1911, 1915, 1917, 1924, 1925) reported and described tests of species collected by the research vessels *Albatross, Tanager,* and *Nero.* More recently, Resig (1969) and Coulbourn & Resig (1975) analyzed the foraminiferal assemblages from 4 O'ahu localities: Kane'ohe Bay, Pearl Harbor, Ewa Plain (cores), and Kahana Bay. Phillips (1977) presented a key to the Recent Foraminifera of Kahe Point, O'ahu, and Kepuhi Point, Kaua'i. These papers and 2 environmental assessment reports (Chave & Miller 1978; Goeggel 1978) include most of what is known about the foraminiferal fauna of Hawai'i. The present paper differs from previous studies in that it excludes rare species and discusses only common Formanifera species for which at least 1 living specimen has been observed.

This paper is divided into sections on habitat, methods, and systematics. The first section is a short discussion of the habitats within Māmala Bay. The third section consists of a systematic checklist in which the habitat, behavior, and coloration of each species of Foraminifera is listed. It also contains abbreviated synonym lists pertinent to the Hawaiian region. Generic name changes are not included here. Loeblich & Tappan (1964) present a complete synonymy of foraminiferal genera.

MĀMALA BAY HABITATS

Māmala Bay, O'ahu, is between Diamond Head on the east and Barbers Point on the west (Text fig. 1). The Foraminifera, both living and dead, from 49 samples collected throughout the bay were identified and counted. The bay contains a wide variety of habitats, including a major port, several streams and estuaries, and 2 sewer outfalls. Many of the common or abundant Foraminifera that occur in the bay were found to be sensitive to factors such as temperature, salinity, food supply, depth of water, ocean currents, and substrate (e.g., rocks, sand grains, seaweed, etc.) as discussed in the next few pages.

Recent studies have shown that foraminiferal assemblages in sediments provide statistically valuable data because large populations can be found in small samples of sediment. Individual species are sensitive to environmental conditions. For example, *Ammonia beccarii*

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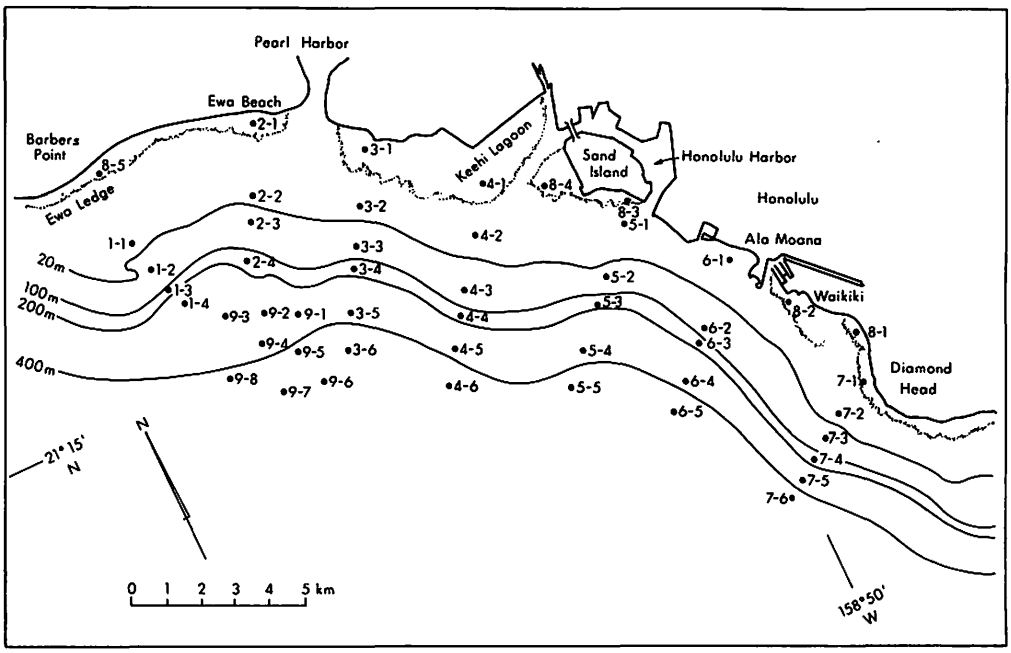


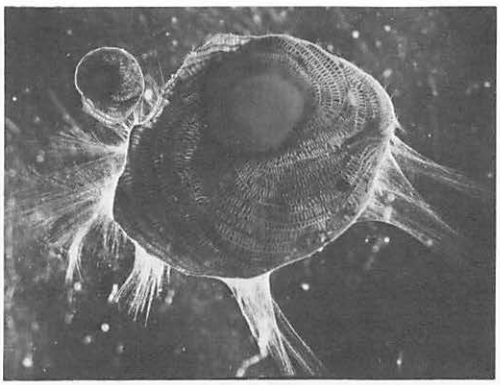
Text fig. 1. Māmala Bay, O'ahu, station locations.

tepida often occurs where fresh water flows into the ocean (Coulbourn & Resig 1975). Presence of this species in sediments from sewer outfalls may indicate a fresh water influx. In addition, Foraminifera may assume a variety of shapes and sizes because of environmental stresses. For example, *Rosalina* spp. can be induced to build float chambers in their tests if they are removed from the benthic macroalgae on which they normally live (Todd 1971; Showers 1980). If these algae die off owing to storms or other factors, many *Rosalina* tests with float chambers occur in the sediments. If algae are actively growing, most of the *Rosalina* in the sediment are without floats. Test shape may also vary within a species. Tests may be fatter or thinner when food is limited (Phleger 1960). A species living in sand may have striated or wedge-shaped tests, whereas the same species living in mud may be smooth (Bolstovskoy & Wright 1976).

Species Living on Reef Flats

Deteriorating coral reefs fringe the shoreline of Māmala Bay. Numerous macroalgal species, notably corallines, are attached to the reef tops and often cover up to 60% of the reef flat (Chave et al. 1973). From the reef edge to depths of 10 m, coral growth is usually sparse; however, there are some coral-rich areas. Surface water temperatures average 26 °C and salinity is usually 35 parts per thousand, except where fresh water runoff occurs.

Foraminifera with algal symbionts in their tissues, such as *Heterostegina depressa* (Text fig. 2), require significantly less food than those without (Röttger 1974, 1976). This association between animals and plants is so successful that the most common shallow reef species in the tropical and subtropical Pacific are of this type (Muller 1974). The species *Amphisorus hemprichii, Amphistegina lessonii, A. lobifera, Heterostegina suborbicularis, Peneroplis planatus,* and *Spirolina arietina* with algal symbionts make up about 74% of the living individuals on the shallow reefs of Māmala Bay. An additional 9 species were found alive at most of the reef flat stations sampled. *Cymbaloporetta bradyi, Fijiella simplex,* and *Rosalina vilardeboana* were found attached to algae in very shallow water. Living individuals of these 3 species are also



Text fig. 2. Light microscope photograph of a living *Heterostegina suborbicularis,* showing the weblike pseudopods radiating from the apertures. The pseudopods are attached to a glass surface (LM 10×, Röttger photo).

found at depths of 90 m or more. The species *Gaudryina siphonifera, Planispirillina tuberculolimbata, Quinqueloculina granulocostata, Q. parkeri, Q. polygona,* and *Textularia foliacea oceanica* tend to have patchier distributions among the shallow-water stations and are restricted to depths of 50 m or less.

Species Living on Fine Sand Near Estuaries

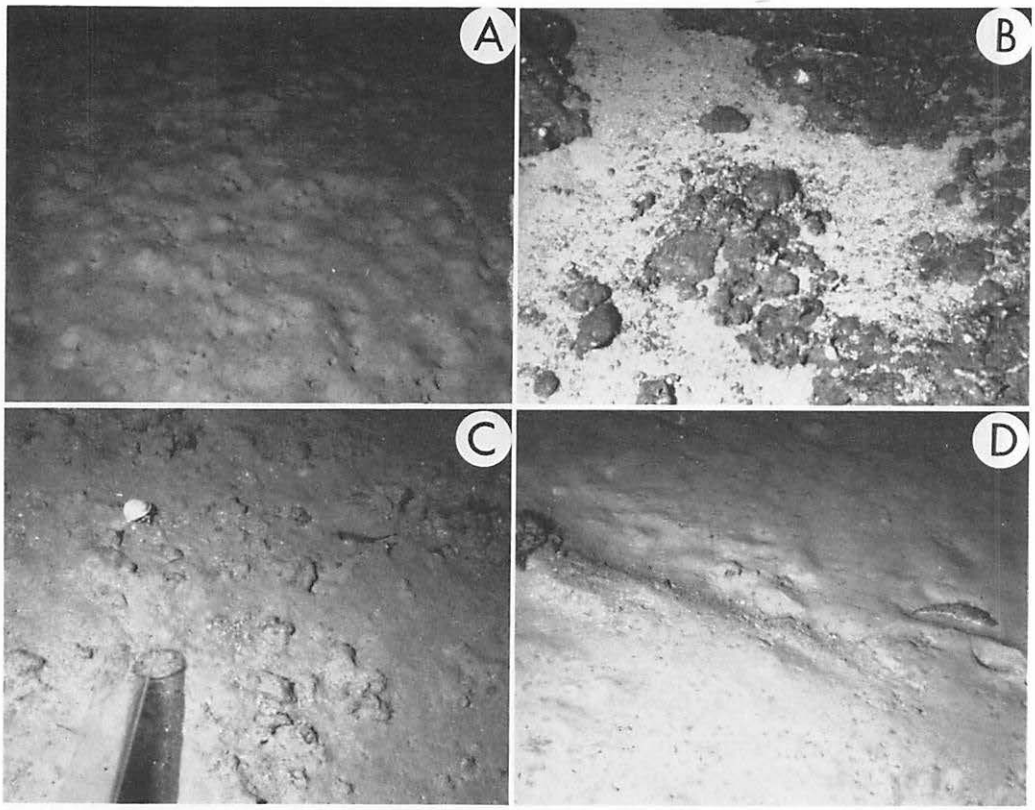
In the nearshore environment, fine sand substrate occurs adjacent to, or at the mouths of, estuaries such as Honolulu Harbor and Pearl Harbor. The sediments from these areas are usually a mixture of dark volcanic material and other debris washed down by the rivers and white sand from the fringing reefs. The 7 most common foraminiferal species that occur in this environment, *Ammonia beccarii tepida, Florilus japonicus, Quinqueloculina bosciana, Q. laevigata, Q. poeyana, Spirillina inaequalis,* and *Triloculina oblonga,* appear to be adapted to lower salinities. Resig (1969) and Coulbourn & Resig (1975) reviewed these species and their habitat preferences. The common Māmala Bay species present no exception to these studies. All species have fairly shallow depth ranges. Six of the species live on fine sand or on silt. *Spirillina inaequalis* is found on filamentous algae.

Species Living at Depths of 40 to 100 Meters

At depths between 40 and 100 m there is less light, fewer animals and plants, and lower turbulence owing to waves than in the shallow areas. The bottom is composed mainly of limestone outcrops and sand flats with some gravel and cobble patches (Text figs. 3A, B). Below 40 m, only samples containing sand and small rocks were collected. Water temperature remains close to surface values until about 80 m and drops about 1 °C every 5 m thereafter (Chave & Miller 1978; unpubl. *Makali'i* dive records 1982, 1983). Common species restricted to this depth range are *Borelis schlumbergeri, Elphidium articulatum, Hauerina orientalis, Loxostomium limbatum, Operculina ammonoides, Pseudomassilina australis, P. macilenta, P. hatchijensis, Quinqueloculina bradyana, Q. lamarkiana, Rosalina orientalis, Schlumbergerina alveoliniformis, Spiroloculina communis, Triloculina* cf. *bicarinata, T. fichteliana, T. linneiana,* and *T. trigonula.*

Species Living at Depths of 100 to 200 Meters

The bottom between 100 and 200 m was not studied as well as the areas above and below, since few submersible dives were conducted there. This offshore area often slopes



Text fig. 3. Māmala Bay deep water substrates: A, Station 5-2 (60 m depth), fine sand with burrows; B, Station 7-3 (94 m depth), coarse sand and limestone; C, Station 2-4 (160 m depth) fine sand and debris; D, Station 3-5 (314 m depth) fine sand and burrows.

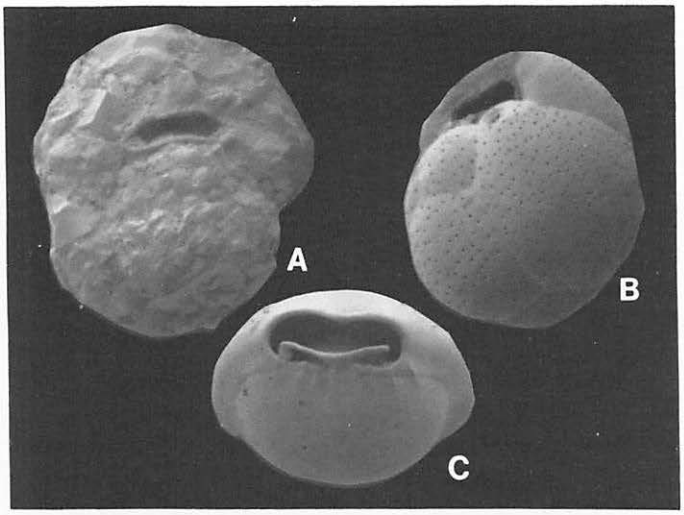
steeply into deeper water, especially at the Ewa and Diamond Head ledges. Water temperature decreases more slowly, from 20 to 15 °C. Sands are rich in shallow-water Foraminifera tests that have been transported down-slope. Several widely ranging species found alive at these depths and whose dead tests are common 100 to 500 m deeper are *Amphistegina bicirculata, Anomalina colligera, Cassidulina crassa, C. sulcata, Cibicides lobatulus, Cylindroclavulina bradyi, Eponides repandus, Nubeculina divaricata,* and *Siphogenerina irregularis.* Those species restricted to between 100 and 200 m depth are *Articulina carinata, A. pacifica, Flintina bradyana, Textularia agglutinans,* and *Nonion boueanum.*

Offshore Species Living at Depths of 200 to 510 Meters or Deeper

Between 200 and 510 m depths, the water temperature drops from ca. 15 to 07 °C. There are large flat areas of sand and debris (Text fig. 3C,D) and occasional rocky outcrops. Ripple marks in the sand in some areas indicate water movement. Sand samples obtained from these areas often contain worn and polished sand grains. The living foraminifers in the region are generally small. Of the 50 species that commonly occur there, 29 are found at depths greater than 400 m, 14 extend throughout the whole depth range, and 7 are restricted to depths between 200 and 400 m. These species, which are too numerous to be listed here, are included in the systematic portion of the paper.

Table 1. Station depth and substrate type.

Station type and no.	Depth (m)	Substrate type
Reef-flat station		
1-1	18	Coarse sand, limestone
2-1	3	Coarse sand, rubble, limestone
3-1	8	Fine sand, rubble
4-1	6	Fine sand, rubble
4-2	14	Coarse sand, rubble
7-1	4	Coarse sand, limestone
7-2	20	Coarse sand
8-1	2	Coarse sand, rubble, limestone
8-2	5	Fine sand, limestone
8-3	4	Fine sand, limestone
8-4	3	Fine sand, rubble, limestone
8-5	3	Coarse sand, limestone
Fine-sand station near estuaries		
2-2	18	Fine sand, limestone
3-2	16	Fine sand, rubble, limestone
5-1	18	Fine sand, limestone
6-1	16	Fine sand
Station at 30–100 m		
1-2	32	Coarse sand
2-3	48	Fine sand
3-3	40	Fine sand
4-3	94	Fine sand
5-2	60	Fine sand, rubble
6-2	68	Coarse sand
7-3	66	Coarse sand
Offshore stations at 100–200 m		
1-3	164	Coarse sand, rubble
2-4	160	Fine sand
3-4	112	Coarse sand
4-4	116	Fine sand
5-3	198	Fine sand
6-3	174	Fine sand
7-4	186	Coarse sand, rubble
Offshore stations at 200–510 m		
1-4	264	Coarse sand
3-5	314	Fine sand
3-6	446	Fine sand
4-5	374	Fine sand
4-6	510	Fine sand
5-4	332	Fine sand
5-5	422	Fine sand
6-4	292	Coarse sand
6-5	416	Fine sand
7-5	330	Worn, fine sand
7-6	506	Fine sand
9-1	282	Worn, fine sand
9-2	246	Fine sand
9-3	268	Fine sand
9-4	394	Worn, fine sand
9-5	428	Fine sand
9-6	466	Polished, fine sand
9-7	444	Coarse sand
9-8	410	Fine sand



Text fig. 4. Major categories of Foraminifera: A, an agglutinated foraminifer with sand grains attached to the test (SEM 50×); B, a calcareous perforate foraminifer with pores in the test (SEM 180×); C, a miliolid foraminifer with a dense, white imperforate test (SEM 100×).

MATERIALS AND METHODS

Foraminifera were collected from 49 stations along transect lines running from the shoreline to 510 m in Māmala Bay (Text fig. 1, Table 1). Above 40 m depth, sediment, algae, and rock samples were hand-collected from various substrates. Below this depth, samples were obtained using corers and grab samplers deployed from the research vessels *Machias, Easy Rider,* and *Noi'i* and/or by the submersible *Makali'i* and surface support vessel *Holokai.*

Part of each sample was immediately placed in a sea water container on the ship. In the laboratory these subsamples were placed in petri dishes and examined with a dissecting microscope for living Foraminifera. Color of protoplasm, method of attachment, and behavior of the animals were examined.

Another part of each sample was dyed with rose bengal (a red dye that stains living protoplasm). The stained samples were then washed, sieved, dried, and split into equal portions of 1 cubic cm. The portions were further split into smaller subsamples so that the foraminifer tests could be counted. About 600 species were found in these splits; only 110 of them were common or abundant. Species are included in this paper if at least 1 living animal was observed and the number of dead individuals found was over 5% of the total number of benthic foraminifer tests present in 1 or more samples. The species were identified and compared with their type descriptions in *The Catalogue of Foraminifera* (Ellis & Messina 1940 et seq.). They were mounted and photographed by scanning electron microscope (SEM) or light microscope (LM).

The systematic ordering of the checklist is based on the classification of Loeblich & Tappan (1964, 1974). Descriptions of 2 new species are included. The genus and species name of each foraminifer is listed, followed by the plate and figure references. The type figure and description (if in a different publication) follow, along with Hawaiian literature citations. If only the type figure is referenced, that same reference includes the type description. Remarks include behavior, habitat, and coloration of the living animals, as well as the depth ranges or stations in which they abundantly or commonly were found. The plates in this paper are arranged into 3 major categories according to the manner in which

Foraminifera construct their tests. Text fig. 4 shows examples of the 3 categories: agglutinated Foraminifera, which cement sand particles together to form tests; miliolid Foraminifera, which construct dense, white, often shiny tests of calcium carbonate without pores; and calcareous perforate Foraminifera, which construct glassy to opaque calcium carbonate tests that have pores in the walls.

ANNOTATED SYSTEMATIC CHECKLIST OF COMMON MĀMALA BAY FORAMINIFERA

Suborder TEXTULARIINA

Family LITUOLIDAE

Ammobaculites calcareus (Brady) Plate 1, fig. 1

Haplophragmium calcareus Brady, 1884 [type figures in Brady 1884, pl. 33, fig. 5, 7–12].

Remarks. Free in coarse sand from 250 to 510 m depth; several specimens stained with dye; color unknown.

Family TEXTULARIIDAE

Textularia agglutinans d'Orbigny Plate 1, fig. 2

Textularia agglutinans d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 1, fig. 17–34].

Remarks. Attached to sand grains and small rocks at Stations 2-4 (168 m depth) and 7-4 (186 m depth); brown.

Textularia agglutinans var. **fistula** Cushman Plate 1, fig. 3

Textularia agglutinans var. *fistula* Cushman, 1911 [type figure in Cushman 1911, part 2, fig. 11].

Remarks. Attached to rocks and coarse sand from 292 to 444 m depth; gray.

Textularia foliacea oceanica Cushman Plate 1, fig. 5

Textularia foliacea oceanica Cushman, 1932 [type figures in Cushman 1932, pl. 1, fig. 11, 12].—Phillips 1977, pl. 2, fig. 1.

Remarks. Attached to coarse sand grains from 1 to 40 m depth; tan.

Family ATAXOPHRAGMIIDAE

Cylindroclavulina bradyi (Cushman) Plate 1, fig. 4

Clavulina bradyi Cushman, 1911 [type figures in Cushman 1911, fig. 118, 119].

Remarks. Attached to coarse sand grains from 100 to 510 m depth; brown.

Gaudryina quadrangularis Bagg Plate 1, fig. 6

Gaudryina quadrangularis Bagg, 1908 [type figure in Bagg 1908, pl. 5, fig. 1].

Remarks. Attached to sand grains, mollusks, and Foraminifera from 200 to 510 m depth; tan.

Gaudryina siphonifera Brady Plate 1, fig. 7

Gaudryina (*Siphogaudryina*) *siphonifera* Brady, 1881 [type description in Brady 1881; type figures in Brady 1884, pl. 42, fig. 25–29].

Remarks. Attached to algae and sand grains from 0 to 50 m depth; reddish brown.

In the following plates, the species are grouped by order, following Loeblich & Tappan (1964). SEM = scanning electron microscope, LM = light microscope.

PLATE 1. AGGLUTINATED FORAMINIFERA

Fig. 1 *Ammobaculites calcareus* (Brady). Lateral view, SEM 22×. This species is laterally flattened. Its aperture is a simple slit on the last chamber. The first several chambers are coiled and enrolled.

Fig. 2 *Textularia agglutinans* d'Orbigny. **Fig. 2A,** apertural view, SEM 101×. **Fig. 2B,** lateral view, SEM 136×. The members of this genus have biserially arranged chambers.

Fig. 3 *Textularia agglutinans* var. *fistula* Cushman. **Fig. 3A,** apertural view, SEM 49×. **Fig. 3B,** lateral view, SEM 42×.

Fig. 4 *Cylindroclavulina bradyi* (Cushman). Lateral view, SEM 46×. The aperture is made up of a network of several holes surrounded by a projecting lip. The species may grow to about 8 mm in length.

Fig. 5 *Textularia foliacea oceanica* Cushman. Lateral view, SEM 81×. This species is biserial. Its last chambers are more inflated than those of the other species in the genus.

Fig. 6 *Gaudryina quadrangularis* Bagg. Lateral view, SEM 68×. This species has 4 tapering flattened sides. The early chambers of this genus are triserial, the last ones biserial.

Fig. 7 *Gaudryina siphonifera* Brady. Lateral view, SEM 58×.

Fig. 8 *Textulariella barrettii* (Jones & Parker). **Fig. 8A,** oblique view, SEM 97×. **Fig. 8B,** apertural view, SEM 115×. This species can grow to at least 5 mm in length.

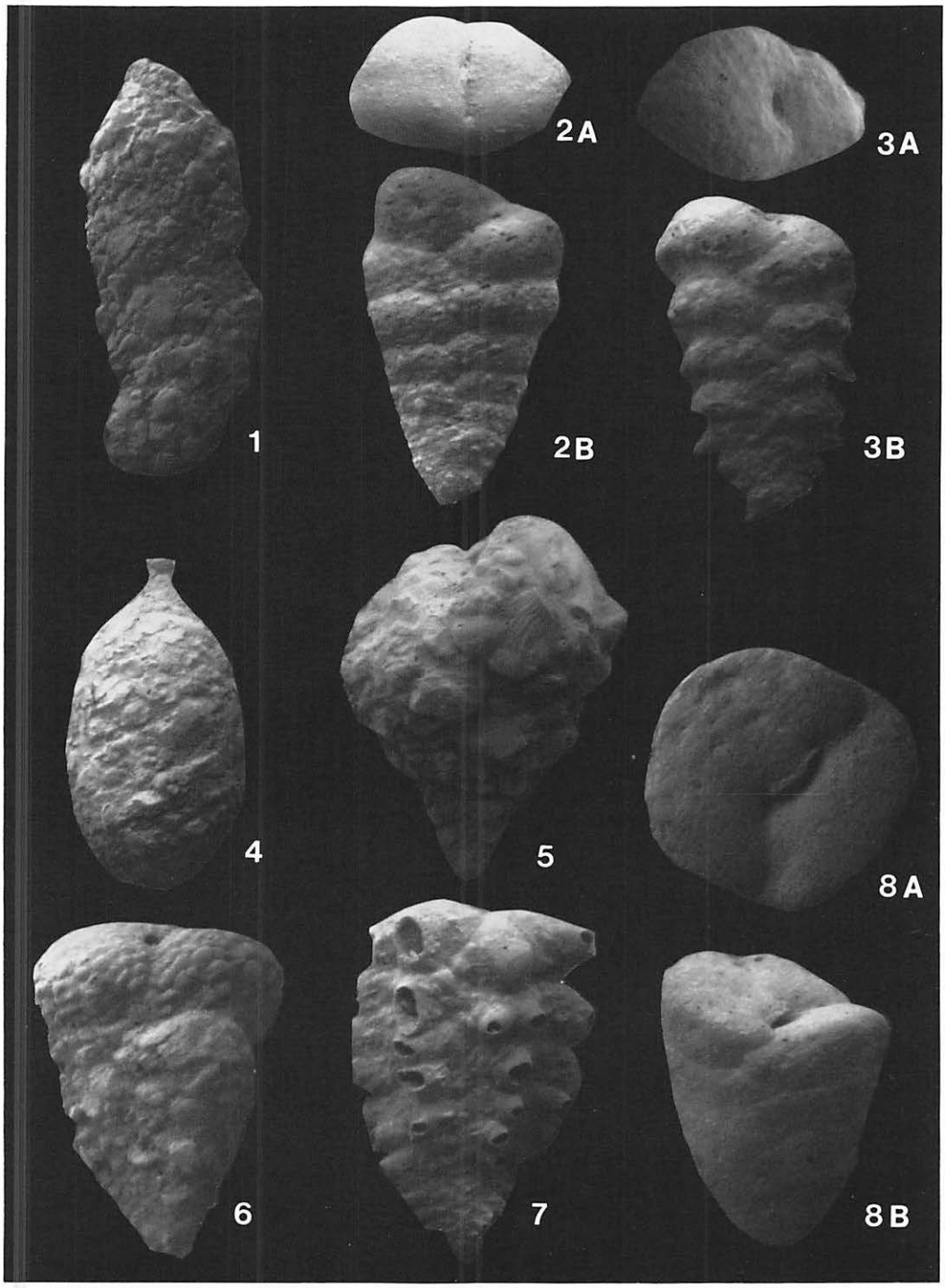

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PLATE 2. MILIOLID FORAMINIFERA

Fig. 1 *Nubeculina divaricata* (Brady). Lateral view, SEM 25×. The neck of this species is white and shiny; it cements sand grains to the rest of its porcellaneous test.

Fig. 2 *Spiroloculina communis* Cushman & Todd. **Fig. 2A,** aperture, SEM 72×. **Fig. 2B,** lateral view, SEM 62×. The genus *Spiroloculina* has numerous chambers arranged in one plane.

Fig. 3 *Spiroloculina corrugata* Cushman & Todd. **Fig. 3A,** aperture, SEM 116×. **Fig. 3B,** lateral view, SEM 81×. Living specimens are often shiny under LM.

Fig. 4 *Articulina carinata* Cushman. Lateral view, SEM 121×. This species has an acute margin to its test. Its aperture is similar to that of *A. pacifica* but lacks the flared lip. It differs from *A. lineata,* another Hawaiian species, in having strongly costate chambers.

Fig. 5 *Vertebralina striata* d'Orbigny. **Fig. 5A,** umbilical view, SEM 64×. **Fig. 5B,** dorsal view, SEM 108×.

Fig. 6 *Biloculinella globulus* (Bornemann). Apertural view, SEM 210×. The specimen shown here is fairly typical, although aperture of this species varies in width.

Fig. 7 *Articulina pacifica* Cushman. Lateral view, SEM 136×. This species has a broad flaring lip. Larger specimens are more coiled in appearance because they have more chambers.

Fig. 8 *Flintina bradyana* Cushman. **Fig. 8A,** lateral view, LM 61×. **Fig. 8B,** apertural view, SEM 71×. Many intact specimens of this species have a cavity in the tooth as shown in Fig. 8A. Under the light microscope this species is very shiny. See Phillips (1977) for a photo of a larger specimen.

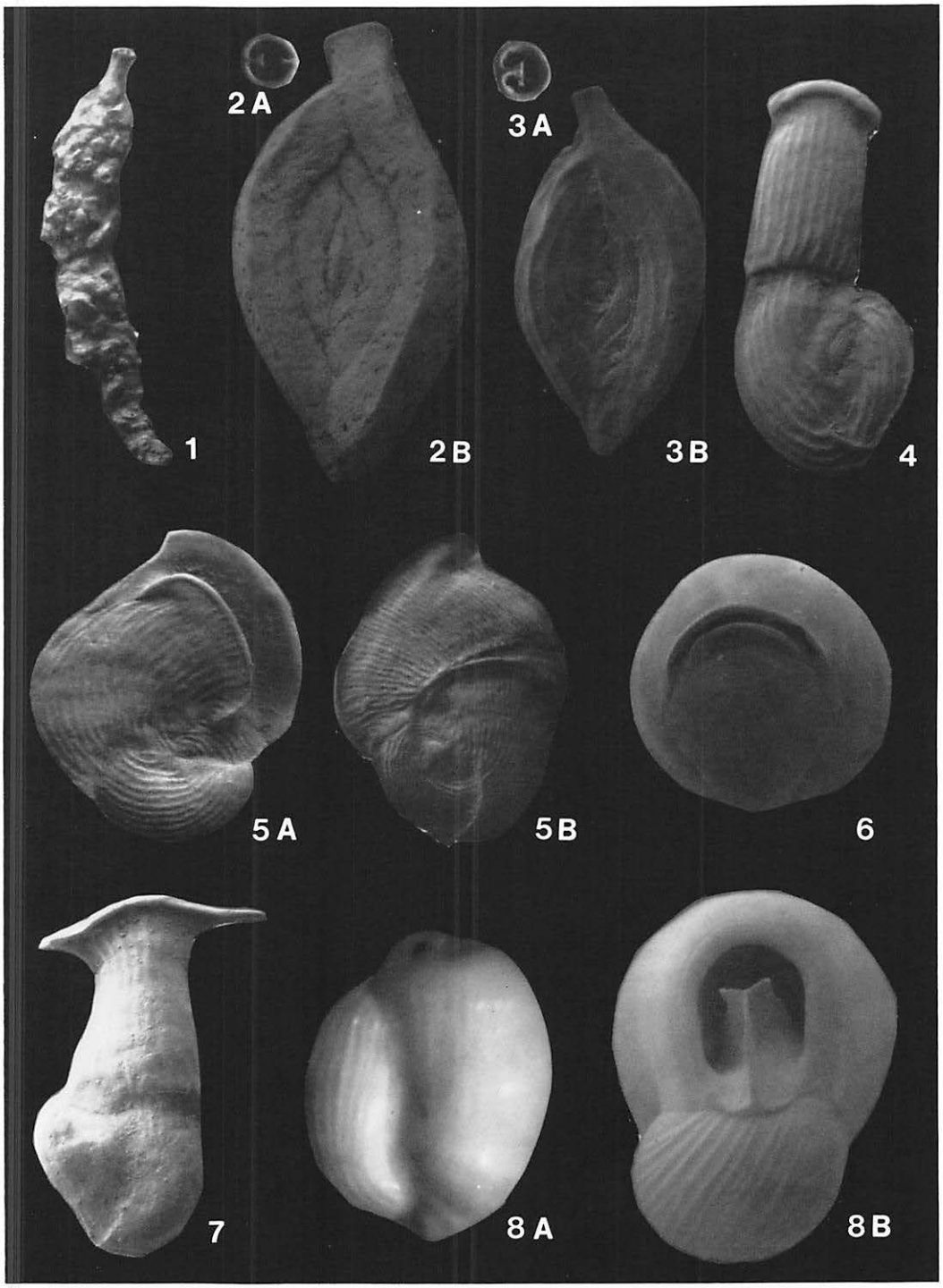
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PLATE 3. MILIOLID FORAMINIFERA

Fig. 1 *Hauerina orientalis* Cushman. Lateral view, SEM 132×. The aperture of the genus *Hauerina* is a plate punctured by holes (see top of photo).

Fig. 2 *Hauerina pacifica* Cushman. Lateral view, SEM 90×. Under SEM this species appears eroded; under LM it is powdery white.

Fig. 3 *Pseudomassilina australis* (Cushman). Lateral view, SEM 84×. Under SEM this species looks pitted, under LM it appears smooth. The species is very flat and has many chambers coiled in one plane. Its aperture is a simple slit.

Fig. 4 *Pseudomassilina macilenta* (Brady). Lateral view, SEM 87×. The ridges on this species distinguish it from *P. australis.* This specimen is a juvenile; the adult test shape is similar to *P. australis.*

Fig. 5 *Pyrgo comata* (Brady). Apertural view, SEM 49×. The test of *Pyrgo* is rounded with only 2 chambers showing on the outside.

Fig. 6 *Pyrgo denticulata* (Brady). Ventral view, SEM 78×. The last chamber of this species is denticulate posteriorly, the apertural tooth is wide and "T-shaped."

Fig. 7 *Pyrgo vespertilio* (Schlumberger). Apertural view, SEM 62×. This species has a large sinuous aperture. Its test is almost spherical in ventral view.

Fig. 8 *Pyrgo elongata* (d'Orbigny). Ventral view, SEM 56×. This species is the only *Pyrgo* with an elongate test.

Fig. 9 *Pyrgo hatchijensis* Uchio. **Fig. 9A,** aperture, SEM 83×. **Fig. 9B,** lateral view, SEM 58×. This species is powdery white under LM. The chamber edges of many specimens are sawlike in appearance.

Fig. 10 *Miliolinella subrotunda* (Montagu). Lateral view, SEM 126×. The chambers of some specimens may appear squeezed or twisted. The test of this species is shiny and white under LM.

Fig. 11 *Schlumbergerina alveoliniformis* (Brady). **Fig. 11A,** apertural view, SEM 84×. **Fig. 11B,** lateral view, SEM 71×. This species cements fine sand grains to its test. Its aperture is a plate with holes. Its chambers are coiled in such a way that the 6 newest may be viewed from the outside.

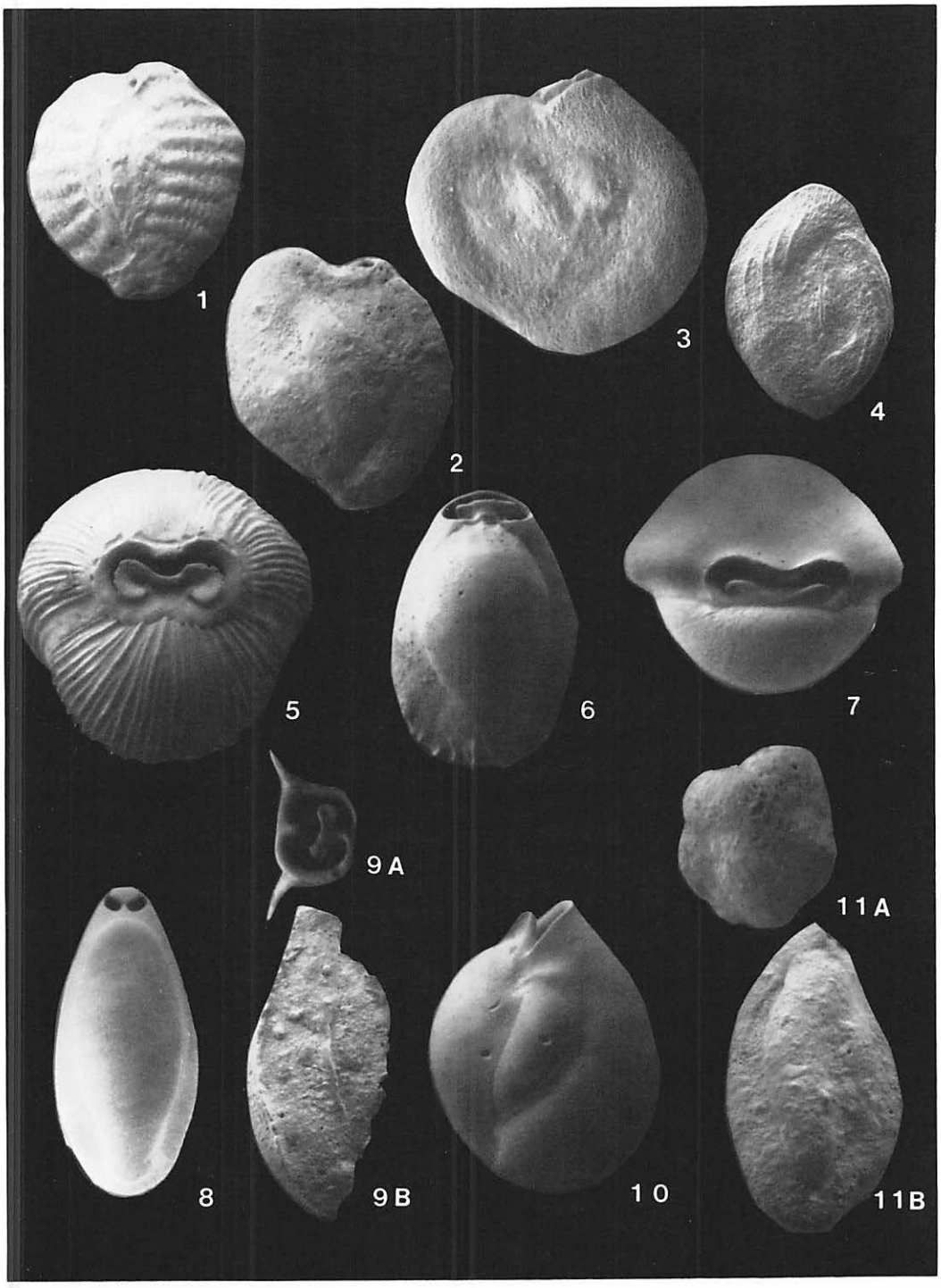
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PLATE 4. MILIOLID FORAMINIFERA

Fig. 1 *Quinqueloculina bicarinata* d'Orbigny. **Fig. 1A,** apertural view, SEM 58×. **Fig. 1B,** lateral view, SEM 61×. The genus *Quinqueloculina* has 5 visible chambers (1A). The test of this species has 2 raised ridges on one side (1B) and 3 sharp angles.

Fig. 2 *Quinqueloculina bosciana* d'Orbigny. Lateral view, SEM 92×. This species is long, smooth, and shiny.

Fig. 3 *Quinqueloculina bradyana* Cushman. Lateral view, SEM 125×. The distorted shape and wide apertural lip of the last chamber distinguish this species.

Fig. 4 *Quinqueloculina parkeri* (Brady). **Fig. 4A,** aperture, SEM 63×. **Fig. 4B,** lateral view, SEM 63×.

Fig. 5 *Quinqueloculina granulocostata* Gemeraad. **Fig. 5A,** aperture, SEM 116×. **Fig. 5B,** lateral view, SEM 55×. The 3 ridges on each chamber and the U-shaped tooth distinguish this species.

Fig. 6 *Quinqueloculina laevigata* d'Orbigny. Lateral view, SEM 126×. This species lacks the raised ridges and sharp chamber angles of *Q. bicarinata.*

Fig. 7 *Quinqueloculina lamarckiana* d'Orbigny. **Fig. 7A,** apertural view, SEM 84×. **Fig. 7B,** lateral view, SEM 127×. The test shape with its 5 projecting chambers (7A) distinguish this species.

Fig. 8 *Quinqueloculina neostriatula* Thalmann. **Fig. 8A,** apertural view, 99×. **Fig. 8B,** lateral view, SEM 92×. The fine striations and tiny double tooth distinguish this species.

Fig. 9 *Quinqueloculina poeyana* d'Orbigny. Lateral view, SEM 134×. This species is longer, and has fewer, more pronounced striations than *Q. neostriatula.*

Fig. 10 *Quinqueloculina polygona* d'Orbigny. **Fig. 10A,** apertural view, SEM 121×. **Fig. 10B,** lateral view, SEM 71×. This species looks somewhat like *Spiroloculina communis*; however, it differs in having 5 chambers projecting in various planes.

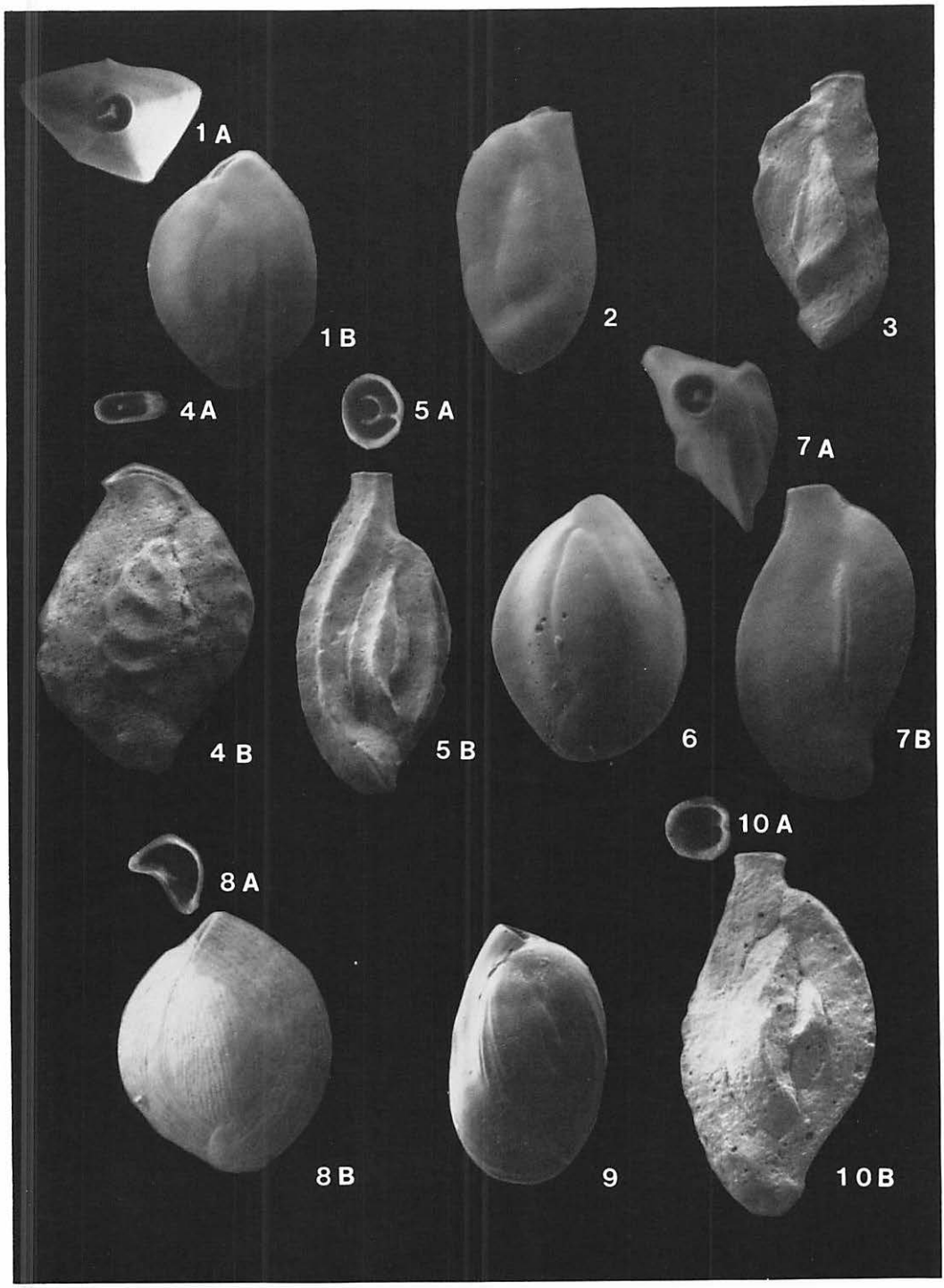
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PLATE 5. MILIOLID FORAMINIFERA

Fig. 1 *Triloculina affinis* d'Orbigny costate var. **Fig. 1A,** ventral view, SEM 113×. **Fig. 1B,** apertural view, SEM 116×. Three Māmala Bay species, *T. affinis, T. tricarinata,* and *T. trigonula* look similar at first glance. However, *T. tricarinata* is markedly triangular and has a long simple tooth. In Hawaii, *T. affinis* and *T. tricarinata* tests are more rounded and are usually costate. The tooth of *T. affinis* differs from *T. trigonula* in that it is Y-shaped and lines up with the triangle of the test.

Fig. 2 *Triloculina* cf. *bicarinata* d'Orbigny. **Fig. 2A,** lateral view, SEM 82×. **Fig. 2B,** apertural view, SEM 82×.

Fig. 3 *Triloculina fichteliana* d'Orbigny. **Fig. 3A,** lateral view, SEM 82×. **Fig. 3B,** apertural view, SEM 87×. This species differs from *T. linneiana* in having finer, more numerous costae. The apertural rim is pointed below the tooth.

Fig. 4 *Triloculina oblonga* (Montagu). Lateral view, SEM 87×. This species is the longest of the *Triloculina* species in Māmala Bay. Its aperture and the curved last chamber are distinctive.

Fig. 5 *Triloculina linneiana* d'Orbigny. **Fig. 5A,** apertural view, SEM 103×. **Fig. 5B,** lateral view, SEM 81×. This species differs from *T. fichteliana* in having fewer and more sharply defined costae.The rim around the aperture is circular.

Fig. 6 *Triloculina tricarinata* d'Orbigny. **Fig. 6A,** ventral view, SEM 83×. **Fig. 6B,** apertural view, SEM 85×.

Fig. 7 *Triloculina trigonula* (Lamarck) costate var. Todd. **Fig. 7A,** apertural view, SEM 100×. **Fig. 7B,** ventral view, SEM 90×.

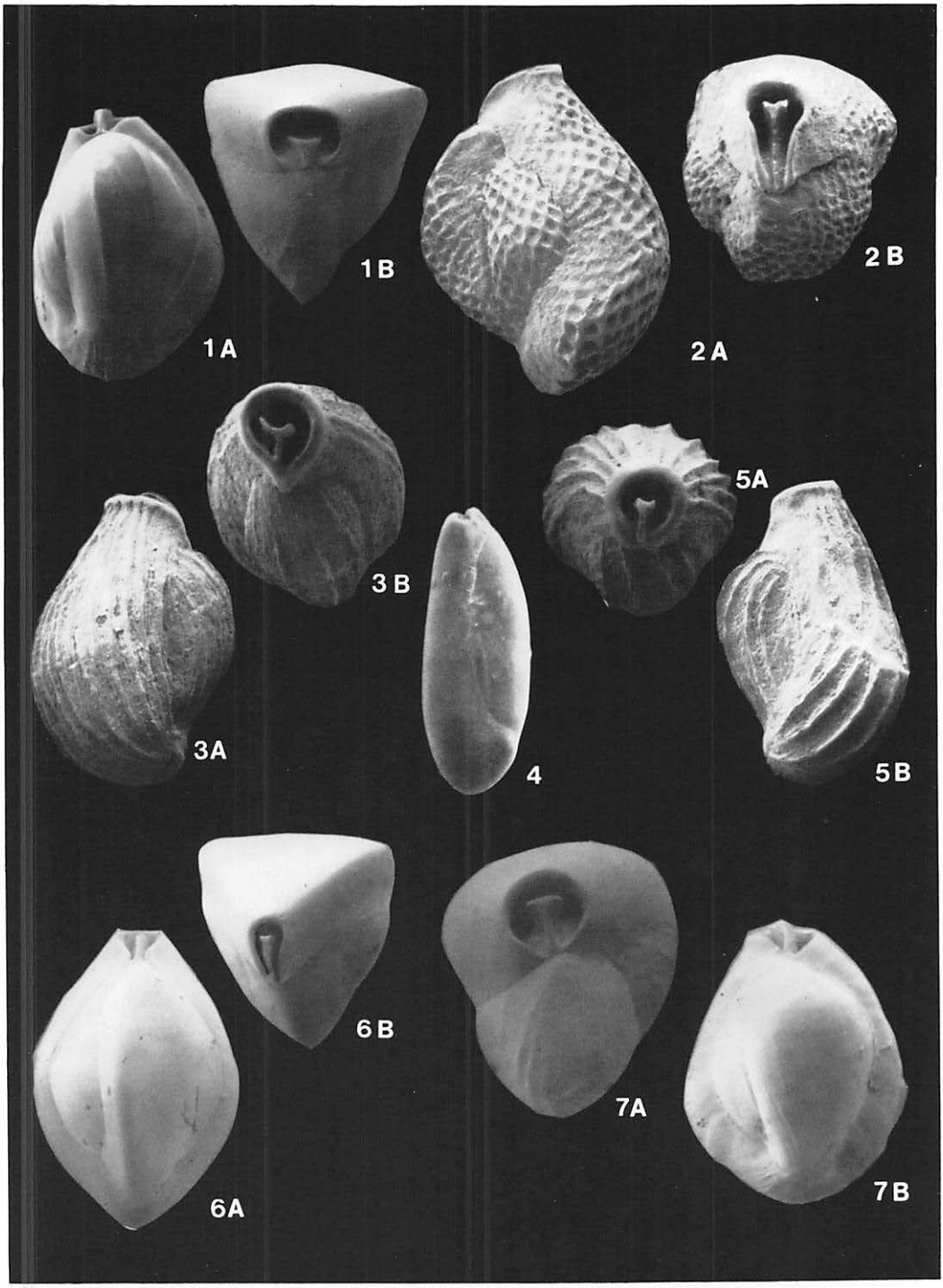
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PLATE 6. MILIOLID FORAMINIFERA

Fig. 1 *Amphisorus hemprichii* Ehrenberg. **Fig. 1A,** lateral view, SEM 82×. **Fig. 1B,** apertural view, SEM 43×. This species has 2 rows of pores along its outer margin.

Fig. 2 *Sorites marginalis* (Lamarck). Lateral view, SEM 53×. This species differs from *A. hemprichii* in having 1 row of pores on its outer margin.

Fig. 3 *Peneroplis planatus* (Fichtel & Moll). **Fig. 3A,** lateral view, SEM 65×. **Fig. 3B,** apertural view, SEM 89×. **Fig. 3C,** apertural view, SEM 85×. This species has 1 row of pores making up its aperture. Fig. 3B and 3C show different types of pores and test shapes of this species.

Fig. 4 *Spirolina arietina* (Batsch). **Fig. 4A,** lateral view, SEM 51×. **Fig. 4B,** apertural view, SEM 87×.

Fig. 5 *Borelis schlumbergeri* (Reichel). Apertural view, SEM 118×.

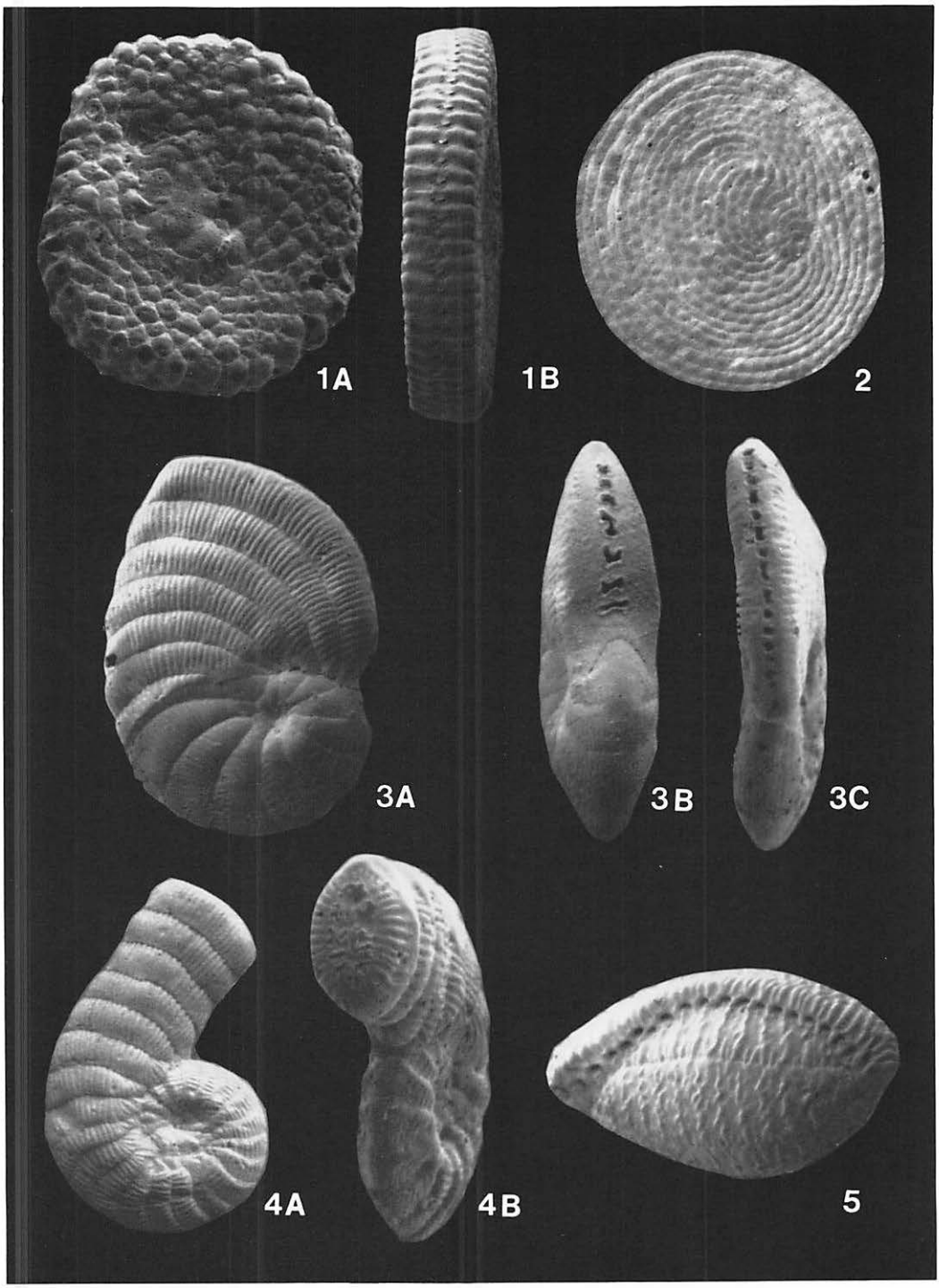
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PLATE 7. CALCAREOUS PERFORATE FORAMINIFERA

(All figures are lateral views)

Fig. 1 *Robulus calcar* (Linnaeus). LM 78×. The small spines on the test distinguish it from other Māmala Bay *Robulus* species.

Fig. 2 *Robulus limbosus* (Reuss). LM 51×. The smaller number of ridged chambers distinguish this species.

Fig. 3 *Robulus suborbicularis* Parr. LM 42×. The ridged margin around the test and numerous curved chambers distinguish this species.

Fig. 4 *Dentalina albatrossi* (Cushman). SEM 19×. Note similar radiate apertures on this and the *Robulus* species. Both genera are glassy under LM.

Fig. 5 *Bolivina glutinata* Egger. SEM 119×. This species is distinctive. Under LM it appears granular.

Fig. 6 *Bolivina macella* (Belford). **Fig. 6A,** SEM 69×. **Fig. 6B,** LM 54×. The figures show the adult animal with fine ridges running from its first chambers upward to the middle of the test. The ridges and shape of the chambers distinguish it from other *Bolivina* species.

Fig. 7 *Bolivina pacifica* Cushman & McCulloch. SEM 93×. This species is the longest and least ornamented of the Māmala Bay *Bolivina* species.

Fig. 8 *Bolivina rhomboidalis* (Millett). SEM 233×.

Fig. 9 *Bolivina spinescens* Cushman. SEM 122×. Under the LM the chambers of this species are glassy. Between the chambers are tiny pores that make these areas appear frosted.

Fig. 10 *Bolivina subreticulata* Parr. SEM 169×.

Fig. 11 *Rectobolivina columellaris* (Brady) var. *semistriata* (Schubert). SEM 50×. This species is transparent under LM.

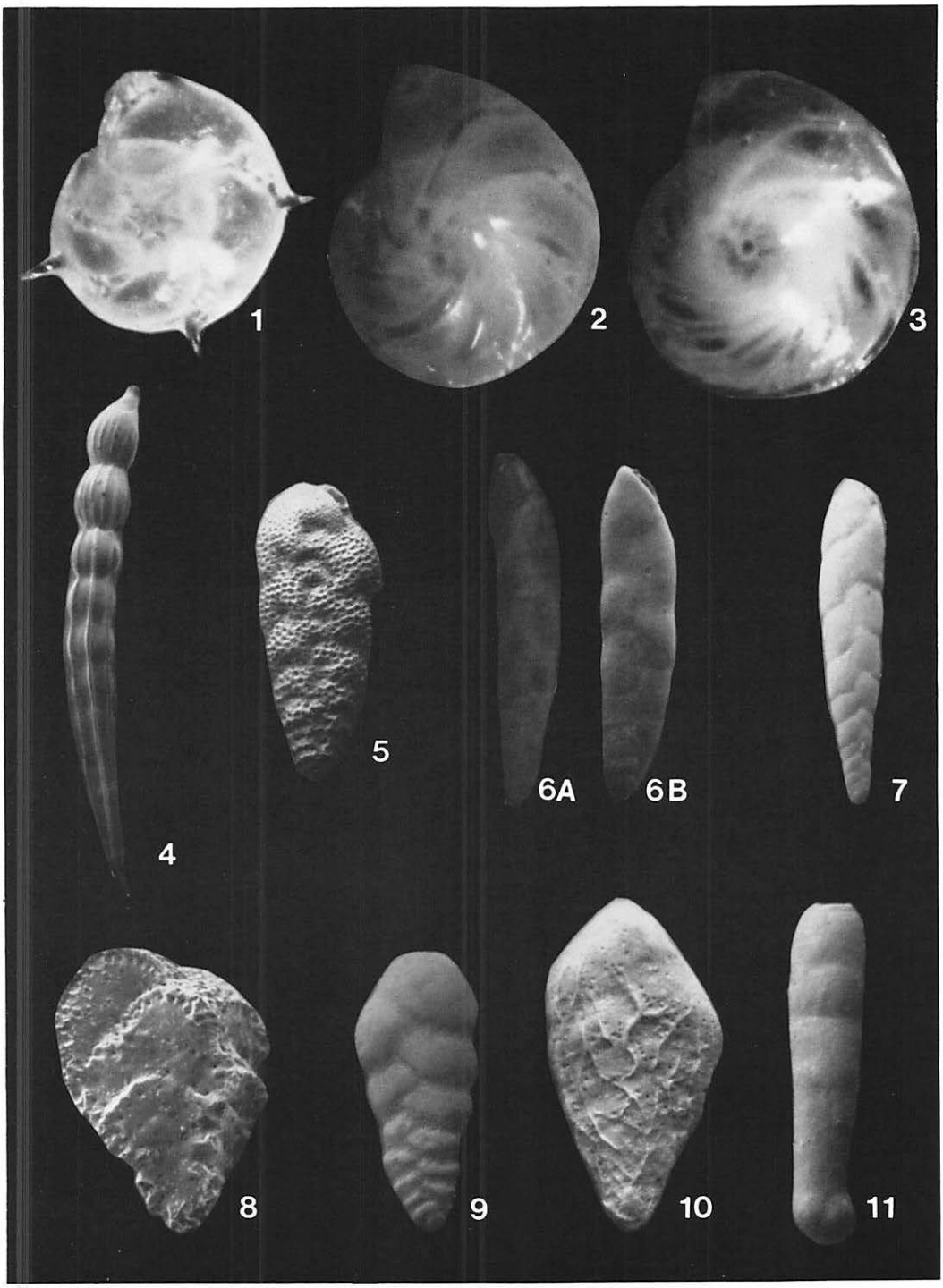
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PLATE 8. CALCAREOUS PERFORATE FORAMINIFERA

Fig. 1 *Cassidulinoides parkerianus* (Brady). Umbilical view, SEM 165×. Under LM the test of this species is transparent. The complex enrolled chambers and loop-shaped aperture distinguish the genus.

Fig. 2 *Bulimina costata* d'Orbigny. Apertural view, SEM 132×. Under LM the test is clear. The location and arrangement of the costae in this species distinguish it from others in the genus.

Fig. 3 *Fijiella simplex* (Cushman). **Fig. 3A,** apertural view, SEM 165×. **Fig. 3B,** lateral view, SEM 87×. Under LM this species is glassy. Fig. 3A shows its unusual aperture.

Fig. 4 *Siphogenerina irregularis* (Bagg). Lateral view, SEM 100×. The first test chambers of this genus are triserial; they become biserial, then uniserial as the animal grows.

Fig. 5 *Siphouvigerina proboscidea* (Schwager). Lateral view, SEM 153×. This genus is less compact than *Uvigerina.* The species has small spines over its entire test.

Fig. 6 *Trifarina bradyi* (Cushman). Lateral view, SEM 167×. Members of this genus are triangular in cross section.

Fig. 7 *Uvigerina asperula* Czjzek. Lateral view, SEM 130×. The chambers of this species are more regularly triserial and have larger bumps and spines than *S. proboscidea.*

Fig. 8 *Uvigerina peregrina* var. *dirupta* Todd. Lateral view, SEM 88×. The elaborate ornamentation of costae and spines distinguish this species.

Fig. 9 *Uvigerina sparsicostata* LeRoy. Lateral view, SEM 84×. This species is the least ornamented of the Māmala Bay *Uvigerina* species.

Fig. 10 *Rosalina concinna* (Brady). **Fig. 10A,** dorsal view, SEM 219×. **Fig. 10B,** lateral view, SEM 175×. Fig. 10A shows the first chamber, which is over ½ the circumference of the test. Fig. 10B shows the float chamber developed by *Rosalina* species.

Fig. 11 *Rosalina vilardeboana* d'Orbigny. **Fig. 11A,** dorsal view, SEM 167×. **Fig. 11B,** apertural view, SEM 167×.

Fig. 12 *Rosalina orientalis* (Cushman). **Fig. 12A,** dorsal view, SEM 124×. **Fig. 12B,** lateral view, SEM 124×.

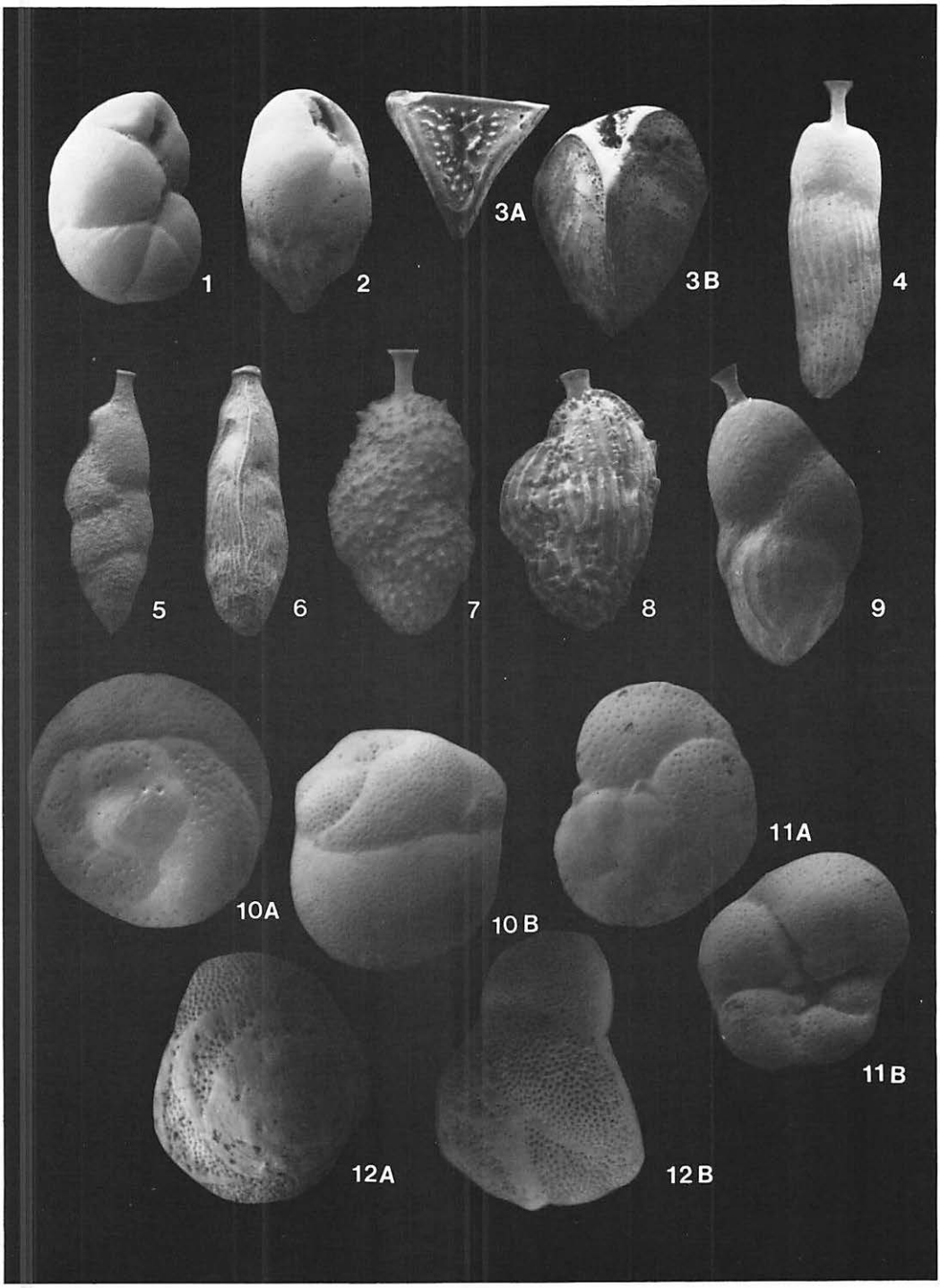
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PLATE 9. CALCAREOUS PERFORATE FORAMINIFERA

Fig. 1 *Rotorbinella lobatula* (Parr). **Fig. 1A,** dorsal view, SEM 175×. **Fig. 1B,** apertural view, SEM 398×.

Fig. 2 *Bueningia* cf. *creeki* Finlay. **Fig. 2A,** dorsal view, SEM 167×. **Fig. 2B,** apertural view, SEM 163×. This species is translucent under LM.

Fig. 3 *Tretomphalus bulloides* (d'Orbigny). Lateral view, SEM 112×. *Tretomphalus* species always have a float chamber and many more chambers than *Rosalina* species.

Fig. 4 *Planispirillina tuberculolimbata* (Chapman). **Fig. 4A,** dorsal view, SEM 89×. **Fig. 4B,** ventral view, SEM 126×.

Fig. 5 *Tretomphalus millettii* (Heron-Allen & Earland). Lateral view, SEM 175×. The float chamber of *T. millettii* is indented, which divides it into 4 sections.

Fig. 6 *Spirillina inaequalis* Brady. **Fig. 6A,** dorsal view, SEM 109×. **Fig. 6B,** ventral view, SEM 117×.

Fig. 7 *Ammonia beccarii tepida* (Cushman). **Fig. 7A,** dorsal view, SEM 181×. **Fig. 7B,** apertural view, SEM 160×.

Fig. 8 *Biarritzina proteiformis* (Goes). Lateral view, SEM 17×.

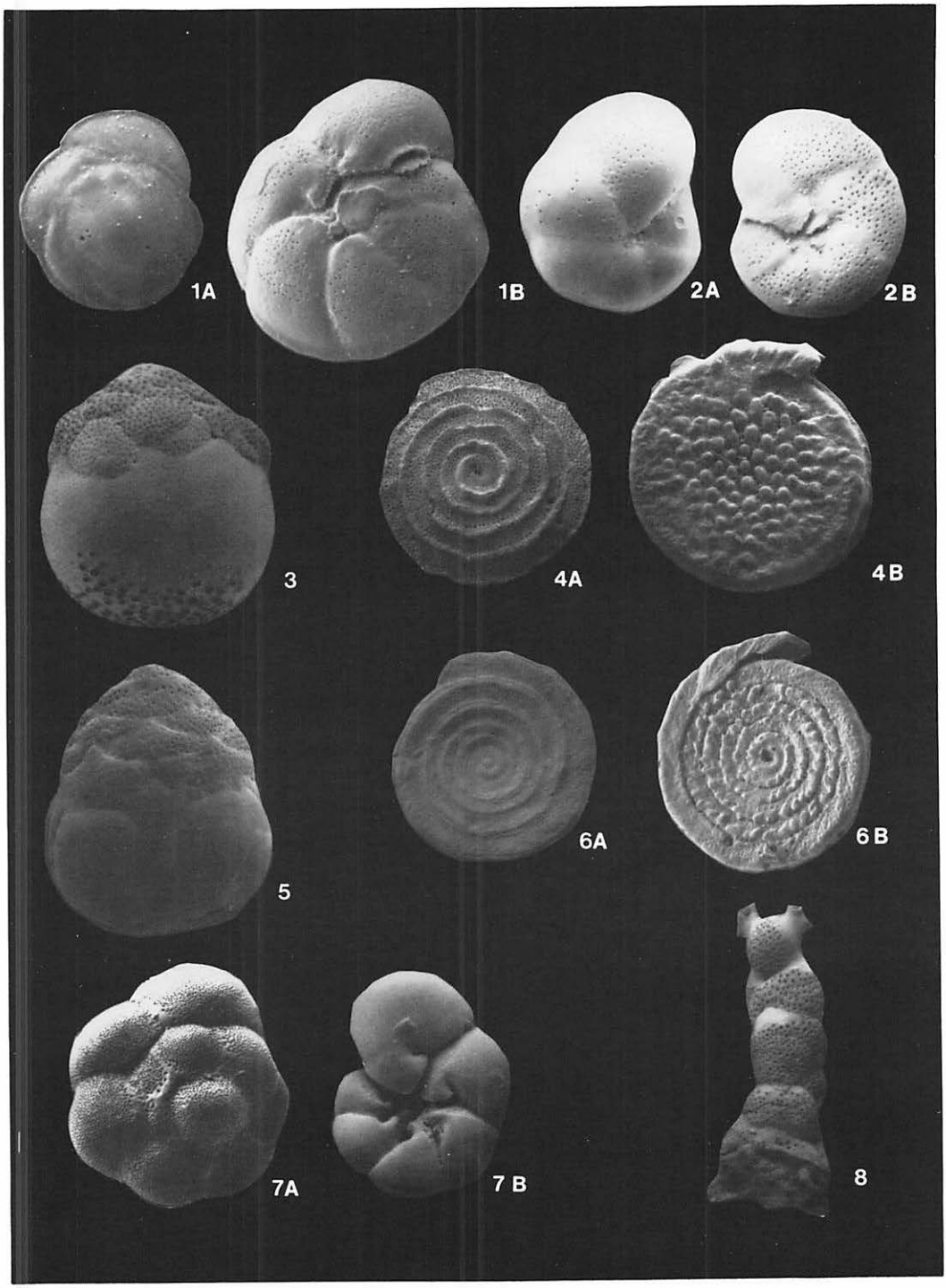
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PLATE 10. CALCAREOUS PERFORATE FORAMINIFERA

Fig. 1 *Elphidium articulatum* (d'Orbigny). **Fig. 1A,** lateral view, SEM 117×. **Fig. 1B,** apertural view, SEM 124×.

Fig. 2 *Operculina ammonoides* (Gronovius). Lateral view, SEM 81×.

Fig. 3 *Eponides berthelotianus* (d'Orbigny). **Fig. 3A,** dorsal view, SEM 65×. **Fig. 3B,** lateral view of aperture, SEM 168×.

Fig. 4 *Eponides repandus* (Fichtel & Moll). **Fig. 4A,** apertural view, SEM 69×. **Fig. 4B,** dorsal view, LM 58×. This species develops more and more pores above its aperture as it grows (Resig 1962).

Fig. 5 *Amphistegina bicirculata* Larsen. Umbilical view, LM 42×.

Fig. 6 *Amphistegina lessonii* d'Orbigny. Umbilical view, LM 62×.

Fig. 7 *Amphistegina lobifera* Larsen. Umbilical view, LM 63×.

Fig. 8 *Cibicides lobatulus* (Walker & Jacob). **Fig. 8A,** dorsal view, SEM 92×. **Fig. 8B,** apertural view, SEM 106×.

Fig. 9 *Cibicides refulgens* Montfort. **Fig. 9A,** dorsal view, SEM 104×. **Fig. 9B,** lateral view, SEM 76×.

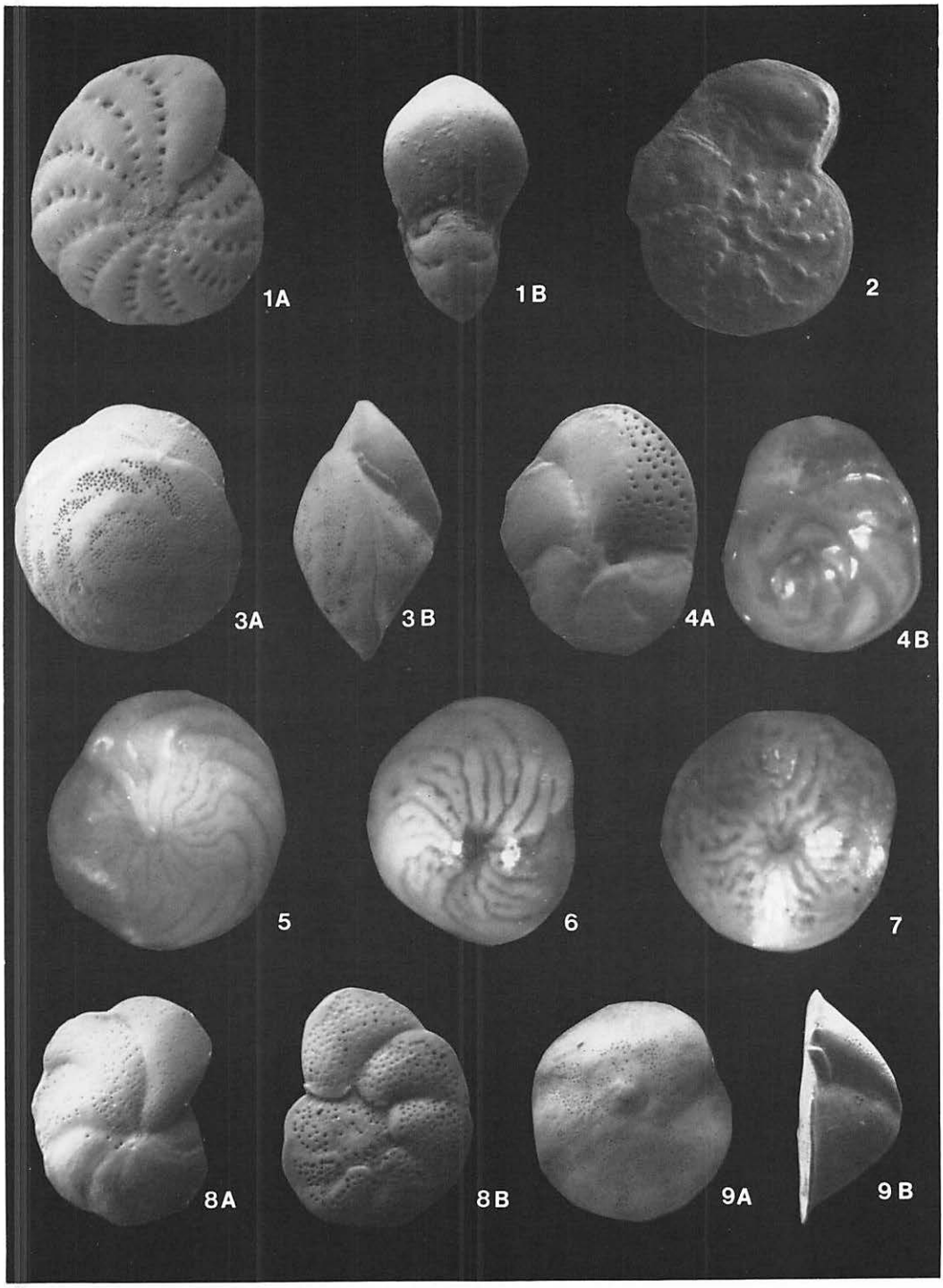
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PLATE 11. CALCAREOUS PERFORATE FORAMINIFERA

Fig. 1 *Cymbaloporetta bradyi* (Cushman). **Fig. 1A,** dorsal view, SEM 81×. **Fig. 1B,** apertural view, SEM 84×.

Fig. 2 *Cymbaloporetta squammosa* (d'Orbigny). **Fig. 2A,** dorsal view, SEM 184×. **Fig. 2B,** apertural view, SEM 118×. This species has fewer, more regular chambers than *C. bradyi.*

Fig. 3 *Miniacina miniacea* (Pallas). SEM 24×.

Fig. 4 *Loxostomum limbatum* (Brady). **Fig. 4A,** lateral view, SEM 122×. **Fig. 4B,** lateral view, LM 55×. This genus resembles *Bolivina* but has a straight, slitlike aperture (instead of curved) and tends to become uniserial.

Fig. 5 *Cassidulina crassa* d'Orbigny. Apertural view, SEM 165×. All *Cassidulina* species appear glassy under LM.

Fig. 6 *Cassidulina laevigata* d'Orbigny. Apertural view, SEM 197×.

Fig. 7 *Cassidulina oriangulata* (Belford). Apertural view, SEM 175×.

Fig. 8 *Cassidulina radiata,* new species. Holotype, apertural view, SEM 284×.

Fig. 9 *Cassidulina sulcata* Belford. **Fig. 9A,** apertural view, SEM 190×. **Fig. 9B,** dorsal view, SEM 267×.

Fig. 10 *Ehrenbergina pacifica* Cushman. Apertural view, SEM 132×.

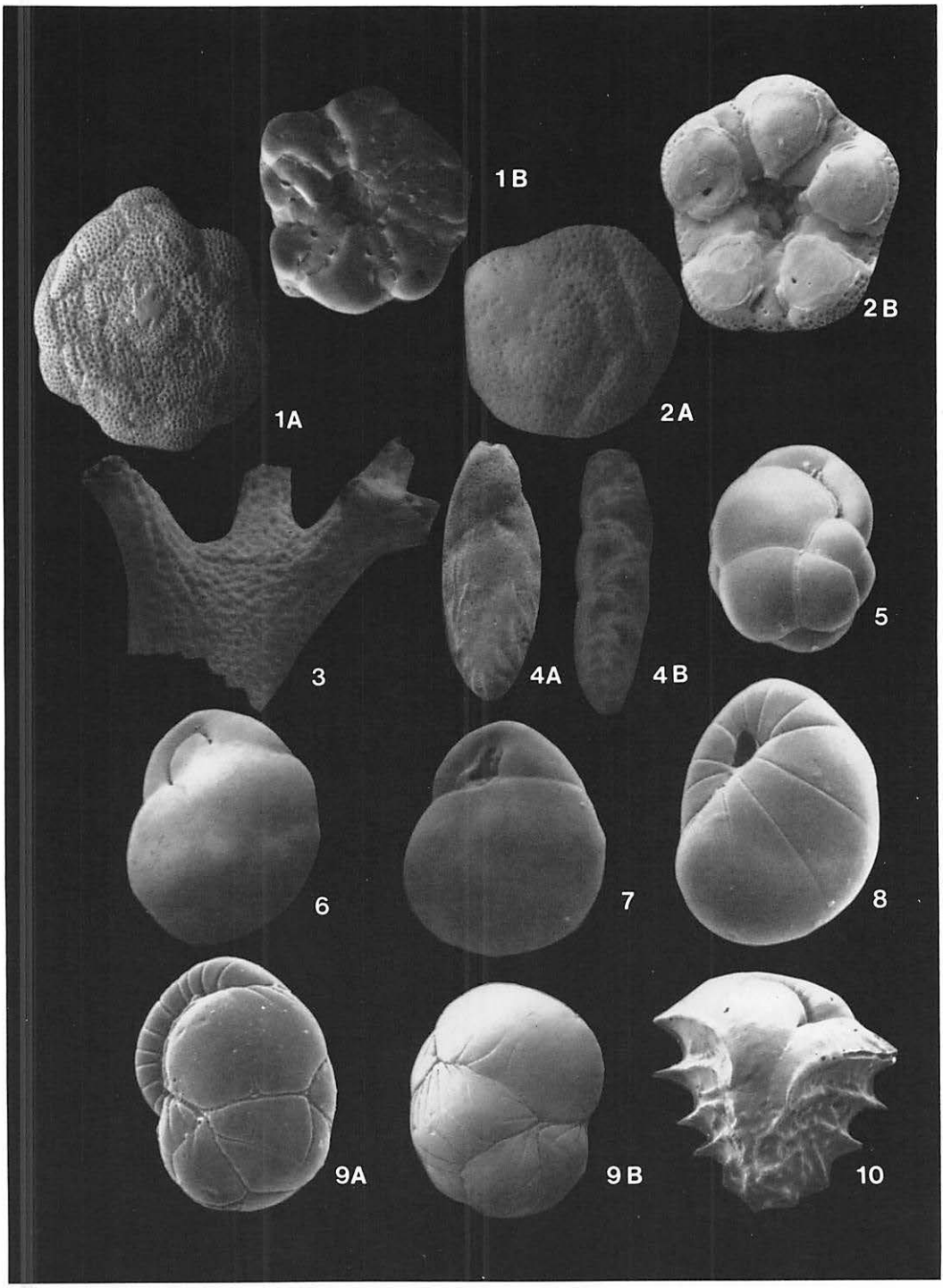
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PLATE 12. CALCAREOUS PERFORATE FORAMINIFERA

Fig. 1 *Florilus japonicus* (Asano). Side view, SEM 232×.

Fig. 2 *Nonion boueanum* (d'Orbigny). Side view, SEM 197×.

Fig. 3 *Alabamina resigae,* new species. **Fig. 3A,** holotype, dorsal view, LM 161×. **Fig. 3B,** paratype, apertural view, SEM 184×.

Fig. 4 *Anomalina colligera* Chapman & Parr. **Fig. 4A,** dorsal view, LM 94×. **Fig. 4B,** umbilical view, SEM 116×.

Fig. 5 *Anomalina glabrata* Cushman. Dorsal view, SEM 81×.

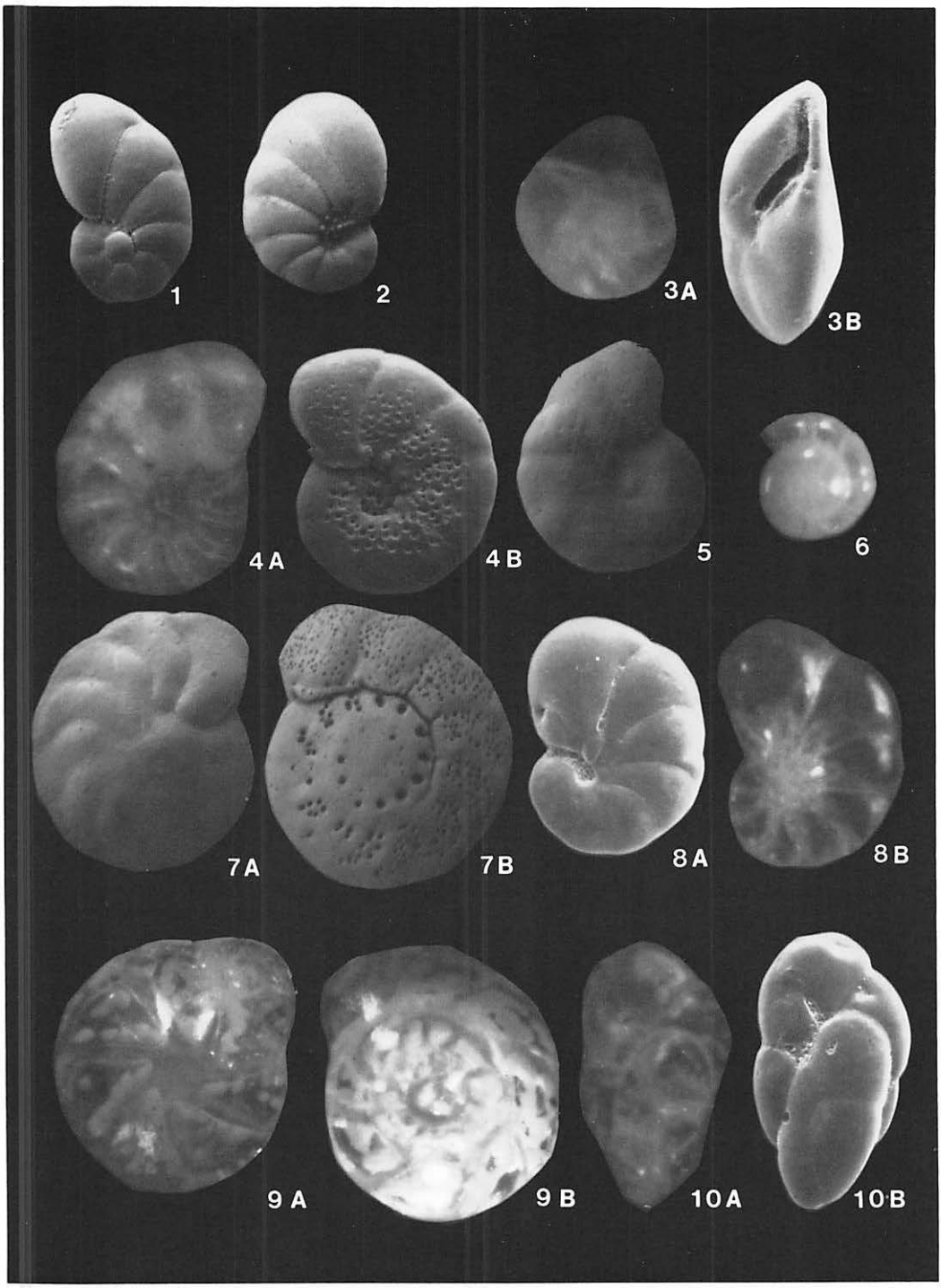
Fig. 6 *Gyroidina orbicularis* d'Orbigny. Dorsal view, LM 85×.

Fig. 7 *Cibicidoides pseudoungerianus* (Cushman). **Fig. 7A,** dorsal view, SEM 93×. **Fig. 7B,** umbilical view, SEM 95×. This species differs from *Cibicides lobatulus* (Walker & Jacob) by being curved on both sides and by having a ring of large pores on the chambers near the aperture.

Fig. 8 *Alliatina excentrica* (di Napoli Alliata). **Fig. 8A,** umbilical view, SEM 160×. **Fig. 8B,** umbilical view, LM 49×.

Fig. 9 *Hoeglundina flinti* (Galloway & Whissler). **Fig. 9A,** umbilical view, LM 49×. **Fig. 9B,** dorsal view, LM 49×. There has been considerable confusion between the deep water species *H. elegans* (d'Orbigny) and *H. flinti.* The Māmala Bay specimens resemble the type figure of *H. flinti* and are found at depths as shallow as 200 m. Specimens of *H. elegans* occur in water deeper than 1,200 m and have less ornamentation.

Fig. 10 *Robertinoides bradyi* (Cushman & Parker). **Fig. 10A,** apertural view, SEM 160×. **Fig. 10B,** apertural view, LM 49×. Under LM this species is transparent and shiny with areas that appear frosted.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Family TEXTULARIELLIDAE

Textulariella barrettii (Jones & Parker) Plate 1, fig. 8

Textularia barrettii Jones & Parker, 1876 [type figures in Jones & Parker 1876, p. 99].

Remarks. Free in coarse sand at Station 1-4 (264 m depth); 1 individual stained with dye; color unknown.

Suborder MILIOLINA

Family NUBECULARIIDAE

Nubeculina divaricata (Brady) Plate 2, fig. 1

Sagrina divaricata Brady, 1879 [type description in Brady 1879; type figures in Brady 1884, pl. 76, fig. 11–16].

Remarks. Free in coarse sand from 100 to 500 m depth; several specimens stained with dye; color unknown.

Spiroloculina communis Cushman & Todd Plate 2, fig. 2

Spiroloculina communis Cushman & Todd, 1944 [type figures in Cushman & Todd 1944, pl. 9, fig. 4, 5, 7, 8].—Resig 1969, pl. 1, fig. 15.—Phillips 1977, pl. 2, fig. 7.

Remarks. Free in sand from 32 to 100 m depth; brown.

Spiroloculina corrugata Cushman & Todd Plate 2, fig. 3

Spiroloculina corrugata Cushman & Todd, 1944 [type figures in Cushman & Todd 1944, pl. 8, fig. 22–25].—Resig 1969, pl. 1, fig. 13.—Phillips 1977, pl. 2, fig. 9.

Remarks. Attached to sand grains in sand pockets of limestone areas from 32 to 200 m depth; pink.

Vertebralina striata d'Orbigny Plate 2, fig. 5

Vertebralina striata d'Orbigny, 1826 [type description in d'Orbigny 1826; type figure in Parker et al. 1871, fig. 27].—Resig 1969, pl. 1, fig. 4.—Phillips 1977, pl. 5, fig. 9.

Remarks. Free in fine sand at 246 m depth; reddish brown.

Articulina carinata Cushman Plate 2, fig. 4

Articulina carinata Cushman, 1944 [type figures in Cushman 1944, pl. 3, fig. 18–20].

Remarks. Free in coarse sand at Station 3-4 (112 m depth); 2 young specimens stained with dye; color unknown.

Articulina pacifica Cushman Plate 2, fig. 7

Articulina pacifica Cushman, 1944 [type figures in Cushman 1944, pl. 4, fig. 14–18].—Resig 1969, pl. 1, fig. 16.—Phillips 1977, pl. 4, fig. 1.

Remarks. Free in coarse sand from 100 to 200 m depth; brownish pink.

Biloculinella globulus (Bornemann) Plate 2, fig. 6

Biloculina globulus Bornemann, 1855 [type figure in Bornemann 1855, pl. 19, fig. 3].

Remarks. Free in fine sand at depths of over 400 m; pink.

Flintina bradyana Cushman Plate 2, fig. 8

Flintina bradyana Cushman, 1921 [type figure in Cushman 1921, pl. 94, fig. 2].—Phillips 1977, pl. 4, fig. 9.

Remarks. Free in sand at Stations 3-4 (112 m depth) and 4-3 (94 m depth); young specimens observed slowly moving through aquarium sand; pink.

Hauerina orientalis Cushman Plate 3, fig. 1

Hauerina orientalis Cushman, 1946 [type figures in Cushman 1946, pl. 4, fig. 22–24].

Remarks. Attached to small rocks with filamentous algae at Station 5-2 (60 m depth); brown.

Hauerina pacifica Cushman Plate 3, fig. 2

Hauerina pacifica Cushman, 1917 [type figure in Cushman 1917, pl. 21, fig. 2].—Resig 1969, pl. 1, fig. 8.—Phillips 1977, pl. 4, fig. 3.

Remarks. Attached to one or more sand grains at Station 4-5 (374 m depth); gray.

Miliolinella subrotunda (Montagu) Plate 3, fig. 10

Vermiculum subrotundum Montagu, 1803 [type description in Montagu 1803; type figure in Walker & Boys 1784, pl. 1, fig. 4].

Remarks. Attached to sand grains from 40 to 200 m depth; pink.

Family MILIOLIDAE

Pseudomassilina australis (Cushman) Plate 3, fig. 3

Massilina australis Cushman, 1932 [type figure in Cushman 1932, part 1, pl. 8, fig. 2].

Remarks. Attached to sand grains from 40 to 100 m depth; specimens placed in an aquarium remained on the sand surface during 2 months of observation; pinkish white.

Pseudomassilina macilenta (Brady) Plate 3, fig. 4

Miliolina macilenta Brady, 1884 [type figures in Brady 1884, pl. 7, fig. 5, 6].
Pseudomassilina cf. *agglutinans*: Phillips 1977, pl. 2, fig. 5.

Remarks. Free in sand at Station 5-2 (60 m depth); 1 specimen was stained with dye; color unknown.

Pyrgo comata (Brady) Plate 3, fig. 5

Biloculina comata Brady, 1884 [type figure in Brady 1884, pl. 3, fig. 9].

Remarks. Attached to sand grains from 400 to 510 m depth; brown.

Pyrgo denticulata (Brady) Plate 3, fig. 6

Biloculina ringens (Lamarck) var. *denticulata* Brady, 1884 [type figures in Brady 1884, pl. 3, fig. 4, 5].
Pyrgo denticulata (Brady): Phillips 1977, pl. 4, fig. 6.

Remarks. Attached to sand grains or to algae from 30 to 120 m depth; pink.

Pyrgo elongata (d'Orbigny) Plate 3, fig. 8

Biloculina elongata d'Orbigny, 1826 [type description in d'Orbigny 1826; type figure in Parker et al. 1871, pl. i, fig. 6].

Remarks. Free in fine sand from 400 to 510 m depth; pink.

Pyrgo hatchijensis Uchio Plate 3, fig. 9

Pyrgo hatchijensis Uchio, 1952 [type figures in Uchio 1952, pl. 6, fig. a, b].

Remarks. Free in sand, common in Stations 1-2, 6-2 and 7-3 (from 32 to 68 m depth); moved to the base of a small rock in an aquarium and remained attached or in the vicinity of the rock during 2 months of observation; brown.

Pyrgo vespertilio (Schlumberger) Plate 3, fig. 7

Biloculina vespertilio Schlumberger, 1891 [type figures in Schlumberger 1891, pl. 10, fig. 74–76].

Remarks. Attached to one or more sand grains from 400 to 510 m depth; brown.

Quinqueloculina bicarinata d'Orbigny Plate 4, fig. 1

Quinqueloculina bicarinata d'Orbigny, 1826 [type description in d'Orbigny 1826; type figure in Terquem 1878, pl. 7, fig. 10].—Phillips 1977, pl. 5, fig. 6.

Remarks. Free in sand at Stations 6-4 (292 m depth) and 6-5 (416 m depth); pinkish tan.

Quinqueloculina bosciana d'Orbigny Plate 4, fig. 2

Quinqueloculina bosciana d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 11, fig. 22–24].—Resig 1969, pl. 2, fig. 8.

Remarks. Free in sand at depths of 1 to 3 m; dark brown.

Quinqueloculina bradyana Cushman Plate 4, fig. 3

Quinqueloculina bradyana Cushman, 1917 [type figure in Cushman 1917, part 6, pl. 18, fig. 2].

Remarks. Free in sand at Stations 6-2 (66 m depth) and 7-3 (68 m depth); pink.

Quinqueloculina granulocostata Germeraad Plate 4, fig. 5

Quinqueloculina granulo-costata Germeraad, 1946 [type description in Germeraad 1946; type figure in Brady 1884, pl. 6, fig. 15–20].—Resig 1969, pl. 2, fig. 10.—Phillips 1977, pl. 3, fig. 7.

Remarks. Attached to sides of sandy reef pockets, algal holdfasts, and large sand grains from 5 to 50 m depth; pink. Barker (1960) republished Brady's (1884) type figure and changed the name of this foraminifer from *Miliolina linnaeana* to *Quinqueloculina granulocostata.*

Quinqueloculina laevigata d'Orbigny Plate 4, fig. 6

Quinqueloculina laevigata d'Orbigny, 1839 [type figures in d'Orbigny 1839c, pl. 3, fig. 31–33].—Resig 1969, pl. 2, fig. 9.

Remarks. Free in sand at Stations 3-2 and 6-1 (both 16 m depth); grayish.

Quinqueloculina lamarckiana d'Orbigny Plate 4, fig. 7

Quinqueloculina lamarckiana d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 11, fig. 14, 15].—Resig 1969, pl. 2, fig. 14.

Remarks. Free in small sand patches on limestone areas at Station 2-3 (48 m depth); several stained with dye; color unknown.

Quinqueloculina neostriatula Thalmann Plate 4, fig. 8

Quinqueloculina neostriatula Thalmann, 1950 [type description in Thalmann 1950; type figures in Cushman 1932, pl. 7, fig. 3, 4].

Remarks. Free in sand from 40 to 120 m depth; several stained with dye; color unknown.

Quinqueloculina parkeri (Brady) Plate 4, fig. 4

Miliolina parkeri Brady, 1884 [type figure in Brady 1884, pl. 7, fig. 14].
Quinqueloculina parkeri (Brady): Phillips 1977, pl. 3, fig. 2.

Remarks. Attached in crevices from 5 m below the reef crest to a depth of 10 m; pink.

Quinqueloculina poeyana d'Orbigny Plate 4, fig. 9

Quinqueloculina poeyana d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 11, fig. 25–27].—Resig 1969, pl. 2, fig. 6.—Phillips 1977, pl. 3, fig. 1.

Remarks. Free in sand or attached to large rocks from 1 to 20 m depth; gray.

Quinqueloculina polygona d'Orbigny Plate 4, fig. 10

Quinqueloculina polygona d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 12, fig. 21–23].—Phillips 1977, pl. 3, fig. 8.

Remarks. Attached to sand grains in shallow sand patches on the reef flat from 1 to 10 m depth; yellow brown.

Schlumbergerina alveoliniformis (Brady) Plate 3, fig. 11

Miliolina alveoliniformis Brady, 1879 [type description in Brady 1879; type figures in Brady 1884, pl. 8, fig. 15–20].
Schlumbergerina alveoliniformis (Brady): Phillips 1977, pl. 4, fig. 7.

Remarks. Free in fine sand from 40 to 66 m depth; grayish brown.

Triloculina affinis d'Orbigny Plate 5, fig. 1

Triloculina affinis d'Orbigny, 1852 [type description in d'Orbigny 1852; type figure in Foransini 1905, pl. 1, fig. 1].

Remarks. Attached to crevices in small rocks from 250 to 466 m depth; light pink.

Triloculina cf. **bicarinata** d'Orbigny Plate 5, fig. 2

Triloculina bicarinata d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 10, fig. 18–20].
Triloculina cf. *bicarinata* d'Orbigny: Phillips 1977, pl. 5, fig. 2.

Remarks. Attached to sand grains from 40 to 100 m depth; pinkish brown.

Triloculina fichteliana d'Orbigny Plate 5, fig. 3

Triloculina fichteliana d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 9, fig. 8–10].—Phillips 1977, pl. 5, fig. 3.

Remarks. Attached to fine sand grains from 40 to 94 m depth; brown.

Triloculina linneiana d'Orbigny Plate 5, fig. 5

Triloculina linneiana d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 9, fig. 11–13].—Phillips 1977, pl. 5, fig. 4.

Remarks. Attached to coarse sand grains from 32 to 68 m depth; brown.

Triloculina oblonga (Montagu) Plate 5, fig. 4

Vermiculum oblongum Montagu, 1803 [type figure in Montagu 1803, pl. 14, fig. 9].
Triloculina oblonga (Montagu): Resig 1969, pl. 1, fig. 6.—Phillips 1977, pl. 5, fig. 7.

Remarks. Free in sand at Stations 2-2 (3 m depth) and 8-4 (18 m depth); gray.

Triloculina tricarinata d'Orbigny Plate 5, fig. 6

Triloculina tricarinata d'Orbigny, 1826 [type description in d'Orbigny 1826; type figure in Parker et al. 1871, pl. 1, fig. 8].

Remarks. Free in coarse sediment at Station 9-7 (444 m depth); light pink.

Triloculina trigonula (Lamarck) costate variety Todd Plate 5, fig. 7

Miliolites trigonula Lamarck, 1804 [type figure in Lamarck 1804, pl. 17].
Triloculina trigonula (Lamarck) costate variety Todd, 1957 [type figure in Todd 1957, pl. 86, fig. 17].—Resig 1969, pl. 1, fig. 7.

Remarks. Attached to algal mats and limestone areas from 20 to 60 m depth; pink.

Family SORITIDAE

Amphisorus hemprichii Ehrenberg Plate 6, fig. 1

Amphisorus hemprichii Ehrenberg, 1840 [type figure in Ehrenberg 1840, pl. 3, fig. 3].—Phillips 1977, pl. 6, fig. 1, 2.

Remarks. Attached to algae and limestone substrates from 0 to 30 m depth; brown with zooxanthellae.

Peneroplis planatus (Fichtel & Moll) Plate 6, fig. 3

Nautilus planatus Fichtel & Moll, 1798 [type figures in Fichtel & Moll 1798, pl. 16, fig. a–c, i].
Peneroplis planatus (Fichtel & Moll): Phillips 1977, pl. 5, fig. 10–12.

Remarks. Attached to reef flat algae from 0 to 20 m depth; red with zooxanthellae.

Sorites marginalis (Lamarck) Plate 6, fig. 2

Orbulites marginalis Lamarck, 1816 [type description in Lamarck 1816; no type figure].
Sorites marginalis (Lamarck): Phillips 1977, pl. 6, fig. 4–6.

Remarks. Free in sand from 50 to 400 m depth; light brown.

Spirolina arietina (Batsch) Plate 6, fig. 4

Nautilus (Lituus) arietinus Batsch, 1791 [type figure in Batsch 1791, pl. 6, fig. 15c].
Spirolina arietina (Batsch): Phillips 1977, pl. 7, fig. 1.

Remarks. Attached to hard substrates from 1 to 20 m in depth; red with zooxanthellae.

Family ALVEOLINIDAE

Borelis schlumbergeri (Reichel) Plate 6, fig. 5

Neoalveolina pygmaea schlumbergeri Reichel, 1937 [type figures in Reichel 1937, pl. 10, fig. 1–3; pl. 11, fig. 6].
Borelis melo (Fichtel & Moll): Phillips 1977, pl. 7, fig. 4.

Remarks. Free in fine-grained sand from 60 to 70 m depth; pink.

Suborder LAGENINA

Family NODOSARIIDAE

Dentalina albatrossi (Cushman) Plate 7, fig. 4

Nodosaria vertebralis Batsch var. *albatrossi* Cushman, 1923 [type figure in Cushman 1923, pl. 15, fig. 1].

Remarks. Free in fine sand at Stations 9-8 (410 m depth) and 3-6 (446 m depth); 3 individuals stained with dye; color unknown.

Family VAGINULINIDAE

Robulus calcar (Linnaeus) Plate 7, fig. 1

Nautilus calcar Linnaeus, 1758 [type figures in Linnaeus 1758, pl. 1, fig. 3g–i, 4l–n].

Remarks. Free in fine sand from 300 to 510 m depth; brown.

Robulus limbosus (Reuss) Plate 7, fig. 2

Cristellaria (*Robulina*) *limbosa* Reuss, 1863 [type figure in Reuss 1863, pl. 6, fig. 69].

Remarks. Free in fine sand from 440 to 510 m depth; several stained with dye; brown.

Robulus suborbicularis Parr Plate 7, fig. 3

Lenticulina (*Robulus*) *suborbicularis* Parr, 1950 [type figures in Parr 1950, pl. 11, fig. 5, 6].

Remarks. Free in fine sand from 264 to 466 m depth; several stained with dye, brown.

Suborder SPIRILLININA

Family SPIRILLINIDAE

Planispirillina tuberculolimbata (Chapman) Plate 9, fig. 4

Spirillina tuberculo-limbata Chapman, 1900 [type figure in Chapman 1900, pl. 1, fig. 8a–c].

Remarks. Attached to hard substrate at reef edges from 5 to 15 m depth; brown.

Spirillina inaequalis Brady Plate 9, fig. 6

Spirillina inaequalis Brady, 1879 [type description in Brady 1879; type figures in Brady 1884, pl. 85, fig. 8–11].

Remarks. Attached to filamentous algae or small rocks at Station 2-2 (18 m depth); grayish green.

Suborder ROTALIINA

Family CERATOBULIMINIDAE

Hoeglundina flinti (Galloway & Whissler) Plate 12, fig. 9

Epistomina flinti Galloway & Whissler, 1927 [type figure in Galloway & Whissler 1927, pl. 9, fig. 1].

Remarks. Free in sand from 200 to 510 m depth; tan to brown.

Family ROBERTINIDAE

Alliatina excentrica (de Napoli Alliata) Plate 12, fig. 8

Cushmanella excentrica di Napoli Alliata, 1952 [type figure in di Napoli Alliata 1952, pl. 5, fig. 1].

Remarks. Free in fine sand from 400 to 510 m depth; brown.

Robertinoides bradyi (Cushman & Parker) Plate 12, fig. 10

Robertina bradyi Cushman & Parker, 1936 [type figure in Cushman & Parker 1936, pl. 16, fig. 9].

Remarks. Free in sand at Station 4-6 (510 m depth); several stained with dye; brown.

Family BOLIVINITIDAE

Bolivina glutinata Egger Plate 7, fig. 5

Bolivina glutinata Egger, 1893 [type figures in Egger 1893, pl. 8, fig. 57–62].

Remarks. Free in fine sand from 450 to 510 m depth; light brown.

Bolivina macella (Belford) Plate 7, fig. 6

Brizalina macella Belford, 1966 [type figures in Belford 1966, pl. 2, fig. 7–10].

Remarks. Free in fine sand from 450 to 510 m depth; brown.

Bolivina pacifica Cushman & McCulloch Plate 7, fig. 7

Bolivina acerosa Cushman var. *pacifica* Cushman & McCulloch, 1942 [type figures in Cushman & McCulloch 1942, pl. 21, fig. 2, 3].

Remarks. Free in fine sand at Station 4-6 (510 m depth); several individuals stained with dye; tan.

Bolivina rhomboidalis (Millett) Plate 7, fig. 8

Textularia rhomboidalis Millett, 1899 [type figure in Millett 1899, pl. 7, fig. 4].
Bolivina rhomboidalis (Millett): Resig 1969, pl. 4, fig. 5.

Remarks. Free in fine sand from 450 to 510 m depth; brown.

Bolivina spinescens Cushman Plate 7, fig. 9

Bolivina spinescens Cushman, 1911 [type figure in Cushman 1911, fig. 47].—Resig 1969, pl. 4, fig. 8.

Remarks. Free in fine sand below 400 m depth; light tan.

Bolivina subreticulata Parr Plate 7, fig. 10

Bolivina subreticulata Parr, 1932 [type figure in Parr 1932, pl. 1, fig. 21].

Remarks. Free in fine sand at Station 3-6 (446 m depth), light brown.

Rectobolivina columellaris (Brady) var. **semistriata** (Schubert) Plate 7, fig. 11

Sagrina raphanus (Parker & Jones) var. *semistriata* Schubert, 1911 [type figure in Schubert 1911, plate 10a,b].

Remarks. Free in fine sand from 400 to 510 m depth; light brown.

Family ISLANDIELLIDAE

Cassidulinoides parkerianus (Brady) Plate 8, fig. 1

Cassidulina parkerianus Brady, 1881 [type description in Brady 1881; type figures in Brady 1884, pl. 54, fig. 11–16].

Remarks. Attached to sand grains from 506 to 510 m depth; brown.

Family BULIMINIDAE

Bulimina costata d'Orbigny Plate 8, fig. 2

Bulimina costata d'Orbigny, 1852 [type description in d'Orbigny 1852; type figure in Foransini 1901, fig. 1].

Remarks. Free in fine sand from 466 to 510 m depth; light brown.

Fijiella simplex (Cushman) Plate 8, fig. 3

Trimosina simplex Cushman, 1929 [type figure in Cushman 1929, fig. 2].
Fijiella simplex (Cushman): Resig 1969, pl. 8, fig. 16a,b.

Remarks. Attached to or moving among sand grains and algae from 3 to 200 m depth; reddish brown.

Family UVIGERINIDAE

Siphogenerina irregularis (Bagg) Plate 8, fig. 4

Sagraina irregularis Bagg, 1908 [type figures in Bagg 1908, pl. 5, fig. 8–10].

Remarks. Free in fine sand from 100 to 500 m depth; tan.

Siphouvigerina proboscidea (Schwager) Plate 8, fig. 5

Uvigerina proboscidea Schwager, 1866 [type figure in Schwager 1866, fig. 96].

Remarks. Free in fine sand at 510 m depth; light brown.

Trifarina bradyi (Cushman) Plate 8, fig. 6

Triplasia bradyi Cushman, 1923 [type figure in Cushman 1923, pl. 22, fig. 3–9].—Phillips 1977, pl. 8, fig. 14.

Remarks. Free in fine sand from 446 to 510 m depth; some stained with dye; brown.

Uvigerina asperula Czjzek Plate 8, fig. 7

Uvigerina asperula Czjzek, 1848 [type figures in Czjzek 1848, pl. 13, fig. 14, 15].

Remarks. Free in fine sand below 400 m depth; light brown.

Uvigerina peregrina var. **dirupta** Todd Plate 8, fig. 8

Uvigerina peregrina Cushman var. *dirupta* Todd, 1948 [type figure in Todd 1948, pl. 34, fig. 3].

Remarks. Free in fine sand from Stations 7-6 (506 m depth) and 4-6 (510 m depth); light brown.

Uvigerina sparsicostata LeRoy Plate 8, fig. 9

Uvigerina sparsicostata LeRoy, 1944 [type figures in LeRoy 1944, pl. 1, fig. 45, 46].

Remarks. Free in fine sand from 300 to 510 m depth; yellow brown.

Family DISCORBIDAE

Rosalina concinna (Brady) Plate 8, fig. 10

Discorbina concinna Brady, 1884 [type figures in Brady 1884, pl. 90, fig. 7, 8].
Rosalina concinna (Brady): Resig 1969, pl. 5, fig. 4.

Remarks. Attached to algae and limestone surfaces from 0 to 200 m depth: free in sand from 200 to 510 m depth; brown.

Rosalina orientalis (Cushman) Plate 8, fig. 12

Discorbis orientalis Cushman, 1925 [type description in Cushman 1925; type figure in Heron-Allen & Earland 1914, pl. 15, fig. 36–39].
Rosalina orientalis (Cushman): Phillips 1977, pl. 9, fig. 9.

Remarks. Attached to algae at Station 3-3 (40 m depth) and to sand grains to 70 m; attached to small rocks in an aquarium during 2 months of observation; yellowish brown.

Rosalina vilardeboana d'Orbigny Plate 8, fig. 11

Rosalina vilardeboana d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 6, fig. 13–16].—Phillips 1977, pl. 9, fig. 8.

Remarks. Attached to algae from 1 to 90 m depth; brown.

Rotorbinella lobatula (Parr) Plate 9, fig. 1

Discorbis lobatulus Parr, 1950 [type figures in Parr 1950, fig. 23–25].

Remarks. Free in fine sand from 264 to 466 m depth; several stained with dye; brown.

Tretomphalus bulloides (d'Orbigny) Plate 9, fig. 3

Rosalina bulloides d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 3, fig. 2–5].—Phillips 1977, pl. 11, fig. 5.

Remarks. Free in sand from 5 to 510 m depth; brown.

Tretomphalus millettii (Heron-Allen & Earland) Plate 9, fig. 5

Cymbalopora milletti Heron-Allen & Earland, 1915 [type figures in Heron-Allen & Earland 1915, pl. 16, fig. 36; pl. 17, fig. 46–48, 50, 51].

Remarks. Free in sand from 200 to 510 m depth; brown.

Family EPONIDIDAE

Eponides berthelotianus (d'Orbigny) Plate 10, fig. 3

Rotalina berthelotiana d'Orbigny, 1839 [type figures in d'Orbigny 1839c, pl. 1, fig. 31–33].

Remarks. Attached to coarse sediment at the Ewa ledge of Stations 1-3 (164 m depth) and 1-4 (264 m depth); individuals under the microscope were observed crawling slowly from sand grain to sand grain; brown.

Eponides repandus (Fichtel & Moll) Plate 10, fig. 4

Nautilus repandus Fichtel & Moll, 1798 [type figures in Fichtel & Moll 1798, pl. 3, fig. a–d].
Eponides repandus (Fichtel & Moll): Resig 1969, pl. 6, fig. 6.
Poroeponides cribrorepandus Asano & Uchio: Phillips 1977, pl. 10, fig. 6.

Remarks. Attached to large sand grains and rocks on steep slopes from 100 to 300 m depth; brown.

Family GLABRATELLIDAE

Bueningia cf. **creeki** Finlay Plate 9, fig. 2

Bueningia creeki Finlay, 1939 [type figures in Finlay 1939, pl. 14, fig. 82–84].

Remarks. Free in fine sand from 400 to 510 m depth; brown.

Family AMPHISTEGINIDAE

Amphistegina bicirculata Larsen Plate 10, fig. 5

Amphistegina bicirculata Larsen, 1976 [type figures in Larsen 1976, pl. 7, fig. 2; pl. 8, fig. 2].

Remarks. Attached to sand grains or small rocks from 100 to 400 m depth; light tan.

Amphistegina lessonii d'Orbigny Plate 10, fig. 6

Amphistegina lessonii d'Orbigny, 1834 [redescription and type figures in Larsen 1977, pl. 1, fig. 1–6].
Amphistegina madagascariensis d'Orbigny: Resig 1969, pl. 6, fig. 5, 7.—Phillips 1977, pl. 11, fig. 1.

Remarks. Attached to algae, the tops of limestone outcrops, and to sides of reef crevices from 0 to 20 m depth; brownish green with zooxanthellae. *Amphistegina madagascariensis* included many of the Pacific *Amphistegina* species until Larsen redescribed and refigured them.

Amphistegina lobifera Larsen Plate 10, fig. 7

Amphistegina lobifera Larsen, 1976 [type figures in Larsen 1976, pl. 7, fig. 3; pl. 8, fig. 3].
Amphistegina madagascariensis d'Orbigny: Phillips 1977, pl. 11, fig. 2.

Remarks. Attached to algae and the tops and sides of limestone outcrops from 5 to 25 m depth; brownish green with zooxanthellae.

Family CIBICIDIDAE

Cibicides lobatulus (Walker & Jacob) Plate 10, fig. 8

Nautilus lobatulus Walker & Jacob, 1798 [type figure in Walker & Jacob 1798, pl. 14, fig. 36].
Cibicides lobatulus (Walker & Jacob): Resig 1969, pl. 7, fig. 1.—Phillips 1977, pl. 13, fig. 4.

Remarks. Attached to sand grains or rocks from 100 to 510 m depth; brown.

Cibicides refulgens Montfort Plate 10, fig. 9

Cibicides refulgens Montfort, 1808 [type figures in Montfort 1808, p. 122; refigured in Brady 1884, pl. 92, fig. 7–9].

Remarks. Attached to rocks or in worn, often polished sand from 200 to 500 m depth; brown.

Family CYMBALOPORIDAE

Cymbaloporetta bradyi (Cushman) Plate 11, fig. 1

Cymbalopora poeyi d'Orbigny var. *bradyi* Cushman, 1915 [type figure in Cushman 1915, pl. 14, fig. 2].
Cymbaloporetta bradyi (Cushman): Resig 1969, pl. 7, fig. 3.—Phillips 1977, pl. 11, fig. 4.

Remarks. Attached to filamentous algae from 1 to 20 m depth; free in sand from 20 to 500 m depth; brown.

Cymbaloporetta squammosa (d'Orbigny) Plate 11, fig. 2

Rosalina squammosa d'Orbigny, 1839 [type figures in d'Orbigny 1839a, pl. 3, fig. 12–14].
Cymbaloporetta squammosa (d'Orbigny): Phillips 1977, pl. 11, fig. 3.

Remarks. Free in sand from 20 to 400 m depth or attached to algae from 20 to 200 m depth; brown.

Family HOMOTREMATIDAE

Miniacina miniacea (Pallas) Plate 11, fig. 3

Millepora miniacea Pallas, 1766 [type description in Pallas 1766; type figure in Blainville 1834, pl. 69, fig. 4].
Miniacina miniacea (Pallas): Phillips 1977, pl. 13, fig. 6.

Remarks. Encrusting on rocks, large sand grains, and in crevices deeper than 30 m; red to pinkish.

Family ROTALIIDAE

Ammonia beccarii tepida (Cushman) Plate 9, fig. 7

Rotalia beccarii Linnaeus var. *tepida* Cushman, 1926 [type figure in Cushman 1926, pl. 1].
Ammonia beccarii tepida (Cushman): Resig 1969, pl. 6, fig. 1.—Phillips 1977, pl. 10, fig. 6.

Remarks. Attached to filamentous algae or free in sand from 0 to 10 m depth; dark brown.

Biarritzina proteiformis (Goes) Plate 9, fig. 8

Carpenteria balaniformis Gray var. *proteiformis* Goes, 1882 [type figures in Goes 1882, pl. 6, 7, fig. 208–219].

Remarks. Encrusting on rocks and gravel at the Ewa ledge at Station 1-4 (264 m depth); light brown.

Family ELPHIDIIDAE

Elphidium articulatum (d'Orbigny) Plate 10, fig. 1

Polystomella articulatum d'Orbigny, 1839 [type figures in d'Orbigny 1839b, pl. 14, fig. 18–20].

Remarks. Attached to algae from 40 to 100 m depth; brown.

Family NUMMULITIDAE

Heterostegina suborbicularis d'Orbigny Text fig. 2

Heterostegina suborbicularis d'Orbigny, 1826 [type description and figures in Foransini 1904, pl. 14, fig. 5–7].—Resig 1969, pl. 6, fig. 4.—Phillips 1977, pl. 7, fig. 8.

Remarks. Attached to sides of limestone crevices or rocks from depths of 0 to 200 m; brown with zooxanthellae. Text figure 2 of this foraminifer was photographed by R. Röttger, who feels that this species is *Heterostegina depressa.*

Operculina ammonoides (Gronovius) Plate 10, fig. 2

Nautilus ammonoides Gronovius, 1781 [type figures in Gronovius 1781, pl. 19, fig. 5, 6].
Operculina philippinensis Cushman: Phillips 1977, pl. 7, fig. 7.

Remarks. Free in sand from 60 to 100 m depth; brown.

Family LOXOSTOMATIDAE

Loxostomum limbatum (Brady) Plate 11, fig. 4

Bolivina limbata Brady, 1881 [type description in Brady 1881; type figures in Brady 1884, pl. 52, fig. 26–28].

Remarks. Free in fine sand from 60 to 100 m depth; brown.

Family CASSIDULINIDAE

Cassidulina crassa d'Orbigny Plate 11, fig. 5

Cassidulina crassa d'Orbigny, 1839 [type figures in d'Orbigny 1839b, pl. 7, fig. 18–20].
Cassidulina minuta Cushman: Phillips 1977, pl. 12, fig. 1.

Remarks. Free in fine sand from 100 to 500 m depth; several specimens stained with dye; color unknown.

Cassidulina laevigata d'Orbigny Plate 11, fig. 6

Cassidulina laevigata d'Orbigny, 1826 [type figures in d'Orbigny 1826, pl. 5, fig. 4, 5].

Remarks. Free in fine sand grains from 400 to 510 m depth, some stained with dye; color unknown.

Cassidulina oriangulata (Belford) Plate 11, fig. 7

Globocassidulina oriangulata Belford, 1966 [type figures in Belford 1966, pl. 25, fig. 1–5].

Remarks. Free or attached to sand grains from 200 to 510 m depth; brown.

Cassidulina radiata Chave, **new species** Plate 11, fig. 8

Type figure. Holotype, Plate 11, fig. 8.

Description. Test subglobular, somewhat dorsoventrally compressed, 2 to 2.5 pairs of biserially enrolled chambers on outer volution; sutures indistinct; chambers smooth; aperture triangular, lined with a lip, its apex extends onto apertural face. Striations radiate in all directions from aperture, extending onto the ultimate and penultimate chambers of apertural face. Dorsal side smooth.

Type locality and level. Holotype and paratypes, HAWAIIAN IS: O'ahu I: Māmala Bay, Station 4-6, Recent surface sediments, 500 m of water.

Repository. Type specimens deposited at the National Museum of Natural History, Washington, D.C. (holotype USNM 411614, paratypes USNM 411615–19).

Remarks. This species was found at 380 to 1,200 m depth (common to abundant deeper than 500 m) in fine-grained sand samples from Hilo, Hawai'i; Māmala Bay, O'ahu; and Nāwiliwili Harbor, Kaua'i. Living specimens have brown protoplasm.

Cassidulina sulcata Belford Plate 11, fig. 9

Cassidulina sulcata Belford, 1966 [type figure in Belford 1966, pl. 24, fig. 11–14].
Cassidulina delicata Cushman: Phillips 1977, pl. 12, fig. 2.

Remarks. Attached to fine sand grains from 100 to 510 m depth; brown.

Ehrenbergina pacifica Cushman Plate 11, fig. 10

Ehrenbergina pacifica Cushman, 1927 [type figure in Cushman 1927, pl. 2, fig. 2].

Remarks. Free in fine sand at Station 4-6 (510 m depth), small individuals stained with dye; color unknown.

Family NONIONIDAE

Florilus japonicus (Asano) Plate 12, fig. 1

Pseudononion japonicum Asano, 1936 [type figures in Asano 1936, p. 348, fig. A–C].—Phillips 1977, pl. 8, fig. 2.

Remarks. Free in sand from 0 to 20 m depth; dark brown.

Nonion boueanum (d'Orbigny) Plate 12, fig. 2

Nonionina boueanum d'Orbigny, 1846 [type figures in d'Orbigny 1846, pl. 5, fig. 11, 12].
Nonion boueanum (d'Orbigny): Phillips 1977, pl. 8, fig. 1.

Remarks. Free in sand from 100 to 200 m depth; animals under the microscope were observed crawling about; brown.

Family ALABAMINIDAE

Alabamina resigae Chave, **new species** Plate 12, fig. 3

Type figures. Holotype, Plate 12, fig. 3a; paratype, Plate 12, fig. 3b.

Description. Test lenticular, trochospiral; periphery subangular with nonporous margins; all chambers visible on spiral side, 4 to 5 enrolled chambers on umbilical side; apertural face infolded, aperture an interomarginal suture with a narrow bordering lip extending from the umbilicus halfway to the test periphery.

Type locality and level. Holotype and paratypes, HAWAIIAN IS: O'ahu I: Māmala Bay, Station 9-4, Recent surface sediments, 390 m of water.

Repository. Type specimens deposited at the National Museum of Natural History, Washington, D.C. (holotype USNM 411620, paratypes 411621–24).

Remarks. This species differs from *A. wilcoxensis* (Toulmin) by age and by having a narrower infolded apertural face and a shorter, wider aperture with a narrower lip. It differs from *A. scitula* (Bandy) by age and by having oblique dorsal sutures and a shorter, wider aperture. Specimens were found in fine-grained sand from 380 to 1,200 m of water from the islands of O'ahu, Kaua'i and Hawai'i. Living animals have light pinkish brown protoplasm.

Gyroidina orbicularis d'Orbigny Plate 12, fig. 6

Gyroidina orbicularis d'Orbigny, 1826 [type description in d'Orbigny 1826; type figures in Brady 1884, pl. 115, fig. 6a–c].

Remarks. Attached to sand grains from 400 to 510 m depth; reddish brown.

Family GAVELINELLIDAE

Anomalina colligera Chapman & Parr Plate 12, fig. 4

Anomalina colligera Chapman & Parr, 1937 [type description in Chapman & Parr 1937; type figures in Brady 1884, pl. 94, fig. 2, 3].

Remarks. Free in fine sand from 100 to 510 m depth; reddish brown.

Anomalina glabrata Cushman Plate 12, fig. 5

Anomalina glabrata Cushman, 1924 [type figures in Cushman 1924, pl. 12, fig. 5–7].—Resig 1969, pl. 3, fig. 18.—Phillips 1977, pl. 13, fig. 1.

Remarks. Free in fine sediment from 400 to 510 m depth; tan.

Cibicidoides pseudoungerianus (Cushman) Plate 12, fig. 7

Truncatulina pseudoungriana Cushman, 1922 [type figure in Cushman 1922, pl. 20, fig. 9].
Cibicides pseudoungerianus (Cushman): Resig 1969, pl. 6, fig. 11.
Cibicides lobatulus (Walker & Jacob): Phillips 1977, pl. 13, fig. 3.

Remarks. Attached to sand grains from 200 to 500 m depth; brown.

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