Eastern Indonesian, Late Cenozoic Smaller Benthic Foraminifera

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Preface

This atlas is produced to give a comprehensive overview of the taxonomy and distribution of Early Miocene to Recent smaller benthic foraminifera from eastern Indonesia, so that it can serve micropaleontologists to help improve the biostratigraphical framework and paleoecological distribution.

Published information on Late Cenozoic smaller benthic foraminifera from Indonesia and adjacent areas is limited compared to other areas. In Indonesia in fact many geological, including micropaleontological, investigations have been carried out by various oil and consulting companies in their search for oil, but the results of these studies are confidential and unpublished. During the first half of this century taxonomic and descriptive reports were made by Koch (1923, 1925, 1926), Van der Vlerk and Umbgrove (1927), Fischer (1927), Umbgrove (1931), Caudri (1934), Thalmann (1934, 1935), Keijzer (1935), Boomgaart and Vroman (1936), Yabe and Asano (1937), Van der Sluis and De Vletter (1942), Valk (1945) and Germeraad (1946). More extensive were the taxonomic and biostratigraphic works of LeRoy, who described and illustrated Late Tertiary faunas from Borneo (1941a), Sumatra (1941b, 1944a), and Java (1941c, 1944b), and of Boomgaart (1949), who described the foraminifera from the Bodjonegoro area of Central Java.

The most recent comprehensive taxonomic and descriptive report on fossil benthic foraminifera from this region is that of Belford (1966), who worked on Miocene - Pliocene smaller foraminifera from Papua New Guinea and Irian Jaya. He described species belonging to two suborders (*Rotaliina* and *Robertinina*). His taxonomic concepts were followed, amending some of his endemic species.

Benthic foraminifera are particularly useful in environmental interpretations. Recently Biswas (1976) established a bathymetric zonation for Holocene foraminifera of the Sunda Shelf, north of Borneo (Kalimantan), and suggested that waterdepth and temperature are the most important factors controlling the distribution of both benthic and planktic foraminifera. Saint Marc and Suminta (1979) divided Late Miocene - Pliocene deep water sediments of eastern Java into four biozones, each with a rich bathyal benthic foraminiferal microfauna. Moore et al. (1980) gave paleobathymetric interpretations for Late Tertiary trench-slope deposits of Nias Island. They qualitatively organized the common benthic foraminifera into four faunal groups and assigned probable paleodepths to these groups based on previously published work on the Upper Depth Limits of living species. Van Gorsel and Troelstra (1981) made paleobathymetric and paleoclimatic interpretations of the Late Neogene microfauna of the Solo River section on Java.

The number of regional papers on Recent benthic foraminifera is also relatively low. Hofker (1927, 1951) presented extensive taxonomic studies on modern foraminifera collected in Indonesian waters during the Siboga Expedition (1899-1900). More recently Hofker (1978) reported on modern benthic foraminifera from bottom samples collected during the Snellius-I Expedition (1929-1930) in the Indonesian Archipelago. Frerichs (1970) analyzed the distribution of benthic foraminifera in the Andaman Sea and related his assemblages to five faunal provinces, defined by salinity, substrate, sediment accumulation rates and active calcium carbonate solution. Burke (1981) analyzed recent benthic foraminifera from the Ontong Java Plateau (western Equatorial Pacific), and reported that the topographic effect of the Plateau, the deep watermasses, the lysocline, terrigenous sediment input from the Solomon Islands and the upwelling of deep water influenced the distribution of the benthic foraminifera. Coustillas (1983) reported on the distribution of modern foraminifera from three profiles across the Mahakan Delta (between Kalimantan and Sulawesi) and illustrated a large number of species. Boichard et al. (1985) studied samples from the Pater Noster Platform in the same area and related the distribution of benthic foraminifera to the sediment build-up. Van Marle (1988) determined the bathymetric frequency distribution of eastern Indonesian benthic foraminifera to develop paleobathymetric criteria for the interpretation of Late Cenozoic microfaunas. His quantitative results are used in high resolution geohistory analysis of the same successions sampled for this atlas (Van Marle, 1989a).

Benthic foraminifera do not have the same chronostratigraphical importance as planktic foraminifera, but can very well be used as additional markers (Boltovskoy, 1978; Van Morkhoven et al., 1986). Because assemblages of smaller benthic foraminifera from all parts of the Indo-Pacific region resemble each other, eventually a biostratigraphical framework can be made for Early Miocene to Recent regional and even interregional (long-distance) correlation per benthic foraminiferal facies. Mislabelling of foraminifera, however, is a negative factor, preventing the easy establishing of such a framework. Therefore reference is given to Van Morkhoven et al. (1986), who stated in their introduction: '.....studies of original material clearly showed how often identical species are present in various collections under quite different names. This lack of continuity in species concept has significantly hindered communication through the medium of scientific literature and ultimately eroded the effective utilization of benthic foraminifera in biostratigraphy and paleoenvironmental analysis.' With this in mind, the author tried as much as possible to avoid local names.

Acknowledgements

The Royal Dutch Academy of Sciences (Koninklijke Nederlandse Academie van Wetenschappen) is sincerely thanked for publishing this atlas. Research was carried out as part of the Snellius-II Expedition, organised by the Netherlands Council of Oceanic Research (SOZ) and by the Indonesian Institute of Science (LIPI); research funds were provided by the Dutch Organisation for Scientific Research (NWO/WOTRO).

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Last but not least, I would like to express my sincere gratitude to my wife Marcoline, for her love, understanding, encouragement and especially her patience during those many, long computer sessions. Hopefully, I can make it up to her.

Introduction

1. MATERIAL STUDIED

During the GF1A and GF2A onshore campaigns of Theme I ('Geology and Geophysics of the Banda Arc') of the Indonesian-Dutch Snellius-II Expedition (1984-85), Late Cenozoic key sections were systematically recorded and sampled on several non-volcanic outer Banda Arc islands (fig. 1). The objective of the program was to reconstruct the Late Miocene to Recent uplift history of the non-volcanic outer Banda Arc, using the methods of geohistory analysis (Van Hinte, 1978). For this purpose both the planktic (Troelstra) and benthic (Van Marle) foraminiferal contents of all samples were analyzed for chronostratigraphic correlation and for paleobathymetric interpretation.

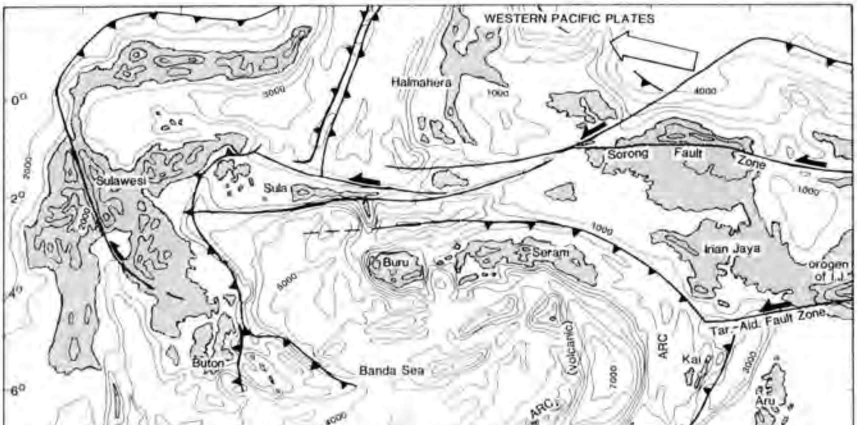

Fig. 1. Tectonic map of eastern Indonesia, showing locations of the islands investigated during the GF1A and GF2A island campaigns of the Indonesian-Dutch Snellius-II Expedition (after De Smet et al., 1990). Open arrows indicate relative movements of the Australian and Pacific Plates relative to the Eurasian Plate.

Per sample, 100 gr dry weight was washed with petrol or soda over a 63 µm (240 mesh) sieve. The remaining residues were oven dried and the fraction larger than 125 µm was examined for foraminifera. If necessary the residues were split over a random microsplitter to yield an aliquot containing 150-200 benthic foraminifera, which were picked, identified and counted. The benthic foraminiferal species encountered are recorded, described and illustrated in this atlas, whereas quantitative results have been published separately (Van Marle, 1989a). The material is filed in the Free University collection of the Dutch National Museum in Leiden (Rijksmuseum van Natuurlijke Historie) under the author's name.

The location of the sections studied and a stratigraphic summary will be given in alphabetical order:

1.1. **Buru**

The island of Buru forms the northwestern end of the Banda island arc (fig. 1). About 500m of Miocene deposits (zone N8 of Blow, 1969) of the Hotong Formation were recorded and sampled along the Hotong River (samples GF2A-U1 - U38) and the tributary Rumbia River (samples GF2A-U40 - U47) in the Bara Bay area of northwestern Buru (fig. 2). The Hotong Formation is characterized by a repetition of conglomerates, sand, silt and shale with a dull, dark-grey color (fig. 3). They are bathyal, open marine deposits, with turbiditic intercalations.

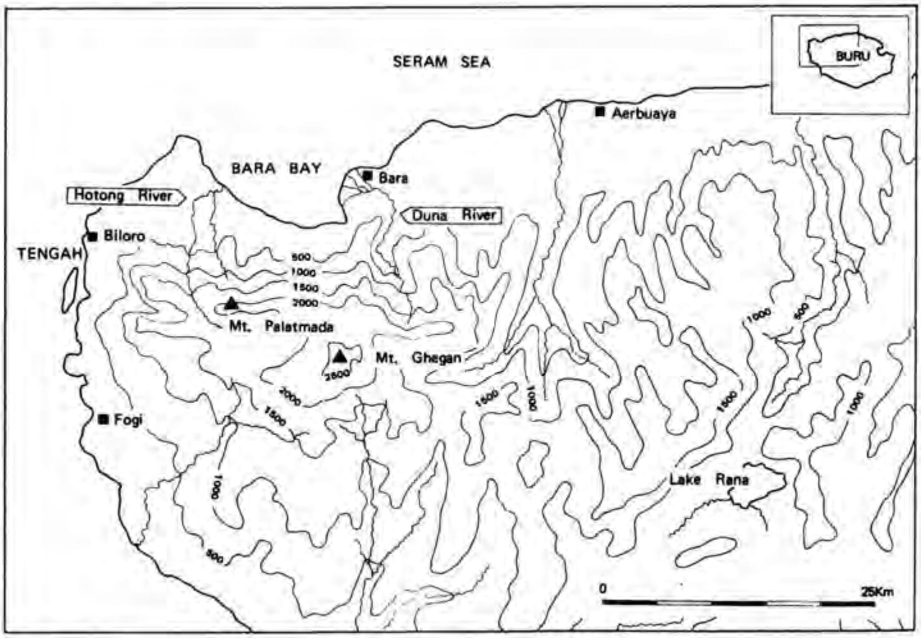

Fig. 2. Topographic map of NW Buru, showing 500 m contour intervals and general location of the sections studied (after Fortuin et al., 1988).

In addition, overlying coarse clastic sediments of Plio-Pleistocene (?) age were studied along Duna River (samples GF2A-U48 - U52). This section incorporates polymict conglomerates, sandstones and limestones, deposited in a fan-delta system, unconformably underlying Quaternary terrace depos-

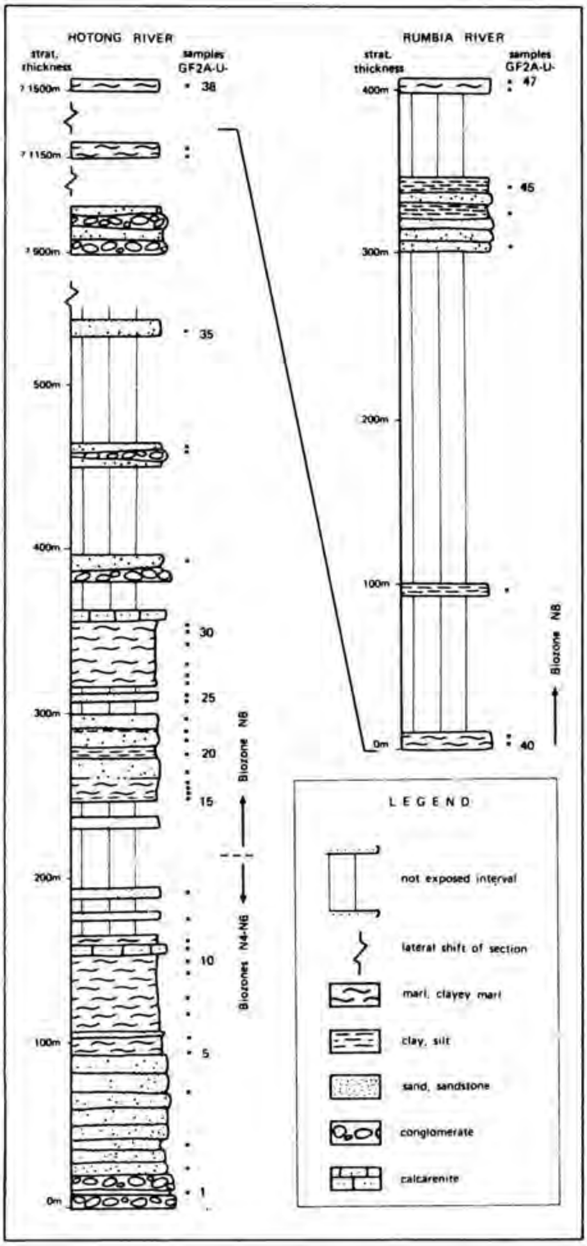

Fig. 3. Lithological column of the Hotong Formation as recorded in the type section along Hotong River and Rumbia River on Buru Island (after Fortuin et al., 1988). See fig. 2 for general location.

its. For the exact locations of the sections, detailed stratigraphic descriptions, and interpretations of the data, the reader is referred to the Snellius-II Progress Report of Campaign GF2 by Fortuin (1986) and to Fortuin et al. (1988).

1.2. **Buton**

In South Buton (fig. 4), two formations were sampled at several locations: the Miocene Tondo Formation and the overlying Miocene-Pliocene Sampolakosa Formation.

The Tondo Formation (Late Serravallian - Early Tortonian; samples GF1A-B282 - B332) consists of a heterogeneous submarine fan sequence of sandstone, conglomerate and mudstone (fig. 5). The oldest sediments of this

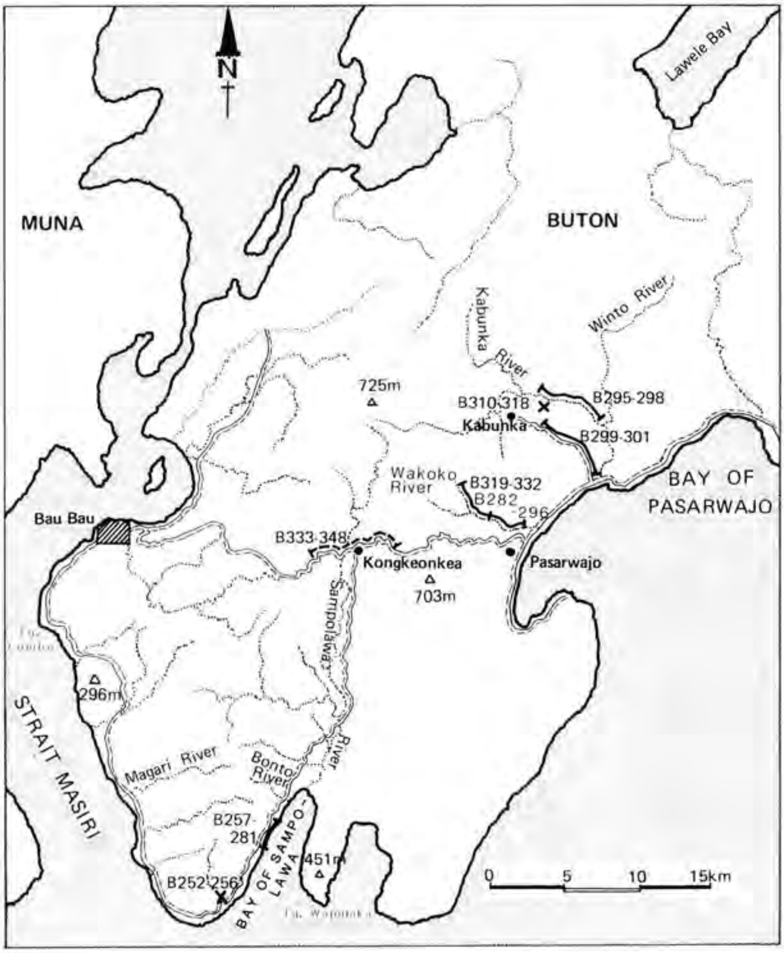

Fig. 4. Topographic map of South Buton, showing the drainage pattern and locations of sections and outcrops studied (after Fortuin et al., 1989). The B-numbers at the various locations indicate the sample numbers.

formation are deposited under neritic conditions, the bulk of the sediments are transitional neritic (outer shelf) to bathyal (upper slope).

The Sampolakosa Formation (Late Tortonian - Early Pliocene; samples GF1A-B252 - B281) consists of hemipelagic foraminiferal chalks and marls,

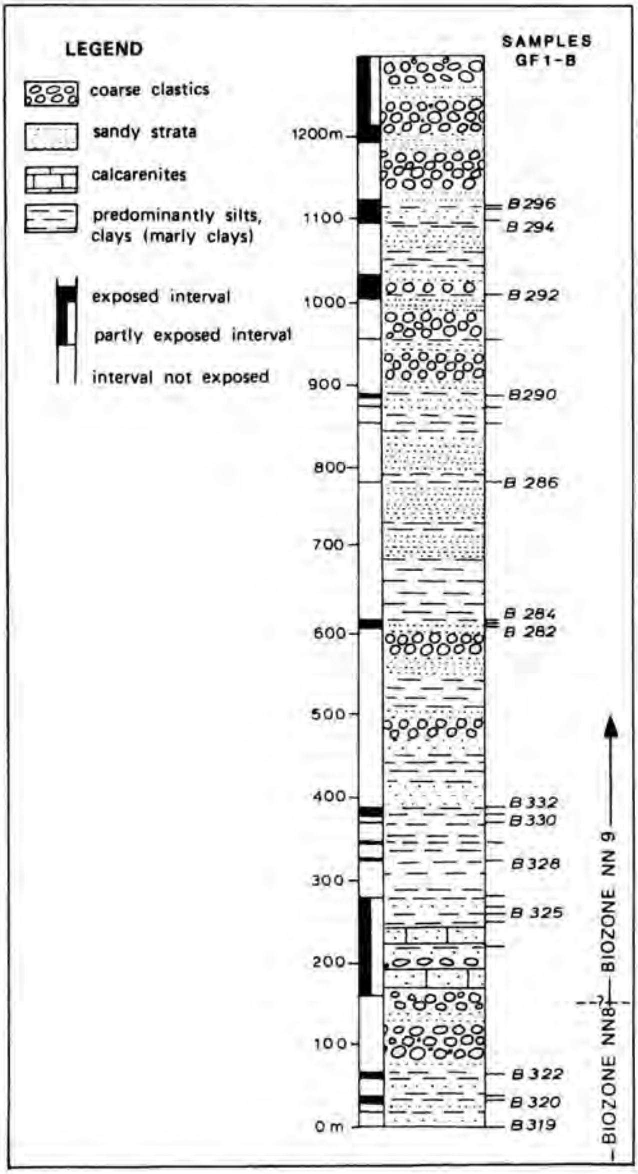

Fig. 5. Lithological column of Wakoko Section (north of Pasarwajo), Tondo Formation on Buton (after Fortuin et al., 1989). Biostratigraphic correlation indicated to the right of the column. The lithology for the not exposed intervals is based on poor evidence using relics of eroded bedrock and is only meant to give a general impression of Tondo lithology. See fig. 4 for general locations.

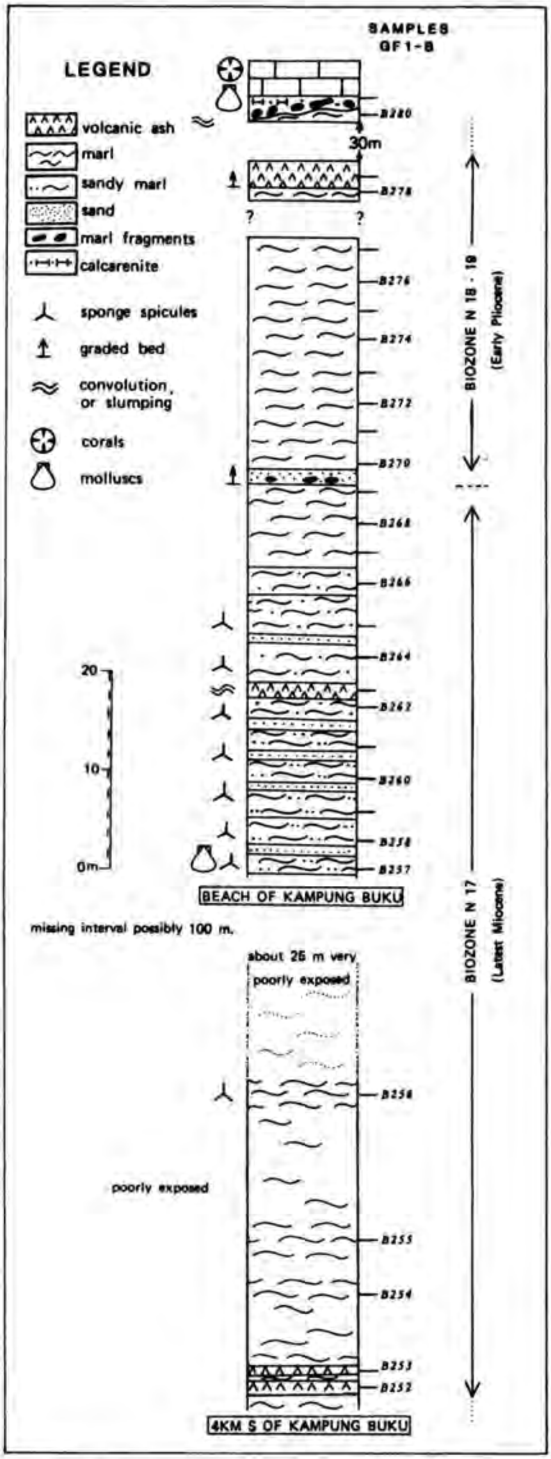

Fig. 6. Lithological column of Sampolawa Bay, Sampolakosa Formation on Buton, with indication of biostratigraphic correlation by means of planktic foraminifera (after Fortuin et al., 1989). Bed thickness is not to scale. See fig. 4 for general locations.

including some minor sandy or tuffaceous turbidite beds (fig. 6). These sediments are deposited under open marine, bathyal conditions.

For detailed stratigraphic descriptions and interpretations, the reader is referred to the Snellius-II Progress Report of Campaign GF1 by Fortuin (1985) and to Fortuin et al. (1989).

1.3. **Kai Kecil**

Because no sections were exposed, only spot samples of Plio-Pleistocene rocks were sampled at two locations on the Island Kai Kecil: in the north near the village Kelanit (samples GF2A-K200 - K203) and in the south near the village Ohoinol (samples GF2A-K204 - K208B; fig. 7). The sediments consist of bioclastic calcarenites and marls, deposited under bathyal conditions. For locations, detailed stratigraphic descriptions and interpretations, see Fortuin (1986) and Van Marle and De Smet (1990).

1.4. **Seram**

In southwestern Seram Late Cenozoic (zones N19-22 of Blow, 1969) deposits are found as the remains of a former, E-W oriented basin. The deposits are

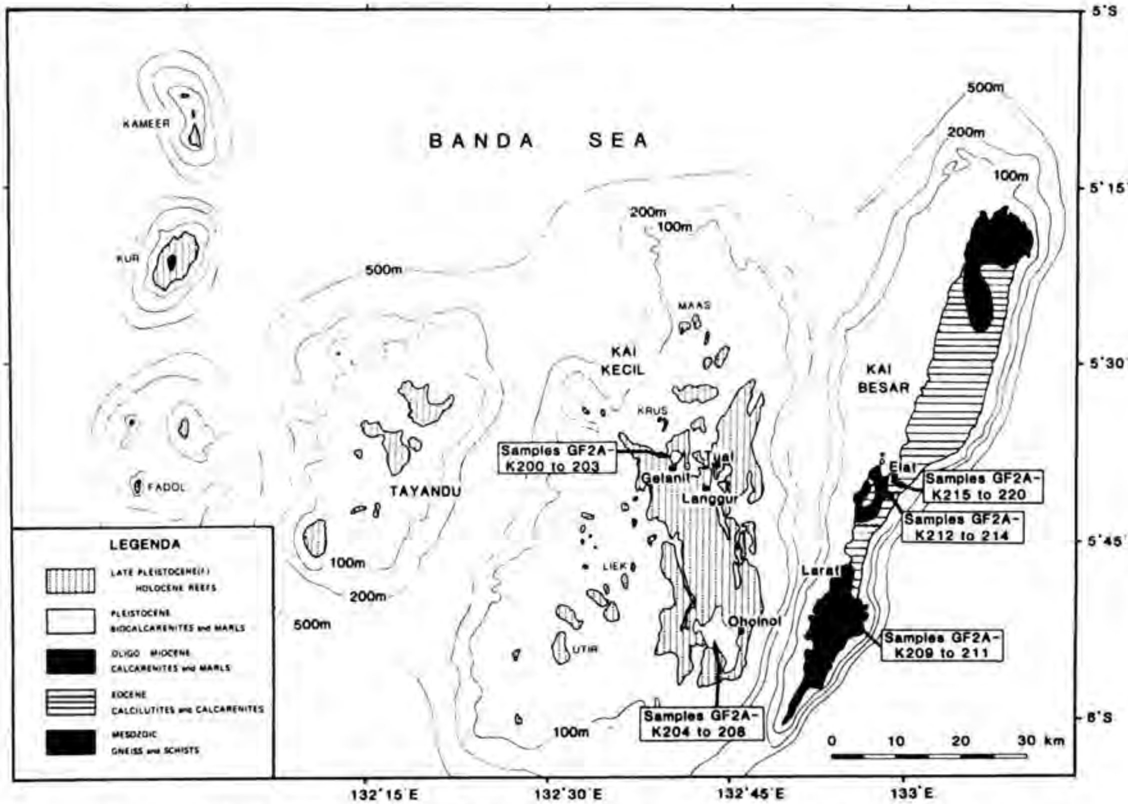

Fig. 7. Geological sketch map of the Kai Island Group (with 100, 200 and 500 m waterdepth contours), showing sample locations (after Van Marle and De Smet, 1990).

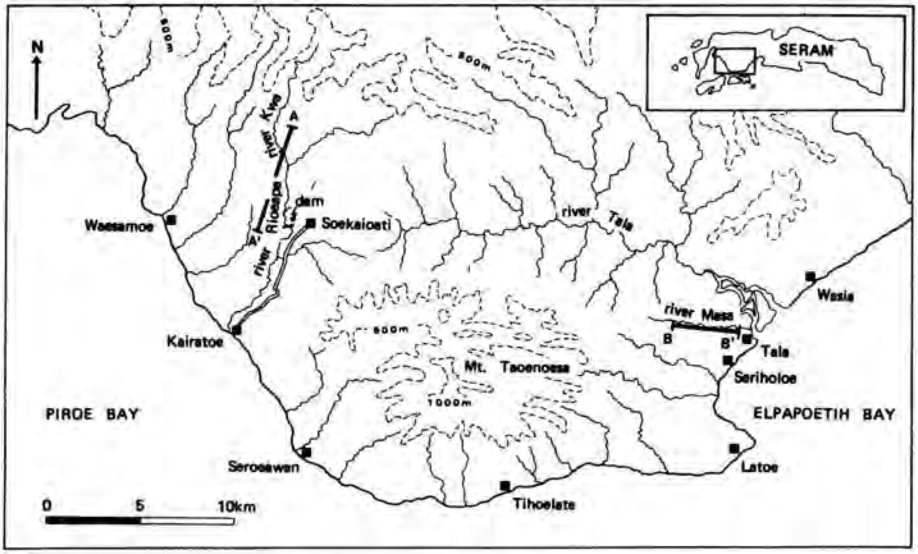

Fig. 8. Topographic map of SW Seram, showing the drainage pattern, 500 m contour interval and locations of the sections studied (after De Smet et al., 1989).

only slightly deformed and cover a paleorelief of metamorphic Paleozoic rocks (schists and phyllites). Two sections have been investigated and sampled, the Masa section at the eastern end (samples GF2A-S60 - S110), and the Kwa-Rioeapa section at the western side of the basin (samples GF2A-S117 - S183; fig. 8). Sediments exposed along both sections consist of turbidite sands and conglomerates, alternating with silty clays (fig. 9). For the exact locations of the sections, detailed stratigraphic descriptions, and interpretations of the data, also in the plate tectonic framework, the reader is referred to De Smet et al. (1989) and to Fortuin (1986).

1.5. **Timor**

Timor is the largest island in the outer Banda Arc (fig. 1). Late Cenozoic (biozones N19-23 of Blow, 1969) deposits were recorded and sampled in the so-called Central Basin (Van Bemmelen, 1949), which is oriented subparallel to the axis of the island (fig. 10). Four sections were selected on the basis of stratigraphic continuity of exposure. The stratigraphic sequence of the basin roughly shows a regressive series. It starts with bathyal, chalky marls (samples GF1A-T20 - T33, T125 - T130 and T155 - T184; biozones N19-20 of Blow, 1969) overlying strongly deformed basement rocks (fig. 11). The limestones are unconformably overlain by sands and sandy marls, deposited in a submarine fan system (samples GF1A-T34 - T53 and T131 - T144), followed by a marl unit which upward becomes progressively richer in turbidites (samples GF1A-T54 - T123). This unit on its turn is unconformably overlain by shallow water clays, marls, conglomerates and reef limestones (samples GF1A-T195 - T220). The top of the section is of Late Pleistocene age (biozone N23

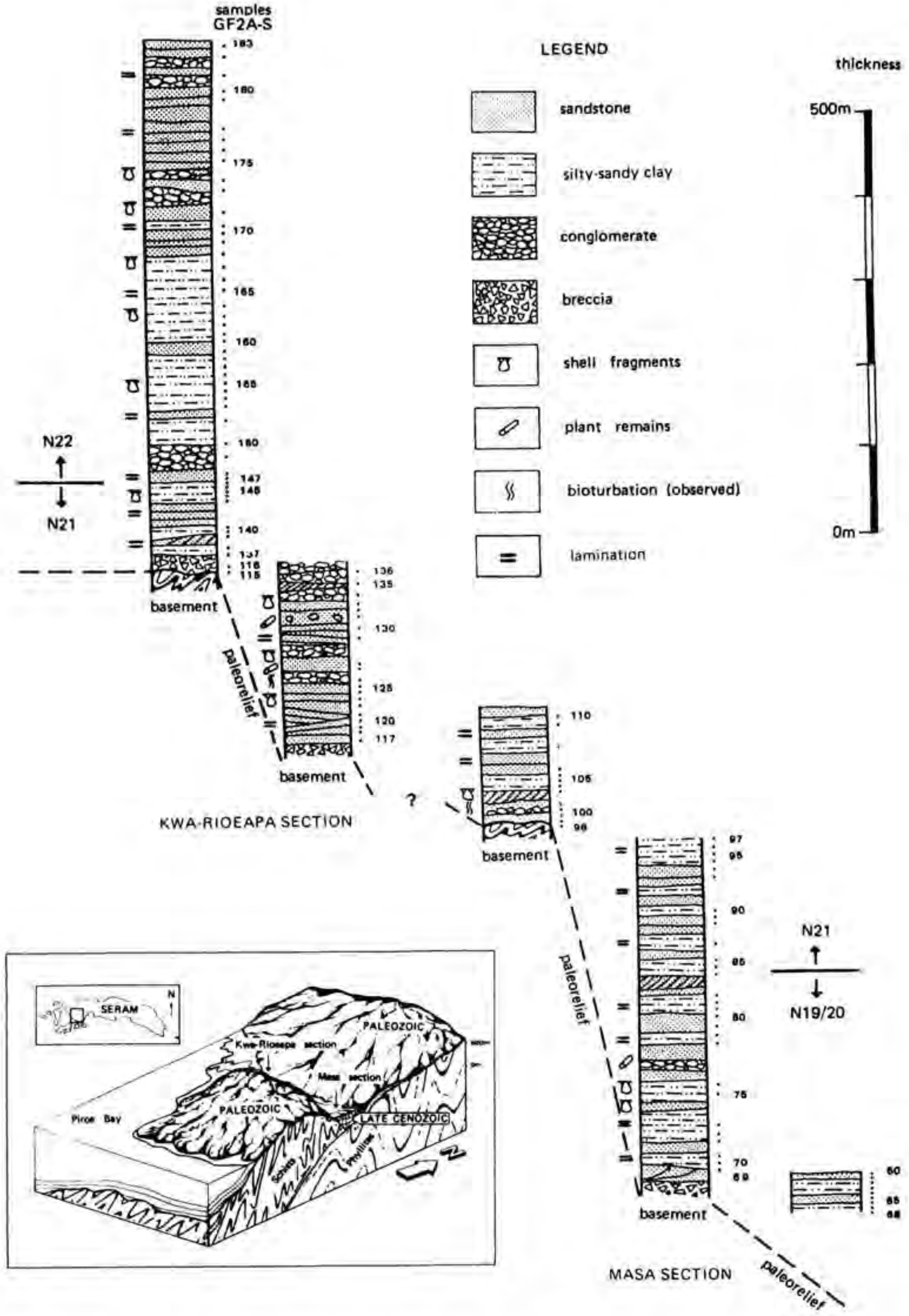

Fig. 9. Lithological column as recorded in the sections studied along Masa River and Kwa-Rioeapa River, with indications of plankton biozones (after De Smet et al., 1989). See fig. 8 for general locations.

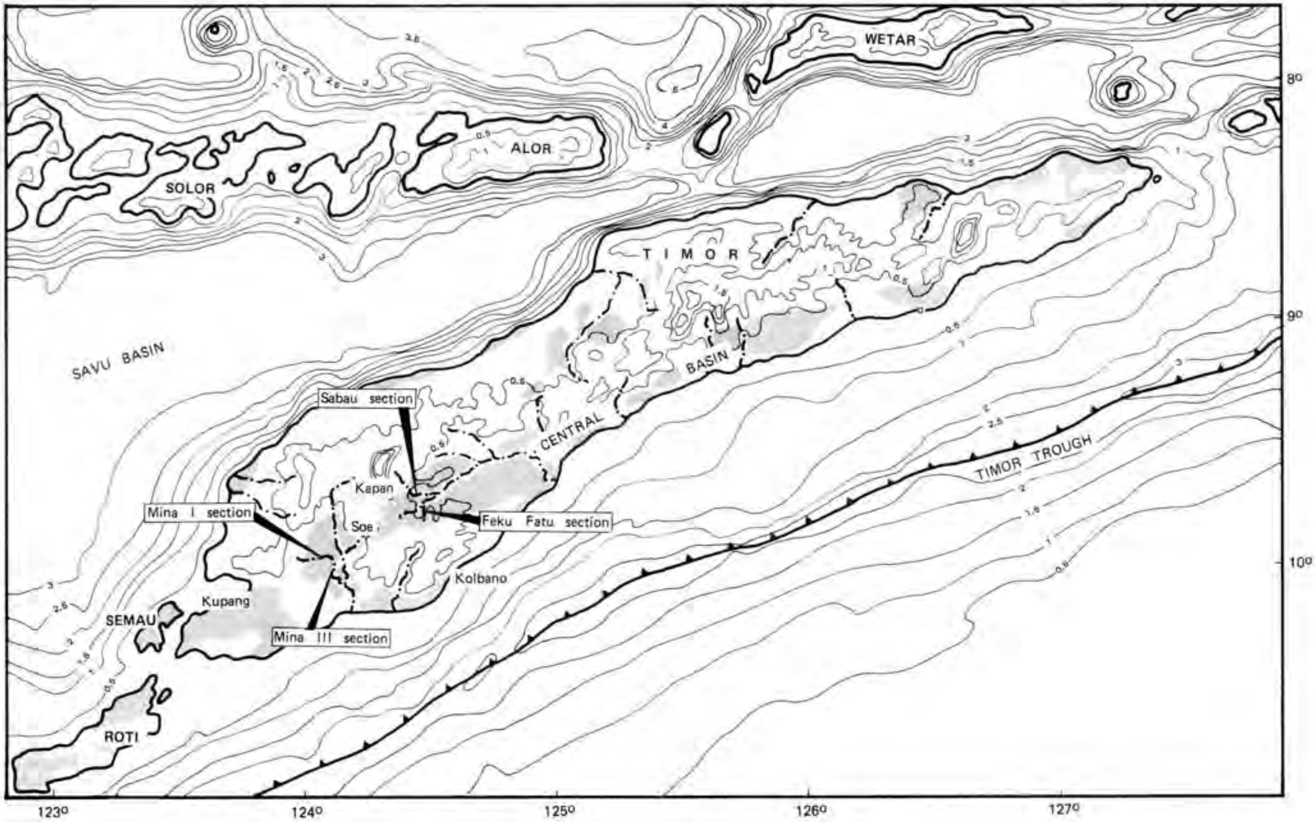

Fig. 10. Topographic map of Timor, showing 500 m contour interval and locations of the sections recorded in the Central Basin (after De Smet et al., 1990).

of Blow, 1969). For the exact locations of the sections, and for detailed stratigraphic descriptions, and interpretations the reader is referred to Fortuin (1985), De Smet et al. (1990), and to Van Marle (1990).

2. STRATIGRAPHIC RANGE OF THE BENTHIC FORAMINIFERAL SPECIES

The samples at our disposal range in age from Early Miocene (biozone N8 of Blow, 1969) to Late Pleistocene (biozone N23 of Blow, 1969) as checked with planktic foraminifera and nannofossils. From the combined ranges in these samples and in the Recent samples of Van Marle (1988), an Early Miocene to Recent species range chart for eastern Indonesia is assembled (fig. 12).

Because biozones N9 - N13 are not covered by samples, this interval is represented as a gap in the various range charts. Biozone N8 was found on the island Buru, but due to the generally poor preservation only some species are reported.

All important taxa occur throughout the entire interval covered, crossing major stratigraphic boundaries without obvious changes and can thus not be used as index fossils. Neither extinctions, nor clear evolutionary trends, such as those of *Globocassidulina subglobosa* and *Planulina wuellerstorfi* found on the Ninetyeast Ridge (Boltovskoy, 1978) have been observed. Of the less frequent taxa, some seem to have more limited time ranges in eastern Indonesia, but regarding their rare or restricted occurrence these species can neither serve as index fossils. The author therefore agrees with Boltovskoy (1978), Douglas and Woodruff (1981) and Van Morkhoven et al. (1986) that during the Neogene the deeper water benthic foraminifera are of subordinate chronostratigraphic value compared to planktic foraminifera. Nevertheless, the role of benthic foraminifera as age markers remains important in cases where dissolution affects the fauna's (because benthic foraminifera are more resistant to dissolution than planktic foraminifera), in case of reworking (see Boltovskoy, 1978), and in local zonations. In this aspect these Neogene associations differ from the Paleogene, where the stratigraphic ranges of selected taxa do offer considerable potential for chronostratigraphic zonation, and can be directly calibrated in terms of planktic foraminiferal zones, magnetic stratigraphy, and, indirectly, absolute time (Douglas and Woodruff, 1981; Van Morkhoven et al., 1986).

3. REMARKS ON THE TAXONOMIC DESCRIPTIONS

The taxa encountered in our material have been arranged alphabetically per subfamily, following the suprageneric classifications of Levine et al. (1980) and of Loeblich and Tappan (1984). For the generic assignments essentially the concepts of Loeblich and Tappan (1964) were maintained, amended with the regional concepts of Belford (1966) and the cosmopolitan concepts of Van Morkhoven et al. (1986), except for the suborder *Lagenina*, where the concepts of Patterson and Richardson (1987) were followed.

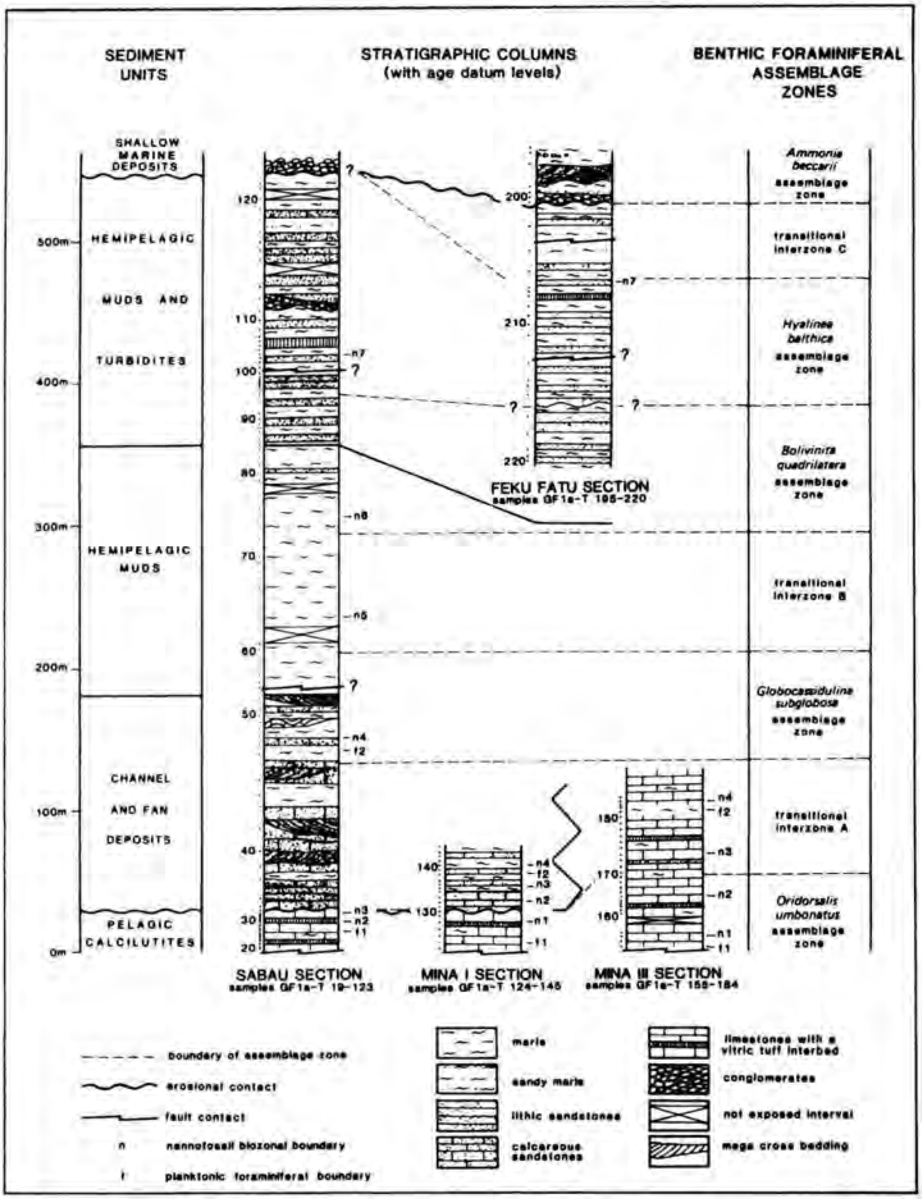

Fig. 11. Lithological columns, planktic foraminiferal biozones, sediment units, and benthic foraminiferal assemblage zones of the sections studied in SE Timor (after De Smet et al., 1990). See fig. 10 for general locations.

In the species descriptions, reference is given (1) to the original description or a redescription of the species, (2) to Brady (monography 1884, as revised by Barker, 1960), and numerous Cushman papers (1911-1946), which are considered to be the foundation for later taxonomic work, and (3) to later Indo-Pacific records in which the species is figured. Endemic names have been avoided as much as possible and were only maintained when a possible relationship was doubtful.

The 'Short descriptions' of the species are composites of the original type-description and more recent records. The descriptive remarks of Belford (1966) were used especially in discriminating between resembling genera, such as *Bolivina* and *Brizalina*, where we relied on his observations and maintained his species concept. 'Remarks' cover differential diagnostic features, variability, synonymies and phylogenetic relationships, whereas under 'Stratigraphic range' the chronostratigraphic distributions in the eastern Indonesian and in the Indo-Pacific region are indicated as compiled from the records documented in the synonymy. The regional stratigraphic distributions of the taxa figured are shown in the plate captions, and of the taxa in general in composite range charts at the end of the systematics of each suborder (or superfamily in case of the suborder *Rotaliina*). 'Occurrence' describes the bathymetric and ecologic distribution, with terminology after fig. 13. In case the species was found in Recent bottom sediments between 60 and 2119 m, sampled during the Snellius-II Expedition (Van Marle, 1988), the UDL (Upper Depth Limit) and the DLO (Depth Limit of Optimal Occurrence; after Van Marle, 1989b) are given. Note that in this Recent material all specimens were treated as being dead when collected.

The important taxa have all been figured in this atlas. The less frequent taxa have only been photographed in case well preserved and unbroken specimens were available. All figured specimens have been photographed using a Scanning Electron Microscope.

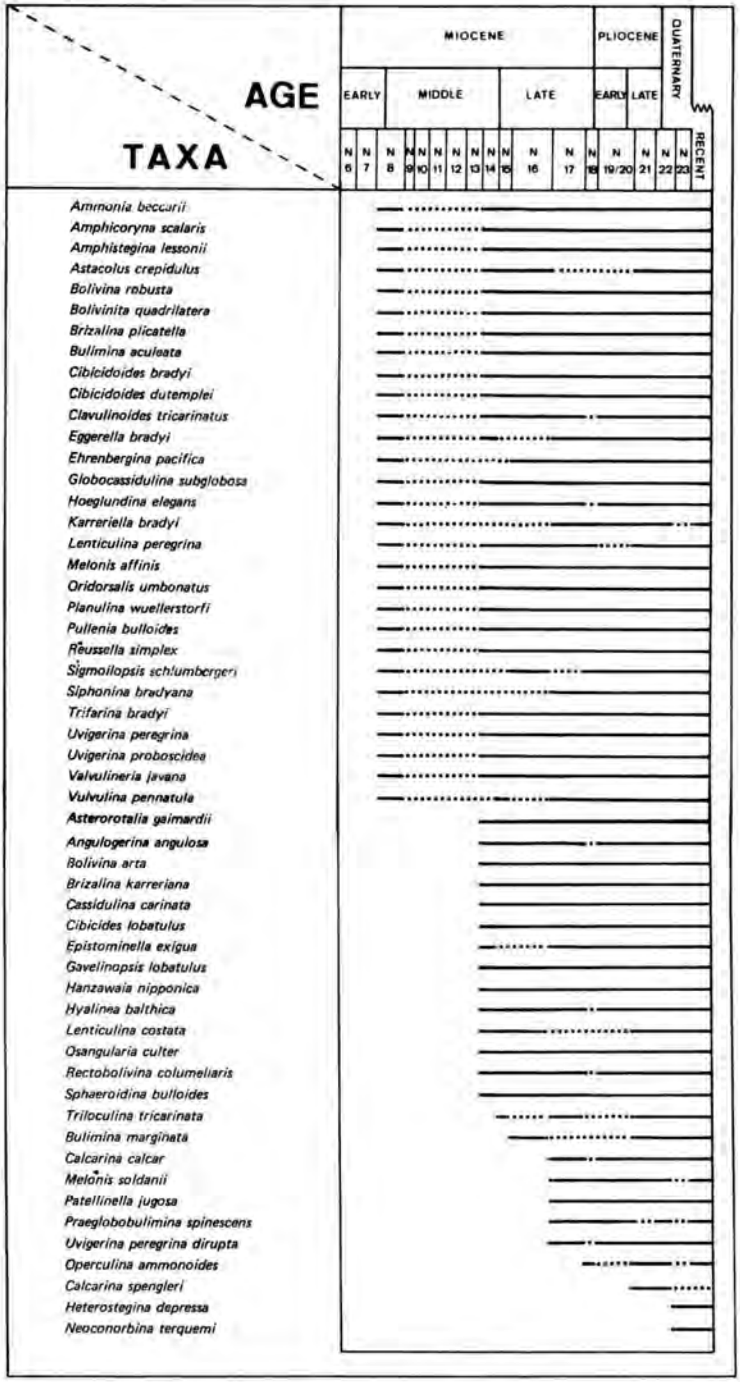

Fig. 12. Early Miocene to Recent, composite species range chart for eastern Indonesia, showing the most frequent taxa and their chronostatigraphic distribution in the material studied (dotted intervals were not or poorly covered by samples).

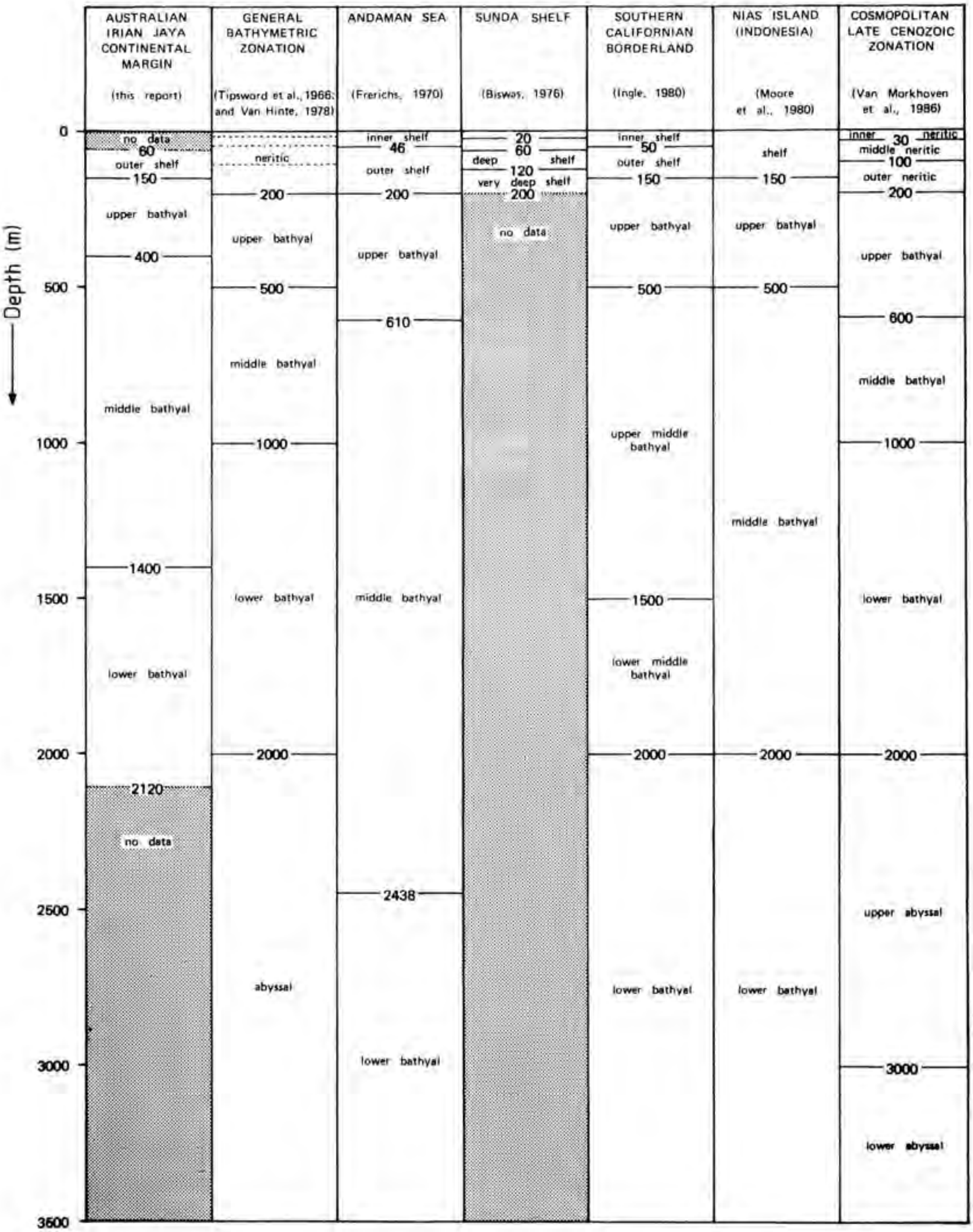

Fig. 13. Comparison of benthic foraminiferal bathymetric biofacies defined by various authors in different areas (after Van Marle, 1988).

Kingdom *Protista*
Subkingdom *Protozoa*
Order *Foraminiferida* Von Eichwald, 1830

Suborder *Lagenina* Delage and Herouard, 1896
Superfamily *Nodosariacea* Ehrenberg, 1838
Family *Lagenidae* Reuss, 1862
Subfamily *Ellipsolageninae* Silvestri, 1923
Genus *Fissurina* Reuss, 1850

Fissurina alveolata (Brady)

1884 *Lagena alveolata* Brady, p. 487, pl. 60, figs. 30, 32.
1913 *Lagena alveolata* Brady; Cushman, p. 33, pl. 18, fig. 1.
1933b *Lagena alveolata* Brady; Cushman, p. 21, pl. 4, figs. 17a-b.
1960 *Fissurina alveolata* (Brady); Barker, p. 127, pl. 60, figs. 30, 32.
1977 *Fissurina alveolata alveolata* (Brady); Boltovskoy and Watanabe, p. 45, pl. 1, fig. 1.
1984 *Fissurina alveolata alveolata* (Brady); Jones, p. 106, pl. 2, figs. 15-16.

Short description: Test pyriform, compressed, lateral edges obtuse, trigonal in section. Base broad and rounded in outline, rarely mucronate. Wall smooth, but ornamented by a median and two lateral carinae, which merge to form two loops on each side of the test, usually separated by a central depression. Aperture slitlike to ovate, terminal, in the center of a cavity, with entosolenian tube projecting from the aperture into the chamber cavity.

Remarks: *F. alveolata* differs from *Fissurina auriculata* (Brady) in being carinate.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Fissurina* spp. : *F. alveolata*, *F. auriculata*, *F. lacunata*, *F. laevigata*, *F. radiata*, *F. revertens*, *F. submarginata*, *F. wrightiana*, and *Parafissurina lateralis* (Cushman), of which *F. alveolata* and *F. submarginata* are the most common. *Fissurina* spp. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). Of the species gathered in *Fissurina* spp. most have also been found in Recent sediments from eastern Indonesian regions (Van Marle, 1988).

Occurrence: *Fissurina* spp. shows a scattered depth distribution down from 100 m in Recent eastern Indonesian sediments (Van Marle, 1988).

Fissurina auriculata (Brady)

1881 *Lagena auriculata* Brady, p. 61 (nomen nudum).

1884 *Lagena auriculata* Brady (part), p. 487, pl. 60, fig. 29 (not 31, 33).

1960 *Fissurina auriculata* (Brady); Barker, p. 126, pl. 60, fig. 29.

1977 *Fissurina auriculata auriculata* (Brady); Boltovskoy and Watanabe, p. 46, pl. 1, fig. 3.

Short description: Test pyriform, subtriangular in outline, compressed at the apertural end, inflated at the aboral end; periphery subacute, with an ovate depression bordered by alae, located along both sides of the aboral margin. Wall smooth, translucent, finely perforate, slightly thickening near apertural end. Aperture fusiform, elevated, with entosolenian tube.

Remarks: *F. auriculata* differs from *Fissurina alveolata* (Brady) in being non-carinate.

Stratigraphic range: See *Fissurina alveolata* (Brady).

Occurrence: See *Fissurina alveolata* (Brady).

Fissurina lacunata (Burrows and Holland)

1884 *Lagena castrensis* Brady (not Schwager), p. 485, pl. 60, figs. 1-2.

1895 *Lagena lacunata* Burrows and Holland, p. 205, pl. 7, figs. 12a-b.

1913 *Lagena orbignyana* (Seguenza) var. *lacunata* (Burrows and Holland); Cushman, p. 43, pl. 20, fig. 1.

1951b *Entosolenia lacunata* (Burrows and Holland); Asano, p. 35, fig. 152.

1960 *Fissurina lacunata* (Burrows and Holland); Barker, p. 124, pl. 60, figs. 1-2.

1964 *Fissurina lacunata* (Burrows and Holland); LeRoy, p. 32, pl. 13, figs. 17-18.

1985 *Fissurina lacunata* (Burrows and Holland); Wang et al., p. 336, pl. 4, fig. 12.

Short description: Test compressed, nearly circular in front view, tapering towards the apertural end; entire periphery tricarinate. Wall ornamented by an irregular network of shallow pitted areas (lacunae) of varying size, though usually relatively large. Aperture fissurine and entosolenian.

Remarks: *F. lacunata* differs from *Fissurina castrensis* (Schwager) by the presence of shallow pittings instead of beads (Burrows and Holland, 1895).

Stratigraphic range: See *Fissurina alveolata* (Brady). *F. lacunata* has been recorded previously in Pliocene to Recent deposits.

Occurrence: See *Fissurina alveolata* (Brady). According to LeRoy (1964) *F. lacunata* is a shallow water species.

Fissurina laevigata Reuss
(pl. 2, fig. 12)

1850 *Fissurina laevigata* Reuss, p. 366, pl. 46, fig. 1.

1884 *Lagena laevigata* (Reuss); Brady, p. 473, pl. 114, figs. 8a-b.
1913 *Lagena laevigata* (Reuss); Cushman, p. 7, pl. 2, fig. 1.
1949 *Entosolenia laevigata* (Reuss); Boomgaart, p. 107, pl. 9, figs. 1a-b.
1960 *Fissurina laevigata* Reuss; Barker, p. 236, pl. 114, figs. 8a-b.
1964 *Fissurina laevigata* Reuss; Loeblich and Tappan, C540, fig. 425,8.
1984 *Fissurina laevigata* Reuss; Jones, p. 106, pl. 2, figs. 13-14.

Short description: Test subglobose to ovate, compressed, pyriform in front view, elliptical in cross section, inflated at aboral end; periphery rounded to subangular. Wall smooth, transparent, thin. Aperture elongate, narrow, with short entosolenian tube; apertural margin thickened and glossy.

Remarks: *F. laevigata* is a simple form without ornamentation, differing from *Fissurina submarginata* (Boomgaart) in being non-carinate and in having a thickened apertural margin.

Stratigraphic range: See *Fissurina alveolata* (Brady). *F. laevigata* has been described previously from Late Miocene to Recent deposits.

Occurrence: See *Fissurina alveolata* (Brady). Lewis (1979) found *F. laevigata* in slope sediments from the continental margin of New Zealand.

Fissurina radiata Seguenza

1862 *Fissurina* (*Produttina*) *radiata* Seguenza, p. 70, pl. 2, figs. 42-43.
1884 *Lagena lagenoides* Brady (not Williamson), p. 479, pl. 60, figs. 13-14.
1913 *Lagena lagenoides* Cushman (not Williamson), p. 39, pl. 16, fig. 2.
1960 *Fissurina radiata* (Seguenza); Barker, p. 126, pl. 60, figs. 13-14.
1983 *Fissurina* sp. 2, Coustillas, pl. 25, fig. 14.

Short description: Test flask-shaped, ovate in front view, compressed, apertural end extended into a short neck; periphery with a wide keel, which shows numerous radiating tubulations and continues upon the apertural neck. Wall smooth, except for the keel and the radiating tubulations, white, opaque. Aperture rounded, elevated, on top of the short neck, entosolenian.

Remarks: Characteristic of *F. radiata* is the wide keel with the numerous radiating tubulations.

Stratigraphic range: See *Fissurina alveolata* (Brady). *F. radiata* has been observed previously in Recent sediments.

Occurrence: See *Fissurina alveolata* (Brady). Coustillas (1983) found *F. radiata* at a depth of 405 m in the Mahakam Delta.

Fissurina revertens (Heron-Allen and Earland)
(pl. 2, fig. 16)

1932 *Lagena revertens* Heron-Allen and Earland, p. 380, pl. 11, figs. 23-28.

Short description: Test flask-shaped, compressed, with a more or less extended or compressed neck, terminating in a lipped fissurine aperture; from this lip two keels extend along the periphery, encircling the shell, usually showing a discontinuity of varying width at the aboral end, which may be smooth, or ornamented by a knob or projecting spine of varying size. Wall smooth to rugose, varying from clear glassy transparent to semi-opaque.

Remarks: *F. revertens* differs from other smooth congeneric species by its double keel.

Stratigraphic range: See *Fissurina alveolata* (Brady). *F. revertens* has been described previously from Recent sediments of New Zealand (Lewis, 1979).

Occurrence: See *Fissurina alveolata* (Brady). Lewis (1979) found *F. revertens* in upper bathyal deposits from the continental margin of New Zealand.

Fissurina submarginata (Boomgaart)
(pl. 2, figs. 13-15)

1803 *Vermiculum marginatum* Montagu, p. 524 (nomen nudum).
1884 *Lagena marginata* Brady (not Walker and Boys), p. 476, pl. 59, figs. 21-22 (not 23).
1913 *Lagena marginata* Cushman (not Walker and Boys), p. 37, pl. 22, figs. 1-7.
1933b *Lagena marginata* (Montagu); Cushman, p. 17, pl. 4, figs. 9, 11-12, 14-16; pl. 5, figs. 2, 4, 6, 8-9.
1941b *Entosolenia marginata* (Montagu); LeRoy, p. 80, pl. 1, figs. 25, 33.
1949 *Entosolenia submarginata* Boomgaart, p. 107, pl. 9, fig. 7.
1951b *Entosolenia marginata* (Montagu); Asano, p. 36, figs. 154-155.
1960 *Fissurina submarginata* (Boomgaart); Barker, p. 122, pl. 59, figs. 21-22.
1964 *Fissurina marginata* (Montagu); Loeblich and Tappan, C541, fig. 425,7.
1983 *Fissurina* sp. 1; Coustillas, pl. 25, fig. 17.
1985 *Fissurina submarginata* (Boomgaart); Boichard et al., p. 94, pl. 17, fig. 32.

Short description: Test compressed, subcircular to ovate in front view, apertural end bluntly rounded. Wall smooth, transparent, thin, bordered by an elevated keel. Aperture fissurine, entosolenian.

Remarks: Boomgaart (1949) renamed the species described by Montagu (1803), because it is synonymous with *Serpula* (*Lagena*) *marginata* Walker and Boys (1784).

F. submarginata differs from *Fissurina laevigata* Reuss in being carinate and in having an elongated aperture, without the thickened apertural margin.

Stratigraphic range: See *Fissurina alveolata* (Brady). *F. submarginata* has been observed previously in Late Miocene to Recent deposits.

Occurrence: See *Fissurina alveolata* (Brady). Lewis (1979) observed *F. submarginata* in upper slope sediments (200-1000 m) offshore New Zealand. Coustillas (1983) found this species at a depth of 64 m in Mahakam Delta and Boichard et al. (1985) in waterdepths between 490 and 715 m on the Pater Noster Platform.

Fissurina wrightiana (Brady)
(pl. 2, fig. 17)

1881 *Lagena wrightiana* Brady, p. 62 (nomen nudum).
1884 *Lagena wrightiana* Brady, p. 482, pl. 61, figs. 6-7.
1960 *Fissurina wrightiana* (Brady); Barker, p. 127, pl. 61, figs. 6-7.
1977 *Fissurina wrightiana* (Brady); Boltovskoy and Watanabe, p. 52, pl. 2, fig. 19.

Short description: Test oval in outline, flattened, with a thin peripheral margin. Except for a small, smooth central portion at each side of the test and the keel, the wall is ornamented by a number of longitudinal, parallel grooves (which may slightly coalesce near the margin). Aperture terminal, elliptical, entosolenian, bordered by a stout phialine lip.

Remarks: *F. wrightiana* is characterized by the distinct ornamentation of longitudinal, parallel grooves (except for the small, smooth central portion).

Fissurina radiato-marginata (Parker and Jones) resembles *F. wrightiana*, but has a different pattern of grooves, with longitudinal, parallel grooves in the median part of the test, while to both sides the grooves become divergent from the center.

Stratigraphic range: See *Fissurina alveolata* (Brady).

Occurrence: See *Fissurina alveolata* (Brady).

Genus *Oolina* d'Orbigny, 1839

Oolina globosa (Montagu)

1784 Serpula (*Lagena*) *laevis globosa* Walker and Boys, p. 3, pl. 1, fig. 8.
1803 *Vermiculum globosum* Montagu, p. 523.
1884 *Lagena globosa* (Montagu); Brady, p. 452, pl. 56, figs. 1-3.
1913 *Lagena globosa* (Montagu); Cushman, p. 3, pl. 4, fig. 2.
1923 *Lagena globosa* (Montagu); Cushman, p. 20, pl. 4, figs. 1-2.
1941a *Lagena globosa* (Montagu); LeRoy, p. 29, pl. 3, fig. 104.
1960 *Oolina globosa* (Montagu); Barker, p. 114, pl. 56, figs. 1-3.
1975 *Oolina globosa* (Montagu); Anderson, p. 90, pl. 7, fig. 14.
1977 *Oolina globosa* (Montagu); Boltovskoy and Watanabe, p. 58, pl. 4, figs. 17-19, 21-22.
1983 *Oolina globosa* (Montagu) forma typica; Boltovskoy and Giussani de Kahn, p. 303, pl. 1, figs. 20-22.
1984 *Oolina globosa globosa* (Montagu); Jones, p. 101, pl. 1, figs. 10-11.
1985 *Oolina globosa* (Montagu); Boichard et al., p. 94, pl. 17, fig. 40.

Short description: Test a single, simple, subspherical to guttiform chamber. Wall smooth, white, thin and transparent to thicker and opaque. Aperture simple, large, subrounded, with entosolenian tube.

Remarks: The name given by Walker and Boys (1784) antedates Linnean nomenclature and therefore became invalid (Ellis and Messina, 1940 et seq.).

Stratigraphic range: See *Oolina hexagona* (Williamson). *O. globosa* has been described previously from Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Oolina hexagona* (Williamson). Boichard et al. (1985) found *O. globosa* in samples from waterdepths between 260 and 715 m on the Pater Noster Platform.

Oolina hexagona (Williamson)
(pl. 2, fig. 11)

1848	*Entosolenia squamosa* (Montagu) var. *hexagona* Williamson, p. 20, pl. 2, fig. 23.
1884	*Lagena hexagona* (Williamson); Brady, p. 472, pl. 58, figs. 32-33.
1913	*Lagena hexagona* (Williamson); Cushman, p. 17, pl. 6, figs. 2-3.
1923	*Lagena hexagona* (Williamson); Cushman, p. 24, pl. 4, fig. 6.
1951	*Entosolenia hexagona* (Williamson); Asano, p. 35, fig. 151.
1960	*Oolina hexagona* (Williamson); Barker, p. 120, pl. 58, figs. 32-33.
1975	*Lagena hexagona* (Williamson); Anderson,p. 90, pl. 7, fig. 15.
1977	*Oolina hexagona* (Williamson); Boltovskoy and Watanabe, p. 58, pl. 5, figs. 2-4.
1983	*Lagena hexagona* (Williamson); Coustillas, pl. 25, fig. 20.
1984	*Oolina hexagona* (Williamson); Jones, p. 102, pl. 1, figs. 17-18.
1985	*Oolina* aff. *hexagona* (Williamson); Boichard et al., p. 94, pl. 17, fig. 38.

Short description: Test a subglobular to ovate chamber, broadly rounded at the apical end, bluntly pointed at the apertural end. Wall opaque, ornamented with a reticulate pattern of hexagonal depressions, arranged in vertical rows, sometimes becoming irregular at the extreme ends. Aperture small, circular, somewhat extended.

Remarks: *O. hexagona* differs from *Oolina melo* d'Orbigny in having a regular, reticulate pattern of hexagonal depressions as ornament, instead of the irregular quadrangular depressions of *O. melo*.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Oolina* spp. : *O. globosa*, *O. hexagona*, *O. longispina*, *O. melo*, and *O. striatopunctata*, of which *O. hexagona* is most common. *Oolina* spp. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). All species assembled in *Oolina* spp. have also been found in Recent sediments from eastern Indonesian regions (Van Marle, 1988).

O. hexagona has been observed previously in Pliocene to Recent deposits.

Occurrence: *Oolina* spp. show a scattered depth distribution down from 60 m in Recent eastern Indonesian sediments (Van Marle, 1988).

Lewis (1979) encountered *O. hexagona* in shelf - upper slope sediments offshore New Zealand. This species occurs in waterdepths between 0 and 100 m in the Mahakam Delta (Coustillas, 1983) and between 549 and 715 m on the Pater Noster Platform (Boichard et al., 1985).

Oolina longispina (Brady)

1881 *Lagena longispina* Brady, p. 61 (nomen nudum).
1884 *Lagena longispina* Brady, p. 454, pl. 56, fig. 36.
1960 *Oolina longispina* (Brady); Barker, p. 116, pl. 56, fig. 36.

Short description: Test a subglobular to ovate chamber, pointed at the apertural end, armed with long, stout, conspicuous spines at the rounded apical end. Wall smooth, white. Aperture simple, rounded, terminal.

Remarks: *O. longispina* differs from *Oolina globosa* (Montagu) by the presence of characteristic, long spines at the apical end.

Stratigraphic range: See *Oolina hexagona* (Williamson).

Occurrence: See *Oolina hexagona* (Williamson).

Oolina melo d'Orbigny

1839 *Oolina melo* d'Orbigny, p. 20, pl. 5, fig. 9.
1884 *Lagena squamosa* Brady (not Montagu), p. 471, pl. 58, figs. 28-31.
1960 *Oolina melo* d'Orbigny; Barker, p. 120, pl. 58, figs. 28-31.
1980 *Lagena melo* (d'Orbigny); Haller, p. 236, pl. 4, fig. 11.
1983 *Oolina melo* d'Orbigny; Boltovskoy and Giussani de Kahn, p. 303, pl. 2, figs. 26-27.

Short description: Test ovate in outline, rounded at the apical end, acuminate at the apertural end. Wall translucent or opaque, ornamentation reticulate, with longitudinal ribs which are interconnected by transverse, concave downward costae, forming irregular quadrangules. Aperture small, simple, with short entosolenian tube.

Remarks: *O. melo* strongly resembles *Oolina squamosa* (Montagu) and *Oolina hexagona* (Williamson). Specifically because some morphological features, such as the number of the ribs, the size of the quadrangular spaces formed by the ribs and crossing costae, and the elongation of the apertural end are highly variable (Boltovskoy and Giussani de Kahn, 1983).

O. hexagona differs from *O. melo* in having a regular, reticulate pattern of hexagonal depressions as ornamentation, instead of the irregular quadrangular ones of *O. melo*. *O. squamosa* is more oval in outline than *O. melo*, with an elongated apertural end and a short neck. The ornamentation forms shallow, triangular depressions, because of the arcuate crossing costae (Boltovskoy et al., 1980, p. 42, pl. 24, figs. 6 and 8), instead of the deeper quadrangular ones of *O. melo*. However, Boltovskoy et al. (1980) observed that variants of *O. squamosa* with shorter or no necks at all grade into the concept of *O.melo*.

Stratigraphic range: See *Oolina hexagona* (Williamson). *O. melo* has been observed previously in Recent deposits from New Zealand (Lewis, 1979).

Occurrence: See *Oolina hexagona* (Williamson). Lewis (1979) found *O. melo* in shelf - upper slope sediments from the continental margin of New Zealand.

Oolina striatopunctata (Parker and Jones)

- 1865 *Lagena sulcata* Walker and Jacob var. *striatopunctata* Parker and Jones, p. 350, pl. 13, figs. 25-27.
- 1884 *Lagena striatopunctata* Parker and Jones; Brady, p. 468, pl. 58, fig. 40.
- 1913 *Lagena striato-punctata* Parker and Jones; Cushman, p. 30, pl. 14, fig. 10.
- 1960 *Oolina striatopunctata* Parker and Jones; Barker, p. 120, pl. 58, fig. 40.
- 1964 *Oolina striatopunctata* Parker and Jones; Loeblich and Tappan, C540, fig. 425,3.
- 1984 *Pseudoolina* (?) *striatopunctata* (Parker and Jones); Jones, p. 120, pl. 4, figs. 23-24.

Short description: Test oval to pyriform, with a long neck at the apertural end. Wall ornamented by 6-20 stout, longitudinal costae, lined on each side by pseudopodial foramina in their thickened bases or sometimes with a single row of foramina in their middle. Aperture simple, rounded, with entosolenian tube.

Remarks: *O. striatopunctata* differs from costate congeneric species by the presence of rows of foramina.

Stratigraphic range: See *Oolina hexagona* (Williamson).

Occurrence: See *Oolina hexagona* (Williamson).

Genus *Parafissurina* Parr, 1947

Parafissurina lateralis (Cushman)

(pl. 2, fig. 18)

- 1884 *Lagena apiculata* Brady (not Reuss), p. 453, pl. 56, figs. 17-18.
- 1913 *Lagena lateralis* Cushman, p. 9, pl. 1, fig. 1.
- 1960 *Parafissurina lateralis* (Cushman); Barker, p. 116, pl. 56, figs. 17-18.
- 1975 *Parafissurina lateralis* (Cushman); Anderson, p. 90, pl. 7, fig. 4.
- 1977 *Parafissurina lateralis* (Cushman) forma typica; Boltovskoy and Watanabe, p. 60, pl. 6, figs. 1-3.
- 1983 *Parafissurina lateralis lateralis* (Cushman); Boltovskoy and Giussani de Kahn, p. 303, pl. 1, figs. 26-27.
- 1984 *Parafissurina lateralis* (Cushman); Jones, p. 128, pl. 6, figs. 11-12.

Short description: Test an elongate, somewhat compressed chamber, ovate in cross section, broadest towards the broadly rounded, truncate basal end, apertural end slightly tapering ('teardrop'). Wall smooth, transparent, the flattened sides punctate. Aperture subterminal below the apex, elongate, elliptical, with lip and with long entosolenian tube more than half the length of the test, flaring-at its inner end.

Remarks: According to Jones (1984) the test shape of *P. lateralis* is variable, with more and less elongate forms. Based on the variation of the test shape Boltovskoy and Watanabe (1977) and Boltovskoy and Giussani de Kahn

(1983) distinguished three subspecies: *P. lateralis lateralis* (the typical 'teardrop' form), *P. lateralis carinata* (a carinate form), and *P. lateralis crassa* (a more globular form). In our material *P. lateralis* was encountered rarely, and all specimens have the 'teardrop' form.

Stratigraphic range: See *Fissurina alveolata* (Brady).

Occurrence: See *Fissurina alveolata* (Brady).

Subfamily *Lageninae* Reuss, 1862

Genus *Lagena* Walker and Jacob, 1798

Lagena amphora Reuss

1863 *Lagena amphora* Reuss, p. 330, pl. 4, fig. 57.

1913 *Lagena costata* (Williamson) var. *amphora* Reuss; Cushman, p. 21, pl. 10, figs. 2-3; pl. 12, fig. 2.

1950 *Lagena amphora* Reuss; Cushman and McCulloch, p. 329, pl. 43, figs. 11-14.

1980 *Lagena* sp. cf. *L. amphora* Reuss; Haller, p. 236, pl. 4, fig. 7.

1984 *Phialinea amphora* ? (Williamson); Jones, p. 125, pl. 5, fig. 21.

Short description: Test unilocular, subglobular, elongate, pyriform with a long, tapering, costate neck, and flattened initial end. Wall finely perforate, with comparatively few (12-14), rounded costae nearly covering the length of the test, including the neck, though often not reaching the apex. Aperture small, rounded, terminal, not radiate.

Remarks: *L. amphora* resembles *Lagena striata* (d'Orbigny), but is more coarsely ornamented. Because of its flattened initial end it also has a more pyriform appearance.

The phialine lips, according to Jones (1984) characteristic for his new erected genus *Phialinea*, are invariably broken off in our specimens of *L. amphora*. The specimen figured by this author as *Phialinea amphora* (?), differs from the typical *L. amphora* by a slightly asymmetrical shell, possessing riblets on the apertural neck.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Lagena* spp. : *L. amphora*, *L. distoma*, *L. elongata*, *L. gracilis*, *L. hispida*, *L. laevis*, *L. perlucida*, *L. striata*, and *L. sulcata*. *Lagena* spp. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). Of the species gathered in *Lagena* spp. most have also been found in Recent sediments from eastern Indonesian regions (Van Marle, 1988).

Occurrence: *Lagena* spp. show a scattered depth distribution down from 141 m in Recent eastern Indonesian sediments (Van Marle, 1988).

Lagena distoma Parker and Jones

1864 *Lagena distoma* Parker and Jones, p. 467, pl. 48, fig. 6.

1865 *Lagena sulcata* (Walker and Jacob) var. *distoma* Parker and Jones; Parker and Jones, p. 356, pl. 13, fig. 20.
1884 *Lagena distoma* Parker and Jones; Brady, p. 461, pl. 58, figs. 11-15.
1913 *Lagena distoma* Parker and Jones; Cushman, p. 22, pl. 13, figs. 1-2.
1950 *Lagena distoma* Parker and Jones; Cushman and McCulloch, p. 337, pl. 44, figs. 12a-b.
1951 *Lagena distoma* Parker and Jones; Asano, p. 30, fig. 131.
1960 *Lagena distoma* Parker and Jones; Barker, p. 119, pl. 58, figs. 11-15.
1975 *Lagena distoma* Parker and Jones; Anderson, p. 90, pl. 5, fig. 4.
1977 *Lagena distoma* Parker and Jones; Boltovskoy and Watanabe, p. 53, pl. 3, fig. 1.
1980 *Lagena distoma* Parker and Jones; Ingle et al., p. 140, pl. 4, fig. 12.
1983 *Lagena distoma* Parker and Jones; Boltovskoy and Giussani de Kahn, p. 302, pl. 2, fig. 17.
1984 *Phialinea distoma distoma* (Parker and Jones); Jones, p. 125, pl. 5, figs. 24-26.
1985 *Lagena distoma* Parker and Jones; Boichard et al., p. 92, pl. 16, fig. 44.

Short description: Test unilocular, elongated fusiform; terminating in long, delicate, gradually tapering necks at both ends. Central portion of shell shows parallel sides. Wall translucent, thin, shiny, ornamented by fine, longitudinal striae. Apertures at both ends, small and rounded, lacking phialine lip at one end.

Remarks: The supposed phialine lip was never observed in our specimens as the apertural ends are always broken off. Jones (1984), however, transferred this species to his new erected genus *Phialinea*, because he was sure of the presence of the phialine lips, although the phialine lips of his specimens were also invariably broken off.

Stratigraphic range: See *Lagena amphora* Reuss. *L. distoma* has been observed previously in Miocene to Recent deposits (see synonymy and LeRoy, 1964).

Occurrence: See *Lagena amphora* Reuss. According to LeRoy (1964) *L. distoma* is an outer neritic - upper bathyal form. Boichard et al. (1985) collected this species from a depth of 490 m on the Pater Noster Platform.

Lagena elongata (Ehrenberg)

1844 *Miliola elongata* Ehrenberg, p. 274 (nomen nudum).
1884 *Lagena elongata* (Ehrenberg); Brady, p. 457, pl. 56, fig. 29.
1884 *Lagena gracillima* Brady (not Seguenza), p. 456, pl. 56, figs. 27-28.
1913 *Lagena elongata* (Ehrenberg); Cushman, p. 12, pl. 1, fig. 5.
1951b *Lagena elongata* (Ehrenberg); Asano, p. 30, fig. 132.
1960 *Lagena elongata* (Ehrenberg); Barker, p. 116, pl. 56, figs. 27-29.
1975 *Lagena elongata* (Ehrenberg); Anderson, p. 90, pl. 5, fig. 5.
1977 *Lagena elongata* (Ehrenberg); Boltovskoy and Watanabe, p. 53, pl. 3, fig. 6.

1983 *Lagena elongata* (Ehrenberg); Boltovskoy and Giussani de Kahn, p. 302, pl. 1, fig. 10.
1985 *Lagena elongata* (Ehrenberg); Boichard et al., p. 94, pl. 17, fig. 34.

Short description: Test unilocular, compressed, very elongate, slender; middle portion subcylindrical, tapering gradually into slender tubular projections at either end. Wall thin, hyaline, smooth, transparent, and finely perforate. Apertural end with slightly projecting lip around small aperture, not radiate; opposite end pointed.

Remarks: The apertural lip is invariably broken off in our specimens.

L. elongata differs from *Lagena gracillima* (Seguenza) in being cylindrical in the centre, with nearly parallel sides for a considerable distance, instead of fusiform.

Stratigraphic range: See *Lagena amphora* Reuss. *L. elongata* has been recorded previously in Pliocene to Recent SE Asian deposits (see synonymy and LeRoy, 1964).

Occurrence: See *Lagena amphora* Reuss. According to LeRoy (1964) *L. elongata* is an outer neritic - upper bathyal form. Boichard et al. (1985) observed this species in samples from waterdepths between 549 and 715 m on the Pater Noster Platform.

Lagena gracilis Williamson
(pl. 2, fig. 7)

1848 *Lagena gracilis* Williamson, p. 13, pl. 1, fig. 5.
1884 *Lagena gracilis* Williamson; Brady, p. 464, pl. 58, figs. 22-24.
1913 *Lagena gracilis* Williamson; Cushman, p. 24, pl. 8, figs. 5-6.
1951b *Lagena gracilis* Williamson; Asano, p. 30, fig. 133.
1960 *Lagena gracilis* Williamson; Barker, p. 119, pl. 58, figs. 22-24.
1975 *Lagena gracilis* Williamson; Anderson, p. 90, pl. 5, fig. 7.
1977 *Lagena* ex gr. *L. gracilis* Williamson; Boltovskoy and Watanabe, p. 54, pl. 3, figs. 8-10.
1983 *Lagena gracilis* Williamson; Boltovskoy and Giussani de Kahn, p. 302, pl. 1, figs. 12-13.
1984 *Lagena gracilis gracilis* Williamson; Jones, p. 131, pl. 7, fig. 2.
1985 *Lagena gracilis* Williamson; Boichard et al., p. 94, pl. 17, figs. 36-37.

Short description: Test unilocular, elongate, fusiform, tapering gradually at the apertural end, rapidly at the aboral end, sometimes with an aboral spine. Wall transparent, thin, ornamented by 4-12 costae or plate-like ribs of which some extend along the apertural neck. Aperture small, rounded, without phialine lip, not radiate.

Remarks: According to Jones (1984) *L. gracilis* does have a thickened lip at the end of the apertural neck, but not a phialine one.

This species is subject to great morphological variation, especially in the number of costae and the form of the aboral end (Boltovskoy et al., 1980; Boltovskoy and Giussani de Kahn, 1983).

Stratigraphic range: See *Lagena amphora* Reuss. *L. gracilis* has been described previously from Pliocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: See *Lagena amphora* Reuss. *L. gracilis* is common in shelf and slope deposits from the continental margin of New Zealand (Lewis, 1979) and occurs in waterdepths between 260 and 715 m on the Pater Noster Platform (Boichard et al., 1985).

Lagena hispida Reuss

1858 *Lagena hispida* Reuss, p. 434 (nomen nudum).
1863 *Lagena hispida* Reuss, p. 335, pl. 6, figs. 77-79.
1884 *Lagena hispida* Reuss; Brady, p. 459, pl. 57, figs. 1-4.
1913 *Lagena hispida* Reuss; Cushman, p. 13, pl. 4, figs. 4-5; pl. 5, fig. 1.
1960 *Lagena hispida* Reuss; Barker, p. 116, pl. 57, figs. 1-4.
1975 *Lagena hispida* Reuss; Anderson, p. 90, pl. 5, fig. 8.
1977 *Lagena hispida* Reuss; Boltovskoy and Watanabe, p. 54, pl. 3, fig. 11.
1983 *Lagena hispida* Reuss; Coustillas, pl. 26, fig. 12.
1984 *Lagena* sp. 13; Jones, p. 136, pl. 8, fig. 13.
1985 *Lagena hispida* Reuss; Boichard et al., p. 92, pl. 16, fig. 25.

Short description: Test unilocular, variously formed, globular to pyriform, broadly rounded at the base, apertural end narrow to slender, with elongate neck. Wall finely perforate, ornamented with blunt, irregular, widely spaced spines, uniformly distributed over the test. Aperture small and rounded, terminal, not radiate.

Remarks: The spines of *L. hispida* are thick, blunt, irregular and widely spaced, while those of *Lagena hispidula* Cushman are delicate, thin and densely spaced.

Stratigraphic range: See *Lagena amphora* Reuss. *L. hispida* has been observed previously in Late Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: See *Lagena amphora* Reuss. *L. hispida* occurs in upper slope deposits from the continental margin of New Zealand (Lewis, 1979), in waterdepths between 0 and 200 m in the Mahakam Delta (Coustillas, 1983), and at a depth of 220 m on the Pater Noster Platform (Boichard et al., 1985).

Lagena laevis (Montagu)

1784 *Serpula* (*Lagena*) *laevis ovalis* Walker and Boys, p. 3, pl. 1, fig. 9.
1803 *Vermiculum laeve* Montagu, p. 524.
1848 *Lagena laevis* (Montagu); Williamson, p. 12, pl. 1, figs. 1-2.

1884 *Lagena semistriata* Brady (not Williamson); Brady, p. 465, pl. 57, figs. 14, 16-18.
1913 *Lagena laevis* (Montagu); Cushman, p. 5, pl. 1, fig. 3; pl. 38, fig. 5.
1950 *Lagena laevis* (Montagu); Cushman and McCulloch, p. 341, pl. 45, figs. 14-16.
1951b *Lagena laevis* (Montagu); Asano, p. 31, figs. 135-136.
1960 *Lagena laevis* (Montagu); Barker, p. 118, pl. 57, figs. 14, 16-18.
1975 *Lagena laevis* (Montagu); Anderson, p. 90, pl. 5, fig. 10.
1985 *Lagena laevis* (Montagu); Boichard et al., p. 92, pl. 16, fig. 9.

Short description: Test unilocular, lagenoform, usually asymmetrical, oval in front view, elliptical to nearly circular in cross section. Apertural end tapering gradually and ending in a thick-walled, elongated, slender neck, subcircular in cross section; aboral end flattened. Wall smooth, usually transparent, very finely perforate. Aperture small and rounded, bordered by phialine lip, not radiate.

Remarks: The name given by Walker and Boys (1784) antedates Linnean nomenclature and therefore became invalid (Ellis and Messina, 1940 et seq.).

L. laevis resembles *Lagena striata* (d'Orbigny) in form, but differs in being smooth and not striate.

Stratigraphic range: See *Lagena amphora* Reuss. *L. laevis* has been described previously from Late Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: See *Lagena amphora* Reuss. *L. laevis* is common in slope sediments from the continental margin of New Zealand (Lewis, 1979). Boichard et al. (1985) found this species at a depth of 260 m on the Pater Noster Platform.

Lagena perlucida (Montagu)
(pl. 2, fig. 9)

1803 *Vermiculum perlicidum* Montagu, p. 525, pl. 14, fig. 3.
1950 *Lagena perlucida* (Montagu); Cushman and McCulloch, p. 342, pl. 46, figs. 1-2.
1951b *Lagena perlucida* (Montagu); Asano, p. 31, figs. 137-138.
1984 *Lagena perlucida* (Montagu); Jones, p. 132, pl. 7, fig. 10.

Short description: Test unilocular, elongate, about twice as long as broad, somewhat pyriform, widest near the base; apertural end extended into an elongate, slender neck; aboral end somewhat flattened, and ornamented by a few short costae. Wall white in color, somewhat transparent, glossy, smooth at the apertural end, costate at the aboral end. Aperture terminal, extremely small, rounded, bordered by a slight lip, not radiate.

Stratigraphic range: See *Lagena amphora* Reuss. *L. perlucida* has been observed previously in Late Miocene to Recent deposits from Japan.

Occurrence: See *Lagena amphora* Reuss.

Lagena striata (d'Orbigny)
(pl. 2, fig. 8)

1839 *Oolina striata* d'Orbigny, p. 21, pl. 5, fig. 12.
1884 *Lagena striata* (d'Orbigny); Brady, p. 460, pl. 57, figs. 22, 24.
1913 *Lagena striata* (d'Orbigny); Cushman, p. 19, pl. 7, figs. 4-5.
1951b *Lagena striata* (d'Orbigny); Asano, p. 33, figs. 144-145.
1960 *Lagena striata* (d'Orbigny); Barker, p. 118, pl. 57, figs. 22, 24.
1977 *Lagena striata* (d'Orbigny); Boltovskoy and Watanabe, p. 56, pl. 4, fig. 5.
1980 *Lagena striata* (d'Orbigny); Haller, p. 236, pl. 4, fig. 9.
1980 *Lagena striata* (d'Orbigny); Ingle et al., p. 140, pl. 4, fig. 13.
1985 *Lagena* aff. *striata* (d'Orbigny); Boichard et al., p. 92, pl. 16, fig. 24.

Short description: Test unilocular, semicircular in cross section, flask-shaped. Body of the test subglobular to ovoid, abruptly extending into an elongate, gradually tapering neck; aboral end broadly rounded with labyrinthic pattern. Wall thin, white, with numerous fine costae running over the entire length of the test, including the neck, sometimes intercalated with shorter costae. Aperture small, rounded, on a cylindrical neck.

Remarks: *L. striata* differs from the other striate-costate lagenids found in our material. *L. striata* is much more globular in outline than the fusiform *Lagena gracilis* Williamson. *Lagena amphora* Reuss is more coarsely costate than *L. striata* and has a flattened aboral end instead of a rounded one. *Lagena distoma* Parker and Jones is elongate fusiform and has tapering necks at both ends. *Lagena sulcata* (Walker and Jacob) is ornamented by plate-like ribs instead of striae as in *L. striata*.

Stratigraphic range: See *Lagena amphora* Reuss. *L. striata* has been observed previously in Late Miocene to Recent deposits (see synonymy; LeRoy, 1941a; Boomgaart, 1949; Lewis, 1979).

Occurrence: See *Lagena amphora* Reuss. *L. striata* is common in inner shelf to mid slope deposits from the continental margin of New Zealand (Lewis, 1979) and at a depth of 220 m on the Pater Noster Platform (Boichard et al., 1985).

Lagena sulcata (Walker and Jacob)
(pl. 2, fig. 10)

1784 *Serpula* (*Lagena*) *striata sulcata rotunda* Walker and Boys, p. 2, pl. 1, fig. 6.
1798 *Serpula* (*Lagena*) *sulcata* Walker and Jacob, p. 634, pl. 14. fig. 5.
1884 *Lagena sulcata* (Walker and Jacob); Brady, p. 462, pl. 57, figs. 33-34.
1913 *Lagena sulcata* (Walker and Jacob); Cushman, p. 22, pl. 9, fig. 2.
1941c *Lagena sulcata* (Walker and Jacob); LeRoy, p. 114, pl. 3, fig. 23.
1960 *Lagena sulcata* (Walker and Jacob); Barker, p. 118, pl. 57, figs. 33-34.
1983 *Lagena sulcata* (Walker and Jacob); Boltovskoy and Giussani de Kahn, p. 302, pl. 2, fig. 24.

1983 *Lagena* sulcata (Walker and Jacob); Coustillas, pl. 25, fig. 23.

Short description: Test unilocular, flask-shaped (clavate); the bulk of the body subglobular, apertural end with short, stout, smooth neck, aboral end truncated or flattened. Wall translucent, white, glossy, ornamented by numerous plate-like, closely set, longitudinal costae, a few more prominent than the others. Aperture terminal, small and rounded, not radiate.

Remarks: The name given by Walker and Boys (1784) antedates Linnean nomenclature and therefore became invalid (Ellis and Messina, 1940 et seq.).

L. sulcata differs from the less strongly costate *Lagena amphora* Reuss by its more pyriform test with a truncated aboral end.

Stratigraphic range: See *Lagena amphora* Reuss. *L. sulcata* has been described previously from Late Pliocene to Recent deposits (see synonymy; Lewis, 1979; Boichard et al., 1985).

Occurrence: See *Lagena amphora* Reuss. Coustillas (1983) observed *L. sulcata* at a depth of 45 m in the Mahakam Delta, whereas Boichard et al. (1985) found this species at a depth of 190 m on the Pater Noster Platform.

Family *Nodosariidae* Ehrenberg, 1838
Subfamily *Nodosariinae* Ehrenberg, 1838
Genus *Amphicoryna* Schlumberger, 1881

Amphicoryna scalaris (Batsch)
(pl. 2, figs. 3-4)

1791 *Nautilus (Orthoceras) scalaris* Batsch, p. 1, pl. 2, fig. 4.
1860 *Marginulina falx* Jones and Parker, p. 302, no. 28.
1884 *Nodosaria scalaris* (Batsch); Brady, p. 510, pl. 63, figs. 28-31.
1884 *Amphicoryne falx* (Jones and Parker); Brady, p. 556, pl. 65, figs. 7-9.
1921 *Nodosaria scalaris* (Batsch); Cushman, p. 199, pl. 35, fig. 6.
1941a *Lagenonodosaria scalaris* (Batsch); LeRoy, p. 28, pl. 1, figs. 73-74; pl. 2, figs. 30-31.
1941b *Lagenonodosaria scalaris* (Batsch); LeRoy, p. 77, pl. 2, fig. 18.
1949 *Nodogenerina scalaris* (Batsch); Boomgaart, p. 101, pl. 8, fig. 16.
1950 *Amphicoryne scalaris* (Batsch); Parr, p. 328, pl. 11, fig. 24.
1951b *Lagenonodosaria scalaris* (Batsch); Asano, p. 20, fig. 93.
1960 *Amphicoryna scalaris* (Batsch); Barker, p. 134, pl. 63, figs. 28-31; p. 136, pl. 65, figs. 7-9.
1961 *Lagenonodosaria scalaris* (Batsch); De Hornibrook, p. 48, pl. 6, fig. 101.
1964 *Amphicoryna scalaris* (Batsch); Loeblich and Tappan, C513, figs. 401,1a-b.
1978 *Orthomorphina scalaris* (Batsch); Boltovskoy, p. 163, pl. 5, figs. 27-28.
1983 *Amphicoryna scalaris* (Batsch); Coustillas, pl. 26, figs. 5a-b.
1984 *Lagenonodosaria scalaris* (Batsch); Govindan, p. 244, pl. 1, fig. 12.
1988 *Amphicoryna scalaris* (Batsch); Van Marle, p. 139, pl. 4, fig. 22.

Short description: Test elongate with rounded base; early chambers compressed and partially coiled; 2-3 adult chambers, globose, rectilinear and uniserial; sutures clear, depressed, horizontal, may be flush and oblique in the early stage. Wall radiate in texture, lamellar, ornamented with longitudinal costae, sometimes smooth, finely perforate. Aperture terminal, central, circular and irregularly radiate, on a long neck, bordered by a lip; the neck may be ornamented by 3-7 ringlike, horizontal projections.

Remarks: The author agrees with Parr (1950) that *A. scalaris* is the megalopheric form and *A. falx* the microspheric form of one and the same species.

Stratigraphic range: This species has been found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). *A. scalaris* has been widely recorded in Early Oligocene to Recent deposits from the Indo-Pacific region.

Occurrence: In Recent eastern Indonesian sediments *A. scalaris* generally occurs down from 60 m at neritic - upper bathyal depths, but also shows scattered deeper occurrences (Van Marle, 1988). Coustillas (1983) found this species in sediments between 50 and 400 m in the Mahakam Delta.

In the Mediterranean, Jonkers (1984) found it in Pliocene sediments from Crete deposited under poor oxygen conditions.

Genus *Astacolus* De Montfort, 1808

Astacolus crepidulus (Fichtel and Moll)
(pl. 1, fig. 8)

1798 *Nautilus crepidulus* Fichtel and Moll, p. 107, pl. 19, figs. g-i.
1808 *Astacolus crepidulatus* De Montfort, p. 262.
1884 *Cristellaria crepidula* (Fichtel and Moll); Brady, p. 542, pl. 67, figs. 20a-b; pl. 68, figs. 1-2.
1913 *Cristellaria crepidula* (Fichtel and Moll); Cushman, p. 70, pl. 29, figs. 5-6; pl. 31, figs. 2-5.
1941a *Astacolus* aff. *crepidulus* (Fichtel and Moll); LeRoy, p. 28, pl. 2, figs. 49-50.
1960 *Astacolus crepidulus* (Fichtel and Moll); Barker, p. 142, pl. 67, figs. 20a-b; pl.68, figs. 1-2.
1964 *Astacolus crepidulus* (Fichtel and Moll); Loeblich and Tappan, C514, fig. 401,3.
1978 *Astacolus crepidulus* (Fichtel and Moll); Boltovskoy, p. 152, pl. 1, fig. 11.
1984 *Astacolus crepidulus* (Fichtel and Moll); Rögl and Hansen, p. 66, pl. 26, figs. 1-2 (redescription).

Short description: Test elongate, strongly compressed, symmetrical, slightly arcuate; periphery rounded, with almost parallel lateral chamber walls. Initial part planispiral, involute, later part uncoiling. Chambers numerous, low, broad, rapidly increasing in size as added, the later chambers do not reach the coiled part. Sutures narrow, straight or slightly sinuous, oblique, highest at outer margin. Wall smooth, finely perforate. Aperture radiate, terminal, at peripheral angle.

Remarks: The originally described type species of the genus *Astacolus*, *A. crepidulatus* De Montfort (1808), is a junior synonym of *Nautilus crepidulus* Fichtel and Moll (1798).

Specimens of the genus *Astacolus* differ from those of *Vaginulina* d'Orbigny (1826) in having oblique sutures and a more distinctly curved axis.

Stratigraphic range: *A. crepidulus* has been observed previously in Oligocene to Recent deposits. We found it in Early - Middle Miocene (N8), Middle - Late Miocene (N14-16), Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: In Recent eastern Indonesian sediments *A. crepidulus* generally occurs down from 60 m at neritic - upper bathyal depths, but also shows scattered deeper occurrences (Van Marle, 1988).

Genus *Dentalina* Risso, 1826

Dentalina advena (Cushman)

(pl. 1, fig. 13)

1884 *Nodosaria (Dentalina) roemeri* Brady (not Neugeboren), p. 505, pl. 63, fig. 1.
1923 *Nodosaria advena* Cushman, p. 79, pl. 14, fig. 12.
1960 *Dentalina advena* (Cushman); Barker, p. 132, pl. 63, fig. 1.
1964 *Dentalina advena* (Cushman); LeRoy, p. 23, pl. 15, fig. 31.
1988 *Dentalina advena* (Cushman); Van Marle, p. 141, pl. 2, fig. 12.

Short description: Test elongate, arcuate, tapering, circular in transverse section; initial end broadly rounded, apertural end slightly drawn out. Few chambers, uniserially arranged. Sutures distinct, oblique, depressed. Wall smooth, finely perforate. Aperture radiate, terminal, nearly central.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Dentalina* spp. : *D. advena*, *D. communis*, *D. filiformis*, and *D. subsoluta*, of which *D. advena* is most common. In our material, *Dentalina* spp. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent deposits from eastern Indonesia (Van Marle, 1988).

D. advena has been observed previously in Miocene - Pliocene and in Recent deposits.

Occurrence: *Dentalina* spp. show a scattered depth distribution in Recent eastern Indonesian sediments (Van Marle, 1988). According to LeRoy (1964) *D. advena* is an outer neritic - upper bathyal form.

Dentalina communis (d'Orbigny)

1826 *Nodosaria (Dentaline) communis* d'Orbigny, p. 254, mod. no. 35.
1884 *Nodosaria communis* d'Orbigny; Brady, p. 504, pl. 62, figs. 21-22.
1913 *Nodosaria communis* d'Orbigny; Cushman, p. 54, pl. 28, figs. 1-2.
1923 *Dentalina communis* (d'Orbigny); Cushman, p. 75, pl. 12, figs. 3-4 and 15-17.
1941b *Dentalina communis* (d'Orbigny); LeRoy, p. 74, pl. 2, fig. 32.
1951b *Dentalina communis* (d'Orbigny); Asano, p. 23, fig. 102.
1960 *Dentalina communis* (d'Orbigny); Barker, p. 130, pl. 62, figs. 21-22.
1964 *Dentalina communis* (d'Orbigny); LeRoy, p. 23, pl. 15, fig. 28.
1978 *Dentalina communis* (d'Orbigny); Boltovskoy, p. 157, pl. 3, fig. 23.
1980 *Dentalina communis* (d'Orbigny); Boltovskoy, p. 165, pl. 1, figs. 12a-b.
1983 *Dentalina communis* (d'Orbigny); Coustillas, pl. 24, figs. 10-12.
1985 *Dentalina communis* (d'Orbigny); Wang et al., p. 336, pl. 4, fig. 10.
1985 *Dentalina communis* (d'Orbigny); Boichard et al., p. 92, pl. 16, fig. 43.

Short description: Test elongate, slender, tapering, straight or slightly curved, circular in transverse section. Numerous chambers, uniserially arranged, slightly inflated, as broad as high, increasing gradually in size as added; sutures oblique, somewhat depressed. Wall thick, smooth, finely perforate. Aperture radiate, terminal, eccentric, somewhat elongate.

Remarks: *D. communis* differs from congeneric species by its different chamber shape and elongate test with a larger number of chambers. *Dentalina advena* (Cushman) has fewer, broader and more closely appressed chambers than *D. communis*. *Dentalina filiformis* (d'Orbigny) has more inflated chambers and a somewhat shorter test. *Dentalina subsoluta* (Cushman) is finely costate to spinose on the basal part of each chamber and has subglobular chambers.

Stratigraphic range: See *Dentalina advena* (Cushman). *D. communis* has been described previously from Late Oligocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Dentalina advena* (Cushman). According to LeRoy (1964) *D. communis* is an outer neritic - upper bathyal form. Coustillas (1983) found this species in sediments between 50 and 400 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 490 m on the Pater Noster Platform.

Dentalina filiformis (d'Orbigny)
(pl. 1, fig. 14)

1826 *Nodosaria (Nodosaire) filiformis* d'Orbigny, p. 253.
1884 *Nodosaria filiformis* d'Orbigny; Brady, p. 500, pl. 63, figs. 3-5.
1913 *Nodosaria filiformis* d'Orbigny; Cushman, p. 55, pl. 27, figs. 1-4.
1950 *Dentalina filiformis* (d'Orbigny); Cushman and McCulloch, p. 314, pl. 40, fig. 17.
1951b *Dentalina* cf. *filiformis* (d'Orbigny); Asano, p. 24, fig. 107.

1960 *Dentalina filiformis* (d'Orbigny); Barker, p. 132, pl. 63, figs. 3-5.
1985 *Dentalina* sp. , Boichard et al., p. 92, pl. 16, fig. 38.

Short description: Test very elongated, slender, arcuate. Numerous chambers, uniserially arranged, distinct, elliptical to ovate, elongate, increasing in height towards the apertural end, later ones somewhat inflated. Wall smooth, finely perforate. Aperture radiate, slightly eccentric, terminal.

Stratigraphic range: See *Dentalina advena* (Cushman). *D. filiformis* has been recorded previously in Late Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: See *Dentalina advena* (Cushman). *D. filiformis* has been found in waterdepths between 18 and 1240 m on the continental margin of New Zealand (Lewis, 1979) and at a depth of 490 m on the Pater Noster Platform (Boichard et al., 1985).

Dentalina subsoluta (Cushman)
(pl. 1, fig. 15)

1884 *Nodosaria soluta* Brady (not Reuss), p. 503, pl. 62, figs. 13-16.
1923 *Nodosaria subsoluta* Cushman; Cushman, p. 74, pl. 13, fig. 1.
1941a *Nodosaria subsoluta* Cushman; LeRoy, p. 26, pl. 3, fig. 53.
1941c *Nodosaria subsoluta* Cushman; LeRoy, p. 114, pl. 1, fig. 30.
1951b *Dentalina subsoluta* (Cushman); Asano, p. 26, figs. 114-115.
1960 *Dentalina subsoluta* (Cushman); Barker, p. 130, pl. 62, figs. 13-16.
1983 *Dentalina subsoluta* (Cushman); Coustillas, pl. 24, figs. 16-17.

Short description: Test elongate, tapering, somewhat arcuate, rather stout, with a single, short basal spine. Chambers few, uniserially arranged, subglobular. Sutures distinct, deeply depressed, oblique. Wall finely perforate, smooth, except for the basal third of each chamber, which is covered with very fine costae. These costae may be interrupted, giving such specimens a spinose appearance. Aperture terminal, slightly protruding and radiate.

Remarks: *D. subsoluta* can be distinguished by its characteristic, well developed spines at the base of each chamber where the costae are broken up.

Stratigraphic range: See *Dentalina advena* (Cushman). *D. subsoluta* has been observed previously in Late Miocene to Recent deposits (see synonymy; Lewis, 1979; Boichard et al., 1985).

Occurrence: See *Dentalina advena* (Cushman). *D. subsoluta* has been found in waterdepths between 113 and 625 m on the continental margin of New Zealand (Lewis, 1979). Coustillas (1983) observed this species between 300 and 400 m in the Mahakam Delta, whereas Boichard et al. (1985) found it at a depth of 715 m on the Pater Noster Platform.

Genus *Frondicularia* Defrance, 1826

Frondicularia lanceolata Van den Broeck

1876 *Frondicularia alata* d'Orbigny var. *lanceolata* Van den Broeck, p. 117, pl. 2, figs. 1-2.

1884 *Frondicularia alata* d'Orbigny var. *lanceolata* Van den Broeck; Brady, p. 522, pl. 66, figs. 3-5.

1960 *Frondicularia lanceolata* Van den Broeck; Barker, p. 138, pl. 66, figs. 3-5.

Short description: Test compressed, flattened, palmate, triangular and lanceolate; initial end bluntly pointed, sometimes with basal spine. Microspheric specimens initially coiled, later uniserial. Low, broad equitant chambers; sutures strongly arched, distinct, reflexed at sharp angle from the median line. Wall smooth, vitreous, finely perforate. Aperture terminal, radiate, single, bordered by a radially cut lip.

Remarks: *F. lanceolata* differs from *Frondicularia complanata* (Defrance) in the fact that in the adult stage the chambers are only slightly curved back.

Stratigraphic range: Because both they occur infrequently, *F. lanceolata* and *F. robusta* have been assembled in *Frondicularia* spp. , which was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: *Frondicularia* spp. have only been found in Recent sediments near Timor, deeper than 914 m (Van Marle, 1988).

Frondicularia robusta Brady

1884 *Frondicularia robusta* Brady, p. 523, pl. 66, figs. 1-2.

1913 *Frondicularia robusta* Brady; Cushman, p. 82, pl. 32, figs. 5-6.

1960 *Frondicularia robusta* Brady; Barker, p. 138, pl. 66, figs. 1-2.

1983 *Frondicularia robusta* Brady; Coustillas, pl. 24, fig. 9.

Short description: Test elongate, compressed, stoutly built; lateral margins nearly parallel, ends obtusely angular or rounded; periphery thick, rounded, slightly lobulate. Chambers numerous, uniserially arranged, nearly uniform in size after the closely coiled, irregular, initial stage; chamber margins obtusely bent, blunt and rounded at the apertural end; sutures distinct, depressed, reflexed at sharp angles from the median line. Wall finely perforate, densely furnished with irregular or interrupted, longitudinal costae. Aperture terminal, radiate.

Remarks: *F. robusta* has a less compressed and flattened form than *Frondicularia lanceolata* Van den Broeck, with a thicker and more solid, costate test, broad, rounded edges, and a different chamber shape.

The specimens figured by Boomgaart (1949, p. 84, pl. 11, figs. 1a-b) as *Frondicularia* species A. resemble *F. robusta*, but are less costate.

Stratigraphic range: See *Frondicularia lanceolata* Van den Broeck. *F. robusta* has been observed previously in Recent sediments.

Occurrence: See *Frondicularia lanceolata* Van den Broeck. Coustillas (1983) found *F. robusta* in sediments between 100 and 200 m in the Mahakam Delta.

Genus *Nodosaria* Lamarck, 1812

Nodosaria catenulata Brady

1884 *Nodosaria catenulata* Brady, p. 515, pl. 63, figs. 32-34.
1913 *Nodosaria catenulata* Brady; Cushman, p. 57, pl. 25, fig. 3.
1951b *Nodosaria catenulata* Brady; Asano, p. 21, fig. 97.
1960 *Nodosaria catenulata* Brady; Barker, p. 134, pl. 63, figs. 32-34.
1983 *Nodosaria catenulata* Brady; Coustillas, pl. 25, figs. 5a-b.

Short description: Test elongate, slender, straight or slightly curved, tapering, rounded in section, apical end with spine. Chambers numerous, rectilinear, elliptical or ovate, sharply separated by deep, straight sutures. Wall smooth, except for the sutures which are ornamented by 4-6 longitudinal, thick costae, that are partly continuous over the chambers. Aperture small, radiate, terminal, on a long tapering, costate neck.

Stratigraphic range: See *Nodosaria longiscata* d'Orbigny. *N. catenulata* has been described previously from Pliocene to Recent deposits.

Occurrence: See *Nodosaria longiscata* d'Orbigny. Coustillas (1983) observed *N. catenulata* in samples from waterdepths between 200 and 400 m in the Mahakam Delta.

Nodosaria inflexa Reuss

1866 *Nodosaria inflexa* Reuss, p. 131, pl. 2, fig. 1.
1884 *Nodosaria inflexa* Reuss; Brady, p. 498, pl. 62, fig. 9.
1913 *Nodosaria inflexa* Reuss; Cushman, p. 52, pl. 25, fig. 1.
1960 *Nodosaria inflexa* Reuss; Barker, p. 130, pl. 62, fig. 9.
1978 *Nodosaria inflexa* Reuss; Hofker, p. 38, pl. 3, fig. 9.

Short description: Test elongate, arcuate, stout, composed of few globular to ovate chambers, inflated, rectilinear; apical end with a short spine. Sutures distinct, depressed, straight, horizontal. Wall white, opaque, smooth, though lower parts of chambers may be slightlty striated. Aperture radiate, at the end of an acute neck.

Remarks: Most authors describe and figure only incomplete tests of *N. inflexa* which lack the initial part (Hofker, 1978).

Stratigraphic range: See *Nodosaria longiscata* d'Orbigny. *N. inflexa* has been described previously from Pliocene to Recent deposits (see synonymy and Boichard et al., 1985).

Occurrence: See *Nodosaria longiscata* d'Orbigny. Boichard et al. (1985) found *N. inflexa* in sediments between 549 and 715 m on the Pater Noster Platform.

Nodosaria longiscata d'Orbigny

(pl. 2, fig. 6)

1846 *Nodosaria longiscata* d'Orbigny, p. 32, pl. 1, figs. 10-12.
1926 *Nodosaria longiscata* d'Orbigny; Chapman, p. 51, pl. 11, fig. 7.
1941a *Nodosaria longiscata* d'Orbigny; LeRoy, p. 27, pl. 3, fig. 69.
1941b *Nodosaria longiscata* d'Orbigny; LeRoy, p. 75, pl. 1, fig. 31.
1949 *Nodosaria longiscata* d'Orbigny; Boomgaart, p. 79, pl. 6, fig. 12.
1961 *Nodosaria longiscata* d'Orbigny; De Hornibrook, p. 46, pl. 6, figs. 93-94.
1964 *Nodosaria longiscata* d'Orbigny; LeRoy, p. 24, pl. 15, fig. 23.
1985 *Nodosaria longiscata* d'Orbigny; Papp and Schmid, p. 23, pl. 3, figs. 1-5 (redescription).

Short description: Test very long and slender, rectilinear. Individual chambers very long, circular in section, increasing somewhat in width near the sutures; the first chambers inflated; sutures distinct, broad. Wall white, entirely smooth, finely perforate.

Remarks: The aperture has not been observed in any of our specimens (always broken off).

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Nodosaria* spp. : *N. catenulata*, *N. inflexa*, *N. longiscata*, *N. pyrula*, and *N. simplex*, of which *N. longiscata* is most common. *Nodosaria* spp. was found in Early - Middle Miocene (N8), Middle Miocene - Quaternary deposits (N14-23), and in Recent East Indonesian sediments (Van Marle, 1988).

N. longiscata has been widely recorded in Oligocene to Recent deposits from the Indo-Pacific region (see synonymy; Chapman, 1926; Coustillas, 1983).

Occurrence: *Nodosaria* spp. show a scattered depth distribution in Recent eastern Indonesian sediments down from 78 m, with the highest frequencies in the upper - middle bathyal zone (Van Marle, 1988).

According to LeRoy (1964) *N. longiscata* is an outer neritic - upper bathyal form, which is confirmed by the data of Coustillas (1983), who found it in samples from waterdepths between 150 and 250 m in the Mahakam Delta.

Nodosaria pyrula d'Orbigny

1826 *Nodosaria pyrula* d'Orbigny, p. 253, mod. no. 13.
1846 *Nodosaria Mariae* d'Orbigny, p. 33, pl. 1, figs. 15-16.
1846 *Nodosaria semirugosa* d'Orbigny, p. 34, pl. 1, figs. 20-23.
1884 *Nodosaria pyrula* d'Orbigny; Brady, p. 497, pl. 62, figs. 10-12.

1913 *Nodosaria pyrula* d'Orbigny; Cushman, p. 49, pl. 26, figs. 1-3.
1941b *Nodosaria pyrula* d'Orbigny var. *semirugosa* d'Orbigny; LeRoy, p. 74, pl. 1, fig. 19.
1951b *Nodosaria pyrula* d'Orbigny; Asano, p. 22, fig. 99.
1960 *Dentalina guttifera* Barker (not d'Orbigny); Barker, p. 130, pl. 62, figs. 10-12.
1961 *Nodosaria pyrula* d'Orbigny; De Hornibrook, p. 47, pl. 6, fig. 97.
1983 *Nodosaria pyrula* d'Orbigny; Coustillas, pl. 25, figs. 4, 6.
1985 *Nodosaria pyrula* d'Orbigny; Papp and Schmid, p. 24, pl. 4, figs. 2-3 and 6-8 (redescription).

Short description: Test elongate, very slender, pyriform. Numerous spherical chambers, varying in size, either rectilinear in a straight line or slightly curved, distinctly separated by characteristic long, narrow, tubular necks. Proloculus extended backwards into a long drawn-out point. Wall smooth, white, finely perforate. Aperture radiate, on a long, tubular neck.

Remarks: The author agrees with Papp and Schmid (1985), who reassigned *Nodosaria semirugosa* d'Orbigny 1846) to *N. pyrula*, that the longitudinal striae at the basis of the chambers are not a genetically fixed species character.

Stratigraphic range: See *Nodosaria longiscata* d'Orbigny. *N. pyrula* has been described previously from Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Nodosaria longiscata* d'Orbigny. Coustillas (1983) found *N. pyrula* at a depth of 211 m in the Mahakam Delta.

Nodosaria simplex Silvestri
(pl. 2, fig. 5)

1872 *Nodosaria simplex* Silvestri, p. 95, pl. 11, figs. 268-272.
1884 *Nodosaria simplex* Silvestri; Brady, p. 496, pl. 62, figs. 4-6.
1913 *Nodosaria simplex* Silvestri; Cushman, p. 49, pl. 28, fig. 5.
1923 *Nodosaria simplex* Silvestri; Cushman, p. 68, pl. 14, fig. 10.
1960 *Nodosaria simplex* Silvestri; Barker, p. 130, pl. 62 figs. 4-6.
1985 *Nodosaria simplex* Silvestri; Boichard et al., p. 92, pl. 16, fig. 45.

Short description: Test straight, rectilinear, irregular, rounded in section, composed of two or more chambers. Initial chamber globular, sometimes with a short spine at the base, the second chamber pyriform, with a drawn-out neck, later chambers fusiform; sutures depressed. Wall smooth, finely perforate. Aperture terminal, radiate.

Remarks: Our specimens of *N. simplex* closely resemble the type description of this species, though the aperture is often broken off.

Stratigraphic range: See *Nodosaria longiscata* d'Orbigny. *N. simplex* has been observed previously in Recent sediments (see synonymy and Lewis, 1979).

Occurrence: See *Nodosaria longiscata* d'Orbigny. *N. simplex* has been found at a depth of 276 m on the continental margin of New Zealand (Lewis, 1979) and at 490 m on the Pater Noster Platform (Boichard et al., 1985).

Genus *Orthomorphina* Stainforth, 1952

Orthomorphina challengeriana (Thalmann)

(pl. 2, figs. 1-2)

1884 *Nodosaria perversa* Brady (not Schwager), p. 512, pl. 64, figs. 25-27.
1937 *Nodogenerina challengeriana* Thalmann, p. 341 (nomen novum).
1960 *Orthomorphina challengeriana* (Thalmann); Barker, p. 136, pl. 64, figs. 25-27.
1964 *Orthomorphina challengeriana* (Thalmann); LeRoy, p. 29, pl. 15, fig. 26.
1978 *Orthomorphina challengeriana* (Thalmann); Boltovskoy, p. 163, pl. 5, figs. 16-17.

Short description: Test irregular, elongate, rectilinear, uniserial, often thickest in the middle part of the test. Chambers inflated; sutures distinct, depressed, horizontal, broad. Wall finely and densely perforate, usually only the basal parts of the chambers ornamented by many, parallel, longitudinal striae, discontinuous over the sutures; upper parts rugose, but sometimes completely striate. Aperture rounded, terminal, on a short neck, with a rim.

Stratigraphic range: *O. challengeriana* was found in Middle Miocene - Quaternary deposits (N14-23). It has been described previously from Early Oligocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: According to LeRoy (1964) *O. challengeriana* is an upper - middle bathyal form.

Genus *Planularia* Defrance, 1826

Planularia australis Chapman

1884 *Cristellaria tricarinella* Brady (not Reuss), p. 540, pl. 68, figs. 3-4.
1915 *Cristellaria tricarinella* Chapman (not Reuss), p. 24, pl. 1, fig. 6.
1941 *Planularia australis* Chapman, p. 158, pl. 9, fig. 1.
1960 *Planularia australis* Chapman; Barker, p. 142, pl. 68, figs. 3-4.
1978 *Planularia australis* Chapman; Hofker, p. 40, pl. 4, figs. 1-2.
1983 *Planularia australis* Chapman; Coustillas, pl. 24, figs. 2-3.

Short description: Test subovate to elongate-arcuate, with much compressed, plate-like sides with a complanate surface and carinate margins. Earlier chambers closely coiled, later ones uncoiling along slightly curved axis, becoming elongate and extending back to previous whorl. Chambers numerous, low, broad, added along slightly curved axis; sutures flush, oblique, highest at outer margin, limbate. Wall smooth, finely and densely perforate; early, coiled portion sometimes spinose. Aperture radiate, terminal, on a slightly protruding neck.

Remarks: According to Chapman (1941) *P. australis* differs from the typical *Cristellaria tricarinella* Reuss in having the sutures flush with the surface. *P. australis* can be distinguished from *Planularia gemmata* (Brady) by the absence of ornamentation.

According to Hofker (1978) the microspheric and megalospheric generations of *P. australis* differ in morphology. The microspheric generation is oval in outline, without spines at the initial end, the megalospheric generation is much more elongate and has one or more spines at its thickened initial end.

Stratigraphic range: *P. australis* occurs in Late Miocene deposits (N15) from Buton. It has been observed previously in Pliocene to Recent deposits.

Occurrence: Hofker (1978) mentioned that *P. australis* occurs in Indonesian waters with relatively high temperatures (6-15 degrees Celsius) corresponding-with depths between 152 to 576 m. Coustillas (1983) found it in samples from waterdepths between 50 and 300 m in the Mahakam Delta.

Planularia gemmata (Brady)
(pl. 1, figs. 4 and 9)

1881 *Cristellaria gemmata* Brady, p. 64 (nomen nudum).
1884 *Cristellaria gemmata* Brady, p. 554, pl. 71, figs. 6-7.
1913 *Cristellaria gemmata* Brady; Cushman, p. 75, pl. 34, fig. 7.
1960 *Planularia gemmata* (Brady); Barker, p. 148, pl. 71, figs. 6-7.
1983 *Planularia gemmata* (Brady); Coustillas, pl. 24, fig. 4.

Short description: Test broad, oblong, planispiral, strongly compressed; lateral faces only slightly convex, dorsal edge acute or subcarinate. Earlier chambers spiral and embracing, later ones broad and arcuate, last two or three free at both lateral margins; sutures oblique, curved, highest at outer margin. Wall finely and densely perforate. Each chamber ornamented with a row of beads upon the sutural lines or parallel to them. Aperture radiate, terminal, at peripheral angle, may protrude slightly.

Remarks: *P. gemmata* differs from congeneric species by its characteristic ornamentation.

Stratigraphic range: *P. gemmata* occurs in Late Miocene deposits (N15) from Buton. It has been described previously from Recent sediments.

Occurrence: Coustillas (1983) found this species in samples from waterdepths between 50 and 300 m in the Mahakam Delta.

Genus *Pseudonodosaria* Boomgaart, 1949

Pseudonodosaria aequalis (Reuss)
(pl. 1, fig. 18)

1863 *Glandulina aequalis* Reuss, p. 48, pl. 3, fig. 28.
1884 *Nodosaria* (*Glandulina*) *aequalis* (Reuss); Brady, p. 492, pl. 61, fig. 32.
1960 *Rectoglandulina aequalis* (Reuss); Barker, p. 128, pl. 61, fig. 32.
1988 *Rectoglandulina aequalis* (Reuss); Van Marle, p. 148, pl. 4, fig. 23.

Short description: Test cylindrical, both ends bluntly pointed, uniserial and rectilinear throughout, normally composed of about 5 chambers, which embrace strongly, at least in early portion, later chambers more inflated and less embracing; sutures distinct, horizontal, slightly depressed. Wall white, smooth, finely perforate. Aperture terminal, radiate.

Remarks: *P. aequalis* has less chambers and less depressed sutures than *Pseudonodosaria radicula* (Linnaeus).

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Pseudonodosaria* spp. : *P. aequalis*, *P. comatula*, *P. radicula*, and *Glandulina laevigata* d'Orbigny, of which *P. aequalis* and *G. laevigata* are most common. *Pseudonodosaria* spp. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). *P. aequalis* and *P. comatula* have also been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: In Recent eastern Indonesian sediments, *Pseudonodosaria* spp. usually occur at upper bathyal depths, but also shows scattered deeper occurrences (Van Marle, 1988).

Pseudonodosaria comatula (Cushman)

1884 *Nodosaria comata* Brady (not Batsch), p. 509, pl. 64, figs. 1-5.
1923 *Nodosaria comatula* Cushman, p. 83, pl. 14, fig. 5.
1950 *Glandulina comatula* (Cushman); Cushman and McCulloch, p. 325, pl. 42, figs. 5-7.
1960 *Rectoglandulina comatula* (Cushman); Barker, p. 134, pl. 64, figs. 1-5.
1980 *Glandulina comatula* (Cushman); Haller, p. 237, pl. 4, fig. 14.

Short description: Test short and stout; initial end broadly rounded, sometimes with a small central spine, apertural end slightly tapering, uniserial and rectilinear. Chambers few, inflated, giving a somewhat lobulate appearance to the periphery; sutures distinct, somewhat depressed. Wall finely perforate, ornamented by numerous low, rounded, continuous, closely spaced longitudinal costae; in the adult the apertural end of the last chamber sometimes smooth. Aperture central, terminal, radiate.

Remarks: *P. comatula* differs from congeneric species by its ornament of numerous longitudinal costae.

Stratigraphic range: See *Pseudonodosaria aequalis* (Reuss).

Occurrence: See *Pseudonodosaria aequalis* (Reuss).

Pseudonodosaria radicula (Linnaeus)
(pl. 1, fig. 17)

1739 'Cornu Hammonis erectum'; Plancus, p. 14, pl. 1, figs. 5a-c.
1767 *Nautilus radicula* Linnaeus, p. 714.
1884 *Nodosaria radicula* (Linnaeus); Brady, p. 495, pl. 61, figs. 28-31.

1941a *Nodosaria radicula* (Linnaeus); LeRoy, p. 26, pl. 1, fig. 51; pl. 2, figs. 3-4.
1941b *Nodosaria radicula* (Linnaeus); LeRoy, p. 75, pl. 1, fig. 24.
1949 *Nodosaria radicula* (Linnaeus); Boomgaart, p. 79, pl. 6, fig. 2.
1960 *Nodosaria radicula* (Linnaeus) var. *glanduliniformis* Dervieux; Barker, p. 128, pl. 61, figs. 28-31.
1964 *Rectoglandulina radicula* (Linnaeus); LeRoy, p. 23, pl. 15, fig. 24.
1983 *Nodosaria radicula* (Linnaeus) var. *glanduliniformis* Dervieux; Coustillas, pl. 25, fig. 7.

Short description: Test elongate, cylindrical, uniserial and rectilinear, tapering to both ends, often with basal spine. Chambers distinct, usually 5-6; sutures depressed, distinct, horizontal. Wall smooth, finely perforate. Aperture radiate, terminal, on a short neck.

Remarks: *P. radicula* consists of more chambers than *Pseudonodosaria aequalis* (Reuss), its sutures are more depressed, and it has a characteristic bulbous initial end.

Stratigraphic range: See *Pseudonodosaria aequalis* (Reuss). *P. radicula* has been previously described from Late Miocene to Recent deposits.

Occurrence: See *Pseudonodosaria aequalis* (Reuss). According to LeRoy (1964) *P. radicula* is an outer neritic - upper bathyal form. Coustillas (1983) found this form in sediments between 300 and 400 m in the Mahakam Delta.

Genus *Saracenaria* Defrance, 1824

Saracenaria italica Defrance

1824 *Saracenaria italica* Defrance, p. 176, pl. 13, figs. 6a-c.
1884 *Cristellaria italica* (Defrance); Brady, p. 544, pl. 68, figs. 17-18 and 20-23.
1913 *Cristellaria italica* (Defrance); Cushman, p. 78, pl. 33, fig. 3.
1941a *Saracenaria italica* Defrance; LeRoy, p. 28, pl. 1, figs. 53-54.
1941b *Saracenaria italica* Defrance; LeRoy, p. 76, pl. 7, figs. 21-24.
1949 *Saracenaria italica* Defrance; Boomgaart, p. 82, pl. 6, fig. 18.
1960 *Saracenaria italica* Defrance; Barker, p. 144, pl. 68, figs. 17-18 and 20-23.
1964 *Saracenaria italica* Defrance; LeRoy, p. 25, pl. 3, figs. 29-30.
1964 *Saracenaria italica* Defrance; Loeblich and Tappan, C524, figs. 408,11a-b.
1976 *Saracenaria italica* Defrance; Berggren and Haq, p. 102, pl. 1, fig. 8.
1983 *Saracenaria italica* Defrance; Coustillas, pl. 23, fig. 20 (not 17).

Short description: Test stout, trihedral, triangular in cross section, margins rounded, but acute. Early chambers closely coiled, later ones uncoiling, short, not extending back to earlier convolutions; sutures somewhat depressed, distinct, slightly oblique. Wall smooth, finely perforate. Apertural face broad and flat, triangular; aperture at peripheral angle, radiate.

Remarks: *S. italica* differs from *Saracenaria latifrons* Brady by its only slightly oblique sutures and broad, flat, triangular apertural face, though the specimens vary considerably in shape (see also Boomgaart, 1949).

Stratigraphic range: *S. italica* was found in Middle - Late Miocene (N14-16) and Late Pliocene - Quaternary island deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

S. italica has been observed previously in Late Miocene to Recent deposits (see synonymy and Boichard et al., 1985).

Occurrence: *S. italica* shows a scattered depth distribution down from 545 m in Recent eastern Indonesian sediments (Van Marle, 1988). According to LeRoy (1964) it is primarily an outer neritic - upper bathyal form, which is confirmed by the data of Coustillas (1983), who observed this species in waterdepths between 100 and 400 m in the Mahakam Delta, and of Boichard et al. (1985), who found it between 190 and 490 m on the Pater Noster Platform.

Subfamily *Plectofrondiculariinae* Cushman, 1927

Genus *Plectofrondicularia* Liebus, 1902

Plectofrondicularia advena (Cushman)

(pl. 1, fig. 12)

1884	*Frondicularia inaequalis* Brady (not Costa), p. 521, pl. 66, figs. 8-12.
1923	*Frondicularia advena* Cushman, p. 141, pl. 20, figs. 1-2.
1951b	*Frondicularia advena* Cushman; Asano, p. 37, fig. 158.
1960	*Parafrondicularia advena* (Cushman); Barker, p. 138, pl. 66, figs. 8-12.
1978	*Frondicularia advena* Cushman; Boltovskoy, p. 160, pl. 4, fig. 9.
1980	*Plectofrondicularia advena* (Cushman); Haller, p. 242, pl. 6, figs. 5-7.
1980	*Plectofrondicularia advena* (Cushman); Keller, p. 844, pl. 1, fig. 13.

Short description: Test compressed, irregularly elliptical, initial end usually narrow, bluntly pointed; margins may have a slight peripheral keel. Proloculus subspherical, following chambers biserially arranged, later ones uniserially, with typical V-shaped frondicularian chambers, highest in the center, from there gradually tapering to the pointed lower ends. Sutures limbate, slightly depressed. Wall thin, translucent, smooth. Aperture terminal, central, circular, radial with elevated margin at outer edge.

Remarks: Though morphologically close to the genus *Frondicularia* Defrance (1826), Boomgaart (1949) transferred this species to the genus *Parafrondicularia* Asano (1938) (junior synonym of *Plectofrondicularia*, see Loeblich and Tappan, 1964), because of the biserial initial stage.

Stratigraphic range: See *Plectofrondicularia helenae* (Chapman). *P. advena* has been observed previously in Middle Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Plectofrondicularia helenae* (Chapman). Asano (1951b) described *P. advena* as a typical Indo-Pacific species.

Plectofrondicularia helenae (Chapman)
(pl. 1, figs. 10-11)

1884 *Frondicularia interrupta* Brady (not Karrer), p. 523, pl. 66, figs. 6-7.
1941 *Parafrondicularia helenae* Chapman, p. 154, 170.
1960 *Parafrondicularia helenae* Chapman; Barker, p. 138, pl. 66, figs. 6-7.

Short description: Test flattened, elongate, broadest near the apertural end, tapering towards the bluntly rounded base. Early chambers biserially arranged, later ones uniserial, frondicularian. Sutures distinct, limbate. Wall finely perforate, ornamented by numerous, fine, longitudinal striations. Aperture terminal, radial, with elevated margin at the outer edge.

Remarks: *Plectofrondicularia japonica* Asano closely resembles *P. helenae* and must be considered as a junior synonym. *Parafrondicularia javana* Boomgaart (1949) also is similar in general morphology, but is a smooth form.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Plectofrondicularia* spp.: *P. advena*, *P. helenae*, and *P. parri*, of which *P. helenae* is most common. *Plectofrondicularia* spp. was found in Middle Miocene - Quaternary deposits (N14-23) and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: *Plectofrondicularia* spp. have in Recent sediments only been found near Timor, deeper than 914 m (Van Marle, 1988).

Plectofrondicularia parri Finlay

1939 *Plectofrondicularia parri* Finlay, p. 516, pl. 68, fig. 4.
1961 *Plectofrondicularia parri* Finlay; De Hornibrook, p. 82, pl. 12, figs. 244-245.
1986 *Plectofrondicularia parri* Finlay; Van Morkhoven et al., p. 128, pl. 41, figs. 1-2.

Short description: Test strongly compressed, tapering, narrowly elongated, greatest width towards the apertural end, sides keeled (tricarinate). Chambers numerous, distinct, increasing in height towards the apertural end, initially biserially arranged, later uniserial. Sutures distinct, depressed, each half sigmoidally curved, slightly limbate. Wall smooth, except for the lower part of the flattened sides of the test which is ornamented by two costae. Aperture terminal, elliptical, radiate.

Remarks: *P. parri* from New Zealand closely resembles the Upper Oligocene - Lower Miocene *Plectofrondicularia floridana* Cushman from Florida (Van Morkhoven et al., 1986). The only difference between the two species lies in the sculpture: *P. floridana* has a single, short median costa over the first few chambers, while in *P. parri* there normally are two costae, running more than halfway up the shell.

Stratigraphic range: See *Plectofrondicularia helenae* (Chapman). *P. parri* has been described previously from Late Oligocene - Late Miocene deposits.

Occurrence: See *Plectofrondicularia helenae* (Chapman).

Family *Vaginulinidae* Reuss, 1860
Subfamily *Lenticulininae* Chapman, Parr and Collins, 1934
Genus *Lenticulina* Lamarck, 1804

Lenticulina calcar (Linnaeus)

1739 'Cornu Hammonis', Plancus, p. 12, pl. 1, figs. 3-4.
1758 *Nautilus calcar* Linnaeus, p. 709.
1798 *Nautilus calcar* Linnaeus var. a Fichtel and Moll, p. 71, pl. 11, figs. a-c.
1846 *Robulina calcar* (Linnaeus); d'Orbigny, p. 99, pl. 4, figs. 18-20.
1884 *Cristellaria calcar* (Linnaeus); Brady, p. 551, pl. 70, figs. 9-12.
1913 *Cristellaria calcar* (Linnaeus); Cushman, p. 72, pl. 32, fig. 4.
1929 *Robulus calcar* (Linnaeus); Cushman, p. 84, pl. 12, fig. 18.
1941a *Robulus calcar* (Linnaeus); LeRoy, p. 24, pl. 1, figs. 88-89.
1951b *Robulus calcar* (Linnaeus); Asano, p. 2, fig. 5.
1960 *Lenticulina calcar* (Linnaeus); Barker, p. 146, pl. 70, figs. 9-12.
1964 *Robulus calcar* (Linnaeus); LeRoy, p. 22, pl. 4, figs. 14-15.
1976 *Lenticulina calcar* (Linnaeus); Berggren and Haq, p. 106, pl. 3, figs. 4-6.
1980 *Lenticulina calcar* (Linnaeus); Haller, p. 233, pl. 3, figs. 4a-b.
1983 *Lenticulina calcar* (Linnaeus); Coustillas, pl. 23, fig. 12.
1984 *Lenticulina calcar* (Linnaeus); Rögl and Hansen, p. 51, pl. 15, figs. 3-4; pl. 17, fig. 1.
1985 *Lenticulina calcar* (Linnaeus); Papp and Schmid, p. 42, pl. 30, figs. 1-3.

Short description: Test large, semicircular in outline, biconvex, tightly planispirally coiled, involute, umbonate. Periphery with a small and distinct keel and a long, acicular spine projecting from each chamber. Five to seven chambers in the last whorl, increasing gradually in size. Sutures distinct, slightly curved, limbate, not depressed. Wall smooth, with distinct central pillar. Aperture at peripheral angle of chamber, radiate, with vertical slit.

Stratigraphic range: See *lenticulina gibba* (d'Orbigny). *L. calcar* has been observed previously in Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Lenticulina gibba* (d'Orbigny). According to LeRoy (1964) *L. calcar* is a shallow water form. Coustillas (1983) found this species in waterdepths greater than 300 m in the Mahakam Delta.

Lenticulina costata (Fichtel and Moll)
(pl. 1, fig. 3)

1798 *Nautilus costatus* Fichtel and Moll, p. 47, pl. 4, figs. g-i.

1826 *Robulina costata* (Fichtel and Moll); d'Orbigny, p. 289, mod. no. 13.
1884 *Cristellaria costata* (Fichtel and Moll); Brady, p. 555, pl. 71, fig. 9.
1913 *Cristellaria costata* (Fichtel and Moll); Cushman, p. 75, pl. 34, fig. 4.
1941a *Robulus costatus* (Fichtel and Moll); LeRoy, p. 24, pl. 1, figs. 64-65.
1951b *Robulus costatus* (Fichtel and Moll); Asano, p. 2, fig. 8.
1960 *Lenticulina costata* (Fichtel and Moll); Barker, p. 148, pl. 71, fig. 9.
1964 *Robulus costatus* (Fichtel and Moll); LeRoy, p. 22, pl. 4, figs. 9-10.
1983 *Lenticulina costata* (Fichtel and Moll) var. *multicostata* (Cushman); Coustillas, pl. 23, fig. 9b.
1984 *Lenticulina costata* (Fichtel and Moll); Rögl and Hansen, p. 38, pl. 9, figs. 1-2.
1985 *Robulus costatus* Fichtel and Moll; Boichard et al., p. 92, pl. 16, fig. 10.
1985 *Lenticulina costata* (Fichtel and Moll); Papp and Schmid, p. 42, pl. 30, figs. 4-7.

Short description: Test semicircular in outline, planispiral, biumbonate, closely coiled, involute, 5-6 chambers in the last whorl, periphery subangular with narrow keel and a few non-pointed projections. Sutures distinct, sometimes thickened and ornamented with a raised ridge which ends near the umbilical region into rows of knobs. Wall, except for the smooth apertural face, distinctly ornamented with several costae parallel to the peripheral margin. Aperture radiate, protruding, with a median slit.

Stratigraphic range: We found this species in Middle - Late Miocene (N14-16), Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). *L. costata* has been widely recorded in Late Miocene to Recent deposits from the Indo-Pacific region (see synonymy and Boomgaart, 1949).

Occurrence: Asano (1951b) described *L. costata* as a typical Indo-Pacific species. LeRoy (1964) reported it to be a neritic form. Coustillas (1983) found it in samples from waterdepths between 45 and 70 m in the Mahakam Delta and Boichard et al. (1985) from 260 m on the Pater Noster Platform.

Lenticulina gibba (d'Orbigny)
(pl. 1, fig. 1)

1839 *Cristellaria gibba* d'Orbigny, p. 40, pl. 7, figs. 20-21.
1884 *Cristellaria gibba* d'Orbigny; Brady, p. 546, pl. 69, figs. 8-9.
1913 *Cristellaria gibba* d'Orbigny; Cushman, p. 69, pl. 35, fig. 1.
1933b *Robulus gibbus* (d'Orbigny); Cushman, p. 6, pl. 2, figs. 2, 6-7.
1941a *Robulus gibbus* (d'Orbigny); LeRoy, p. 24, pl. 3, figs. 58-59.
1960 *Lenticulina gibba* (d'Orbigny); Barker, p. 144, pl. 69, figs. 8-9.
1961 *Lenticulina gibba* (d'Orbigny); De Hornibrook, p. 39, pl. 3, fig. 50.
1988 *Lenticulina gibba* (d'Orbigny); Van Marle, p. 145, pl. 1, fig. 21.

Short description: Test oval, planispirally coiled; slightly biconvex, longer than broad, involute. Inner face decidedly contracted, peripheral margin slightly keeled. Seven to ten chambers in the final whorl, elongate, strongly curved. Sutures distinct, not depressed, limbate. Wall smooth, finely perforate. Aperture radiate at the peripheral angle with a distinct vertical slit. Apertures of earlier chambers apparent, even in adult conditions.

Remarks: L. gibba is characterized by its elongated, oval form and the distinct apertures of earlier chambers.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Lenticulina* spp.: *L. calcar*, *L. iota*, *L. orbicularis*, and *L. vortex*, of which *L. gibba* is most common (N.B. *Lenticulina costata* (Fichtel and Moll) and *Lenticulina peregrina* (Schwager) have not been included). *Lenticulina* spp. was found in Early - Middle Miocene (N8), Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

L. gibba has been observed previously in Late Miocene to Recent deposits (see synonymy; Lewis, 1979; Coustillas, 1983).

Occurrence: In eastern Indonesian regions *Lenticulina* spp. have been found in waterdepths between 60 and 550 m, and are isobathyal in the upper bathyal zone between 150 and 317 m (Van Marle, 1988). Similar observations have been made by Boichard et al. (1985) on the Pater Noster Platform.

L. gibba has been observed in samples from waterdepth between 100 and 500 m on the continental margin of New Zealand (Lewis, 1979) and between 150 and 300 m in the Mahakam Delta (Coustillas, 1983).

Lenticulina iota (Cushman)

1884 *Cristellaria cultrata* Brady (not De Montfort), p. 550, pl. 70, figs. 4-6.
1923 *Cristellaria iota* Cushman, p. 111, pl. 29, fig. 2; pl. 30, fig. 1.
1941b *Robulus iota* (Cushman); LeRoy, p. 73, pl. 6, figs. 7-8.
1951b *Robulus iotus* (Cushman); Asano, p. 4, figs. 17-18.
1960 *Lenticulina iota* (Cushman); Barker, p. 146, pl. 70, figs. 4-6.
1983 *Lenticulina iota* (Cushman); Coustillas, pl. 23, fig. 3.

Short description: Test subcircular in outline, lenticular in side view, planispiral, closely coiled, involute. Periphery with a thin, broad keel. Umbonal region occupied by a large, thickened, transparent umbo. Twelve to fifteen chambers in the last whorl. Sutures curved, very slightly limbate. Wall smooth, finely perforate. Aperture radiate with distinct median slit.

Remarks: *L. iota* has more chambers than *Lenticulina calcar* (Linnaeus), and does not have the long, acicular spines projecting from each chamber.

Stratigraphic range: See *Lenticulina gibba* (d'Orbigny). *L. iota* has been described previously from Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Lenticulina gibba* (d'Orbigny). Coustillas (1983) observed *L. iota* in samples from waterdepths between 50 and 400 m in the Mahakam Delta.

Lenticulina orbicularis (d'Orbigny)

1798 *Nautilus calcar* Linnaeus var. B Fichtel and Moll, p. 72, pl. 11, figs. d-f.
1826 *Robulina orbicularis* d'Orbigny, p. 288, pl. 15, figs. 8-9.
1884 *Cristellaria orbicularis* (d'Orbigny); Brady, p. 549, pl. 69, fig. 17.
1913 *Cristellaria orbicularis* (d'Orbigny); Cushman, p. 67, pl. 36, figs. 4-5.
1941a *Robulus orbicularis* (d'Orbigny); LeRoy, p. 23, pl. 2, figs. 13-14.
1951b *Robulus orbicularis* (d'Orbigny); Asano, p. 6, fig. 27.
1960 *Robulus orbicularis* (d'Orbigny); Barker, p. 144, pl. 69, fig. 17.
1983 *Lenticulina orbicularis* (d'Orbigny); Coustillas, pl. 23, figs. 1-2.
1984 *Lenticulina orbicularis* (d'Orbigny); Rögl and Hansen, p. 51, pl. 15, fig. 5; pl. 16, fig. 5; pl. 17, figs. 2, 4.

Short description: Test circular in outline, biumbonate, planispiral, closely coiled, involute. Periphery extended into a marginal keel, variable in width, without spines. About 10-14 elongate and strongly retroverted chambers in the last whorl. Sutures distinct, strongly curved, not depressed. Wall smooth, with distinct, glossy umbonal plug. Aperture radiate, with vertical slit.

Remarks: *L. orbicularis* has much stronger curved and retroverted sutures than *Lenticulina iota* (Cushman).

Stratigraphic range: See *Lenticulina gibba* (d'Orbigny). *L. orbicularis* has been observed previously in Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Lenticulina gibba* (d'Orbigny). Coustillas (1983) found *L. orbicularis* in sediments between 50 and 200 m in the Mahakam Delta.

Lenticulina peregrina (Schwager)
(pl. 1, fig. 2)

1866 *Cristellaria peregrina* Schwager, p. 245, pl. 7, fig. 89.
1884 *Cristellaria variabilis* Brady (not Schwager), p. 541, pl. 68, figs. 11-16.
1923 *Cristellaria peregrina* Schwager; Cushman, p. 113, pl. 30, figs. 3-4.
1950 *Lenticulina peregrina* (Schwager); Cushman and McCulloch, p. 302, pl. 39, fig. 5.
1951b *Lenticulina peregrina* (Schwager); Asano, p. 10, figs. 49-51.
1960 *Lenticulina peregrina* (Schwager); Barker, p. 144, pl. 68,figs. 11-16.
1964 *Lenticulina peregrina* (Schwager); LeRoy, p. 22, pl. 4, figs. 5-6.
1980 *Lenticulina peregrina* (Schwager); Srinivasan and Sharma, p. 34, pl. 6, fig. 24 (neotype).
1986 *Lenticulina peregrina* (Schwager); Van Morkhoven et al., p. 92, pl. 27, figs. 1-2.
1988 *Lenticulina peregrina* (Schwager); Van Marle, p. 145, pl. 2, fig. 24.

Short description: Test compressed, oval in outline, planispiral, closely coiled, involute. Periphery sometimes with a transparent, thin flange. Three to four chambers in the last whorl, which gradually increase in height as added, the last chamber tending to become evolute. Sutures slightly curved, distinct, sometimes slightly depressed. Wall thin, translucent, smooth, finely perforate. Radiate aperture, early position peripheral, the last one nearly terminal, central.

Remarks: Brady's illustrations (1884, pl. 68, figs. 11-16) depict the range of variation observed in this species (Srinivasan and Sharma, 1980). The weak to moderately developed keel may not always be present on the specimens found here (see also Van Morkhoven et al., 1986).

Stratigraphic range: *L. peregrina* was found in Early - Middle Miocene (N8), Middle Miocene - Early Pliocene (N14-18), Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Oligocene to Recent deposits.

Occurrence: In eastern Indonesian regions *L. peregrina* occurs generally in samples from waterdepths between 711 and 1654 m with its DLO at 1100 m, and has its UDL at 545 m (Van Marle, 1988).

L. peregrina is a cosmopolitan, deep water form (Pflum and Frerichs, 1976; Srinivasan and Sharma, 1980; Van Morkhoven et al., 1986).

Lenticulina vortex (Fichtel and Moll)

1798	*Nautilus vortex* Fichtel and Moll, p. 33, pl. 2, figs. d-i.
1826	*Robulina vortex* (Fichtel and Moll); d'Orbigny, p. 288, mod. no. 4.
1884	*Cristellaria vortex* (Fichtel and Moll); Brady, p. 548, pl. 69, figs. 14-16.
1913	*Cristellaria vortex* (Fichtel and Moll); Cushman, p. 68, pl. 32, fig. 3.
1946	*Robulus vortex* (Fichtel and Moll); Cushman, p. 6, pl. 1, figs. 3-4.
1960	*Robulus vortex* (Fichtel and Moll); Barker, p. 144, pl. 69, figs. 14-16.
1961	*Robulus vortex* (Fichtel and Moll); De Hornibrook, p. 38, pl. 3, fig. 49.
1964	*Robulus vortex* (Fichtel and Moll); LeRoy, p. 21, pl. 4, figs. 7-8.
1984	*Lenticulina vortex* (Fichtel and Moll); Rögl and Hansen, p. 30, pl. 2, figs. 3-4.
1985	*Lenticulina vortex* (Fichtel and Moll); Papp and Schmid, p. 44, pl. 33, figs. 4-8.

Short description: Test semicircular in outline, biumbonate, biconvex, planispiral, involute. Periphery angled, with a rounded keel. Chambers very low and strongly curved to almost tangential, enlarging slowly as added; 9 chambers in the last whorl, each with a smooth elevation of the lateral chamber wall, producing an impression of additional sutures. Sutures glossy, limbate, strongly curved. The sutures merge into a distinct, undifferentiated smooth, glossy umbonate mass. Wall smooth, finely perforate. Aperture at peripheral angle, radiate, with distinct vertical slit.

Remarks: *L. vortex* resembles *Lenticulina orbicularis* (d'Orbigny), but differs in having raised lateral chamber walls.

Stratigraphic range: See *Lenticulina gibba* (d'Orbigny). *L. vortex* has been described previously from Early Oligocene to Recent deposits.

Occurrence: See *Lenticulina gibba* (d'Orbigny). According to LeRoy (1964) *L. vortex* is an outer neritic - upper bathyal form.

Subfamily *Marginulininae* Wedekind, 1937

Genus *Marginulina* d'Orbigny, 1826

Marginulina glabra d'Orbigny

(pl. 1, figs. 5-6)

1826 *Marginulina glabra* d'Orbigny, p. 259, mod. no. 6.
1884 *Marginulina glabra* d'Orbigny; Brady, p. 527, pl. 65, figs. 5-6.
1913 *Marginulina glabra* d'Orbigny; Cushman, p. 79, pl. 23, fig. 3.
1950 *Marginulina glabra* d'Orbigny; Cushman and McCulloch, p. 308, pl. 40, figs. 6, 8.
1951b *Marginulina glabra* d'Orbigny; Asano, p. 16, fig. 80.
1960 *Marginulina glabra* d'Orbigny; Barker, p. 136, pl. 65, figs. 5-6.
1964 *Marginulina glabra* d'Orbigny; LeRoy, p. 23, pl. 16, fig. 29.
1964 *Marginulina glabra* d'Orbigny; Loeblich and Tappan, C520, fig. 406,10.
1983 *Marginulina* sp. Coustillas, pl. 24, fig. 5a (not 6).
1985 *Marginulina glabra* d'Orbigny; Papp and Schmid, p. 36, pl. 21, figs. 1-4.

Short description: Test short, stout, subspherical and subcylindrical. Early portion closely coiled, later uncoiling to rectilinear. Subcylindrical, inflated chambers increase rapidly in size as added. Sutures slightly depressed, oblique, especially in early portion of test. Wall smooth, finely perforate. Aperture radiate, at dorsal angle, somewhat extended.

Stratigraphic range: *M. glabra* was found in Late Miocene (N16) and Late Pliocene - Quaternary deposits (N21-23) on the islands. It has been recorded previously from Late Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: According to LeRoy (1964) *M. glabra* is an upper bathyal form, though occuring rarely in his material. Lewis (1979) found this species in sediments between 329 and 2127 m on the continental margin of New Zealand, and Coustillas (1983) at a depth of 44 m in the Mahakam Delta.

Subfamily *Vaginulininae* Reuss, 1860

Genus *Vaginulina* d'Orbigny, 1826

Vaginulina elegans d'Orbigny

1826 *Vaginulina elegans* d'Orbigny, p. 257, mod. no. 54.
1964 *Vaginulina legumen* Loeblich and Tappan (non Linnaeus), C524, figs. 410,1-2.

Short description: Test straight, elongate to arcuate, laterally compressed, initial end with a spine. Chambers in a linear series. Sutures oblique to the longitudinal axis, distinct, thickened. Wall often translucent, smooth, except for the limbate, thickened sutures. Aperture at dorsal angle, radiate, often on a short neck.

Remarks: This species has distinct, thick sutures, as illustrated by Loeblich and Tappan (1964).

Stratigraphic range: *V. elegans* occurs in Late Miocene deposits (N16) from Buton. It has been recorded previously in Early Paleocene to Recent deposits (see synonymy; LeRoy, 1941b; Boomgaart, 1949; De Hornibrook, 1961).

Occurrence: *V. elegans* has in the Buton samples been found in association with typical outer neritic - upper bathyal species.

Genus *Vaginulopsis* Silvestri, 1904

Vaginulopsis sublegumen Parr
(pl. 1, fig. 7)

1884 *Vaginulina legumen* Brady (not Linnaeus), p. 530, pl. 66, figs. 13-14.
1950 *Vaginulopsis sublegumen* Parr, p. 325, pl. 11, fig. 18.
1960 *Vaginulopsis sublegumen* Parr; Barker, p. 138, pl. 66, figs. 13-14.

Short description: Test straight to arcuate, slightly compressed, ovate in section. Involute and planispiral in early stage, later uncoiling and uniserial. Chambers wider than high, increasing gradually in width and height as added. Sutures flush, oblique, broad, sometimes slightly depressed. Wall smooth, white. Aperture at dorsal angle, radiate.

Remarks: *V. sublegumen* is characterized by its smooth form with flush sutures.

Stratigraphic range: *V. sublegumen* occurs in Late Miocene deposits (N16) from Buton. It has been previously described from Recent sediments.

Occurrence: In the Buton samples this species is found in association with outer neritic - upper bathyal species.

Family *Polymorphinidae* d'Orbigny, 1839
Subfamily *Polymorphininae* d'Orbigny, 1839
Genus *Globulina* d'Orbigny, 1839

Globulina australis d'Orbigny
(pl. 1, fig. 20)

1839b *Globulina australis* d'Orbigny, p. 60, pl. 1, figs. 1-4.

Short description: Test guttiform in outline, somewhat compressed, ovate in transverse section. Chambers arranged in quinqueloculine spiral series, the later chambers embracing the earlier part of the test, usually only 2-3 elongate, gibbous chambers visible externally. Sutures flush, not depressed. Wall translucent, shiny, striate in the aboral part of the test and smooth in the apertural area. Aperture terminal, radiate.

Remarks: *G. australis* resembles *Globulina gibba* d'Orbigny, but differs in being striate.

Stratigraphic range: Because both species occur rarely, *G. australis* and *G. gibba* have been assembled in *Globulina* spp., found in Late Miocene (N16) and Late Pliocene - Quaternary deposits (N21-23).

Occurrence: In samples from eastern Indonesia, *Globulina* spp. occurs in outer neritic - upper bathyal assemblages.

Globulina gibba d'Orbigny

1826 *Polymorphina (Globuline) gibba* d'Orbigny, p. 266, mod. no. 63.
1846 *Globulina gibba* d'Orbigny, p. 227, pl. 13, figs. 13-14.
1884 *Polymorphina lactea* Brady (not Walker and Jacob), p. 559, pl. 71, fig. 11.
1884 *Polymorphina gibba* d'Orbigny; Brady, p. 561, pl. 71, figs. 12a-b.
1913 *Polymorphina gibba* d'Orbigny; Cushman, p. 85, pl. 41, fig. 4.
1960 *Globulina gibba* d'Orbigny; Barker, p. 148, pl. 71, figs. 11-12.
1961 *Globulina gibba* d'Orbigny; De Hornibrook, p. 60, pl. 7, fig. 124.
1964 *Globulina gibba* d'Orbigny; Loeblich and Tappan, C530, figs. 516, 1a-b.
1985 *Globulina gibba* d'Orbigny; Papp and Schmid, p. 79, pl. 71, figs. 5-12.

Short description: Test globular to ovate, nearly circular in front view. Chambers arranged in quinqueloculine spiral series, strongly overlapping, the later chambers largely embracing the earlier test. Sutures flush, not depressed, broad. Wall smooth. Aperture radiate, broad-oval, may be closed.

Remarks: *G. gibba* is a smooth form, easily recognized from the striate *Globulina australis* d'Orbigny.

G. gibba has a similar chamber arrangement as *Guttulina sequenzana* (Brady), but is distinguished from the latter species by its different shape.

Stratigraphic range: See *Globulina australis* d'Orbigny. *G. gibba* is a common faunal component of Middle Eocene to Recent deposits.

Occurrence: See *Globulina australis* d'Orbigny.

Genus *Guttulina* d'Orbigny, 1839

Guttulina seguenzana (Brady)

1884 *Polymorphina seguenzana* Brady, p. 567, pl. 72, figs. 16-17.
1960 *Guttulina seguenzana* (Brady); Barker, p. 150, pl. 72, figs. 16-17.
1961 *Guttulina seguenzana* (Brady); De Hornibrook, p. 54, pl. 7, fig. 116.

Short description: Test elongate, fusiform, compressed on three sides, broadest somewhat below the center, tapering towards the oral end, and even more towards the aboral extremity, which ends in a sharp point. Few, long, inflated, narrow and erect chambers, added in quinqueloculine series. Externally only three chambers are visible. Sutures distinct, depressed. Wall smooth. Aperture radiate, terminal.

Remarks: *G. seguenzana* has a similar chamber arrangement as *Globulina gibba* d'Orbigny, but a completely different form. In *G. seguenzana* both ends of the test are pointed like in *Pyrulina fusiformis* (Roemer), but this species has a different chamber arrangement.

Stratigraphic range: *G. seguenzana* was found in Late Miocene (N17) and Late Pliocene - Quaternary deposits (N21-22) on the eastern Indonesian islands. It has been recorded previously in Middle Eocene to Recent deposits.

Occurrence: In the eastern Indonesian material *G. seguenzana* is common in outer neritic - upper bathyal assemblages.

Genus *Pyrulina* d'Orbigny, 1839

Pyrulina fusiformis (Roemer)

(pl. 1, fig. 19)

1838 *Polymorphina (Globuline) fusiformis* Roemer, p. 386, pl. 3, fig. 37.
1884 *Polymorphina sororia* Brady var. *cuspidata* Brady, p. 563, pl. 72, fig. 4.
1960 *Pyrulina fusiformis* (Roemer); Barker, p. 150, pl. 72, fig. 4.
1961 *Pyrulina fusiformis* (Roemer); De Hornibrook, p. 61, pl. 7, fig. 127.
1964 *Pyrulina fusiformis* (Roemer); LeRoy, p. 27, pl. 5, fig. 26.
1978 *Pyrulina fusiformis* (Roemer); Boltovskoy, p. 167, pl. 6, fig. 30.
1980 *Pyrulina fusiformis* (Roemer); Boltovskoy, p. 168, pl. 3, figs. 3a-b.

Short description: Test fusiform, elongate, compressed on three sides, broadest near the center, tapering to both ends. Initial end acute or sharply pointed, apertural end obtusely pointed. Early chambers arranged in spiral series, approximately 120 degrees apart. Later chambers biserial, subglobose, elongate, last chamber slightly inflated. Sutures flush, somewhat depressed. Wall smooth. Aperture radiate.

Remarks: In *P. fusiformis* both ends are pointed as in *Guttulina seguenzana* (Brady), but the two species can be distinguished from each other by the different chamber arrangements.

Stratigraphic range: *P. fusiformis* was found in Early - Middle Miocene deposits (N8) from Buru. It has been recorded previously from Early Oligocene to Recent deposits.

Occurrence: According to LeRoy (1964) *P. fusiformis* is an outer neritic - upper bathyal form.

Family *Glandulinidae* Reuss, 1860
Subfamily *Glandulininae* Reuss, 1860
Genus *Glandulina* d'Orbigny, 1839

Glandulina laevigata d'Orbigny
(pl. 1, fig. 16)

1826	*Nodosaria (Glandulina) laevigata* d'Orbigny, p. 252, pl. 10, figs. 1-3.
1884	*Nodosaria (Glandulina) laevigata* d'Orbigny; Brady, p. 490, pl. 61, figs. 20-22.
1913	*Nodosaria (Glandulina) laevigata* d'Orbigny; Cushman, p. 47, pl. 24, figs. 1-2.
1941a	*Glandulina laevigata* d'Orbigny; LeRoy, p. 29, pl. 2, fig. 87.
1941c	*Glandulina laevigata* d'Orbigny; LeRoy, p. 115, pl. 3, figs. 42-43.
1950	*Pseudoglandulina laevigata* (d'Orbigny); Cushman and McCulloch, p. 325, pl. 42, fig. 4.
1951b	*Pseudoglandulina laevigata* (d'Orbigny); Asano, p. 18, fig. 86.
1960	*Rectoglandulina torrida* (Cushman); Barker, p. 128, pl. 61, figs. 20-22.
1964	*Rectoglandulina laevigata* (d'Orbigny); LeRoy, p. 23, pl. 14, figs. 29-30.
1964	*Glandulina laevigata* d'Orbigny; Loeblich and Tappan, C537, figs. 421,1-2.
1983	*Glandulina* sp. Coustillas, pl. 25, figs. 8a-c.
1985	*Glandulina laevigata* d'Orbigny; Taylor et al., p. 20, pl. 1, figs. 1-4.

Short description: Test fusiform, elongate-ovate, circular in section, about twice as long as broad, tapering rapidly to both ends; apical end somewhat rounded. Early stage biserial, later uniserial in microspheric generation, macrospheric generation uniserial throughout. Chambers few, strongly overlapping and enlarging rapidly as added, the last chamber covering almost the entire test. Sutures distinct, flush. Wall usually smooth, sometimes slightly striate. Aperture terminal, central, radiate.

Remarks: The basal spine is absent in our specimens and the last chamber constitutes a greater portion of the test than was described in the type-description (see also LeRoy, 1941a).

Stratigraphic range: See *Pseudonodosaria aequalis* (Reuss). *G. laevigata* has been observed previously in Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Pseudonodosaria aequalis* (Reuss). LeRoy (1964) considered *G. laevigata* to be an outer neritic - upper bathyal form. According to Lutze (1974) this species is cosmopolitan and common in sediments from depths between 400 and 900 m in the Persian Gulf. Coustillas (1983) found this form at a depth of 45 m in the Mahakam Delta.

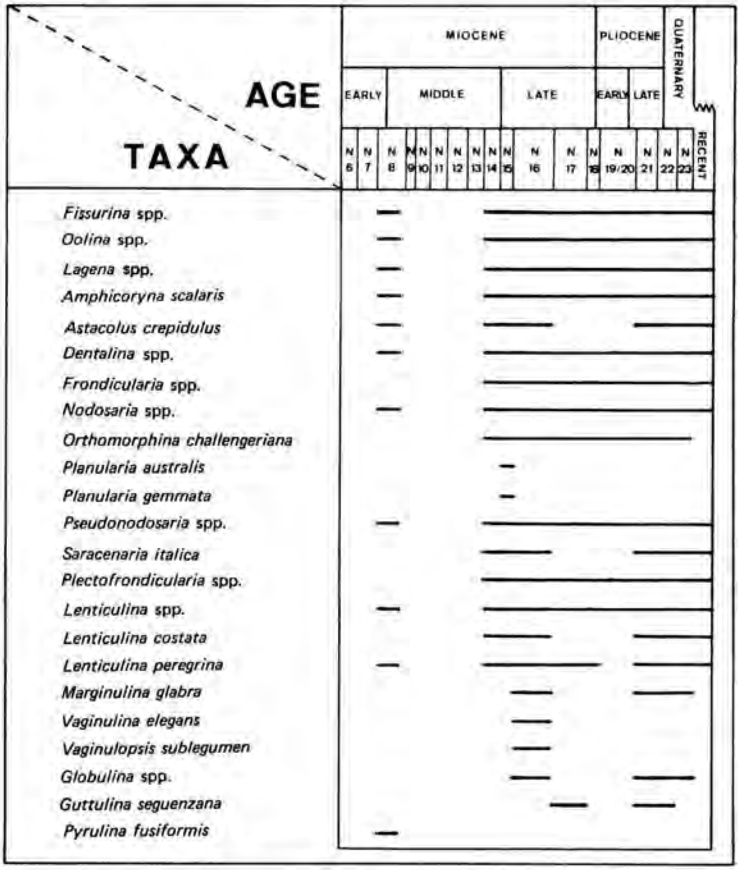

Figure 14. Composite range chart of the suborder *Lagenina* in eastern Indonesia.

Suborder *Miliolina* Delage and Herouard, 1896
Superfamily *Cornuspiracea* Schultze, 1854
Family *Cornuspiridae* Schultze, 1854
Subfamily *Cornuspirinae* Schultze, 1854
Genus *Cyclogyra* Wood, 1842

Cyclogyra involvens (Reuss)

1850 *Operculina involvens* Reuss, p. 370, pl. 46, fig. 20.
1864 *Cornuspira archimedis* Stache, p. 180, pl. 22, fig. 1.
1884 *Cornuspira involvens* (Reuss); Brady, p. 200, pl. 11, figs. 1-2.
1921 *Cornuspira involvens* (Reuss); Cushman, p. 389, pl. 77, figs. 3-4.
1935 *Cornuspira involvens* (Reuss); Keijzer, p. 99, figs. 3a-c.
1960 *Cornuspira involvens* (Reuss); Barker, p. 22, pl. 11, figs. 1-2.
1961 *Cornuspira archimedis* Stache; De Hornibrook, p. 33, pl. 3, fig. 44.
1983 *Cornuspira involvens* (Reuss); Coustillas, pl. 34, fig. 6.

Short description: Test circular in outline, disc-shaped, compressed with rounded periphery. Globular proloculus followed by an undivided second chamber, which is a gradually expanding, evolute, planispiral tube of 6-10 whorls. Sutures distinct, slightly depressed. The delicate, somewhat translucent wall exhibits growth lines. Aperture comprises entire terminal end of second chamber.

Remarks: The specimens figured by Stache (1864) as *Cornuspira archimedis* completely follow the description of *C. involvens*, only slightly varying in having a smaller aperture (which in most cases is broken off anyhow). *C. archimedis* therefore is considered as a junior synonym of *C. involvens*.

Cyclogyra carinata (Costa) differs from *C. involvens* in having a flatter form and a keel. *Cyclogyra planorbis* (Schultze) can be distinguished from *C. involvens* by having fewer convolutions.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in 'miliolids div.': *C. involvens*, *Cornuloculina inconstans* (Brady), *Ophthalmidium acutimargo* (Brady), *Flintina bradyana* Cushman, *Miliolinella australis* (Parr), and *Planispirinoides bucculentus* (Brady). Miliolids div. was found in Middle Miocene - Quaternary deposits (N14-23). Of the species gathered in 'miliolids div.' most have also been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

C. involvens has been recorded previously from Pliocene to Recent deposits (see synonymy and Boichard et al., 1985).

Occurrence: In Recent eastern Indonesian sediments 'miliolids div.' occur isobathyal between 60 and 317 m, with DLO at 100 m.

Coustillas (1983) found *C. involvens* in sediments at depths between 50 and 100 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 319 m on the Pater Noster Platform.

Family *Ophthalmidiidae* Wiesner, 1920
Genus *Cornuloculina* Burbach, 1886

Cornuloculina inconstans (Brady)

1879	*Hauerina inconstans* Brady, p. 268 (nomen nudum).
1884	*Ophthalmidium inconstans* (Brady); Brady, p. 189, pl. 12, figs. 5, 7-8.
1921	*Ophthalmidium inconstans* (Brady); Cushman, p. 393, pl. 78, figs. 2-3.
1960	*Hauerinella inconstans* (Brady); Barker, p. 24, pl. 12, figs. 5, 7-8.
1964	*Cornuloculina inconstans* (Brady); Loeblich and Tappan, C448, figs. 340,3-7.
1985	*Hauerinella inconstans* (Brady); Boichard et al., p. 94, pl. 17, figs. 14-15.

Short description: Test oval in outline, periphery bordered by a broad, thin flange, planispirally coiled and evolute. Globular proloculus followed by second chamber of up to 3 whorls. Then chambers of approximately one-half coil in length or slightly less follow (spiroloculine arrangement). Chambers arcuate, sigmoid, loosely coiled, those of adjacent whorls being separated by thin plate. Aperture an open end of final chamber.

Remarks: Only broken specimens of *C. inconstans* were found.

Stratigraphic range: See *Cyclogyra involvens* (Reuss). *C. inconstans* has been observed previously in Recent sediments.

Occurrence: See *Cyclogyra involvens* (Reuss). Boichard et al. (1985) found *C. inconstans* in sediments at a depth of 490 m on the Pater Noster Platform.

Genus *Ophthalmidium* Kubler and Zwingli, 1870

Ophthalmidium acutimargo (Brady)

1884	*Spiroloculina acutimargo* Brady, p. 154, pl. 10, figs. 13a-b (not 12 and 14-15).
1960	*Ophthalmidium acutimargo* (Brady); Barker, p. 20, pl. 10, figs. 13a-b.
1964	*Ophthalmidium acutimargo* (Brady); Loeblich and Tappan, C448, figs. 340,2a-b.

Short description: Test oval in outline, flattened, periphery acute or carinate, extremities obtuse or slightly rounded. Test consisting of globular proloculus followed by spirally wound second chamber of half to a complete coil in length; later chambers half a coil in length, regularly added. Chambers arcuate, angular, tapering slightly from early portion to apertural end. Aperture terminal small and ovate.

Remarks: The chambers are loosely coiled with a flattened plate in between the whorls, which is the intervening keel of the previous convolution.

Stratigraphic range: See *Cyclogyra involvens* (Reuss).

Occurrence: See *Cyclogyra involvens* (Reuss). In Recent sediments from the continental margin of New Zealand *O. acutimargo* has been found between 18 and 1419 m (Lewis, 1979).

Superfamily *Miliolacea* Ehrenberg, 1839
Family *Miliolidae* Ehrenberg, 1839
Subfamily *Miliolinae* Ehrenberg, 1839
Genus *Flintina* Cushman, 1921

Flintina bradyana Cushman

1884	*Miliolina fichteliana* Brady (not d'Orbigny), p. 169, pl. 4, fig. 9.
1921	*Flintina bradyana* Cushman, p. 467, pl. 94, fig. 2.
1960	*Flintina bradyana* Cushman; Barker, p. 8, pl. 4, fig. 9.
1964	*Flintina bradyana* Cushman; Loeblich and Tappan, C461, figs. 349, 7-9.
1983	*Flintina bradyana* Cushman; Coustillas, pl. 31, fig. 3.

Short description: Test ovate to rounded; early portion with two chambers per whorl, later increasing to three, in triloculine arrangement, but tending to become planispiral. Wall polished with numerous fine, longitudinal, slightly oblique costae. Aperture high, ovate, with thickened lip and large tooth.

Remarks: The tooth is bifid in young stage, but develops later into a large plate-like portion, which merges with the border of the aperture by several projections. This circular plate may even become perforated in the center and serve as the aperture.

Stratigraphic range: See *Cyclogyra involvens* (Reuss). *F. bradyana* has been observed previously in Recent SE Asian sediments.

Occurrence: See *Cyclogyra involvens* (Reuss). Coustillas (1983) found *F. bradyana* in sediments at depths between 50 and 200 m in the Mahakam Delta.

Genus *Massilina* Schlumberger, 1893

Massilina arenaria (Brady)
(pl. 3, fig. 1)

1884 *Spiroloculina arenaria* Brady, p. 153, pl. 8, figs. 12a-b.
1960 *Praemassilina arenaria* (Brady); Barker, p. 16, pl. 8, figs. 12a-b.
1983 *Massilina arenaria* (Brady); Coustillas, pl. 33, figs. 11-15.
1985 *Praemassilina arenaria* (Brady); Boichard et al., p. 94, pl. 17, figs. 6-7.

Short description: Test oblong or ovate in outline, somewhat flattened; both ends obtusely angular or slightly rounded. Chambers one-half coil in length; early ones in quinqueloculine arrangement, later ones broader, added in a single plane on alternate sides; sutures indistinct, slightly depressed. Wall agglutinated, enclosing sand grains and calcareous shell fragments. Aperture small, rounded, on a neck, sometimes with a bifid tooth.

Stratigraphic range: *M. arenaria* was found in Late Miocene (N16), Late Pliocene (N21), and Quaternary deposits (N23). Previously, it has been recorded in Recent sediments from Indonesia.

Occurrence: Coustillas (1983) found *M. arenaria* primarily in sediments at depths between 50 and 200 m in the Mahakam Delta and reported that smaller forms of *M. arenaria* occur shallower (0-150 m) than the larger forms (150-400 m). Boichard et al. (1985) found this species between 490 and 715 m on the Pater Noster Platform.

Genus *Pyrgo* Defrance, 1824

Pyrgo comata (Brady)
(pl. 3, fig. 2)

1881 *Biloculina comata* Brady, p. 45 (nomen nudum).
1884 *Biloculina comata* Brady, p. 144, pl. 3, figs. 9a-b.
1921 *Biloculina comata* Brady; Cushman, p. 477, pl. 96, figs. 3a-b.
1941 *Pyrgo comata* (Brady); Chapman, p. 189.
1960 *Pyrgo comata* (Brady); Barker, p. 6, pl. 3, figs. 9a-b.

1985 *Pyrgo comata* (Brady); Boichard et al., p. 94, pl. 17, figs. 8-9.
1986 *Pyrgo comata* (Brady); Boersma, p. 1029, pl. 14, figs. 3-4.

Short description: Test subglobular, periphery rounded. Chambers moderately inflated. Wall shows numerous closely spaced, regular, longitudinal striae. Terminal, rounded to elongate aperture, with distinct, bifid tooth.

Remarks: *P. comata* is characterized by the numerous longitudinal striae.

Stratigraphic range: See *Pyrgo murrhina* (Schwager). *P. comata* has been described previously from Late Miocene to Recent deposits.

Occurrence: See *Pyrgo murrhina* (Schwager). Boichard et al. (1985) observed *P. comata* in samples from waterdepths between 490 and 715 m on the Pater Noster Platform.

Pyrgo depressa (d'Orbigny)

1826 *Biloculina depressa* d'Orbigny, p. 298, mod. no. 7.
1884 *Biloculina depressa* d'Orbigny; Brady, p. 145, pl. 2, figs. 12, 16-17 (not 15); pl. 3, figs. 1-2.
1929 *Pyrgo depressa* (d'Orbigny); Cushman, p. 71, pl. 19, figs. 4-5.
1960 *Pyrgo depressa* (d'Orbigny); Barker, p. 4, pl. 2, figs. 12, 16-17; pl. 3, figs. 1-2.
1964 *Pyrgo depressa* (d'Orbigny); LeRoy, p. 21, pl. 12, figs. 29-30.
1973 *Pyrgo depressa* (d'Orbigny); Douglas, p.619, pl. 6, fig. 8.
1978 *Pyrgo depressa* (d'Orbigny); Boltovskoy, p. 167, pl. 6, fig. 25.
1983 *Biloculina depressa* d'Orbigny; Coustillas, pl. 32, fig. 14.

Short description: Test subglobular, nearly circular in front view, compressed, elliptical in apertural view; periphery carinate. Wall porcelaneous, imperforate, smooth. Aperture an elongated to linear slit, upper lip may project somewhat, sometimes with wide, low bifid tooth.

Remarks: *P. depressa* differs from *Pyrgo murrhina* (Schwager, 1866) in lacking a rounded aperture at the end of its neck.

Stratigraphic range: See *Pyrgo murrhina* (Schwager). *P. depressa* has been observed previously in Late Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Boichard et al., 1985).

Occurrence: See *Pyrgo murrhina* (Schwager). According to LeRoy (1964) *P. depressa* is a neritic - upper bathyal form. Coustillas (1983) found this species at a depth of 404 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 490 m on the Pater Noster Platform.

Pyrgo lucernula (Schwager)

1866 *Biloculina lucernula* Schwager, p. 202, pl. 4, figs. 14a-c, 17a-b.
1884 *Biloculina bulloides* Brady (not d'Orbigny), p. 142, pl. 2, figs. 5-6.
1884 *Biloculina tubulosa* Brady (not Costa), p. 147, pl. 3, fig. 6.
1884 *Miliolina trigonula* Brady (not Lamarck), p. 164, pl. 3, fig. 14 (not figs. 15-16).

1921 *Biloculina lucernula* Schwager; Cushman, p. 475, pl. 98, figs. 1-2.
1941b *Pyrgo lucernula* (Schwager); LeRoy, p. 72, pl. 2, figs. 27-28; pl. 3, figs. 17-18.
1960 *Pyrgo lucernula* (Schwager); Barker, p. 4, pl. 2, figs. 5-6; pl. 3, figs. 6, 14.
1978 *Pyrgo lucernula* (Schwager); Boltovskoy, p. 167, pl. 6, fig. 29.
1980 *Pyrgo lucernula* (Schwager); Srinivasan and Sharma, p. 21, pl. 3, figs. 10-11 (neotype).
1986 *Pyrgo lucernula* (Schwager); Van Morkhoven et al., p. 43, pl. 12, figs. 1-2.

Short description: Test subglobular with oval outline. Chambers moderately inflated, with subangular margins. Last chamber strongly inflated, ovate. Aperture, on a cylindrical neck, rounded with distinct bifid tooth.

Remarks: This taxon is distinguished by the large, robust, finely agglutinated test and the strongly inflated, ovate central chamber with subangular chamber margins (Van Morkhoven et al., 1986).

Srinivasan and Sharma (1980) selected a neotype for *P. lucernula*, as one of the type specimens of this species illustrated by Schwager (1866) turned out to be a triloculine form, which was renamed *Triloculina lucernula* (Schwager).

Stratigraphic range: See *Pyrgo murrhina* (Schwager). *P. lucernula* has been described previously from Middle Miocene to Recent deposits.

Occurrence: See *Pyrgo murrhina* (Schwager). According to Van Morkhoven et al. (1986) the cosmopolitan *P. lucernula* has only been found in middle bathyal to abyssal deposits.

Pyrgo murrhina (Schwager)
(pl. 3, fig. 3)

1866 *Biloculina murrhina* Schwager, p. 203, pl. 4, figs. 15a-c.
1884 *Biloculina depressa* d'Orbigny var. *murrhyna* Schwager; Brady, p. 146, pl. 2, figs. 10-11, 15.
1917 *Biloculina murrhyna* Schwager; Cushman, p. 75, pl. 28, fig. 3; pl. 29, fig. 1.
1941c *Pyrgo* sp. aff. *P. murrhyna* (Schwager); LeRoy, p. 113, pl. 3, figs. 29-30.
1960 *Pyrgo murrhyna* (Schwager); Barker, p. 4, pl. 2, figs. 10-11, 15.
1964 *Pyrgo murrhina* (Schwager); LeRoy, p. 21, pl. 12, figs. 32-33.
1973 *Pyrgo murrhina* (Schwager); Douglas, p. 619, pl. 6, fig. 9.
1978 *Pyrgo murrhina* (Schwager); Boltovskoy, p. 167, pl. 6, fig. 26.
1979 *Pyrgo murrhina* (Schwager); Corliss, p. 6, pl. 1, figs. 15-18.
1980 *Pyrgo murrhina* (Schwager); Srinivasan and Sharma, p. 22, pl. 3, figs. 6-7 (neotype).
1981 *Pyrgo murrhyna* (Schwager); Burke, p. 4, pl. 1, fig. 9.
1984b *Pyrgo murrhina* (Schwager); Boersma, p. 1273, pl. 5, fig. 2; pl. 6, fig. 2.
1985 *Pyrgo murrhina* (Schwager); Thomas, p. 678, pl. 1, fig. 10.
1985 *Pyrgo murrhyna* (Schwager); Boichard et al., p. 94, pl. 17, figs. 10-11.

1986 *Pyrgo murrhina* (Schwager); Kurihara and Kennett, p. 1069, pl. 1, fig. 13.

1986 *Pyrgo murrhina* (Schwager); Van Morkhoven et al., p. 50, pl. 15, figs. 1-2.

Short description: Test nearly circular in side view, slightly compressed and elliptical in apertural view; periphery extended and carinate, the carina interrupted at the point opposite to the aperture leaving a sinus. Aperture on a short neck, nearly circular to oval, with small, distinct bifid tooth.

Remarks: Srinivasan and Sharma (1980) and Van Morkhoven et al. (1986) reported that *P. murrhina* varies strongly in size and shape. The characteristic sinus at the lower end of the test is often lacking in adult specimens, and especially the apertural features, such as the tooth, may vary during ontogeny.

P. murrhina differs from *Pyrgo depressa* (d'Orbigny) by having a rounded aperture on a neck, with a distinct bifid tooth, instead of a slit-like aperture without a neck and with a wide, very low tooth or no tooth at all.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Pyrgo* spp.: *P. comata*, *P. depressa*, *P. lucernula*, *P. murrhina*, *P. subsphaerica*, and *P. vespertilio*. *Pyrgo* spp. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). Of the species gathered in *Pyrgo* spp. most have been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

P. murrhina has been described previously from Late Oligocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *Pyrgo* spp. occur scattered down from 100 m, in upper bathyal and deeper habitats (Van Marle, 1988).

Van Morkhoven et al. (1986) reported that *P. murrhina* is cosmopolitan and only has been found in middle bathyal to abyssal depths. Corliss (1979) found *P. murrhina* in sediments between 2500 and 4600 m in the southeastern Indian Ocean, considering it to be the dominant *Pyrgo*-species in the deep sea, and Boichard et al. (1985) found it at a depth of 715 m on the Pater Noster Platform. Lewis (1979), though, found this species as shallow as 372 m on the continental margin of New Zealand.

Pyrgo subsphaerica (d'Orbigny)

(pl. 3, figs. 4-5)

1839a *Biloculina subsphaerica* d'Orbigny, p. 162, pl. 8, figs. 25-27.

1929 *Pyrgo subsphaerica* (d'Orbigny); Cushman, p. 68, pl. 18, figs. 1-2.

1941a *Pyrgo subspherica* (d'Orbigny); LeRoy, p. 22, pl. 1, figs. 33-34.

1949 *Pyrgo subsphaerica* (d'Orbigny); Boomgaart, p. 68, pl. 5, fig. 17.

Short description: Test globulose, nearly spherical. Sutures depressed, occasionally sinuous. Wall smooth, showing a large, ovate aperture with a high upper border and a bifurcating tooth.

Remarks: Characteristic for this species are its nearly spherical form, and its flattened bifurcating tooth in the large, ovate aperture. The form figured by Boomgaart (1949) as *Pyrgo anomala* (Schlumberger) probably represents a slightly oblong variety of *P. subsphaerica.*

Stratigraphic range: See *Pyrgo murrhina* (Schwager). *P. subsphaerica* has been observed previously in Late Miocene - Pliocene deposits.

Occurrence: See *Pyrgo murrhina* (Schwager). According to LeRoy (1964) *P. subsphaerica* is an outer neritic - upper bathyal form.

Pyrgo vespertilio (Schlumberger)

(pl. 3, figs. 6-7)

1884 *Biloculina ringens* Brady (not Lamarck), p. 142, pl. 2, fig. 8.
1893 *Biloculina vespertilio* Schlumberger, p. 561, pl. 10, figs. 74-76.
1932 *Pyrgo vespertilio* (Schlumberger); Thalmann, p. 295.
1935 *Biloculina vespertilio* Schlumberger; Keijzer, p. 101, fig. 5a-e.
1960 *Pyrgo vespertilio* (Schlumberger); Barker, p. 4, pl. 2, fig. 8.
1980 *Pyrgo vespertilio* (Schlumberger); Haller, p. 232, pl. 3, figs. 3a-b.

Short description: Test inflated, ovate, circular in section. Aperture slightly extended and elongate, filled up by a broad bifid tooth.

Remarks: *P. vespertilio* morphologically resembles *Pyrgo lucernula* (Schwager), but differs in having a tooth, which almost completely fills up the aperture, and no neck.

Stratigraphic range: See *Pyrgo murrhina* (Schwager). *P. vespertilio* has been recorded previously in Pliocene to Recent deposits (see synonymy and Boichard et al., 1985).

Occurrence: See *Pyrgo murrhina* (Schwager). Boichard et al. (1985) found *P. vespertilio* in sediments at a depth of 490 m on the Pater Noster Platform.

Genus *Quinqueloculina* d'Orbigny, 1826

Quinqueloculina amygdaloides (Brady)

1884 *Miliolina amygdaloides* Brady, p. 163, pl. 6, fig. 10.
1960 *Quinqueloculina amygdaloides* (Brady); Barker, p. 12, pl. 6, fig. 10.

Short description: Test small, compressed, elongate-oval in outline with tapering ends, one face nearly flat, the other convex and subangular; periphery sharp. Numerous long and narrow chambers; sutures flush. Wall smooth, thin and opalescent. Aperture circular, extended, with simple tooth.

Stratigrahic range: See *Quinqueloculina seminulum* (Linnaeus).

Occurrence: See *Quinqueloculina seminulum* (Linnaeus).

Quinqueloculina boueana d'Orbigny
(pl. 3, fig. 8)

1846 *Quinqueloculina boueana* d'Orbigny, p. 293, pl. 19, figs. 7-9.
1884 *Miliolina boueana* (d'Orbigny); Brady, p. 173, pl. 7, figs. 13a-c.
1941c *Quinqueloculina boueana* d'Orbigny; LeRoy, p. 112, pl. 3, figs. 36-38.
1960 *Quinqueloculina boueana* d'Orbigny; Barker, p. 14, pl. 7, figs. 13a-c.
1985 *Quinqueloculina boueana* d'Orbigny; Papp and Schmid, p. 101, pl. 96, figs. 8-9.

Short description: Test broadly oval in outline, pointed at both ends; periphery rounded. Chambers arcuate; sutures distinct, slightly depressed. Wall shows distinct, longitudinal striae. Aperture subcircular, with distally enlarged tooth.

Remarks: *Q. boueana* is characterized by its rounded periphery and its ornamentation of fine, parallel, longitudinal striae (LeRoy, 1941c; Papp and Schmid, 1985).

Stratigraphic range: See *Quinqueloculina seminulum* (Linnaeus). *Q. boueana* has been observed previously in Middle Miocene through Quaternary deposits.

Occurrence: See *Quinqueloculina seminulum* (Linnaeus).

Quinqueloculina granulocostata Germeraad

1884 *Miliolina linneana* Brady (not d'Orbigny), p. 174, pl. 6, figs. 15-20.
1946 *Quinqueloculina granulocostata* Germeraad, p. 63.
1960 *Quinqueloculina granulocostata* Germeraad; Barker, p. 12, pl. 6, figs. 15-20.
1983 *Quinqueloculina granulocostata* Germeraad; Coustillas, pl. 33, figs. 1-2.

Short description: Test elongate, two times higher than broad. Sutures not very distinct, slightly depressed. Wall finely granulated; in the adult each chamber is ornamented by 5-6 irregular, granulated costae. Aperture a wide opening on a short neck with indistinct lip and bifid tooth.

Stratigraphic range: See *Quinqueloculina seminulum* (Linnaeus). *Q. granulocostata* has been recorded previously in Pliocene to Recent deposits.

Occurrence: See *Quinqueloculina seminulum* (Linnaeus). Coustillas (1983) found *Q. granulocostata* in samples from waterdepths between 50 and 400 m in the Mahakam Delta.

Quinqueloculina pseudoreticulata Parr
(pl. 3, figs. 9-10)

1884 *Miliolina reticulata* Brady (not d'Orbigny), p. 177, pl. 9, figs. 2-3 (not 4).
1941 *Quinqueloculina pseudoreticulata* Parr, p. 305.
1960 *Quinqueloculina pseudoreticulata* Parr; Barker, p. 18, pl. 9, figs. 2-3.
1983 *Quinqueloculina pseudoreticulata* Parr; Coustillas, pl. 30, fig. 26.

1985 *Quinqueloculina pseudoreticulata* Parr; Wang et al., p. 336, pl. 4, fig. 6.
1988 *Quinqueloculina pseudoreticulata* Parr; Van Marle, p. 147, pl. 1, figs. 16-17.

Short description: Test broadly oval in outline, with rounded periphery. Chambers rounded with uniform diameter throughout; sutures slightly depressed. Wall showing reticulate ornament. Terminal, slightly extended, ellipsoid aperture, with small lip and distinct bifid tooth.

Remarks: *Q. pseudoreticulata* is characterized by its typical reticulate ornamentation.

Stratigraphic range: See *Quinqueloculina seminulum* (Linnaeus). *Q. pseudoreticulata* has been described previously from Recent sediments (see synonymy and Boichard et al., 1985).

Occurrence: See *Quinqueloculina seminulum* (Linnaeus). Coustillas (1983) found *Q. pseudoreticulata* in sediments between 50 and 200 m in the Mahakam Delta and Boichard et al. (1985) between 45 and 319 m on the Pater Noster Platform.

Quinqueloculina seminulum (Linnaeus)
(pl. 3, figs. 11-13)

1758 *Serpula seminulum* Linnaeus, p. 786.
1884 *Miliolina seminulum* (Linnaeus); Brady, p. 157, pl. 5, figs. 6a-c.
1921 *Quinqueloculina seminulum* (linnaeus); Cushman, p. 416, pl. 88, figs. 4a-c.
1935 *Quinqueloculina seminulum* (Linnaeus); Keijzer, p. 116, figs. 16a-f.
1941c *Quinqueloculina* sp. aff. *Q. seminulum* (Linnaeus); LeRoy, p. 112, pl. 3, figs. 13-15.
1960 *Quinqueloculina seminulum* (Linnaeus); Barker, p. 10, pl. 5, figs. 6a-c.
1964 *Quinqueloculina seminulum* (Linnaeus); Loeblich and Tappan, C458, figs. 349,1a-c (neotype).
1983 *Quinqueloculina seminulum* (Linnaeus); Coustillas, pl. 30, fig. 12.
1985 *Quinqueloculina seminulum* (Linnaeus); Boichard et al., p. 90, pl. 15, fig. 11.

Short description: Test regular, oval in outline, with rounded peripheral margin. Chambers of uniform diameter throughout their length; sutures depressed. Terminal aperture, semicircular, with rim and thin bifid tooth.

Remarks: Loeblich and Tappan (1964) designated a neotype for *Q. seminulum*, because the original type was lost and as a result a wide variety of forms was included in this species by various authors.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Quinqueloculina* spp.: *Q. amygdaloides*, *Q. boueana*, *Q. granulocostata*, *Q. pseudoreticulata*, *Q. seminulum*, and *Q. venusta*, of which *Q. seminulum* is most common. *Quinqueloculina* spp. were found in Early - Middle Miocene (N8), Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Q. seminulum has been described previously from Late Pliocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *Quinqueloculina* spp. show a scattered depth distribution down from 60 m (Van Marle, 1988). Coustillas (1983) found *Q. seminulum* in sediments between 50 and 100 m in the Mahakam Delta, while Boichard et al. (1985) found it at a depth of 45 m on the nearby Pater Noster Platform.

Hageman (1979) and Boltovskoy et al. (1980) considered *Q. seminulum* to be a cosmopolitan mud-dweller, found in open, normal marine shelf environments and also in somewhat restricted, slightly hypersaline environments.

Quinqueloculina venusta Karrer
(pl. 3, figs. 14-16)

1868 *Quinqueloculina venusta* Karrer, p. 147, pl. 2, fig. 6.
1884 *Miliolina venusta* (Karrer); Brady, p. 162, pl. 5, fig. 5 (not 7).
1921 *Quinqueloculina venusta* Karrer; Cushman, p. 420, pl. 91, figs. 2a-c.
1935 *Quinqueloculina venusta* Karrer; Keijzer, p. 113, figs. 14a-i.
1960 *Quinqueloculina venusta* Karrer; Barker, p. 10, pl. 5, fig. 5.
1978 *Quinqueloculina venusta* Karrer; Boltovskoy, p. 167, pl. 6, figs. 32-33.
1983 *Quinqueloculina* sp. aff. *Q. venusta* Karrer; Coustillas, pl. 30, fig. 10.
1986 *Quinqueloculina venusta* Karrer; Kurihara and Kennett, p. 1069, pl. 1, figs. 14-15.
1988 *Quinqueloculina venusta* Karrer; Van Marle, p. 147, pl. 1, fig. 18.

Short description: Test oblong, triangular in top view, with sharp, slightly carinate peripheral angles. Aboral end rounded, apertural end blunt. Chambers with sharp margins; sutures distinct, depressed. Terminal, semicircular, extended aperture with small, simple tooth.

Remarks: *Q. venusta* differs from *Quinqueloculina seminulum* (Linnaeus) by its sharp, slightly carinate periphery, and resembles in this way *Quinqueloculina lamarckiana* d'Orbigny, an even more strongly carinate and less regular form.

Stratigraphic range: See *Quinqueloculina seminulum* (Linnaeus). *Q. venusta* has been observed previously in Middle Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: See *Quinqueloculina seminulum* (Linnaeus). According to Corliss (1979) *Q. venusta* is an abyssal form occurring in sediments between 3000 and 4600 m in the southeastern Indian Ocean. Lewis (1979) found this species between 1649 and 2432 m on the continental margin of New Zealand. However, Coustillas (1983) observed similar forms in waterdepths between 0 and 30 m in the Mahakam Delta.

Genus *Triloculina* d'Orbigny, 1826

Triloculina tricarinata d'Orbigny, 1826
(pl. 4, figs. 1-2)

1826 *Triloculina tricarinata* d'Orbigny, p. 299, mod. no. 94.
1884 *Miliolina tricarinata* (d'Orbigny); Brady, p. 165, pl. 3, figs. 17a-b.
1929 *Triloculina tricarinata* d'Orbigny; Cushman, p. 56, pl. 13, fig. 3.
1935 *Triloculina tricarinata* d'Orbigny; Keijzer, p. 103, figs. 6a-e.
1941c *Triloculina tricarinata* d'Orbigny; LeRoy, p. 113, pl. 1, figs. 18-19.
1960 *Triloculina tricarinata* d'Orbigny; Barker, p. 6, pl. 3, figs. 17a-b.
1964 *Triloculina tricarinata* d'Orbigny; LeRoy, p. 20, pl. 3, figs. 32-33.
1985 *Triloculina tricarinata* d'Orbigny; Wang et al., p. 336, pl. 4, fig. 5.
1988 *Triloculina tricarinata* d'Orbigny; Van Marle, p. 149, pl. 4, fig. 24.

Short description: Test sharply triangular in apertural view, sides straight, periphery angular to carinate. Sutures slightly depressed. Terminal aperture semicircular with typical, distinct, bifid tooth.

Remarks: *T. tricarinata* differs from *Triloculina trigonula* (Lamarck, 1804) in being sharply tricarinate and having a semicircular aperture with distinct bifid tooth.

Stratigraphic range: *T. tricarinata* was found in Late Miocene (N15 and N17) and Late Pliocene - Quaternary deposits (N21-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Coustillas, 1983).

Occurrence: In Recent eastern Indonesian sediments *T. tricarinata* shows a scattered depth distribution down from 141 m (Van Marle, 1988). Coustillas (1983) found this species in sediments between 0 and 400 m in the Mahakam Delta.

According to Poag (1981) *T. tricarinata* prefers carbonate-rich environments in the Gulf of Mexico.

Subfamily *Miliolinellinae* Vella, 1957
Genus *Miliolinella* Wiesner, 1931

Miliolinella australis (Parr)

1884 *Miliolina subrotunda* Brady (not Montagu), p. 168, pl. 5, figs. 10-11.
1932 *Quinqueloculina australis* Parr, p. 7, pl. 1, fig. 8.
1960 *Miliolinella australis* (Parr); Barker, p. 10, pl. 5, figs. 10-11.
1983 *Miliolinella australis* (Parr); Coustillas, pl. 31, figs. 9-10.

Short description: Test rounded in front view, as long as broad, periphery subangular. Chambers triangular in transverse section; sutures distinct, not depressed. Walls of chambers thickened on the outside angle. Semicircular aperture at open end of final chamber with an extended tooth.

Remarks: Barker (1960) regarded *M. australis* to be congeneric with *Miliolinella subrotunda* (Montagu), the genotype of the genus *Miliolinella*. *M. australis* differs from *M. subrotunda* by its less compressed and less regular form, and by the presence of the thickened outside angle of the chambers (almost amounting to a broad keel), particularly in the early stages (Parr, 1932).

Stratigraphic range: See *Cyclogyra involvens* (Reuss). *M. australis* has been observed previously in Recent sediments.

Occurrence: See *Cyclogyra involvens* (Reuss). Coustillas (1983) found *M. australis* in sediments between 50 and 150 m in the Mahakam Delta.

Genus *Nummoloculina* Steinmann, 1881

Nummoloculina irregularis (d'Orbigny)
(pl. 4, fig. 3)

1839b *Biloculina irregularis* d'Orbigny, p. 67, pl. 8, figs. 20-21.
1884 *Biloculina irregularis* d'Orbigny; Brady, p. 140, pl. 1, figs. 17-18.
1921 *Biloculina irregularis* d'Orbigny; Cushman, p. 479, pl. 95, figs. 1a-b.
1960 *Nummoloculina irregularis* (d'Orbigny); Barker, p. 2, pl. 1, figs. 17-18.

Short description: Test irregularly oval to biconvex, compressed at the margins. Chambers laterally compressed, convex, not carinate, irregular; sutures obscure. Wall imperforate, smooth, thick. Aperture, at open end of final chamber, triangular to semicircular in outline, largely filled up by broad, triangular tooth.

Remarks: The wall of this species is composed of successive laminae added over the entire test, thickening the wall and obscuring the chamber division (Cushman, 1921).

Stratigraphic range: *N. irregularis* was found in Quaternary deposits (N23) from Timor and in Recent sediments from eastern Indonesia (Van Marle, 1988).

N. irregularis has been previously described from Late Miocene - Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: *N. irregularis* has only been found in Recent sediments near the island Timor, in waterdepths between 60 and 550 m (Van Marle, 1988).

Subfamily *Sigmoilopsinae* Vella, 1957
Genus *Sigmoilopsis* Finlay, 1947

Sigmoilopsis schlumbergeri (Silvestri)
(pl. 4, fig. 4)

1884 *Planispirina celata* Brady (not Costa), p. 197, pl. 8, figs. 1-4.
1904 *Sigmoilina schlumbergeri* Silvestri, p. 267 (figured by Schlumberger, 1887, pl. 7, figs. 12-14).
1929 *Sigmoilina schlumbergeri* Silvestri; Cushman, p. 49, pl. 11, figs. 1-3.
1941b *Sigmoilina schlumbergeri* Silvestri; LeRoy, p. 72, pl. 7, figs. 31-32.

1946 *Sigmoilina schlumbergeri* Silvestri; Cushman, p. 36, pl. 6, figs. 1-4.
1960 *Sigmoilopsis schlumbergeri* (Silvestri); Barker, p. 16, pl. 8, figs. 1-4.
1964 *Sigmoilopsis schlumbergeri* (Silvestri); Loeblich and Tappan, C466, figs. 353,2a-b.
1978 *Sigmoilina schlumbergeri* Silvestri; Boltovskoy, p. 167, pl. 7, figs. 5-6.
1984a *Sigmoilina schlumbergeri* Silvestri; Boersma, p. 663, pl. 1, fig. 8.
1984b *Sigmoilopsis schlumbergeri* (Silvestri); Boersma, p. 1273, pl. 8, fig. 2.
1985 *Sigmoilopsis schlumbergeri* (Silvestri); Boichard et al., p. 94, pl. 17, figs. 4-5.
1986 *Sigmoilopsis schlumbergeri* (Silvestri); Boersma, p. 1029, pl. 14, figs. 5-6.
1986 *Sigmoilopsis schlumbergeri* (Silvestri); Kurihara and Kennett, p. 1069, pl. 1, figs. 11-12.
1986 *Sigmoilopsis schlumbergeri* (Silvestri); Schroeder, p. 638, pl. 2, fig. 16.
1986 *Sigmoilopsis schlumbergeri* (Silvestri); Van Morkhoven et al., p. 57, pl. 18, figs. 1a-e.
1988 *Sigmoilopsis schlumbergeri* (Silvestri); Van Marle, p. 149, pl. 5, fig. 25.

Short description: Test ovate in outline, biconvex in end view, periphery subacute to rounded. Chambers obscured; sutures indistinct. Agglutinated wall with calcareous cement enclosing sand grains, calcareous shell fragments and sponge needles. Terminal, rounded aperture on a short neck with small tooth.

Remarks: *S. schlumbergeri* is characterized by its ovate form and small bifid tooth.

Stratigraphic range: *S. schlumbergeri* has been found in Early - Middle Miocene (N8), Late Miocene (N16), and Late Miocene - Quaternary deposits (N18-23) on the islands, and in Recent deposits from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments the cosmopolitan *S. schlumbergeri* shows a scattered depth distribution down from 60 m (Van Marle, 1988) with its DLO at 150 m. However, based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 5.1 degrees Celsius for this species, which corresponds with waterdepths of about 1000 m, confirming the opinion of Van Morkhoven et al. (1986). *S. schlumbergeri* is common in sediments between 1240 and 2469 m on the continental margin of New Zealand (Lewis, 1979). Boichard et al. (1985) found this species at a depth of 490 m on the Pater Noster Platform.

Pflum and Frerichs (1976) and Berggren and Haq (1976) reported that this species is most common at 500-600 m in the Gulf of Mexico.

Subfamily *Spiroloculininae* Wiesner, 1920

Genus *Planispirinoides* Parr, 1950

Planispirinoides bucculentus (Brady)

1884 *Miliolina bucculenta* Brady, p. 170, pl. 114, fig. 3.
1941 *Planispirina bucculenta* (Brady); Chapman, p. 186.
1960 *Planispirinoides bucculentus* (Brady); Barker, p. 234, pl. 114, fig. 3.
1964 *Planispirinoides bucculenta* (Brady); Loeblich and Tappan, C453, fig. 344,1.

Short description: Test subglobular, compressed, the two sides nearly symmetrical, margin lobulated. Chambers inflated, broad and embracing, the last three forming a single whorl, which completely encloses the preceding ones. Aperture a long, irregularly arched, transverse slit, on the face of the terminal chamber, near the line of union with the previous whorl, with broad flap-like lip.

Remarks: Only broken specimens of *P. bucculentus* were found.

Stratigraphic range: See *Cyclogyra involvens* (Reuss).

Occurrences: See *Cyclogyra involvens* (Reuss). Bandy and Rodolfo (1964) reported *P. bucculentus* to have its UDL at 3150 m in the Peru-Chili Trench.

Genus *Spiroloculina* d'Orbigny, 1826

Spiroloculina communis Cushman and Todd

(pl. 4, figs. 5-6)

1884 *Spiroloculina excavata* Brady (not d'Orbigny), p. 151, pl. 9, figs. 5-6.
1884 *Spiroloculina impressa* Brady (not Terquem), p. 151, pl. 10, figs. 3-4.
1944 *Spiroloculina communis* Cushman and Todd, p. 63, pl. 9, figs. 4-5, 7-8.
1960 *Spiroloculina communis* Cushman and Todd; Barker, p. 18, pl. 9, figs. 5-6; pl. 10, figs. 3-4.
1983 *Spiroloculina communis* Cushman and Todd; Coustillas, pl. 31, figs. 1, 4-6.
1985 *Spiroloculina communis* Cushman and Todd; Wang et al., p. 336, pl. 4, fig. 7.

Short description: Test elliptical in outline, strongly compressed, 1.5-2 times as long as broad, strongly concave with the central part of the periphery the thickest part. Periphery usually concave and distinctly angled at the margins. Chambers increase rapidly in size and thickness as added, projecting strongly in a point at the initial end, extending into a neck at the apertural end; sutures distinct, depressed. Aperture circular, bordered by a slightly flaring lip, with a slender T-shaped tooth on the inner margin, and a simple tooth on the opposite margin.

Remarks: Characteristic of *S. communis* are the peripheral margins of earlier chambers, which persist as raised ridges in the early part. The chambers tend to be raised above and overlap the previous chambers in the adult stage. Due to this overlapping the sutures become irregular.

S. communis is extremely variable in shape, also in the characteristic prominence of the early peripheral margins raised above the surface (Cushman and Todd, 1944). Coustillas (1983) clearly figured the teeth of *S. communis*.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Spiroloculina* spp.: *S. communis*, *S. depressa*, and *S. rotunda*, of which *S. communis* is most common. *Spiroloculina* spp. were found in Early - Middle Miocene (N8), Middle - Late Miocene (N14-16), and Late Pliocene - Quaternary deposits (N21-23) on the islands, and they occur in Recent sediments from eastern Indonesia (Van Marle, 1988). They have been described previously from Pliocene to Recent deposits (see synonymy; LeRoy, 1964; Boichard et al., 1985).

Occurrence: In Recent eastern Indonesian sediments *Spiroloculina* spp. occur generally at neritic - upper bathyal depths, but also show scattered deeper occurrences (Van Marle, 1988). Coustillas (1983) found them in sediments between 0 and 400 m in the Mahakam Delta and Boichard et al. (1985) between 45 and 319 m on the Pater Noster Platform.

Waller (1960) reported *S. communis* to occur in samples from waterdepths between 90 and 135 m in the South China Sea. According to LeRoy (1964) this species prefers a warm, shallow environment.

Spiroloculina depressa d'Orbigny
(pl. 4, fig. 7)

1826	*Spiroloculina depressa* d'Orbigny, p. 298 (nomen nudum).
1884	*Spiroloculina limbata* Brady (not d'Orbigny), p. 150, pl. 9, figs. 17a-b.
1921	*Spiroloculina depressa* d'Orbigny; Cushman, p. 394, pl. 81, fig. 2; pl. 100, figs. 4-5.
1935	*Spiroloculina depressa* d'Orbigny; Keijzer, p. 109, figs. 11a-f.
1941a	*Spiroloculina depressa* d'Orbigny; LeRoy, p. 21, pl. 1, figs. 71-72.
1944	*Spiroloculina depressa* d'Orbigny; Cushman and Todd, p. 28, pl. 1, figs. 1, 6; pl. 5, figs. 1-9.
1960	*Spiroloculina depressa* d'Orbigny; Barker, p. 18, pl. 9, figs. 17a-b.
1964	*Spiroloculina depressa* d'Orbigny; Loeblich and Tappan, C453, figs. 343,1-2.
1988	*Spiroloculina depressa* d'Orbigny; Van Marle, p. 149, pl. 4, fig. 25.

Short description: Test elliptical in outline, with flattened sides, slightly longer than wide, peripheral margin angulate. Chambers quadrate in section, ending in straight line, where they butt against earlier chambers, thus forming a zig-zag line along longitidinal axis; last chamber with neck on outside margin. Sutures depressed. Wall white and rough. Aperture elongate, large, almost rectangular with lip and a short, narrow, simple tooth.

Remarks: *S. depressa*, the type-species of the genus *Spiroloculina*, resembles *Spiroloculina rotunda* d'Orbigny, but can be distinguished from the latter by its elliptical form and by its simple, small tooth. The tooth of *S. depressa* is usually short and simple, but sometimes a small, bifid tooth is present.

Stratigraphic range: See *Spiroloculina communis* Cushman and Todd. *S. depressa* has been recorded previously in Late Miocene - Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Spiroloculina communis* Cushman and Todd.

Spiroloculina rotunda d'Orbigny
(pl. 4, fig. 8)

1826 *Spiroloculina rotunda* d'Orbigny, p. 299 (nomen nudum).
1884 *Spiroloculina limbata* Brady (not d'Orbigny); Brady, p. 150, pl. 9, figs. 15-16.
1944 *Spiroloculina rotunda* d'Orbigny; Cushman and Todd, p. 41, pl. 1, fig. 2; pl. 6, figs. 16-18.
1960 *Spiroloculina rotunda* d'Orbigny; Barker, p. 18, pl. 9, figs. 15-16.
1983 *Spiroloculina rotunda* d'Orbigny; Coustillas, pl. 32, figs. 2-3.

Short description: Test nearly circular in outline, flat, thickest at the periphery, evenly concave over the front surface. Periphery flat, with limbate margins. Chambers numerous, gradually increasing in size as added, of equal width from base to apertural end, the outer margin of each chamber limbate and raised; basal end curved inward, apertural end curved outward. Sutures distinct, depressed. Quadrangular aperture with a stout tooth, enlarged on the inner margin, and bordered by thick, slightly flaring lip.

Remarks: *S. rotunda* resembles *Spiroloculina depressa* d'Orbigny, but is nearly circular in outline and has an enlarged tooth (Coustillas, 1983).

Stratigraphic range: See *Spiroloculina communis* Cushman and Todd. *S. rotunda* has been observed previously in Recent sediments.

Occurrence: See *Spiroloculina communis* Cushman and Todd. Coustillas (1983) found *S. rotunda* in sediments between 0 and 400 m in the Mahakam Delta.

Superfamily *Soritacea* Ehrenberg, 1839
Family *Peneroplidae* Schultze, 1854
Genus *Peneroplis* De Montfort, 1808

Peneroplis pertusus (Forskal)
(pl. 4, fig. 10)

1775 *Nautilus pertusus* Forskal, p. 125 (nomen nudum).
1884 *Peneroplis pertusus* (Forskal) var. *pertusus* (Forskal); Brady, p. 204, pl. 13, figs. 16-17, 23.
1930 *Peneroplis pertusus* (Forskal); Cushman, p. 35, pl. 12, figs. 3-6.
1960 *Peneroplis pertusus* (Forskal); Barker, p. 26, pl. 13, figs. 16-17, 23.
1964 *Peneroplis pertusus* (Forskal); LeRoy, p. 28, pl. 5, fig. 20.

Short description: Test strongly compressed, planispirally enrolled and involute in earlier stage, later uncoiling and somewhat flaring. External form variable, periphery rounded to angled. Chambers broad, low, arched, not subdivided, up to 20 in the final whorl. Sutures moderately depressed and slightly curved, relatively broad. Wall ornamented by many, parallel, longitudinal, continuous striae. Aperture a terminal row of slits, in slight depression along the apertural face.

Remarks: *P. pertusus* differs from *Peneroplis planatus* (Fichtel and Moll) in having a less flaring later part of the test and in having more, and less broad, chambers in the last whorl.

Stratigraphic range: See *Peneroplis planatus* (Fichtel and Moll). *P. pertusus* has been described previously from Miocene and Recent deposits.

Occurrence: According to LeRoy (1964) *P. pertusus* prefers a shallow water environment.

Peneroplis planatus (Fichtel and Moll)
(pl. 4, fig. 9)

1798 *Nautilus planatus* Fichtel and Moll var. a, p. 91, pl. 16, figs. a-c.
1884 *Peneroplis pertusus* Brady (not Forskal), p. 204, pl. 13, fig. 15.
1960 *Peneroplis planatus* (Fichtel and Moll); Barker, p. 26, pl. 13, fig. 15.
1964 *Peneroplis planatus* (Fichtel and Moll); Loeblich and Tappan, C482, figs. 369,1a-b.
1983 *Peneroplis planatus* (Fichtel and Moll); Coustillas, pl. 16, fig. 9.
1984 *Peneroplis planatus* (Fichtel and Moll); Rögl and Hansen, p. 61, pl. 22, figs. 1-2; pl. 28, fig. 1.
1988 *Peneroplis planatus* (Fichtel and Moll); Van Marle, p. 148, pl. 1, fig. 10.

Short description: Test fan-like, strongly compressed, planispiral. Involute in the early part, partly uncoiling and flaring in the later part. Chambers arched and very broad, especially in the later part; up to 16 chambers in the final whorl. Sutures slightly curved, and moderately depressed, relatively broad. Wall ornamented by many, parallel, continuous, longitudinal striae. Aperture multiple, in slightly depressed, elongate band.

Remarks: The morphology of *P. planatus* varies depending on the ontogenetic stage of the particular specimen (Rögl and Hansen, 1984). Adult specimens may even become irregularly twisted. The aperture of *P. planatus* consists of irregularly shaped openings, each bordered by an elevated rim.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Peneroplis* spp.: *P. pertusus*, *P. planatus*, and *Archaias angulatus* (Fichtel and Moll). *Peneroplis* spp. were found in Late Pliocene - Quaternary deposits (N22-23). *P. planatus* and *A. angulatus* were also found in Recent sediments from eastern Indonesia (Van Marle, 1988).

P. planatus has been described previously from Recent sediments.

Occurrence: In Recent eastern Indonesian sediments *Peneroplis* spp. occur at neritic - upper bathyal depths (Van Marle, 1988). *P. planatus* was found isobathyal in waterdepths between 60 (shallowest sample) and 150 m, with its DLO at 90 m. Coustillas (1983) found this species between 0 and 15 m in the Mahakam Delta.

Family *Soritidae* Ehrenberg, 1839
Subfamily *Archaiasinae* Cushman, 1927
Genus *Archaias* De Montfort, 1808

Archaias angulatus (Fichtel and Moll)

1798 *Nautilus angulatus* Fichtel and Moll, p. 113, pl. 22, figs. a-e.
1884 *Orbiculina adunca* Brady (not Fichtel and Moll), p. 209, pl. 14, figs. 1-2, 5-6, 10-13.
1946 *Archaias angulatus* (Fichtel and Moll); Cushman, p. 15, pl. 4, figs. 2-3.
1960 *Archaias angulatus* (Fichtel and Moll); Barker, p. 28, pl. 14, figs. 1-2, 5-6, 10-13.
1964 *Archaias angulatus* (Fichtel and Moll); Loeblich and Tappan, C494, figs. 382,1-5.
1984 *Archaias angulatus* (Fichtel and Moll); Rögl and Hansen, p. 69, pl. 27, figs. 1-6; pl. 28, figs. 2-6; pl. 29, figs. 1-4.

Short decription: Test planispiral, involute, compressed, symmetrical, nearly circular in outline, periphery angled. Chambers broad, low, strongly curved, up to 17 in the last whorl. Sutures distinct, somewhat elevated. Chambers are rather wide in the umbilical part, narrowing towards the periphery, leading to an elongated, lanceolate, apertural face, which is densely and finely pitted. Multiple, areal aperture, with elliptical openings, bordered by rims, covering the entire apertural face.

Remarks: The forms originally described by Fichtel and Moll (1798) as *Nautilus orbiculus* (p. 112, pl. 21, figs. a-d) and *Nautilus aduncus* (p. 115, pl. 23, figs. a-e) must be considered as synonyms of *A. angulatus*, because they are identical in internal characters and external morphology (Cushman, 1946; Rögl and Hansen, 1984) .

Stratigraphic range: See *Peneroplis planatus* (Fichtel and Moll).

Occurrence: See *Peneroplis planatus* (Fichtel and Mall). *A. angulatus* is the dominant species in shallow-shelf communities of the Florida-Bahamas carbonate province and in the Gulf of Mexico (Poag, 1981; Hallock et al., 1986; Martin, 1986).

According to Martin (1986) the occurrence of *A. angulatus* is limited by extremity of salinity, light intensity and wave energy. As it lives attached on vegetation, extreme wave action causes disturbance of the attachment.

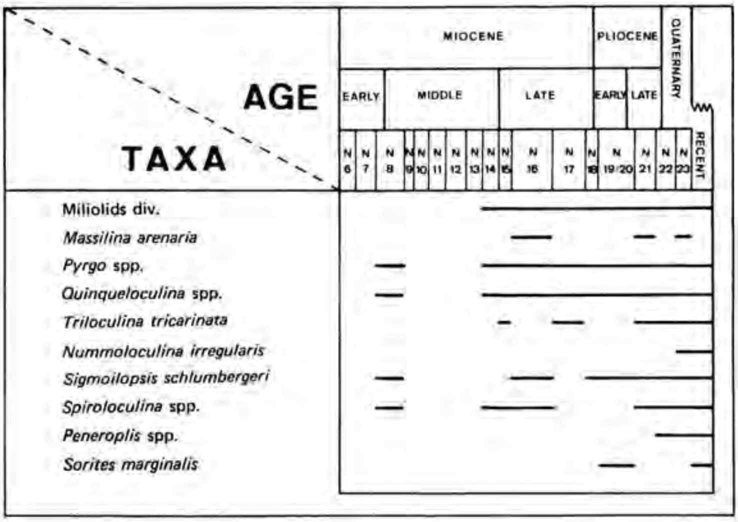

Fig. 15. Composite range chart of the suborder *Miliolina* in eastern Indonesia.

Subfamily *Soritinae* Ehrenberg, 1839
Genus *Sorites* Ehrenberg, 1839

Sorites marginalis (Lamarck)

1816 *Orbulites marginalis* Lamarck, p. 196 (nomen nudum).
1884 *Orbitolites marginalis* (Lamarck); Brady, p. 214, pl. 15, figs. 1-3, 5 (not 4).
1960 *Sorites marginalis* (Lamarck); Barker, p. 30, pl. 15, figs. 1-3, 5.
1964 *Sorites marginalis* (Lamarck); Loeblich and Tappan, C496, figs. 385,1-2.

Short description: Test discoidal, strongly compressed, periphery rounded. Chambers divided into chamberlets, interconnected by stolons; each chamber communicating with two chambers in preceding whorls. Wall pitted. Apertures consisting of small pores in a narrow band in the middle of the periphery, either in a single or multiple line.

Remarks: Only broken specimens of *S. marginalis* were found.

Stratigraphic range: *S. marginalis* was found in Early - Late Pliocene deposits (N19/20) from Timor, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: In Recent eastern Indonesian sediments *S. marginalis* has been found in waterdepths between 60 and 150 m (Van Marle, 1988).

Suborder *Robertinina* Loeblich and Tappan, 1984
Superfamily *Duostominacea* Brotzen, 1963
Family *Ceratobuliminidae* Cushman, 1927
Subfamily *Ceratobulimininae* Cushman, 1927
Genus *Ceratobulimina* Toula, 1915

Ceratobulimina pacifica Cushman and Harris
(pl. 4, figs. 11-12)

1884 *Bulimina contraria* Brady (not Reuss), p. 409, pl. 54, figs. 18a-b.
1927 *Ceratobulimina pacifica* Cushman and Harris, p. 176, pl. 29, figs. 9a-c.
1941a *Ceratobulimina pacifica* Cushman and Harris; LeRoy, p. 42, pl. 1, figs. 30-32.
1941b *Ceratobulimina pacifica* Cushman and Harris; LeRoy, p. 85, pl. 4, figs. 34-35.
1944b *Ceratobulimina pacifica* Cushman and Harris; LeRoy, p. 89, pl. 7, figs. 7-8.
1946 *Ceratobulimina pacifica* Cushman and Harris; Cushman, p. 113, pl. 18, figs. 11-16.
1951 *Ceratobulimina pacifica* Cushman and Harris; Hofker, p. 316, text-figs. 214-218.
1960 *Ceratobulimina pacifica* Cushman and Harris; Barker, p. 112, pl. 54, figs. 18a-b.
1964 *Ceratobulimina pacifica* Cushman and Harris; LeRoy, p. 40, pl. 9, figs. 23-24.
1965 *Ceratobulimina pacifica* Cushman and Harris; Todd, p. 57, pl. 23, fig. 1.
1966 *Ceratobulimina pacifica* Cushman and Harris; Belford, p. 186, pl. 36, figs. 1-7.
1988 *Ceratobulimina pacifica* Cushman and Harris; Van Marle, p. 141, pl. 3, figs. 21-23.

Short description: Test elongate, oblong, nearly as broad as long, periphery very broadly rounded, deeply umbilicate. Chambers trochospirally arranged in a few dextral coils. Usually 6 chambers in the last whorl, enlarging rapidly as added. Sutures distinct, slightly depressed. Wall aragonitic, laminated, smooth, polished. Aperture an umbilical and elongate slit, extending into a groove up the face of the final chamber on umbilical side, narrowing towards the middle of the apertural face.

Remarks: *C. pacifica* differs from *Ceratobulimina contraria* (Reuss) by its more globular and inflated test, with individually bulging chambers, and by its distinct and elongate aperture, that extends as a straight slit into the apertural face (Todd, 1965).

Stratigraphic range: We found *C. pacifica* in Late Miocene deposits (N16) from Buton. *C. pacifica* has frequently been encountered in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: In eastern Indonesia, *C. pacifica* occurs isobathyal between 911 and 2119 m, with its DLO at 1760 m and its UDL at 711 m (Van Marle, 1988). Based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 5.5 degrees Celsius for this species, which corresponds with waterdepths of about 900 m.

These observations contradict the opinions of LeRoy (1964) and Moore et al. (1980), who considered this species to be outer neritic - upper bathyal.

Genus *Lamarckina* Berthelin, 1881

Lamarckina ventricosa (Brady)
(pl. 4, fig. 13)

1884 *Discorbina ventricosa* Brady, p. 654, pl. 91, figs. 7a-c.
1915 *Discorbis ventricosa* (Brady); Cushman, p. 22, pl. 13, figs. 1a-c.
1931 *Lamarckina ventricosa* (Brady); Cushman, p. 34, pl. 7, figs. 5a-c.
1960 *Lamarckina ventricosa* (Brady); Barker, p. 188, pl. 91, figs. 7a-c.
1966 *Lamarckina ventricosa* (Brady); Belford, p. 189, pl. 35, figs. 10-14.

Short description: Test oblong, rounded, slightly compressed, plano-convex, with carinate periphery. Chambers increasing rapidly in size as added, broad and low, trochospirally arranged in usually two dextral coils; 6-7 chambers in the last whorl, of which the final chamber occupies nearly half of the test. Sutures distinct, depressed. Wide and deep umbilicus, with a sharp angle at the umbilical margin. Wall aragonitic, with pustulose spiral side; opposite side smooth and polished, finely perforate. Aperture an umbilical, *interiomarginal* arch, covered by a thin valvular flap.

Remarks: *L. ventricosa* differs from *Lamarckina scabra* (Brady) by its more rounded appearance, with an inflated last chamber, and its more pustulose dorsal side (see Belford, 1966).

Stratigraphic range: *L. ventricosa* was found in Late Pliocene - Quaternary deposits (N22) from Seram and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Miocene to Recent deposits (see synonymy and LeRoy, 1964).

Occurrence: In eastern Indonesia, *L. ventricosa* has only been found near Tanimbar at neritic - upper bathyal depths (Van Marle, 1988). LeRoy (1964) assumed a similar depth habitat for this species.

Family *Epistominidae* Wedekind, 1937
Subfamily *Epistomininae* Wedekind, 1937
Genus *Hoeglundina* Brotzen, 1948

Hoeglundina elegans (d'Orbigny)
(pl. 4, figs. 14-16)

1826 *Rotalia* (*Turbuline*) *elegans* d'Orbigny, p. 276, mod. no. 54.
1884 *Pulvinulina elegans* (d'Orbigny); Brady, p. 699, pl. 105, figs. 3-6.

1915 *Pulvinulina elegans* (d'Orbigny); Cushman, p. 63, pl. 26, figs. 3a-c.
1931 *Epistomina elegans* (d'Orbigny); Cushman, p. 65, pl. 13, figs. 6a-c.
1941a *Epistomina elegans* (d'Orbigny); LeRoy, p. 40, pl. 1, figs. 5-7.
1941b *Epistomina elegans* (d'Orbigny); LeRoy, p. 84, pl. 4, figs. 13-15.
1944a *Epistomina elegans* (d'Orbigny); LeRoy, p. 35, pl. 3, figs. 15-17.
1946 *Epistomina suturo-limbata* Germeraad, p. 70, pl. 2, figs. 23-25.
1949 *Epistomina elegans* (d'Orbigny); Boomgaart, p. 130, pl. 10, fig. 1.
1951 *Epistomina elegans* (d'Orbigny); Hofker, p. 375, text-figs. 254-257.
1951a *Hoeglundina elegans* (d'Orbigny); Asano, p. 17, figs. 130-131.
1960 *Hoeglundina elegans* (d'Orbigny); Barker, p. 216, pl. 105, figs. 3-6.
1961 *Epistomina elegans* (d'Orbigny); De Hornibrook, p. 122, pl. 17, fig. 367.
1964 *Hoeglundina elegans* (d'Orbigny); LeRoy, p. 38, pl. 6, figs. 27-28.
1964 *Hoeglundina elegans* (d'Orbigny); Loeblich and Tappan, C775, figs. 636,3-5.
1965 *Hoeglundina elegans* (d'Orbigny); Todd, p. 56, pl. 23, fig. 2.
1966 *Hoeglundina elegans* (d'Orbigny); Belford, p. 190, pl. 36, figs. 8-13.
1979 *Hoeglundina elegans* (d'Orbigny); Corliss, p. 12, pl. 5, figs. 11-13.
1980 *Hoeglundina elegans* (d'Orbigny); Coulbourn, p. 717, textfig. 6G.
1980 *Hoeglundina elegans* (d'Orbigny); Haller, p. 257, pl. 12, figs. 1a-c.
1980 *Hoeglundina elegans* (d'Orbigny); Ingle et al., p. 138, pl. 2, fig. 11.
1981 *Hoeglundina elegans* (d'Orbigny); Burke, p. 8, pl. 3, figs. 12-13.
1983 *Hoeglundina elegans* (d'Orbigny); Coustillas, pl. 40, figs. 1-2.
1985 *Hoeglundina elegans* (d'Orbigny); Boichard et al., p. 94, pl. 17, figs. 25-27.
1985 *Hoeglundina elegans* (d'Orbigny); Papp and Schmid, p. 59, pl. 49, figs. 1-6.
1986 *Hoeglundina elegans* (d'Orbigny); Van Morkhoven et al., p. 97, pl. 29, figs. 1-2.
1988 *Hoeglundina elegans* (d'Orbigny); Van Marle, p. 145, pl. 5, figs. 18-19.

Short description: Test subcircular in outline, slightly biconvex to planoconvex, peripheral margins acute and carinate, umbilical area closed. Chambers triangular umbilically, quadrate spirally, trochospirally arranged in 2-3 whorls, with 6-7 chambers in the last whorl. Sutures limbate, curved on spiral side, radial and straight on umbilical side. Wall aragonitic, translucent, shiny, smooth, finely perforate, with irregular white blotches. Primary aperture a small, open arch on umbilical side. Secondary aperture an arched, flanged linear slit along the periphery on the same side, extending the breadth of the final chamber.

Remarks: Characteristic of *H. elegans* is the clear wall with irregular blotches of white shell material (Todd, 1965). The supplementary apertures of earlier chambers are usually closed, filled up with clear shell material, and visible only as scars along the periphery.

The specimens figured by Germeraad (1946) as *Epistomina suturo-limbata* completely follow the type description of *H. elegans*, only varying slightly in

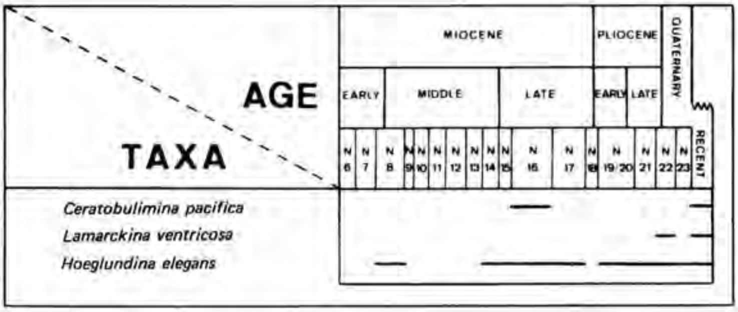

Fig. 16. Composite range chart of the suborder *Robertinina* in eastern Indonesia.

having a thicker keel and more limbate sutures. These features are considered as intraspecific variation, and *E. suturo-limbata* is therefore considered to be a junior synonym of *H. elegans*.

Stratigraphic range: *H. elegans* has been widely recorded in Middle Eocene to Recent deposits from the Indo-Pacific region (see synonymy and Lewis, 1979).

It was found in Early - Middle Miocene (N8), Middle - Late Miocene (N14-17), and Early Pliocene - Quaternary deposits (N19/20-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: *H. elegans* shows a scattered depth distribution down from 90 m in Recent eastern Indonesian sediments (Van Marle, 1988). Based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 6.0 degrees Celsius for this species, which corresponds with waterdepths of about 800 m.

Berggren and Haq (1976) reported this species to be an isobathyal, middle to lower bathyal form, and Burke (1981) reported *H. elegans* to be characteristic of the deep oxygen minimum layer (1200-2400 m) in the western Pacific. Yet, Lewis (1979) found this species in waterdepths between 113 and 2469 m on the continental margin of New Zealand. Coustillas (1983) found it between 90 and 300 m in the Mahakam Delta and Boichard et al. (1985) encountered this form between 190 and 715 m on the Pater Noster Platform. Van Morkhoven et al. (1986) recorded a scattered distribution between 50 and 4300 m for this cosmopolitan species.

According to Corliss (1985), *H. elegans* also lives infaunal in the top 0-2 cm of the sediment.

Suborder *Rotaliina* Delage and Herouard, 1896
Superfamily *Acervulinacea* Schultze, 1854
Family *Acervulinidae* Schultze, 1854
Genus *Acervulina* Schultze, 1854

Acervulina inhaerens Schultze
(pl. 18, fig. 18)

1854 *Acervulina inhaerens* Schultze, p. 68, pl. 6, fig. 12.
1884 *Gypsina inhaerens* (Schultze); Brady, p. 718, pl. 102, figs. 1-6.
1955 *Acervulina inhaerens* Schultze; Cushman, p. 343, pl. 37, figs. 8-10.
1957 *Acervulina inhaerens* Schultze; Todd, p. 292, pl. 93, fig. 15.
1960 *Acervulina inhaerens* Schultze; Barker, p. 210, pl. 102, figs. 1-6.
1964 *Acervulina inhaerens* Schultze; Loeblich and Tappan, C694, fig. 64.

Short description: Small brownish test attached to other organisms, made up out of a few irregular, hemispheric chambers, that usually form a closed ring. If found free, the species forms a foliated test which was initially attached, but grew further after falling off its substrate. Wall thick, transparent, coarsely perforate with funnel-shaped pore-canals.

Remarks: Of *A. inhaerens* only a few specimens have been found in our material, attached to pieces of coral; no free specimens have been observed.

Stratigraphic range: *A. inhaerens* was found in Late Pliocene - Quaternary deposits (N22-23) on the eastern Indonesian islands.

Occurrence: *A. inhaerens* is characteristic of relatively warm, shallow water environments (Todd, 1965).

Superfamily *Astigerinacea* d'Orbigny, 1839
Family *Amphistiginidae* Cushman, 1927
Genus *Amphistegina* d'Orbigny, 1826

Amphistegina lessonii d'Orbigny
(pl. 21, figs. 7-8)

1826 *Amphistegina lessonii* d'Orbigny, p. 304, pl. 17, figs. 1-4.
1884 *Amphistegina lessonii* d'Orbigny; Brady, p. 740, pl. 111, figs. 1, 3-6.
1903 *Amphistegina lessonii* d'Orbigny; Fornasini, pl. 2, fig. 1.
1941a *Amphistegina lessonii* d'Orbigny; LeRoy, p. 41, pl. 3, figs. 18-19.
1960 *Amphistegina lessonii* d'Orbigny; Barker, p. 230, pl. 111, figs. 1, 3-6.
1965 *Amphistegina lessonii* d'Orbigny; Todd, p. 33, pl. 11, fig. 4.
1976 *Amphistegina lessonii* d'Orbigny; Larsen, p. 2, pl. 1, figs. 1-5; pl. 7, fig. 1; pl. 8, fig. 1.
1977 *Amphistegina lessonii* d'Orbigny; Larsen and Drooger, p. 225, fig. 1, no. 2a-b.
1977 *Amphistegina lessonii* d'Orbigny; Larsen, p. 274, pl. 1, figs. 1-6 (neotype).

1978 *Amphistegina lessonii* d'Orbigny; Larsen, p. 224, pl. 5, figs. 8-9; pl. 7, fig. 2.

1983 *Amphistegina lessonii* d'Orbigny; Coustillas, p. 106, pl. 22, figs. 1-4.

1984 *Amphistegina lessonii* d'Orbigny; Reiss and Hottinger, p. 217, figs. G.11 and G.12d-e.

1984 *Amphistegina lessonii* d'Orbigny; Hallock, p. 253, pl. 1, figs. 8a-b.

1985 *Amphistegina lessonii* d'Orbigny; Boichard et al., p. 90, pl. 15, figs. 12-13.

1988 *Amphistegina lessonii* d'Orbigny; Van Marle, p. 139, pl. 1, fig. 5.

Short description: Test lenticular, slightly unequally biconvex, with irregularly star-shaped umbo; generally consisting of 4-5, multichambered, sinistrally coiled whorls. Spiral side involute with broad chambers showing alar prolongations; sutures radiate, falciform, undulating near umbo. Umbilical sutures slightly limbate, broad, irregularly radiating, angled near periphery. Wall thick, smooth, finely perforate. Aperture a narrow, interiomarginal slit on the umbilical side, with lip and granulate surface.

Remarks: In *A. lessonii* the umbilical sutures (septa) are divided by deep constrictions forming secondary lobes that have the appearance of secondary chamberlets in a rosette around the umbo, which is formed by the irregular coalescence of the sutures (Loeblich and Tappan, 1964).

Confusion has arisen regarding this species and *Amphistegina quoyii* d'Orbigny due to errors in the type descriptions by d'Orbigny (1826). Brady referred all resembling species to *A. lessonii* and considered *A. quoyii* to be a less inflated and multichambered, larger variant of the typical *A. lessonii* and not a distinct species. Differentiation between these two endmembers of a continuous cline was highly arbitrary, and because of this Fornasini (1902) regarded *A. lessonii* to be the only valid speciesname and *A. quoyii* as a synonym. Until recently, the taxonomic status of several modern *Amphistegina* species remained in doubt, and the name *A. lessonii* has been used as a 'wastebasket' containing a variety of both fossil and modern forms (Crouch and Poag, 1979).

Larsen (1976) published detailed studies on the species of *Amphistegina*, and provided a stable categorization of the modern species (of which some have long fossil records) that is primarily based on test morphology. As of 1977, Larsen recognized six modern species in the world ocean: *A. lessonii* d'Orbigny, *A. gibbosa* d'Orbigny, *A. papillosa* Said, *A. radiata* (Fichtel and Moll), *A. lobifera* Larsen and *A. bicirculata* Larsen. Forms with a simple star-shaped pattern of the supplementary chambers, simple linear sutures or softly bent at distinct angle to periphery, an interiomarginal slitlike aperture on the umbilical side, and a moderate relative test thickness are referred to *A. lessonii*. The specimens found throughout our samples all have these characteristics and can, following his concepts, be regarded as *A. lessonii*, though variations in size occur, as mentioned by Larsen (1977).

Stratigraphic range: *A. lessonii* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been recorded previously in Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: In Recent eastern Indonesian sediments *A. lessonii* occurs isobathyal in waterdepths between 60 and 150 m, with its DLO at 90 m, but also shows some scattered (displaced) occurrences between 150 and 495 m (Van Marle, 1988). Coustillas (1983) observed this species in sediments between 45 and 60 m in the Mahakam Delta and Boichard et al. (1985) reported it between 45 and 319 m with highest frequencies between 45 and 191 m on the Pater Noster Platform. Waller (1960) reported this species to occur in waterdepths between 50 and 90 m in the South China Sea.

Superfamily *Buliminacea* Jones, 1875
Family *Bolivinitidae* Cushman, 1927
Genus *Bolivinita* Cushman, 1927

Bolivinita compressa Finlay

1939 *Bolivinita compressa* Finlay, p. 319, pl. 27, figs. 101-102.
1966 *Bolivinita compressa* Finlay; Belford, p. 19, pl. 4, figs. 1-3.

Short description: Test compressed with broad concave sides, rhomboid in cross section and apertural view; angles strongly carinate, particularly on outer edges. Chambers biserially arranged throughout, gradually inceasing in breadth; sutures straight, depressed on lateral edges. Wall thin, finely and densely perforate. Subcircular, elliptical aperture, perpendicular to suture, with bordering lip and narrow tooth, formed by the folded free edge of toothplate.

Remarks: Characteristic of *B. compressa* are the rhomboid form and the two strongly developed outer keels, while those towards the centre of the test are less distinct, particularly on the later chambers.

Stratigraphic range: *B. compressa* was found in Late Miocene (N15-16) and Late Pliocene - Quaternary deposits (N21-23). It has been described previously from Middle - Late Miocene deposits.

Occurrence: *B. compressa* has in our material always been found in association with typical outer neritic - upper bathyal species.

Bolivinita quadrilatera (Schwager)
(pl. 6, figs. 4-6)

1866 *Textilaria quadrilatera* Schwager, p. 253, pl. 7, fig. 103.
1884 *Textilaria quadrilatera* Schwager; Brady, p. 358, pl. 42, figs. 8-12.
1927 *Bolivinita quadrilatera* (Schwager); Cushman, p. 90.
1941a *Bolivinita quadrilatera* (Schwager); LeRoy, p. 31, pl. 1, figs. 99-101.
1941b *Bolivinita quadrilatera* (Schwager); LeRoy, p. 79, pl. 2, figs. 3-4.

1949 *Bolivinita quadrilatera* (Schwager); Boomgaart, p. 95, pl. 8, figs. 3a-b.
1951 *Bolivina quadrilatera* (Schwager); Hofker, p. 102, text-figs. 60-62.
1960 *Bolivinita quadrilatera* (Schwager); Barker, p. 86, pl. 42, figs. 8-12.
1964 *Bolivinita quadrilatera* (Schwager); Loeblich and Tappan, C548, fig. 434,1-3.
1966 *Bolivinita quadrilatera* (Schwager); Belford, p. 18, pl. 4, figs. 4-7.
1978 *Bolivina quadrilatera* (Schwager); Hofker, p. 42, pl. 4, figs. 3-7.
1980 *Bolivinita quadrilatera* (Schwager); Keller, p. 842, pl. 1, fig. 14.
1983 *Bolivinita quadrilatera* (Schwager); Coustillas, pl. 29, fig. 13.
1984 *Bolivinita quadrilatera* (Schwager); Govindan, p. 244, pl. 1, fig. 9.
1985 *Bolivinita quadrilatera* (Schwager); Boichard et al., p. 94, pl. 17, figs. 18-19.

Short description: Test compressed, narrow, elongate, with broad, flat to slightly concave sides; quadrate in transverse section, the four angles with strongly developed axial costae. Chambers biserially arranged throughout, gradually increasing in breadth; sutures straight, depressed on lateral edges, oblique. Wall thin, smooth to slightly lobulate, finely and densely perforate. Aperture basal, subcircular, elliptical, perpendicular to suture, with bordering lip and narrow tooth, formed by folded free edge of the toothplate.

Remarks: Characteristic of *B. quadrilatera* is its quadrate peripheral outline with strongly developed axial costae along the four angles. In the eastern Indonesian specimens the sutures are slightly limbate and a basal spine was sometimes present.

Stratigraphic range: *B. quadrilatera* was found in Early - Middle Miocene (N8) and Middle Miocene - Quarternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Early Miocene to Recent deposits from the Indo-Pacific region (see synonymy; Asano, 1964; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments, Van Marle (1988) observed *B. quadrilatera* near Timor in samples from waterdepths between 684 and 1097 m. Hofker (1978) found no specimens of *B. quadrilatera* shallower than 513 m in his Snellius-I samples.

This species occurs in sediments from the continental margin of New Zealand in waterdepths between 48 and 2469 m (Lewis, 1979), between 200 and 400 m in the Mahakam Delta (Coustillas, 1983), and at a depth of 715 m on the Pater Noster Platform (Boichard et al., 1985).

Bolivinita subangularis (Brady)
(pl. 6, figs. 7-8)

1881 *Bolivina subangularis* Brady, p. 59 (nomen nudum).
1884 *Bolivina subangularis* Brady, p. 427, pl. 53, figs. 32-33.
1937 *Bolivina subangularis* Brady; Cushman, p. 133, pl. 17, figs. 5-10.
1946 *Bolivina subangularis* Brady var. *irregularis* Germeraad, p. 68, pl. 3, figs. 15-16.

1960 *Bolivinita subangularis* (Brady); Barker, p. 109, pl. 53, figs. 32-33.
1966 *Bolivinita subangularis* (Brady); Belford, p. 19, pl. 3, figs. 8-11.

Short description: Test compressed, oblong, initial end obtusely pointed; rhomboid in cross section, with concave sides and wide longitudinal central depression. Peripheral angle provided with costae. Chambers biserially arranged throughout. Wall finely and densely perforate. Aperture loop-shaped, basal, with bordering lip and narrow tooth formed by folded free edge of toothplate.

Remarks: Characteristic of *B. subangularis* is the deep, longitudinal, wide, central depression, bordered by thin costae.

The form described by Germeraad (1946) resembles the description of *B. subangularis*, only being slightly irregular.

Stratigraphic range: We found *B. subangularis* in Late Pliocene - Quaternary deposits (N22-23) from Timor. It has been observed previously in Late Miocene to Recent deposits.

Occurrence: According to Moore et al. (1980) *B. subangularis* is indicative for neritic depths (0-150 m).

Family *Buliminidae* Jones, 1875
Subfamily *Bulimininae* Jones, 1875
Genus *Bulimina* d'Orbigny, 1826

Bulimina aculeata d'Orbigny
(pl. 5, figs. 3-5)

1826 *Bulimina aculeata* d'Orbigny, p. 269, mod. no. 7 (nomen nudum).
1884 *Bulimina aculeata* d'Orbigny; Brady, p. 406, pl. 51, figs. 7-9.
1945 *Bulimina aculeata* d'Orbigny; Cushman and Todd, p. 39, pl. 6, fig. 11.
1950 *Bulimina aculeata* d'Orbigny; Asano, p. 3, figs. 8-9.
1951 *Bulimina aculeata* d'Orbigny; Hofker, p. 151, text-figs. 92-94.
1960 *Bulimina aculeata* d'Orbigny; Barker, p. 104, pl. 51, figs. 7-9.
1964 *Bulimina aculeata* d'Orbigny; LeRoy, p. 30, pl. 11, fig. 7.
1966 *Bulimina aculeata* d'Orbigny; Belford, p. 58, pl. 5, figs. 1-3.
1976 *Bulimina aculeata* d'Orbigny; Berggren and Haq, p. 108, pl. 4, figs. 1-5.
1980 *Bulimina aculeata* d'Orbigny; Keller, p. 842, pl. 1, fig. 16.
1981 *Bulimina aculeata* d'Orbigny; Burke, p. 4, pl. 1, fig. 13.
1984a *Bulimina aculeata* d'Orbigny; Boersma, p. 663, pl. 2, figs. 7-8.
1986 *Bulimina aculeata* d'Orbigny; Boersma, p. 988, pl. 5, fig. 1.
1986 *Bulimina aculeata* d'Orbigny; Kurihara and Kennett, p. 1070, pl. 2, fig. 11.
1986 *Bulimina aculeata* d'Orbigny; Van Morkhoven et al., p. 31, pl. 7, figs. 1-3.
1988 *Bulimina aculeata* d'Orbigny; Van Marle, p. 139, pl. 5, fig. 17.

Short description: Test elongate or oval, tapering towards the basal end, usually with distinct basal spine or spines. Chambers distinct, somewhat globular with basal constrictions, arranged in about 5 whorls. Sutures depressed. Wall finely perforate; all chambers but those of the last whorl with series of long spines extending from the lower edges; chambers of last whorl relatively smooth. Aperture loop-shaped with distinct lip.

Remarks: Although *B. aculeata* and *Bulimina marginata* d'Orbigny are often considered to be the extreme end members of one continuous morphological cline, the author has not observed a gradational series in our material and, as differentiation between the two species on external appearance is possible (Hoeglund, 1947), considers them to be separate species. All specimens having a series of spines fringing the outer margins of the chambers were taken as *B. aculeata*, and specimens with serrate edges at the sharply undercut lower chamber margins as *B. marginata*.

Stratigraphic range: *B. aculeata* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Early Miocene to Recent deposits from the Indo-Pacific region (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *B. aculeata* occurs in waterdepths deeper than 141 m, with its DLO at 1760 m (Van Marle, 1988).

Berggren and Haq (1976) reported *B. aculeata* to be an isobathyal, middle - lower bathyal form with its UDL at 200-350 m. Lewis (1979) reported this species in sediments from the continental margin of New Zealand in waterdepths between 180 and 2469 m. According to Van Morkhoven et al. (1986) *B. aculeata* is the deeper water ecophenotype of *B. marginata*, occurring isobathyal in the upper bathyal to abyssal zone.

B. aculeata shows higher frequencies in waters of Pacific origin, which are relatively low in oxygen (Van Marle, 1988). Pflum and Frerichs (1976) also reported this species to be successful at low oxygen values and to have a preference for clastic substrates in the Gulf of Mexico. Similar observations have been made by Van der Zwaan (1982), who found *B. aculeata* to be a mud-dweller with a wide environmental range and resistant to oxygen deficiency as it is abundant in oxygen depleted sediments from Crete.

Bulimina alazanensis Cushman
(pl. 5, figs. 1-2)

1927a *Bulimina alazanensis* Cushman, p. 161, pl. 25, fig. 4.
1966 *Bulimina alazanensis* Cushman; Belford, p. 62, pl. 5, figs. 9-11.
1973 *Bulimina alazanensis* Cushman; Douglas, p. 613, pl. 7, figs. 1-2.
1984b *Bulimina alazanensis* Cushman; Boersma, p. 1286, pl. 3, fig. 4.
1985 *Bulimina alazanensis* Cushman; Thomas, p. 675, pl. 2, fig. 6.
1986 *Bulimina alazanensis* Cushman; Boersma, p. 1020, pl. 5, fig. 7.
1988 *Bulimina alazanensis* Cushman; Van Marle, p. 139, pl. 2, fig. 9.

Short description: Test small, longer than broad, broadest near the apertural end, tapering towards the initial end; often with small basal spine. Chambers and sutures, except for the smooth and finely perforate last chamber, obscured by ornament of distinct, longitudinal, continuous costae ending at the basal end in spinose projections. Wall finely and sparsely perforate. Aperture elongate, loop-shaped with small tooth formed by the narrowly folded free edge of the toothplate.

Remarks: Some authors identified resembling specimens as *Bulimina rostrata* Brady, but these differ from the originally described holotypes of that species, which are tapering at each end and ornamented by longitudinal costae that are discontinuous at the sutures. Our specimens do not show any interruption in the costae at the sutures at all, have only perforations on the lower parts of the chamber, and do not narrow at the apertural end, so they were taken as *B. alazanensis* (see Belford, 1966).

Stratigraphic range: *B. alazanensis* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been found previously in Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *B. alazanensis* occurs isobathyal in waterdepths between 711 and 1504 m, with its DLO at 685 m and its UDL at 344 m (Van Marle, 1988).

Poag (1981) frequently observed this species in sediments from the middle and lower slope in the Gulf of Mexico.

Bulimina exilis Brady

1884	*Bulimina elegans* d'Orbigny var. *exilis* Brady, p. 399, pl. 50, figs. 5-6.
1922	*Bulimina elegans* d'Orbigny var. *exilis* Brady; Cushman, p. 106, pl. 17, figs. 7-12.
1947	*Bulimina exilis* Brady; Cushman and Parker, p. 124, pl. 28, fig. 29.
1960	*Bulimina exilis* Brady; Barker, p. 102, pl. 50, figs. 5-6.
1966	*Buliminella* sp. cf. *B. tenuata* (Cushman); Belford, p. 16, pl. 6, figs. 22-24.
1980	*Buliminella exilis* (Brady); Keller, p. 853, pl. 1, fig. 15.
1986	*Bulimina exilis* Brady; Van Morkhoven et al., p. 24, pl. 4, figs. 1-2.

Short description: Test elongated, slender, tapering, compressed on three sides; apertural end subacute or rounded, basal end acuminate, sometimes with spine. Chambers arranged in a regular triserial spire, numerous, elongate, oblique, slightly inflated, sharply angled; sutures distinct, slightly depressed. Wall smooth, polished, very finely perforate. Aperture broad, loop-shaped, placed on the apex of the test pointing directly downward to meet the junction of the second and third chambers.

Remarks: Belford (1966) separated *B. exilis* and *Buliminella tenuata* (Cushman) by the presence or absence of an initial spine, but also stated that the similarity in overall morphology, especially in apertural character, toothplate pores, and wall texture suggests that the initial spine is a feature due to geographic subspecification, in which case *B. tenuata* must be considered as a variety of *B. exilis*.

According to Jonkers (1984) the width of the aperture in *B. exilis* is also subject to variation.

Stratigraphic range: *B. exilis* was found in Quaternary deposits (N23) from Timor. The species has been recorded previously from Late Miocene to Recent SE Asian deposits.

Occurrence: Keller (1980) found *B. exilis* in Pleistocene, lower middle bathyal deposits (1500-2000 m) off the coast of Japan. Van Morkhoven et al. (1986) described *B. exilis* as a bathyal taxon, occurring for instance at bathyal depths in Pleistocene deposits off the continental margin of the northeastern United States, with highest frequencies from 500-1000 m.

Van der Zwaan (1982) reported this species to be highly tolerant to oxygen deficiency. In addition Jonkers (1984) observed that in Pliocene deposits from Crete *B. exilis* is most commonly associated with sapropels and diatomites, deposited under conditions of significant oxygen depletion.

Bulimina marginata d'Orbigny
(pl. 5, figs. 9-10)

1826 *Bulimina marginata* d'Orbigny, p. 269, pl. 12, figs. 10-12.
1884 *Bulimina marginata* d'Orbigny; Brady, p. 405, pl. 1, figs. 3-5.
1945 *Bulimina marginata* d'Orbigny; Cushman and Todd, p. 39, pl. 6, fig. 8.
1950 *Bulimina marginata* d'Orbigny; Asano, p. 4, figs. 13-14.
1951 *Bulimina marginata* d'Orbigny; Hofker, p. 154, text-fig. 96.
1957 *Bulimina marginata* d'Orbigny; Todd and Brönniman, p. 32, pl. 8, figs. 4-5.
1960 *Bulimina marginata* d'Orbigny; Barker, p. 104, pl. 51, figs. 3-5.
1966 *Bulimina marginata* d'Orbigny; Belford, p. 55, pl. 5, figs. 4-5.
1983 *Bulimina marginata* d'Orbigny; Coustillas, pl. 28, fig. 10.
1985 *Bulimina marginata* d'Orbigny; Wang et al., p. 336, pl. 4, fig. 13.
1986 *Bulimina marginata* d'Orbigny; Van Morkhoven et al., p. 18, pl. 2, figs. 1a-b.
1988 *Bulimina marginata* d'Orbigny; Van Marle, p. 141, pl. 2, fig. 8.

Short description: Test elongate or oval, tapering towards the apertural end. Chambers distinct, enlarging rapidly; lower chamber margins sharply constricted, with serrate edges; upper chamber margins inflated, with a retracting part underneath; sutures depressed, distinct. Wall smooth, finely perforate. Aperture loop-shaped with a distinct lip.

Remarks: The toothplate of *B. marginata* is similar to that of *Bulimina aculeata* d'Orbigny, with a narrowly folded free edge forming a small serrated tooth in the aperture, continuing around the apertural margin as a thin, high rim.

Though *B. marginata* and *B. aculeata* are often considered to be the extreme end members of one continuous morphological cline, we have not observed a gradational series in our material and, as differentiation between the two species on external appearance is possible (Hoeglund, 1947), consider them to be separate species. All specimens with sharply constricted lower chamber margins ornamented with a spinose rim were taken as *B. marginata*, and the specimens with more rounded, less sharply constricted chamber margins and irregular series of spines fringing the outer margin as *B. aculeata*.

Stratigraphic range: *B. marginata* was found in Late Miocene (N16) and Late Miocene - Quaternary deposits (N21-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *B. marginata* occurs generally in waterdepths between 344 (UDL) and 1097 m, with its DLO at 495 m (Van Marle, 1988). It occurs in sediments between 18 and 625 m off New Zealand (Lewis, 1979) and between 50 and 400 m in the Mahakam Delta (Coustillas, 1983). Poag (1981) frequently observed *B. marginata* on the outer shelf and upper slope in the Gulf of Mexico.

Hageman (1979) considered this species to be an open marine mud-dweller.

Van Morkhoven et al. (1986) consider *B. marginata* to be the shallower water ecophenotype of *B. aculeata*, as they observed intergradations between both species. According to them *B. marginata* and its morphovariant represent a cline restricted to stenohaline conditions and fine-grained substrate at depths between 0 and 500 m.

Bulimina striata d'Orbigny
(pl. 5, figs. 6-8)

1826 *Bulimina striata* d'Obigny, p. 269, mod. no. 2 (nomen nudum).
1884 *Bulimina inflata* Seguenza; Brady, p. 406, pl. 51, figs. 10-13.
1922 *Bulimina inflata* Seguenza var. *mexicana* Cushman, p. 95, pl. 21, fig. 2.
1941a *Bulimina inflata* Seguenza; LeRoy, p. 32, pl. 2, figs. 71-72.
1941b *Bulimina inflata* Seguenza; LeRoy, p. 79, pl. 1, fig. 5.
1944b *Bulimina inflata* Seguenza; LeRoy, p. 85, pl 7, fig. 21.
1947 *Bulimina striata* d'Orbigny; Cushman and Parker, p. 119, pl. 28, figs. 1-3.
1949 *Bulimina inflata* Seguenza; Boomgaart, p. 106, pl. 11, fig. 6.
1960 *Bulimina striata* d'Orbigny var. *mexicana* Cushman; Barker, p. 104, pl. 51, figs. 10-13.
1966 *Bulimina striata* d'Orbigny; Belford, p. 59, pl. 5, figs. 6-8.
1980 *Bulimina striata mexicana* Cushman and Parker; Ingle et al., p. 131, pl. 4, fig. 4.
1980 *Bulimina striata* d'Orbigny; Keller, p. 842, pl. 2, fig. 2.

1983 *Bulimina striata* d'Orbigny; Coustillas, pl. 28, fig. 11.
1984 *Bulimina striata* d'Orbigny; Govindan, p. 244, pl. 1, fig. 8.
1986 *Bulimina striata* d'Orbigny; Kurihara and Kennett, p. 1070, pl. 2, fig. 13.
1986 *Bulimina mexicana* Cushman; Van Morkhoven et al., p. 59, pl. 19, figs. 1-4.
1988 *Bulimina striata* d'Orbigny; Van Marle, p. 141, pl. 2, fig. 10.

Short description: Test small, conical in outline, tapering from the widest portion at the middle part, with numerous small basal spines. Chambers distinct, arranged in about 5 coils, somewhat inflated, enlarging rapidly, those of each coil distinctly overhanging previous ones. Wall except for last chambers ornamented with low, longitudinal costae ending spinose at lower margins, obscuring sutures; last chambers smooth, finely perforate, costated chambers coarsely perforate. Aperture loop-shaped.

Remarks: *Bulimina inflata* Seguenza is here considered to be a junior synonym of *B. striata* d'Orbigny, only differing in having the costae terminated by short spines. Like Coustillas (1983), the author considers forms referred to as *Bulimina costata* d'Orbigny to be varieties of *B. striata*, having a more elongated test with long costae without spines (see also pl. 5, fig. 8). Van Morkhoven et al. (1986) considered *B. striata* to be the same as *Bulimina mexicana* Cushman, in which case the latter form must be considered as a junior synonym.

Stratigraphic range: *B. striata* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). Though under different names, *B. striata* has been widely recorded in Late Oligocene to Recent deposits from the Indo-Pacific region (see synonymy; LeRoy, 1964; Boltovskoy, 1978; Boersma, 1986).

Occurrence: In Recent eastern Indonesian sediments *B. striata* occurs generally in waterdepths between 545 and 2119 m, with its DLO at 714 m and its UDL at 317 m (Van Marle, 1988). Coustillas (1983) reported a similar UDL from the Mahakam Delta and Boichard et al. (1985) observed this species between 490 and 549 m on the Pater Noster Platform.

Bandy (1961) reported this form as the dominant species representative of the upper middle bathyal biofacies (610-914 m) in the Gulf of California. Ingle et al. (1980) observed it in waterdepths between 150 and 2000 m in the Peru-Chili Trench area, with greatest abundancies between 500 and 1500 m. Van Morkhoven et al. (1986) regarded this form as upper - middle bathyal, occuring primarily between 100 and 2000 m with highest frequencies between 500-1500 m.

According to Van der Zwaan (1982) *B. striata* is a mud-dweller, with a slight tolerance to increased salinities, which is most abundant during periods of oxygen deficiency and nutrient abundance.

Genus *Globobulimina* Cushman, 1927

Globobulimina pacifica Cushman
(pl. 5, figs. 11-12)

1927a *Globobulimina pacifica* Cushman, p. 67, pl. 14, figs. 12a-b.
1941a *Globobulimina pacifica* Cushman; LeRoy, p. 33, pl. 3, figs. 70-71.
1951 *Globobulimina pacifica* Cushman; Hofker, p. 260, text-fig. 173.
1960 *Globobulimina pacifica* Cushman; Barker, p. 102, pl. 50, figs. 7-10.
1964 *Globobulimina pacifica* Cushman; Loeblich and Tappan, C559-560, figs. 442,4a-c.
1966 *Globobulimina* sp. A, Belford, p. 66, pl. 7, figs. 1-2.
1980 *Globobulimina pacifica* Cushman; Ingle et al., p. 136, pl. 2, figs. 7-8.

Short description: Test subglobular, oval to almost circular in outline, broadest near the initial end. Chambers triserially arranged, strongly overlapping, inflated. Wall very thin, smooth, finely and densely perforate. Aperture loop-shaped with a small tooth formed by folded free edge of toothplate.

Remarks: The chambers are very strongly overlapping in specimens of *G. pacifica*, and consequently in the adult stage only three chambers make up the exterior by enclosing the preceding ones. In our specimens the perforations are usually elongated or oval, never rounded. Apertural collars, as described by Hofker (1951), have not been observed (see also Belford, 1966).

Stratigraphic range: Because both species occur infrequently, *G. pacifica* and *Praeglobobulimina pupoides* have during the countings been assembled in *Globobulimina* spp., found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

G. pacifica has been described previously from Early Oligocene to Recent deposits (see synonymy; De Hornibrook, 1961; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *Globobulimina* spp. occurs scattered down from 210 m (Van Marle, 1988).

Based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 5.5 degrees Celsius for *G. pacifica*, which corresponds with waterdepths of about 900 m. Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 186 and 2432 m.

According to Corliss (1985) *G. pacifica* also lives infaunal, deeper than 6 cm within the sediment, and can survive the prevailing low oxygen conditions.

Genus *Praeglobobulimina* Hofker, 1951

Praeglobobulimina pupoides (d'Orbigny) s.l.
(pl. 5, figs. 13-14)

1846 *Bulimina pupoides* d'Orbigny, p. 125, pl. 11, figs. 11-12.

1884 *Bulimina pupoides* d'Orbigny; Brady, p. 400, pl. 50, figs. 15a-b.
1937 *Bulimina pupoides* d'Orbigny; Cushman, p. 47, pl. 6, figs. 2-3.
1941a *Bulimina pupoides* d'Orbigny; LeRoy, p. 32, pl. 1, figs. 93-94.
1951 *Protoglobobulimina pupoides* (d'Orbigny); Hofker, p. 252, text-figs. 168a-c.
1952 *Bulimina pupoides* d'Orbigny; Asano, p. 11, figs. 59-60.
1960 *Bulimina pupoides* d'Orbigny; Barker, p. 102, pl. 50, figs. 15a-b.
1964 *Praeglobobulimina pupoides* (d'Orbigny); Loeblich and Tappan, C561, figs. 442,14-15.
1966 *Protoglobobulimina pupoides* (d'Orbigny); Belford, p. 67, pl. 6, figs. 4-5.
1980 *Globobulimina pupoides* (d'Orbigny); Ingle et al., p. 136, pl. 7, fig. 4.
1983 *Bulimina pupoides* d'Orbigny; Coustillas, pl. 28, fig. 12.
1985 *Bulimina* sp., Boichard et al., p. 94, pl. 17, fig. 24.

Short description: Test elongate, ovate, broadest near the apertural end, obtuse in front view, less at back view. Chambers arranged in 4 whorls, inflated, strongly overlapping, convex; sutures depressed. Wall thick, smooth, finely perforate. Aperture large, open, loop-shaped with a distinct collar showing sawed borders and small tooth formed by the folded free edge of the toothplate.

Remarks: In our specimens of *P. pupoides* the chambers are arranged in four large whorls, of which the last one is formed out of three strongly overlapping chambers, occupying about 1/3 of the total length of the test. The perforations in our specimens are elongate or oval but never rounded, and variation in the length-width ratio has been observed (see also LeRoy, 1964).

Differentiation between the species *P. pupoides*, *Praeglobobulimina ovata* (d'Orbigny, 1846) and *Praeglobobulimina affinis* (d'Orbigny, 1839) can only be made on internal features such as the form of the toothplate and attachment of this toothplate to the previous toothplate (Belford, 1966). However, no external characteristics are known to separate these species and thus *P. ovata* and *P. affinis* were taken as varieties of *P. pupoides* s.l.

Stratigraphic range: See *Globobulimina pacifica* Cushman. *P. pupoides* has been observed previously in Early Miocene to Recent deposits.

Occurrence: See *Globobulimina pacifica* Cushman. Coustillas (1983) reported *P. pupoides* to have its UDL at 300 m in the Mahakam Delta and Boichard et al. (1985) found it at a depth of 715 m on the Pater Noster Platform.

Praeglobobulimina spinescens (Brady)
(pl. 5, figs. 15-16)

1884 *Bulimina pyrula* d'Orbigny var. *spinescens* Brady, p. 400, pl. 50, figs. 11-12.
1947 *Bulimina pyrula* d'Orbigny var. *spinescens* Brady; Cushman and Parker, p. 124, pl. 28, figs. 30-31.
1951 *Praeglobobulimina spinescens* (Brady); Hofker, p. 249, text-figs. 165-167.

1960 *Bulimina pyrula* d'Orbigny var. *spinescens* Brady; Barker, p. 102, pl. 50, figs. 11-12.
1964 *Praeglobobulimina spinescens* (Brady); Loeblich and Tappan, C561, figs. 442,12-13.
1966 *Praeglobobulimina spinescens* (Brady); Belford, p. 73, pl. 6, figs. 19-21.
1988 *Globobulimina spinescens* (Brady); Van Marle, p. 143, pl. 5, fig. 16.

Short description: Test oval, subcircular in outline, with triserially arranged chambers in three whorls of which the last one occupies 7/8 of the exterior. Chambers large, strongly overlapping, 3 in the last whorl, ornamented at their lower margins by sharp spinose projections. Wall thin, smooth, finely perforate. Aperture narrow, elongate, loop-shaped extending along basal suture, with tooth formed by the narrowly folded free edge of toothplate.

Remarks: In our specimens of *P. spinescens* the perforations are elongate to oval, but never rounded.

P. spinescens differs from *Praeglobobulimina pupoides* d'Orbigny s.l. by its more strongly overlapping chambers, which are ornamented at their lower margins by numerous, small spinose projections.

Stratigraphic range: *P. spinescens* was found in Late Miocene - Late Pliocene (N17-19/20) and Late Pliocene - Quaternary deposits (N22) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *P. spinescens* occurs scattered down from 486 m (Van Marle, 1988). Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 130 and 1419 m.

Family *Reussellidae* Cushman, 1933

Genus *Reussella* Galloway, 1933

Reussella simplex (Cushman)

(pl. 6, figs. 1-3)

1884 *Verneuilina spinulosa* Brady (not Reuss), p. 384, pl. 47, fig. 1 (not figs. 2-3).
1929 *Trimosina simplex* Cushman, p. 158, text-fig. 2.
1945 *Reussella simplex* (Cushman); Cushman, p. 40, pl. 7, fig. 9.
1960 *Reussella simplex* (Cushman); Barker, p. 96, pl. 47, fig. 1.
1981 *Fijiella simplex* (Cushman); Burke, p. 4, pl. 1, fig. 14.
1983 *Reussella simplex* (Cushman); Coustillas, pl. 28, fig. 4.
1985 *Reussella simplex* (Cushman); Boichard et al., p. 90, pl. 15, figs. 15-16.
1988 *Reussella simplex* (Cushman); Van Marle, p. 148, pl. 1, fig. 7.

Short description: Test small, triangular in both side and apertural view; angles acute. Chambers triserially arranged, uniformily enlarging; angles of chambers slightly spinose, the outer angle thickened, almost carinate; sutures distinct, not depressed, slightly limbate. Wall thick, smooth, coarsely perforate especially along the borders. Aperture elongate without lip; supplementary openings present in the centre of the apertural face.

Remarks: The differences in appearance with both *Reussella aculeata* Cushman and *Reussella spinulosa* (Reuss) are minor and trivial. *R. simplex* is distinguished from *R. aculeata* in being less spinose on the angles, and from *R. spinulosa* in having a more tapering form. All specimens found during this study are hardly spinose at the chamber edges and have a tapering form, so in our opinion they belong to *R. simplex*. The specimen figured by Belford (1966, p. 75, pl. 9, fig. 15) as *R. aculeata* is interpreted as a specimen of *R. simplex*, though Belford stated that the absence of spines was due to abrasion.

R. simplex differs from *Reussella spinulosa* (Reuss) var. *laevigata* Cushman, found by LeRoy (1941b, p. 81, pl. 5, figs. 19-20) and by Boomgaart (1949, p. 116, pl. 11, figs. 11a-b), in being spinose on the angles.

Stratigraphic range: *R. simplex* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Recent sediments.

Occurrence: In Recent eastern Indonesian sediments *R. simplex* occurs generally in waterdepths between 60 and 244 m, with its DLO at 90 m and shows scattered occurrences between 244 and 495 m (Van Marle, 1988). This confirms the opinion of Burke (1981), who also considered it to be a shallow water species. Coustillas (1983) found it between 60 and 90 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 45 m on the Pater Noster Platform.

Family *Siphogenerinoididae* Saidova, 1981
Subfamily *Siphogenerininae* Loeblich and Tappan, 1984
Genus *Rectobolivina* Cushman, 1927

Rectobolivina bifrons (Brady)
(pl. 6, figs. 9-11)

1881 *Sagrina bifrons* Brady, p. 64 (nomen nudum).
1884 *Sagrina bifrons* Brady, p. 582, pl. 75, figs. 18-20.
1937 *Siphogenerina bifrons* (Brady) var. *striatula* (Cushman); Cushman, p. 205, pl. 23, figs. 17-18.
1941a *Rectobolivina bifrons* (Brady) var. *striatula* (Cushman); LeRoy, p. 35, pl. 2, figs. 7-8.
1941b *Rectobolivina bifrons* (Brady) var. *striatula* (Cushman); LeRoy, p. 80, pl. 1, fig. 9.
1951 *Rectobolivina bifrons* (Brady); Hofker, p. 60, text-fig. 27.
1960 *Rectobolivina bifrons* (Brady); Barker, p. 156, pl. 75, figs. 18-20.
1964 *Rectobolivina bifrons* (Brady); LeRoy, p. 34, pl. 3, figs. 1-2.
1966 *Rectobolivina bifrons* (Brady); Belford, p. 45, pl. 9, figs. 13-14.

1983 *Rectobolivina bifrons* (Brady); Coustillas, pl. 28, fig. 17.

Short description: Test elongate, compressed, both sides with a longitudinal central depression, or with a small central depression at the base of each chamber; slightly oval in section; periphery thick and rounded. Chambers initially biserially arranged, later uniserial, distinct, numerous, short, not inflated; sutures flush. Wall thin, finely perforate. Aperture large, oval, bordered by a sessile lip.

Remarks: *R. bifrons* is characterized by the longitudinal central depressions present at the base of each chamber, the relatively short biserial stage and the elongate, multichambered uniserial stage. On some specimens longitudinal striations are present, like in *R. bifrons* (Brady) var. *striatula* (Cushman).

Stratigraphic range: *R. bifrons* was found in Middle - Late Miocene (N14-17) and Early Pliocene - Quaternary deposits (N19/20-23) on the eastern Indonesian islands. It has been widely recorded in Late Miocene to Recent deposits of the Indo-Pacific region (see synonymy and Boichard et al., 1985).

Occurrence: Coustillas (1983) reported *R. bifrons* from depths greater than 300 m in the Mahakam Delta and Boichard et al. (1985) found it between 220 and 260 m on the Pater Noster Platform.

Rectobolivina columellaris (Brady)

(pl. 6, figs. 12-13)

1881 *Sagrina columellaris* Brady, p. 64 (nomen nudum).
1884 *Sagrina columellaris* Brady, p. 581, pl. 75, figs. 15-17.
1941a *Rectobolivina columellaris* (Brady); LeRoy, p. 35, pl. 1, figs. 57-58.
1951 *Rectobolivina columellaris* (Brady); Hofker, p. 68, text-figs. 33-35.
1960 *Rectobolivina columellaris* (Brady); Barker, p. 156, pl. 75, figs. 15-17.
1966 *Rectobolivina columellaris* (Brady); Belford, p. 47, pl. 9, figs. 9-12.
1983 *Rectobolivina columellaris* (Brady); Coustillas, pl. 28, figs. 18-19.

Short description: Test elongate, nearly straight, cylindrical, slightly tapering; enlarged basal end rounded or bluntly angular, apertural end broad and convex. Few distinct, biserially arranged chambers, numerous uniserial chambers, short, very little constricted at the flush sutures. Wall thin, finely perforate. Aperture large, simple, with sessile, phialine lip.

Remarks: Our specimens are usually slightly bent in the upper part of the cylindrical uniserial stage. Some specimens are ornamented by longitudinal striations.

Stratigraphic range: *R. columellaris* was found in Middle Miocene - Quaternary deposits (N14-23) on the islands and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *R. columellaris* shows a scattered depth distribution down from 141 m (Van Marle, 1988).

Lewis (1979) observed this species in sediments from the continental margin of New Zealand at a depth of 329 m and Coustillas (1983) found it between 50 and 400 m in the Mahakam Delta.

Rectobolivina dimorpha (Parker and Jones)
(pl. 6, figs. 14-15)

1865 *Uvigerina (Sagrina) dimorpha* Parker and Jones, p. 364, pl. 18, fig. 18.
1884 *Sagrina dimorpha* Parker and Jones; Brady, p. 582, pl. 76, figs. 1-3.
1926 *Siphogenerina* aff. *dimorpha* (Parker and Jones) var. *pacifica* Cushman, p. 13, pl. 1, fig. 9.
1941a *Siphogenerina dimorpha* (Parker and Jones) var. *pacifica* Cushman; LeRoy, p. 37, pl. 3, figs. 97-98.
1951 *Rectobolivina dimorpha* (Parker and Jones); Hofker, p. 116, text-figs. 69-71.
1960 *Rectobolivina dimorpha* (Parker and Jones) var. *pacifica* (Cushman); Barker, p. 158, pl. 76, figs. 1-3.
1964 *Rectobolivina dimorpha* (Parker and Jones); LeRoy, p. 34, pl. 3, figs. 3-4.
1966 *Rectobolivina dimorpha* (Parker and Jones); Belford, p. 43, pl. 9, figs. 7-8.
1983 *Rectobolivina dimorpha* (Parker and Jones); Coustillas, pl. 28, fig. 16.
1988 *Rectobolivina dimorpha* (Parker and Jones); Van Marle, p 148, pl. 2, figs. 14-15.

Short description: Test short, cylindrical, somewhat compressed; basal end rounded to bluntly pointed. Small initial biserial stage; later stage uniserial. Chambers distinct, broadly crenulate at base; sutures crenulate, slightly depressed. Wall coarsely perforate, covered by irregular reticulate ornament. Aperture terminal, oval to round, bordered by slightly raised rim.

Remarks: Specimens of *R. dimorpha* are characterized by their short, cylindrical tests, the crenulate lower chamber margins and sutures, and by the irregular reticulate ornament.

Stratigraphic range: *R. dimorpha* was found in Early - Middle Miocene (N8) and Late Miocene - Quaternary deposits (N17-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *R. dimorpha* occurs generally in waterdepths between 485 and 711 m, with its DLO at 495 m and its UDL at 485 m, and shows scattered occurrences between 711 and 1097 m (Van Marle, 1988). Coustillas (1983) reported it to occur at depths greater than 200 m in the Mahakam Delta.

Rectobolivina indica (LeRoy)
(pl. 6, fig. 16)

1884 *Sagrina raphanus* Brady (not Parker and jones), p. 585, pl. 75, fig. 23 (not figs. 21-22, 24).

1941a *Siphogenerina indica* LeRoy, p. 37, pl. 2, figs. 64-65.
1960 *Siphogenerina indica* LeRoy; Barker, p. 156, pl. 75, fig. 23.
1966 *Rectobolivina indica* (LeRoy); Belford, p. 46, pl. 9, figs. 5-6.
1983 *Siphogenerina raphanus* Coustillas (not Parker and Jones), pl. 28, fig. 2 (not fig. 3).

Short description: Test cylindrical, elongate, broadening gradually towards apertural end, tapering towards the semi-acute basal end. Chambers biserially to uniserially arranged, distinct, with slightly crenulate base; sutures flush, horizontal, partly obscured by the ornament. Wall finely perforate and except for smooth last chamber ornamented by heavy, raised, longitudinal costae, continuous over the sutures. Aperture terminal, rounded, extended, with a distinct, broad phialine lip.

Remarks: *R. indica* differs from the typical *Rectobolivina raphana* (Parker and Jones) in having a characteristically extended, uvigerine aperture with a broad phialine lip, and a smaller test with a tapering initial end, in addition to usually less longitudinal costae (Loeblich and Tappan, 1964), and was therefore designated as a separate species by LeRoy (1941a).

The specimen figured by Cushman (1926, p. 6, pl. 5, fig. 8) as *Siphogenerina raphanus* (Parker and Jones) var. *tropicana* Cushman strongly resembles specimens of *R. indica* and is possibly synonymous.

Stratigraphic range: *R. indica* was found in Late Pliocene - Quaternary deposits (N21-22) from Seram. It has been observed previously in Middle Miocene to Recent deposits.

Occurrence: Coustillas (1983) found this form in waterdepths between 70 and 400 m in the Mahakam Delta.

Rectobolivina limbata (Brady)
(pl. 6, figs. 17-18)

1881 *Bolivina limbata* Brady, p. 27 (nomen nudum).
1884 *Bolivina limbata* Brady, p. 419, pl. 52, figs. 26-28.
1937 *Loxostomum limbatum* (Brady); Cushman, p. 186, pl. 21, figs. 26-29.
1946 *Loxostomum limbatum* (Brady) var. *striatum* Germeraad, p. 69, pl. 3, fig. 19.
1949 *Loxostoma limbata* (Brady); Boomgaart, p. 114, pl. 3, fig. 19.
1960 *Loxostomum limbatum* (Brady); Barker, p. 108, pl. 52, figs. 26-28.
1966 *Rectobolivina limbata* (Brady); Belford, p. 49, pl. 4, figs. 12-15.
1983 *Loxostomum limbatum* (Brady); Coustillas, pl. 29, figs. 24-25.

Short description: Test elongate, tapering, compressed, more or less twisted, with angular or slightly rounded, sinuous margins. Chambers biserially arranged, except for the last 2-3, which tend to become uniserial, distinct; sutures irregularly curved, limbate. Wall smooth or striate, finely and densely perforate. Aperture terminal, large, oval with a slightly raised lip.

Remarks: Though it was known from literature that both carinate-striate and smooth forms exist within *R. limbata*, Belford (1966) still erected two new species: *Rectobolivina papula* (p. 50, pl. 4, figs. 16-19) and *Rectobolivina fasciata* (p. 52, pl. pl. 4, figs. 22-23), which in our opinion are no more than varieties of the striate forms of *R. limbata*. *R. papula* differs from those specimens in having 14-20 strong, continuous, longitudinal costae, obscuring the sutures, and a stronger developed apertural rim. *R. fasciata* differs in having an ornamentation of low and often faint costae, longitudinal at the centre of the test and oblique near the periphery, with new costae appearing on successive chambers, and a narrower and elongated aperture.

Stratigraphic range: *R. limbata* was found in Early - Middle Miocene (N8), Middle Miocene (N14), and Late Miocene - Quaternary deposits (N17-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

R. limbata (and included varieties) have been observed previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *R. limbata* generally occurs at neritic - upper bathyal depths with its UDL at 60 m, but also shows scattered deeper occurrences (Van Marle, 1988).

Lutze (1974) reported this species to be cosmopolitan and to occur at depths between 28 and 200 m in sediments from the Persian Gulf. Coustillas (1983) found it between 60 and 175 m in the Mahakam Delta.

Rectobolivina tenuicostata Belford
(pl. 7, fig. 1)

1966 *Rectobolivina tenuicostata* Belford, p. 48, pl. 4, figs. 10-11.

Short description: Test slender, elongate; maximum width quickly reached, sides then parallel. Chambers biserially to uniserially arranged; biserial chambers compressed, slowly enlarging; uniserial chambers inflated, oval, uniform in size; sutures initially smooth, oblique, later distinct, narrow, depressed and horizontal. Wall finely perforate, ornamented by numerous low, narrow, distinct, wavy costae on early chambers, becoming faint on last two chambers. Aperture terminal, elongate-oval, with slightly raised lip.

Remarks: In specimens of *R. tenuicostata* the small, globular proloculus is followed by 4-5 pairs of biserial chambers, then one or two chambers transitional to uniserial growth, with a maximum of 4 uniseral chambers. The costae sometimes bifurcate and have smaller costae intercalated.

R. tenuicostata can be distinguished from *Rectobolivina limbata* (Brady) in having longer transitional (from biserial to uniserial) and uniserial stages and in the different shape of the chamber.

Stratigraphic range: *R. tenuicostata* was found in Middle Miocene (N14), Late Miocene (N17), Early - Late Pliocene (N19/20-21), and Quaternary deposits (N23) on the eastern Indonesian islands. Belford (1966) described it from Pliocene deposits.

Occurrence: *R. tenuicostata* has in the eastern Indonesian material always been encountered in association with typical upper bathyal species.

Genus *Rectuvigerina* Mathews, 1945

Rectuvigerina striata (Schwager)
(pl. 7, figs. 4-5)

1866 *Dimorphina striata* Schwager, p. 251, pl. 7, figs. 99.
1884 *Sagrina striata* (Schwager); Brady, p. 584, pl. 75, figs. 25-26.
1941a *Siphogenerina striata* (Schwager); LeRoy, p. 37, pl. 3, figs. 88-89.
1945 *Rectuvigerina striata* (Schwager); Mathews, p. 597, pl. 81, figs. 3-4.
1949 *Siphogenerina striata* (Schwager); Boomgaart, p. 121, pl. 9, fig. 2.
1960 *Siphogenerina striata* (Schwager); Barker, p. 158, pl. 75, figs. 25-26.
1964 *Rectuvigerina striata* (Schwager); LeRoy, p. 35, pl. 3, fig. 8.
1966 *Rectuvigerina striata* (Schwager); Belford, p. 84, pl. 9, figs. 1-2.
1980 *Rectuvigerina striata* (Schwager); Srinivasan and Sharma, p. 51, pl. 7, fig. 13 (neotype).
1986 *Rectuvigerina striata* (Schwager); Boersma, p. 990, pl. 17, fig. 5.
1986 *Rectuvigerina striata* (Schwager); Van Morkhoven et al., p. 110, pl. 34, figs. 1-3.

Short description: Test slender, elongate; periphery lobulate, usually with basal spine. Initial chambers triserially arranged, later ones biserial to uniserial. Chambers broad, inflated; sutures deeply depressed. Wall thin, glassy, finely perforate, ornamented with fine, closely spaced, longitudinal striae, sometimes ending as spines. Aperture terminal, on a neck, rounded with distinct phialine lip.

Remarks: Though the initial chamber arrangement is often obscured by the ornament, *R. striata* can still be distinguished from siphogenerinids by its distinct aperture and ornamentation, and by the lobulate periphery, resulting from the almost spherical shape of the uniserial chambers.

R. striata differs from *Rectuvigerina striatissima* (Stache) in having the striae discontinuous over the chamber margins (Boersma, 1986).

Stratigraphic range: *R. striata* was found in Middle Miocene - Quaternary deposits (N14-23) on the eastern Indonesian islands. It has been widely recorded in Early Miocene to Recent deposits from the Indo-Pacific region (see synonymy and Coustillas, 1983).

Occurrence: According to Van Morkhoven et al. (1986) *R. striata* is primarily an upper - middle bathyal taxon. Coustillas (1983) found this form in sediments between 50 and 400 m in the Mahakam Delta.

Genus *Siphogenerina* Schlumberger, 1882

Siphogenerina costata Schlumberger

(pl. 7, figs. 2-3)

1883 *Siphogenerina costata* Schlumberger, p. 118, fig. B.

1964 *Siphogenerina costata* Schlumberger; Loeblich and Tappan, C569, figs. 449,1-4.

1966 *Siphogenerina costata* Schlumberger; Belford, p. 86, pl. 9, figs. 3-4.

Short description: Test elongate, fusiform, multichambered. Small, initial triserial stage followed by uniserial adult chamber arrangement; last 2-3 chambers narrowed along the straight sutures. Wall finely perforate, ornamented by 8-14 distinct, blunt, longitudinally oriented and continuous costae. Aperture on a short neck or rim, rounded.

Remarks: Loeblich and Tappan (1964) designated *S. costata* as the type species of *Siphogenerina*. According to them, *S. costata* differs from *Rectobolivina raphana* (Parker and Jones) in having only 5-6 longitudinal costae, and in having an early triserial microspheric stage, instead of a biserial one.

The specimens observed in our material agree well with the specimens depicted by Belford (1966), i.e. characterized by a small triserial initial stage and the absence of true biserial chambers, though before uniserial chambers are developed the coiling becomes looser and a biserial arrangement is approached. Belford rarely encountered biserial to uniserial specimens, but such forms have not been observed by us.

Stratigraphic range: *S. costata* was found in Middle - Late Miocene (N14-17), and Early Pliocene - Quaternary deposits (N19/20-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been found previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *S. costata* generally occurs at neritic - upper bathyal depths, but also shows scattered deeper occurrences (Van Marle, 1988).

Family *Uvigerinidae* Haeckel, 1894
Subfamily *Uvigerininae* Haeckel, 1894
Genus *Uvigerina* d'Orbigny, 1826

Uvigerina canariensis d'Orbigny

(pl. 8, figs. 9-11)

1839 *Uvigerina canariensis* d'Orbigny, p. 138, pl. 1, figs. 25-27.

1884 *Uvigerina canariensis* d'Orbigny; Brady, p. 573, pl 74, figs. 1-3.

1913 *Uvigerina canariensis* d'Orbigny; Cushman, p. 92, pl. 42, fig. 6.

1951 *Aluvigerina indonesiae* Hofker, p. 206, text-fig. 104.

1960 *Uvigerina canariensis* d'Orbigny; Barker, p. 154, pl. 74, figs. 1-3.

1961 *Uvigerina canariensis* d'Orbigny; De Hornibrook, p. 65, pl. 8, fig. 143.

Short description: Test slender, elongate, broadest near the center, tapering towards both ends. Chambers numerous, triserially arranged throughout in about 5 whorls, inflated, globulose; sutures distinct, depressed. Wall finely perforate, very finely spinose. Aperture on a short, wide, tubular neck, with distinct phialine lip.

Remarks: The specimens of *U. canariensis* are very finely spinose and almost have a smooth appearance.

In our opinion *Aluvigerina indonesiae* Hofker (1951) is a smaller sized variety of *U. canariensis*. Many authors consider *U. canariensis* to belong to the morphological cline of hispid uvigerinids, of which *Uvigerina proboscidea* Schwager is the most prominent form, but by us *U. canariensis* has been taken separately because of its deviating depth-range.

Stratigraphic range: *U. canariensis* was found in Middle - Late Miocene (N14-15 and N17) and Late Pliocene - Quaternary deposits (N21-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *U. canariensis* occurs generally in waterdepths between 60 and 150 m, with its DLO at 90 m, but also shows scattered occurrences between 150 and 1290 m (Van Marle, 1988).

Borsetti et al. (1986) reported that hispid uvigerinids, such as *U. canariensis* and *U. proboscidea* s.l. can only stand small fluctuations in oxygen conditions, as opposed to costate uvigerinids.

Uvigerina crassicostata Schwager
(pl. 7, figs. 12-13)

1866 *Uvigerina crassicostata* Schwager, p. 248, pl. 7, fig. 94.
1934 *Uvigerina crassicostata* Schwager; Cushman, p. 125, pl. 15, fig. 8.
1944b *Uvigerina crassicostata* Schwager; LeRoy, p. 86, pl. 2, fig. 7.
1949 *Uvigerina crassicostata* Schwager; Boomgaart, p. 117, pl. 12, fig. 8.
1950 *Uvigerina crassicostata* Schwager; Asano, p. 15, figs. 63-64.
1964 *Uvigerina crassicostata* Schwager; LeRoy, p. 35, pl. 4, fig. 1.
1966 *Euuvigerina crassicostata* (Schwager); Belford, p. 79, pl. 7, figs. 17-20.
1980 *Hofkeruva crassicostata* (Schwager); Srinivasan and Sharma, p. 49, pl. 7, figs. 16, 19 (neotype and topotype).
1984 *Uvigerina crassicostata* Schwager; Govindan, p. 246, pl. 2, fig. 12.
1984c *Uvigerina crassicostata* Schwager; Boersma, p. 39, pl. 1, figs. 1-4; pl. 2, figs. 1-4.
1988 *Uvigerina crassicostata* Schwager; Van Marle, p. 149, pl. 4, fig. 21.

Short description: Test large, relatively short, broad, greatest width across final whorl. Chambers few, triserially coiled in about 2.5 whorls, enlarging rapidly, very inflated, bulbous; final chamber slightly squared. Wall thick, radiate in texture, finely perforate, ornamented with widely spaced, sharp, elevated and longitudinal costae. Aperture at the end of a broad, short neck, set into a slight depression, with reverted lip and small tooth formed by the folded free edge of the toothplate.

Remarks: *U. crassicostata* differs from *Uvigerina javana* Koch and *Uvigerina soendaensis* LeRoy by the morphology of its costae, which die out on the final chamber. Nearly every second costa is continuous from one chamber to the next, some may even extend over several chambers.

Uvigerina schwageri Brady has fewer costae, which are low, rounded and interrupted at the sutures. *Uvigerina nitidula* Schwager also has numerous, low, rounded costae, but these are not as closely spaced as in *U. crassicostata* and are not present on the final chamber.

Stratigraphic range: *U. crassicostata* was found in Early - Middle Miocene (N8), Middle Miocene (N14), Late Miocene (N17), and Late Pliocene - Quaternary deposits (N22-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: In Recent eastern Indonesian sediments *U. crassicostata* generally occurs at neritic - upper bathyal depths, but also shows scattered deeper occurrences (Van Marle, 1988). This supports the opinion of LeRoy (1964), who assumed *U. crassicostata* to be an outer neritic - upper bathyal form. Yet, in the Tasman Sea it has been observed at a depth of 1000 m (Boersma, 1984c).

According to Boersma (1984c) this species occurs frequently in carbonate-rich foraminiferal marls in the Indo-Pacific region.

Uvigerina flintii Cushman, 1923
(pl. 8, figs. 1-3)

1923 *Uvigerina flintii* Cushman, p. 165, pl. 42, fig. 13.
1966 *Euuvigerina flintii* (Cushman); Belford, p. 80, pl. 7, figs. 21-23.

Short description: Test elongate, fusiform or oval, lobulate in outline. Chambers obscure; sutures slightly depressed, hidden by ornamentation. Wall thin, translucent, shining, ornamented by numerous, slightly raised, sometimes bifurcating, longitudinal costae. Aperture terminal, on a long neck with its base in a depression in the apertural face, with flaring lip; sides of the neck ornamented by 2-3 ringlike projections.

Remarks: Though several species, such as *Uvigerina hantkeni* Cushman and Edwards and *Uvigerina finelineata* Keijzer, resemble the external morphology of *U. flintii*, these all lack the characteristic apertural rims on the sides of the neck.

Stratigraphic range: *U. flintii* was found in Middle - Late Miocene (N14-17) and Late Pliocene - Quaternary deposits (N22-23) on the eastern Indonesian islands. It has been described previously from Early Miocene to Recent deposits.

Occurrence: Pflum and Frerichs (1976) and Poag (1981) observed this species in carbonate rich outer shelf - upper slope environments of the Gulf of Mexico.

Uvigerina hispida Schwager

(pl. 8, figs. 15-16)

1866 *Uvigerina hispida* Schwager, p. 249, pl. 7, fig. 95.
1929 *Uvigerina hispida* Schwager; Cushman, p. 95, pl. 13, fig. 35.
1941a *Uvigerina hispida* Schwager; LeRoy, p. 36, pl. 1, figs. 102-103.
1941b *Uvigerina hispida* Schwager; LeRoy, p. 82, pl. 2, fig. 15.
1964 *Uvigerina hispida* Schwager; LeRoy, p. 34, pl. 4, figs. 2-3.
1966 *Euuvigerina hispida* (Schwager); Belford, p. 78, pl. 7, figs. 14-16.
1978 *Uvigerina hispida* Schwager; Boltovskoy, p. 171, pl. 8, figs. 12-16.
1980 *Uvigerina hispida* Schwager; Ingle et al., p. 146, pl. 8, fig. 8.
1980 *Euuvigerina hispida* (Schwager); Srinivasan and Sharma, p. 48, pl. 7, figs. 14-15 (neotype and topotype).
1984 *Uvigerina hispida* Schwager; Govindan, p. 246, pl. 2, fig. 11.
1984a *Uvigerina hispida* Schwager; Boersma, p. 664, pl. 3, figs. 6-7.
1984b *Uvigerina hispida* Schwager; Boersma, p. 1286, pl. 5, fig. 3.
1984c *Uvigerina hispida* Schwager; Boersma, p. 74, pl. 1, figs. 1-4.
1986 *Uvigerina hispida* Schwager; Boersma, p. 1035, pl. 20, figs. 5-6.
1986 *Uvigerina hispida* Schwager; Kurihara and Kennett, p. 1071, pl. 3, figs. 7-8.
1986 *Uvigerina hispida* Schwager; Van Morkhoven et al., p. 62, pl. 20, figs. 1-4.
1988 *Uvigerina hispida* Schwager; Van Marle, p. 149, pl. 3, fig. 13.

Short description: Test elongate, large, fusiform, about 2-2.5 times as long as broad; periphery lobulate, initial end often pointed. Chambers triserially arranged in about 3 coils, later ones biserial, inflated, lobulate, increasing gradually and uniformily in size as added; last chamber concave towards the apertural end; sutures distinctly depressed. Wall ornamented by very coarse, closely spaced spines, also on the neck; final chamber slightly less ornamented. Aperture on short, cylindrical neck with reverted lip.

Remarks: *U. hispida* differs from the very finely hispid, relatively smooth *Uvigerina canariensis* d'Orbigny by its coarsely spinose appearance. According to Boersma (1984c), some specimens of *Uvigerina proboscidea* Schwager, which develop biserial chambers with rapid translation rate up the coiling axis, appear to grade into very spinose, thin and small forms of *U. hispida* (see pl. 8, fig. 14). However, usually *U. hispida* is larger, more coarsely spinose and always developing biserial chambers, and therefore taken separately.

Hispid specimens similar to those of *U. hispida* have been recorded from New Zealand as *Uvigerina notohispida* Finlay (Belford, 1966; Srinivasan and Sharma, 1980).

Stratigraphic range: *U. hispida* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits (see synonymy and LeRoy, 1944b).

Occurrence: In Recent eastern Indonesian sediments *U. hispida* occurs generally in waterdepths between 911 and 2119 m, with its DLO at 2119 m and its UDL at 317 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to have its UDL at 1860 m in the Peru-Chili Trench and to be characteristic for depths of over 2000 m. Pflum and Frerichs (1976) reported it to occur at lower bathyal to abyssal depths in the Gulf of Mexico. Moore et al. (1980) considered *U. hispida* to be indicative of depths between 500 and 2000 m. Van Morkhoven et al. (1986) considered the cosmopolitan *U. hispida* to be primarily a bathyal form.

Boersma (1984c) reported this species to be present in upwelling zones. Borsetti et al. (1986) recorded that hispid uvigerinids, such as *U. hispida*, *U. canariensis*, and *U. proboscidea* s.l. can only stand small fluctuations in oxygen conditions, as opposed to costate uvigerinids.

Uvigerina peregrina Cushman
(pl. 7, figs. 14-15)

1884 *Uvigerina pygmaea* Brady (not d'Orbigny), p. 575, pl. 74, figs. 11-12 (not figs. 13-14).
1923 *Uvigerina peregrina* Cushman, p. 166, pl. 42, figs. 7-10.
1927 *Uvigerina peregrina* Cushman; Galloway and Wissler, p. 76, pl. 12, figs. 1-2.
1951 *Euuvigerina peregrina* (Cushman); Hofker, p. 219, text-figs. 148-149.
1960 *Euuvigerina peregrina* (Cushman); Barker, p. 154, pl. 74, figs. 11-12.
1966 *Euuvigerina peregrina* (Cushman); Belford, p. 75, pl. 7, figs. 6-7 (not figs. 3-5).
1978 *Uvigerina peregrina* Cushman; Boltovskoy, p. 171, pl. 8, fig. 4.
1980 *Uvigerina peregrina* Cushman; Ingle et al., p. 146, pl. 3, fig. 6.
1983 *Eouvigerina* aff. *peregrina* (Cushman); Coustillas, pl. 27, figs. 5-6.
1984 *Uvigerina peregrina* Cushman; Govindan, p. 244, pl. 1, fig. 10.
1984a *Uvigerina peregrina* Cushman; Boersma, p. 664, pl. 3, fig. 3.
1984c *Uvigerina peregrina* Cushman; Boersma, p. 124, pl. 1, figs. 1-4.
1986 *Uvigerina peregrina* Cushamn; Kurihara and Kennett, p. 1071, pl. 3, fig. 1.
1988 *Uvigerina peregrina* Cushman; Van Marle, p. 149, pl. 2, figs. 6-7.

Short description: Test elongate, fusiform, about twice as long as broad, widest in the middle part; periphery lobulate, with rounded ends. Chambers numerous, triserially coiled in 3 whorls, enlarging gradually, slightly inflated; sutures distinct, slightly depressed. Wall finely perforate and ornamented by platy, longitudinal costae, 6-8 per chamber, high, thin and sharp, discontinuous over the sutures. Aperture on a smooth, broad neck, with reverted lip.

Remarks: The costae may reduce slightly in height on the final chamber and are sometimes even absent.

U. peregrina differs from *Uvigerina pygmaea* d'Orbigny by the high, plate-like costae and the very granular surface between the costae. *Uvigerina mediterranea* Hofker closely resembles *U. peregrina*, differing only in having fewer, thicker, clearly discontinuous costae, and strongly inflated chambers (Boersma, 1984c; Van Morkhoven et al., 1986).

Stratigraphic range: *U. peregrina* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Oligocene to Recent deposits from the Indo-Pacific region (see synonymy; Lewis, 1979; Peterson, 1984).

Occurrence: In Recent eastern Indonesian sediments *U. peregrina* occurs generally in waterdepths between 344 and 1504 m, with its DLO at 904 m and its UDL at 210 m (Van Marle, 1988).

Pflum and Frerichs (1976) and Van Morkhoven et al. (1986) reported this species to be primarily an upper bathyal form with a preference for clastic substrates in the Gulf of Mexico. Lewis (1979) observed it in sediments from the continental margin of New Zealand in waterdepths between 18 and 2469 m. Moore et al. (1980) considered *U. peregrina* to be indicative for depths between 150 and 500 m. Coustillas (1983) found this species in sediments between 50 and 400 m in the Mahakam Delta. In the eastern Indian Ocean *U. peregrina* has its maximum abundance in waterdepths between 2000 and 3800 m (Peterson, 1984).

Boersma (1984c) stated that this species is cosmopolitan and occurs from 45 to more than 4500 m. According to her *U. peregrina* was especially frequent during glacials, because during such periods the surface productivity is higher (and consequently the oxygen content near the bottom lower). Van der Zwaan (1982) reported this species to be a mud-dweller (see also Hageman, 1979, and Sejrup et al., 1981) characteristic of stable marine conditions with slight tolerance to oxygen deficiency and none at all to increased salinity. Borsetti et al. (1986) considered costate uvigerinids, such as *U. peregrina*, to be tolerant and proliferant during low oxygen conditions, as opposed to hispid uvigerinids.

Uvigerina peregrina Cushman var. *dirupta* Todd
(pl. 7, figs. 16-17)

1948 *Uvigerina peregrina* Cushman var. *dirupta* Todd, p. 267, pl. 43, fig. 3.

1966 *Euuvigerina peregrina* Belford (not Cushman), p. 76, pl. 7, figs. 3-5 (not figs. 6-7).

1978 *Uvigerina peregrina* Cushman var. *dirupta* Todd; Boltovskoy, p. 171, pl. 8, fig. 5.

1980 *Uvigerina peregrina* Cushman var. *dirupta* Todd; Haller, p. 250, pl. 7, figs. 13-14.

1980 *Uvigerina peregrina* Cushman var. *dirupta* Todd; Keller, p. 845, pl. 5, fig. 2.

1984c *Uvigerina dirupta* Todd; Boersma, p. 44, pl. 1, figs. 1-4.

1985 *Uvigerina dirupta* Todd; Wang et al., p. 336, pl. 4, fig. 15.

1988 *Uvigerina peregrina* Cushman var. *dirupta* Todd; Van Marle, p. 149, pl. 3, fig. 14.

Short description: This variety differs from typical *Uvigerina peregrina* Cushman in the larger size and in the ornamentation: the costae become strongly serrate and break up into spines towards the apertural end; the last chamber is completely spinose in most specimens.

Remarks: *U. peregrina* var. *dirupta* is distinguished from *Uvigerina peregrina* Cushman because of its deviating depth range. In literature resembling forms are recorded under different names, such as *Uvigerina bradyana* Fornasini, *Uvigerina peregrina* Cushman var. *parvula* Cushman, *Uvigerina hispido-costata* Cushman and Todd, *Uvigerina aculeata* d'Orbigny, and *Uvigerina peregrina* Cushman var. *hollicki* Thalmann.

Stratigraphic range: *U. peregrina* var. *dirupta* was found in Late Miocene (N17) and Early Pliocene - Quaternary deposits (N19/20-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Oligocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *U. peregrina* var. *dirupta* occurs generally in waterdepths between 711 and 2119 m, with its DLO at 904 m and its UDL at 344 m (Van Marle, 1988).

Bandy and Rodolfo reported this variety to have its UDL at 1170 m in the Peru-Chili Trench. In the Gulf of Mexico, Pflum and Frerichs (1976) observed it to have its UDL in the upper bathyal zone, but to occur generally deeper. Moore et al. (1980) considered *U. peregrina* var. *dirupta* to be indicative for depths between 500 and 2000 m. Boersma (1984c) reported this variety to be cosmopolitan and to occur in depths from 75 to over 4500 m.

Uvigerina porrecta Brady
(pl. 8, figs. 7-8)

1879 *Uvigerina porrecta* Brady, p. 274, pl. 8, figs. 15-16.

1884 *Uvigerina porrecta* Brady, p. 577, pl. 74, figs. 21-23.

1942 *Uvigerina porrecta* Brady; Cushman, p. 48, pl. 13, figs. 7-8.

1951 *Neouvigerina porrecta* (Brady); Hofker, p. 213, text-figs. 141-142.

1960 *Neouvigerina porrecta* (Brady); Barker, p. 156, pl. 74, figs. 21-23.

1978 *Uvigerina porrecta* Brady; Boltovskoy, p. 171, pl. 8, fig. 20.

1981 *Siphouvigerina porrecta* (Brady); Burke, p. 4, pl. 1, fig. 17.

1983 *Neouvigerina porrecta* (Brady); Coustillas, pl. 27, fig. 14.

1988 *Uvigerina porrecta* Brady; Van Marle, p. 149, pl. 4, fig. 20.

Short description: Test elongate, relatively small and irregular. Earlier chambers compact, triserially arranged, obscured. Later chambers uniserial, alternating irregularly, separated by having constrained sutures. Wall thick, ornamented by delicate, irregular, longitudinal costae, sometimes ending in spines. Aperture on short, tubular neck, with small lip.

Remarks: The characteristically irregular and relatively small form of *U. porrecta* distinguishes this species from other, more regular species such as *Uvigerina graciliformis* Papp and Turnovsky.

Stratigraphic range: *U. porrecta* was found in Early - Middle Miocene (N8) and Early Pliocene - Quaternary deposits (N19/20-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been found previously in Early Miocene to Recent deposits (see synonymy and Boichard et al., 1985).

Occurrence: In Recent eastern Indonesian sediments *U. porrecta* generally occurs at neritic depths, but also shows scattered deeper occurrences (Van Marle, 1988).

Burke (1981) reported this species to be a shallow water species and to be characteristic of the deep oxygen minimum layer (1200-2400 m) on the Ontong Java Plateau. Coustillas (1983) found this species in sediments between 50 and 100 m in the Mahakam Delta and Boichard et al. (1985) between 230 and 260 m on the Pater Noster Platform.

Uvigerina proboscidea Schwager s.l.
(pl. 8, figs. 12-14)

1866 *Uvigerina proboscidea* Schwager, p. 250, pl. 7, fig. 96.
1942 *Uvigerina proboscidea* Schwager; Cushman, p. 49, pl. 14, figs. 1-4.
1944b *Uvigerina proboscidea* Schwager; LeRoy, p. 86, pl. 2, fig. 5.
1945 *Uvigerina proboscidea* Schwager; Cushman and Todd, p. 50, pl. 7, figs. 28a-b.
1950 *Uvigerina proboscidea* Schwager; Asano, p. 16, fig. 73.
1966 *Siphouvigerina proboscidea* (Schwager); Belford, p. 87, pl. 8, figs. 12-18.
1973 *Uvigerina proboscidea* Schwager; Douglas, p. 614, pl. 8, fig. 8.
1978 *Uvigerina proboscidea* Schwager; Boltovskoy, p. 171, pl. 8, figs. 22-23.
1980 *Uvigerina proboscidea* Schwager; Keller, p. 845, pl. 5, figs. 11-12.
1980 *Neouvigerina proboscidea* (Schwager); Srinivasan and Sharma, p. 52, pl. 7, fig. 21 (neotype).
1980 *Uvigerina proboscidea* Schwager; Boltovskoy, p. 168, pl. 3, figs. 8a-b.
1981 *Uvigerina asperula* Czjzek; Burke, p. 4, pl. 1, fig. 15.
1984 *Uvigerina proboscidea* Schwager; Govindan, p. 244, pl. 1, fig. 7.
1984a *Uvigerina proboscidea* Schwager; Boersma, p. 664, pl. 3, figs. 5, 8.
1984b *Uvigerina proboscidea* Schwager; Boersma, p. 1286, pl. 8, fig. 3.
1984c *Uvigerina proboscidea* Schwager; Boersma, p. 131, pl. 1, figs. 1-5.
1986 *Uvigerina proboscidea* Schwager; Boersma, p. 1035, pl. 20, figs. 1-2.

1986 *Uvigerina proboscidea* Schwager; Kurihara and Kennett, p. 1071, pl. 3, fig. 6.

1986 *Uvigerina proboscidea* Schwager; Van Morkhoven et al., p. 28, pl. 6, figs. 1-4.

1988 *Uvigerina proboscidea* Schwager; Van Marle, p. 149, pl. 3, figs. 11-12.

Short description: Test elongate, fusiform, tapering towards basal end, about twice as long as broad, greatest breadth at end of triserial stage; basal part compact with spine. Coiling triserial to stretched biserial with occasional uniserial chambers. Chambers strongly inflated, elongated upwards; sutures distinct, depressed. Wall finely perforate, ornamented with fine to medium spines, continuing on the neck. Aperture at end of long and tubular neck, with small reverted lip.

Remarks: As mentioned by Schwager (1866) and Srinivasan and Sharma (1980) individual variations in chamber morphology, such as changes in lobateness and compaction, are present within *U. proboscidea*, without significantly changing the total appearance of the species. According to this concept, all finely hispid forms of *Uvigerina* belong to one continuous morphological cline. Though several of these forms have previously been recorded as different taxa, we support the opinion of Boltovskoy (1978) and Boersma (1984c) that they can not be considered as independent taxa and, like them, we combine these forms in *U. proboscidea* s.l.. The most common among these forms is *U. proboscidea* s.s. (see description above), but also forms such as *Uvigerina auberiana* d'Orbigny (biserially coiled after the first whorl), *Uvigerina asperula* Czjzek (with spines arranged in distinct rows), *Uvigerina asperula* Czjzek var. *ampullacea* Brady (with a dimorphous growth-habit as the earlier, triserially arranged chambers form a broad, rounded, compact cluster and added to these are two uniserially arranged chambers joined only end to end, terminating in an extended, long, tubular neck), and *Uvigerina interrupta* (chambers arranged around a long axis; earlier chambers combined to form a compact spire, the 1-2 last formed chambers placed independently in single, irregular series) appear in the samples.

The very finely hispid form *Uvigerina canariensis* d'Orbigny is often also considered to belong to this cline, but has been taken separately here because of its deviating depth-range.

According to Boersma (1984c), some specimens of *U. proboscidea*, which develop biserial chambers with rapid translation rate up the coiling axis, appear to grade into very spinose, thin and small forms of *Uvigerina hispida* Schwager (see pl. 8, fig. 14). However, usually specimens of *U. hispida* are larger, more coarsely spinose, always developing biserial chambers, and were therefore and because of their deviating depth-range, taken separately.

Stratigraphic range: *U. proboscidea* s.l. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

It has been widely recorded in Late Oligocene to Recent deposits from the Indo-Pacific region.

Occurrence: In Recent eastern Indonesian sediments *U. proboscidea* occurs generally in waterdepths between 317 and 2119 m, with its DLO at 711 m and its UDL at 244 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to have its UDL at 1860 m and to be characteristic for depths of more than 2000 m in the Peru-Chili Trench. Moore et al. (1980) considered *U. proboscidea* to be indicative for depths between 500 and 2000 m. Van Morkhoven et al. (1986) reported this form to be bathyal.

According to Boersma (1984c) this open marine species may be an index for low rates of organic accumulation in the sediments.

Borsetti et al. (1986) reported that hispid uvigerinids, such as *U. hispida*, *U. proboscidea* s.l., and *U. canariensis*, can only stand small fluctuations in oxygen conditions, as opposed to costate uvigerinids.

Uvigerina reineri (Belford)
(pl. 8, figs. 4-6)

1966 *Euuvigerina reineri* Belford, p. 82, pl. 8, figs. 22-24.
1983 *Uvigerina tenuistriata* Coustillas (not Reuss), pl. 27, figs. 12-13.
1985 *Uvigerina* aff. *cushmani* Boichard et al. (not Todd), p. 92, pl. 16, fig. 8.

Short description: Test elongate, irregularly oval in apertural view, broadly rounded and lobate in side view; broadening only slightly with growth. Early chambers loosely triserially arranged, last chambers transitional to uniserial. Sutures narrow, distinct, depressed, curved, often sinuous. Wall finely and densely perforate, ornamented by many, low, fine costae, only rarely crossing the sutures. Aperture on long neck with lip and narrow, curved tooth formed by folded free edge of toothplate.

Remarks: *U. reineri* resembles *Uvigerina schencki* Asano, but differs in having less deeply incised sutures and larger initial chambers, in being more finely striate, and in never developing fully uniserial chambergrowth.

Uvigerina tenuistriata Reuss also resembles *U. reineri*, but has wider spaced, vague striae. Because *U. tenuistriata* is a typical Oligocene species, and not a Recent one, the specimens shown by Coustillas (1983) should in our opinion be transferred to *U. reineri*.*Uvigerina cushmani* Todd differs from *U. reineri* by its wider spaced striae, longer apertural neck and, most important of all, by its finely hispid appearance. The specimens figured by Boichard et al. (1985) are not hispid and should therefore be transferred to *U. reineri*.

Stratigraphic range: *U. reineri* was found in Late Miocene (N15-17) and Early Pliocene - Quaternary deposits (N19/20-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene - Pliocene and Recent deposits from Indonesia.

Occurrence: In Recent eastern Indonesian sediments *U. reineri* occurs near Timor at a depth of 317 m (Van Marle, 1988). Coustillas (1983) found it in samples from waterdepths greater than 300 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 260 m on the Pater Noster Platform.

Subfamily *Angulogerininae* Galloway, 1933
Genus *Angulogerina* Cushman, 1927

Angulogerina angulosa (Williamson)
(pl. 7, figs. 6-7)

1858 *Uvigerina angulosa* Williamson, p. 67, pl. 5, fig. 140.
1884 *Uvigerina angulosa* Williamson; Brady, p. 576, pl. 74, figs. 15-16.
1960 *Angulogerina angulosa* (Williamson); Barker, p. 154, pl. 74, figs. 15-16.
1964 *Trifarina angulosa* (Williamson); Loeblich and Tappan, C571, figs. 450,1-3.
1980 *Angulogerina angulosa* (Williamson); Haller, p. 253, pl. 7, fig. 10.
1980 *Trifarina angulosa* (Williamson); Ingle et al., p. 144, pl. 3, figs. 1 and 4.
1983 *Uvigerina angulosa* Williamson; Coustillas, pl. 27, fig. 11.
1988 *Angulogerina angulosa* (Williamson); Van Marle, p. 139, pl. 5, figs. 11-12.

Short description: Test ovate, oblong, irregular and asymmetrical, rudely triangular in section. Chambers triserially arranged, of nearly equal length and breadth. Wall finely perforate, ornamented by longitudinal costae, which are in the centre of each chamber strongly developed, thus forming prominent ribs, continuing along the entire length of the test, producing a triangular outline. Aperture circular on a short, straight tube with lip.

Remarks: *A. angulosa* differs from *Uvigerina pygmaea* d'Orbigny by the conspicuous and less regular costae, the smaller test size and less symmetrical form. *A. angulosa* can be distinguished from *Trifarina bradyi* Cushman by its ornamented, irregularly arranged and unsymmetrically triangular test.

Stratigraphic range: *A. angulosa* was found in Middle - Late Miocene (N14-17) and Early Pliocene - Quaternary deposits (N19/20-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been found previously in Pliocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *A. angulosa* occurs scattered deeper than 711 m (Van Marle, 1988).

Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 18 and 2432 m. Coustillas (1983) found it between 200 and 405 m in the Mahakam Delta.

Sejrup et al. (1981) reported it to be most common on coarse substrates.

Genus *Trifarina* Cushman, 1923

Trifarina bradyi Cushman
(pl. 7, figs. 8-9)

1884 *Rhabdogonium tricarinatum* Brady (not d'Orbigny), p. 525, pl. 67, figs. 1-3.
1923 *Trifarina bradyi* Cushman, p. 99, pl. 22, figs. 3-9.
1941a *Trifarina bradyi* Cushman; LeRoy, p. 38, pl. 2, figs. 114-115.
1941b *Trifarina bradyi* Cushman; LeRoy, p. 82, pl. 2, fig. 24.
1951 *Angulogerina (Trifarina) tricarinata* (Brady); Hofker, p. 196, text-figs. 127-130.
1958 *Trifarina bradyi* Cushman; Asano, p. 40, pl. 7, figs. 1-3.
1960 *Trifarina bradyi* Cushman; Barker, p. 140, pl. 67, figs. 1-3.
1961 *Trifarina bradyi* Cushman; De Hornibrook, p. 70, pl. 9, figs. 163-164.
1964 *Trifarina bradyi* Cushman; LeRoy, p. 35, pl. 3, figs. 17-18.
1964 *Trifarina bradyi* Cushman; Loeblich and Tappan, C571, figs. 450,5-6.
1966 *Trifarina bradyi* Cushamn; Belford, p. 88, pl. 9, figs. 16-17.
1978 *Trifarina bradyi* Cushman; Boltovskoy, p. 171, pl. 8, fig. 1.
1983 *Trifarina bradyi* Cushman; Coustillas, pl. 27, fig. 16.
1988 *Trifarina bradyi* Cushman; Van Marle, p 149, pl. 5, fig. 10.

Short description: Test elongate, tapering towards both ends, somewhat twisted, triangular in outline, with thin and fairly high carinae at the three angles, running from the basal end to the apertural neck. Chambers distinct, initially closely appressed, triserially coiled; later uniserial; sutures distinct, not depressed. Wall thin, translucent, finely perforate. Aperture oval, on a short neck, with phialine lip.

Remarks: *T. bradyi* differs from *Trifarina reussi* (Cushman) by its longer and more slender, smooth test. *T. bradyi* can be distinguished from *Angulogerina angulosa* (Williamson) by its regular, symmetrically triangular, smooth form.

Stratigraphic range: *T. bradyi* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Middle Eocene to Recent deposits from the Indo-Pacific region (see synonymy; Boomgaart, 1949; Lewis, 1979; Boersma, 1986).

Occurrence: In Recent eastern Indonesian sediments *T. bradyi* occurs in waterdepths between 60 and 1560 m, with its DLO at 684 m (Van Marle, 1988).

According to LeRoy (1964) *T. bradyi* is an outer neritic - upper bathyal form. Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 18 and 1240 m. Coustillas (1983) found it between 100 and 400 m in the Mahakam Delta.

Trifarina reussi (Cushman)
(pl. 7, figs. 10-11)

1884 *Rhabdogonium minutum* Brady (not Reuss), p. 526, pl. 67, figs. 4-6.

1913 *Triplasia reussi* Cushman, p. 63, pl. 39, fig. 3.
1960 *Trifarina reussi* (Cushman); Barker, p. 140, pl. 67, figs. 4-6.
1983 *Trifarina* sp., Coustillas, pl. 27, fig. 15.

Short description: Test thick and short, irregularly triangular in section; sides of test carinate. Chambers few, somewhat elongate, initially triserially ar-

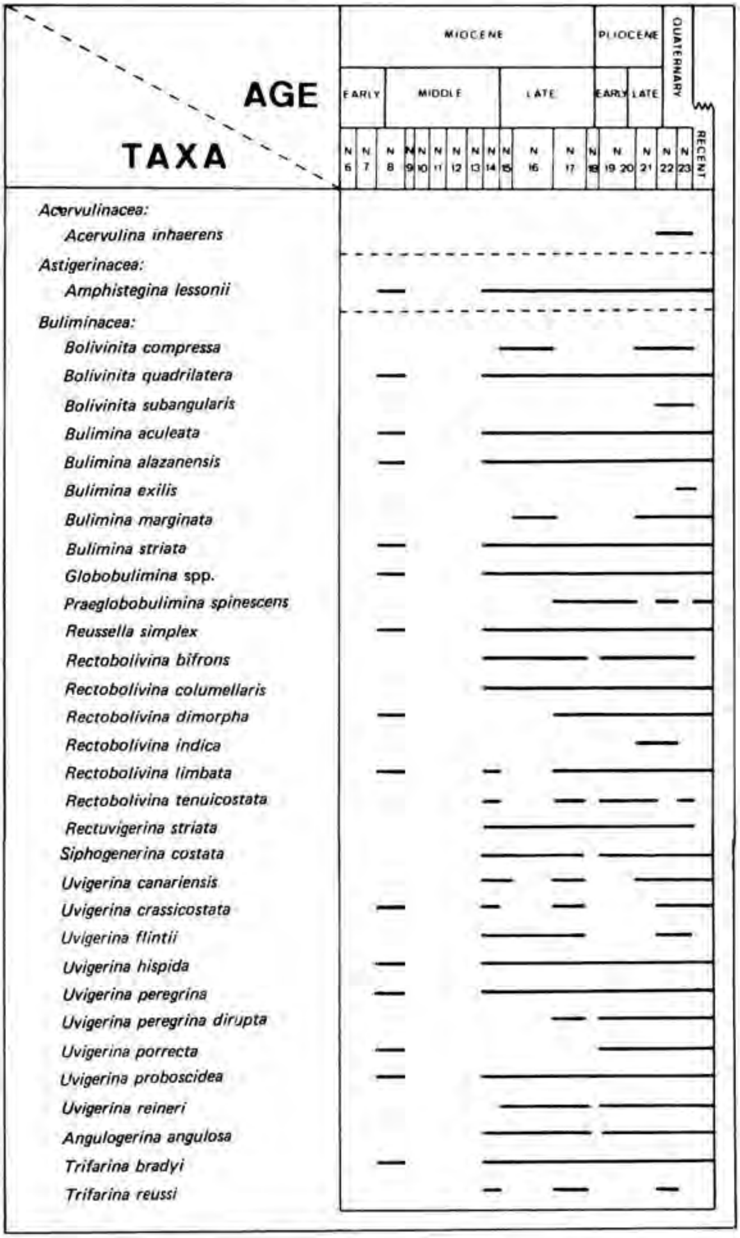

Fig. 17. Composite range chart of the superfamilies *Acervulinacea*, *Astigerinacea* and *Buliminacea* of the suborder *Rotaliina* in eastern Indonesia.

ranged. Wall coarse, thick, finely perforate. Aperture ovate, at the end of a short neck with thickened rim.

Remarks: *T. reussi* is shorter and thicker than *Trifarina bradyi* Cushman, with coarser appearing walls.

Stratigraphic range: *T. reussi* was found in Middle Miocene (N14), Late Miocene (N17), and Late Pliocene - Quaternary deposits (N22) on the eastern Indonesian islands. It has been observed previously in Recent deposits.

Occurrence: Coustillas (1983) found *T. reussi* at a depth of 76 m in the Mahakam Delta.

Superfamily *Cassidulinacea* d'Orbigny, 1839
Family *Bolivinellidae* Hayword, 1980
Genus *Bolivinella* Cushman, 1927

Bolivinella elegans Parr
(pl. 9, figs. 1-2)

1884 *Textularia folium* Brady (not Parker and Jones), p. 357, pl. 42, figs. 3-5.
1932 *Bolivinella elegans* Parr, p. 223-224.
1960 *Bolivinella elegans* Parr; Barker, p. 86, pl. 42, figs. 3-5.
1980 *Bolivinella elegans* Parr; Hayward and Brazier, p. 109, pl. 2, figs. 7-12, 26-27; pl. 3, figs. 3-4.

Short description: Test compressed, triangular to flabelliform in outline, apertural end almost parallel-sided, tapering gently; periphery acutely rounded. Chambers broad, low, fairly narrow, moderately recurved, somewhat sigmoid, not overlapping, biserially arranged. Sutural ribs thin, raised ridges, never meeting medial rib. Medial rib a single, unbeaded, straight ridge, raised higher than sutural ribs, extending two-thirds the length of the test and passing upwards into two medial ribs, separated by a wavy medial groove. Aperture cribrate, at the base of the last two chambers.

Remarks: *B. elegans* differs from *Bolivinella folium* (Parker and Jones) by its smaller size, triangular to flabelliform shape, its fewer, proportionally higher chambers, the less convex apertural end, and by the absence of beading on the sutures.

Stratigraphic range: *B. elegans* was found in Late Pliocene - Quaternary deposits (N22-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Oligocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: In Recent eastern Indonesian sediments *B. elegans* occurs only near Timor at a depth of 711 m (Van Marle, 1988).

Hayward and Brazier (1980) observed that *B. elegans* is a wide-spread, shallow (0-100 m), tropical species, and the only *Bolivinella*-species found in the Indian Ocean.

Family *Cassidulinidae* d'Orbigny, 1839
Subfamily *Cassidulininae* d'Orbigny, 1839
Genus *Cassidulina* d'Orbigny, 1826

Cassidulina carinata Silvestri
(pl. 9, figs. 9-10)

1884 *Cassidulina laevigata* Brady (not d'Orbigny), p. 428, pl. 54, figs. 2-3 (not fig. 1).
1896 *Cassidulina laevigata* d'Orbigny var. *carinata* Silvestri, p. 104, pl. 2, fig. 10.
1922 *Cassidulina laevigata* d'Orbigny var. *carinata* Cushman (not Silvestri), p. 124, pl. 25, figs. 6-7.
1946 *Cassidulina laevigata* d'Orbigny var. *carinata* Cushman; Germeraad, p. 72, pl. 4, figs. 6-8.
1960 *Cassidulina carinata* Silvestri; Barker, p. 110, pl. 54, figs. 2-3.
1965 *Cassidulina carinata* Silvestri; Todd, p. 40, pl. 17, fig. 4.
1966 *Cassidulina laevigata* d'Orbigny var. *carinata* Cushman (not Silvestri); Belford, p. 138, pl. 24, figs. 1-4.
1980 *Cassidulina carinata* Silvestri; Haller, p. 259, pl. 12, fig. 5.
1980 *Cassidulina laevigata* d'Orbigny var. *carinata* Silvestri; Ingle et al., p. 131, pl. 6, figs. 5-8.
1980 *Cassidulina carinata* Silvestri; Rodrigues et al., p. 54, pl. 5, figs. 3, 6, 9.
1985 *Cassidulina carinata* Silvestri; Wang et al., p. 336, pl. 4, fig. 17.
1986 *Cassidulina carinata* Silvestri; Kurihara and Kennett, p. 1073, pl. 5, figs. 1-3.
1988 *Cassidulina carinata* Silvestri; Van Marle, p. 141, pl. 2, figs. 4-5.

Short description: Test lenticular, biumbonate with clear central bosses; periphery with thin keel. Chambers biserially arranged, alternating on each side of periphery. Sutures distinct, depressed. Wall finely and densely perforate, smooth. Aperture an elongate, loop-shaped slit, extending from base of final chamber upward, parallel to periphery, with narrow lip on lower margin.

Remarks: *C. carinata* differs from the typical *Cassidulina laevigata* d'Orbigny by its characteristic, peripheral keel.

Cassidulina neocarinata Thalmann is considered to be a variety of *C. carinata*, differing in having a less elongate aperture, a broad flap covering the aperture and a slightly different chambershape (see Rodrigues et al., 1980, p. 54, 58).

Stratigraphic range: *C. carinata* was found in Middle Miocene - Quaternary deposits (N14-23) on the islands, and in Recent sediments from the eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *C. carinata* occurs generally in waterdepths between 344 and 2119 m, with higher frequencies between 1097 and 1504 m. Its DLO lies at 1402 m and its UDL at 244 m (Van Marle, 1988).

According to Hageman (1979) *C. carinata* is an open marine mud-dweller.

Cassidulina crassa d'Orbigny
(pl. 9, figs. 13-15)

1839b	*Cassidulina crassa* d'Orbigny, p. 56, pl. 7, figs. 18-20.
1884	*Cassidulina crassa* d'Orbigny; Brady, p. 429, pl. 54, figs. 4-5.
1925	*Cassidulina crassa* d'Orbigny; Cushman, p. 54, pl. 8, figs. 37-39.
1960	*Cassidulina crassa* d'Orbigny; Barker, p. 110, pl. 54, figs. 4-5.
1966	*Globocassidulina crassa* (d'Orbigny); Belford, p. 151, pl. 26, figs. 5-9.
1976	*Cassidulina crassa* d'Orbigny; Berggren and Haq, p. 102, pl. 1, fig. 23.
1978	*Cassidulina crassa* d'Orbigny; Boltovskoy, p. 154, pl. 2, fig. 19.
1979	*Cassidulina crassa* d'Orbigny; Osterman and Kellogg, p. 263, pl. 2, fig. 3.
1980	*Cassidulina crassa* d'Orbigny; Haller, p. 259, pl. 12, fig. 4.
1986	*Cassidulina* sp. B, Kurihara and Kennett, p. 1073, pl. 4, figs. 9, 12.

Short description: Test oval, convex, obtuse or with rounded peripheral margins. Alternating, overlapping, regular chamber arrangement, biserial throughout. Chambers relatively few in number, oval or elongate, convex, joining at the centre of the test; last chamber convex. Sutures slightly depressed. Wall thick and opaque, white, glossy, finely perforate. Aperture an elongate slit almost paralleling the periphery, sometimes forming a triangular depression in the centre of the chamber.

Remarks: Belford (1966) observed a trifid aperture in his specimens of *C. crassa*, and therefore placed them in the genus *Globocassidulina*. Though the aperture is often triangular in the central part, it is not trifid, but comparable with the *Cassidulina* type of aperture, and this species is therefore retained in the genus *Cassidulina*. Belford's specimens are most probably specimens of *Globocassidulina rossensis* Kennett (1967), a resembling species with tripartite aperture.

Stratigraphic range: *C. crassa* was found in Middle - Late Miocene (N14-15) and Late Miocene - Quaternary deposits (N17-23) on the islands, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *C. crassa* occurs in the upper bathyal zone and deeper, with its DLO at 714 m and its UDL at 210 m (Van Marle, 1988).

Cassidulina delicata Cushman
(pl. 9, fig. 8)

1927a	*Cassidulina delicata* Cushman, p. 168, pl. 6, fig. 2.
1941a	*Cassidulina delicata* Cushman; LeRoy, p. 42, pl. 3, figs. 15-17.

1965 *Cassidulina delicata* Cushman; Todd, p. 42, pl. 17, figs. 6-7.
1966 *Cassidulina delicata* Cushman; Belford, p. 140, pl. 24, figs. 5-10.
1966 *Cassidulina sulcata* Belford, p. 142, pl. 24, figs. 11-14.
1980 *Cassidulina delicata* Cushman; Haller, p. 259, pl. 12, fig. 3.
1980 *Cassidulina delicata* Cushman; Ingle et al., p. 131, pl. 4, fig. 6.

Short description: Test compressed, broadly ovate; periphery subacute. Chambers biserially arranged, distinct, inflated, broad; 4 pairs making up the last formed coil, the chambers of the opposite series barely showing as a very small triangle near the periphery. Sutures distinct, depressed, not limbate. Wall thin, very finely perforate, smooth. Aperture an elongate, narrow slit of uniform width, following the curve of the previous chamber from umbilical end to periphery.

Remarks: *C. delicata* resembles *Cassidulina laevigata* d'Orbigny, but is more rounded at the periphery, and has a characteristic, very elongated aperture, extending from the umbilical end towards the periphery.

Cassidulina sulcata Belford is considered to be a variety of *C. delicata*, differing in having fine, irregularly distributed grooves (see Belford, 1966, and pl. 9, fig. 8). Belford already stated that both species are similar in general appearance and internal structure, and may be grouped together.

Stratigraphic range: *C. delicata* was found in Late Miocene - Early Pliocene (N17-18) and Late Pliocene - Quaternary deposits (N21-23) on the eastern Indonesian islands. It has been observed previously in Late Miocene to Recent deposits.

Occurrence: Bandy and Rodolfo (1964) reported *C. delicata* to be dominant at depths around 800 m in the Peru-Chili Trench.

Cassidulina elegans Sidebottom
(pl. 9, fig. 16)

1910 *Cassidulina elegans* Sidebottom, p. 106, pl. 4, fig. 1.
1978 *Cassidulina elegans* Sidebottom; Boltovskoy, p. 155, pl. 2, fig. 25-26.

Short description: Test somewhat globular, slightly compressed at the sides. Chambers biserially arranged in a coil, alternating on each side of the periphery. The upper chamber parts are raised and almost angular, the lower parts more transparent. Sutures slightly depressed, distinct. Wall hyaline, finely perforate and slightly rough. Aperture an oblique, curved slit with a raised edge, paralleling anterior margin of chamber.

Remarks: *C. elegans* has a distinct form with characteristic, raised upper portion of the chambers.

Stratigraphic range: *C. elegans* was found in Late Miocene - Quaternary deposits (N17-23) on the eastern Indonesian islands. It has been observed previously in Quaternary deposits.

Occurrence: *C. elegans* has in the eastern Indonesian material always been found in association with typical middle bathyal species.

Cassidulina laevigata d'Orbigny
(pl. 9, figs. 11-12)

1826 *Cassidulina laevigata* d'Orbigny, p. 282, pl. 15, figs. 4-5.
1921 *Cassidulina laevigata* d'Orbigny; Cushman, p. 171, pl. 31, fig. 7.
1978 *Cassidulina laevigata* d'Orbigny; Boltovskoy, p. 155, pl. 2, fig. 27.

Short description: Test lenticular, compressed, biumbonate; periphery not keeled. Chambers biserially arranged, alternating on each side of the periphery. Wall finely and densely perforate. Aperture an elongate slit, loop-shaped, extending from base of final chamber upward in a curve, paralleling anterior margin of chamber, with narrow bordering lip on lower margin, and flap or narrow ridge extends from the opposite margin; free edges of the flap and lip are serrated.

Remarks: *C. laevigata*, the type species of the genus *Cassidulina*, differs from *Cassidulina carinata* Silvestri by the absence of a keel. The specimens shown as *C. laevigata* by Belford (1966; p. 138, pl. 24, figs. 1-4) are distinctly keeled and therefore referred to *C. carinata*. *Cassidulina teretis* Tappan differs from *C. laevigata* by its much larger size and the clear umbilical bosses on both sides of the test.

Stratigraphic range: *C. laevigata* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23) on the islands and in Recent sediments from the eastern Indonesia (Van Marle, 1988). It has been described previously from Late Eocene to Recent deposits (see synonymy; De Hornibrook, 1961; Belford, 1966).

Occurrence: In Recent eastern Indonesian sediments *C. laevigata* usually occurs at neritic - upper bathyal depths, but also shows scattered deeper occurrences. Its DLO lies at 90 m and its UDL at 60 m (Van Marle, 1988). According to Poag (1981) this is a typical shelf species.

Cassidulina teretis Tappan

1951 *Cassidulina teretis* Tappan, p. 121, pl. 1, fig. 30.
1960 *Cassidulina teretis* Tappan; Barker, p. 110, pl. 54, fig. 1.
1980 *Cassidulina teretis* Tappan; Rodrigues et al., p. 59, pl. 2, figs. 1, 3, 5; pl. 5, figs. 1, 4, 7; pl. 6, figs. 7, 10.
1983 *Cassidulina teretis* Tappan; Coustillas, pl. 40, fig. 7.

Short description: Description follows that of *Cassidulina laevigata* d'Orbigny (1826), only differing in having a larger test size and a clear umbilical boss on each side of the periphery.

Remarks: *C. teretis* was often considered to belong to *C. laevigata*. However, Mackensen et al. (1985; p. 302) proved them to be separate species, *C. teretis* being the much larger form with clear umbilical bosses and *C. laevigata* the smaller form without the bosses.

Stratigraphic range: *C. teretis* was found in Early - Late Pliocene deposits (N19/20-21) on the eastern Indonesian islands. It has been observed previously in Recent sediments.

Occurrence: Coustillas (1983) found *C. teretis* in samples from waterdepths between 30 and 60 m in the Mahakam Delta.

Genus *Favocassidulina* Loeblich and Tappan, 1957

Favocassidulina favus (Brady)
(pl. 10, figs. 1-2)

1877 *Pulvinulina favus* Brady, p. 535 (nomen nudum).
1884 *Pulvinulina favus* Brady, p. 701, pl. 104, figs. 12-16.
1957 *Favocassidulina favus* (Brady); Loeblich and Tappan, p. 230, pl. 73, figs. 7-11.
1960 *Favocassidulina favus* (Brady); Barker, p. 214, pl. 104, figs. 12-16.
1964 *Favocassidulina favus* (Brady); Loeblich and Tappan, C738, figs. 604,3-4.
1966 *Favocassidulina favus* (Brady); Belford, p. 145, pl. 26, figs. 28-31.
1973 *Favocassidulina favus* (Brady); Douglas, p. 614, pl. 6, figs. 4-5.
1981 *Favocassidulina favus* (Brady); Burke, p. 8, pl. 3, figs. 3-4.
1986 *Favocassidulina favus* (Brady); Kurihara and Kennett, p. 1074, pl. 6, figs. 1-2.

Short description: Test lenticular, nearly symmetrically biconvex; periphery acute. Chambers biserially arranged, each chamber extending to umbilicus on one side with only a small triangular portion to opposite side. Wall finely perforate, except for apertural area ornamented by honeycomb-like secondary growth, with relatively wide hexagonal open areas separated by narrow, elevated ridges. Aperture an elongate, oblique, curved slit, extending upward from base of final chamber.

Remarks: The raised reticulate ornamentation is characteristic for the genus *Favocassidulina*, of which *F. favus* is the type species.

Stratigraphic range: *F. favus* was found in Late Pliocene deposits (N21) from Timor. It has been observed previously in Middle Miocene to Recent deposits.

Occurrence: According to Douglas and Woodruff (1981) *F. favus* is a typical Pacific species, though also encountered in the Indian Ocean.

Based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 4 degrees Celsius for this species, which corresponds with waterdepths of about 1250 m. Burke (1981) reported this species from waterdepths greater than 2500 m in the western Pacific.

Genus *Globocassidulina* Voloshinova, 1960

Globocassidulina bicornis (Brady)
(pl. 10, figs. 6-7)

1888 *Ehrenbergina bicornis* Brady, p. 5, pl. 1, fig. 3.
1934 *Ehrenbergina bicornis* Brady; Cushman, p. 133, pl. 16, figs. 10-11.
1965 *Ehrenbergina bicornis* Brady; Todd, p. 47, pl. 21, fig. 1.
1966 *Globocassidulina bicornis* (Brady); Belford, p. 154, pl. 25, figs. 27-28.

Short description: Test subspherical with rounded periphery and closed umbilicus; armed with two outwards directed spines. Chambers biserially arranged and completely enrolled. Wall smooth, finely perforate. Aperture an elongate slit, parallel to the periphery.

Remarks: The aperture is similar to that of *Ehrenbergina* species (an elongate slit parallel to periphery), but *G. bicornis* possesses a completely enrolled test and is therefore transferred to the genus *Globocassidulina* (see Belford, 1966).

Stratigraphic range: *G. bicornis* was found in Late Miocene - Late Pliocene deposits (N17-19/20) on the eastern Indonesian islands. It has been described previously from Early - Late Miocene and Recent sediments.

Occurrence: *G. bicornis* has in the eastern Indonesian material always been found in association with typical middle - lower bathyal species.

Globocassidulina murrhyna (Schwager)
(pl. 10, figs. 3-5)

1866 *Sphaeroidina murrhyna* Schwager, p. 250, pl. 7, fig. 97.
1946 *Cassidulina moluccensis* Germeraad, p. 72, pl. 2, figs. 29-32.
1965 *Cassidulina moluccensis* Germeraad; Todd, p. 43, pl. 15, fig. 2.
1966 *Globocassidulina murrhyna* (Schwager); Belford, p. 152, pl. 26, figs. 10-13.
1980 *Globocassidulina murrhyna* (Schwager); Srinivasan and Sharma, p. 59, pl. 6, fig. 8 (neotype).
1981 *Cassidulina moluccensis* Germeraad; Burke, p. 7, pl. 2, figs. 9-10.

Short description: Test globular, suboval in front view, involute; periphery lobate. Chambers slightly inflated, overlapping, irregular, biserial; sutures slightly depressed, each bisecting next and running straight across the surface. Wall thick, smooth, polished, finely perforate. Aperture central, loop-shaped, broad, rounded, with small lip at its inner margin; apertural face folded inward to form a broad ledge above aperture.

Remarks: *G. murrhyna* is characterized by the bulbous initial chamber part, the tapering chamber end, and the large semicircular aperture.

The type description of *Cassidulina moluccensis* by Germeraad (1946) agrees with the description of *G. murrhyna*, and *C. moluccensis* is therefore regarded as a junior synonym of *G. murrhyna*. Belford (1966) considered *Cassidulina cuneata*

Finlay (1940) also to be a synonym of *G. murrhyna*, only differing in the presence of an extended beak-like chamber and a fissure-like aperture (see also Srinivasan and Sharma, 1980).

Stratigraphic range: *G. murrhyna* was found in Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from the eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *G. murrhyna* occurs in the middle bathyal zone and deeper, with its DLO at 904 m and its UDL at 486 m (Van Marle, 1988).

According to Burke (1981) this form is associated with the influence of terrigenous sediments on the Ontong Java Plateau.

Globocassidulina oblonga (Reuss)
(pl. 10, figs. 8-9)

1850	*Cassidulina oblonga* Reuss, p. 376, pl. 48, figs. 5-6.
1925	*Cassidulina oblonga* Reuss; Cushman, p. 55, pl. 9, figs. 19-22.
1949	*Cassidulina oblonga* Reuss; Boomgaart, p. 135, pl. 13, fig. 4.
1964	*Globocassidulina oblonga* (Reuss); Loeblich and Tappan, C738, fig. 604,7.
1966	*Globocassidulina oblonga* (Reuss); Belford, p. 150, pl. 26, figs. 1-4.
1978	*Cassidulina oblonga* Reuss; Boltovskoy, p. 155, pl. 2, fig. 31.
1988	*Globocassidulina oblonga* (Reuss); Van Marle, p. 143, pl. 5, fig. 21.

Short description: Test relatively small, elongate-ovate, convex, without umbilical boss. Chambers biserially arranged and enrolled, somewhat lobate, elongate-hexagonal; sutures very thin, deep, which interfere at the peripheral end between opposite chambers. Wall smooth, glossy, finely perforate. Aperture a simple longitudinal slit at the inner side of the concave apertural face of the elongate-oval last chamber, with a small tooth, formed by the free edge of the folded toothplate.

Remarks: In most of our specimens the last chamber is elongated and somewhat twisted, but the test never uncoils as much as in *Cassidulinoides bradyi* (Norman). The tripartite aperture, mentioned by Norvang (1958; p. 35, pl. 8, fig. 17), has not been observed in eastern Indonesian specimens, which all possess the more slit-like aperture.

Stratigraphic range: *G. oblonga* was found in Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Oligocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *G. oblonga* shows a scattered depth distribution, with its UDL at 141 m (Van Marle, 1988).

Globocassidulina subglobosa (Brady) s.l.
(pl. 10, figs. 10-11)

1881 *Cassidulina subglobosa* Brady, p. 60 (nomen nudum).
1884 *Cassidulina subglobosa* Brady, p. 430, pl. 54, fig. 17.
1925 *Cassidulina subglobosa* Brady; Cushman, p. 54, pl. 8, figs. 48-50.
1941b *Cassidulina subglobosa* Brady; LeRoy, p. 85, pl. 6, figs. 16-17.
1951 *Cassidulina subglobosa* Brady; Hofker, p. 289, text-figs. 196-199.
1960 *Cassidulina subglobosa* Brady; Barker, p. 110, pl. 54, fig. 17.
1964 *Globocassidulina subglobosa* (Brady); Loeblich and Tappan, C738, fig. 604,6.
1965 *Cassidulina subglobosa* Brady; Todd, p. 45, pl. 16, fig. 7.
1966 *Globocassidulina subglobosa* (Brady); Belford, p. 149, pl. 25, figs. 11-16.
1973 *Cassidulina subglobosa* Brady; Douglas, p. 613, pl. 6, fig. 3.
1976 *Cassidulina subglobosa* Brady; Berggren and Haq, p. 102, pl. 1, fig. 24.
1980 *Cassidulina subglobosa* Brady; Ingle et al., p. 132, pl. 1, figs. 14-15.
1980 *Cassidulina subglobosa subglobosa* Brady; Boltovskoy, p. 165, pl. 1, figs. 8a-b.
1981 *Cassidulina subglobosa* Brady; Burke, p. 7, pl. 2, fig. 11.
1984b *Globocassidulina subglobosa* (Brady); Boersma, p. 1286, pl. 8, fig. 5.
1984 *Cassidulina subglobosa* Brady; Boltovskoy, p. 326, pl. 1, figs. 9-10.
1985 *Globocassidulina subglobosa* (Brady); Wang et al., p. 336, pl. 4, fig. 18.
1985 *Globocassidulina subglobosa* (Brady); Thomas, p. 676, pl. 7, fig. 4.
1986 *Globocassidulina subglobosa* (Brady); Kurihara and Kennett, p. 1073, pl. 5, figs. 4-8.
1988 *Globocassidulina subglobosa* (Brady); Van Marle, p. 143, pl. 5, fig. 22.

Short description: Test large, few-chambered, subglobular; periphery rounded, umbilicus closed. Chambers globular, biserially arranged and enrolled; sutures narrow, smooth, sometimes slightly depressed. Wall thick, smooth, finely perforate. Aperture a narrow, elongate, tripartite, obliquely-set loop with a small lip on the basal margin, and an elongate tooth formed by the free edge of the folded toothplate.

Remarks: Many authors differentiate between *G. subglobosa* forma *subglobosa* Brady (or *G. subglobosa* s.s.), the form usually found in our material and *G. subglobosa* forma *horizontalis* Cushman and Renz. In *G. subglobosa* forma *horizontalis* the aperture runs parallel with the suture between the last and the previous chamber, while in *G. subglobosa* forma *subglobosa* the aperture is situated almost perpendicular to this suture. Originally *G. subglobosa* forma *horizontalis* was described from the Oligocene-Miocene of Venezuela, while *G. subglobosa* forma *subglobosa* is a Miocene-Quaternary species. Boltovskoy (1978) proposed an evolutionary trend for *G. subglobosa*. According to him offshoots develop from *Cassidulina cuneata* Finlay during the Oligocene, of which *G. subglobosa* forma *subglobosa* was the most consistent as it still lives today. *G. subglobosa* forma *horizontalis* was a less resistant offshoot which became extinct at the beginning of the Pliocene, being already rare in the Late Miocene.

The main characteristic of *Globocassidulina gemma* (Todd) are the numerous low striations around the apertural margi. These striations are usually vague and only visible under Scanning Electron Microscope, for which reason specimens of *G. gemma* could in most cases during the countings not be distinguished from *G. subglobosa* s.s. and were included into *G. subglobosa* s.l.

Globocassidulina oriangulata Belford (1966) is considered to be a variety of *G. subglobosa* s.s. with a slightly different, more trifid, aperture. *Globocassidulina oribunda* Belford was also taken as a variety of *G. subglobosa* s.s., only differing in its larger test size and the more undulating sutures. The characteristic supplementary apertures described by Belford (1966) were not observed in any of our specimens, which for this reason resemble *Globocassidulina pacifica* (Cushman).

During the countings also specimens were found similar to the specimens described by Belford (1966) as *G. subglobosa* var. *ornata* (Cushman), which differ from *G. subglobosa* s.s. in the presence of the irregular ornament of the earlier chambers. In our opinion these differences between both forms are not large enough to consider *G. subglobosa* var. *ornata* as a separate species (as was done by Belford), and these specimens are therefore also included in *G. subglobosa* s.l.

Stratigraphic range: *G. subglobosa* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Middle Eocene to Recent deposits from the Indo-Pacific region (see synonymy; De Hornibrook, 1961; LeRoy, 1964; Boltovskoy, 1978; Corliss, 1979; Peterson, 1984; Boersma, 1986).

Occurrence: In Recent eastern Indonesian sediments *G. subglobosa* shows a scattered depth distribution down from 60 m, with higher frequencies deeper than 1097 m (Van Marle, 1988). This confirms the opinion of Berggren and Haq (1976), who reported this species to have a widespread bathymetric range, but predominantly being bathyal.

According to LeRoy (1941b) *G. subglobosa* is a deep water form. This is confirmed by the data of Corliss (1979) and Peterson (1984). Corliss (1979) found this species in sediments between 2500 and 4600 m in the southeastern Indian Ocean, and Peterson reported it to have its maximum abundance in waterdepths between 2000 and 3800 m in eastern Indian Ocean.

Corliss (1979) related the testsize of *G. subglobosa* to waterdepth and reported that smaller specimens are found deeper (>3500 m) and larger specimens shallower (<3500 m).

Subfamily *Ehrenbergininae* Cushman , 1927
Genus *Ehrenbergina* Reuss, 1850

Ehrenbergina hystrix Brady
(pl. 9, fig. 7)

1881 *Ehrenbergina hystrix* Brady, p. 60 (nomen nudum).

1884 *Ehrenbergina hystrix* Brady, p. 434, pl. 55, figs. 8-11.
1951 *Ehrenbergina hystrix* Brady; Hofker, p. 279, text-figs. 186-187.
1960 *Ehrenbergina hystrix* Brady; Barker, p. 112, pl. 55, figs. 8-11.
1973 *Ehrenbergina hystrix* Brady; Douglas, p. 614, pl. 10, figs. 1-2.
1978 *Ehrenbergina hystrix* Brady; Boltovskoy, p. 158, pl. 3, fig. 36.

Short description: Test ovate, compressed, with broad and rounded apertural end; periphery carinate. Chambers biserially arranged and enrolled, regularly alternating on the dorsal side, irregular on the ventral side, their free ends terminating in lateral spines. Dorsal sutures marked by rows of spines, sometimes fused into fringe-like projection. Wall finely perforate, smooth; ventral surface of the earlier chambers beset with stout spines or pustules. Aperture a large, curved, elongated slit, in a depression on the inflated apertural face, which is ornamented by radiating lines.

Remarks: *E. hystrix* is characterized by the radiate zone around the aperture.

Stratigraphic range: *E. hystrix* was found in Late Pliocene - Quaternary deposits (N22) from Seram, and in Recent sediments from the eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits.

Occurrence: See *Ehrenbergina pacifica* Cushman.

Ehrenbergina pacifica Cushman
(pl. 9, figs. 3-4)

1884 *Ehrenbergina serrata* Brady (not Reuss), p. 434, pl. 55, figs. 4, 6-7.
1927b *Ehrenbergina pacifica* Cushman, p. 5, pl. 2, fig. 2.
1951 *Ehrenbergina pacifica* Cushman; Hofker, p. 281, text-figs. 188-195.
1960 *Ehrenbergina pacifica* Cushman; Barker, p. 112, pl. 55, figs. 4, 6-7.
1965 *Ehrenbergina pacifica* Cushman; Todd, p. 47, pl. 20, fig. 1.
1978 *Ehrenbergina pacifica* Cushman; Hofker, p. 47, pl. 6, figs. 1-3.
1983 *Ehrenbergina pacifica* Cushman; Coustillas, pl. 40, figs. 9-10.
1985 *Ehrenbergina pacifica* Cushman; Boichard et al. p. 94, pl. 17, figs. 21-22.

Short description: Test triangular in front view, dorsal side convex, ventral side with a narrow median furrow whch may be entirely closed; periphery with long spinose projections from the upper angle of each chamber extending straight out from the test. Chambers biserially arranged and enrolled, numerous, low and broad; the ventral angle of each chamber having a raised ridge continuing to the spine at the periphery. Sutures distinct, dorsally flush, ventrally depressed. Wall finely perforate, smooth. Aperture an elongated, narrow, slightly curved slit.

Remarks: Boersma (1986) observed within *E. pacifica* latitudinal gradients both in the degree of spinosity and in the number of chambers in the adult.

Ehrenbergina trigona (Goess) is considered to be a variety of *E. pacifica* with a more regular trigonal and less convex form, and less long spines.

Stratigraphic range: *E. pacifica* was found in Early - Middle Miocene (N8) and Late Miocene - Quaternary deposits (N16-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Pliocene to Recent deposits (see synonymy; LeRoy, 1964; Boersma, 1986).

Occurrence: Van Marle (1988) assembled *E. hystrix*, *E. pacifica*, and *E. pupa* in *Ehrenbergina* spp., which show a scattered depth distribution down from 90 m in Recent eastern Indonesian sediments, with higher frequencies between 914 and 1564 m.

According to LeRoy (1964) *E. pacifica* is an outer neritic - upper bathyal form. Coustillas (1983) found it in sediments from deeper than 200 m in the Mahakam Delta and Boichard et al. (1985) between 490 and 715 m on the Pater Noster Platform.

Ehrenbergina pupa (d'Orbigny)

(pl. 9, figs. 5-6)

1839b *Cassidulina pupa* d'Orbigny, p. 57, pl. 7, figs. 21-23.
1884 *Ehrenbergina pupa* (d'Orbigny); Brady, p. 433, pl. 55, fig. 1.
1960 *Ehrenbergina pupa* (d'Orbigny); Barker, p. 112, pl. 55, fig. 1.
1980 *Ehrenbergina pupa* (d'Orbigny); Coulbourn, p. 710, text-fig. 11-I.

Short description: Test oblong, compressed, arcuate, elongated and rounded in outline. Chambers initially compressed and arcuate in outline, slightly keeled, overlapping and spirally arranged; later rounded to oval, large, flattened, growing more erected. Wall finely perforate, smooth, glossy. Aperture a curved slit, situated at the internal margin of the last chamber, parallel to the suture with the previous chamber.

Remarks: *E. pupa* differs from congeneric species by its compressed and smaller test.

Stratigraphic range: *E. pupa* was found in Late Pliocene - Quaternary deposits (N22) from Seram, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: See *Ehrenbergina pacifica* Cushman.

Superfamily *Chilostomellacea* Brady, 1881
Family *Alabaminidae* Hofker, 1951
Subfamily *Alabamininae* Hofker, 1951

Genus *Svratkina* Pokorny, 1956
Svratkina tubulifera (Heron-Allen and Earland)

(pl. 11, figs. 5-7)

1914 *Truncatulina tubulifera* Heron-Allen and Earland, p. 710, pl. 52, figs. 37-40.

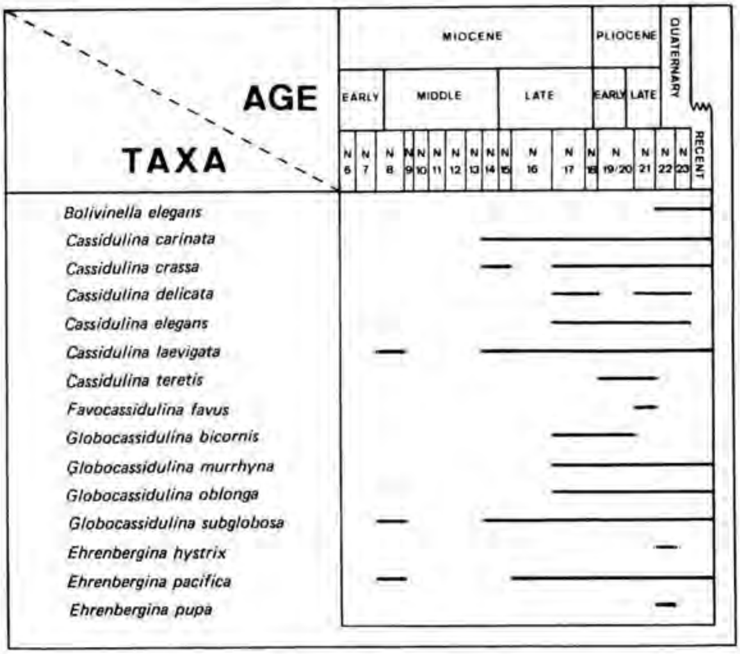

Fig. 18. Composite range chart of the superfamily *Cassidulinacea* of the suborder *Rotaliina* in eastern Indonesia.

1951 *Alabamina tubulifera* (Heron-Allen and Earland); Hofker, p. 392, text-figs. 271-273.

1965 *Epistominella tubulifera* (Heron-Allen and Earland); Todd, p. 31, pl. 10, fig. 2.

1966 *Alabamina tubulifera* (Heron-Allen and Earland); Belford, p. 160, pl. 27, figs. 1-6.

1983 *Epistominella tubulifera* (Heron-Allen and Earland); Coustillas, pl. 39, figs. 9a-b.

1987 *Svratkina tubulifera* (Heron-Allen and Earland); Crouch and Poag, p. 173, pl. 4, figs. 8-9.

Short description: Test lenticular, biconvex, trochospiral, consisting of 2-3 convolutions, evolute on spiral side, involute on opposite side; periphery rounded to subangular. Chambers all show distinct marginal prolongation and a peripheral depression in the plane of coiling; 6-7 in the last whorl. Sutures thick, oblique and curved spirally, radial around umbilical depression on opposite side. Chamber walls between the sutures coarsely perforate, each perforation extended into a raised tube; tubes may coalesce to form a cristate growth following the curve of the chamber and opening at the top into a crater. Aperture an interiomarginal slit, extending from near periphery almost to umbilicus, with narrow bordering lip.

Remarks: Hofker (1951) and Belford (1966) both referred this species to *Alabamina* (Toulmin, 1941), because of the granular wall texture, the distinct marginal prolongations of the chambers and the peripheral depression in the plane of coiling associated with the infundibulum. However, these features are also characteristic for the genus *Svratkina*, which differs from *Alabamina* by the large pores opening into tubercles. These are characteristic of this species, which is therefore transferred to the genus *Svratkina*.

Stratigraphic range: *S. tubulifera* was found in Late Miocene - Quaternary deposits (N16-23) on the eastern Indonesian islands. It has been observed previously in Early Miocene to Recent deposits.

Occurrence: Coustillas (1983) observed *S. tubulifera* in samples from waterdepths between 50 and 100 m in the Mahakam Delta.

Subfamily *Gyroidininae* Saidova, 1981
Genus *Gyroidina* d'Orbigny, 1826

Gyroidina neosoldanii Brotzen s.l.
(pl. 11, figs. 11-12)

1884 *Rotalia (Gyroidina) soldanii* Brady (not d'Orbigny), p. 706, pl. 107, figs. 6-7.
1936 *Gyroidina neosoldanii* Brotzen, p. 158.
1941b *Gyroidina soldanii* d'Orbigny; LeRoy, p. 83, pl. 4, figs. 19-21.
1960 *Gyroidina neosoldanii* Brotzen; Barker, p. 220, pl. 107, figs. 6-7.
1976 *Gyroidinoides neosoldanii* (Brotzen); Berggren and Haq, p. 102, pl. 1, figs. 25-26.
1980 *Gyroidina neosoldanii* Brotzen; Ingle et al., p. 138, pl. 7, figs. 10-11.
1980 *Gyroidina acuta* Boomgaart; Boltovskoy, p. 165, pl. 2, figs. 7a-b; pl. 4, figs. 3a-b.
1984 *Gyroidinoides neosoldanii* (Brotzen); Govindan, p. 246, pl. 2, figs. 3-4.
1986 *Gyroidina neosoldanii* Brotzen; Kurihara and Kennett, p. 1075, pl. 7, fig. 8.

Short description: Test circular in outline, trochospiral, planoconvex; periphery slightly lobate in top view. Chambers arranged in 3-4 whorls, increasing slowly in size as added, slightly overlapping on the dorsal side. Sutures narrow, distinct, on both sides straight and radial, weakly depressed on dorsal side. Wall smooth, glossy, finely and densely perforate. Strongly developed infundibulum associated with depression in apertural face; wide umbilicus, with deep pseudoumbilicus. Aperture a low interiomarginal slit, umbilical-extraumbilical, with narrow lip.

Remarks: Because of the morphological differences between the holotype of *Gyroidina soldanii* d'Orbigny and the specimens figured by Brady (1884) as *G. soldanii* d'Orbigny, Brotzen (1936) transferred Brady's specimens to his new formed species *G. neosoldanii*. According to him specimens with oblique sutures on the dorsal side and more convex chambers should be considered as *G. soldanii*, and specimens with oblique sutures on the spiral side and flattened chambers to *G. neosoldanii*.

Some of our specimens have raised dorsal sutures and resemble in that way *Gyroidina soldanii* d'Orbigny var. *altiformis* Stewart and stewart. However, because the sutures are not as strongly raised as in the that variety, and because these specimens were only rarely found, they were considered as a variety of our *G. neosoldanii* s.l. and not as a separate species.

Few specimens resemble *Gyroidina broeckhiana* (Karrer) in being somewhat convex on the dorsal side and having more chambers, but they never become that strongly biconvex to be considered as specimens of the latter species and were therefore maintained within *G. neosoldanii* s.l.

Boomgaart (1949) and Belford (1966) distinguished the species *Gyroidina acuta* Boomgaart and *Gyroidina cushmani* Boomgaart. Like Boomgaart we consider the form *acuta* to be no more than a smaller variety of *G. neosoldanii* s.l.The form *cushmani*, though originally described by Boomgaart as a separate species, is also in our opinion no more than a variety of *G. neosoldanii* s.l. with a thickened umbilical margin, a large umbilicus, and a deeper pseudoumbilicus.

Stratigraphic range: *G. neosoldanii* s.l. was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). *G. neosoldanii* and the included varieties have been recorded previously from Late Oligocene to Recent deposits (see synonymy; Boomgaart, 1949; De Hornibrook, 1961; LeRoy, 1964; Belford, 1966; Lewis, 1979; Coustillas, 1983).

Occurrence: In Recent eastern Indonesian sediments *G. neosoldanii* occurs generally in waterdepths between 711 and 2119 m, with its DLO at 714 m and its UDL at 150 m (Van Marle, 1988).

Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 48 and 2329 m. Coustillas (1983) found it between 50 and 400 m in the Mahakam Delta.

Gyroidina orbicularis d'Orbigny
(pl. 11, figs. 8-10)

1826 *Gyroidina* (*Rotalia*) *orbicularis* d'Orbigny, p. 278, mod. no. 13.
1884 *Rotalia orbicularis* d'Orbigny; Brady, p. 706, pl. 115, fig. 6 (not pl. 107, fig. 5).
1931 *Gyroidina orbicularis* d'Orbigny; Cushman, p. 37, pl. 8, figs. 1-2.
1951a *Gyroidina orbicularis* d'Orbigny; Asano, p. 8, figs. 61-62.
1960 *Gyroidina orbicularis* d'Orbigny; Barker, p. 238, pl. 115, fig. 6.
1964 *Gyroidina orbicularis* d'Orbigny; Loeblich and Tappan, C750, figs. 614,5-6.
1966 *Gyroidina orbicularis* d'Orbigny; Belford, p. 164, pl. 27, figs. 7-14.
1978 *Gyroidina orbicularis* d'Orbigny; Boltovskoy, p. 160, pl. 4, figs. 16-17.
1981 *Gyroidinoides orbicularis* (d'Orbigny); Corliss and Honjo, p. 359, pl. 4, figs. 1-14.

Short description: Test planoconvex, circular in outline, slightly lobate in top view. Chambers arranged in 3-4 whorls, increasing strongly in size as added; sutures narrow, distinct, straight and radial ventrally, oblique on opposite side. Wall brownish-white, opaque, glossy, finely and densely perforate, smooth. Strongly developed infundibulum associated with depression in apertural face; wide, shallow umbilicus with pseudoumbilicus. Aperture an interio-marginal, umbilical-extraumbilical slit.

Remarks: *G. orbicularis* has a relatively flat test compared with the strongly convex test of *Gyroidina neosoldanii* Brotzen s.l.

Stratigraphic range: *G. orbicularis* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Middle Miocene to Recent deposits from the Indo-Pacific region (see synonymy; Lewis, 1979; Coustillas, 1983).

Occurrence: In Recent eastern Indonesian sediments *G. orbicularis* occurs generally in waterdepths between 545 and 1760 m, with its DLO at 1290 m and its UDL at 60 m (Van Marle, 1988).

Corliss (1979) found this species in sediments between 2500 and 4600 m in the southeastern Indian Ocean. Lewis (1979) observed it in sediments from the continental margin of New Zealand between 18 and 2432 m and Coustillas (1983) found it between 100 and 400 m in the Mahakam Delta.

Family *Chilostomellidae* Brady, 1881

Genus *Allomorphina* Reuss, 1849

Allomorphina pacifica Cushman and Todd

(pl. 10, figs. 14-15)

1884 *Allomorphina trigonula* Brady (not Reuss), p. 438, pl. 55, figs. 24-26.
1944b *Valvulineria* aff. *allomorphinoides* (Reuss); LeRoy, p. 87, pl. 3, figs. 21-23.
1949 *Allomorphina pacifica* Cushman and Todd, p. 68, pl. 12, figs. 6-9.
1960 *Allomorphina pacifica* Cushman and Todd (not Hofker); Barker, p. 112, pl. 55, figs. 24-26.
1966 *Allomorphina pacifica* Cushman and Todd (not Hofker); Belford, p. 154, pl. 30, figs. 14-16.
1978 *Allomorphina pacifica* Cushman and Todd; Boltovskoy, p. 150, pl. 1, fig. 1.
1986 *Allomorphina pacifica* Cushman and Todd; Kurihara and Kennett, p. 1074, pl. 6, fig. 9.

Short description: Test trochospiral, involute, one end broader than the other and nearly straight, though incised in the middle, the opposite end broadly rounded. Chambers very distinct, inflated, usually 3 per whorl, the last-formed chamber making up the bulk of the test, extending backward on the ventral side; the preceding two chambers equally sized. Sutures distinct, depressed on the ventral side. Wall finely perforate, smooth. Aperture a low, narrow opening at one side of the ventral angle of the final chamber bordered by a slight lip.

Remarks: The form (with a distinct dentate apertural lip) described by Hofker (1951) as *Allomorphina pacifica* is a junior homonym of the form described by Cushman and Todd (1949), and therefore renamed *A. fragilis* in 1952 (on request of Thalmann). The figures given by both Barker (1960) and Belford (1966) were erroneously named *A. pacifica* Hofker, but should according to the description of the holotype be named *A. pacifica* Cushman and Todd.

A. pacifica differs from *Allomorphina trigona* Reuss in having a larger proportion of the test occupied by the earlier chambers, and by the presence of a projection of the ventral side of the last-formed chamber with the aperture at one side of this projection.

Stratigraphic range: *A. pacifica* was found in Late Pliocene - Quaternary deposits (N21-23) from Timor and in Recent sediments offshore Timor (Van Marle, 1988). It has been described previously from Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *A. pacifica* occurs near Timor at a depth of 1509 m (Van Marle, 1988).

Genus *Chilostomella* Reuss, 1849

Chilostomella oolina Schwager
(pl. 10, figs. 12-13)

1878 *Chilostomella oolina* Schwager, p. 527, pl. 1, fig. 16.
1884 *Chilostomella ovoidea* Brady (not Reuss), p. 436, pl. 55, figs. 12-14, 17-18.
1934 *Chilostomella oolina* Schwager; Cushman, p. 133, pl. 17, fig. 3.
1941a *Chilostomella oolina* Schwager; LeRoy, p. 43, pl. 1, figs. 14-16.
1949 *Chilostomella oolina* Schwager; Boomgaart, p. 136, pl. 9, fig. 10.
1951a *Chilostomella oolina* Schwager; Asano, p. 9, fig. 1.
1960 *Chilostomella oolina* Schwager; Barker, p. 112, pl. 55, figs. 12-14, 17-18.
1978 *Chilostomella oolina* Schwager; Hofker, p. 45, pl. 5, fig. 8.
1980 *Chilostomella oolina* Schwager; Ingle et al., p. 132, pl. 6, figs. 9-10.
1985 *Chilostomella oolina* Schwager; Boichard et al., p. 94, pl. 17, fig. 41.
1986 *Chilostomella oolina* Schwager; Kurihara and Kennett, p. 1074, pl. 6, fig. 10.

Short description: Test oblong, elongate-ovate, rounded, planispiral and involute. Proloculus elliptical to rounded, initial chambers often obliquely situated to the elongate axis of the test. Chambers strongly embracing, two per whorl, last chamber occupying 3/4 of the total test. Wall thin, smooth, shining, finely perforate. Aperture an elongate, narrow, interiomarginal, equatorial slit at about 2/3 of the whole length, sometimes with a small lip.

Remarks: The test of *Chilostomella ovoidea* Reuss is broader and more egg-shaped compared to the elongate-ovate form of *C. oolina.* Though no real specimens of *C. ovoidea* were found, smaller and broader specimens of *C. oolina* tend to resemble *C. ovoidea.*

Stratigraphic range: *C. oolina* was found in Early - Middle Miocene (N8), Middle - Late Miocene (N14-17), and Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

It has been observed previously in Late Miocene to Recent deposits (see synonymy; LeRoy, 1964; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *C. oolina* occurs scattered at middle bathyal depths or deeper (Van Marle, 1988), with its UDL at 486 m. Based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 3.1 degrees Celsius for this species, which corresponds with waterdepths of about 2000-2500 m.

Berggren and Haq (1976) reported *C. oolina* to occur predominantly at upper bathyal depths. Lewis (1979) found this species in sediments from the continental margin of New Zealand in waterdepths between 479 and 2469 m, and Boichard et al. (1985) at a depth of 715m on the Pater Noster Platform.

In the Gulf of Mexico *C. oolina* shows a preference for clastic substrates (Pflum and Frerichs, 1976). According to Corliss (1985) *C. oolina* also lives infaunal, deeper than 6 cm within the sediment, and can survive the prevailing low oxygen conditions.

Family *Gavelinellidae* Hofker, 1956
Genus *Anomalinoides* Brotzen, 1942

Anomalinoides colligerus Chapman and Parr
(pl. 13, figs. 6-8)

1884 *Anomalina ammonoides* Brady (not Reuss), p. 672, pl. 94, figs. 2-3.
1937 *Anomalina colligera* Chapman and Parr, p. 117, pl. 9, fig. 26.
1941a *Anomalina ammonoides* Brady (not Reuss); LeRoy, p. 45, pl. 2, figs. 40-42.
1941b *Anomalina ammonoides* Brady (not Reuss); LeRoy, p. 92, pl. 6, figs. 19-24.
1960 *Anomalina colligera* Chapman and Parr; Barker, p. 194, pl. 94, figs. 2-3.
1966 *Anomalinoides colligerus* (Chapman and Parr); Belford, p. 178, pl. 32, figs. 8-15.
1983 *Anomalina colligera* Chapman and Parr; Coustillas, pl. 37, fig. 3.
1988 *Anomalinoides colligerus* (Chapman and Parr); Van Marle, p. 139, pl. 2, figs. 16-17.

Short description: Test low trochospiral to nearly planispiral, nearly involute on both sides, planoconvex; periphery subacute to rounded. Spiral side with umbonal boss, opposite side with depressed umbilicus, partially covered by distinctive umbilical flaps of successive chambers. Chambers arcuate, numerous, arranged in three coils; sutures radiate and more or less limbate. Wall coarsely perforate on the dorsal side, finely or non-perforate ventrally. Aperture an interiomarginal, periphero-spiral, equatorial arch.

Remarks: Concerning *A. colligerus* Chapman and Parr (1937) stated: 'hitherto this species has been confused with Reuss's *Rosalina ammonoides* described from the chalk of Bohemia, and a common species in the Cretaceous of Europe. Reuss's form is a true cibicid, and is perfectly distinct from the form figured under the name of *Anomalina ammonoides* (Reuss) by Brady (1884). The specimens figured by Brady were from Fiji and Papua.'

Belford (1966) transferred this species to the genus *Anomalinoides* Brotzen, a concept followed here, because Hansen and Rögl (1980) proved *Anomalina* to be invalid as a genus, a concept followed by Loeblich and Tappan (1981). *Anomalina flintii* Cushman resembles *A. colligerus*, only differing in being coarser perforate on both sides of the test and by the raised spiral suture on the dorsal side. *Anomalina inversa* Boomgaart (1949; p. 149, pl. 13, figs. 7a-c) is also similar, but has a subacute periphery and is coarsely perforate on both sides.

Stratigraphic range: *A. colligerus* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Miocene to Recent deposits from Indonesia (see synonymy and Boichard et al., 1985).

Occurrence: In Recent eastern Indonesian sediments *A. colligerus* generally occurs at neritic - upper bathyal depths, with its DLO lies at 317 m and its UDL at 100 m (Van Marle, 1988). Coustillas (1983) found this species in sediments between 50 and 300 m in the Mahakam Delta and Boichard et al. (1985) between 490 and 549 m on the Pater Noster Platform.

Anomalinoides globulosus (Chapman and Parr)
(pl. 13, figs. 3-5)

1884 *Anomalina grosserugosa* Brady (not Gümbel), p. 673, pl. 94, figs. 4-5.
1937 *Anomalina globulosa* Chapman and Parr, p. 117, pl. 9, fig. 27.
1951a *Anomalina globulosa* Chapman and Parr; Asano, p. 15, figs. 13-15.
1960 *Anomalina globulosa* Chapman and Parr; Barker, p. 194, pl. 94, figs. 4-5.
1978 *Anomalina globulosa* Chapman and Parr; Boltovskoy, p. 152, pl. 1, figs. 5-8.
1980 *Anomalina globulosa* Chapman and Parr; Boltovskoy, p. 165, pl. 1, figs. 1a-b; pl. 4, figs. 1a-b.
1984 *Anomalina globulosa* Chapman and Parr; Boltovskoy, p. 326, pl. 1, figs. 1-4.

1985 *Anomalinoides globulosus* (Chapman and Parr); Thomas, p. 675, pl. 12, figs. 6-7.
1986 *Anomalinoides globulosus* (Chapman and Parr); Boersma, p. 988, pl. 2, figs. 1-3.
1986 *Anomalinoides globulosus* (Chapman and Parr); Kurihara and Kennett, p. 1077, pl. 9, fig. 9.
1986 *Anomalinoides globulosus* (Chapman and Parr); Van Morkhoven et al., p. 36, pl. 9, figs. 1-3.

Short description: Test planoconvex, with a highly convex and involute umbilical side, except for the depressed umbilical region, and a somewhat depressed and evolute spiral side; periphery rounded. About 7 strongly inflated chambers in last coil; sutures deeply impressed. Wall coarsely perforate. Aperture crescentic, placed almost symmetrically in median line.

Remarks: Chapman and Parr (1937) stated that Brady's specimens (1884), recorded as *Anomalina grosserugosa* (Gümbel), are distinct from Gümbel's type specimens from the Nummulitic limestone of Kressenberg, Bavaria (Germany). The type figure of *Anomalina grosserugosa* is a more elongated, helicoid, involute shell.

A. globulosus clearly differs from *Anomalinoides colligerus* (Chapman and Parr) by its stronger convex umbilical side, by its more irregular lobate chamber growth and by its coarsely perforate test. Like *A. colligerus* this species has, for the time being, been transferred to *Anomalinoides.*

Stratigraphic range: *A. globulosus* was found in Late Miocene (N17) and Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been previously observed in Late Oligocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *A. globulosus* occurs scattered down from 711 m (Van Marle, 1988).

Pflum and Frerichs (1976) reported *A. globulosus* from lower bathyal to abyssal depths in the Gulf of Mexico. Berggren and Haq (1976) considered it to be indicative for middle bathyal and greater depths, while Moore et al. (1980) regarded it as characteristic of depths of more than 2000 m. According to Van Morkhoven et al. (1986) this cosmopolitan species is a marker for middle bathyal depths and deeper.

Genus *Cibicidoides* Thalmann, 1939

Cibicidoides bradyi (Trauth)

(pl. 12, figs. 14-16)

1884 *Truncatulina dutemplei* Brady (not d'Orbigny), p. 662, pl. 95, fig. 5.
1918 *Truncatulina bradyi* Trauth, p. 235.
1951 *Cibicides hyalina* Hofker, p. 359, text-figs. 244-245.
1960 *Cibicides bradyi* (Trauth); Barker, p. 196, pl. 95, fig. 5.
1964 *Eponides hyalinus* (Hofker); LeRoy, p. 37, pl. 7, figs. 24-26.

1964 *Cibicidoides hyalinus* (Hofker); Loeblich and Tappan, C757, fig. 621,2.
1966 *Parrelloides bradyi* (Trauth); Belford, p. 100, pl. 11, figs. 10-19.
1978 *Cibicides bradyi* (Trauth); Boltovskoy, p. 155, pl. 3, figs. 6-8.
1980 *Cibicidoides bradyi* (Trauth); Ingle et al., p. 132, pl. 6, figs. 11-12.
1980 *Cibicides bradyi* (Trauth); Boltovskoy, p. 165, pl. 1, figs. 11a-b.
1983 *Cibicides bradyi* (Trauth); Coustillas, pl. 35, fig. 9.
1984a *Cibicidoides bradyi* (Trauth); Boersma, p. 663, pl. 5, figs. 1-7.
1984 *Cibicides bradyi* (Trauth); Boltovskoy, p. 326, pl. 1,figs. 11-15.
1985 *Cibicidoides bradyi* (Trauth); Thomas, p. 675, pl. 10, figs. 7-8.
1986 *Cibicidoides bradyi* (Trauth); Boersma, p. 1021, pl. 6, figs. 1-3.
1986 *Cibicidoides bradyi* (Trauth); Kurihara and Kennett, p. 1077, pl. 9, figs. 1-3.
1986 *Cibicidoides bradyi* (Trauth); Van Morkhoven et al., p. 100, pl. 30, figs. 1-2.
1988 *Parrelloides bradyi* (Trauth); Van Marle, p. 148, pl. 3, figs. 16-17.

Short description: Test circular in outline, with lobulate, rounded margins, biconvex and biumbonate, evolute spiral side, involute ventral side, which may be somewhat concave in the center. Chambers trochospirally arranged in 3-5 coils; sutures oblique on spiral side, straight to limbate on ventral side. Wall hyaline, smooth, shining, translucent, coarsely perforate on spiral side, finely perforate on opposite side. Aperture a small and rounded arch, just below the margin.

Remarks: Characteristic of *C. bradyi* are the biconvex test and the coarse perforations on the spiral side.

Hofker (1951) mentioned that his new formed species *C. hyalina* strongly resembles *C. bradyi*, but he decided to erect this new species because of the inaccuracy of the type description of the latter species. Belford (1966), after examining Recent specimens, stated that Hofker confused *C. hyalina* with *C. bradyi*, and that therefore *C. hyalina* must be considered as a junior synonym of *C. bradyi*.

Larger specimens of *C. bradyi* have often been considered to be specimens of *Cibicidoides robertsonianus* (Brady), since this species has a larger test size. However, this species is less strongly biconvex, shows longer and narrower chambers, and has more chambers per whorl.

Stratigraphic range: *C. bradyi* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Eocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *C. bradyi* occurs generally in waterdepth between 545 and 2119 m, with its DLO at 1654 m and its UDL at 210 m (Van Marle, 1988).

Pflum and Frerichs (1976) reported this species to have its UDL at 1000 m in the Gulf of Mexico. Corliss (1979) observed this form in waterdepths between 2500 and 4600 m in the southeastern Indian Ocean. Coustillas

(1983) found it deeper than 150 m in the Mahakam Delta. Van Morkhoven et al (1986) reported the cosmopolitan *C. bradyi* to occur in outer neritic to abyssal depths.

According to Van der Zwaan (1982) *C. bradyi* is a mud-dweller which prefers deep, stable waters, and shows no tolerance to increased salinities or to oxygen deficiency.

Cibicidoides dutemplei (d'Orbigny) s.l.
(pl. 12, figs. 11-13)

1846 *Rotalina dutemplei* d'Orbigny, p. 157 (nomen nudum).
1868 *Rotalia praecincta* Karrer, p. 189, pl. 5, fig. 7.
1884 *Truncatulina praecinta* (Karrer); Brady, p. 667, pl. 95, figs. 1-3.
1884 *Heterolepa simplex* Franzenau, p. 214.
1915 *Truncatulina praecincta* (Karrer); Cushman, p. 39, pl. 26, figs. 2a-c.
1941a *Eponides praecinctus* (Karrer); LeRoy, p. 39, pl. 1, figs. 66-68.
1941b *Eponides praecinctus* (Karrer); LeRoy, p. 83, pl. 3, figs. 25-27.
1941c *Eponides praecinctus* (Karrer); LeRoy, p. 116, pl. 2, figs. 22-24.
1944a *Eponides praecinctus* (Karrer); LeRoy, p. 34, pl. 2, figs. 31-33.
1944b *Eponides praecinctus* (Karrer); LeRoy, p. 89, pl. 5, figs. 4-6.
1951a *Eponides praecinctus* (Karrer); Asano, p. 11, figs. 80-82.
1960 *Cibicides praecinctus* (Karrer); Barker, p. 196, pl. 95, figs. 1-3.
1964 *Heterolepa dutemplei* (d'Orbigny); Loeblich and Tappan, C759, fig. 623,3.
1966 '*Eponides*' *praecinctus* (Karrer); Belford, p. 125, pl. 16, figs. 1-6.
1974 *Heterolepa praecincta* (Karrer); Lutze, p. 38, pl. 9, figs. 142-144.
1983 *Cibicides praecinctus* (Karrer); Coustillas, pl. 35, figs. 4-7.
1985 *Heterolepa dutemplei* (d'Orbigny); Papp and Schmid, p. 61, pl. 52, figs. 1-6.
1985 *Heterolepa dutemplei* (d'Orbigny); Wang et al., p. 337, pl. 5, fig. 7.
1986 *Cibicidoides dutemplei* (d'Orbigny); Van Morkhoven et al., p. 112, pl. 35, figs. 1-2.
1988 *Heterolepa dutemplei* (d'Orbigny); Van Marle, p. 145, pl. 1, figs. 11-13.

Short description: Test semicircular in outline, trochospiral, inequally biconvex to planoconvex; periphery blunt and thickened, sometimes slightly keeled. Flat to slightly convex spiral side, evolute, with numerous chambers in slowly enlarging whorls, final whorl consisting of 8-10 chambers. Involute, highly convex umbilical side with radial and sometimes raised sutures. Wall thick, coarsely and regularly perforate. Aperture slitlike, interiomarginal, extending about half of the distance to umbilicus on umbilical side, and extending across periphery on spiral side; may also extend for some distance along spiral suture.

Remarks: Franzenau (1884) originally described his *Heterolepa simplex* as the type species of the genus *Heterolepa*, but already in 1885 stated that this name was a synonym of *Rotalina dutemplei* d'Orbigny (see Loeblich and Tappan, 1962).

Oligocene forms like *Cibicidoides mexicanus* (Nuttall), originally described as *Cibicides mexicana*, resemble the form of *C. dutemplei* s.l., differing only in having a slightly concave dorsal side, and may be phylogenetic ancestors of *C. dutemplei* (see Van Morkhoven et al., 1986).

C. praecinctus (Karrer) is here included as a junior synonym of *C. dutemplei* s.l., because morphological differences are only small and fall within the wide range of variation observed in *C. dutemplei*.

Stratigraphic range: *C. dutemplei* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *C. dutemplei* occurs generally in waterdepths between 60 and 317 m, with its DLO at 150 m, but also shows some scattered deeper occurrences (Van Marle, 1988).

Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 186 and 625 m. Van Morkhoven et al. (1986) considered it as a typical outer neritic - upper bathyal form.

Hageman (1979) reported *C. dutemplei* to be an epiphytic, shallow water form with low salinity tolerance. According to Van der Zwaan (1982) it is a mud-dweller with little tolerance for oxygen deficiency and increased salinities.

Coustillas (1983) found this form in sediments between 30 and 400 m in the Mahakam Delta, and related the morphological variation within *C. dutemplei* s.l. (described by him as *C. praecinctus*) to bathymetry: the shallower forms have a flattened spiral side, whereas the deeper forms have a more convex spiral side.

Cibicidoides mediocris (Finlay)
(pl. 12, figs. 8-10)

1866 *Truncatulina pachyderma* Rzehak, p. 87, pl. 1, figs. 5a-c.
1884 *Truncatulina ungeriana* Brady (not d'Orbigny), p. 664, pl. 94, figs. 9a-c.
1918 *Truncatulina floridana* Cushman, p. 62, pl. 19, fig. 2.
1922 *Truncatulina pseudoungeriana* Cushman, p. 97, pl. 20, fig. 9.
1931 *Cibicides floridana* (Cushman); Cushman, p. 122, pl. 23, figs. 3-5.
1940 *Cibicides mediocris* Finlay, p. 464, pl. 67, figs. 198-199.
1941b *Cibicides* aff. *pseudoungerianus* (Cushman); LeRoy, p. 89, pl. 3, figs. 1-3.
1960 *Cibicides pseudoungerianus* (Cushman); Barker, p. 194, pl. 94, figs. 9a-c.
1961 *Cibicides mediocris* Finlay; De Hornibrook, p. 160, pl. 25, figs. 499-500, 502.
1964 *Cibicides pseudoungerianus* (Cushman); LeRoy, p. 45, pl. 8, figs. 13-15.

1965 *Cibicides floridanus* (Cushman); Todd, p. 52, pl. 22, fig. 6.
1966 *Heterolepa mediocris* (Finlay); Belford, p. 181, pl. 23, figs. 10-11.
1973 *Cibicidoides pseudoungerianus* (Cushman); Douglas, p. 614, pl. 20, figs. 1-3, 7-9; pl. 25, figs. 7-8.
1976 *Cibicidoides pseudoungeriana* (Cushman); Berggren and Haq, p. 107, pl. 2, figs. 4-6.
1981 *Cibicides pseudoungerianus* (Cushman); Burke, p. 7, pl. 2, fig. 7.
1983 *Cibicidoides pseudoungerianus* (Cushman); Coustillas, pl. 37, figs. 9a-b.
1985 *Cibicides pseudoungerianus* (Cushman); Boichard et al., p. 92, pl. 16, figs. 27-29.
1986 *Cibicidoides pachyderma* (Rzehak); Van Morkhoven et al., p. 68, pl. 22, figs. 1a-c.
1988 *Heterolepa mediocris* (Finlay); Van Marle, p. 145, pl. 1, figs. 22-24.

Short description: Test semicircular, compressed, planoconvex to slightly biconvex, trochospiral; periphery sharp. Dorsally flat or faintly convex, evolute, with 10-12 chambers in final whorl; sutures first at right angles to spiral suture, then strongly curved and depressed on last 3-4 chambers, not limbate. Ventrally convex, medially flattened, involute; sutures curved into weak umbilicus. Wall thick, smooth and shining, finely and densely perforate on ventral side, regularly, coarsely and densely perforate on dorsal side. Aperture slit-like, interiomarginal, extending about half of distance to umbilicus on umbilical side and extending across periphery on dorsal side; may also extend along spiral suture.

Remarks: Although we agree with Van Morkhoven et al. (1986, p. 69-70) that names like *floridanus*, *mediocris* and *pseudoungerianus* must be considered as synonyms of *pachyderma*, we maintain the name *C. mediocris* (Finlay) because this form was described from the same geographic area (Finlay, 1940; De Hornibrook, 1961; Belford, 1966), and because the valid name, *C. pachyderma* (Rzehak), is only rarely used in literature.

Stratigraphic range: *C. mediocris* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Eocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: In Recent eastern Indonesian sediments *C. mediocris* occurs at all depths, but with highest frequencies between 60 and 344 m, and therefore has its DLO at 210 m (Van Marle, 1988). Coustillas (1983) found this species in sediments deeper than 200 m in the Mahakan Delta and Boichard et al. (1985) found it at a depth of 490 m on the Pater Noster Platform. This supports the opinion of LeRoy (1964), Pflum and Frerichs (1976), Moore et al. (1980), and Van Morkhoven et al. (1980), who considered *C. mediocris* to be primarily an upper bathyal species, which also occurs shallower and deeper.

Cibicidoides robertsonianus (Brady)

1881 *Truncatulina robertsoniana* Brady, p. 65 (nomen nudum).
1884 *Truncatulina robertsoniana* Brady, p. 664, pl. 95, figs. 4a-c.
1957 *Cibicides* cf. *robertsonianus* (Brady); Todd and Brönniman, p. 41, pl. 12, fig. 13.
1960 *Cibicides robertsonianus* (Brady); Barker, p. 196, pl. 95, figs. 4a-c.
1964 *Cibicidoides robertsonianus* (Brady); Parker, p. 624, pl. 100, figs. 26-27.
1965 *Cibicides robertsonianus* (Brady); Todd, p. 54, pl. 22, figs. 4a-c.
1980 *Cibicidoides robertsonianus* (Brady); Ingle et al., p. 132, pl. 9, fig. 10.
1985 *Cibicidoides robertsonianus* (Brady); Thomas, p. 676, pl. 10, figs. 5-6.
1986 *Cibicidoides robertsonianus* (Brady); Van Morkhoven et al., p. 41, pl. 11, figs. 1a-c.

Short description: Test semicircular in outline, lenticular, planoconvex to slightly biconvex; periphery angular, not constricted at sutures. Dorsal side evolute, slightly convex; ventral side convex, involute, somewhat depressed at the umbilicus. Numerous, elongate chambers, trochospirally arranged in 4 convolutions, 13-14 chambers in last convolution; sutures oblique on spiral side, straight or somewhat limbate on ventral side, coalescing in a mass of clear shell substance. Wall hyaline, smooth, shining, translucent, clear, finely perforate on ventral side, more coarsely on spiral side, periphery imperforate. Aperture a rounded interiomarginal arch.

Remarks: Compared to *Cibicidoides bradyi* (Trauth), *C. robertsonianus* has a typically transparent umbilical mass and an angular, imperforate periphery, in addition to more and elongated chambers per whorl and a larger test-size (see also remarks of *C. bradyi*).

Stratigraphic range: *C. robertsonianus* was found in Late Miocene - Quaternary deposits (N17-23) on the eastern Indonesian islands. It has been observed previously in Late Eocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: Berggren and Haq (1976) reported *C. robertsonianus* to be indicative of waterdepths of more than 500 m. Poag (1981) observed this species on the outer shelf and (upper) slope in the Gulf of Mexico. LeRoy and Levinson (1974) and Van Morkhoven et al. (1986) consider this species to be a marker for middle bathyal depths and deeper.

According to Van der Zwaan (1982) it is a mud-dweller with little tolerance to increased salinities or to oxygen deficiency.

Cibicidoides soendaensis (LeRoy)
(pl. 13, figs. 1-2)

1941c *Cibicides soendaensis* LeRoy, p. 119, pl. 2, figs. 1-3.
1966 *Parrelloides soendaensis* (LeRoy); Belford, p. 102, pl. 12, figs. 1-7.

Short description: Test small, almost circular in transverse section, nearly bilaterally symmetrical; periphery subacute. Chambers trochospirally arranged usually 8 in the last whorl, of uniform shape, enlarging only slightly as added. Sutures distinct, slightly curved and somewhat radial on ventral side, dorsally oblique, faintly curved. Wall hyaline, finely perforate. Aperture an interiomarginal narrow slit, with a small narrow lip, beginning near the periphery on the ventral side and extending along the spiral suture.

Remarks: Only rarely found in our material. Characteristic of *C. soendaensis* are the subacute periphery, the less convex dorsal side, and the stronger curved sutures on both sides. *C. soendaensis* has a smaller test size than *Cibicidoides bradyi* (Trauth).

Stratigraphic range: *C. soendaensis* was found in Middle - Late Miocene (N14-15) and Early Pliocene - Quaternary deposits (N19/20-23) on the eastern Indonesian islands. It has been observed previously in Pliocene - Quaternary deposits from Indonesia.

Occurrence: *C. soendaensis* has in the eastern Indonesian material always been found in association with typical middle bathyal species.

Genus *Hanzawaia* Asano, 1944

Hanzawaia nipponica Asano
(pl. 12, figs. 5-7)

1944 *Hanzawaia nipponica* Asano, p. 99, pl. 4, figs. 1-2.
1951a *Hanzawaia nipponica* Asano, p. 16, figs. 24-26.
1964 *Hanzawaia nipponica* Asano; Loeblich and Tappan, C759, figs. 623, 1-2.
1985 *Hanzawaia nipponica* Asano; Wang et al., p. 337, pl. 5, fig. 6.
1988 *Hanzawaia nipponica* Asano; Van Marle, p. 145, pl. 1, figs. 19-20.

Short description: Test compressed, circular in outline, trochoid, planoconvex; periphery moderately angled with keel. Flattened ventral side, partially involute, with elevated flaps on lower margin of chamber overlapping chambers of previous whorl and coalescing over entire central area; dorsal side involute, without open umbilicus, central area with clear boss. Sutures strongly curved, thickened. Wall coarsely perforate, except for the clear area above aperture, central flaps, thickened sutures and keel. Aperture a peripheral arch, extending onto dorsal side and continuing laterally with opening under central flap of final chamber.

Remarks: *H. nipponica* resembles the european species *Hanzawaia boueana* (d'Orbigny), but is less strongly keeled and has less chambers.

Stratigraphic range: *H. nipponica* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *H. nipponica* occurs generally in waterdepths between 60 and 495 m, with highest frequencies between 60 and 317 m (DLO at 90 m), and shows some scattered deeper occurrences (Van Marle, 1988). Similar observations were made by Waller (1960), who found this species in waterdepths between 50 and 90 m in the South China Sea, and LeRoy (1964), who assumed *H. nipponica* to be an outer neritic - upper bathyal form.

Family *Oridorsalidae* Loeblich and Tappan, 1984
Genus *Oridorsalis* Andersen, 1961

Oridorsalis umbonatus (Reuss)
(pl. 11, figs. 13-15)

1851 *Rotalina umbonata* Reuss, p. 75, pl. 5, fig. 35.
1884 *Pulvinulina umbonata* (Reuss); Brady, p. 695, pl. 105, fig. 2.
1921 *Pulvinulina umbonata* (Reuss); Cushman, p. 339, pl. 71, fig. 1.
1929 *Eponides umbonata* (Reuss); Cushman, p. 98, pl. 14, fig. 8.
1941a *Eponides umbonata* (Reuss); LeRoy, p. 39, pl. 2, figs. 102-104.
1941b *Eponides umbonata* (Reuss); LeRoy, p. 84, pl. 3, figs. 19-21.
1946 *Eponides umbonatus* (Reuss); Germeraad, p. 45, pl. 6, figs. 8-9.
1951a *Eponides umbonatus* (Reuss); Asano, p. 12, figs. 91-92.
1960 *Eponides umbonatus* (Reuss); Barker, p. 216, pl. 105, fig. 2.
1965 *Oridorsalis umbonatus* (Reuss); Todd, p. 23, pl. 6, fig. 2.
1966 *Oridorsalis umbonatus* (Reuss); Belford, p. 172, pl. 30, figs. 1-6.
1973 *Oridorsalis umbonatus* (Reuss); Douglas, p. 615, pl. 13, figs. 1-6; pl. 24, figs. 9-12.
1978 *Oridorsalis tener* (Brady) var. *umbonatus* (Reuss); Boltovskoy, p. 162, pl. 5, figs. 5-6.
1980 *Oridorsalis umbonatus* (Reuss); Boltovskoy, p. 168, pl. 3, figs. 1a-b; pl. 4, figs. 8a-b.
1981 *Oridorsalis umbonatus* (Reuss); Burke, p. 8, pl. 3, figs. 9-10.
1984a *Oridorsalis umbonatus* (Reuss); Boersma, p. 663, pl. 4, figs. 10-13.
1984 *Oridorsalis umbonatus* (Reuss); Boltovskoy, p. 327, pl. 1, figs. 23-24.
1985 *Oridorsalis umbonatus* (Reuss); Thomas, p. 677, pl. 4, figs. 7-8.
1986 *Oridorsalis umbonatus* (Reuss); Kurihara and Kennett, p. 1074, pl. 6, figs. 11-13.
1988 *Oridorsalis umbonatus* (Reuss); Van Marle, p. 148, pl. 3, figs. 10 and 15.

Short description: Test lenticular, compressed; umbilical side strongly convex, involute; spiral side flattened, evolute; periphery pentagonal, rounded in side view and lobate in top view. Chambers arranged in a low trochospiral coil, broad, triangular, somewhat lobate. Sutures straight, slightly depressed on the spiral side, broad towards the umbilical periphery. Wall smooth, glossy, finely perforate. Aperture interiomarginal extending from periphery nearly to closed umbilicus, with a distinct, narrow lip. Supplementary umbilical apertures open into small hollows; spirally small openings occur along the sutures.

Remarks: In literature often differentiation is made between three forms: *Oridorsalis (tener) stellatus* (Silvestri), *Oridorsalis (tener) tener* (Brady) and *Oridorsalis (tener) umbonatus* (Reuss). The first form being equally biconvex with a sharp periphery, and with the chambers of the last whorl almost equal in size. The second form with a rather flat, biconvex test, a sharp periphery, and with the chambers of the last whorl enlarging rapidly as added. The third form is planoconvex to slightly biconvex, with a strongly convex umbilical side, a more flattened spiral side, and a rounded periphery (see Pflum and Frerichs, 1976, pl. 5, figs. 8-9; pl. 6, figs. 1-7).

In our material usually the form *O. umbonatus* was found and only rarely forms tending towards *O. stellatus*, while no forms tending towards *O. tener* were found. We therefore only distinguished *O. umbonatus*, and regarded the somewhat different forms as varieties of this species.

Stratigraphic range: *O. umbonatus* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Eocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: In Recent eastern Indonesian sediments *O. umbonatus* occurs generally in waterdepths between 911 and 2119 m, with its DLO at 1760 m and its UDL at 344 m (Van Marle, 1988).

Pflum and Frerichs (1976) reported *O. umbonatus* to be cosmopolitan with its UDL at middle bathyal depths in the Gulf of Mexico.

Burke (1981) observed that *O. umbonatus* is associated with the upwelling of deep water on the Ontong Java Plateau.

According to Van der Zwaan (1982) *O. umbonatus* is a mud-dweller without tolerance to oxygen deficiency, but Jonkers (1984) reported this species from sediments deposited under more or less stagnant conditions, indicating a slight tolerance to lower oxygen conditions.

Family *Osangulariidae* Loeblich and Tappan, 1964
Genus *Osangularia* Brotzen, 1940

Osangularia bengalensis (Schwager)
(pl. 11, fig. 16; pl. 12, fig. 1)

1866 *Anomalina bengalensis* Schwager, p. 259, pl. 7, fig. 111.
1934 *Pulvinulinella bengalensis* (Schwager); Cushman, p. 131, pl. 17, fig. 6.
1960 *Osangularia bengalensis* (Schwager); Reiss, text-figs. 2a-b, pl. 3, figs. 5-8.
1964 *Osangularia bengalensis* (Schwager); Loeblich and Tappan, C752, figs. 615,3-4.
1966 *Osangularia bengalensis* (Schwager); Belford, p. 176, pl. 35, figs. 6-9.
1980 *Osangularia bengalensis* (Schwager); Srinivasan and Sharma, p. 60, pl. 8, figs. 3-5 (neotype).
1981 *Osangularia bengalensis* (Schwager); Burke, p. 8, pl. 3, figs. 11 and 14.

Short description: Test discoidal, trochiform, biconvex; spiral side flat and evolute, umbilical side strongly convex and involute; periphery with a wide, serrate keel. Chambers closely trochospirally arranged, angular on spiral side, lobate on opposite side, enlarging rapidly. Sutures slightly depressed and reflexed. Wall smooth, imperforate. Oblique, areal, narrow and elongate primary aperture; smaller secondary interiomarginal aperture near umbilicus.

Remarks: The type specimens of *O. bengalensis* are more heavily built than those of *Osangularia culter* (Parker and Jones), having more chambers per whorl and more reflexed sutures (see Belford, 1966). *O. bengalensis* is often considered to be a junior synonym of *O. culter* (Todd, 1965).

Stratigraphic range: *O. bengalensis* was found in Early - Middle Miocene (N8) and Early - Late Pliocene deposits (N19/20) on the eastern Indonesian islands. It has been described previously from Late Oligocene to Recent deposits (see synonymy; LeRoy, 1964; Lewis, 1979; Boersma, 1986).

Occurrence: In fossil samples from Timor, *O. bengalensis* was always found in association with typical lower bathyal species.

Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 1240 and 2329 m.

Osangularia culter (Parker and Jones)
(pl. 12, figs. 2-4)

1865 *Planorbulina farcata* (Fichtel and Moll) var. *ungeriana* (d'Orbigny) subvar. *culter* Parker and Jones, p. 382, pl. 19, fig. 1.
1884 *Truncatulina culter* (Parker and Jones); Brady, p. 668, pl. 96, fig. 3.
1929 *Pulvinulinella culter* (Parker and Jones); Cushman, p. 100, pl. 14, fig. 13.
1951 *Parrella culter* (Parker and Jones); Hofker, p. 336, text-figs. 229-232.
1960 *Osangularia bengalensis* Barker (not Schwager), p. 198, pl. 96, fig. 3.
1965 *Osangularia culter* (Parker and Jones); Todd, p. 25, pl. 15, fig. 1.
1966 *Osangularia culter* (Parker and Jones); Belford, p. 175, pl. 35, figs. 1-5.
1978 *Osangularia culter* (Parker and Jones); Boltovskoy, p. 163, pl. 5, figs. 32-34.
1980 *Osangularia culter* (Parker and Jones); Boltovskoy, p. 168, pl. 3, figs. 16a-b; pl. 4, figs. 9a-b.
1986 *Osangularia culter* (Parker and Jones); Boersma, p. 989, pl. 12, figs. 4-6.
1986 *Osangularia culter* (Parker and Jones); Kurihara and Kennett, p. 1075, pl. 7, figs. 4-6.
1988 *Osangularia culter* (Parker and Jones); Van Marle, p. 148, pl. 2, figs. 18-20.

Short description: Test discoidal, biconvex, trochiform, spiral side flat, angular, and evolute; umbilical side lobate and involute; periphery bordered by a distinct, serrate keel. Usually 15 chambers, trochospirally arranged; sutures slightly depressed and reflexed. Wall smooth, finely perforate. Two apertures are developed in each chamber, one areal and elongate, extending obliquely into the apertural face near the periphery, the other a rounded to oval opening near the umbilicus, usually on a neck.

Remarks: The specimens of *O. culter* are less heavily built, have less chambers and less reflexed sutures than those of *Osangularia bengalensis* (Schwager), in addition to a sharp and serrate keel and characteristic apertures.

Stratigraphic range: *O. culter* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Oligocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *O. culter* occurs generally in waterdepths between 495 and 1760 m, with its DLO at 684 m and its UDL at 60 m (Van Marle, 1988).

Moore et al. (1980) considered *O. culter* to be indicative for depths between 150 and 500 m. Boersma (1986) reported that *O. culter* displays latitudinal and depth-related frequency gradients.

Family *Quadrimorphinidae* Saidova, 1981
Genus *Quadrimorphina* Finlay, 1939

Quadrimorphina laevigata (Phleger and Parker)
(pl. 11, figs. 1-4)

1951 *Valvulineria laevigata* Phleger and Parker, p. 25, pl. 13, figs. 11-12.
1964 *Valvulineria laevigata* Phleger and Parker; LeRoy, p. 37, pl. 16, figs. 27-28.
1966 *Quadrimorphina laevigata* (Phleger and Parker); Belford, p. 155, pl. 37, figs. 21-25.
1978 *Valvulineria laevigata* Phleger and Parker; Boltovskoy, p. 173, pl. 8, figs. 42-43.
1980 *Valvulineria laevigata* Phleger and Parker; Ingle et al., p. 146, pl. 8, figs. 5-7.

Short description: Test trochospiral, closely coiled, slightly trochoid, with broadly rounded periphery. Evolute dorsal side, commonly 4-5 chambers per whorl, with narrow, slightly curved and depressed sutures; chambers enlarging rapidly as added, final chamber occupying a large portion of the test. Wall smooth, thin, fragile, finely perforate, granular in texture, monolamellid. Aperture interiomarginal, extending from the umbilicus on ventral side over to dorsal side, with a small umbilical flap partially covering it.

Remarks: In *Q. laevigata* always 4-5 chambers are present per whorl and all internal structures seem to be absent.

Belford (1966) considered *Quadrimorphina* to be the most satisfactory generic assignment for this species, but also mentioned that the differences with

Rotamorphina are arbitrary and that future investigation might lead to a combination of the two genera. Anyhow, the wall-texture of this species is granular and not radiate as in *Valvulineria*, excluding the possibility that this species belongs to that genus.

Stratigraphic range: *Q. laevigata* was found in Middle - Late Miocene (N14-15), Late Miocene (N17), and Early - Late Pliocene deposits (N19/20) on the eastern Indonesian islands. It has been described previously from Late Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *Q. laevigata* has only been observed near Timor at a depth of 1954 m (Van Marle, 1988).

Superfamily *Discorbacea* Ehrenberg, 1838
Family *Bagginidae* Cushman, 1927
Subfamily *Baggininae* Cushman, 1927
Genus *Baggina* Cushman, 1926

Baggina indica (Cushman)
(pl. 13, figs. 9-10)

1884 *Pulvinulina hauerii* Brady (not d'Orbigny), p. 690, pl. 106, fig. 6.
1921 *Pulvinulina indica* Cushman, p. 332.
1941a *Baggina* aff. *hauerii* (d'Orbigny); LeRoy, p. 41, pl. 3, figs. 40-42.

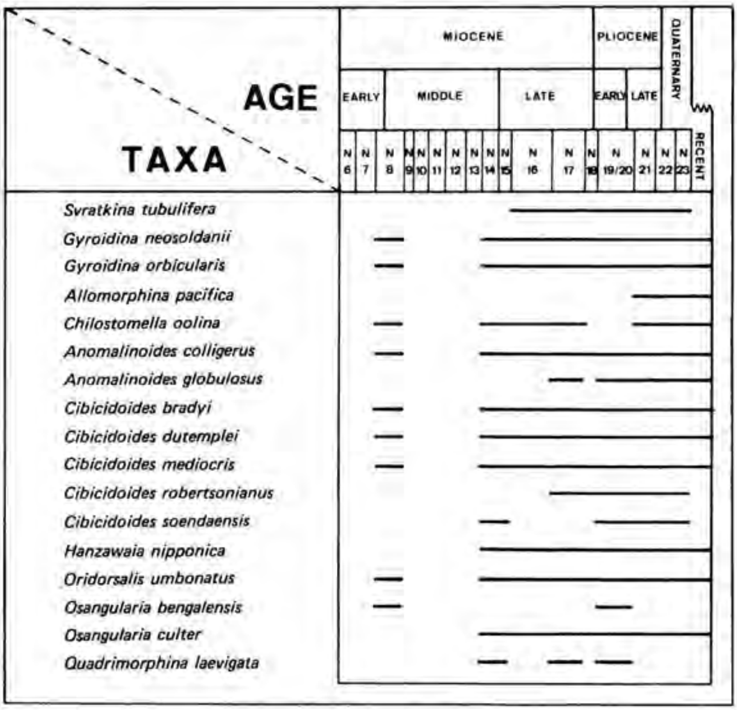

Fig. 19. Composite range chart of the superfamily *Chilostomellacea* of the suborder *Rotaliina* in eastern Indonesia.

1951a *Cancris indicus* (Cushman); Asano, p. 20, figs. 146-147.
1960 *Cancris indicus* (Cushman); Barker, p. 218, pl. 106, fig. 6.
1966 *Baggina indica* (Cushman); Belford, p. 96, pl. 15, figs. 10-14.

Short description: Test subglobular, somewhat longer than broad, biconvex, ventral side not umbilicate. Chambers trochospirally arranged in about two whorls; last whorl consisting out of 6 chambers, gradually increasing in length as added, slightly overlapping; sutures deeply depressed. Wall thin, smooth, densely perforate; final chamber ventrally covered with an irregular, oval area of clear calcite. Aperture a narrow, arcuate, peripheral slit.

Remarks: Cushman (1921) already mentioned the resemblance between this species and *Baggina philippinensis* (Cushman). Both only seem to differ in their depth-habitat, *B. indica* being the shallowest of the two.

Stratigraphic range: *B. indica* was found in Late Miocene - Quaternary deposits (N15-22) on the eastern Indonesian islands. It has been described previously from Early Miocene to Recent deposits.

Occurrence: *B. indica* has in the eastern Indonesian material always been found in association with typical upper bathyal species.

Genus *Cancris* De Montfort, 1808

Cancris auriculus (Fichtel and Moll)
(pl. 13, figs. 11-12)

1798 *Nautilus auricula* Fichtel and Moll, p. 108, pl. 20, figs. a-c; p. 118, pl. 20, figs. d-f.
1921 *Pulvinulina auricula* (Fichtel and Moll); Cushman, p. 329, pl. 69, fig. 3.
1927a *Cancris auricula* (Fichtel and Moll); Cushman, p. 164, pl. 5, fig. 10.
1941c *Cancris auriculus* (Fichtel and Moll); LeRoy, p. 117, pl. 3, figs. 7-9, 16-18.
1944a *Cancris auriculus* (Fichtel and Moll); LeRoy, p. 36, pl. 3, figs. 4-9.
1949 *Cancris auriculus* (Fichtel and Moll); Boomgaart, p. 131, pl. 9, figs. 13a-c.
1951a *Cancris auriculus* (Fichtel and Moll); Asano, p. 19, pl. 144-145.
1964 *Cancris auriculus* (Fichtel and Moll); Loeblich and Tappan, C586, fig. 462,3.
1965 *Cancris auriculus* (Fichtel and Moll); Todd, p. 22, pl. 5, fig. 5.
1966 *Cancris auriculus* (Fichtel and Moll); Belford, p. 96, pl. 15, figs. 1-5.
1983 *Cancris auriculus* (Fichtel and Moll); Coustillas, pl. 39, figs. 6a-b.
1984 *Cancris auriculus* (Fichtel and Moll); Rögl and Hansen, p. 67, pl. 26, figs. 3-8.
1988 *Cancris auriculus* (Fichtel and Moll); Van Marle, p. 141, pl. 4, fig. 12.

Short description: Test relatively flat, biconvex, elongate in outline, irregularly elliptical; periphery initially rounded, later strongly compressed. Spiral side evolute, depressed at periphery, sutures narrow, depressed; umbilical side inflated, involute, with deep umbilicus, covered by non-perforate, glassy umbilical flanges. Chambers trochospirally arranged, left coiled, increasing rapidly in size as added, 8 in the final whorl. Wall smooth, finely perforate. Aperture a narrow slit from near the periphery into the umbilicus, beneath the overhanging flange.

Remarks: *Cancris oblongus* (d'Orbigny) is a narrower, more elongate, oblong form, with an egg-shaped last chamber. In our opinion the specimens shown by Barker (1960) on plate 106, figures 5a-c as *C. oblongus* therefore indeed belong to this species, but the specimens shown in 4a-c to *C. auriculus*.

Within *C. auriculus* variations in width and lobulation of the periphery are present (Todd, 1965).

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Cancris* spp.: *C. auriculus*, *C. bodjongensis*, and *C. oblongus*. *Cancris* spp. were found in Early - Middle Miocene (N8), Middle - Late Miocene (N14-16), and Early Pliocene - Quaternary deposits (N19/20-23) on the eastern Indonesian islands. All species gathered in *Cancris* spp. have also been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

C. auriculus has been found previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *Cancris* spp. generally occur at neritic depths, with UDL at 78 m, but also show scattered deeper occurrences (Van Marle, 1988).

According to LeRoy (1964), Todd (1965), Lutze (1974), Moore et al. (1980), and Coustillas (1983) *C. auriculus* is a cosmopolitan, shallow water form, occurring in waterdepths between 0 and 200 m.

Lutze (1974) reported that *C. auriculus* is particularily abundant on coarse sediments in the Persian Gulf. Hageman (1979) reported this shallow water species to have tolerance for hyposaline conditions and to flourish with increasing sedimentation rates and not too high energy conditions. According to Van der Zwaan (1982) and Jonkers (1984) it is a mud-dweller with tolerance for oxygen deficiency.

Cancris bodjongensis (LeRoy)
(pl. 13, figs. 13-14)

1941a *Discorbis* aff. *bodjongensis* LeRoy, p. 38, pl. 2, figs. 123-125.
1941b *Discorbis bodjongensis* LeRoy, p. 82, pl. 3, figs. 13-15.
1941c *Discorbis bodjongensis* LeRoy, p. 116, pl. 1, figs. 9-11.
1966 *Cancris bodjongensis* (LeRoy); Belford, p. 97, pl. 15, figs. 6-9.
1988 *Cancris bodjongensis* (LeRoy); Van Marle, p. 141, pl. 4, fig. 11.

Short description: Test slightly longer than broad, somewhat compressed, biconvex; periphery lobulate, acute, with a faint, narrow, limbate keel. Chambers trochospirally arranged, distinct, enlarging rapidly, inflated; the last chamber occupies one-third of the entire test-size. Sutures distinct, curved, limbate, dorsally slightly raised, ventrally depressed or flush with the surface.

Wall smooth, finely perforate. Aperture an elongate, interio-marginal slit, opening into the umbilical area and bordered by a slight lip.

Remarks: Belford (1966) transferred this species from *Discorbis* to *Cancris*, because it has the generic characteristics of *Cancris*.

The specimen figured by Cushman (1921, p. 330, pl. 58, fig. 3) as *Pulvinulina scabra* Brady shows close resemblance with *C. bodjongensis* and was placed in the synonymy of this species by Belford.

Stratigraphic range: See *Cancris aurilicus* (Fichtel and Moll). *C. bodjongensis* has been found previously in Middle Miocene to Recent deposits.

Occurrence: See *Cancris aurilicus* (Fichtel and Moll).

Cancris oblongus (d'Orbigny)

(pl. 13, figs. 15-16; pl. 14, fig. 1)

1839c	*Valvulina oblonga* d'Orbigny, p. 136, pl. 1, figs. 40-42.
1858	*Rotalina oblonga* Williamson, p. 51, pl. 4, figs. 98-100.
1884	*Pulvinulina oblonga* (Williamson); Brady, p. 688, pl. 106, figs. 5a-c (not 4a-c).
1960	*Cancris oblongus* (Williamson?); Barker, p. 218, pl. 106, figs. 5a-c.

Short description: Test oblong or elongate, depressed, rounded in outline, more convex in initial stage than in later stage. Chambers trochospirally arranged in two whorls, inflated, enlarging rapidly, 6-7 chambers in the last whorl, overlapping previous whorl, slightly arcuate; final chamber large, egg-shaped, covering the umbilical area with a flange. Suteres distinct, slightly depressed. Wall smooth, shining, finely perforate. Aperture an elongate slit at base of last chamber, running beneath overhanging flange.

Remarks: The form described by Williamson (1858) is similar to the form described by d'Orbigny (1839), so Williamson's form is regarded as a junior synonym of the latter form.

Stratigraphic range: See *Cancris aurilicus* (Fichtel and Moll). *C. oblongus* has been described previously from Recent sediments (see synonymy and Boichard et al, 1985).

Occurrence: See *Cancris auriculus* (Fichtel and Moll). Berggren and Haq (1976) considered *C. oblongus* to be indicative of neritic depths (0-200 m). Boichard et al. (1985) found this species in sediments at a depth of 549 m on the Pater Noster Platform.

Genus *Valvulineria* Cushman, 1926

Valvulineria javana LeRoy

(pl. 14, figs. 2-4)

1941b	*Valvulineria* aff. *araucana* (d'Orbigny) var. *malagaensis* Kleinpell; LeRoy, p. 83, pl. 4, figs. 22-24.
1944b	*Valvulineria javana* LeRoy, p. 88, pl. 7, figs. 4-6.
1966	*Valvulineria javana* LeRoy; Belford, p. 98, pl. 37, figs. 16-20.

Short description: Test ovoid in outline, umbilicate, biconvex; periphery subrounded to lobulate. Chambers trochospirally arranged, inflated, broad, enlarging gradually as added. Sutures radial, distinct, dorsally reflexed, strongly depressed near the open umbilicus. Wall smooth, finely to coarsely perforate (except for the clear imperforate area around umbilical margin). Aperture interiomarginal, umbilical-extraumbilical, with a broad, thin flap projecting over the umbilicus.

Remarks: The specimens named *Valvulineria bradyi* Brotzen by Van Marle (1988, p. 149, pl. 2, figs. 22-23) closely resemble *V. javana*, as they lack the characteristic, extremely large-sized last chamber, are coarsely perforate, and have less reflexed sutures on the dorsal side, and are hereby transferred to *V. javana*.

V. javana differs from *Valvulineria rugosa* (d'Orbigny) by its smoother appearance and different chamber-shape.

Stratigraphic range: *V. javana* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early to Late Miocene deposits from Indonesia.

Occurrence: In Recent eastern Indonesian sediments *V. javana* (see remarks) occurs generally in waterdepths between 495 and 1190 m, with its DLO at 684 m and its UDL at 90 m (Van Marle, 1988).

Family *Bueningiidae* Saidova, 1981

Genus *Bueningia* Finlay, 1939

Bueningia butonensis (Keijzer)

(pl. 14, figs. 5-7)

1953 *Ruttenella butonensis* Keijzer, p. 280, pl. 4, figs. 11-16.
1964 *Bueningia butonensis* (Keijzer); Loeblich and Tappan, C589, fig. 464,5.
1966 *Bueningia creeki* Belford (not Finlay), p. 99, pl. 13, figs. 6-11.

Short description: Test small, planoconvex to slightly concavo-convex, circular in outline. Involute umbilical side flattened to slightly concave with regular, limbate peripheral keel and deep umbilicus. Involute opposite side convex with limbate sutures. Chambers inflated, flattened on umbilical side, globular on opposite side, enlarging rapidly as added, 4(-5) in the last whorl; last chamber elevated and embracing the previous ones. Wall thick, smooth, finely perforate. Umbilical aperture with small apertural lip.

Remarks: The specimens described by Belford (1966) as *Bueningia creeki* Finlay are considered to be specimens of *B. butonensis* (the typical Indonesian form) with 4(-5) chambers in the last whorl and a more regular keel.

Stratigraphic range: *B. butonensis* was found in Late Miocene - Quaternary deposits (N17-22) on the eastern Indonesian islands. It has been described previously from Late Miocene - Pliocene deposits from Indonesia.

Occurrence: *B. butonensis* has in the eastern Indonesian material always been found in association with typical upper bathyal species.

Family *Conorbinidae* Hofker, 1954
Genus *Neoconorbina* Hofker, 1951

Neoconorbina terquemi (Rzehak)
(pl. 14, figs. 15-16)

1876 *Rosalina orbicularis* Terquem, p. 166, pl. 9, fig. 4.
1884 *Discorbina orbicularis* (Terquem); Brady, p. 647, pl. 88, figs. 5-8.
1888 *Discorbina terquemi* Rzehak, p. 228.
1931 *Discorbis orbicularis* (Terquem); Cushman, p. 27, pl. 6, fig. 3.
1951a *Discopulvinulina orbicularis* (Terquem); Asano, p. 6, figs. 41-43.
1951 *Neoconorbina terquemi* (Rzehak); Hofker, p. 435, text-figs. 298-299.
1960 *Neoconorbina terquemi* (Rzehak); Barker, p. 182, pl. 88, figs. 5-8.
1964 *Neoconorbina terquemi* (Rzehak); Loeblich and Tappan, C582, fig. 457,5.
1965 *Neoconorbina terquemi* (Rzehak); Todd, p. 16, pl. 5, fig. 6.
1983 *Neoconorbina terquemi* (Rzehak); Coustillas, pl. 39, figs. 1-4.
1988 *Neoconorbina terquemi* (Rzehak); Van Marle, p. 147, pl. 1, figs. 8-9.

Short description: Test conical, circular in outline, concavo-convex; periphery acutely angled and keeled. Chambers trochospirally arranged in 8 whorls, each with 3 irregular, elongated, compressed, sharp-edged, arcuate chambers, increasing rapidly in breadth as added. Chambers on umbilical side with distinct flap at centre, and with apertural re-entrants on both sides. Wall smooth, transparent, shining. Aperture on umbilical side in re-entrants, covered by succeeding chambers to remain an intercameral opening; secondary aperture occuring in other re-entrants of the final chamber.

Remarks: Terquem's form was homonymous with d'Orbigny's *Rosalina orbicularis* and was therefore renamed *Discorbina terquemi* by Rzehak (1888).

Stratigraphic range: *N. terquemi* was found in Quaternary deposits (N23) from Timor, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Pliocene to Recent deposits (see synonymy and Boichard et al., 1985).

Occurrence: In Recent eastern Indonesian sediments *N. terquemi* occurs generally in waterdepths between 60 and 150 m, with its DLO and UDL at 60 m (Van Marle, 1988). Coustillas (1983) found it in sediments between 60 and 90 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 45 m on the Pater Noster Platform.

Family *Discorbidae* Ehrenberg, 1838
Subfamily *Discorbinae* Ehrenberg, 1838
Genus *Discorbis* Lamarck, 1804

Discorbis australis Parr
(pl. 14, fig. 8)

1884 *Discorbina valvulata* Brady (not d'Orbigny), p. 664, pl. 87, figs. 5-7.
1932 *Discorbis australis* Parr, p. 227, pl. 22, fig. 31.
1951a *Discopulvinulina australis* (Parr); Asano, p. 3, figs. 20-22.
1960 *Discorbis australis* Parr; Barker, p. 180, pl. 87, figs. 5-7.

Short description: Test nearly circular in outline, planoconvex, trochoid; ventral side slightly concave. Chambers trochospirally arranged in about 3 coils, with 4-5 chambers in final coil, slightly inflated, with a flap extending from the basal portion of each chamber toward the umbilical region. Sutures strongly recurved, thick and heavily limbate. Wall thick, coarsely perforate or punctate on dorsal side, smooth on the opposite side; initial part light brown in color. Primary aperture an interiomarginal, umbilical-extraumbilical, arched slit, opening into the umbilical region; secondary sutural openings occur at opposite side of chamber flap, remaining open.

Remarks: *D. australis* is thicker-walled, more coarsely perforate, and has more limbate sutures than *Discorbina valvulata* d'Orbigny.

Stratigraphic range: *D. australis* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Pliocene to Recent deposits.

Occurrence: Van Marle (1988) assembled *D. australis* and *D. rosacea* in *Discorbis* spp., which shows a scattered depth distribution down from 60 m in Recent eastern Indonesian sediments.

Discorbis rosacea (d'Orbigny)
(pl. 14, fig. 9)

1826 *Rotalia rosacea* d'Orbigny, p. 273, mod. no. 39.
1884 *Discorbina rosacea* (d'Orbigny); Brady, p. 644, pl. 87, figs. 4a-c.
1960 *Discorbis* sp., Barker, p. 180, pl. 87, figs. 4a-c.

Short description: Test flattened, oval in outline, planoconvex. Umbilical side flattened to slightly concave, involute and spiral side slightly convex, evolute and umbonate; periphery angled. Chambers simple, slightly inflated, trochospirally arranged in about 3 whorls, with prominent, flange-like, umbilical flaps. Sutures thick, heavily limbate, strongly recurved spirally. Wall thick, distinctly perforate. Primary aperture an interiomarginal, extraumbilical arch; secondary apertures sutural slits, along proximal side of umbilical flaps.

Remarks: This species is characterized by the prominent, flange-like, umbilical flaps, extending from basal portion of each chamber towards the umbilical region, where they coalesce in the center to form a distinct plug.

Stratigraphic range: *D. rosacea* was found in Late Pliocene - Quaternary deposits (N22-23) from Timor, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: See *Discorbis australis* Parr.

Genus *Epistominella* Husezima and Maruhasi, 1944

Epistominella exigua (Brady)
(pl. 15, figs. 4-6)

1884	*Pulvinulina exigua* Brady, p. 696, pl. 103, figs. 13-14.
1951	*Pulvinulinella exigua* (Brady); Hofker, p. 322, text-figs. 220-221.
1960	*Epistominella exigua* (Brady); Barker, p. 212, pl. 103, figs. 13-14.
1965	*Epistominella exigua* (Brady); Todd, p. 30, pl. 10, fig. 1.
1965	*Pseudoparrella exigua* (Brady); Lipps, p. 133, pl. 1, fig. 9.
1978	*Epistominella exigua* (Brady); Boltovskoy, p. 158, pl. 3, figs. 37-38.
1979	*Epistominella exigua* (Brady); Corliss, p. 7, pl. 2, figs. 7-9.
1980	*Epistominella exigua* (Brady); Ingle et al., p. 134, pl. 2, fig. 4.
1980	*Epistominella exigua* (Brady); Haller, p. 254, pl. 10, figs. 3a-c.
1980	*Epistominella exigua* (Brady); Boltovskoy, p. 165, pl. 2, figs. 2a-b.
1981	*Epistominella exigua* (Brady); Burke, p. 7, pl. 2, figs. 1-2.
1983	*Epistominella* sp., Coustillas, pl. 39, fig. 8.
1985	*Epistominella exigua* (Brady); Thomas, p. 676, pl. 13, figs. 3-4.
1986	*Epistominella exigua* (Brady); Kurihara and Kennett, p. 1071, pl. 3, figs. 10-12.
1988	*Epistominella exigua* (Brady); Van Marle, p. 143, pl. 3, figs. 6-8.

Short description: Test rotaliform, slightly biconvex; periphery acute or slightly keeled, lobulated. Spiral side evolute, umbilical side involute. Chambers trochospirally arranged in three coils, usually with five chambers in the last coil. Sutures slightly depressed, oblique on the spiral side, radial on umbilical side. Wall smooth, finely perforate. Aperture an elongate vertical slit near the peripheral keel.

Remarks: According to Todd (1965), *E. exigua* differs from its shallow water counterpart, *Epistominella vitrea* Parker, in the following respects: 5-6 (instead of 6-7) chambers in the last whorl, angled periphery (instead of rounded and slightly lobulate), and straight sutures (instead of slightly curved and depressed ones).

Stratigraphic range: *E. exigua* was found In Middle - Late Miocene (N14-15) and Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Oligocene to Recent deposits (see synonymy; Boltovskoy, 1984; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *E. exigua* occurs generally in waterdepths between 91 and 2119 m, with its DLO at 1951 m and its UDL at 344 m (Van Marle, 1988).

Corliss (1979) reported this species to be a dominant deep sea form, found between 2500 and 4600 m in the southeastern Indian Ocean, while in the eastern Indian Ocean *E. exigua* has its maximum abundance in waterdepths between 3800 and 4400 m (Peterson, 1984). Lewis (1979) found this species in sediments from the continental margin of New Zealand in waterdepths between 18 and 2469 m. Burke (1981) reported it from sediments deeper than 2500 m in the western Pacific. Coustillas (1983) found *E. exigua* in sediments between 76 and 400 m in the Mahakam Delta.

Pflum and Frerichs (1976) observed that in the Gulf of Mexico this species shows a preference for carbonate (non clastic) environments.

Epistominella pulchra (Cushman)
(pl. 15, figs. 7-9)

1933a *Pulvinulinella pulchra* Cushman, p. 92, pl. 9, fig. 10.
1965 *Epistominella pulchra* (Cushman); Todd, p. 31, pl. 10, figs. 3-4.
1988 *Epistominella pulchra* (Cushman); Van Marle, p. 143, pl. 5, figs. 13-15.

Short description: Test small, unequally biconvex; dorsal side flattened or slightly convex in the center, ventral side strongly convex; periphery with a crinkled keel. Chambers trochospirally arranged, distinct, usually 5 in final whorl, enlarging gradually as added. Sutures distinct, dorsally oblique, ventrally slightly curved, depressed. Wall coarsely perforate, smooth. Aperture elongate, rounded, near periphery.

Remarks: According to Todd (1965) this species superficially resembles species of the genus *Siphonina*. The coarse pores and the small tubules radiating outwards around the periphery (making an impression of a crinkled periphery) suggest this, but the position of the aperture and the chamber arrangement place this species in the genus *Epistominella*.

Stratigraphic range: *E. pulchra* was found in Middle Miocene (N14), Late Miocene - Early Pliocene (N17-18), and Late Pliocene - Quaternary deposits (N21-22), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: In Recent eastern Indonesian sediments *E. pulchra* generally occurs at neritic - upper bathyal depths, with its UDL at 90 m, but also shows scattered deeper occurrences (Van Marle, 1988).

Epistominella umbonifera (Cushman)
(pl. 15, fig. 10)

1933a *Pulvinulinella umbonifera* Cushman, p. 90, pl. 9, fig. 9.
1965 *Nuttalides umboniferus* (Cushman); Todd, p. 29, pl. 11, fig. 1.
1979 *Epistominella umbonifera* (Cushman); Corliss, p. 7, pl. 2, figs. 10-12.

1981 *Epistominella umbonifera* (Cushman); Corliss and Honjo, p. 359, pl. 3, figs. 1-5.
1981 *Nutallides umbonifera* (Cushman); Burke, p. 7, pl. 2, figs. 5-6.
1985 *Nuttalides umbonifera* (Cushman); Thomas, p. 677, pl. 13, figs. 1-2.
1986 *Epistominella umbonifera* (Cushman); Kurihara and Kennett, p. 1072, pl. 4, figs. 1-3.

Short description: Test small, biconvex, ventral side more strongly convex than the dorsal side and with a very distinct umbonal plug; periphery lobulate, acute and crinkled. Chambers trochospirally arranged, distinct, 6-9 in the last whorl, of uniform shape, enlarging slowly. Sutures distinct, dorsally strongly oblique to somewhat limbate, ventrally slightly oblique and depressed. Wall thick, transparent, smooth. Aperture elongate, rounded, near peripheral keel.

Remarks: According to Todd (1965) this species exhibits considerable variation in size, thickness, lobulation of periphery, number of chambers, relative prominence of umbilical plug, degree to which an infolding of the wall extends into the apertural face, and smoothness and transparency of the wall. The distinguishing characteristics of this species seem to be the presence of the umbonal plug, and the appearance of a crinkled periphery, resulting from concentration of coarse pores or tubules along periphery.

Stratigraphic range: *E. umbonifera* was found in Early Pliocene - Quaternary deposits (N19/20-23) on the eastern Indonesian islands. It has been observed previously in Early Miocene to Recent deposits (see synonymy and Boersma, 1986).

Occurrence: Corliss (1979) reported this species to be a dominant deep sea form. Burke (1981) found this deep water species in sediments deeper than 2500 m on the Ontong Java Plateau, showing an increase in frequency below the lysocline. In the eastern Indian Ocean *E. umbonifera* has its maximum abundance in waterdepths between 3800 and 4400 m (Peterson, 1984).

Genus *Gavelinopsis* Hofker, 1951

Gavelinopsis lobatulus (Parr)

(pl. 14, figs. 10-12)

1884 *Discorbina isabelleana* Brady (not d'Orbigny), p. 646, pl. 88, fig. 1.
1950 *Discorbis lobatulus* Parr, p. 354, pl. 13, figs. 23-25.
1960 *Gavelinopsis lobatulus* (Parr); Barker, p. 182, pl. 88, fig. 1.
1978 *Gavelinopsis lobatulus* (Parr); Boltovskoy, p. 160, pl. 4, figs. 12-13.
1988 *Gavelinopsis lobatulus* (Parr); Van Marle, p. 143, pl. 2, figs. 1-3.

Short description: Test trochoid, conical, asymmetrically bicovex to almost planoconvex; evolute dorsal side more convex than the involute ventral side, which shows prominent umbilical plug; periphery subacute, somewhat lobulate, occasionally slightly carinate. Chambers trochospirally arranged in usually 3-4, depressed coils, with 5-6 chambers in the last coil. Sutures slightly depressed and curved umbilically; dorsally thickened, curving back near periphery. Wall hyaline, finely perforate. Aperture a narrow slit extending backwards from periphery to umbilical region, with slight lip.

Remarks: *G. lobatulus* resembles *Gavelinopsis praegeri* (Heron-Allen and Earland), but differs in having a less convex dorsal side and a more flattened umbilical side (resulting in an almost planoconvex appearance), distinct chambers on dorsal side, and sutures curved backwards at periphery.

Stratigraphic range: *G. lobatulus* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Pliocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *G. lobatulus* occurs generally in waterdepths between 317 and 2119 m, with higher frequencies between 317 and 1402 m (DLO at 914 m), and its UDL at 90 m (Van Marle, 1988).

Lewis (1979) found this species in sediments from the continental margin of New Zealand in waterdepths between 130 and 1419 m.

Genus *Laticarinina* Galloway and Wissler, 1927

Laticarinina altocamerata (Heron-Allen and Earland)

1884 *Truncatulina tenuimargo* Brady, p. 662, pl. 93, figs. 2a-c.
1922 *Truncatulina tenuimargo* Brady var. *altocamerata* Heron-Allen and Earland, p. 209, pl. 7, figs. 24-27.
1940 *Parvicarinina altocamerata* (Heron-Allen and Earland); Finlay, p. 467, pl. 62, figs. 30-34.
1960 *Parvicarinina altocamerata* (Heron-Allen and Earland); Barker, p. 192, pl. 93, fig. 2.
1964 *Laticarinina altocamerata* (Heron-Allen and Earland); Loeblich and Tappan, C580, fig. 457,4.
1966 *Parvicarinina altocamerata* (Heron-Allen and Earland); Belford, p. 93, pl. 14, figs. 14-16.
1978 *Laticarinina altocamerata* (Heron-Allen and Earland); Hofker, p. 54, pl. 8, fig. 1.
1986 *Laticarinina altocamerata* (Chapman and Parr); Boersma, p. 1027, pl. 12, figs. 1-3.
1986 *Laticarinina altocamerata* (Chapman and Parr); Kurihara and Kennett, p. 1072, pl. 4, figs. 9-10.

Short description: Test rounded, circular in outline, dorsal side flat, ventral side flat to slightly concave; periphery slightly lobulate, keeled, with keel curved towards the dorsal side forming distinct channel. Chambers planispirally arranged in 2 whorls, inflated dorsally, conical, variable in height, with rounded upper margins, usually 8 per whorl; deep sutures, gradually transforming into the keel. Wall finely perforate. Primary aperture a low, marginal slit perpendicular to the periphery; supplementary apertures on umbilical side at the ends of elongated prolongations of chamber walls.

Remarks: Loeblich and Tappan (1964) regarded *Parvicarinina* as junior synonym of *Laticarinina*, because of the closely related apertural characteristics.

Without further reference, Boersma (1986) and Kurihara and Kennett (1986) reported in their plate descriptions Chapman and Parr to be the original authors of *L. altocamerata* instead of Heron-Allen and Earland.

Stratigraphic range: *L. altocamerata* was rarely found in Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Eocene to Recent deposits (see synonymy; De Hornibrook, 1961; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *L. altocamerata* has only been observed near Timor at a depth of 1954 m (Van Marle, 1988).

Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 329 and 1649 m.

Laticarinina pauperata (Parker and Jones)
(pl. 15, figs. 13-15)

1865 *Pulvinulina repanda* (Fichtel and Moll) var. *menardii* (d'Orbigny) subvar. *pauperata* Parker and Jones, p. 395, pl. 16, figs. 50-51.

1884 *Pulvinulina pauperata* Parker and Jones; Brady, p. 696, pl. 104, figs. 3-11.

1915 *Pulvinulina pauperata* Parker and Jones; Cushman, p. 61, pl. 23, figs. 2-3.

1931 *Laticarinina pauperata* (Parker and Jones); Cushman, p. 114, pl. 20, fig. 4; pl. 21, fig. 1.

1941a *Laticarinina pauperata* (Parker and Jones); LeRoy, p. 46, pl. 2, figs. 18-19.

1941b *Laticarinina pauperata* (Parker and Jones); LeRoy, p. 88, pl. 6, figs. 30-31.

1951 *Laticarinina pauperata* (Parker and Jones); Hofker, p. 408, text-figs. 283-285.

1960 *Laticarinina halophera* (Stache); Barker, p. 214, pl. 104, figs. 3-11.

1964 *Laticarinina pauperata* (Parker and Jones); LeRoy, p. 44, pl. 9, fig. 25.

1964 *Laticarinina pauperata* (Parker and Jones); Loeblich and Tappan, C580, figs. 457,2-3.

1965 *Laticarinina pauperata* (Parker and Jones); Todd, p. 51, pl. 21, fig. 6.

1966 *Laticarinina pauperata* (Parker and Jones); Belford, p. 92, pl. 14, figs. 9-13.

1973 *Laticarinina pauperata* (Parker and Jones); Douglas, p. 614, pl. 10, fig. 8.

1978 *Laticarinina pauperata* (Parker and Jones); Boltovskoy, p. 162, pl. 4, fig. 32.

1978 *Laticarinina pauperata* (Parker and Jones); Hofker, p. 52, pl. 7, fig. 7.
1980 *Laticarinina pauperata* (Parker and Jones); Ingle et al., p. 140, pl. 9, fig. 12.
1980 *Laticarinina pauperata* (Parker and Jones); Keller, p. 844, pl. 2, fig. 3.
1980 *Laticarinina pauperata* (Parker and Jones); Boltovskoy, p. 165, pl. 2, figs. 8a-b; pl. 4, figs. 6a-b.
1981 *Laticarinina pauperata* (Parker and Jones); Burke, p. 7, pl. 2, fig. 3.
1984b *Laticarinina halophera* (Stache); Boersma, p. 1286, pl. 7, fig. 10.
1985 *Laticarinina halophora* (Stache); Boichard et al., p. 94, pl. 17, fig. 23.
1985 *Laticarinina pauperata* (Parker and Jones); Thomas, p. 677, pl. 11, fig. 10.
1986 *Laticarinina pauperata* (Parker and Jones); Kurihara and Kennett, p. 1072, pl. 4, fig. 11.
1986 *Laticarinina pauperata* (Parker and Jones); Van Morkhoven et al., p. 89, pl. 26, figs. 1a-c.
1988 *Laticarinina pauperata* (Parker and Jones); Van Marle, p. 145, pl. 3, figs. 1-3.

Short description: Test discoidal, flattened, rounded to oval in outline, with an extremely broad and thin marginal keel. Chambers planispirally arranged, bulbous. Wall finely perforate. Small rounded aperture on dorsal side of the keel and an elongate narrow aperture on ventral side along the inner and proximal chamber borders.

Remarks: The keel divides the planispirally arranged chambers into unequal lobes and extends through the proximal part of each chamber. The keel is formed before the chambers in which it occurs and on completely preserved specimens extends forward beyond the distal margin of the final chamber. The keel is made up out of two layers of shell material, because it is formed by the tight folding of the lamina forming each chamber. The bulbous chambers are built around the marginal keel and at the same time the forward extension of the keel, which will divide the next chamber, is formed; the line of junction is shown between successive laminae. The narrow aperture on the ventral side is not always clearly visible, but often covered by subsequent shell laminae, which are visible as elongated backwardly directed extensions of the inner ventral margins of the chambers.

Stache (1864) described an almost identical form, *Cristellaria* (*Robulina*) *halophera*, from New Zealand Eocene deposits, one year before Parker and Jones described *L. pauperata*. However, according to Van Morkhoven et al. (1986) this is a lenticulinid species and a senior synonym of *Robulina coronalunae* Stache (see De Hornibrook, 1971).

The form observed by Germeraad (1946) as *Laticarinina* sp. resembles *L. pauperata* in shape, but has a very heavily built keel, which can be thicker than the chambers, with an ornament of backwardly directed grooves.

Stratigraphic range: *L. pauperata* was found in Early - Middle Miocene (N8) and Late Miocene - Quaternary deposits (N16-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Oligocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979; Boltovskoy, 1984).

Occurrence: In Recent eastern Indonesian sediments *L. pauperata* occurs generally in waterdepths between 914 and 2119 m, with its DLO at 1290 m and its UDL at 711 m (Van Marle, 1988). Based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 5 degrees Celsius for this species, which corresponds with waterdepths of about 1000 m.

Bandy and Rodolfo (1964) reported this species to have its UDL at 1170 m in the Peru-Chili Trench. Lewis (1979) observed it in sediments from the continental margin of New Zealand in waterdepths between 1649 and 2432 m. Moore et al. (1980) considered *L. pauperata* to be indicative for depths between 500 and 2000 m. Boichard et al. (1985) found it in sediments deeper than 490 m on the Pater Noster Platform. Van Morkhoven et al. (1986) reported this species as a typical bathyal - abyssal form.

Genus *Patellinella* Cushman, 1928

Patellinella jugosa (Brady)
(pl. 15, figs. 11-12)

1884 *Textularia jugosa* Brady, p. 358, pl. 42, fig. 7.
1954 *Patellinella jugosa* (Brady); Cushman et al., p. 358, pl. 89, fig. 3.
1960 *Patellinella jugosa* (Brady); Barker, p. 86, pl. 42, fig. 7.
1964 *Patellinella jugosa* (Brady); LeRoy, p. 35, pl. 2, figs. 33-34.
1965 *Patellinella carinata* Collins; Todd, p. 9, pl. 1, fig. 5 (not 6).
1988 *Patellinella jugosa* (Brady); Van Marle, p. 148, pl. 4, figs. 14-15.

Short description: Test oblong, tapering, compressed; oral end elliptical, truncate, aboral end subangular or rounded. Chambers numerous, biserially arranged in later stage. Sutures marked by stout raised bands of translucent calcite. Wall hyaline, thin, smooth, nearly transparent, finely perforate, radiate in texture. Aperture a broad ventral arch opening into umbilicus.

Remarks: *P. jugosa* differs from *Patellinella inconspicua* (Brady) by its raised sutures and sharper edges. *Patellinella carinata* Collins has sharper, carinate and serrate edges, and might be an endemic variety of *P. jugosa.*

Stratigraphic range: *P. jugosa* was found in Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Pliocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *P. jugosa* has been found near Timor and Tanimbar in waterdepths between 60 and 100 m (Van Marle, 1988).

Subfamily *Rosalininae* Reiss, 1963

Genus *Rosalina* d'Orbigny, 1826

Rosalina vilardeboana d'Orbigny

(pl. 14, figs. 13-14)

1839b *Rosalina vilardeboana* d'Orbigny, p. 44, pl. 6, figs. 13-15.
1884 *Discorbina vilardeboana* (d'Orbigny); Brady, p. 645, pl. 86, fig. 9.
1960 *Rosalina vilardeboana* d'Orbigny; Barker, p. 178, pl. 86, fig. 9.
1965 *Rosalina vilardeboana* d'Orbigny; Todd, p. 13, pl. 3, figs. 2, 5.
1988 *Rosalina vilardeboana* d'Orbigny; Van Marle, p. 149, pl. 4, figs. 9-10.

Short description: Test subrounded, biconvex, slightly compressed, trochoid; periphery angular, slightly lobulate around last 2-3 chambers. Chambers trochospirally arranged in a flat spire of about 2-3 coils, 5-6 chambers in final whorl, dorsally not inflated, ventrally gradually more inflated, enlarging regularly as added. Sutures distinct, slightly arcuate, depressed. Wall smooth, coarsely perforate; initial stage colored yellowish-brown, later white or nearly transparent. Aperture opening into wide, open umbilicus under projecting edge of last chamber, extending nearly to periphery.

Remarks: *R. vilardeboana* differs from the congeneric type species *Rosalina globularis* d'Orbigny, by its russet tint of the early chambers compared to the white later ones, a more projecting spire, and a less perforate wall. *R. vilardeboana* is more convex on the umbilical side than spirally, probably caused by an attached way of life (Todd, 1965).

Stratigraphic range: *R. vilardeboana* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: In Recent eastern Indonesian sediments *R. vilardeboana* generally occurs at neritic - upper bathyal depths, down from 60 m, but also shows scattered (probably displaced) deeper occurrences (Van Marle, 1988). This supports the opinion of Todd (1965), who considered this species to be a shallow water form.

Family *Eponididae* Hofker, 1951

Subfamily *Eponidinae* Hofker, 1951

Genus *Eponides* De Montfort, 1808

Eponides bradyi Earland

1884 *Truncatulina pygmaea* Brady (not Hantken), p. 666, pl. 95, figs. 9-10.
1934 *Eponides bradyi* Earland, p. 187, pl. 8, figs. 36-38.
1960 *Eponides bradyi* Earland; Barker, p. 196, pl. 95, figs. 9-10.
1978 *Eponides bradyi* Earland; Boltovskoy, p. 158, pl. 4, figs. 1-3.
1980 *Eponides bradyi* Earland; Boltovskoy, p. 165, pl. 2, figs. 3a-b.

Short description: Test trochoid, biconvex, with broad depression in the umbilical region, filled by a solid plug of clear shell substance; periphery angled.

Chambers trochospirally arranged, dorsally 3 coils visible, ventrally only the 7-9 chambers of the last coil. Sutures oblique and flush, indistinct on the dorsal side, recurved on the opposite side. Wall finely perforate. Aperture an arched slit.

Remarks: The species described by Cushman as *Pulvinulinella bradyana* proved, after examination of the apertural characters, to be a young individual of *E. Bradyi* (see Earland, 1934).

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Eponides* spp.: *E. bradyi*, *E. procerus*, and *E. repandus*. *Eponides* spp. were found in Middle Miocene - Quaternary deposits (N14-23). All species gathered in *Eponides* spp. have also been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

E. bradyi has been observed previously in Late Oligocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *Eponides* spp. show a scattered depth distribution down from 90 m (Van Marle, 1988).

Eponides procerus (Brady)

1881 *Pulvinulina procera* Brady, p. 66 (nomen nudum).
1884 *Pulvinulina procera* Brady, p. 698, pl. 105, fig. 7.
1941b *Eponides procerus* (Brady); LeRoy, p. 83, pl. 3, figs. 31-33.
1951 *Alabamina procera* (Brady); Hofker, p. 396, text-figs. 274-275.
1960 *Eponides procera* (Brady); Barker, p. 216, pl. 105, fig. 7.
1964 *Eponides procerus* (Brady); LeRoy, p. 38, pl. 7, figs. 22-23.
1983 *Eponides procera* (Brady); Coustillas, pl. 38, fig. 2.

Short description: Test conical, with flat or truncate oral side and rounded opposite side; periphery subacute. Chambers trochospirally arranged, numerous, about 6 in the last whorl. Sutures limbate, oblique. Wall finely perforate. Aperture an arched slit near closed umbilicus.

Remarks: Characteristic, high conical form, resembling in this way the forms of the genus *Neoeponides*.

Stratigraphic range: See *Eponides bradyi* Earland. *E. procerus* has been found previously in Pliocene to Recent deposits.

Occurrence: See *Eponides bradyi* Earland. According to LeRoy (1964) *E. procerus* is an outer neritic - upper bathyal form. Coustillas (1983) found it in samples from waterdepths between 30 and 70 m in the Mahakam Delta.

Eponides repandus (Fichtel and Moll)

1798 *Nautilus repandus* Fichtel and Moll, p. 35, pl. 3, figs. a-d.
1878 *Rosalina lateralis* Terquem, p. 25, pl. 2, fig. 11.
1884 *Pulvinulina repanda* (Fichtel and Moll); Brady, p. 684, pl. 104, fig. 18.
1944 *Poroeponides lateralis* (Terquem); Cushman, p. 34, pl. 4, fig. 23.

1951 *Eponides repanda* (Fichtel and Moll); Hofker, p. 330, text-figs. 225-226.

Short description: Test biconvex; periphery lobulated, angled, with a rounded keel. Spiral side evolute, slightly convex; umbilical side involute, convex, with closed umbilicus. Chambers trochospirally arranged in about 2-3 left coiled whorls, 7 chambers in last coil, slightly inflated on umbilical side. Sutures limbate, curved, spirally broad and irregular, depressed to faintly limbate on umbilical side. Wall smooth, finely perforate. Aperture a low arch, bordered by narrow, overhanging lip, extending almost from umbilicus to periphery.

Remarks: *Rosalina lateralis* Terquem (1878) closely resembles *E. repandus* and must be regarded as a junior synonym of the latter species.

De Montfort (1808) designated *E. repandus* as the type species of his new formed genus *Eponides* (see also Rögl and Hansen, 1984).

Stratigraphic range: See *Eponides bradyi* Earland. *E. repandus* has been found previously in Late Eocene to Recent deposits (see synonymy; De Hornibrook, 1961; Todd, 1965; Coustillas, 1983; Boichard et al., 1985).

Occurrence: See *Eponides bradyi* Earland. Coustillas (1983) found *E. repandus* in sediments between 50 and 100 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 45 m on the Pater Noster Platform.

Genus *Neoeponides* Reiss, 1960

Neoeponides berthelotianus (d'Orbigny)
(pl. 15, figs. 1-3)

1839c *Rotalina berthelotianus* d'Orbigny, p. 130, pl. 1, figs. 31-31.
1884 *Pulvinulina berthelotianus* (d'Orbigny); Brady, p. 701, pl. 106, fig. 1.
1960 *Eponides berthelotianus* (d'Orbigny); Barker, p. 218, pl. 106, fig. 1.
1966 *Neoeponides berthelotianus* (d'Orbigny); Belford, p. 117, pl. 17, figs. 1-6.

Short description: Test suborbicular, biconvex, equally elevated and conical; periphery strongly carinate; apex blunt; umbilicus small. Chambers trochospirally arranged in conical spire of 4 whorls, elevated, gradually enlarging; 7 chambers in last whorl, carinate, angular, oblique, with marginal prolongations. Sutures raised, broad, radial on ventral side, thickening towards the middle and meeting there. Wall smooth, finely perforate. Aperture an interiomarginal arch, extending from periphery to umbilicus, bordered by a small, imperforate lip.

Remarks: *N. berthelotianus* has a stronger convex and conical form than *Neoeponides subornatus* (Cushman).

Stratigraphic range: Because both *N. berthelotianus* and *N. subornatus* occur rarely, they have during the countings been assembled in *Neoeponides* spp., found in: Early - Middle Miocene (N8), Middle - Late Miocene (N14-15), and Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

N. berthelotianus has been observed previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *Neoeponides* spp. usually occur at neritic - upper bathyal depths, down from 78 m, but also show scattered deeper occurrences (Van Marle, 1988).

Neoeponides subornatus (Cushman)

1921 *Pulvinulina berthelotiana* (d'Orbigny) var. *subornata* Cushman, p. 333, pl. 70, fig. 1.
1941a *Eponides berthelotiana* (d'Orbigny) var. *subornata* Cushman; LeRoy, p. 39, pl. 2, figs. 15-17.
1944a *Eponides berthelotiana* (d'Orbigny) var. *subornata* Cushman; LeRoy, p. 34, pl. 8, figs. 38-40.
1944b *Eponides berthelotiana* (d'Orbigny) var. *subornata* Cushman; LeRoy, p. 89, pl. 5, figs. 7-9.
1951a *Eponides subornatus* (Cushman); Asano, p. 11, figs. 85-87.
1964 *Eponides subornatus* (Cushman); LeRoy, p. 38, pl. 7, figs. 27-29.
1966 *Neoeponides subornatus* (Cushman); Belford, p. 118, pl. 17, figs. 7-12.

Short description: Test large, planoconvex; dorsal side conical with rounded apex, ventral side slightly convex; periphery keeled; umbilical area with stel-

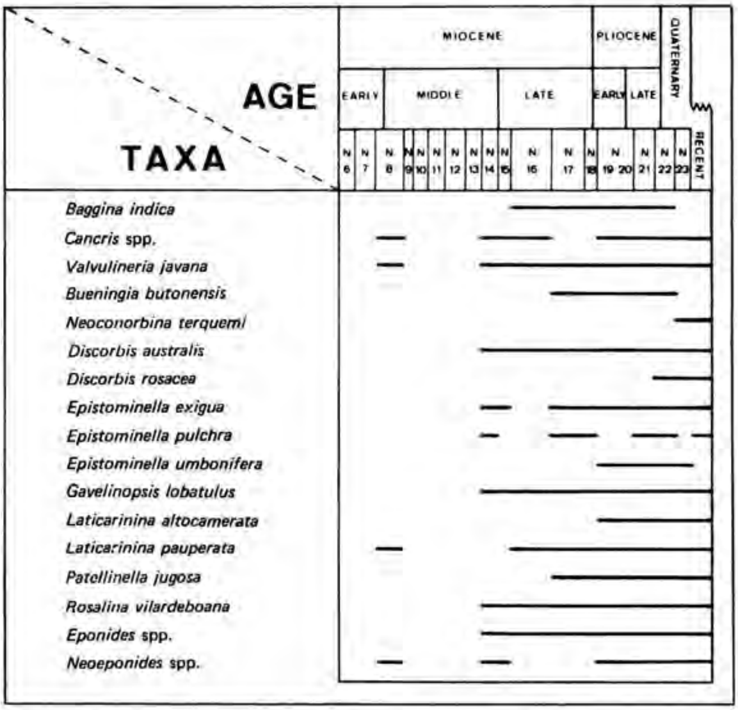

Fig. 20. Composite range chart of the superfamily *Discorbacea* of the suborder *Rotaliina* in eastern Indonesia.

late mass of secondary shell material. Chambers trochospirally arranged, 9-11 chambers in the last whorl. Sutures thick, raised and strongly oblique dorsally, depressed and curved ventrally. Wall smooth. Narrow, curved aperture at ventral border of last chamber.

Remarks: *N. subornatus* has a less convex and conical form than *Neoeponides berthelotianus* (d'Orbigny).

Stratigraphic range: See *Neoeponides berthelotianus* (d'Orbigny).

N. subornatus has been recorded previously from Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: See *Neoeponides berthelotianus* (d'Orbigny). According to LeRoy (1964) *N. subornatus* is an outer neritic - upper bathyal form.

Superfamily *Eouvigerinacea* Cushman, 1927
Family *Bolivinidae* Glaessner, 1937
Genus *Bolivina* d'Orbigny, 1839

Bolivina arta Macfadyen
(pl. 16, figs. 1-3)

1930 *Bolivina arta* Macfadyen, p. 58, pl. 4, figs. 21a-b.
1937 *Bolivinita arta* (Macfadyen); Cushman, p. 79, pl. 9, figs. 23-26.
1941a *Bolivina* aff. *B. arta* Macfadyen; LeRoy, p. 34, pl. 2, figs. 91-92.
1976 *Brizalina arta* (Macfadyen); Berggren and Haq, p. 111, pl. 5, fig. 3.
1983 *Brizalina* sp., Coustillas, pl. 29, fig. 20.

Short description: Test narrow and elongate, flattened, moderately compressed, tapering, greatest breadth formed by the last pair of chambers; initial end bluntly rounded; periphery rounded. Chambers biserially arranged with usually 6-9 pairs, rectangular, except at the upper corners where they are rounded off and a roughly triangular mass of translucent calcite is present; sutures flush, straight to slightly limbate. Wall smooth and extremely finely perforate. Aperture a large, elongate, wide loop.

Remarks: *B. arta* shows a close relationship with *Brizalina semilineata* Belford, as already stated by Belford himself (1966, p. 36). Compared with the latter, *B. arta* has a similar shape of the test and a similar chamber shape, but is a smooth form. *Bolivina arta* Macfadyen var. *striatocola* Smitter (1956; p. 115, fig. 40h) is considered to be a variety of *B. semilineata*.

Stratigraphic range: *B. arta* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene and Recent sediments.

Occurrence: In Recent eastern Indonesian sediments *B. arta* generally occurs at neritic - upper bathyal depths, down from 78 m, but also shows scattered deeper occurrences (Van Marle, 1988). Coustillas (1983) found this species at a depth of 198 m in the Mahakam Delta.

Bolivina sp. cf. *B. asanoi* Uchio
(pl. 16, figs. 4-5)

1951 *Bolivina asanoi* Uchio, p. 373, pl. 5, fig. 10.
1952 *Bolivina asanoi* Uchio; Asano, p. 12, figs. 64-65.

Short description: Test elongate, nearly twice as long as broad, somewhat compressed, apertural end elliptical, truncate, opposite end rounded; periphery rounded, slightly lobulate. Chambers biserially arranged, 6-7 pairs, inflated, low, relatively broad. Sutures slightly oblique, distinct, marked by stout, broad, raised bands of calcite. Wall smooth, coarsely and densely perforate. Aperture a narrow, elongate loop up the chamber face.

Remarks: The specimens found in our material closely resemble specimens of *B. asanoi*, as they both have the characteristic raised, broad sutures, but they differ from the holotypes in having a rounded and less tapering apical end, and less strongly oblique sutures.

Stratigraphic range: *Bolivina* sp. cf. *B. asanoi* was found in Middle Miocene - Quaternary deposits (N14-23) on the eastern Indonesian islands. It has been described previously from the Miocene of Japan (Uchio, 1951; Asano, 1952).

Occurrence: *B. asanoi* has in the eastern Indonesian material always been found in association with typical upper bathyal species.

Bolivina lobata Brady
(pl. 16, figs. 10-11)

1881 *Bolivina lobata* Brady, p. 58 (nomen nudum).
1884 *Bolivina lobata* Brady, p. 425, pl. 53, figs. 22-23.
1960 *Loxostomum lobatum* (Brady); Barker, p. 110, pl. 53, figs. 22-23.
1988 *Bolivina lobata* Brady; Van Marle, p. 139, pl. 5, fig. 3.

Short description: Test elongate, depressed, digitate; apertural end obliquely truncate or rounded, opposite end obtuse. Chambers biserially arranged, may become uniserial at the end, inflated, with subangular margins. Sutures broad, depressed. Wall hyaline, finely perforate. Aperture a long oval slit contracted at the middle, nearly central.

Remarks: *B. lobata* has more angular chambers than *Bolivina subspinescens* Cushman, and the last chambers show a more granulated surface. Further both apertures are different, and the wall of *B. subspinescens* is transparent.

Stratigraphic range: *B. lobata* was found in Middle - Late Miocene (N14-15) and Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene to Pliocene deposits (see synonymy; Boomgaart, 1949; LeRoy, 1964).

Occurrence: In Recent eastern Indonesian sediments *B. lobata* shows a scattered depth distribution down from 60 m (Van Marle, 1988).

According to LeRoy (1964) *B. Lobata* prefers shallow water environments.

Bolivina robusta Brady
(pl. 16, figs. 8-9)

1881 *Bolivina robusta* Brady, p. 57 (nomen nudum).
1884 *Bolivina robusta* Brady, p. 421, pl. 53, figs. 7-9.
1937 *Bolivina robusta* Brady; Cushman, p. 131, pl. 17, figs. 1, 3.
1941a *Bolivina robusta* Brady; LeRoy, p. 33, pl. 1, figs. 75-76.
1941b *Bolivina robusta* Brady; LeRoy, p. 80, pl. 1, fig. 2; pl. 2, figs. 9-10.
1949 *Bolivina robusta* Brady; Boomgaart, p. 111, pl. 12, fig. 1.
1951 *Bolivina robusta* Brady; Hofker, p. 76, text-figs. 41-42.
1960 *Bolivina robusta* Brady; Barker, p. 108, pl. 53, figs. 7-9.
1966 *Bolivina robusta* Brady; Belford, p. 21, pl. 1, figs. 5-7.
1983 *Bolivina robusta* Brady; Coustillas, pl. 29, figs. 1-3.
1984 *Bolivina robusta* Brady; Govindan, p. 244, pl. 1, fig. 1.
1985 *Bolivina robusta* Brady; Wang et al., p. 336, pl. 4, fig. 14.
1985 *Bolivina robusta* Brady; Boichard et al., p. 94, pl. 17, fig. 23.
1988 *Bolivina robusta* Brady; Van Marle, p. 139, pl. 1, figs. 25-26.

Short description: Test elongate, compressed, broad and rounded at the apertural end, tapering to a point and frequently terminating in a long, stout spine at the opposite end; thickest on the median line, and sloping away symmetrically to the sides; periphery subacute. Chambers numerous, about 10 in each series, long, curved, obliquely set, with overlapping margins; retral processes visible. Sutures thickened, usually limbate and somewhat crenulate. Aperture a narrow, elongate loop.

Remarks: The specimens figured by Germeraad (1946) as *Bolivina indopacifica* (p. 68, pl. 2, figs. 13-14) resemble smaller (juvenile) specimens of *B. robusta*, which may have spinose projections at the outer chamber margins.

Stratigraphic range: *B. robusta* was found in Early - Middle Miocene (N8) and in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Early Miocene to Recent deposits from the Indo-Pacific region (see synonymy; LeRoy, 1964; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *B. robusta* occurs generally in waterdepths between 60 and 1954 m, with higher frequencies between 244 and 1097 m, having its DLO at 495 m (Van Marle, 1988). Similar observations have been made by Lewis (1979), who found this species in sediments from the continental margin of New Zealand in waterdepths between 18 and 1649 m. Moore et al. (1980) considered *B. robusta* to be indicative for depths between 150 and 500 m. Coustillas (1983) found it in sediments deeper than 300 m in the Mahakam Delta and Boichard et al. (1985) between 220 and 549 m on the Pater Noster Platform.

Bolivina schwageriana Brady s.l.
(pl. 16, figs. 6-7)

1881 *Bolivina schwageriana* Brady, p. 58 (nomen nudum).
1884 *Bolivina schwageriana* Brady, p. 425, pl. 53, figs. 24-25.
1937 *Bolivina schwageriana* Brady; Cushman, p. 130, pl. 16, figs. 22-24.
1941a *Bolivina schwageriana* Brady; LeRoy, p. 34, pl. 2, figs. 34-35.
1960 *Bolivina schwageriana* Brady; Barker, p. 110. pl. 53, figs. 24-25.
1983 *Bolivina schwageriana* Brady; Coustillas, pl. 29, fig. 14.

Short description: Test biconvex, broad and rounded at apertural side, rhomboid in front view, tapering to a blunt point at the initial end; periphery initially subacute later distinctly keeled. Chambers biserially arranged, relatively broad; sutures wide, smooth, curved, oblique, limbate, meeting in centre of the test in raised triangular areas of imperforate shell material. Wall finely perforate, smooth, except for ornament of two parallel, central, longitudinal costae, at either side of central groove on both sides of the test. Aperture large and elongate, with an obliquely projecting tooth.

Remarks: Species, such as *Bolivina hantkenina* Brady, *Bolivina semicostata* Cushman, and *Brizalina patula* Belford, are considered to be varieties of *B. schwageriana*, being similar in outline and chamber shape, and only differing in the accentuation of the ornament. Specimens resembling *B. schwageriana* s.s. or any of these forms were taken into *B. schwageriana* s.l.

Stratigraphic range: *B. schwageriana* s.l. was found in Middle Miocene - Quaternary sediments (N14-23) on the eastern Indonesian islands. It has been described previously from Early Miocene to Recent deposits.

Occurrence: Coustillas (1983) found *B. schwageriana* in sediments between 200 and 400 m in the Mahakam Delta between Kalimantan and Sulawesi.

Bolivina spathulata (Williamson) s.l.
(pl. 16, figs. 15-16)

1858 *Textularia variabilis* Williamson var. *spathulata* Williamson, p. 76, pl. 6, figs. 164-165.
1884 *Bolivina dilatata* Reuss; Brady, p. 418, pl. 52, figs. 20-21.
1942 *Bolivina dilatata* Reuss var. *javana* Van der Sluis and De Vletter, p. 1012, text-fig. 4.
1949 *Bolivina subspathulata* Boomgaart, p. 112, pl. 12, fig. 4.
1956 *Bolivina spatuloides* Hofker, p. 66, pl. 6, fig. 20; pl. 7, figs. 8-11.
1960 *Bolivina spathulata* (Williamson); Barker, p. 106, pl. 52, figs. 20-21.
1966 *Brizalina* sp. cf. *B. variabilis* (Williamson); Belford, p. 27, pl. 1, figs. 10-12.
1988 *Bolivina spathulata* (Williamson); Van Marle, p. 147, pl. 5, fig. 1.

Short description: Test long and slender, compressed; broad and rounded at the apertural end, lanceolate at the opposite end; periphery sharp, smooth, with thin keel, tapering backwards and outwards to a point. Chambers arcuate, flat or slightly convex, their breadth greatly exceeding their length; sutures curving backwards, slightly depressed. Wall hyaline and smooth, with fine, distinct pores usually in a single row, but in the last-formed chambers in several rows, sometimes covering almost the entire surface. Aperture a narrow, low slit, with a sharp, protruding tooth.

Remarks: Characteristic of *B. spathulata* s.s. are the pores at the initial suture, and the straight, but oblique, sharp sutures. Although retral processes were not observed we decided to maintain this species within the genus *Bolivina*, rather then to transfer it to the genus *Brizalina*, because of its close morphological resemblance with *B. robusta*.

Forms like *Bolivina dilatata* Reuss, *Bolivina subspathulata* Boomgaart and *Bolivina spatuloides* Hofker are considered to be junior synonyms of *B. spathulata*, showing only minor morphological alterations.

Specimens resembling *Bolivina punctata* d'Orbigny and *Bolivina albatrossi* Cushman were taken into *B. spathulata* s.l. The first only being more densely and coarsely perforate and the second having a network of fine reticulations on the initial part of its translucent wall, obscuring the sutures, but with the typical rows of pores along the initial sutures in the later portion.

Stratigraphic range: *B. spathulata* was found in Early - Middle Miocene (N8) and in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene to Recent deposits (see synonymy; Lewis, 1979; Coustillas,1983).

Occurrence: In Recent eastern Indonesian sediments *B. spathulata* generally shows bathyal occurrences, with its DLO at 1097 m and its UDL at 78 m (Van Marle, 1988).

Waller (1960) reported *B. spathulata* to occur at upper bathyal depths (135-220 m) in the South China Sea. Lewis (1979) observed it in sediments from the continental margin of New Zealand in waterdepths between 18 and 2432 m. Coustillas (1983) found it between 50 and 250 m in the Mahakam Delta.

According to Van der Zwaan (1982) *B. spathulata* is a mud-dweller with a wide environmental range (see also Hageman, 1979), which shows enormous tolerance to increased salinities and significant oxygen deficiency (see also Jonkers, 1984), and possibly preferred high nutrient environments.

Bolivina subspinescens Cushman
(pl. 16, figs. 12-14)

1884	*Bolivina textilarioides* Brady (not Reuss), p. 419, pl. 52, figs. 24-25.
1922	*Bolivina subspinescens* Cushman, p. 48, pl. 7, fig. 5.
1960	*Bolivina subspinescens* Cushman; Barker, p. 108, pl. 52, figs. 24-25.
1988	*Bolivina subspinescens* Cushman; Van Marle, p. 139, pl. 5, fig. 2.

Short description: Test minute, elongate, tapering, initial end bluntly pointed, apertural end angular, periphery lobulated. Chambers biserially arranged throughout, distinct, angular, concave; sutures distinct, depressed.

Wall outer part smooth, remainder covered with short close-set spines, in the early portions granular, roughened. Aperture rounded.

Remarks: *B. subspinescens* resembles *Bolivina spinescens* Cushman (1911), but the angular form of the chambers is much more marked and the test is definitely tapering. *Bolivina lobata* has even more angular chamber edges and granulated adult chamber walls than *B. subspinescens*.

Stratigraphic range: *B. subspinescens* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Pliocene to Recent deposits (see synonymy; Boltovskoy, 1978; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *B. subspinescens* shows a scattered depth distribution down from 78 m (Van Marle, 1988).

Lewis (1979) found this species in sediments from the continental margin of New Zealand in waterdepths between 130 and 2329 m.

Bolivina tortuosa Brady

(pl. 16, figs. 17-19)

1881	*Bolivina tortuosa* Brady, p. 57 (nomen nudum).
1884	*Bolivina tortuosa* Brady, p. 420, pl. 52, figs. 31-32.
1937	*Bolivina tortuosa* Brady; Cushman, p. 133, pl. 17, figs. 11-19.
1945	*Bolivina tortuosa* Brady; Cushman and Todd, p. 44, pl. 7, fig. 6.
1951	*Bolivina tortuosa* Brady; Hofker, p. 75, text-figs. 39a-d.
1957	*Bolivina tortuosa* Brady; Todd and Brönniman, p. 34, pl.8, fig. 24.
1957	*Sigmavirgulina tortuosa* (Brady); Loeblich and Tappan, p. 227, pl. 73, figs. 1-2.
1960	*Sigmavirgulina tortuosa* (Brady); Barker, p. 108, pl. 52, figs. 31-32.
1961	*Bolivina* sp. cf. *B. tortuosa* Brady; De Hornibrook, p. 72, pl. 10, fig. 191.
1964	*Sigmavirgulina tortuosa* (Brady); Loeblich and Tappan, C733, fig. 601, 1-3.
1966	*Sigmavirgulina tortuosa* (Brady); Belford, p. 137, pl. 9, figs. 22-23.
1981	*Sigmavirgulina tortuosa* (Brady); Burke, p. 7, pl. 2, figs. 4 and 8.
1984b	*Bolivina tortuosa* Brady; Boersma, p. 1286, pl. 3, fig. 3.
1988	*Sigmavirgulina tortuosa* (Brady); Van Marle, p. 149, pl. 5, fig. 9.

Short description: Test elongate, tapering, broadest near the top; the sides bent obliquely towards the median line, giving the test a twisted appearance; periphery thin, sharp and lobulate. Initial stage a tight low spire, later becoming high spired and regularly biserial; chambers numerous, long, narrow, projecting and rounded at the free ends. Wall densely perforate. Aperture an elongate, oval slit at the inner margin of the final chamber, with a lip, gradually transforming into the peripheral keel.

Remarks: Van der Zwaan (1982) considered *B. tortuosa* to be a morphotype of *B. spathulata* with a twisted test and thicker wall with coarser perforations.

Stratigraphic range: *B. tortuosa* was found in Late Miocene - Quaternary deposits (N15-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: In Recent eastern Indonesian sediments *B. tortuosa* has only been found near Tanimbar in waterdepths between 90 and 150 m (Van Marle, 1988).

Genus *Brizalina* Costa, 1856, emend. Loeblich and Tappan, 1964

Brizalina alata (Seguenza)
(pl. 17, figs. 1-2)

1862	*Vulvulina alata* Seguenza, p. 115, pl. 2, figs. 5-5a.
1884	*Bolivina beyrichi* Reuss var. *alata* (Seguenza); Brady, p. 442, pl. 53, figs. 2-4.
1937	*Bolivina alata* (Seguenza); Cushman, p. 106, pl. 13, figs. 3-11.
1941a	*Bolivina alata* (Seguenza); LeRoy, p. 34, pl. 2, figs. 45-46.
1960	*Bolivina alata* (Seguenza); Barker, p. 108, pl. 53, figs. 2-4.
1966	*Brizalina alata* (Seguenza); Belford, p. 24, pl. 1, figs. 1-2.
1976	*Brizalina alata* (Seguenza); Berggren and Haq, p. 111, pl. 5, fig. 1.
1980	*Bolivina alata* (Seguenza); Ingle et al., p. 131, pl. 3, fig. 12.
1983	*Bolivina alata* (Seguenza); Coustillas, pl. 29, fig. 7.
1984	*Brizalina alata* (Seguenza); Govindan, p. 244, pl. 1, fig. 3.

Short description: Test elongate, strongly compressed; periphery sharply keeled, with spinose projections at basal chamber edges, turned sharply back towards initial end. Chambers initially low and broad, later gradually increasing in relative height until in the adult stage the height is greater than the breadth, overlapping, slightly inflated. Sutures distinct, somewhat limbate, the peripheral angle very strongly oblique, slightly depressed. Wall smooth, finely and distinctly perforate. Aperture elongate and narrow, with a tooth formed by the narrowly folded free edge of the toothplate.

Remarks: *B. alata* is often considered to be a variety of *Brizalina pseudobeyrichi* (Cushman), but we agree with the opinion of Belford (1966) that the two must be considered as separate species, *B. alata* being the form with a much broader general outline of the test and a larger, better developed, peripheral keel. However, the type description of *Vulvulina alata* by Seguenza is better comparable with *B. pseudobeyrichi* than with *B. alata* itself, and therefore the description of Cushman (1937) is used here.

Stratigraphic range: *B. alata* was found in Early - Middle Miocene (N8) and in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits (see synonymy; Boomgaart, 1949; LeRoy, 1964; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *B. alata* has only been found near Irian Jaya at a depth of 486 m (Van Marle, 1988).

Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 329 and 1649 m. Poag (1981) reported it to occur on the upper slope in the Gulf of Mexico. Coustillas (1983) found this species between 50 and 150 m in the Mahakam Delta.

According to Jonkers (1984) *B. alata* is frequent in 'moderately low oxygen laminites' from Crete.

Brizalina hastula Belford
(pl. 17, fig. 5)

1966 *Brizalina hastula* Belford, p. 38, pl. 2, figs. 20-22.

Short description: Test slender, elongate, tapering, greatest width at last pair of chambers, diamond-shaped to sharply elliptical in end view; periphery narrowly rounded. Small, globular proloculus followed by 10-12 pairs of biserial chambers, wider than high, enlarging slowly. Sutures narrow, smooth, curved and strongly oblique, sometimes with small re-entrants. Wall coarsely perforate, ornamented by very faint continuous striae. Aperture narrow and elongate, with imperforate margin, reaching to basal suture of chamber.

Remarks: The small re-entrants along the sutures of *B. hastula* are similar to those of *Bolivina robusta* Brady, but are not as strongly developed and indications of associated internal ridges have not been observed. Further, *B. hastula* is distinct from *Bolivina* species by its slender, elongate test and its striate ornament on early chambers (Belford, 1966). To avoid confusion and because there is no indication of internal ridges with the re-entrants, we follow Belford's concept and maintain *B. hastula* in the genus *Brizalina*.

Stratigraphic range: *B. hastula* was found in Late Miocene - Quaternary deposits (N17-23) on the eastern Indonesian islands. It has been observed previously in Early - Late Miocene deposits from eastern Indonesia (Belford, 1966).

Occurrence: *B. hastula* has in the eastern Indonesian material always been found in association with typical outer neritic - upper bathyal species.

Brizalina karreriana (Brady)
(pl. 18, figs. 4-6)

1881 *Bolivina karreriana* Brady, p. 28 (nomen nudum).
1884 *Bolivina karreriana* Brady, p. 424, pl. 53, figs. 19-21.
1941c *Loxostomum karrerianum* (Brady); LeRoy, p. 115, pl. 2, figs. 38-39.
1950 *Loxostoma karreriana* (Brady); Asano, p. 11, figs. 44-45.
1960 *Loxostomum karrerianum* (Brady); Barker, p. 110, pl. 53, figs. 19-21.
1964 *Loxostomum karrerianum* (Brady); LeRoy, p. 33, pl. 2, figs. 26-27.
1966 *Brizalina karreriana* (Brady); Belford, p. 39, pl. 2, figs. 23-25.
1983 *Loxostomum* aff. *karrerianum* (Brady); Coustillas, pl. 29, figs. 18-19.

Short description: Test elongate, tapering, broadest near the top, somewhat depressed; initial end pointed, often mucronate and with a basal spine; periphery thick, rounded, lobulate. Chambers biserially arranged, inflated; sutures obscured. Wall ornamented with numerous delicate, often branching, or otherwise irregular longitudinal ribs. Aperture large, rounded, oblique and not terminal, with a small, protruding tooth.

Remarks: Belford (1966, pl. 2, figs. 23-25) artificially enhanced the sutures of his figured specimens. In reality these are obscured by longitudinal ribs and can only be distinguished by small twists in these ribs.

Stratigraphic range: *B. karreriana* was found in Middle Miocene - Quaternary deposits (N14-23) on the eastern Indonesian islands. It has been described previously from Late Miocene to Recent deposits (see synonymy; LeRoy, 1941a and 1941b; Boomgaart, 1949; Lewis, 1979).

Occurrence: According to LeRoy (1964) *B. karreriana* is an outer neritic - upper bathyal form. Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 40 and 1419 m. Coustillas (1983) found it between 125 and 350 m in the Mahakam Delta.

Brizalina macella Belford
(pl. 17, fig. 13)

1966 *Brizalina macella* Belford, p. 33, pl. 2, figs. 7-10.

Short description: Test slender, elongate, oval in apertural view, gradually broadening from initial end; periphery broadly rounded. Proloculus followed by 5-8 pairs of biserial chambers, enlarging gradually; sutures narrow, distinct, slightly depressed, strongly oblique. Wall finely and densely perforate, smooth, rarely ornamentated on the lower parts by faint continuous striae. Aperture broad, oval, with an imperforate margin, reaching to suture, with a tooth formed by the folded free edge of the toothplate.

Remarks: The specimens figured by Brady (1884, pl. 52, figs. 18-19) as *Bolivina punctata* d'Orbigny do not agree with the type description of this species, but resemble *B. macella*. Barker (1960) referred Brady's specimens to *Bolivina earlandi* Parr, but this species has a very narrow, elongate aperture compared to the broad, oval aperture of the specimens shown.

Bolivina arta Macfadyen resembles *B. macella*, but the chambers in the former species never become as high as in the latter species, and also the apertures are different. The largest difference, however, is the absence in *B. macella* of the triangular mass of clear shell substance occupying the space left by the roundings of the upper corners of the chambers.

Stratigraphic range: *B. macella* was found in Middle Miocene - Quaternary deposits (N14-23) on the eastern Indonesian islands. It has been observed previously in Late Miocene deposits from eastern Indonesia.

Occurrence: *B. macella* has in the eastern Indonesian material always been found in association with typical outer neritic - upper bathyal species.

Brizalina multilineata Belford
(pl. 17, figs. 8-10)

1966 *Brizalina multilineata* Belford, p. 31, pl. 2, figs. 1-6.

Short description: Test compressed, more or less triangular in outline, broadening gradually to greatest width at last pairs of chambers; periphery with wide, thin, fragile imperforate keel, sometimes spinose on early chambers. Globular proloculus followed by 4-5 pairs of biserial chambers, broader than high, enlarging slowly; sutures narrow, distinct, straight or slightly curved, strongly oblique, meeting at the centre of the test in thickened and raised areas of clear shell substance. Wall very finely and densely perforate, ornamented by low, fine, continuous costae. Aperture large, oval, with raised imperforate rim, reaching to suture, with a narrow tooth formed by the folded free edge of the toothplate.

Remarks: The eastern Indonesian specimens hardly ever show the well developed keel. According to Belford (1966) the length/breadth ratio usually lies between 1.4 to 1.5.

Stratigraphic range: *B. multilineata* was found in Middle Miocene (N14) and in Early Pliocene - Quaternary deposits (N19/20-23) on the eastern Indonesian islands. It has been described previously from Early - Late Miocene deposits from eastern Indonesia.

Occurrence: In the eastern Indonesian material *B. multilineata* has always been found in association with typical outer neritic - upper bathyal species.

Brizalina plicatella (Cushman)
(pl. 17, figs. 3-4)

1930 *Bolivina plicatella* Cushman, p. 46, pl. 8, figs.10a-b.
1966 *Brizalina plicatella* (Cushman); Belford, p. 26, pl. 1, figs. 8-9.

Short description: Test small, short and broad, compressed, greatest width near the apertural end; periphery subacute. Chambers, except for the last two, obscured by the irregular, reticulate ornamentation. Wall coarsely perforate, ornamented by two rounded or sharp, longitudinal ridges, interconnected by transverse ridges, coinciding partially with the chambers, breaking the wall into irregular depressions. Aperture an elongate loop.

Remarks: The longitudinal and transverse ridges are usually indistinct, but very clear are the coarsely perforate surface and the irregular depressions.

Belford (1966) observed the presence of re-entrants along the sutures, so also this species could have been transferred to the genus *Bolivina*, but again to avoid confusion and because no associated internal ridges were found we maintained the name *Brizalina plicatella*.

According to Ellis and Messina (1940, supplement for 1977) this species is very close, if not identical, with a species now living off the coasts of Australia which has been referred to *Bolivina plicata* d'Orbigny, but is very different from that species.

Stratigraphic range: *B. plicatella* was found in Early - Middle Miocene (N8) and in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Middle Eocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: In Recent eastern Indonesian sediments *B. plicatella* has only been found near Irian Jaya at a depth of 486 m (Van Marle, 1988).

According to Van der Zwaan (1982) this mud-dweller is highly tolerant to raised salinities and to oxygen deficiency.

Brizalina pseudobeyrichi (Cushman)
(pl. 17, figs. 6-7)

1884 *Bolivina beyrichi* Brady (not Reuss), p. 422, pl. 33, fig. 1.
1926 *Bolivina pseudobeyrichi* Cushman, p. 45.
1937 *Bolivina pseudobeyrichi* Cushman, p. 139, pl. 19, figs. 4, 5a-b.
1960 *Bolivina bradyi* Asano; Barker, p. 108, pl. 53, fig. 1.
1961 *Loxostomum pseudobeyrichi* (Cushman); Bandy, p. 21, pl. 4, figs. 13a-b.
1966 *Brizalina pseudobeyrichi* (Cushman); Belford, p. 28, pl. 1, figs. 15a-b.
1980 *Bolivina bramletti* Kleinpell, p. 132, pl. 7 figs. 15a-b.
1980 *Loxostomum pseudobeyrichi* (Cushman); Coulbourn, p. 708, text-fig. 9A.
1980 *Bolivina pseudobeyrichi* Cushman; Haller, p. 248, pl. 8, figs. 11a-b.
1988 *Brizalina pseudobeyrichi* (Cushman); Van Marle, p. 139, pl. 5, figs. 5-6.

Short description: Test elongate, strongly compressed, rather rapidly increasing in width; periphery distinctly keeled. Chambers increasing in height as added, distinct, slightly inflated; the posterior angle extended and pointed. Sutures distinct, depressed, oblique. Wall distinctly and coarsely perforate. Aperture elliptical to oval, with a distinct raised lip.

Remarks: *Brizalina alata* (Seguenza) resembles *B. pseudobeyrichi*, but is broader and has a larger and better developed peripheral keel (Belford, 1966, text-fig. 2; see also remarks of *B. alata*).

Bolivina bradyi Asano and *Bolivina bramletti* Kleinpell are considered to be more slender and elongate varieties ('ecological variants' according to Smith, 1963) of *B. pseudobeyrichi*, both being 2.5-3 times as long as broad, instead of 1.5-2 times.

Stratigraphic range: *B. pseudobeyrichi* was found in Late Pliocene - Quaternary deposits (N22) from Timor, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been recorded previously from Late Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *B. pseudobeyrichi* shows a scattered depth distribution down from 244 m (Van Marle, 1988).

Brizalina pygmaea (Brady)
(pl. 17, figs. 17-18)

1881 *Bolivina pygmaea* Brady, p. 57 (nomen nudum).
1884 *Bolivina pygmaea* Brady, p. 421, pl. 53, figs. 5-6.
1951 *Bolivina pygmaea* Brady; Hofker, p. 94, text-fig. 53.
1960 *Bolivina pygmaea* Brady; Barker, p. 108, pl. 53, figs. 5-6.
1966 *Brizalina* sp. cf. *B. pygmaea* (Brady); Belford, p. 31, pl. 1, figs. 19-22.
1984 *Bolivina pygmaea* Brady; Govindan, p. 244, pl. 1, fig. 4.

Short description: Test compressed, biconvex, widest near the top and tapering to a point at the base; sometimes laterally slightly carinate. Chambers numerous, biserially arranged, somewhat inflated, the peripheral ends extended into sharp points directed obliquely or horizontally. Sutures distinct, slightly depressed. Wall densely and coarsely perforate. Aperture loopshaped, extending up from base of final chamber.

Remarks: Most specimens of *B. pygmaea* in the eastern Indonesian material are elongate, similar to the ones found by Belford (1966), though also shorter and more compressed specimens were encountered.

Stratigraphic range: *B. pygmaea* was found in Late Miocene (N17) and Late Pliocene - Quaternary deposits (N22-23) on the eastern Indonesian islands. It has been described previously from Early Miocene to Recent deposits.

Occurrence: *B. pygmaea* has in our material always been found in association with typical upper - middle bathyal species.

Brizalina semicarinata Belford
(pl. 17, figs. 11-12)

1946 *Bolivina striato-carinata* Germeraad (not Cushman), p. 45, pl. 5, fig. 20.
1966 *Brizalina semicarinata* Belford, p.42, pl. 3, figs. 12-13.

Short description: Test slender, elongate, broadening slowly to greatest width at last pairs of chambers; periphery of lower part of test with narrow keel, rounded in the upper part. Globular proloculus followed by 7-10 pairs of biserially arranged chambers, enlarging slowly. Sutures of early chambers obscured by ornament, later narrow, distinct, smooth, strongly oblique. Wall coarsely and densely perforate; early part of the test ornamented by 10-15 continuous, low, narrow, longitudinal costae. Aperture small, oval, with low rounded imperforate rim, reaching to basal suture of chamber, with narrow tooth formed by the folded free edge of the toothplate.

Remarks: *B. semicarinata* resembles *Brizalina semilineata* Belford, but differs in chamber shape, in the presence of a small and narrow keel on the lower part of its test and in the ornamentation.

Bolivina subaenariensis Cushman differs from *B. semicarinata* by its slightly different chamber shape, its distinct sutures (even in the lower parts of the test), and its thicker and longer costae, covering almost the entire test.

Bolivina striato-carinata Cushman also resembles *B. semicarinata*, differing in having a distinct, strongly carinate margin, more elongated longitudinal costae, and a different chamber shape, with slightly overlapping chambers and limbate, strongly oblique sutures. The specimen shown by Germeraad (1946) lacks these features and must be considered as a specimen of *B. semicarinata*, and not of *B. striato-carinata*.

Stratigraphic range: *B. semicarinata* was found in Middle Miocene - Quaternary deposits (N14-23) on the eastern Indonesian islands. It has been observed previously in Middle Miocene - Pliocene deposits from eastern Indonesia.

Occurrence: *B. semicarinata* has in the Recent eastern Indonesian material always been encountered in association with typical outer neritic - upper bathyal species.

Brizalina semilineata Belford
(pl. 17, figs. 14-15)

1966 *Brizalina semilineata* Belford, p. 35, pl. 2, figs. 13-16.
1988 *Brizalina semilineata* Belford; Van Marle, p. 139, pl. 5, figs. 7-8.

Short description: Test elongate, gradually increasing in width towards last chamber. Periphery initially angular, later rounded. Large, globular proloculus followed by 4-5 pairs of biserially arranged chambers. Sutures narrow, but distinct and slightly depressed, strongly oblique, meeting at the centre of the test in small, smooth triangular areas of clear calcite. Wall finely and densely perforate; lower part ornamented by low, irregularly spaced costae. Aperture broad oval, reaching to basal suture, with narrow tooth formed by the folded free edge ot the toothplate.

Remarks: Some specimens of *B. semilineata* resemble shorter specimens of *B. macella* Belford in the shape of the test and in chamber shape, but differ in being initially costate and in having the triangular areas of clear shell substance. *Bolivina arta* Macfadyen is similar in the general shape of the test and in chamber shape to *B. semilineata*, but is a smooth form.

The type description of *Bolivina pusilla* Schwager (1866) is almost identical to the one given by Belford (1966) for *B. semilineata*, which therefore could be a junior synonym of *B. pusilla*. Nevertheless the name *B. semilineata* is maintained here because Belford described his holotype from the same geographic region.

Stratigraphic range: *B. semilineata* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early - Late Miocene deposits from eastern Indonesia, but forms resembling our material have under different names been recorded from Oligocene to Recent sediments of the Indo-Pacific region.

Occurrence: In Recent eastern Indonesian sediments *B. semilineata* generally occurs at neritic depths, with its UDL at 60 m, but also shows scattered deeper occurrences (Van Marle, 1988).

Brizalina seranensis (Germeraad)
(pl. 17, figs. 19-20)

1946 *Bolivina seranensis* Germeraad, p. 68, pl. 3, figs. 20-21.
1966 *Brizalina tuberosa* Belford, p. 41, pl. 3, figs. 5-7.

Short description: Test compressed, elongate, broadening gradually from rounded initial end to greatest width at last two chambers; periphery rounded. Chambers biserially arranged, enlarging slowly, wider than high; sutures narrow, straight or slightly curved, strongly oblique. Wall coarsely perforate, ornamented by raised, rounded or tubular projections forming openings for coarse pores, mainly along periphery. Aperture a narrow oval slit, with slightly raised imperforate margin reaching suture, and with small tooth formed by the folded free edge of toothplate.

Remarks: The specimens figured by Belford (1966) as *Brizalina tuberosa* closely resemble the type description of *B. seranensis*, and *B. tuberosa* is therefore regarded to be a junior synonym of *B. seranensis*.

Stratigraphic range: *B. seranensis* was found in Late Miocene - Quaternary deposits (N16-23) on the eastern Indonesian islands. It has been described previously from Early Miocene to Recent deposits from eastern Indonesia.

Occurrence: *B. seranensis* has in the eastern Indonesian material always been encountered in association with typical middle bathyal species.

Brizalina subreticulata (Parr)
(pl. 18, figs. 1-3)

1884 *Bolivina reticulata* Brady, p. 426, pl. 53, figs. 30-31.
1932 *Bolivina subreticulata* Parr, p. 12, pl. 1, fig. 21.
1937 *Bolivina subreticulata* Parr; Cushman, p. 148, pl. 19, figs. 24-26.
1960 *Bolivina subreticulata* Parr; Barker, p. 110, pl. 53, figs. 30-31.
1964 *Bolivina subreticulata* Parr; LeRoy, p. 31, pl. 2, fig. 16.
1966 *Brizalina subreticulata* (Parr); Belford, p. 29, pl. 1, figs. 17-18; text-fig. 3 (lectotype).
1983 *Bolivina subreticulata* Parr; Coustillas, pl. 29, fig. 5.
1988 *Bolivina subreticulata* Parr; Van Marle, p. 139, pl. 5, fig. 4.

Short description: Test small, rhomboid in front view, thickest along the median line, with sharp edges. Chambers biserially arranged, much longer than wide, slightly inflated in the later portion of the test; sutures distinct, limbate, sinuous. Wall finely perforate, ornamented in the early part of the test with a few irregular costae, later with reticulate network of thickened lines. Aperture an elongate-oval loop.

Remarks: The characteristic, irregular, reticulate ornament varies considerably in the specimens found in the eastern Indonesian material, but in all of them the last pair of chambers is smooth (see also Belford, 1966).

Stratigraphic range: *B. subreticulata* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *B. subreticulata* has only been observed near Irian Jaya at a depth of 150 m (Van Marle, 1988).

According to Parr (1932) and LeRoy (1964) *B. subreticulata* is an outer neritic - upper bathyal form, which is confirmed by the data of Coustillas (1983), who observed this species in waterdepths between 50 and 300 m in the Mahakam Delta.

Brizalina vescistriata Belford
(pl. 17, fig. 16)

1966 *Brizalina vescistriata* Belford, p. 34, pl. 2, figs. 11-12.

Short description: Test slender, elongate, test oval in end view, greatest width at 2/3 of length, higher sides of test parallel; periphery rounded. Globular proloculus followed by 8-11 pairs of biserially arranged chambers, enlarging gradually; sutures narrow, distinct, slightly depressed, straight to oblique. Wall finely perforate, ornamented by 12-14 low, fine, faint, continuous striations which vary in extent, being confined to the lower part of the test or extending over all but the last 2 chambers. Aperture narrow, elongate, with imperforate margin, reaching suture, with small tooth formed by the folded free edge of the toothplate.

Remarks: *B. vescistriata* resembles *Brizalina macella* Belford, but differs in having more chambers and in having the fine striations on the lower part of the test. *B. vescistriata* differs from *Brizalina semilineata* Belford in having more and slightly different chambers and in being striate.

Stratigraphic range: *B. vescistriata* was found in Late Pliocene - Quaternary deposits (N22-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Pliocene deposits from eastern Indonesia.

Occurrence: In Recent eastern Indonesian sediments *B. vescistriata* shows a scattered depth distribution down from 210 m (Van Marle, 1988).

Genus *Laterostomella* De Klasz and Rerat, 1962

Laterostomella voluta Belford
(pl. 18, figs. 7-9)

1966 *Laterostomella voluta* Belford, p. 44, pl. 3, figs. 14-16.

Short description: Test small, slender, oval in apertural view, gradually broadening to greatest width at last pair of chambers, twisted to different degrees. Globular proloculus followed by 5-6 pairs of biserially arranged, inflated chambers, enlarging slowly. Sutures narrow, distinct, depressed, slightly oblique. Wall finely and densely perforate, ornamented by 10-12 low, thin, continuous costae on all except last pair of chambers. Aperture large, rounded to elliptical, oblique, with small tooth formed by the narrowly folded free edge of the toothplate.

Remarks: *L. voluta* differs from the Lower Miocene *Laterostomella striata* De Klasz and Rerat in being twisted (sometimes through an angle of 90 degrees from first to last pair of chambers), less heavily ornamented and more compressed, with an oval outline in apertural view (Belford, 1966).

Stratigraphic range: *L. voluta* was found in Quaternary deposits (N23) from Timor. It has been observed previously in Early Miocene - Pliocene deposits from eastern Indonesia.

Occurrence: *L. voluta* has in the eastern Indonesian material always been found in association with typical outer neritic - upper bathyal species.

Family *Islandiellidae* Loeblich ans Tappan, 1964
Subfamily *Reissiinae* Saidova, 1961
Genus *Cassidulinoides* Cushman, 1927

Cassidulinoides bradyi (Norman)
(pl. 18, fig. 10)

1881	*Cassidulina bradyi* Norman, p. 59 (nomen nudum).
1884	*Cassidulina bradyi* Norman; Brady, p. 431, pl. 54, figs. 6-9.
1925	*Cassidulina bradyi* Norman; Cushman, p. 52, pl. 8, figs. 3-5.
1930	*Cassidulinoides bradyi* (Norman); Cushman, p. 58, pl. 11, figs. 8a-b.
1941b	*Cassidulinoides bradyi* (Norman); LeRoy, p. 85, pl. 6, figs. 18-19.
1960	*Cassidulinoides bradyi* (Norman); Barker, p. 112, pl. 54, figs. 6-9.
1964	*Cassidulinoides bradyi* (Norman); LeRoy, p. 41, pl. 12, fig. 5-6.
1966	*Cassidulinoides bradyi* (Norman); Belford, p. 53, pl. 26, figs. 22-27.
1984a	*Cassidulinoides bradyi* (Norman); Boersma, p. 663, pl. 4, fig. 5.
1984b	*Cassidulinoides bradyi* (Norman); Boersma, p. 1298, pl. 6, fig. 10.
1988	*Cassidulinoides bradyi* (Norman); Van Marle, p. 141, pl. 5, fig. 20.

Short description: Test crosier-shaped, subcylindrical, somewhat compressed; early stage subglobular, short, with chambers biserially arranged and enrolled, later part uncoiling, but continuing its biserial arrangement, straight, cylindrical. Chambers long and oblique, ends of the chambers overlapping alternatively; sutures distinct, slightly depressed. Wall smooth, finely perforate. Aperture loop-shaped, situated in a depression in the apertural face, sometimes with a small apertural flap.

Remarks: This species resembles strongly uncoiling species of the genus *Cassidulina* (superfamily *Cassidulinacea*) in general appearance. The morphological reasons, such as wall structure and structures around the aperture, for which this species (and the genus) was transferred to the superfamily *Eouvigerinacea* are not visible under a conventional microscope (see Rodrigues et al., 1980).

Stratigraphic range: *C. bradyi* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Oligocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: In Recent eastern Indonesian sediments *C. bradyi* has its UDL at 486 m and occurs scattered in the middle bathyal zone, but also shows deeper occurrences (Van Marle, 1988). However, according to LeRoy (1964) *C. bradyi* prefers neritic environments.

Family *Stilostomellidae* Finlay, 1947
Genus *Stilostomella* Guppy, 1894

Stilostomella abyssorum (Brady)

1881 *Nodosaria abyssorum* Brady, p. 63 (nomen nudum).
1884 *Nodosaria abyssorum* Brady, p. 504, pl. 63, figs. 8-9.
1960 *Stilostomella abyssorum* (Brady); Barker, p. 132, pl. 63, figs. 8-9.
1964 *Siphonodosaria abyssorum* (Brady); Loeblich and Tappan, C559, figs. 440,5-6.
1973 *Siphonodosaria abyssorum* (Brady); Douglas, p. 615, pl. 5, fig. 11.
1978 *Stilostomella abyssorum* (Brady); Boltovskoy, p. 169, pl. 7, fig. 16.
1985 *Stilostomella abyssorum* (Brady); Thomas, p. 678, pl. 14, fig. 9.

Short description: Test elongate, rectilinear to curvilinear, irregular, with a number of short basal spines. Usually 5, uniserially arranged, subglobose, irregular chambers, gradually enlarging; sutures constricted. Wall thick, smooth, finely perforate. Aperture terminal, rounded, on a short, broad neck with a large phialine lip and a projecting tooth.

Remarks: *S. abyssorum* differs from *Stilostomella consobrina* (d'Orbigny) by having a subglobular chamber shape, and from *Stilostomella antillea* (Cushman) by having completely smooth chambers instead of spinose ones.

Stratigraphic range: See *Stilostomella antillea* (Cushman). *S. abyssorum* has been described previously from Late Eocene to Recent deposits.

Occurrence: See *Stilostomella antillea* (Cushman).

Stilostomella antillea (Cushman)
(pl. 18, figs. 12-14)

1884 *Sagrina virgula* Brady, p. 583, pl. 76, figs. 9-10.
1923 *Nodosaria antillea* Cushman, p. 91, pl. 14, fig. 9.
1960 *Stilostomella antillea* (Cushman); Barker, p. 158, pl. 76, figs. 9-10.

1985 *Stilostomella antillea* (Cushman); Boichard et al., p. 92, pl. 16, figs. 41-42.

Short description: Test elongate and tapering, rectilinear to curvilinear. Chambers uniserially arranged, 6-10, angled near the base, the later ones may be somewhat remote; sutures distinct. Wall thick, finely perforate, upper part of the chambers smooth, basal part with a series of short spines or broken costae. Aperture on a short cylindrical neck with broad phialine lip.

Remarks: *S. antillea* differs from *Stilostomella abyssorum* (Brady) by having spinose or costate lower chamber margins, instead of smooth ones.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Stilostomella* spp.: *S. abyssorum*, *S. antillea*, *S. bradyi*, *S. consobrina*, *S. lepidula*, and *S. subspinosa*, of which *S. antillea* is most common. *Stilostomella* spp. were found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). Most species gathered in *Stilostomella* spp. have also been found in Recent sediments from eastern Indonesia (Van Marle, 1988).

S. antillea has been observed previously in Recent sediments.

Occurrence: In Recent eastern Indonesian sediments *Stilostomella* spp. have been found near Timor in waterdepths of 1951 m (Van Marle, 1988).

Bandy and Rodolfo reported *S. antillea* to have its UDL at 3150 m in the Peru-Chili Trench. Boichard et al. (1985) found this species in sediments at a depth of 490 m on the Pater Noster Platform.

Stilostomella bradyi (Cushman)

(pl. 18, fig. 11)

1884 *Sagrina virgula* Brady, p. 583, pl. 76, fig. 8.
1927a *Nodogenerina bradyi* Cushman, p. 79.
1960 *Stilostomella bradyi* (Cushman); Barker, p. 158, pl. 76, fig. 8.
1964 *Stilostomella bradyi* (Cushman); Loeblich and Tappan, C559, figs. 440,10-11.

Short description: Test elongate, rectilinear or curvilinear. Chambers uniserially arranged, enlarging gradually, inflated, widest near the finely spinose base, angled; sutures constricted. Wall smooth, finely perforate. Aperture rounded to elliptical, on a short neck with a phialine lip.

Remarks: *S. bradyi* differs from cogeneric species by having a spinose basal ridge on every chamber and by having constricted sutures.

Stratigraphic range: See *Stilostomella antillea* (Cushman).

Occurrence: See *Stilostomella antillea* (Cushman).

Stilostomella consobrina (d'Orbigny)

1846 *Dentalina consobrina* d'Orbigny, p. 46, pl. 2, figs. 1-3.
1884 *Nodosaria consobrina* (d'Orbigny); Brady, p. 501, pl. 62, figs. 23-24.
1949 *Nodogenerina consobrina* (d'Orbigny); Boomgaart, p. 98, pl. 8, fig. 12.

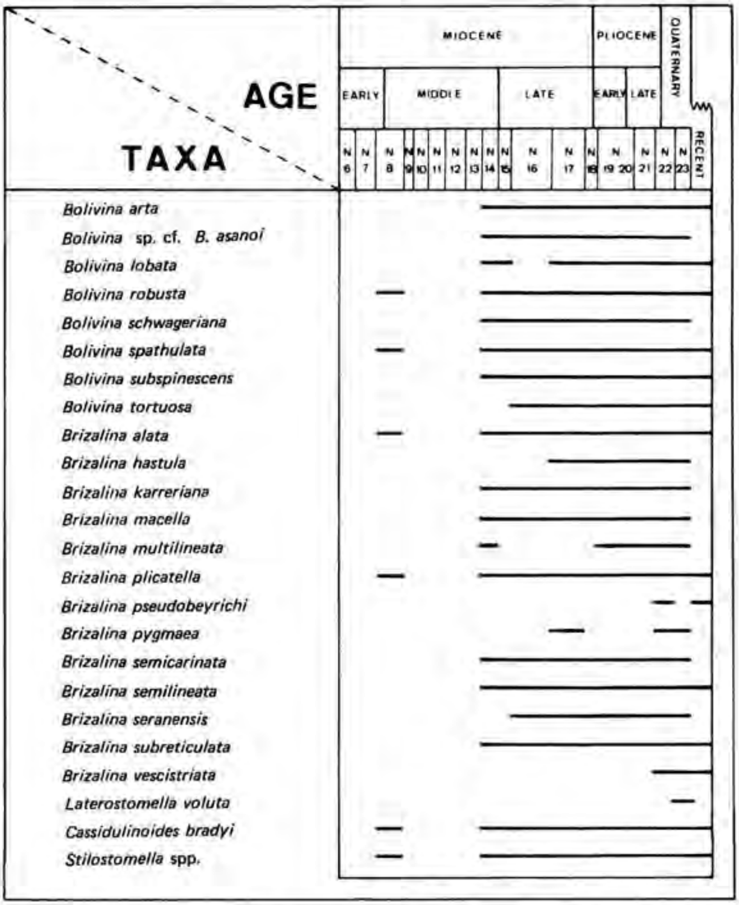

Fig. 21. Composite range chart of the superfamily *Eouvigerinacea* of the suborder *Rotaliina* in eastern Indonesia.

1960 *Stilostomella consobrina* (d'Orbigny); Barker, p. 130, pl. 62, figs. 23-24.
1985 *Stilostomella consobrina* (d'Orbigny); Papp and Schmid, p. 128, pl. 11, figs. 1-5.
1985 *Stilostomella consobrina* (d'Orbigny); Thomas, p. 678, pl. 14, figs. 6-7.
1986 *Stilostomella consobrina* (d'Orbigny); Boersma, p. 1028, pl. 13, figs. 4-5.

Short description: Test elongate, rectilinear or curvilinear. Chambers uniserially arranged, relatively broad, long, arcuate; sutures distinct, broad, slightly depressed. Wall coarsely perforate, usually smooth, but sometimes with spines randomly distributed over the chambers. Aperture terminal, extended, rounded, with a broad phialine lip and a distinct tooth.

Remarks: *S. consobrina* differs from *Stilostomella abyssorum* (Brady) by its chamber shape, and from *Stilostomella lepidula* (Schwager) by having more elongated chambers, especially the last one, and in being smooth.

Stratigraphic range: See *Stilostomella antillea* (Cushman). *S. consobrina* has been observed previously in Late Eocene to Late Pliocene deposits.

Occurrence: See *Stilostomella antillea* (Cushman).

Stilostomella lepidula (Schwager)

1866 *Nodosaria lepidula* Schwager, p. 210, pl. 5, figs. 27-28.
1921 *Nodosaria lepidula* Schwager; Cushman, p. 203, pl. 36, fig. 6.
1941a *Nodogenerina lepidula* (Schwager); LeRoy, p. 31, pl. 1, fig. 104.
1941b *Nodogenerina lepidula* (Schwager); LeRoy, p. 79, pl. 1, fig. 28.
1949 *Nodogenerina lepidula* (Schwager); Boomgaart, p. 99, pl. 8, fig. 13.
1951a *Ellipsonodosaria lepidula* (Schwager); Asano, p. 28, figs. 123-124.
1978 *Stilostomella* ex gr. *S. lepidula* (Schwager); Boltovskoy, p. 170, pl. 7, figs. 32-46.
1980 *Stilostomella lepidula* (Schwager); Haller, p. 252, pl. 8, fig. 7.
1980 *Stilostomella lepidula* (Schwager); Srinivasan and Sharma, p. 46, pl. 7, figs. 1-6 (neotype and topotype).
1980 *Stilostomella lepidula* (Schwager); Keller, p. 845, pl. 1, fig. 7.
1980 *Stilostomella* ex gr. *S. lepidula* (Schwager); Boltovskoy, p. 168, pl. 3, figs. 14a-b; pl. 4, figs. 13a-b.
1984a *Stilostomella lepidula* (Schwager); Boersma, p. 663, pl. 2, figs. 13-14.
1984b *Stilostomella lepidula* (Schwager); Boersma, p. 1286, pl. 7, fig. 9.
1985 *Stilostomella lepidula* (Schwager); Thomas, p. 678, pl. 14, fig. 8.
1986 *Stilostomella lepidula* (Schwager); Boersma, p. 990, pl. 16, figs. 1-4.

Short description: Test elongate, rectilinear or curvilinear, usually with basal spine. Chambers uniserially arranged, pyriform, enlarging gradually, the basal part of each chamber broad and somewhat excavated, furnished by a series of short pointed spines; sutures depressed, distinct. Wall smooth, except for the spinose lower chamber margins, finely perforate. Aperture rounded, on an elongate neck, with a broad phialine lip.

Remarks: We agree with Thomas (1985) that *Stilostomella consobrina* (d'Orbigny) should be used for forms in which the last chambers are elongated and *S. lepidula* for forms with more rounded chambers, with a ridge or ring of spines along the lower edge of each chamber. According to Boltovskoy (1978) and to Boersma (1986), *S. lepidula* includes a group of morphotypes which has evolved through time. All of these morphotypes are more or less curvilinear and possess few or more randomly distributed spines, some of which may line up on the chamber margins.

S. lepidula differs from *Stilostomella antillea* (Cushman), the other spinose species found in our material, by its chamber shape.

Stratigraphic range: See *Stilostomella antillea* (Cushman). *S. lepidula* has been widely recorded in Late Oligocene to Recent deposits from the Indo-Pacific region (see synonymy; LeRoy, 1964; Boltovskoy, 1984; Boichard et al., 1985).

Occurrence: See *Stilostomella antillea* (Cushman). According to LeRoy (1964) *S. lepidula* is an outer neritic - upper bathyal form. Boichard et al. (1985) found this species in sediments from 490 m on the Pater Noster Platform.

Stilostomella subspinosa (Cushman)

1943 *Ellipsonodosaria subspinosa* Cushman, p. 92, pl. 16, figs. 16-17.
1978 *Stilostomella subspinosa* (Cushman); Boltovskoy, p. 170, pl. 7, figs. 24-28.
1980 *Stilostomella subspinosa* (Cushman); Boltovskoy, p. 171, pl. 4, figs. 14a-b.
1985 *Stilostomella subspinosa* (Cushman); Thomas, p. 678, pl. 14, fig. 10.

Short description: Test elongate, rectilinear or curvilinear. Chambers uniserially arranged, broad and elongate, gradually increasing in size as added; sutures distinct and depressed. Wall covered with strong spines; in addition a basal ring of spines may be present on later chambers. Aperture rounded, on an elongate neck, with a broad phialine lip.

Remarks: *S. subspinosa* is completely covered with strong spines compared to the relatively smooth forms of *Stilostomella consobrina* (d'Orbigny) and *Stilostomella lepidula* (Schwager), though the latter form may have some delicate spines, especially at the lower chamber margins.

Stratigraphic range: See *Stilostomella antillea* (Cushman). *S. subspinosa* has been described previously from Eocene to Recent deposits (see synonymy and Boersma, 1986).

Occurrence: See *Stilostomella antillea* (Cushman). According to Boersma (1986) *S. subspinosa* is a deeper water form which is often observed in association with *Melonis pompilioides* (Fichtel and Moll).

Superfamily *Fursenkoinacea* Loeblich and Tappan, 1961
Family *Fursenkoinidae* Loeblich and Tappan, 1961
Subfamily *Fursenkoininae* Loeblich and Tappan, 1961
Genus *Fursenkoina* Loeblich and Tappan, 1961

Fursenkoina bradyi (Cushman)

1884 *Virgulina subsquammosa* Brady (not Egger), p. 415, pl. 52, fig. 9.
1922 *Virgulina bradyi* Cushman, p. 115, pl. 24, fig. 1.
1960 *Virgulina bradyi* Cushman; Barker, p. 106, pl. 52, fig. 9.
1985 *Fursenkoina bradyi* (Cushman); Thomas, p. 676, pl. 3, fig. 7.

Short description: Test elongate, slightly compressed, fusiform, rounded in section; initial end bluntly rounded, apertural end rounded. Chambers biserially arranged, twisted on the axis, comparatively few in number, inflated, greater in height than breadth; sutures distinct, oblique and depressed. Wall smooth, glossy, finely perforate. Aperture elongate to oval, extending up face of final chamber, the inner end broadest, with a slight rim, sometimes with a small denticulated tooth.

Stratigraphic range: See *Fursenkoina schreibersiana* (Czjzek). *F. bradyi* has been described previously from Miocene to Recent deposits.

Occurrence: See *Fursenkoina schreibersiana* (Czjzek).

Fursenkoina complanata (Egger)

1893 *Virgulina schreibersiana* Czjzek var. *complanata* Egger, p. 292, pl. 8, figs. 91-92.
1937 *Virgulina complanata* Egger; Cushman, p. 26, pl. 4, figs. 13-17.
1978 *Virgulina complanata* Egger; Boltovskoy, p. 173, pl. 8, figs. 34-35.
1980 *Stainforthia complanata* (Egger); Ingle et al., p. 144, pl. 5, figs. 10-11.
1985 *Stainforthia complanata* (Egger); Wang et al., p. 336, pl. 4, fig. 9.
1985 *Stainforthia complanata* (Egger); Thomas, p. 678, pl. 2, fig. 9.
1986 *Stainforthia complanata* (Egger); Kurihara and Kennett, p. 1070, pl. 2, fig. 17.

Short description: Test elongate, strongly compressed, flat; initial end sharp with a spine, apertural end rounded. Chambers elongate, biserially arranged, twisted on the axis; sutures deeply depressed and distinct. Wall smooth, densely and finely perforate. Aperture broad, loop-shaped, extending up the face of final chamber, with a slight rim.

Remarks: *F. complanata* has a broader aperture than any congeneric species.

Stratigraphic range: See *Fursenkoina schreibersiana* (Czjzek). *F. complanata* has been observed previously in Middle Miocene to Recent deposits.

Occurrence: See *Fursenkoina schreibersiana* (Czjzek).

Fursenkoina schreibersiana (Czjzek)
(pl. 18, figs. 15-17)

1848 *Virgulina schreibersiana* Czjzek, p. 147, pl. 13, figs. 18-21.
1884 *Virgulina schreibersiana* Czjzek; Brady, p. 414, pl. 52, figs. 1-3.
1922 *Virgulina schreibersiana* Czjzek; Cushman, p. 117, pl. 26, fig. 6.
1937 *Virgulina schreibersiana* Czjzek; Cushman, p. 13, pl. 2, figs. 11-20.
1949 Virgulina schreibersiana Czjzek; Boomgaart, p. 110, pl. 9, fig. 5.
1960 *Virgulina davisi* Barker (not Chapman and Parr), p. 106, pl. 52, figs. 1, 3.
1960 *Cassidella pacifica* Barker (not Hofker), p. 106, pl. 52, fig. 2.
1964 *Virgulina schreibersiana* Czjzek; LeRoy, p. 33, pl. 3, fig. 14.
1966 *Fursenkoina schreibersiana* (Czjzek); Belford, p. 136, pl. 9, figs. 18-21.

Short description: Test elongate, compressed; early part sharp, highly twisted with biserially arranged chambers; the twisting is lost in the rounded adult stage. Chambers elongate, slightly inflated, alternating irregularly, enlarging rapidly; sutures distinct, slightly depressed. Wall smooth, finely perforate.

Aperture loop-shaped to elongate-oval, with a slight rim and small tooth formed by the narrowly folded toothplate.

Remarks: The specimens shown by Barker (1960) as *Virgulina davisi* and *Cassidella pacifica* differ from the original description of that species, and resemble *F. schreibersiana.*

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Fursenkoina* spp.: *F. bradyi, F. complanata, F. schreibersiana*, and *F. texturata*, of which *F. schreibersiana* is most common. *Fursenkoina* spp. were found in Early - Middle Miocene (N8) and in Middle Miocene - Quaternary deposits (N14-23). All species gathered in *Fursenkoina* spp. have also been observed in Recent sediments from eastern Indonesia (but were erroneously named *Virgulina* spp.; Van Marle, 1988).

F. schreibersiana has been observed previously in Late Eocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: In Recent eastern Indonesian sediments *Fursenkoina* spp. occur at middle bathyal depths and deeper, with their DLO at 1290 m and their UDL at 317 m (Van Marle, 1988).

According to LeRoy (1964) the species *F. schreibersiana* prefers shallow water environments, and also Hageman (1979) reported this species to be a shallow marine mud-dweller.

According to Van der Zwaan (1982) all *Fursenkoina*-species are relatively tolerant to lower oxygen conditions as they can survive stagnant conditions.

Fursenkoina texturata (Brady)

1884 *Virgulina texturata* Brady, p. 415, pl. 52, fig. 6.
1960 *Virgulina texturata* Brady; Barker, p. 106, pl. 52, fig. 6.
1978 *Virgulina texturata* Brady; Boltovskoy, p. 173, pl. 8, figs. 36-37.
1983 *Virgulina texturata* Brady; Coustillas, pl. 28, fig. 15.

Short description: Test elongate, somewhat compressed, broadest near obtuse or rounded apertural end and tapering to a point at the opposite end; margin lobulated. Chambers numerous, biserially arranged, ventricose, regular; sutures distinct, depressed. Wall smooth, finely perforate. Aperture a nearly erect, loop-shaped slit on inner face of final chamber, with slight rim.

Stratigraphic range: See *Fursenkoina schreibersiana* (Czjzek). *F. texturata* has been described previously from Middle Miocene to Recent deposits.

Occurrence: See *Fursenkoina schreibersiana* (Czjzek). Coustillas (1983) found *F. texturata* in sediments between 50 and 100 m in the Mahakam Delta.

Superfamily *Glabratellacea* Loeblich and Tappan, 1964
Family *Buliminoididae* Seiglie, 1970
Genus *Buliminoides* Cushman, 1911

Buliminoides williamsonianus (Brady)
(pl. 19, fig. 8)

1881 *Bulimina williamsonianus* Brady, p. 56 (nomen nudum).

1884 *Bulimina williamsonianus* Brady, p. 408, pl. 51, figs. 16-17.
1960 *Buliminoides williamsonianus* (Brady); Barker, p. 104, pl. 51, figs. 16-17.
1964 *Buliminoides williamsonianus* (Brady); Loeblich and Tappan, C544, figs. 426,8-11.
1987 *Buliminoides williamsonianus* (Brady); Crouch and Poag, p. 167, pl. 1, fig. 4.

Short description: Test elongate, cylindrical, sinuate in contour, circular in transverse section; initial end slightly tapering and rounded, arranged in a low trochospiral coil, later part obliquely truncate, coiling around the open umbilicus. Chambers long, narrow, nearly erect; sutures indistinct, flush. Wall finely perforate, ornamented by series of sinuate, diagonal, parallel costae. Aperture umbilical, simple, in a depression at the center of the oblique apertural face, bordered by radiating lines.

Remarks: *B. williamsonianus* is characterized by the ornament of diagonal, parallel costae and the oblique apertural face.

Stratigraphic range: *B. williamsonianus* was found in Late Miocene (N16-17), in Early - Late Pliocene (N19/20-21), and Quaternary deposits (N23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Late Miocene to Recent deposits from the Indo-Pacific region.

Occurrence: In Recent eastern Indonesian sediments *B. williamsonianus* has only been found near Timor at a depth of 100 m (Van Marle, 1988).

Family *Glabratellidae* Loeblich and Tappan, 1964
Genus *Glabratella* Dorreen, 1948

Glabratella australensis (Heron-Allen and Earland)
(pl. 19, figs. 1-4)

1884 *Discorbina pileolina* Brady (not d'Orbigny), p. 649, pl. 89, figs. 2-4.
1932 *Discorbis australensis* Heron-Allen and Earland, p. 416.
1951a *Discorbis australensis* Heron-Allen and Earland; Asano, p. 2, figs. 6-7.
1960 *Pileolina* (?) *australensis* (Heron-Allen and Earland); Barker, p. 184, pl. 89, figs. 2-4.

Short description: Test trochoid, circular in outline, planoconvex, with a strongly convex, evolute spiral side, and flattened, involute umbilical side with strongly depressed, open umbilicus; periphery broadly rounded. Few, curved, long and narrow chambers, trochospirally arranged, enlarging rapidly; sutures limbate on spiral side, radial on opposite side. Wall hyaline, finely perforate, with smooth spiral surface and umbilical side with characteristic radial ornamentation consisting of fine grooves alternating with radially arranged rows of pustules. Aperture a small, rounded opening, restricted to the open umbilicus.

Remarks: This species is transferred to the genus *Glabratella* because of: (1) the typical, umbilical, radial ornamentation, (2) its aperture, which is restricted to open umbilicus and (3) the lack of umbilical alar prolongations of chambers, characteristic for *Discorbis* (see Loeblich and Tappan, 1964).

The sexual reproduction of *G. australensis* is plastogametic (Lipps, 1982), as is shown on pl. 19, fig. 1. During plastogamy two or more gamonts come together with their apertural sides appressed, forming a single 'brood chamber' (Lipps and Erskian, 1969).

Stratigraphic range: *G. australensis* was found in Late Miocene (N17) and in Early Pliocene - Quaternary deposits (N19/20-23) on the eastern Indonesian islands.

Occurrence: *G. australensis* has in the eastern Indonesian material always been found in association with typical upper - middle bathyal species.

Genus *Heronallenia* Chapman and Parr, 1931

Heronallenia lingulata (Burrows and Holland)
(pl. 19, figs. 5-7)

1884	*Discorbina biconcava* Brady (not Jones and Parker), p. 653, pl. 91, fig. 3 (not 2).
1895	*Discorbina lingulata* Burrows and Holland, p. 297, pl. 7, figs. 33a-c.
1957	*Heronallenia lingulata* (Burrows and Holland); Todd and Brönniman, p. 37, pl. 11, figs. 7-8.
1960	*Heronallenia lingulata* (Burrows and Holland); Barker, p. 188, pl. 91, fig. 3.
1965	*Discorbina lingulata* Burrows and Holland; Todd, p. 26, pl. 5, fig. 3.
1985	*Heronallenia lingulata* (Burrows and Holland); Thomas, p. 677, pl. 13, fig. 7.

Short description: Test compressed, planoconvex; umbilical side flat to concave with broad, open umbilicus, spiral side slightly convex, evolute; periphery somewhat square. Chambers trochospirally arranged, increasing rapidly in width as added; sutures limbate and thickened on the spiral side, with interlocking angles on the umbilical side. Wall finely perforate, smooth, except for the spiral side which is ornamented by a slightly raised boss. Aperture a large ovate opening into umbilicus.

Remarks: *H. lingulata* differs from *Planulinoides biconcavus* (Jones and Parker) in having limbate sutures upon one side only, in being planoconvex, and in lacking a prominent square and limbate periphery.

Stratigraphic range: *H. lingulata* was found in Late Pliocene - Quaternary deposits (N22-23) from Timor. It has been described previously from Pliocene to Recent deposits.

Occurrence: *H. lingulata* has in the eastern Indonesian material always been found in association with typical outer neritic - upper bathyal species.

Superfamily *Nonionacea* Schultze, 1854
Family *Almaenidae* Myatlyuk, 1959
Subfamily *Anomalinellinae* Saidova, 1981
Genus *Anomalinella* Cushman, 1927

Anomalinella rostrata (Brady)
(pl. 20, figs. 9-10)

1881 *Truncatulina rostrata* Brady, p. 65 (nomen nudum).
1884 *Truncatulina rostrata* Brady, p. 668, pl. 94, figs. 6a-c.
1954 *Anomalinella rostrata* (Brady); Cushman et al., p. 371, pl. 91, fig. 24.
1960 *Anomalinella rostrata* (Brady); Barker, p. 194, pl. 94, figs. 6a-c.
1964 *Anomalinella rostrata* (Brady); LeRoy, p. 44, pl. 6, figs. 15-17.
1964 *Anomalinella rostrata* (Brady); Loeblich and Tappan, C764, fig. 628,4.
1965 *Anomalinella rostrata* (Brady); Todd, p. 50, pl. 21, figs. 7-10.
1966 *Anomalinella rostrata* (Brady); Belford, p. 185, pl. 33, figs. 9-13.
1983 *Anomalinella rostrata* (Brady); Coustillas, pl. 37, fig. 6.
1988 *Anomalinella rostrata* (Brady); Van Marle, p. 139, pl. 4, fig. 1.

Short description: Test lenticular, trochoid to nearly planispiral, involute, biumbonate, with carinate periphery. Chambers planispirally arranged, numerous, enlarging gradually; sutures thickened, limbate, distinct. Wall hyaline, smooth and coarsely perforate, excluded the peripheral keel and sutures. Aperture an interiomarginal arch against peripheral margin of previous whorl, with lip; secondary aperture an elongate slit paralleling peripheral keel.

Remarks: The characteristic supplementary aperture is in most cases only open on the last chamber and closed on the earlier chambers by a porous plate which in time becomes fused with the chamber wall so that the outline of the aperture cannot be detected (see Belford, 1966).

Stratigraphic range: *A. rostrata* was found in Middle Miocene (N14), Late Miocene - Early Pliocene (N17-18), and Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Early Miocene to Recent deposits from the Indo-Pacific region (see synonymy and LeRoy, 1941a and 1941b).

Occurrence: In Recent eastern Indonesian sediments *A. rostrata* generally occurs at neritic depths, with its UDL at 60 m. Scattered deeper occurrences have been observed (Van Marle, 1988). Coustillas (1983) found this species in waterdepths between 50 and 150 m in the Mahakam Delta. These observations support the opinion of LeRoy (1964) and Todd (1965), who consider *A. rostrata* to be a widespread species in warm and relatively shallow waters.

Family *Melonidae* Chapman, Parr and Collins, 1934
Genus *Melonis* De Montfort, 1808

Melonis affinis (Reuss)
(pl. 20, figs. 1-3)

1851 *Nonionina affine* Reuss, p. 72, pl. 5, figs. 32a-b.
1858 *Nonionina barleeana* Williamson, p. 32, pl. 3, figs. 68-69.
1884 *Nonionina umbilicata* (Montagu); Brady, p. 726, pl. 109, figs. 8-9.
1929 *Nonion affinis* (Reuss); Cushman, p. 89, pl. 13, figs. 24a-b.
1939 *Nonion affine* (Reuss) ; Cushman, p. 9, pl. 2, figs. 13a-b.
1941b *Nonion affinis* (Reuss); LeRoy, p. 77, pl. 6, figs. 26-27.
1960 *Gavelinonion barleeanum* (Williamson); Barker, p. 224, pl. 109, figs. 8-9.
1966 *Melonis affinis* (Reuss); Belford, p. 184, pl. 31, figs. 1-4.
1973 *Melonis affinis* (Reuss); Douglas, p. 638, pl. 9, figs. 1-2.
1978 *Nonion affine* (Reuss); Boltovskoy, p. 162, pl. 5, figs. 1-2.
1979 *Melonis barleeanum* (Williamson); Corliss, p. 10, pl. 5, figs. 7-8.
1980 *Melonis barleeanus* (Williamson); Coulbourn, p. 705, text-fig. 6D.
1980 *Melonis barleeanus* (Williamson); Haller, p. 265, pl. 16, figs. 4a-b, 6.
1980 *Melonis affinis* (Reuss); Ingle et al., p. 140, pl. 5, figs. 1-2.
1980 *Melonis barleeanum* (Williamson); Ingle et al., p. 142, pl. 7, figs. 14-15.
1980 *Melonis affinis* (Reuss); Keller, p. 859, pl. 3, fig. 13.
1980 *Melonis affine* (Reuss); Boltovskoy, p. 165, pl. 2, figs. 11a-b.
1984a *Nonion barleeanum* (Williamson); Boersma, p. 667, pl. 3, figs. 11-13.
1984b *Nonion barleeanum* (Williamson); Boersma, p. 1298, pl. 6, figs. 3-5.
1985 *Melonis barleeanus* (Williamson); Thomas, p. 677, pl. 12, fig. 3.
1986 *Melonis barleeanus* (Williamson); Kurihara and Kennett, p. 1077, pl. 9, figs. 10-11.
1988 *Melonis affinis* (Reuss); Van Marle, p. 147, pl. 3, fig. 9.

Short description: Test slightly longer than broad, early stage slightly trochspiral, adult planispiral, involute, symmetrical, compressed, deeply biumbilicate; periphery broadly rounded. Chambers distinct, 10-14 in last whorl, uniform, increasing regularly in size as added; sutures distinct, straight or slightly curved, depressed near periphery, sometimes ending in a thickened rim near umbilicus. Wall coarsely perforate. Aperture a low, curved slit at the base of the apertural face, extending laterally to umbilicus on both sides of the test.

Remarks: We agree with Boltovskoy (1978) that *Melonis barleeanum* (Williamson, 1858) is a junior synonym of *M. affinis.*

Of the three Melonis species found in the eastern Indonesian material, *M. affinis* is the most slender and deepest umbilicate form.

Stratigraphic range: *M. affinis* was found in Early - Middle Miocene (N8) and in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Oligocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *M. affinis* occurs generally in waterdepth between 545 and 2119 m, with its DLO at 1654 m and its UDL at 244 m (Van Marle, 1988).

Pflum and Frerichs (1976) reported this species from neritic to lower bathyal depths in the Gulf of Mexico. Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 479 and 2469 m.

According to Corliss (1985) *M. affinis* also lives infaunal, deeper than 6 cm within the sediment, and can survive the prevailing low oxygen conditions.

Melonis pompilioides (Fichtel and Moll)
(pl. 20, figs. 4-6)

1798 *Nautilus pompilioides* Fichtel and Moll, p. 31, pl. 2, figs. a-c.
1884 *Nonionina pompilioides* (Fichtel and Moll); Brady, p. 727, pl. 109, figs. 10-11.
1929 *Nonion pompilioides* (Fichtel and Moll); Cushman, p. 89, pl. 13, figs. 25a-b.
1939 *Nonion pompilioides* (Fichtel and Moll); Cushman, p. 19, pl. 5, figs. 9-12.
1941b *Nonion pompilioides* (Fichtel and Moll); LeRoy, p. 78, pl. 6, figs. 28-29.
1950 *Nonion pompilioides* (Fichtel and Moll); Asano, p. 4, figs. 15-16.
1960 *Nonion pompilioides* (Fichtel and Moll); Barker, p. 224, pl. 109, figs. 10-11.
1964 *Nonion pompilioides* (Fichtel and Moll); LeRoy, p. 27, pl. 10, figs. 10-11.
1964 *Melonis pompilioides* (Fichtel and Moll); Loeblich and Tappan, C761, figs. 627,1a-b.
1966 *Melonis pompilioides* (Fichtel and Moll); Belford, p. 183, pl. 30, figs. 17-20.
1973 *Melonis pompilioides* (Fichtel and Moll); Douglas, p. 614, pl. 9, figs. 8-9.
1976 *Melonis pompilioides* (Fichtel and Moll); Hansen and Lykke-Andersen, p. 24, pl. 22, figs. 10-13.
1978 *Nonion pompilioides* (Fichtel and Moll); Boltovskoy, p. 162, pl. 5, figs. 3-4.
1979 *Melonis pompilioides* (Fichtel and Moll); Corliss, p. 12, pl. 5, figs. 9-10.
1980 *Melonis pompilioides* (Fichtel and Moll); Ingle et al., p. 142, pl. 9, figs. 14-15.
1980 *Melonis pompilioides* (Fichtel and Moll); Keller, p. 844, pl. 3, figs. 11-12.
1984 *Melonis pompilioides* (Fichtel and Moll); Rögl and Hansen, p. 30, pl. 2, figs. 1-2; pl. 3, fig. 1.
1985 *Melonis pompilioides* (Fichtel and Moll); Thomas, p. 677, pl. 12, figs. 1-2.

1986 *Melonis pompilioides* (Fichtel and Moll); Kurihara and Kennett, p. 1077, pl. 9, figs. 7-8.

1986 *Melonis pompilioides* (Fichtel and Moll); Van Morkhoven et al., p. 72, pl. 23A, figs. 1-2; pl. 23C, figs. 1a-d.

Short description: Test biumbilicate, slightly compressed, involute; periphery very broadly rounded. Chambers planispirally arranged, low and broad, increasing slowly in size as added, usually 11 in the final whorl; sutures straight, radiating, smooth. Wall coarsely perforate, except for imperforate sutures and apertural face. Aperture an interiomarginal, equatorial slit with distinct protruding lip, that continues into the umbilici, remaining open in previous chambers.

Remarks: *M. pompilioides* differs from *Melonis soldanii* (d'Orbigny) by the stronger increase in width of the chambers, the thin, straight, smooth to slightly depressed sutures, radiating out from the center of umbilicus, and the coarser perforations (Berggren and Haq, 1976; Hasegawa, 1983; Van Morkhoven et al., 1986). When we compare the *Melonis*-species found in eastern Indonesia, *M. pompilioides* is the form with the widest chambers, *M. affinis* a deeply umbilicate form with the most slender chambers, and *M. soldanii* the intermediate form.

Smaller, wider, more inflated and coarser perforate forms, often described as *Melonis sphaeroides* Voloshinova (1958), have not been found (see Hasegawa, 1983; Van Morkhoven et al., 1986).

Stratigraphic range: *M. pompilioides* was found in Late Miocene - Quaternary deposits (N17-22), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been recorded previously from Late Oligocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: In Recent eastern Indonesian sediments *M. pompilioides* has only been found near Timor at a depth of 1954 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to have its UDL at 2500 m in the Peru-Chili Trench. Pflum and Frerichs (1976) reported this form to occur at abyssal depths in the Gulf of Mexico. Corliss (1979) observed this species in the southeastern Indian Ocean in waterdepths between 2500 and 4600 m, and regarded it as an important deep sea form. Moore et al. (1980) considered this species to be indicative for depths exceeding 2000 m.

Hageman (1979) and Jonkers (1984) considered this to be an open, normal marine species.

According to Van Morkhoven et al. (1986) *M. pompilioides* is a deep water species. However, the type specimens are from neritic deposits and therefore the deep water ecotype is often renamed *M. sphaeroides* Voloshinova (1958).

Melonis soldanii (d'Orbigny)

(pl. 20, figs. 7-8)

1846 *Nonionina soldanii* d'Orbigny, p. 109, pl. 5, figs. 15-16.

1939 *Nonion soldanii* (d'Orbigny); Cushman, p. 13, pl. 3, figs. 10-11; pl. 4, fig. 23.

1976 *Melonis soldanii* (d'Orbigny); Berggren and Haq, p. 102, 105, pl. 1, figs. 21-22.

1986 *Melonis soldanii* (d'Orbigny); Van Morkhoven et al., p. 74, pl. 23B, figs. 1-2.

Short description: Test closely coiled, biumbilicate, the umbilical area deeply excavated; periphery very broadly rounded, almost truncate. Chambers planispirally arranged, uniform, not inflated, increasing very slightly in size as added; sutures distinct, not depressed, limbate, slightly curved. Wall smooth, coarsely perforate. Aperture a low, broad opening at base of apertural face, extending to both umbilici.

Remarks: *M. soldanii* differs from *Melonis pompilioides* (Fichtel and Moll) by the lesser width of the last chambers, the smaller pores, and the broad, flush and tangentially curved sutures (Berggren and Haq, 1976; Hasegawa, 1983; Van Morkhoven et al., 1986). Corliss (1979) observed similar forms in the southeastern Indian Ocean.

Stratigraphic range: *M. soldanii* was found in Late Miocene - Quaternary deposits (N17-22), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *M. soldanii* occurs generally in waterdepths between 911 and 2119 m, with its DLO at 1654 m and its UDL at 684 m (Van Marle, 1988).

M. soldanii is often considered to be the bathyal homeomorph of *M. pompilioides* (Pflum and Frerichs, 1976; Berggren and Haq, 1976; Van Morkhoven et al., 1986).

Family *Nonionidae* Schultze, 1854
Subfamily *Nonioninae* Schultze, 1854
Genus *Nonion* De Montfort, 1808

Nonion depressulum (Walker and Jacob)
(pl. 20, fig. 16)

1798 *Nautilus depressulus* Walker and Jacob, p. 641, pl. 14, fig. 33.

1884 *Nonionina depressula* (Walker and Jacob); Brady, p. 725, pl. 109, figs. 6-7.

1930 *Nonion depressulum* (Walker and Jacob); Cushman, p. 3, pl. 1, figs. 3-6.

1939 *Nonion depressulum* (Walker and Jacob); Cushman, p. 20, pl. 5, figs. 22-25.

1960 *Nonion depressulum* (Walker and Jacob); Barker, p. 224, pl. 109, figs. 6-7.

1976 *Nonion depressulum* (Walker and Jacob); Hansen and Lykke-Andersen, p. 21, pl. 19, figs. 3-6.

Short description: Test compressed, symmetrical, nearly involute, biumbilicate with depressed umbilical regions; periphery rounded. Chambers planispirally arranged, increasing in height as added, 9-10 chambers in last whorl; sutures distinct, deeply depressed, recurved. Wall finely perforate, smooth. Aperture an obscure, narrow arched slit at base of apertural face.

Remarks: The name *N. depressulum* derived from the characteristic depressed sutures, which become even more depressed near the umbilici.

Stratigraphic range: *N. depressulum* was found in Middle Miocene (N14) and Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Pliocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *N. depressulum* shows a scattered depth distribution down from 78 m (Van Marle, 1988).

According to Hageman (1979) and Murray (1983) *N. depressulum* is primarily a shallow species which shows tolerance for decreasing salinities.

Nonion scaphum (Fichtel and Moll)
(pl. 21, figs. 1-2)

1798 *Nautilus scapha* Fichtel and Moll, p. 105, pl. 19, figs. d-f.
1884 *Nonionina scapha* (Fichtel and Moll); Brady, p. 730, pl. 109, figs. 14-15.
1939 *Nonion scaphum* (Fichtel and Moll); Cushman, p. 20, pl. 5, figs. 18-21.
1953 *Nonion scaphum* (Fichtel and Moll); Asano, p. 4, figs. 17-18.
1960 *Nonion scaphum* (Fichtel and Moll); Barker, p. 224, pl. 109, figs. 14-15.
1988 *Nonion scaphum* (Fichtel and Moll); Van Marle, p. 147, pl. 4, fig. 8.

Short description: Test compressed, symmetrical, involute, except for the last chambers which tend to become evolute, biumbonate; periphery broadly rounded, unornamented, lobulate in outline. Chambers planispirally arranged, increasing slowly in size as added, 10-12 in the last whorl; the last ones broadening on proximal end and more inflated; sutures distinct, depressed, radial, slightly curved. Wall smooth, finely perforate. Aperture a small opening at base of apertural face.

Stratigraphic range: *N. scaphum* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *N. scaphum* generally occurs at neritic depths (60-150 m), but also shows scattered deeper occurrences (Van Marle, 1988). Lewis (1979) found it in sediments from the continental margin of New Zealand in waterdepths between 479 and 1419 m.

Genus *Nonionella* Cushman, 1926

Nonionella bradii (Chapman)

1884 *Nonionina scapha* Brady (not Fichtel and Moll), p. 730, pl. 109, fig. 16.

1916 *Nonionina scapha* (Fichtel and Moll) var. *bradii* Chapman, p. 71, pl. 5, fig. 42.

1960 *Nonionella bradii* (Chapman); Barker, p. 224, pl. 109, fig. 16.

Short description: Test trochospiral, compressed; periphery rounded. Spiral side partially evolute with umbonal boss, opposite side involute with final chamber forming a distinct umbilical flap overhanging umbilical region. Chambers numerous, broad, low; sutures distinct, depressed. Wall smooth, finely perforate. Aperture a low interiomarginal arch near periphery, extending somewhat onto umbilical side.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Nonionella* spp.: *N. bradii*, *N. japonica*, and *N. turgida*. *Nonionella* spp. were found in Late Miocene (N15-16) and Early Pliocene - Quaternary deposits (N19/20-22). All species gathered in *Nonionella* spp. have also been found in Recent sediments from eastern Indonesia (Van Marle, 1988).

N. bradii has been observed previously in Recent sediments (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *Nonionella* spp. generally occur at neritic - upper bathyal depths, with its UDL at 78 m, but also show scattered deeper occurrences (Van Marle, 1988).

Lewis (1979) found *N. bradii* in sediments from the continental margin of New Zealand in waterdepths between 276 and 2329 m.

Nonionella japonica (Asano)

1936 *Pseudononion japonicum* Asano, p. 347-348, text-figs. A-C.

1939 *Nonionella japonica* (Asano); Cushman, p. 32, pl. 9, fig. 1.

1953 *Pseudononion japonicum* Asano, p. 4, figs. 19-21.

1978 *Pseudononion japonicum* Asano; Boltovskoy, p. 166, pl. 6, figs. 10-11.

1982 *Pseudononion japonicum* Asano; Saunders and Müller-Merz, p. 262, pl. 1, figs. 1-3.

Short description: Test trochospiral, asymmetrical, compressed; periphery subacute. Spiral side slightly convex and partially evolute; umbilical side nearly completely evolute and relatively flat; small umbilicus partly covered by short chamber lobes. Chambers distinct, 10-12 in last whorl, increasing rapidly in height; sutures distinct, gently curved, slightly depressed, paralleled by raised bands of clear calcite. Wall smooth, finely perforate. Aperture a narrow slit at base of apertural face.

Remarks: We transferred our specimens from *Pseudononion* Asano to *Nonionella* because of the evoluteness of the test and the small chamber lobes, which partially cover the umbilicus.

Nonionella (Pseudononion) japonica (Asano, 1936) must not be confused with *Nonion japonicum* Asano (1938), as the former is, apart from other significant differences, trochospiral and the latter planispiral (Saunders and Müller-Merz, 1982).

Stratigraphic range: See *Nonionella bradii* (Chapman). *N. japonica* has been described previously from Early Miocene to Recent deposits.

Occurrence: See *Nonionella bradii* (Chapman).

Nonionella turgida (Williamson)

1858 *Rotalina turgida* Williamson, p. 50, pl. 4, figs. 95-97.
1884 *Nonionina turgida* (Williamson); Brady, p. 731, pl. 109, figs. 17-19.
1914 *Nonionina turgida* (Williamson); Cushman, p. 29, pl. 15, figs. 3a-b.
1930 *Nonionella turgida* (Williamson); Cushman, p. 15, pl. 6, figs. 1-4.
1939 *Nonionella turgida* (Williamson); Cushman, p. 32, pl. 9, figs. 2-3.
1960 *Nonionella turgida* (Williamson); Barker, p. 224, pl. 109, figs. 17-19.

Short description: Test longer than broad, compressed, irregularly heart-shaped; periphery rounded. Dorsal side evolute, ventral side involute. Chambers trochospirally arranged, increasing rapidly in size and length as added; final chamber on ventral side has an elongated lob extending over the umbilical area. Sutures distinct, straight or radial, strongly curved towards periphery. Wall smooth, finely perforate. Aperture a narrow slit below the bulbous portion of final chamber on ventral side.

Remarks: *N. turgida* is the most frequently encountered *Nonionella*-species in our material. It differs from congeneric species by its very high chambers, which extend over the umbilical area.

Stratigraphic range: See *Nonionella bradii* (Chapman). *N. turgida* has been described previously from Recent sediments.

Occurrence: See *Nonionella bradii* (Chapman). Lewis (1979) found *N. turgida* in sediments from the continental margin of New Zealand in waterdepths between 40 and 2063 m.

Subfamily *Pulleninae* Schwager, 1877

Genus *Pullenia* Parker and Jones, 1862

Pullenia bulloides (d'Orbigny)

(pl. 20, figs. 13-15)

1823 *Nonionina bulloides* d'Orbigny, p. 293, mod. no. 2 (nomen nudum).
1884 *Pullenia sphaeroides* (d'Orbigny); Brady, p. 615, pl. 84, figs. 12-13.
1941a *Pullenia sphaeroides* (d'Orbigny); LeRoy, p. 43, pl. 1, figs. 1-2.
1941b *Pullenia sphaeroides* (d'Orbigny); LeRoy, p. 86, pl. 6, figs. 20-21.
1943 *Pullenia bulloides* (d'Orbigny); Cushman and Todd, p. 13, pl. 2, figs. 15-18.
1944b *Pullenia sphaeroides* (d'Orbigny); LeRoy, p. 90, pl. 4, figs. 20-21.
1946 *Pullenia* sp. Germeraad, p. 72, pl. 5, figs. 3-4.
1960 *Pullenia bulloides* (d'Orbigny); Barker, p. 174, pl. 84, figs. 12-13.
1964 *Pullenia bulloides* (d'Orbigny); Loeblich and Tappan, C748, fig. 613,6.

1965 *Pullenia bulloides* (d'Orbigny); Todd, p. 48, pl. 18, fig. 6.
1973 *Pullenia bulloides* (d'Orbigny); Douglas, p. 615, pl. 8, figs. 1-2.
1976 *Pullenia bulloides* (d'Orbigny); Hansen and Lykke-Andersen, 23, pl. 22, figs. 1-4.
1978 *Pullenia bulloides* (d'Orbigny); Boltovskoy, p. 166, pl. 6, fig. 12.
1979 *Pullenia bulloides* (d'Orbigny); Corliss, p. 8, pl. 4, figs. 1-2.
1980 *Pullenia bulloides* (d'Orbigny); Haller, p. 261, pl. 14, figs. 4a-b.
1980 *Pullenia bulloides* (d'Orbigny); Ingle et al., p. 142, pl. 5, fig. 7.
1980 *Pullenia bulloides* (d'Orbigny); Boltovskoy, p. 168, pl. 3, figs. 2a-b; pl. 4, figs. 10a-b.
1981 *Pullenia bulloides* (d'Orbigny); Burke, p. 8, pl. 3, figs. 5-6.
1983 *Pullenia bulloides* (d'Orbigny); Coustillas, pl. 40, fig. 13.
1984 *Pullenia bulloides* (d'Orbigny); Govindan, p. 246, pl. 2, fig. 5.
1985 *Pullenia bulloides* (d'Orbigny); Papp and Schmid, p. 174, pl. 34, figs. 6-9.
1986 *Pullenia bulloides* (d'Orbigny); Kurihara and Kennett, p. 1074, pl. 6, figs. 5-6.
1988 *Pullenia bulloides* (d'Orbigny); Van Marle, p. 148, pl. 3, fig. 4.

Short description: Test almost sphaeroidal, planispiral, involute, hardly compressed; periphery not lobulated, broadly rounded. Chambers slightly convex, 4-4.5 chambers in the final whorl; last chamber with relatively high apertural face; sutures radial, flush. Wall smooth, shining, finely perforate. Aperture a narrow, interiomarginal crescentic slit, extending from umbilicus to umbilicus; generally open in the median part, the lateral parts closed by secondary material.

Remarks: Characteristic species with spherical form, flush sutures and low apertural face (Todd, 1965). *P. bulloides* differs from *Pullenia quinqueloba* (Reuss) by its spherical form, with 4-4.5 chambers in the last whorl.

Stratigraphic range: *P. bulloides* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Paleocene to Recent deposits from the Indo-Pacific region (see synonymy; Boomgaart, 1949; De Hornibrook, 1961; LeRoy, 1964; Lewis, 1979; Boltovskoy, 1984; Boersma, 1986).

Occurrence: In Recent eastern Indonesian sediments *P. bulloides* occurs generally in waterdepths between 545 and 2119 m with higher frequencies between 1654 and 2119 m, with its DLO at 1954 m and its UDL at 545 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported *P. bulloides* to have its UDL at 1860 m in the Peru-Chili Trench. Pflum and Frerichs (1976) reported this species from upper - middle bathyal depths in the Gulf of Mexico. Corliss (1979) observed this species in waterdepths between 2500 and 4600 m in the southeastern Indian Ocean. Lewis (1979) found it in sediments from the continental margin of New Zealand between 1240 and 2469 m. Moore et al

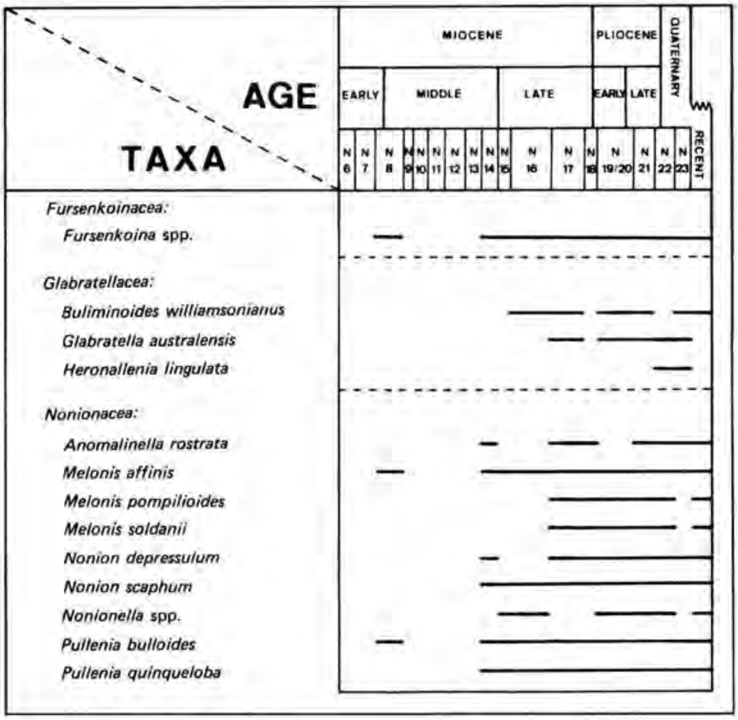

Fig. 22. Composite range chart of the superfamilies *Fursenkoinacea*, *Glabratellacea* and *Nonionacea* of the suborder *Rotaliina* in eastern Indonesia.

(1980) considered this species to be indicative for depth of more than 2000 m. Burke (1981) observed *P. bulloides* in waterdepths greater than 2500 m. Coustillas (1983) reported it to have its UDL at 404 m in the Mahakam Delta.

Pullenia quinqueloba (Reuss)
(pl. 20, figs. 11-12)

1851 *Nonionina quinqueloba* Reuss, p. 71, pl. 5, fig. 31.
1884 *Pullenia quinqueloba* (Reuss); Brady, p. 617, pl. 84, figs. 14-15.
1943 *Pullenia quinqueloba* (Reuss); Cushman and Todd, p. 10, pl. 2, fig. 5; pl. 3, fig. 8.
1960 *Pullenia subcarinata* (d'Orbigny); Barker, p. 174, pl. 84, figs. 14-15.
1965 *Pullenia quinqueloba* (Reuss); Todd, p. 48, pl. 18, fig. 7.
1973 *Pullenia quinqueloba* (Reuss); Douglas, p. 615, pl. 9, figs. 4-5.
1978 *Pullenia subcarinata* (d'Orbigny) var. *quinqueloba* (Reuss); Boltovskoy, p. 166, pl. 6, figs. 23-24.
1980 *Pullenia quinqueloba* (Reuss); Ingle et al., p. 142, pl. 5, fig. 8.
1980 *Pullenia subcarinata quinqueloba* (Reuss); Boltovskoy, p. 171, pl. 4, figs. 12a-b.

1984b *Pullenia quinqueloba* (Reuss); Boersma, p. 1286, pl. 8, fig. 8.
1985 *Pullenia quinqueloba* (Reuss); Thomas, p. 678, pl. 4, fig. 2.
1988 *Pullenia quinqueloba* (Reuss); Van Marle, p. 148, pl. 3, fig. 5.

Short description: Test suborbicular, quadrate in side view, compressed, planispiral, involute, with rounded to subacute periphery. Chambers quinquelob, convex, 5-6 in final whorl; sutures slightly depressed near periphery, thickened near umbilicus, radial. Wall smooth, shining, finely perforate. Horse-shoe shaped apertural face; aperture a narrow, interiomarginal crescentic slit, only open in the median part.

Remarks: *P. quinqueloba* differs from *Pullenia bulloides* (d'Orbigny) by its compressed test (though periphery remains rounded), its higher horse-shoe shaped apertural face, and in having 5-6 chambers in the final whorl.

Stratigraphic range: *P. quinqueloba* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Paleocene to Recent deposits (see synonymy; Boomgaart, 1949; De Hornibrook, 1961; Boltovskoy, 1984).

Occurrence: In Recent eastern Indonesian sediments *P. quinqueloba* occurs generally in waterdepths between 711 and 2119 m, with its DLO at 1954 m and its UDL at 495 m (Van Marle, 1988).

Superfamily *Nummulitacea* De Blainville, 1827
Family *Nummulitidae* De Blainville, 1827
Genus *Heterostegina* d'Orbigny, 1826

Heterostegina depressa d'Orbigny
(pl. 21, fig. 4)

1826 *Heterostegina depressa* d'Orbigny, p. 305, pl. 17, figs. 5-7.
1884 *Heterostegina depressa* d'Orbigny; Brady, p. 746, pl. 112, figs. 14-16.
1960 *Heterostegina depressa* d'Orbigny; Barker, p. 232, pl. 112, figs. 14-16.
1977 *Heterostegina depressa* d'Orbigny; Hottinger, p. 102, figs. 24B-E, 33C-E, 34, 35D, 36C.
1983 *Heterostegina depressa* d'Orbigny; Coustillas, pl. 14, figs. 7-8.
1984 *Heterostegina depressa* d'Orbigny; Hallock, p. 253, pl. 1, fig. 9.
1985 *Heterostegina depressa* d'Orbigny; Boichard et al., p. 90, pl. 15, fig. 3.
1985 *Heterostegina depressa* d'Orbigny; Hughes, p. 13, text-fig. 4.
1987 *Heterostegina depressa* d'Orbigny; Crouch and Poag, p. 169, pl. 2, fig. 8.
1988 *Heterostegina* sp. cf. *H. depressa* d'Orbigny; Van Marle, p. 145, pl. 4, figs. 6-7.

Short description: Test lenticular, strongly compressed, discoidal, involute, planispiral. Chambers subdivided into chamberlets. Wall smooth, finely perforate, sometimes ornamented with raised imperforate bands on primary and secondary sutures. Aperture an arched slit at base of apertural face.

Remarks: Röttger and Hallock (1982) reported strong variations in shape within *H. depressa*. The initial median chambers are simple, but later chambers are subdivided into rectangular chamberlets, without direct communication between the neighbouring chamberlets of the same chamber. Complex canalsystem of septal, marginal, and vertical canals is present. Canals of intraseptal canal system are simple, without bifurcations, in both primary and secondary chamber sutures.

Stratigraphic range: *H. depressa* was found in Quaternary deposits (N23) from Timor, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been previously observed in Pliocene to Recent deposits.

Occurrence: This species occurs worldwide in tropical and subtropical waters, and shows an increase in size with increasing waterdepth in the Gulf of Elat (Hottinger, 1977). In Recent eastern Indonesian sediments *H. depressa* has been found near Irian Jaya and Tanimbar at neritic depths (Van Marle, 1988). Coustillas (1983) encountered this species in sediments between 50 and 200 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 45 m on the Pater Noster Platform.

According to Crouch and Poag (1987) *H. depressa* prefers clear, warm, quiet marine waters in carbonate-rich environments. Only light intensity and wave action seem to limit the occurrence of this tropical species (Röttger, 1975).

Genus *Operculina* d'Orbigny, 1826

Operculina ammonoides (Gronovius)
(pl. 21, figs. 3-4)

1781 *Nautilus ammonoides* Gronovius, p. 282 (nomen nudum).
1884 *Operculina complanata* Brady (not Defrance), p. 745, pl. 112, figs. 3-9, 11-13 (not 1-2).
1914 *Operculina ammonoides* (Gronovius); Cushman, p. 37, pl. 14, fig. 7.
1941b *Operculina ammonoides* (Gronovius); LeRoy, p. 78, pl. 6, figs. 24-25.
1960 *Operculina ammonoides* (Gronovius); Barker, p. 230, pl. 112, figs. 3-9, 11-13.
1963 *Operculina ammonoides* (Gronovius); Cole, p. 14, pl. 5, figs. 13-24, 26-30, 33-35.
1977 *Operculina ammonoides* (Gronovius); Hottinger, p. 100, figs. 7, 11-12, 23, 24A, 25-28, 36B.
1983 *Operculina ammonoides* (Gronovius); Coustillas, p. 107, pl. 13, figs. 1-8; pl. 14, figs. 1-3.
1984 *Operculina ammonoides* (Gronovius); Hallock, p. 253, pl. 1, figs. 10a-b.
1985 *Operculina ammonoides* (Gronovius); Boichard et al., p. 90, pl. 15, fig. 2.
1988 *Operculina ammonoides* (Gronovius); Van Marle, p. 148, pl. 1, figs. 3-4.

Short description: Test lenticular, discoidal, nearly symmetrical, umbilical area somewhat depressed; periphery sharply rounded, non-lobulate. Chambers planispirally arranged, distinct, 10-12 in the last whorl (14-18 in megalospheric forms), last 2-3 inflated; sutures distinct, flush to slightly raised, limbate; spiral sutures distinct, limbate. Wall smooth or ornamented, finely perforate. Aperture a peripheral arched slit at base of last chamber.

Remarks: Wide variations in shape and size characterize modern operculinids in the Indo-Pacific region (Cole, 1963; Hottinger, 1977; Coustillas, 1983): specimens vary from small and unornamented, evenly lenticular, involute tests to relatively large, compressed, evolute tests.

Stratigraphic range: *O. ammonoides* was found in Late Miocene - Early Pliocene (N18) and Late Pliocene - Quaternary deposits (N21-22), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *O. ammonoides* occurs generally in waterdepths between 60 and 244 m, showing higher frequencies between 60 and 150 m and with its DLO at 90 m (Van Marle, 1988).

According to Hottinger (1977) this species occurs worldwide in tropical and subtropical waters, predominantly between 30 and 150 m, and shows preference for soft substrates. Coustillas (1983) found this species in samples from waterdepths between 0 and 40 m in the Mahakam Delta and established a bathymetric zonation based on morphological differences: in the littoral zone mostly megalospheric forms occur, whereas deeper smoother mostly microspheric forms occur. At intermediate depths more coarsely ornamented forms can be found. Boichard et al. (1985) found *O. ammonoides* at a depth of 45 m on the Pater Noster Platform.

Fermont et al. (1983) observed that involute specimens of *O. ammonoides* are most frequent in shallow, vegetated areas, whereas the evolute types predominate on muddy substrates.

Superfamily *Planorbulinacea* Schwager, 1877
Familiy *Cibicididae* Cushman, 1927
Subfamily *Cibicidinae* Cushman, 1927
Genus *Cibicides* De Montfort, 1808

Cibicides kullenbergi Parker
(pl. 21, figs. 9-11)

1953 *Cibicides kullenbergi* Parker; Parker, p. 49, pl. 11, figs. 7-8.
1978 *Cibicides kullenbergi* Parker; Boltovskoy, p. 155, pl. 3, figs. 9-12.
1979 *Cibicidoides kullenbergi* (Parker); Corliss, p. 10, pl. 3, figs. 4-6.
1980 *Cibicides kullenbergi* Parker; Boltovskoy, p. 165, pl. 1, figs. 13a-b.
1984a *Heterolepa kullenbergi* (Parker); Boersma, p. 663, pl. 5, fig. 8.
1984b *Heterolepa kullenbergi* (Parker); Boersma, p. 1286, pl. 4, fig. 5; pl. 8, figs. 7, 9.
1985 *Cibicidoides kullenbergi* (Parker); Thomas, p. 675, pl. 8, figs. 1-2.

1986 *Cibicidoides kullenbergi* (Phleger and Parker); Kurihara and Kennett, p. 1076, pl. 8, figs. 1-3.

Short description: Test large, biconvex, spiral side evolute and less convex than involute, umbilical side; periphery acute with a narrow keel. Chambers trochospirally arranged in 3 whorls, 11-13 in the last whorl, meeting at the center on umbilical side in irregular mass of clear shell material; sutures flush, strongly curved. Wall thick, smooth, finely perforate, with a few large pores widely spaced on each spiral chamber. Aperture a peripheral, low, interiomarginal, peripheral opening, extending slightly on both sides, with a narrow lip.

Remarks: According to Parker (1953; in Phleger et al.) *C. kullenbergi* differs from *Cibicidoides robertsonianus* (Brady) in having a less translucent wall, fewer chambers in the adult form, broader and fewer whorls, more curving sutures, and more, widely spaced, large pores.

C. kullenbergi differs from *Cibicidoides mundulus* (Brady, Parker and Jones) in its larger size, greater convexity of the involute, umbilical side, the strongly curved sutures, and in having an extension of the aperture onto the evolute spiral side. Van Morkhoven et al. (1986) did not find any other morphological differences between *C. kullenbergi* and *C. mundulus* than the differences in test size, and considered *C. kullenbergi* therefore to be a junior synonym of *C. mundulus*.

Boersma (1984a, 1984b, 1986) transferred this species to the genus *Heterolepa* because of the apertural characteristics: the peripheral aperture, with lip, extends onto the umbilical side and onto the spiral side. Boersma also reported her *Heterolepa kullenbergi* to be a dissolution-resistant species.

Stratigraphic range: *C. kullenbergi* was found in Late Miocene - Early Pliocene (N17-18) and in Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been found previously in Late Oligocene to Recent deposits (see synonymy; Boltovskoy, 1984; Boersma, 1986; Van Morkhoven et al., 1986).

Occurrence: In Recent eastern Indonesian sediments *C. kullenbergi* occurs scattered deeper than 1288 m (Van Marle, 1988). This agrees with the opinion of Van Morkhoven et al., (1986) who consider this species to be a common form in Neogene deep sea sediments.

Pflum and Frerichs (1976) reported this species to have its UDL in the middle bathyal zone in the Gulf of Mexico. According to Van der Zwaan (1982) it prefers deep waters with stable marine conditions.

Corliss (1985) observed *C. kullenbergi* living infaunal within the top 0-2 cm of the sediment.

Cibicides lobatulus (Walker and Jacob)

(pl. 21, figs. 12-14)

1798 *Nautilus lobatulus* Walker and Jacob, p. 642, pl. 14, fig. 36.

1884 *Truncatulina lobatula* (Walker and Jacob); Brady, p. 660, pl. 93, figs. 1, 4-5.

1921 *Truncatulina lobatula* (Walker and Jacob); Cushman, p. 313, pl. 63, figs. 2a-c.

1931 *Cibicides lobatulus* (Walker and Jacob); Cushman, p. 118, pl. 21, figs. 3a-c.

1941c *Cibicides lobatulus* (Walker and Jacob); LeRoy, p. 119, pl. 1, figs. 12-14.

1960 *Cibicides lobatulus* (Walker and Jacob); Barker, p. 192, pl. 93, figs. 1, 4-5.

1965 *Cibicides lobatulus* (Walker and Jacob); Todd, pl. 52, pl. 22, fig. 1.

1979 *Cibicides lobatulus* (Walker and Jacob); Corliss, p. 10, pl. 3, figs. 7-9.

1979 *Cibicides lobatulus* (Walker and Jacob); Osterman and Kellogg, p. 264, pl. 1, figs. 1-3.

1980 *Cibicides lobatulus* (Walker and Jacob); Haller, p. 266, pl. 18, figs. 3-5.

1983 *Cibicides lobatulus* (Walker and Jacob); Coustillas, pl. 35, fig. 10.

1984 *Cibicides lobatulus* (Walker and Jacob); Papp and Schmid, p. 64, pl. 56, figs. 1-5.

1988 *Cibicides lobatulus* (Walker and Jacob); Van Marle, p. 141, pl. 4, figs. 18-19.

Short description: Test trochospiral, compressed; periphery sharp, irregular, lobulated in later part of test. Dorsal side convex, with convex chambers, separated by deep sutures. Ventral side variously developed, either flat or concave. Wall thick, coarsely and distinctly perforate. Interiomarginal aperture, extending onto spiral side, sometimes with small lip.

Remarks: The wide morphological variation is partly due to the fact that specimens live attached, and that the test varies in relation to the configuration of the substratum (Todd, 1965; Haller, 1982).

Stratigraphic range: *C. lobatulus* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Miocene to Recent deposits (see synonymy; LeRoy, 1941a, 1941b, and 1964; Boichard et al., 1985).

Occurrence: In Recent eastern Indonesian sediments *C. lobatulus* generally occurs at neritic - upper bathyal depths, with its DLO at 150 m and its UDL at 60 m, but also shows scattered deeper occurrences (Van Marle, 1988).

This supports the opinion of LeRoy (1964) and Pflum and Frerichs (1976), who considered *C. lobatulus* to be an outer neritic - upper bathyal form. Coustillas (1983) found this species in samples from waterdepths between 50 and 400 m in the Mahakam Delta and Boichard et al. (1985) between 45 and 230 m on the Pater Noster Platform.

Hageman (1979) observed that this species has tolerance for restricted marine conditions. Sejrup et al. (1981) reported that this species is common on coarse sediments, deposited in higher energy environments. According to

Van der Zwaan (1982) this epiphytic form shows tolerance to increased salinities.

Cibicides refulgens De Montfort
(pl. 21, figs. 15-16; pl. 22, fig. 1)

1808 *Cibicides refulgens* De Montfort, p. 122-123 (nomen nudum).
1884 *Truncatulina refulgens* (De Montfort); Brady, p. 659, pl. 92, figs. 7-9.
1921 *Truncatulina refulgens* (De Montfort); Cushman, p. 312, pl. 63, figs. 1a-c.
1960 *Cibicides refulgens* De Montfort; Barker, p. 190, pl. 92, figs. 7-9.
1964 *Cibicides refulgens* De Montfort; Loeblich and Tappan, C688, figs. 554,1a-c.
1966 *Cibicides* sp. cf *C. refulgens* De Montfort; Belford, p. 133, pl. 23, figs. 1-6.
1979 *Cibicides refulgens* De Montfort; Osterman and Kellogg, p. 264, pl. 1, figs. 4-5.
1983 *Cibicides refulgens* De Montfort; Coustillas, p. 102, pl. 36, figs. 1-7 (not 8-10).
1985 *Cibicides refulgens* De Montfort; Boichard et al., p. 92, pl. 16, figs. 5-7.

Short description: Test small, conical, trochospiral, planoconvex; spiral side flat to excavated and evolute, umbilical side strongly convex and involute; periphery angular, with small keel. Chambers conical; sutures smooth, broad and slightly curved spirally, narrow and sinuous umbilically. Wall coarsely perforate on spiral side, more finely on umbilical side, with imperforate keel and apertural face. Aperture low and interiomarginal, with broad lip, may extend along spiral suture.

Remarks: *C. refulgens* resembles *Cibicides tenuimargo* (Brady), but differs by its smaller keel and somewhat more regular test. Further characteristic of *C. refulgens* are the curved sutures on the flat spiral (attached) side and the conical shape of the opposite side (Todd, 1965).

Coustillas (1983) showed the wide morphological variation of this species, which he considered to be caused by the substrate: slightly biconvex forms dwell on a soft substrate and planoconvex forms on a harder substrate.

Stratigraphic range: *C. refulgens* was found in Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been previously observed in Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *C. refulgens* shows a scattered depth distribution down from 60 m (Van Marle, 1988).

According to LeRoy (1964) *C. refulgens* is an outer neritic - upper bathyal form. Coustillas (1983) found it in sediments between 30 and 400 m, with highest frequencies between 30 and 90 m, in the Mahakam Delta and Boichard et al. (1985) at a depth of 220 m on the Pater Noster Platform.

Cibicides tenuimargo (Brady)
(pl. 22, figs. 2-3)

1884 *Truncatulina tenuimargo* Brady, p. 662, pl. 93, fig. 3 (not 2).
1960 *Cibicides tenuimargo* (Brady); Barker, p. 192, pl. 93, fig. 3.
1964 *Cibicides tenuimargo* (Brady); LeRoy, p. 44, pl. 8, figs. 30-32.
1966 *Cibicides tenuimargo* (Brady); Belford, p. 135, pl. 23, figs. 7-9.

Short description: Test small, trochospiral, planoconvex; spiral side flat and evolute, umbilical side strongly convex and involute; periphery with well defined, continuous, thin peripheral keel. Chambers few, 5-6 visible on the ventral side, arranged in only 1.5-2 whorls; sutures distinct, broad, slightly curved and depressed. Wall smooth, coarsely perforate at spiral side and more finely perforate at umbilical side. Aperture small, interiomarginal and peripheral, extending along the spiral suture.

Remarks: *C. tenuimargo* is characterized by the thin, continuous peripheral keel and the somewhat more irregular shape, which distinguish it from *Cibicides refulgens* De Montfort. Coustillas (1983, pl. 36, figs. 8-10) depicted some specimens of *Cibicides refulgens* De Montfort, which forms he considered to be transitional to *C. tenuimargo*. In our opinion these forms are already within the morphological range of that species.

Stratigraphic range: *C. tenuimargo* was found in Middle Miocene (N14) and Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Miocene to Recent deposits (see synonymy and Coustillas, 1983).

Occurrence: In Recent eastern Indonesian sediments *C. tenuimargo* has only been found near Irian Jaya at a depth of 150 m and (probably displaced) at 2119 m (Van Marle, 1988).

According to LeRoy (1964) *C. tenuimargo* is an outer neritic - upper bathyal form, which is confirmed by the data of Coustillas (1983), who found this species in sediments between 100 and 400 m in the Mahakam Delta.

Family *Cymbaloporidae* Cushman, 1927
Subfamily *Cymbaloporinae* Cushman, 1927
Genus *Cymbaloporetta* Cushman, 1928

Cymbaloporetta bradyi (Cushman)
(pl. 23, figs. 1-2)

1884 *Cymbalopora poeyi* Brady (not d'Orbigny), p. 637, pl. 102, fig. 14.
1915 *Cymbalopora poeyi* (d'Orbigny) var. *bradyi* Cushman, p. 25, pl. 10, fig. 2; pl. 14, fig. 2.
1924 *Cymbalopora bradyi* Cushman, p. 34, pl. 10, figs. 2-4.
1954 *Cymbaloporetta bradyi* (Cushman); Cushman et al., p. 364, pl. 90, figs. 13-14.
1957 *Cymbaloporetta bradyi* (Cushman); Todd and Brönniman, p. 37, pl. 11, fig. 9.

1960 *Cymbaloporetta bradyi* (Cushman); Barker, p. 210, pl. 102, fig. 14.
1965 *Cymbaloporetta bradyi* (Cushman); Todd, p. 37, pl. 19, figs. 1-4; pl. 20, fig. 4.
1983 *Cymbaloporetta bradyi* (Cushman); Coustillas, pl. 40, fig. 20.

Short description: Test variable, conical in outline; spiral side highly convex, opposite side flat to depressed near small open umbilicus; periphery rounded. Early chambers trochospirally arranged, later ones alternating in annual series; sutures oblique and flush spirally, umbilically broad, deeply depressed and radial. Wall densely and coarsely perforate on spiral side, and less densely to imperforate on umbilical side. Apertures consisting of one or more sutural openings at each side of the chambers on umbilical side.

Remarks: *C. bradyi* shows an extreme variability in shape, as is typical of attached species (Todd, 1965, p. 37).

C. bradyi has a flatter and more spreading form than the genoholotype of *Cymbaloporetta squammosa* (d'Orbigny), in addition to more, irregular lobes on the umbilical side, a thinner, more delicate wall, and the absence of a porous plate covering the umbilical side.

C. bradyi is more compressed and has a much more open arrangement of the chambers on the umbilical side than *Cymbaloporetta poeyi* (d'Orbigny).

Stratigraphic range: *C. bradyi* was found in Late Miocene (N17) and Late Pliocene - Quaternary deposits (N22), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been recorded previously from Pliocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *C. bradyi* has only been found near Irian Jaya at a depth of 150 m (Van Marle, 1988).

According to LeRoy (1964) and Todd (1965) *C. bradyi* is widespread in shallow waters. Coustillas (1983) found this species in samples from waterdepths between 150 and 400 m in the Mahakam Delta.

Family *Planorbulinidae* Schwager, 1877

Genus *Planorbulina* d'Orbigny

Planorbulina mediterranensis d'Orbigny

(pl. 23, figs. 3-4)

1826 *Planorbulina mediterranensis* d'Orbigny, p. 280, pl. 14, figs. 4-6.
1884 *Planorbulina mediterranensis* d'Orbigny; Brady, p. 656, pl. 92, figs. 1-3.
1960 *Planorbulina mediterranensis* d'Orbigny; Barker, p. 190, pl. 92, figs. 1-3.
1964 *Planorbulina mediterranensis* d'Orbigny; Loeblich and Tappan, C692, figs. 560,1-2.
1985 *Planorbulina mediterranensis* d'Orbigny; Papp and Schmid, p. 64, pl. 55, figs. 5-7.

Short description: Test flat, discoidal, trochospiral, attached. Chambers arched dorsally, flat ventrally; early portion spirally coiled, chambers each with single aperture, later two apertures developing per chamber, each giving rise to a new biapertural chamber, thus making numerous spirals of chambers. Wall coarsely perforate, brownish in color. Usually 1-2 interiomarginal, peripheral, oval apertures on each chamber of final whorl, each with a narrow bordering lip; smaller supplementary openings occur on both side of the test.

Remarks: The external morphological variation that this species exhibits can partly be explained by the fact that specimens live attached, and that the test varies in relation to the configuration of the substratum.

Stratigraphic range: *P. mediterranensis* was found in Late Miocene deposits (N17) from Buton, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *P. mediterranensis* has only been found near Timor and Tanimbar in waterdepths between 60 and 210 m (Van Marle, 1988).

According to Hageman (1979) this is a shallow water form with a preference for normal marine conditions.

Family *Planulinidae* Bermudez, 1952
Subfamily *Planulininae* Bermudez, 1952
Genus *Hyalinea* Hofker, 1951

Hyalinea balthica (Schroeter)
(pl. 22, figs. 4-5)

1783 'Das platte Ammonshorn aus der Ostsee', Schroeter, p. 20, pl. 1, fig. 2.
1791 *Nautilus balthicus* Gmelin, p. 3370.
1884 *Operculina ammonoides* Brady (not Gronovius), p. 745, pl. 112, figs. 1-2.
1931 *Anomalina balthica* (Schroeter); Cushman, p. 108, pl. 19, figs. 3a-c.
1949 *Anomalina balthica* (Schroeter); Boomgaart, p. 148, pl. 14, fig. 7.
1951 *Hyalinea balthica* (Schroeter); Hofker, p. 508, text-figs. 345-348.
1951a *Anomalina balthica* (Schroeter); Asano, p. 14, figs. 6-7.
1960 *Hyalinea balthica* (Schroeter); Barker, p. 230, pl. 112, figs. 1-2.
1964 *Hyalinea balthica* (Schroeter); LeRoy, p. 44, pl. 9, figs. 34-36.
1964 *Hyalinea balthica* (Schroeter); Loeblich and Tappan, C686, figs. 522,2-3.
1966 *Hyalinea balthica* (Schroeter); Belford, p. 124, pl. 14, figs. 1-8.
1983 *Hyalinea balthica* (Schroeter); Coustillas, pl. 35, fig. 3.
1984 *Hyalinea balthica* (Schroeter); Govindan, p. 246, pl. 2, fig. 8.
1984 *Hyalinea balthica* (Schroeter); Ross, p. 134, pl. 1, figs. 1-16.
1985 *Hyalinea balthica* (Schroeter); Wang et al., p. 337, pl. 5, fig. 13.
1986 *Hyalinea balthica* (Schroeter); Wang and Lutze, p. 57, fig. 5, no. 2a-c; pl. 3, figs. 1a-c, 11-16.
1986 *Hyalinea balthica* (Schroeter); Van Morkhoven et al., p. 21, pl. 3, figs. 1-3.
1988 *Hyalinea balthica* (Schroeter); Van Marle, p. 145, pl. 2, fig. 21.

Short description: Test flat, discoidal, strongly compressed, slightly trochospiral to planispiral, nearly evolute on both sides; periphery angled, with broad imperforate keel; 9-12 chambers in final whorl, slowly enlarging, extended at each side to form distinct umbilical flaps; sutures curved, limbate, thickened, sometimes slightly raised, merging with keel. Wall hyaline, finely perforate. Primary aperture an interiomarginal, equatorial arch, bordered by a thickened lip; secondary apertures open beneath umbilical flaps on both sides of the test.

Remarks: According to Wang and Lutze (1986), the last stage in ontogeny of foraminifera does not necessarily reflect a next step in phylogeny, but can be considered as a general phenomenon of adaption. Recent spiral, hyaline benthic foraminifera, such as *H. balthica*, show a tendency towards inflated chambers late in ontogeny. Two ontogenetic stages may be recognized within a test: an early stage with compactly built, thicker walled, flattened chambers, and a late stage with inflated, thinner walled chambers. Variations in the proportions between these stages are partially controlled by environmental conditions: the more marginal environments contain more inflated specimens of *H. balthica*, which are thinner walled, without a peripheral keel and limbate sutures, whereas the thicker walled, keeled ecophenotypes with limbate sutures are indicative for open marine conditions.

Stratigraphic range: *H. balthica* was found in Middle - Late Miocene (N14-17) and Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene to Recent deposits (see synonymy and Boichard et al., 1985) and served as a biostratigraphic marker for Pleistocene and younger deposits.

Occurrence: In Recent eastern Indonesian sediments *H. balthica* occurs generally in waterdepths between 344 and 1097 m, with its DLO at 711 m and its UDL at 60 m (Van Marle, 1988). Based on Snellius-I bottom samples, Hofker (1978) determined an average water temperature of 6.3 degrees Celsius for this species, which corresponds with waterdepths of about 700-800 m.

Lutze (1974) reported this species to be cosmopolitan and to occur also at shallower depths (55-105 m) in the Persian Gulf. Coustillas (1983) found it in sediments deeper than 100 m in the Mahakam Delta and Boichard et al. (1985) deeper than 549 m on the Pater Noster Platform. According to Van Morkhoven et al. (1986) *H. balthica* is primarily a neritic - upper bathyal species, which ranges from 0 to 1000 m.

Genus *Planulina* d'Orbigny, 1826

Planulina ariminensis d'Orbigny
(pl. 22, fig. 6)

1826 *Planulina ariminensis* d'Orbigny, p. 280, pl. 14, figs. 1-3.

1884 *Anomalina ariminensis* (d'Orbigny); Brady, p. 674, pl. 93, figs. 10-11.
1960 *Planulina ariminensis* d'Orbigny; Barker, p. 192, pl. 93, figs. 10-11.
1964 *Planulina ariminensis* d'Orbigny; Loeblich and Tappan, C868, figs. 552,1a-c and 553.
1976 *Planulina ariminensis* d'Orbigny; Berggren and Haq, p. 102, 107, pl. 2, fig. 11.
1980 *Planulina ariminensis* d'Orbigny; Haller, p. 265, pl. 16, figs. 7a-c.
1984b *Planulina ariminensis* d'Orbigny; Boersma, p. 1286, pl. 5, fig. 10.
1986 *Planulina ariminensis* d'Orbigny; Van Morkhoven et al., p. 38, pl. 10, figs. 1-4.

Short description: Test strongly compressed, discoidal, trochospiral; spiral side evolute, opposite side moderately evolute, showing umbilical flaps with crenulate edges; periphery keeled, somewhat square; 11 chambers in the last whorl, final chambers lobulate; sutures limbate, slightly depressed. Wall at spiral side strongly punctate, somewhat less on opposite side, densely perforate. Aperture an equatorial, interiomarginal arch, with narrow, bordering lip, extending along spiral suture under umbilical flaps.

Remarks: d'Orbigny (1826) designated *P. ariminensis* as the type-species of the genus *Planulina*.

Stratigraphic range: *P. ariminensis* was found in Middle Miocene (N14) and Late Miocene - Quaternary deposits (N17-23), and in Recent deposits from eastern Indonesia (Van Marle, 1988). It has been observed previously in Middle Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *P. ariminensis* occurs scattered deeper than 210 m (Van Marle, 1988).

Berggren and Haq (1976) considered *P. ariminensis* to be predominantly an upper bathyal form, with its maximum abundance between 300 and 500 m. Lewis (1979) found this species in sediments from the continental margin of New Zealand in waterdepths between 304 and 1419 m. According to Poag (1981) it is an inner shelf - upper slope species.

Planulina plana Belford
(pl. 22, figs. 7-8)

1966 *Planulina plana* Belford, p. 122, pl. 10, figs. 14-19.
1988 *Planulina plana* Belford; Van Marle, p. 148, pl. 4, figs. 16-17.

Short description: Test planoconvex to concavo-convex, compressed, oval in outline, trochospiral, evolute; dorsal side flat to concave, opposite side convex; periphery narrowly rounded with clear keel, lobulate in side view. Chambers arranged in 1.5-2.5 whorls, enlarging slowly, 8-9 chambers in the last whorl; sutures broad, smooth, curved, reflexed, depressed between the last 2-3 chambers. Wall coarsely perforate dorsally, finely and irregularly perforate ventrally. Aperture a peripheral, interiomarginal slit with narrow lip, extending along spiral suture.

Remarks: *P. plana* vaguely resembles *Planulina ariminensis* d'Orbigny in the evoluteness of the compressed test, the finely perforate ventral side, the radiate wall texture, and the bilamellid septal walls, and was therefore transferred to the genus *Planulina* by Belford (1966).

Stratigraphic range: *P. plana* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Miocene to Recent deposits from eastern Indonesia.

Occurrence: In Recent eastern Indonesian sediments *P. plana* occurs scattered deeper than 150 m (Van Marle, 1988).

Planulina retia Belford
(pl. 22, figs. 9-10)

1966 *Planulina retia* Belford, p. 122, pl. 11, figs. 1-9.

Short description: Test trochoid, circular in outline, planoconvex to concavoconvex; dorsal side flat, evolute, ventral side convex, partially involute; periphery narrowly rounded with small margin of clear calcite. Chambers trochospirally arranged in 1.5-2 coils, enlarging slowly, 6-7 in final whorl; sutures narrow, strongly curved, reflexed, depressed between later chambers. Wall finely perforate, with a raised irregularly reticulate ornamentation. Aperture an interiomarginal slit, extending back over several chambers along the spiral suture.

Remarks: According to Belford (1966) *P. retia* resembles the more regularly arranged specimens of *Cibicides lobatulus* (Walker and Jacob), such as the one shown by Brady (1884) and Barker (1960) on pl. 93, fig. 4, but is more compressed, and has narrower chambers, strongly reflexed sutures, and a characteristic reticulate ornament.

Stratigraphic range: *P. retia* was found in Early - Middle Miocene (N8), Early - Late Pliocene (N19/20-21), and Quaternary deposits (N23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early - Late Miocene deposits from eastern Indonesia.

Occurrence: In Recent eastern Indonesian sediments *P. retia* has only been found at upper bathyal depths near Timor, with its UDL at 150 m, but also shows scattered deeper occurrences (Van Marle, 1988).

Planulina ungeriana (d'Orbigny)
(pl. 22, figs. 11-13)

1846 *Rotalina ungeriana* d'Orbigny, p. 157, pl. 8, figs. 16-18.
1884 *Truncatulina ungeriana* (d'Orbigny); Brady, p. 664, pl. 94, fig. 9.
1921 *Truncatulina ungeriana* (d'Orbigny); Cushman, p. 327, pl. 65, figs. 3a-c.
1941a *Cibicides dorsupustulosus* LeRoy, p. 47, pl. 1, figs. 85-87.
1941b *Cibicides dorsupustulosus* LeRoy, p. 88, pl. 3, figs. 4-6.
1960 *Cibicides pseudoungerianus* Barker (not Cushman), p. 194, pl. 94, fig. 9.

1966 *Planulina ungeriana* (d'Orbigny); Belford, p. 121, pl. 10, figs. 7-13.
1976 *Cibicidoides ungeriana* (d'Orbigny); Berggren and Haq, p. 102, pl. 2, figs. 1-3.
1985 *Cibicides ungerianus* (d'Orbigny); Papp and Schmid, p. 60, pl. 51, figs. 7-11.

Short description: Test lenticular, planoconvex; spiral side flat to slightly convex and evolute with distinct crenulation, ventral side arched and partially evolute; periphery sharply keeled. Chambers trochospirally arranged in 2-2.5 whorls; sutures curved or sinuous, not depressed. Wall thin, distinctly perforate on both sides; pustulose in center of spiral side. Aperture an interiomarginal slit, with narrow bordering lip extending along spiral suture.

Remarks: *P. ungeriana* differs from *Cibicidoides mediocris* (Finlay), in literature often referred to as *Cibicidoides pseudoungerianus* (Cushman) or *Cibicidoides pachyderma* (Rzehak), by its distinctive, large pustules and small ridges in central area of dorsal side, its non-depressed sinuous sutures, and by the absence of a raised central part on the ventral side.

Because of the presence of the large pustules on the dorsal side, the name *Cibicidoides dorsupustulosus* (LeRoy) is very appropriate, but unfortunately a junior synonym.

P. ungeriana is not the same species as the homonymous Paleogene deeper water form and for this reason Van Morkhoven et al. (1986) renamed the latter *Cibicidoides praemundulus*.

Stratigraphic range: *P. ungeriana* was found in Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Early Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *P. ungeriana* occurs scattered deeper than 711 m (Van Marle, 1988).

According to Van der Zwaan (1982) this is an open marine mud-dweller without tolerance to oxygen deficiency or raised salinities.

Planulina wuellerstorfi (Schwager)
(pl. 22, figs. 14-16)

1866 *Anomalina wuellerstorfi* Schwager, p. 258, pl. 7, figs. 105-107.
1884 *Truncatulina wuellerstorfi* (Schwager); Brady, p. 662, pl. 93, figs. 9a-c.
1921 *Truncatulina wuellerstorfi* (Schwager); Cushman, p. 314, pl. 64, figs. 1a-c.
1941a *Cibicides wuellerstorfi* (Schwager); LeRoy, p. 46, pl. 1, figs. 27-29.
1941b *Cibicides wuellerstorfi* (Schwager); LeRoy, p. 89, pl. 3, figs. 7-9.
1949 *Planulina wuellerstorfi* (Schwager); Boomgaart, p. 150, pl. 6, figs. 17a-b.
1951 *Cibicides wuellerstorfi* (Schwager); Hofker, p. 350, text-figs. 237a-k.
1951a *Planulina wuellerstorfi* (Schwager); Asano, p. 15, figs. 19-20.
1960 *Planulina wuellerstorfi* (Schwager); Barker, p. 192, pl. 93, figs. 9a-c.
1964 *Cibicides wuellerstorfi* (Schwager); LeRoy, p. 45, pl. 8, figs. 15-16.

1965 *Planulina wuellerstorfi* (Schwager); Todd, p. 51, pl. 23, figs. 3-5.
1966 *Planulina wuellerstorfi* (Schwager); Belford, p. 120, pl. 10, figs. 1-6.
1973 *Cibicidoides wuellerstorfi* (Schwager); Douglas, p. 614, pl. 18, figs. 7-9; pl. 25, figs. 15-16.
1978 *Cibicides wuellerstorfi* (Schwager); Boltovskoy, p. 157, pl. 3, figs. 19-21.
1979 *Planulina wuellerstorfi* (Schwager); Corliss, p. 7, pl. 2, figs. 13-16.
1980 *Planulina wuellerstorfi* (Schwager); Haller, p. 265, pl. 17, figs. 2a-c.
1980 *Cibicides wuellerstorfi* (Schwager); Srinivasan and Sharma, p. 56, pl. 8, figs. 11-13 (neotype).
1980 *Planulina wuellerstorfi* (Schwager); Keller, p. 845, pl. 2, fig. 12.
1984 *Cibicides wuellerstorfi* (Schwager); Boltovskoy, p. 327, pl. 1, figs. 16-20.
1984 *Cibicidoides wuellerstorfi* (Schwager); Govindan, p. 246, pl. 2, figs. 6-7.
1985 *Planulina wuellerstorfi* (Schwager); Boichard et al., p. 92, pl. 16, figs. 2-4.
1985 *Cibicidoides wuellerstorfi* (Schwager); Thomas, p. 676, pl. 11, figs. 1-4.
1986 *Cibicidoides wuellerstorfi* (Schwager); Kurihara and Kennett, p. 1076, pl. 8, figs. 4-6.
1986 *Planulina wuellerstorfi* (Schwager); Van Morkhoven et al., p. 48, pl. 14, figs. 1-2.
1988 *Planulina wuellerstorfi* (Schwager); Van Marle, p. 148, pl. 3, figs. 18-20.

Short description: Test large, flattened, planoconvex; spiral side flat to slightly excavated, umbilical side gently convex; periphery with distinct keel. Chambers trochospirally arranged in 3 whorls, with 8-10 chambers in final whorl; sutures strongly recurved on both sides, limbate on dorsal side; youngest sutures on umbilical side are slightly hooked towards central portion. Wall thick, coarsely and densely perforate spirally, finely perforate umbilically. Aperture a low arch at the base of the final chamber.

Remarks: The limbation of the sutures, the width of the final whorl, and the expansion of the final chambers are all variable (Bandy, 1967; Corliss, 1979; Srinivasan and Sharma, 1980; Van Morkhoven et al., 1986). In our material, the last chamber is often overlapping, thinner and (more) fragile (Todd, 1965).

Boersma (1986) observed intergrades between *P. wuellerstorfi*, *Cibicidoides kullenbergi* (Phleger and Parker) and *Cibicidoides rugosa* (Phleger and Parker) in Middle Miocene deposits from the Tasman Sea (southwestern Pacific).

According to Sen Gupta (1989) *P. wuellerstorfi* should generically be placed in *Cibicides* de Montfort and not in *Planulina* d'Orbigny nor *Cibicidoides* Thalmann, because of the shape of its final whorl and its planoconvex form. However, since Sen Gupta's paper appeared as the plates and plate captions were already printed, concepts could not be changed anymore and the species is maintained in the genus *Planulina*.

Stratigraphic range: *P. wuellerstorfi* was found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded in Late Oligocene to Recent deposits from the Indo-Pacific region (see synonymy; Lewis, 1979; Boersma, 1986).

Occurrence: In Recent eastern Indonesian sediments *P. wuellerstorfi* occurs generally in waterdepths between 711 and 2119 m, with its DLO at 1954 m and its UDL at 495 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to be dominant at 800 m in the Peru-Chili Trench. Pflum and Frerichs (1976) and Poag (1981) reported an UDL in the middle bathyal zone and a characteristic depth distribution in lower bathyal to abyssal depths in the Gulf of Mexico. It was found in sediments between 2500 and 4600 m in the southeastern Indian Ocean (Corliss, 1979), and between 304 and 2329 m offshore New Zealand (Lewis, 1979). Moore et al. (1980) considered this species to be indicative for depths of more than 500 m. Boichard et al. (1985) found this species deeper than 549 m on the Pater Noster Platform. According to Van Morkhoven et al. (1986) this is the dominant planulinid in lower bathyal and abyssal depths.

Bandy (1967) reported that 'shallower' specimens have smoothly curved sutures and deeper ones (1000 m) hooked or recurved sutures. Boersma (1986) observed a marked variation in porosity within *P. wuellerstorfi*, which she related to environmental factors, such as latitude.

According to Corliss (1985) *P. wuellerstorfi* also lives infaunal within the top 0-2 cm of the sediment.

Superfamily *Pleurostomellacea* Reuss, 1860
Family *Pleurostomellidae* Reuss, 1860
Subfamily *Pleurostomellinae* Reuss, 1860
Genus *Pleurostomella* Reuss, 1860

Pleurostomella acuminata Cushman
(pl. 24, figs. 6-7)

1884 *Pleurostomella alternans* Brady (not Schwager), p. 412, pl. 51, figs. 22a-b.
1922 *Pleurostomella acuminata* Cushman, p. 50, pl. 19, fig. 6.
1960 *Pleurostomella acuminata* Cushman; Barker, p. 106, pl. 51, figs. 22a-b.
1978 *Pleurostomella acuminata* Cushman; Boltovskoy, p. 163, pl. 5, figs. 39-41.
1980 *Pleurostomella acuminata* Cushman; Boltovskoy, p. 165, pl. 2, figs. 10a-b.

Short description: Test elongate, subcylindrical or fusiform with pointed initial end, terminating in a distinct spine. Chambers biserially arranged, inflated; last chambers nearly uniserial and much less crowded; sutures distinct, slightly depressed, oblique in early stage, later nearly straight and horizontal. Wall smooth, finely perforate. Aperture terminal, in a rounded depression of the broadly rounded apertural face, narrow, vertical, with an upwardly projecting tooth at either side.

Remarks: *P. acuminata* differs from *Pleurostomella alternans* Schwager in having a basal spine, an irregularly coiled initial stage (which is crowded because of this), and in being broader and lower.

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Pleurostomella* spp.: *P. acuminata*, *P. alternans*, and *P. brevis*. *Pleurostomella* spp. were found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). *P acuminata* and *P. brevis* have also been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

P. acuminata has been observed previously in Late Oligocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *Pleurostomella* spp. occur scattered deeper than 244 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported *P. acuminata* to have its UDL at 3150 m in the Peru-Chili Trench.

Pleurostomella alternans Schwager
(pl. 24, figs. 8-9)

1866 *Pleurostomella alternans* Schwager, p. 238, pl. 6, figs. 79-80.
1884 *Pleurostomella alternans* Schwager; Brady, p. 412, pl. 51, figs. 23a-b.
1941a *Pleurostomella alternans* Schwager; LeRoy, p. 38, pl. 3, figs. 54-55.
1941b *Pleurostomella alternans* Schwager; LeRoy, p. 82, pl. 2, figs. 12-13.
1951 *Pleurostomella alternans* Schwager; Hofker, p. 274, text-figs. 183-185.
1960 *Pleurostomella alternans* Schwager; Barker, p. 106, pl. 51, figs. 23a-b.
1978 *Pleurostomella alternans* Schwager; Boltovskoy, p. 164, pl. 5, figs. 43-44.
1978 *Pleurostomella barkeri* Hofker, p. 44, pl. 5, fig. 5.
1980 *Pleurostomella alternans* Schwager; Srinivasan and Sharma, p. 57, pl. 8, figs. 14-17 (neotype and topotype).
1985 *Pleurostomella alternans* Schwager; Thomas, p. 677, pl. 14. fig. 5.
1986 *Pleurostomella alternans* Schwager; Boersma, p. 1020, pl. 5, fig. 6.

Short description: Test elongate, slender, subcylindrical or fusiform, tapering towards the sharp initial end; apertural end broadly rounded in front view, in side view acute and tapering. Chambers regular, biserially arranged, enlarging gradually, inflated, especially the later ones; sutures distinct, slightly depressed, oblique. Wall thin, smooth, finely and densely perforate. Aperture large, irregularly oval, terminal, in a rounded depression of the inner face of the chamber, with a projecting hood on one side and two small, pointed teeth on opposite side.

Remarks: *P. alternans* is more regularly built and elongate than *Pleurostomella acuminata* Cushman. It, moreover, lacks a basal spine and has strongly inflated chambers.

Hofker (1978) renamed Brady's (and Barker's) specimens *Pleurostomella barkeri*, because of their somewhat elongated test. In our opinion this is a junior synonym of *P. alternans*.

Stratigraphic range: See *Pleurostomella acuminata* Cushman. *P. alternans* has been widely recorded in Early Oligocene to Recent deposits from the Indo-Pacific region (see synonymy; Boomgaart, 1949; LeRoy, 1964; De Hornibrook, 1961).

Occurrence: See *Pleurostomella acuminata* Cushman. Bandy and Rodolfo (1964) reported *P. alternans* to have its UDL at 3150 m in the Peru-Chili Trench. Yet, according to LeRoy (1964) it is an outer neritic - upper bathyal form.

Pleurostomella brevis Schwager
(pl. 24, figs. 4-5)

1866 *Pleurostomella brevis* Schwager, p. 239, pl. 6, fig. 81.
1884 *Pleurostomella brevis* Schwager; Brady, p. 411, pl. 51, figs. 20a-b.
1946 *Pleurostomella brevis* Schwager; Germeraad, p. 69, pl. 3, fig. 24.
1960 *Pleurostomella brevis* Schwager; Barker, p. 104, pl. 51, figs. 20a-b.
1964 *Pleurostomella brevis* Schwager; Loeblich and Tappan, C727, fig. 594,3.
1980 *Pleurostomella brevis* Schwager; Srinivasan and Sharma, p. 58, pl. 8, figs. 1-2 (neotype).
1984a *Pleurostomella brevis* Schwager; Boersma, p. 663, pl. 3, fig. 8.

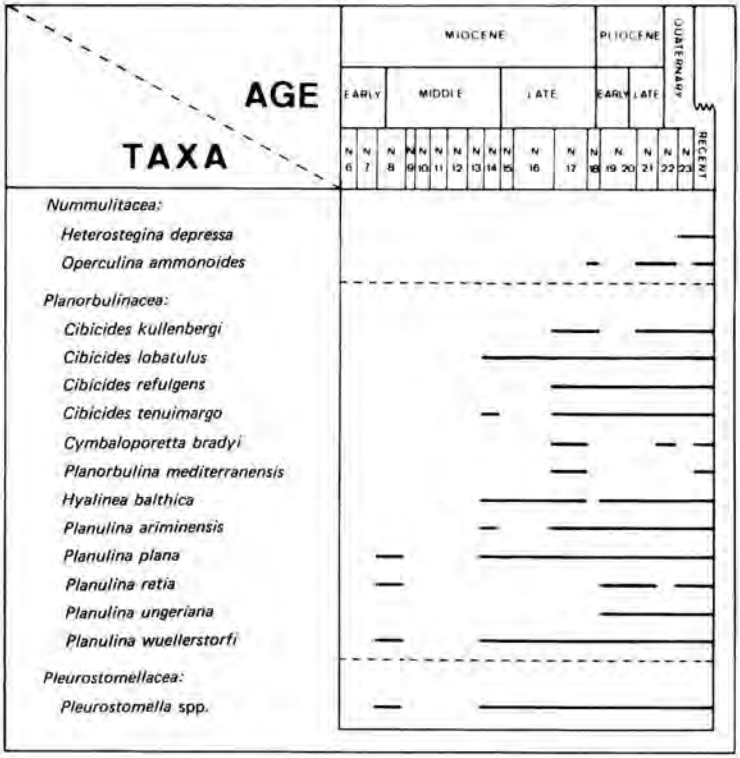

Fig. 23. Composite range chart of the superfamilies *Nummulitacea*, *Planorbulinacea* and *Pleurostomellacea* of the suborder *Rotaliina* in eastern Indonesia.

Short description: Test small, short, compressed, elliptical in outline; initial end bluntly rounded, apertural end rounded in front view, acute and tapering in side view. Chambers biserially arranged in early stage and lobate, last 5-6 increasing strongly in size as added and tending to become uniserial; sutures oblique, deeply depressed. Wall smooth, finely perforate. Aperture terminal, narrow, vertical, in a rounded depression of the inner face of the chamber, with hood on one side and two small projected plate-like teeth on opposite side.

Remarks: *P. brevis* differs from congeneric species by its characteristic, short, elliptical test.

Stratigraphic range: See *Pleurostomella acuminata* Cushman. *P. brevis* has been observed previously in Early Miocene to Recent deposits (see synonymy and LeRoy, 1964).

Occurrence: See *Pleurostomella acuminata* Cushman. According to LeRoy (1964) *P. brevis* is an outer neritic - upper bathyal form.

Superfamily *Rotaliacea* Ehrenberg, 1839
Family *Calcarinidae* Schwager, 1876
Genus *Calcarina* d'Orbigny, 1826

Calcarina calcar d'Orbigny

1826 *Calcarina calcar* d'Orbigny, p. 276, mod. no. 34.
1884 *Rotalia calcar* (d'Orbigny); Brady, p. 709, pl. 108, figs. 3a-c.
1941b *Rotalia calcar* (d'Orbigny); LeRoy, p. 84. pl. 7, figs. 1-3.
1946 *Calcarina calcar* d'Orbigny; Germeraad, p. 70, pl. 4, figs. 1-5.
1960 *Calcarina calcar* d'Orbigny; Barker, p. 222, pl. 108, figs. 3a-c.
1971 *Pararotalia calcar* (d'Orbigny); Hansen and Reiss, p. 335, pl. 9, figs. 1-5; pl. 10, figs. 4-6.
1980 *Calcarina calcar* d'Orbigny; Hottinger and Leutenegger, p. 123, pl. 1, figs. 1-17.
1983 *Pararotalia ozawai* Coustillas (not Asano), p. 94, pl. 19, fig. 6.
1984 *Calcarina calcar* d'Orbigny; Hallock, p. 253, pl. 1, figs. 13a-b.

Short description: Test lenticular, compressed, suborbicular, biconvex, with little or no differentiation between spiral and umbilical sides. Chambers trochospirally arranged in 3 whorls, 9 chambers in the last whorl, elongated, pointed; each chamber, except the last one, with canaliculate spine; sutures radial, depressed, largely obscured by secondary calcite growth on umbilical side. Wall coarsely perforate, covered with lamellar calcite and tubercules. Apertural face heavily ornamented by radial ridges; aperture narrow, indented, interiomarginal, with multiple intercameral foramina.

Remarks: The intensity of the ornamentation of the outer surface varies considerably within *C. calcar* (see Hottinger and Leutenegger, 1980).

The specimens figured by Coustillas (1983) as *Pararotalia ozawai* clearly deviate from the originally described holotype of that species (Asano, 1951a).

This holotype shows a carinate periphery with only a few spines protruding irregularly from it, unlike in the specimens figured by Coustillas, which show peripheral spines protruding regularly from every chamber of the last whorl, as is common in *C. calcar.*

The specimens figured by Germeraad (1946, p. 71, pl. 4, figs. 2-5) as *Calcarina umbilicata* are no more than varieties of *C. calcar* with a deeper umbilicus.

Stratigraphic range: *C. calcar* was found in Late Miocene (N17) and Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *C. calcar* has been found near Timor and Irian Jaya in waterdepths between 100 and 150 m (Van Marle, 1988). Coustillas (1983) observed this form between 50 and 300 m in the Mahakam Delta.

Calcarina spengleri (Gmelin)
(pl. 23, fig. 5)

1791 *Nautilus spengleri* Gmelin, p. 3371 (figured by Spengler (1781), p. 373, pl. 2, figs. 9a-c).
1884 *Calcarina spengleri* (Gmelin); Brady, p. 712, pl. 108, figs. 5, 7.
1960 *Tinoporus spengleri* (Gmelin); Barker, p. 222, pl. 108, figs. 5, 7.
1964 *Calcarina spengleri* (Gmelin); LeRoy, p. 40, pl. 5, fig. 3.
1971 *Calcarina spengleri* (Gmelin); Hansen and Reiss, p. 336, pl. 11, figs. 1-6; pl. 12, figs. 1-5.
1980 *Calcarina spengleri* (Gmelin); Hottinger and Leutenegger, p. 124, pl. 6, figs. 1-13; pl. 7, figs. 1-3, 7-8.
1981 *Calcarina spengleri* (Gmelin); Hansen, p. 198, pl. 4, figs. 1-2.
1983 *Tinoporus spengleri* (Gmelin); Coustillas, pl. 18, figs. 7-9 (not 5).
1984 *Calcarina spengleri* (Gmelin); Hallock, p. 253, pl. 1, figs. 15a-b.
1984 *Calcarina spengleri* (Gmelin); Rögl and Hansen, p. 59, pl. 20, figs. 3-6; pl. 21, figs. 1-6.
1988 *Tinoporus spengleri* (Gmelin); Van Marle, p. 149, pl. 1, figs. 1-2.

Short description: Test large, lenticular, biconvex; usually with a wide umbilicus, crowded by a network of communicating umbilical canals; periphery with a few stout, elongate, longitudinally striate spines protruding irregularly from it. Chambers numerous, trochospirally arranged; sutures radial, depressed, faint, largely obscured by secondary lamellar calcite on umbilical side. Wall composed of thin inner layer and thicker, coarsely perforate outer layer, heavily ornamented with tubercules and lamellar calcite. Aperture narow, indented, interiomarginal.

Remarks: Hottinger and Leutenegger (1980) described a large variety in ornamentation and spinosity within *C. spengleri* in the Indo-Pacific region. According to them it is difficult to distinguish between the umbilical and the dorsal surface, because the chambers and sutures are indistinct and the size of the ornamental pillars varies to a considerable extent.

According to Rögl and Hansen (1984) *C. spengleri* demonstrates differences in morpholgy between young spinose specimens and adult ones with more blunt spines and heavy ornamentation (anchorage on reef algae).

Stratigraphic range: *C. spengleri* was found in Late Pliocene - Quaternary deposits (N21-22) from Seram. It has been observed previously in Pliocene to Recent deposits (see synonymy and Boichard et al., 1985).

Occurrence: In Recent eastern Indonesian sediments *C. spengleri* occurs generally in waterdepths between 60 and 150 m, with its DLO at 90 m (Van Marle, 1988). This supports the opinion of LeRoy (1964), who considered *C. spengleri* to be a shallow species. Coustillas (1983) found this species between 50 and 90 m in the Mahakam Delta and Boichard et al. (1985) between 45 and 319 m on the Pater Noster Platform.

Family *Elphidiidae* Galloway, 1933
Subfamily *Elphidiinae* Galloway, 1933
Genus *Elphidium* De Montfort

Elphidium advenum (Cushman)
(pl. 23, fig. 5)

1884 *Polystomella subnodosa* Brady (not Munster), p. 734, pl. 110, figs. 1a-b.
1922 *Polystomella advena* Cushman, p. 56, pl. 9, figs. 11-12.
1939 *Elphidium advenum* (Cushman); Cushman, p. 60, pl.16, figs. 31-35.
1941c *Elphidium advenum* (Cushman); LeRoy, p. 115, pl. 1, figs. 28-29.
1953 *Elphidium advenum* (Cushman); Asano, p. 6, figs. 32-33.
1957 *Elphidium advenum* (Cushman); Todd and Brönniman,p. 39, pl. 6, figs. 5-7.
1960 *Elphidium advena* (Cushman); Barker, p. 226, pl. 110, figs. 1a-b.
1976 *Elphidium advenum* (Cushman); Hansen and Lykke-Andersen, p. 7, pl. 2, figs. 10-12; pl. 3, fig. 1.
1983 *Elphidium advenum* (Cushman); Coustillas, pl. 34, figs. 15a-b.
1985 *Elphidium advenum* (Cushman); Wang et al., p. 337, pl. 5, fig. 14.
1988 *Elphidium advenum* (Cushman); Van Marle, p. 143, pl. 1, fig. 6.

Short description: Test lenticular, compressed, biconvex, symmetrical, involute; umbilical region slightly depressed, with central boss of clear calcite; periphery acute with narrow keel, lobulate. Chambers planispirally arranged, 10-15 in last whorl, slightly inflated; sutures curved, depressed. With 12-15 retral processes of about 1/4 of the width of the chamber along the sutures in depressed channels, the intermediate portions being raised, inflated, increasing in width towards the perphery. Wall smooth, except for sutural parts, finely perforate. Aperture a series of small rounded pores at the base of the apertural face of the last chamber.

Remarks: *E. advenum* is a carinate form, with distinct umbonal plugs and with characteristic retral processes, much smaller than in for instance *Elphidium crispum* (Linnaeus).

Stratigraphic range: Because individual species occur rarely, the following species have during the countings been assembled in *Elphidium* spp.: *E. advenum*, *E. crispum*, *E. incertum*, and *E. macellum*. *Elphidium* spp. were found in Early - Middle Miocene (N8) and Late Miocene - Quaternary deposits (N17-23). All species gathered in *Elphidium* spp. have also been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

E. advenum has been recorded previously from Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *Elphidium* spp. occur generally in waterdepths between 60 and 210 m, with DLO at 150 m (Van Marle, 1988). According to Van der Zwaan (1982) all *Elphidium*-species are shallow marine, vegetation bound, with a great tolerance to increased salinities.

Waller (1960), Lutze (1974) and Moore et al. (1980) reported the cosmopolitan *E. advenum* to occur at neritic depths (0-200 m). Coustillas (1983) found it in sediments between 0 and 30 m in the Mahakam Delta.

According to Hageman (1979) *E. advenum* shows a preference for clayey and sandy, shallow marine environments with normal marine salinities.

Elphidium crispum (Linnaeus)
(pl. 23, fig. 7)

1758 *Nautilus crispus* Linnaeus, p. 709 (figured by Plancus, pl. 1, figs. 2d-f).
1846 *Polystomella crispa* (Linnaeus); d'Orbigny, p. 125, pl. 6, figs. 9-14.
1884 *Polystomella crispa* (Linnaeus); Brady, p. 736, pl. 110, figs. 6-7.
1960 *Elphidium crispum* (Linnaeus); Barker, p. 226, pl. 110, figs. 6-7.
1964 *Elphidium crispum* (Linnaeus); Loeblich and Tappan, C634, figs. 506,4a-b.
1976 *Elphidium crispum* (Linnaeus); Berggren and Haq, p. 110, 112, pl. 6, figs. 5-6.
1976 *Elphidium crispum* (Linnaeus); Hansen and Lykke-Andersen, p. 6, pl. 1, figs. 10-12; pl. 2, figs. 1-2.
1983 *Elphidium crispum* (Linnaeus); Coustillas, pl. 34, fig. 7.
1985 *Elphidium crispum* (Linnaeus); Boichard et al., p. 90, pl. 15, figs. 19-20.
1985 *Elphidium crispum* (Linnaeus); Papp and Schmid, p. 50, pl. 40, figs. 5-8.

Short description: Test large, lenticular, symmetrical, involute, with massive central pillar with rounded pits; apertural view rhombic, angular; periphery irregular, narrowly keeled. Chambers planispirally arranged, slender, gently curved, 13-28 in last whorl; 15-17 retral processes along sutures of last chambers, sickle-shaped, with small pore grooves, regularly separated by septal bridges. Wall coarsely perforate. Aperture formed by 6-12 large pores at base of apertural face.

Remarks: *E. crispum* resembles *Elphidium macellum* (Fichtel and Moll), but is rhombic and broader in apertural view and has massive central pillars in the umbilical region.

Stratigraphic range: See *Elphidium advenum* (Cushman). *E. crispum* has been found previously in Recent sediments.

Occurrence: See *Elphidium advenum* (Cushman). Coustillas (1983) found *E. crispum* in samples from waterdepths between 0 and 30 m in the Mahakam Delta and Boichard et al. (1985) between 45 and 260 m on the Pater Noster Platform.

Elphidium incertum (Williamson)

(pl. 23, fig. 8)

1858 *Polystomella umbilicata* (Walker) var. *incerta* Williamson, p. 44, pl. 3, fig. 82a.
1884 *Polystomella striatopunctata* Brady (not Fichtel and Moll), p. 739, pl. 109, fig. 23.
1960 *Elphidium incertum* (Williamson); Barker, p. 226, pl. 109, fig. 23.
1976 *Elphidium incertum* (Williamson); Hansen and Lykke-Andersen, p. 15, pl. 12, figs. 5-9.

Short description: Test lenticular, compressed, symmetrical, with depressed umbilicus, involute, planispiral; periphery rounded to subacute. Chambers strongly embracing, 8-11 in final whorl; sutures curved, depressed. Few, short and scattered retral processes, sometimes forming long, radiating grooves, but usually appearing as small oval pits along the sutures. Wall densely perforate. Multiple interiomarginal aperture, surrounded by dense, fine tuberculation.

Stratigraphic range: See *Elphidium advenum* (Cushman).

Occurrence: See *Elphidium advenum* (Cushman). According to Hageman (1979) *E. incertum* is a shallow water species with a preference for vegetated areas.

Elphidium macellum (Fichtel and Moll)

(pl. 23, figs. 9-10)

1798 *Nautilus macellus* var. B Fichtel and Moll, p. 66, pl. 10, figs. h-k.
1884 *Polystomella macella* (Fichtel and Moll); Brady, p. 737, pl. 110, figs. 8, 11 (not 9).
1927b *Elphidium macella* (Fichtel and Moll); Cushman, p. 51, pl. 10, fig. 5.
1946 *Elphidium macellum* (Fichtel and Moll); Cushman, p. 10, pl. 2, fig. 9.
1960 *Elphidium macellum* (Fichtel and Moll); Barker, p. 226, pl. 110, figs. 8, 11.

1964 *Elphidium macellum* (Fichtel and Moll); Loeblich and Tappan, C633, figs. 505,1-2.
1976 *Elphidium macellum* (Fichtel and Moll); Hansen and Lykke-Andersen, p. 5, pl. 1, figs. 1-9.
1983 *Elphidium macellum* (Fichtel and Moll); Coustillas, pl. 34, fig. 11.
1984 *Elphidium macellum* (Fichtel and Moll); Rögl and Hansen, p. 50, pl. 14, figs. 2, 5-6; pl. 15, figs. 1-2.

Short description: Test lenticular, somewhat compressed, symmetrical, involute, planispiral; umbilici slightly depressed, without ornamentation or plug; periphery sharply angled and keeled. Chambers narrow and curved, 16-17 in last whorl; sutures slightly curved. Retral processes long and distinct, 8-15 on each chamber. Wall densely and finely perforate. Low, curved apertural face with fine pustules; aperture interiomarginal, equatorial, multiple openings, with small protruding lips.

Remarks: *E. macellum* resembles *Elphidium crispum* (Linnaeus), but is more compressed and has a depressed umbilical region.

Stratigraphic range: See *Elphidium advenum* (Cushman). *E. macellum* has been described previously from Recent sediments.

Occurrence: See *Elphidium advenum* (Cushman). Coustillas (1983) found *E. macellum* in sediments between 50 and 150 m in the Mahakam Delta.

Family *Rotaliidae* Ehrenberg, 1839
Subfamily *Rotaliinae* Ehrenberg, 1839
Genus *Ammonia* Brunnich, 1772

Ammonia beccarii (Linnaeus) s.l.
(pl. 23, figs. 11-12)

1758 *Nautilus beccarii* Linnaeus, p. 710 (figured by Plancus, pl. 1, figs. 1a-c).
1931 *Rotalia beccarii* (Linnaeus); Cushman, p. 58, pl. 12, figs. 1-7; pl. 13, figs. 1-2.
1964 *Ammonia beccarii* (Linnaeus); Loeblich and Tappan, C607, figs. 479,2-3.
1966 *Ammonia beccarii* (Linnaeus); Belford, p. 108, pl. 19, figs. 2-8.
1971 *Ammonia beccarii* (Linnaeus); Hansen and Reiss, p. 331, pl. 1, figs. 1-3; pl. 2, figs. 4-6; pl. 3, figs. 1-6; pl. 4, figs. 1-6; pl. 5, figs. 1-4.
1976 *Ammonia beccarii* (Linnaeus); Berggren and Haq, p. 111, pl. 5, figs. 8-9.
1980 *Ammonia beccarii* (Linnaeus); Billman et al., p. 85, pl. 1, figs. 1-10; pl. 2, figs. 1-6.
1980 *Ammonia beccarii* (Linnaeus); Müller-Merz, p. 28, pl. 4, figs. 2, 4-6; pl. 11, figs. 2-6; pl. 15, fig. 4.
1983 *Ammonia beccarii* (Linnaeus); Coustillas, pl. 19, figs. 1-2.
1988 *Ammonia beccarii* (Linnaeus); Van Marle, p. 139, pl. 4, figs. 2-3.

Short description: Test lenticular, biconvex, low trochospiral coil of 3-4 convolutions, with rounded, slightly lobulate periphery. On umbilical side usually 6-8, slightly inflated chambers visible; all whorls on opposite side; sutures slightly curved, spirally thickened, depressed umbilically. Wall finely perforate, on spiral side smooth, on opposite side irregular granules and numerous fused pillars and bosses along sutures and in umbilical region. Aperture a low, interiomarginal umbilical opening, along thickened umbilical chamber margins.

Remarks: A large variability of forms exists within this very common species. It is clear from the numerous quotations in micropaleontological literature that there are difficulties in deciding on the specific limits of *A. beccarii* and related rotaliid species (Belford, 1966; Hottinger, 1966; Billman et al., 1980). Because these limits still have not been established, we maintain *A. beccarii* sensu lato, i.e both comprising *A. beccarii* sensu stricto and all varieties.

Stratigraphic range: *A. beccarii* s.l. was found in all studied Miocene - Recent intervals from eastern Indonesia. The species has been described previously from Early Miocene to Recent deposits (see synonymy and Asano, 1951a).

Occurrence: In Recent eastern Indonesian sediments *A. beccarii* occurs at neritic - upper bathyal depths, with its DLO at 317 m and its UDL at 78 m, but also shows scattered (probably displaced) deeper occurrences (Van Marle, 1988). The reader has to remember that Recent samples shallower than 60 m were not studied and that the species might very well occur in this shallower interval, as reported in literature.

Moore et al. (1980) considered this species to be indicative for neritic depths (0-150 m). Coustillas (1983) found it in sediments between 0 and 150 m, with highest frequencies between 30 and 90 m, in the Mahakam Delta.

Ammonia supera Belford
(pl. 23, figs. 13-15)

1966 *Ammonia supera* Belford, p. 111, pl. 19, figs. 17-19; pl. 20, figs. 1-4.
1983 *Ammonia* sp. 3, Coustillas, pl. 19, fig. 3.

Short description: Test trochoid, circular in outline, biconvex; periphery lobate in side view, rounded in edge view. Spirally slightly convex, evolute, thickened by deposits of clear calcite, ventrally strongly convex, involute. Chambers trochospirally arranged in 3-3.5 whorls, enlarging slowly, 7-8 in last whorl; sutures dorsally broad, straight, slightly reflexed, slightly depressed in last whorl; ventrally straight, radial, depressed, doubling near umbilicus, narrowing towards periphery. Wall finely and densely perforate, smooth, except for umbilical region. Umbilicus wide, open, with numerous small, irregularly distributed, separate umbilical bosses; umbilical ends of chambers thickened with calcite. Aperture a low, interiomarginal opening, midway between periphery and umbilicus.

Remarks: This species is maintained in the genus *Ammonia* because it lacks an umbilical and interseptal canalsystem, a thickened peripheral margin, and because there is no separation of the chambers, while also no double layers of shell material have been demonstrated in the apertural face (see Belford, 1966). However, its structure is more complicated than that of *Ammonia beccarii* (Linnaeus), tending toward that of the genus *Pseudorotalia*.

Stratigraphic range: *A. supera* was found in Early - Late Pliocene (N19/20) and Late Pliocene - Quaternary deposits (N22) from Seram. It has been found previously in Late Miocene and Recent sediments from Indonesia.

Occurrence: *A. supera* has in the eastern Indonesian material always been found in association with typical neritic - upper bathyal species. Coustillas (1983) found this form in samples from waterdepths between 200 and 400 m in the Mahakam Delta.

Genus *Asterorotalia* Hofker, 1951

Asterorotalia gaimardii (d'Orbigny)

(pl. 23, fig. 16; pl. 24, figs. 1-3)

1826 *Rotalia (Turbinulina) gaimardii* d'Orbigny, p. 275, mod. no. 46.
1884 *Rotalia papillosa* Brady, p. 708, pl. 106, figs. 9a-c; pl. 107, figs. 1a-c.
1915 *Rotalia papillosa* Brady; Cushman, p. 70, pl. 31, figs. 1a-c.
1921 *Rotalia papillosa* Brady; Cushman, p. 347, pl. 72, figs. 3a-b.
1941a *Rotalia papillosa* Brady; LeRoy, p. 40, pl. 2, figs. 51-53.
1960 *Streblus gaimardii* (d'Orbigny); Barker, p. 218, pl. 106, figs. 9a-c; p. 220, pl. 107, figs. 1a-c.
1966 *Pseudorotalia gaimardii* (d'Orbigny); Belford, p. 115, pl. 20, figs. 5-11.
1980 *Asterorotalia gaimardii* (d'Orbigny); Billman et al., p. 98, pl. 21, figs. 1-11; pl. 22, figs. 1-6.
1983 *Asterorotalia gaimardii* (d'Orbigny); Coustillas, p. 94, pl. 20, figs. 2-4.
1988 *Ammonia gaimardii* (d'Orbigny); Van Marle, p. 139, pl. 4, figs. 4-5.

Short description: Test lenticular, planoconvex to slightly biconvex; ventral side convex, dorsal side flat to only slightly convex; periphery keeled. Chambers trochospirally arranged, 9-14 in last whorl; dorsal sutures inclined backwards, straight, ventral sutures radial, depressed. Wall finely and densely perforate, heavily ornamented on the spiral side by raised bands of imperforate calcite; ventral side ornamented along the sutures by rows of alternating pillars, and the umbilical region by bosses and inflational pillars. Aperture a wide, interiomarginal, anterior opening; secondary openings occur along umbilical bosses.

Remarks: *A. gaimardii* is characterized by the heavy ornament on both sides of the test, though intraspecific variation in morphology occurs. Coustillas (1983) considered this variation to be a function of bathymetry. He observed shallower forms with a less raised ornament and a flattened dorsal side, while his deeper forms (outer shelf to upper bathyal) have a prominent raised ornament and a convex dorsal side.

Because *A. gaimardii* lacks a well developed umbilical and interseptal canal system it is transferred from *Pseudorotalia* to *Asterorotalia* (see Belford, 1966; Billman et al., 1980).

Stratigraphic range: *A. gaimardii* was found in Middle - Late Miocene (N14-16) and Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Late Miocene to Recent deposits (see synonymy and Boichard et al., 1985).

According to Billman et al. (1980) the known stratigraphic range of *A. gaimardii* is Late Pliocene - Recent, and older specimens belong to the subspecies *A. gaimardii inermis*, which ranges from Late Miocene to Late Pliocene.

Occurrence: In Recent eastern Indonesian sediments *A. gaimardii* occurs generally in waterdepths between 60 and 344 m, with its DLO at 210 m (Van Marle, 1988). Coustillas (1983) found this species in sediments from 30 to deeper than 400 m in the Mahakam Delta and Boichard et al. (1985) between 45 and 230 m on the Pater Noster Platform.

According to Billman et al. (1980) *A. gaimardii* is a typical Indo-Pacific species.

Genus *Pseudorotalia* Reiss and Merling, 1958

Pseudorotalia schroeteriana (Parker and Jones)

1862	*Rotalia schroeteriana* Parker and Jones, p. 213, pl. 13, figs 7-9.
1884	*Rotalia schroeteriana* Parker and Jones; Brady, p. 707, pl. 115, figs. 7a-c.
1927	*Rotalia schroeteriana* Parker and Jones; Hofker, p. 39, pl. 18, figs. 1-4; pl. 19, figs. 1-12; pl. 21, figs. 1-2, 7, 11, 13.
1935	*Rotalia schroeteriana* Parker and Jones; Keijzer, p. 132, pl. 4, figs. 3-5, 7-10.
1960	*Streblus schroeterianus* (Parker and Jones); Barker, p. 238, pl. 115, figs. 7a-c.
1964	*Pseudorotalia schroeteriana* (Parker and Jones); Loeblich and Tappan, C614, figs. 487,1-5.
1966	*Pseudorotalia schroeteriana* (Parker and Jones); Belford, p. 114, pl. 20, figs. 12-16; pl. 21, figs. 1-3.
1971	*Pseudorotalia schroeteriana* (Carpenter, Jones and Parker); Hansen and Reiss, p. 334, pl. 6, figs. 1-5; pl. 7, figs. 1-6; pl. 7, figs. 1-5.
1980	*Pseudorotalia schroeteriana* (Parker and Jones); Billman et al., p. 103, pl. 27, figs. 1-5, 10-15; pl. 28, figs. 1-8; text-fig. 23.
1980	*Pseudorotalia schroeteriana* (Parker and Jones); Müller-Merz, p. 29, pl. 6, figs. 3-5; pl. 14, figs. 3, 5; pl. 15, fig. 7.
1983	*Pseudorotalia schroeteriana* (Carpenter, Jones and Parker); Coustillas, p. 97, pl. 21, figs. 1-4.

Short description: Test conical to subglobose, planoconvex to slightly biconvex, dorsal side flat or slightly convex, ventral side strongly convex; periphery acute, with imperforate keel. Chambers trochospirally arranged, 10-20 in the last whorl, with umbilical lips and plate-like extensions covering the umbilical area; sutures straight, slightly recurved on dorsal side, radial on opposite side. Wall coarsely perforate, ornamented by imperforate, raised bands of calcite along spiral and radial sutures and in umbilical region. Cameral, interiomarginal aperture on umbilical side, partly covered by narrow extensions of apertural face.

Remarks: Billman et al. (1980; pl. 28) observed transitional forms between *P. schroeteriana* and *Pseudorotalia indopacifica* (Thalmann). Coustillas (1983) managed to construct a complete phylogenetic line between these endmembers of one continuous cline.

Stratigraphic range: *P. schroeteriana* was found in Late Miocene (N15-16) and Late Pliocene - Quaternary deposits (N22-23) on the eastern Indonesian islands. It has been observed previously in Early Miocene to Recent deposits.

Occurrence: According to Billman et al. (1980) *P. schroeteriana* is a typical Indo-Pacific species.

Coustillas (1983) found this species primarily in sediments between 0 and 100 m in the Mahakam Delta, and related the remarkable morphologic variation within the *P. schroeteriana* to bathymetry: rounded shallower forms, compared to conical deeper forms (outer shelf). However, he did not exclude that other environmental parameters, such as salinity, turbidity, nutrient supply and oxygen depletion, could have caused this morphologic variation.

Superfamily *Siphoninacea* Cushman, 1927
Family *Discorbinellidae* Sigal, 1952
Subfamily *Discorbinellinae* Sigal, 1952
Genus *Discorbinella* Cushman and Martin, 1935

Discorbinella bertheloti (d'Orbigny)
(pl. 19, figs. 11-12)

1839c *Rosalina bertheloti* d'Orbigny, p. 135, pl. 1, figs. 28-30.
1884 *Discorbina bertheloti* (d'Orbigny); Brady, p. 650, pl. 89, figs. 11-12.
1931 *Discorbis bertheloti* (d'Orbigny); Cushman,p. 16, pl. 3, fig. 2.
1960 *Discopulvinulina bertheloti* (d'Orbigny); Barker, p. 184, pl. 89, figs. 11-12.
1964 *Discorbinella bertheloti* (d'Orbigny); Loeblich and Tappan, C575, fig. 453,3.
1966 *Discorbinella bertheloti* (d'Orbigny); Belford, p. 90, pl. 12, figs. 15-22.
1976 *Discorbinella bertheloti* (d'Orbigny); Berggren and Haq, p. 110, 112, pl. 6, figs. 9-10.
1983 *Discorbinella bertheloti* (d'Orbigny); Coustillas, pl. 38, figs. 8-9.

Short description: Test concavo-convex, oval in outline, depressed, involute; spiral side convex, opposite side flattened to concave, umbilicate; periphery distinctly carinate and sharp. Chambers trochospirally arranged in 2 coils, strongly embracing, 6 in the last whorl, compressed, arcuate, slightly convex; sutures distinct, slightly depressed. Wall thin and shiny, finely and densely perforate, smooth. Aperture interiomarginal at the umbilical side with apertural lips on dorsal side.

Remarks: *D. bertheloti* has a characteristic form, though considerable variation in the involution of the chambers on the spiral side exists. Belford (1966) differentiated between *D. bertheloti* and *Discorbinella subbertheloti* (Cushman), which is a more compressed form, more evolute on the ventral side and with 5-6 chambers in the last whorl. In our material only specimens of *D. bertheloti* were found, and no specimens of *D. subbertheloti*.

Stratigraphic range: *D. bertheloti* was found in Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988), though erroneously named *Discopulvinulina bertheloti* (d'Orbigny). It has been recorded previously from Oligocene to Recent deposits (see synonymy; Asano, 1951a; De Hornibrook, 1961; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *D. bertheloti* shows a scattered depth distribution down from 78 m (Van Marle, 1988).

Berggren and Haq (1976) considered *D. bertheloti* to be indicative of neritic depths (0-200 m). Lewis (1979) found this species in sediments offshore New Zealand in waterdepths between 40 and 479 m and Coustillas (1983) between 50 and 400 m in the Mahakam Delta.

Family *Planulinoididae* Saidova, 1981

Genus *Planulinoides* Parr, 1941

Planulinoides biconcavus (Jones and Parker)

(pl. 19, figs. 9-10)

1862 *Discorbina biconcava* Jones and Parker (in Carpenter, Jones and Parker), p. 210, fig. 32G.
1865 *Discorbina biconcava* Jones and Parker; Parker and Jones, p. 385, pl. 19, fig. 10.
1884 *Discorbina biconcava* Jones and Parker; Brady, p. 653, pl. 91, fig. 2.
1941 *Planulinoides biconcavus* (Jones and Parker); Parr, p. 305, text-figs. a-c.
1960 *Discorbinella biconcava* (Jones and Parker); Barker, p. 188, pl. 91, fig. 2.
1964 *Planulinoides biconcava* (Jones and Parker); Loeblich and Tappan, C584, figs. 458,4-6.
1965 *Planulinoides biconcavus* (Jones and Parker); Todd, p. 27, pl. 5, fig. 1.

Short description: Test biconcave, nearly planispiral, evolute; periphery square, with broad truncate double keel. Chambers arranged in 2 whorls, 9-11 in last whorl, compressed, arcuate, slightly overlapping; sutures slightly raised and limbate on dorsal side, flush and indistinct on opposite side. Wall hyaline, thick, finely perforate. Primary aperture elongate, areal, variable in length, set oblique towards the umbilical side, bordered by a lip; supplementary apertures may be present on umbilical side at inner margin of the chambers under rudimentary flaps.

Remarks: This species was originally described as a small isomorph of *Planulina ariminensis* d'Orbigny, which it superficially resembles. Closer investigations proved this species to belong to an other genus and superfamily (see Todd, 1965).

P. biconcavus resembles *Heronallenia lingulata* (Burrows and Holland), but differs in being biconcave, in having a characteristic, square periphery and limbate sutures on the dorsal side.

Stratigraphic range: *P. biconcavus* was found in Late Miocene - Early Pliocene (N18) and Late Pliocene - Quaternary deposits (N21-23) on eastern Indonesian islands. It has been observed previously in Pliocene to Recent deposits.

Occurrence: *P. biconcavus* has in the eastern Indonesian material always been encountered in association with typical outer shelf - upper bathyal species.

Family *Siphoninidae* Cushman, 1927
Subfamily *Siphonininae* Cushman, 1927
Genus *Siphonina* Reuss, 1850

Siphonina bradyana Cushman
(pl. 19, figs. 13-14)

1884 *Truncatulina reticulata* Brady (not Czjzek), p. 669, pl. 96, figs. 8a-c.
1927b *Siphonina bradyana* Cushman, p. 11, pl. 1, fig. 4.
1927b *Siphonina australis* Cushman, p. 8, pl. 2, figs. 6a-c; pl. 3, figs. 7-8.
1941a *Siphonina australis* Cushman; LeRoy, p. 41, pl. 2, figs. 88-90.
1941b *Siphonina australis* Cushman; LeRoy, p. 84, pl. 4, figs. 10-12.
1949 *Siphonina australis* Cushman; Boomgaart, p. 131, pl. 12, figs. 15a-b.
1960 *Siphonina bradyana* Cushman; Barker, p. 198, pl. 96, figs. 8a-c.
1988 *Siphonina bradyana* Cushman; Van Marle, p. 149, pl. 2, fig. 13.

Short description: Test lenticular, trochospiral, nearly equally biconvex, with open umbilicus; periphery acute with a broad, thin keel, somewhat fimbriate, but the fine tubules do not reach to the edge of the keel. About 5 chambers in the last whorl, not inflated; sutures distinct, oblique on spiral side, radial on umbilical side, limbate, not depressed. Wall smooth, except for a pustulose area near periphery, finely to coarsely perforate. Aperture elliptical, nearly equatorial in position, standing on a very short neck and bordered by a broad, flaring, phialine lip.

Remarks: *S. bradyana* differs from the type species *Siphonina reticulata* (Czjzek) in being stronger and nearly equally biconvex, and in the fact that the tubules do not reach the edge of the keel.

S. australis is similar in morphology to *S. bradyana* and considered to be a junior synonym.

Stratigraphic range: *S. bradyana* was found in Early - Middle Miocene (N8) and Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Miocene to Pliocene deposits.

Occurrence: In Recent eastern Indonesian sediments *S. bradyana* occurs generally in waterdepths between 317 and 711 m, with its DLO at 545 m and its UDL at 210 m (Van Marle, 1988).

Siphonina tubulosa Cushman
(pl. 19, figs. 15-16)

1884 *Truncatulina reticulata* Brady (not Czjzek), p. 669, pl. 96, figs. 5-7.
1924 *Siphonina tubulosa* Cushman, p. 40, pl. 13, figs. 1-2.
1960 *Siphonina tubulosa* Cushman; Barker, p. 198, pl. 96, figs. 5-7.
1965 *Siphonina tubulosa* Cushman; Todd, p. 22, pl. 15, fig. 4.
1983 *Siphonina tubulosa* Cushman; Coustillas, pl. 40, fig. 21.
1987 *Siphonina tubulosa* Cushman; Crouch and Poag, p. 173, pl. 4, fig. 3.

Short description: Test lenticular, compressed, nearly equally biconvex, broadly and coarsely keeled. Chambers trochospirally arranged, about 3-4 in the last coil, slightly inflated; sutures depressed, limbate, spirally oblique, umbilically radial. Wall covered by numerous, short tubular projections; periphery with a border of longer projections of the same type. Aperture elliptical, nearly equatorial in position, standing on compressed, short tubular neck, bordered by widely flaring, phialine lip.

Remarks: *S. tubulosa* differs from *Siphonina reticulata* (Czjzek) by its distinct, spinose, tubular projections, already present in the young stage.

Stratigraphic range: *S. tubulosa* was found in Late Pliocene - Quaternary deposits (N22) from Timor. It has been observed previously in Pliocene to Recent deposits (see synonymy; LeRoy, 1964; Lewis, 1979; Boichard et al., 1985).

Occurrence: According to LeRoy (1964) *S. tubulosa* is a shallow water species. Lewis (1979) found this species in sediments from the continental margin of New Zealand at a depth of 329 m. Coustillas (1983) encountered this form in samples from waterdepths between 50 and 400 m in the Mahakam Delta and Boichard et al. (1985) between 490 and 715 m on the Pater Noster Platform.

Subfamily *Siphoninoidinae* Loeblich and Tappan, 1984
Genus *Siphoninoides* Cushman, 1927

Siphoninoides echinata (Brady)

1879 *Planorbulina echinata* Brady, p. 283, pl. 8, figs. 31a-c.
1884 *Truncatulina echinata* (Brady); Brady, p. 670, pl. 96, figs. 9-14.
1927b *Siphoninoides echinata* (Brady); Cushman, p. 77, pl. 16, fig. 12.

1954 *Siphoninoides echinata* (Brady); Cushman et al., p. 361, pl. 89, figs. 31-32.
1960 *Siphoninoides echinata* (Brady); Barker, p. 198, pl. 96, figs. 9-14.
1964 *Siphoninoides echinata* (Brady); Loeblich and Tappan, C591, figs. 468,3-6.
1965 *Siphoninoides echinata* (Brady); Todd, p. 23, pl. 15, figs. 5-6.

Short description: Test subglobular to nearly spherical, irregularly trochospiral, involute. Few chambers per whorl, usually 4 in the last whorl, ventricose, unequally arched, strongly embracing. Wall fragile, coarsely perforate, usually spinose or tuberculate. Aperture circular, on a short neck and with a small phialine lip.

Remarks: Because of the fragility of the test, no complete specimens have been found in our material.

Stratigraphic range: *S. echinata* was found in Early - Late Pliocene deposits (N19/20) from Timor, and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *S. echinata* occurs scattered at neritic depths, with its UDL at 92 m (Van Marle, 1988). This supports the opinion of Todd (1965) that this species is a cosmopolitan, shallow water form.

Superfamily *Turrilinacea* Cushman, 1927
Family *Pavoninidae* Eimer and Fickert, 1899
Genus *Pavonina* d'Orbigny, 1826

Pavonina flabelliformis d'Orbigny

1826 *Pavonina flabelliformis* d'Orbigny, p. 260, mod. no. 56.
1884 *Pavonina flabelliformis* d'Orbigny; Brady, p. 374, pl. 45, figs. 17, 19-21.
1945 *Pavonina flabelliformis* d'Orbigny; Cushman, p. 48, pl. 8, figs. 6-10.
1951 *Valvopavonina flabelliformis* (d'Orbigny); Hofker, p. 35, text-figs. 12-15.
1960 *Pavonina flabelliformis* d'Orbigny; Barker, p. 92, pl. 45, figs. 17, 19-21.
1964 *Pavonina flabelliformis* d'Orbigny; Loeblich and Tappan, C563, figs. 444,1-3.

Short description: Test flabelliform, multichambered, compressed, twisted; periphery concave; initial 3 chambers triserial, later ones biserial to finely uniserial and spreading, with low, broad, arched chambers, strongly recurved at the margins; sutures limbate, depressed. Wall thin, transparent, coarsely perforate. Aperture terminal, multiple.

Stratigraphic range: *P. flabelliformis* was found in Late Pliocene - Quaternary deposits (N22) from Timor. It has been described previously from Late Miocene to Recent deposits.

Occurrence: *P. flabelliformis* has in the eastern Indonesian material always been encountered in association with typical neritic species.

Family *Sphaeroidinidae* Cushman, 1927
Genus *Sphaeroidina* d'Orbigny, 1826

Sphaeroidina bulloides d'Orbigny
(pl. 21, figs. 5-6)

1826 *Sphaeroidina bulloides* d'Orbigny, p. 267, mod. no. 65.
1884 *Sphaeroidina bulloides* d'Orbigny; Brady, p. 620, pl. 84, figs. 1-2.
1924 *Sphaeroidina bulloides* d'Orbigny; Cushman, p. 36, pl. 7, figs. 1-6.
1941a *Sphaeroidina bulloides* d'Orbigny; LeRoy, p. 43, pl. 1, figs. 11-13.
1941b *Sphaeroidina bulloides* d'Orbigny; LeRoy, p. 86, pl. 6, figs. 5-6.
1949 *Sphaeroidina bulloides* d'Orbigny; Cushman and Todd, p. 13, pl. 3, figs. 8-11.
1960 *Sphaeroidina bulloides* d'Orbigny; Barker, p. 174, pl. 84, figs. 1-2.
1961 *Sphaeroidina bulloides* d'Orbigny; De Hornibrook, p. 90, pl. 11, fig. 210.
1964 *Sphaeroidina bulloides* d'Orbigny; Loeblich and Tappan, C547, figs. 432,1-3.
1965 *Sphaeroidina bulloides* d'Orbigny; Todd, p. 49, pl. 18, fig. 4.
1976 *Sphaeroidina bulloides* d'Orbigny; Berggren and Haq, p. 102, pl. 1, fig. 16.
1978 *Sphaeroidina bulloides* d'Orbigny; Boltovskoy, p. 169, pl. 7, fig. 11.

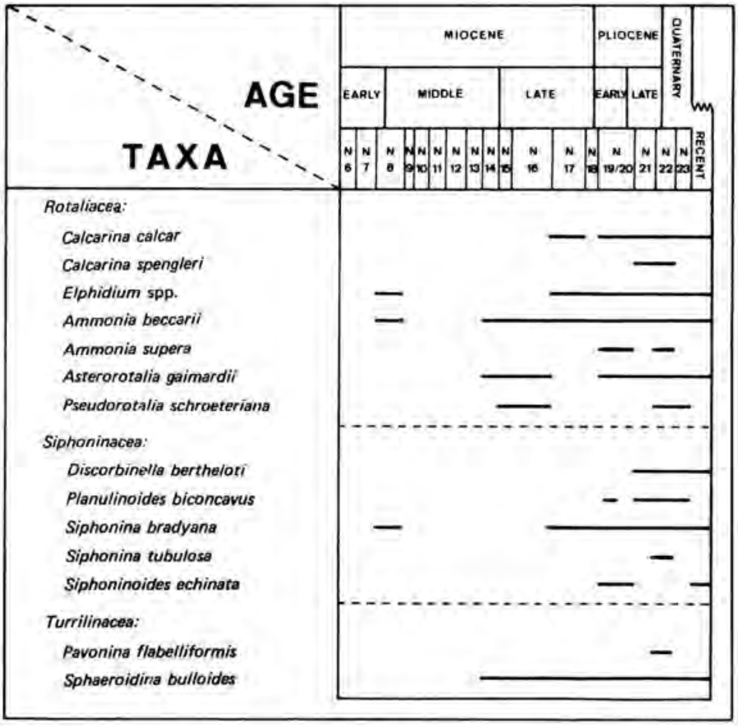

Fig. 24. Composits range chart of the superfamilies *Rotaliacea*, *Siphoninacea* and *Turrilinacea* of the suborder *Rotaliina* in eastern Indonesia.

1979 *Sphaeroidina bulloides* d'Orbigny; Corliss, p. 7, pl. 2, figs. 1-2.
1980 *Sphaeroidina bulloides* d'Orbigny; Haller, p. 262, pl. 14, figs. 7a-b.
1980 *Sphaeroidina bulloides* d'Orbigny; Ingle et al., p. 144, pl. 9, fig. 16.
1980 *Sphaeroidina bulloides* d'Orbigny; Boltovskoy, p. 168, pl. 3, figs. 7a-b.
1984b *Sphaeroidina bulloides* d'Orbigny; Boersma, p. 1286, pl. 3, fig. 13.
1984 *Sphaeroidina bulloides* d'Orbigny; Boltovskoy, p. 327, pl. 1, figs. 31-34.
1984 *Sphaeroidina bulloides* d'Orbigny; Govindan, p. 246, pl. 2, fig. 1.
1986 *Sphaeroidina bulloides* d'Orbigny; Kurihara and Kennett, p. 1070, pl. 2, fig. 1.
1986 *Sphaeroidina bulloides* d'Orbigny; Van Morkhoven et al., p. 80, pl. 24, figs. 1-2.
1988 *Sphaeroidina bulloides* d'Orbigny; Van Marle, p. 149, pl. 2, fig. 11.

Short description: Test subglobular. Chambers hemispherical and strongly embracing. Each new chamber is added centrally above previous aperture, but few are visible; sutures distinct, slightly depressed. Wall very finely perforate, smooth, sometimes faintly roughened near aperture. Aperture a crescentic slit near suture above the junction of the last three chambers, bordered by a slight lip, with simple to bifid tooth.

Remarks: Characteristic of *S. bulloides* are the subglobular form and the crescentic aperture. Coiling is variable, as stated by Loeblich and Tappan (1964): 'Median apertural planes of later chambers diverging from those of earlier ones, alternating to left and right, or constantly to one side, or irregularly to right and left by angle up to 180 degrees, commonly 90 degrees, in latter case resulting in relatively regular spiral' (see also Van Morkhoven et al., 1986).

Stratigraphic range: *S. bulloides* was found in Middle Miocene - Quaternary deposits (N14-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded from Late Eocene to Recent deposits of the Indo-Pacific region (see synonymy; Boomgaart, 1949; LeRoy, 1964; Lewis, 1979; Boersma, 1986).

Occurrence: In Recent eastern Indonesian sediments *S. bulloides* occurs generally in waterdepths between 344 and 2119 m, with its DLO at 711 m and its UDL at 150 m (Van Marle, 1988). This supports the opinion of Van Morkhoven et al. (1986), who reported this species to be common at upper and middle bathyal depths with its UDL in the neritic zone.

Corliss (1979) found this species in sediments between 2500 and 4300 m in the southeastern Indian Ocean. Lewis (1979) reported it from sediments of the continental margin of New Zealand between 18 and 2432 m. Moore et al. (1980) considered this species to be indicative for depths between 150 and 500 m.

According to Hageman (1979) this species is a stenohaline, open marine mud-dweller. Pflum and Frerichs (1976) reported this species in the Gulf of Mexico to be abundant on clastic substrates of the bathyal zone.

Suborder *Spirillinina* Hohenegger and Piller, 1975
Family *Patellinidae* Rhumbler, 1906
Subfamily *Patellininae* Rhumbler, 1906
Genus *Patellina* Williamson, 1858

Patellina corrugata Williamson
(pl. 24, figs. 10-12)

1858 *Patellina corrugata* Williamson, p. 46, pl. 3, figs. 86-89.
1884 *Patellina corrugata* Williamson; Brady, p. 634, pl. 86, figs. 1-7.
1926 *Patellina corrugata* Williamson; Chapman, p. 75, pl. 15, fig. 5.
1951a *Patellina* cf. *corrugata* Williamson; Asano, p. 1, figs. 1-2.
1960 *Patellina corrugata* Williamson; Barker, p. 178, pl. 86, figs. 1-7.
1961 *Patellina corrugata* Williamson; De Hornibrook, p. 97, pl. 13, fig. 250.
1964 *Patellina corrugata* Williamson; Loeblich and Tappan, C604, figs. 477, 6-7.

Short description: Test circular in outline, conical; periphery angular and carinate; spiral side convex and evolute, umbilical side planar to concave and involute. Chambers planispirally to high trochospirally arranged. Sutures limbate on spiral side. Primary chambers divided by numerous, incomplete, secondary transverse septa, giving a typical cancellated appearance to the test. Wall thin, fragile, translucent, with growth lines, finely perforate. Aperture an elongate, low arch, located on internal edge of last chamber.

Remarks: Because of the fragility of the test, the peripheral margin is often broken in the specimens of *P. corrugata* found in our material. Often 'double specimens' of *P. corrugata* were observed, being gamontogamous specimens that mate in a process in which two or more individuals come together and exchange gametes (Myers, 1935; Lipps, 1982).

Stratigraphic range: *P. corrugata* was found in Late Miocene - Early Pliocene (N18) and Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from the eastern Indonesia (Van Marle, 1988). It has been found previously in Late Eocene to Recent deposits.

Occurrence: *P. corrugata* has been found in Recent sediments near Irian Jaya at a waterdepth of 150 m (Van Marle, 1988).

Family *Spirillinidae* Reuss and Fritsch, 1861
Genus *Spirillina* Ehrenberg, 1843

Spirillina limbata Brady

1879 *Spirillina limbata* Brady, p. 278, pl. 8, fig. 26.
1884 *Spirillina limbata* Brady, p. 632, pl. 85, figs. 18-21.
1960 *Spirillina limbata* Brady; Barker, p. 176, pl. 85, figs. 18-21.

Short description: Test discoidal, biconcave, symmetrical, equilateral, planispiral, with square, truncated periphery. Proloculus followed by closely appressed, spirally wound, undivided, tubular second chamber. Wall hyaline, distinctly and finely perforate, smooth, except for the spiral sutural lines, which are marked by raised bands. Aperture terminal, peripheral, crescentic.

Remarks: *S. limbata* differs from *Spirillina vivipara* Ehrenberg in having a less delicate, symmetrical and biconcave test, more whorls, distinct and raised sutures, and a square periphery.

Stratigraphic range: See *Spirillina vivipara* Ehrenberg. *S. limbata* has been observed previously in Recent sediments (see synonymy and Coustillas, 1983).

Occurrence: See *Spirillina vivipara* Ehrenberg. Coustillas (1983) found *S. limbata* in sediments between 50 and 100 m in the Mahakam Delta.

Spirillina vivipara Ehrenberg
(pl. 24, fig. 13)

1843 *Spirillina vivipara* Ehrenberg, p. 323, pl. 3, fig. 41.
1884 *Spirillina vivipara* Ehrenberg; Brady, p. 630, pl. 85, figs. 1-5.
1931 *Spirillina vivipara* Ehrenberg; Cushman, p. 3, pl. 1, figs. 1-4.
1960 *Spirillina vivipara* Ehrenberg; Barker, p. 176, pl. 85, figs. 1-5.
1964 *Spirillina vivipara* Ehrenberg; Loeblich and Tappan, C600, figs. 475, 1-2.

Short description: Test circular in outline, subconical, concavo-convex, with rounded periphery. Second chamber coiled in a low trochospire of 4-9 whorls, providing a step-like effect towards the proloculus. Chambers planar on convex side, inflated on concave side; sutures depressed. Wall hyaline, thin, with prominent growth-lines, coarsely perforate on convex side. Aperture terminal, peripheral, semicircular, sometimes turning in towards umbilicus.

Remarks: *S. vivipara* differs from *Spirillina limbata* Brady in having an unornamented, delicate, concavo-convex test, a second chamber of 4-9 whorls long, depressed sutures and a rounded periphery. As the wall is thin and fragile, the peripheral margin is often broken (see pl. 24, fig. 13).

Stratigraphic range: Because both *S. limbata* and *S. vivipara* occur rarely in the eastern Indonesian material, they have during the countings been taken together in *Spirillina* spp. These were found in Middle - Late Miocene (N14-17) and Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

S. vivipara has been observed previously in Recent sediments (see synonymy; Corliss, 1979; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *Spirillina* spp. generally occur in waterdepths between 60 and 150 m, but also show scattered deeper occurrences (Van Marle, 1988).

Lutze (1974) observed the cosmopoloitan *S. vivipara* in sediments between 35 and 150 m in the Persian Gulf. Lewis (1979) found this species in waterdepths between 40 and 2469 m on the continental margin of New Zealand.

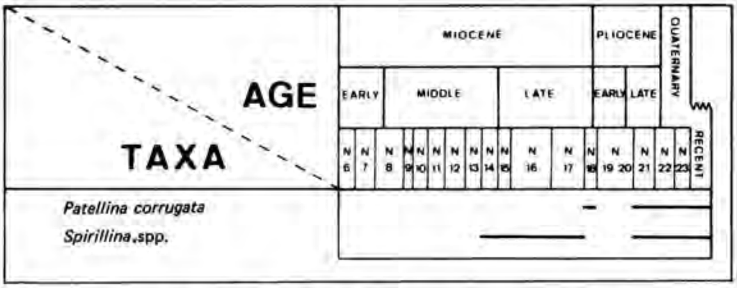

Fig. 25. Composite range chart of the suborder *Spirillinina* in eastern Indonesia.

Suborder *Textulariina* Delage and Herouard, 1896
Superfamily *Ammodiscacea* Reuss, 1862
Family *Ammodiscidae* Reuss, 1862
Subfamily *Ammodiscinae* Reuss, 1862
Genus *Ammodiscus* Reuss, 1862

Ammodiscus incertus (d'Orbigny)

1839b *Operculina incerta* d'Orbigny, p. 49, pl. 6, figs. 16-17.
1884 *Ammodiscus incertus* (d'Orbigny); Brady, p. 330, pl. 38, figs. 1, 3.
1946 *Ammodiscus incertus* (d'Orbigny); Germeraad, p. 62, pl. 1, figs. 1-3.
1960 *Involutina anguillae* (Hoeglund); Barker, p. 78, pl. 38, figs. 1, 3.
1980 *Ammodiscus incertus* (d'Orbigny); Ingle et al., p. 131, pl. 9, fig. 9.
1986 *Ammodiscus incertus* (d'Orbigny); Schroeder, p. 636, pl. 2, fig. 11.

Short description: Test discoidal, compressed, biconcave, with rounded margins. Proloculus followed by undivided, planispirally enrolled tubular chamber, which may show tranverse growth constrictions, but no internal partitions. Sutures deeply depressed, distinct. Wall rather smooth, yellowish-brown in color. Aperture at open end of the tubular chamber.

Stratigraphic range: *A. incertus* was found in Late Miocene deposits (N16-17) from Buton. It has been described previously from Late Miocene to Recent deposits (see synonymy and Boomgaart, 1949).

Occurrence: In Recent eastern Indonesian sediments *A. incertus* occurs scattered deeper than 911 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to have its UDL at 1170 m in the Peru-Chili Trench. Moore et al. (1980) considered *A. incertus* to be indicative for depths between 500 and 2000 m.

Genus *Glomospira* Rzehak, 1885

Glomospira charoides (Jones and Parker)
(pl. 24, figs. 14-15)

1860 *Trochammina squamata* Jones and Parker var. *charoides* Jones and Parker, p. 304.

1884 *Ammodiscus charoides* (Jones and Parker); Brady, p. 334, pl. 38, figs. 10-16.
1950 *Glomospira* sp. Van der Sluis, p. 22, pl. 2, figs. 2a-b.
1960 *Glomospira charoides* (Jones and Parker); Barker, p. 78, pl. 38, figs. 10-16.
1980 *Glomospira charoides* (Jones and Parker); Ingle et al., p. 136, pl. 9, fig. 6.
1986 *Glomospira charoides* (Jones and Parker); Schroeder, p. 636, pl. 2, fig. 5.
1988 *Glomospira charoides* (Jones and Parker); Van Marle, p. 143, pl. 3, figs. 24-25.

Short description: Test irregularly spherical to conical, with rounded margins. Proloculus followed by undivided streptospirally enrolled tubular chamber, of which the last part may grow somewhat irregular. Sutures distinct, slightly depressed. Wall rather smooth and glossy, brown in color. Aperture at the open end of tubular chamber.

Remarks: *G. charoides* has a streptospirally and regularly arranged second chamber compared to the planispiral and irregular second chamber of *Glomospira gordialis* (Jones and Parker).

Stratigraphic range: *G. charoides* was found in Late Pliocene - Quaternary deposits (N22-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *G. charoides* occurs in waterdepths between 711 and 2119 m, with its DLO at 1564 m and its UDL at 545 m (Van Marle, 1988). On the continental margin of New Zealand, Lewis (1979) found this species in samples from waterdepths between 1419 and 2329 m.

Pflum and Frerichs (1976) reported this species to be abundant in the Gulf of Mexico on clastic substrates of the bathyal zone.

Subfamily *Tolypamminінae* Cushman, 1928

Genus *Ammolagena* Eimer and Fickert, 1899

Ammolagena clavata (Jones and Parker)

1860 *Trochammina irregularis* (d'Orbigny) var. *clavata* Jones and Parker, p. 304.
1884 *Webbina clavata* (Jones and Parker); Brady, p. 349, pl. 41, figs. 12-16.
1960 *Ammolagena clavata* (Jones and Parker); Barker, p. 84, pl. 41, figs. 12-16.
1964 *Ammolagena clavata* (Jones and parker); Loeblich and Tappan, C214, fig. 126,3.
1986 *Ammolagena clavata* (Jones and Parker); Schroeder, p. 636, pl. 2, fig. 1.

Short description: Test attached, consisting of a pyriform (lagenoid) chamber with elongate tubular neck. Wall fine, smooth, yellowish-brown in color. Aperture terminal, rounded.

Remarks: Specimens of *A. clavata* were in the eastern Indonesian material always found attached to other foraminiferal tests (Schroeder, 1986). The aperture was usually broken off.

Stratigraphic range: *A. clavata* was found in Late Miocene (N17) and Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Recent sediments.

Occurrence: In Recent eestern Indonesian sediments *A. clavata* has only been found near Irian Jaya at a waterdepth of 684 m, attached to planktic foraminiferal tests (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to be dominant at 800 m in the Peru-Chili Trench. Coustillas (1983) observed this species in waterdepths greater than 125 m in the Mahakam Delta.

Superfamily *Astrorhizacea* Brady, 1881
Family *Bathysiphonidae* Avnimelech, 1952
Genus *Bathysiphon* M. Sars, 1872

Bathysiphon filiformis M. Sars

1872 *Bathysiphon filiformis* M. Sars, p. 251 (nomen nudum).
1884 *Bathysiphon filiformis* M. Sars; Brady, p. 248, pl. 26, figs. 15-20.
1918 *Bathysiphon filiformis* M. Sars; Cushman, p. 27, pl. 11, figs. 4-5.
1960 *Bathysiphon filiformis* M. Sars; Barker, p. 52, pl. 26, figs. 15-20.
1964 *Bathysiphon filiformis* M. Sars; Loeblich and Tappan, C186, fig. 105,4.

Short description: Test a large, elongate, narrow, irregular, more or less flexible, cylindrical tube, which may have annular constrictions. Wall thick. Aperture at the open end of the tube.

Remarks: *B. filiformis* has a relatively fragile test and is therefore hardly ever found completely in fossil deposits. In the fossil eastern Indonesian samples also only fragments have been found in well preserved material.

Stratigraphic range: *B. filiformis* was found in Early Pliocene - Late Pliocene deposits (N19/20-21), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Recent sediments.

Occurrence: In Recent eastern Indonesian sediments *B. filiformis* has only been found near Irian Jaya at a depth of 1816 m (Van Marle, 1988).

Family *Saccamminidae* Brady, 1884
Subfamily *Saccammininae* Brady, 1884
Genus *Saccammina* M. Sars, 1869

Saccammina sphaerica M. Sars

1872 *Saccammina sphaerica* M. Sars, p. 250 (nomen nudum).

1884 *Saccammina sphaerica* M. Sars; Brady, p. 253, pl. 18, figs. 11-15, 17 (not 16).
1918 *Saccammina sphaerica* M. Sars; Cushman, p. 44, pl. 16, figs. 4-5.
1960 *Saccammina sphaerica* M. Sars; Barker, p. 36, pl. 18, figs. 11-15, 17.
1964 *Saccammina sphaerica* M. Sars; Loeblich and Tappan, C196, fig. 112,1.
1980 *Saccammina sphaerica* M. Sars; Haller, p. 227, pl. 1, fig. 3.

Short description: Test a single globular or pyriform chamber. Wall with pseudochitinous base and coarsely agglutinated outer layer, firmly cemented. Aperture rounded, may be extended on a short neck.

Remarks: The specimens of *S. sphaerica* found in the eastern Indonesian material resemble the specimens figured by Brady (1884) and Barker (1960).

Stratigraphic range: *S. sphaerica* was found in Middle - Late Miocene (N14-15 and N17), Late Pliocene (N21), and Quaternary deposits (N23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Recent sediments (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *S. sphaerica* has only been found near Timor in waterdepths between 711 and 914 m (Van Marle, 1988).

On the continental margin of New Zealand, Lewis (1979) observed this species in samples from waterdepths between 329 and 2469 m.

Superfamily *Ataxophragmiacea* Schwager, 1877
Family *Dorothiidae* Balakhmatova, 1972
Subfamily *Dorothiinae* Balakhmatova, 1972
Genus *Dorothia* Plummer, 1931

Dorothia bradyana Cushman
(pl. 25, fig. 1)

1884 *Gaudryina subrotundata* Brady (not Schwager), p. 380, pl. 46, figs. 13a-c.
1936 *Dorothia bradyana* Cushman, p. 31, pl. 5, fig. 2.
1960 *Dorothia bradyana* Cushman; Barker, p. 94, pl. 46, figs. 13a-c.

Short description: Test large, stout, elongate, initial portion tapering, sides nearly parallel in adult, periphery broadly rounded. Small trochospiral initial stage with 4 or more chambers per whorl, followed by biserial stage. Chambers low, inflated, uniform, slightly overlapping; sutures depressed. Wall finely agglutinated, smooth. Aperture an interiomarginal, low slit.

Remarks: *D. bradyana* differs from *Dorothia scabra* (Brady) in having a finely agglutinated test, more pairs of chambers in the biserial stage, low and uniform chambers, and a smaller aperture.

Stratigraphic range: Because both *D. bradyana* and *D. scabra* occur rarely in our material, they have during the countings been assembled in *Dorothia* spp., found in Early Pliocene - Quaternary deposits (N19/20-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

D. bradyana has been observed previously in Recent sediments.

Occurrence: In Recent eastern Indonesian sediments *Dorothia* spp. has only been found near Timor and Tanimbar in waterdepths between 60 and 210 m (Van Marle, 1988).

Dorothia scabra (Brady)

1884 *Gaudryina scabra* Brady, p. 381, pl. 46, figs. 7a-b.
1921 *Gaudryina scabra* Brady; Cushman, p. 146, pl. 23, fig. 5.
1960 *Dorothia scabra* (Brady); Barker, p. 94, pl. 46, figs. 7a-b.
1978 *Dorothia scabra* (Brady); Boltovskoy, p. 158, pl. 3, fig. 32.

Short description: Test elongate, tapering, somewhat compressed; apertural end broad and rounded, initial part narrow and obtusely pointed; lateral edges thick and rounded. Initial stage small, triserial, followed by biserial stage of about 5-6 pairs of relatively high chambers, slowly increasing in size as added. Wall coarsely agglutinated. Aperture an interiomarginal, simple, open arch along the last suture.

Remarks: *D. scabra* differs from *Dorothia bradyana* Cushman in having a more coarsely agglutinated test, less pairs of chambers in the biserial stage, slightly higher chambers, and a larger and more open aperture.

Stratigraphic range: See *Dorothia bradyana* Cushman. *D. scabra* has been found previously in Early Miocene to Recent deposits..

Occurrence: See *Dorothia bradyana* Cushman.

Family *Eggerellidae* Cushman, 1937
Subfamily *Eggerellinae* Cushman, 1937
Genus *Eggerella* Cushman, 1933

Eggerella bradyi (Cushman)
(pl. 25, figs. 5-6)

1884 *Verneuilina pygmaea* Brady (not Egger), p. 385, pl. 47, figs. 4-7.
1911 *Verneuilina bradyi* Cushman; Cushman, p. 54, text-figs. 87a-b.
1933b *Eggerella bradyi* (Cushman); Cushman, p. 52, pl. 15, figs. 19a-b.
1941a *Eggerella bradyi* (Cushman); LeRoy, p. 20, pl. 2, figs. 9-10.
1941b *Eggerella bradyi* (Cushman); LeRoy, p. 70, pl. 5, figs. 21-22.
1960 *Eggerella bradyi* (Cushman); Barker, p. 96, pl. 47, figs. 4-7.
1964 *Eggerella bradyi* (Cushman); LeRoy, p. 18, pl. 1, figs. 13-14.
1964 *Eggerella bradyi* (Cushman); Loeblich and Tappan, C275, fig. 186,1.
1978 *Eggerella bradyi* (Cushman); Boltovskoy, p. 158, pl. 3, fig. 33.
1979 *Eggerella bradyi* (Cushman); Corliss, p. 5, pl. 1, figs. 3-4.
1980 *Eggerella bradyi* (Cushman); Haller, p. 230, pl. 2, figs. 1a-c.
1980 *Eggerella bradyi* (Cushman); Keller, p. 854, pl. 1, fig. 8.
1980 *Eggerella bradyi* (Cushman); Boltovskoy, p. 165, pl. 2, figs. 1a-b.
1981 *Eggerella bradyi* (Cushman); Burke, p. 4, pl. 1, fig. 6.
1984 *Eggerella bradyi* (Cushman); Govindan, p. 246, pl. 2, fig. 10.

1984a *Eggerella bradyi* (Cushman); Boersma, p. 665, pl. 1, fig. 7.
1984b *Eggerella bradyi* (Cushman); Boersma, p. 1300, pl. 8, fig. 1.
1985 *Eggerella bradyi* (Cushman); Thomas, p. 676, pl. 1, fig. 4.
1986 *Eggerella bradyi* (Cushman); Boersma, p. 1025, pl. 10, figs. 1-2.
1986 *Eggerella bradyi* (Cushman); Schroeder, p. 638, pl. 2, fig. 13.

Short description: Test pyramidal, with rounded margins. In early stage trochospirally arranged with 5 chambers per whorl, gradually reduced to triserial arrangement in adult. Chambers inflated, gradually increasing in size as added; sutures distinct, depressed. Wall finely agglutinated, smooth, rather polished. Aperture a low, interiomarginal slit with a thickened lip.

Remarks: The specimens of *E. bradyi* found in the eastern Indonesian material resemble the type description of this species, though the testsize may vary.

Stratigraphic range: *E. bradyi* was found in Early - Middle Miocene (N8), Middle Miocene (N14), and Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been widely recorded from Late Oligocene to Recent deposits of the Indo-Pacific region.

Occurrence: In Recent eastern Indonesian sediments *E. bradyi* occurs generally in waterdepths between 711 and 2119 m, with its DLO at 1290 m and its UDL at 344 m (Van Marle, 1988).

Pflum and Frerichs (1976) reported this cosmopolitan species to occur at middle bathyal to abyssal depths in the Gulf of Mexico. In the southeastern Indian Ocean *E. bradyi* has been found in waterdepths between 2500 and 4500 m (Corliss, 1979), while in the eastern Indian Ocean it is especially abundant in waterdepths between 2000 and 3800 m (Peterson, 1984). Lewis (1979) found this species between 625 and 2469 m in sediments offshore New Zealand.

Genus *Karreriella* Cushman, 1933

Karreriella bradyi (Cushman)
(pl. 25, figs. 2-4)

1884 *Gaudryina pupoides* Brady (not d'Orbigny), p. 378, pl. 46, figs. 1-4.
1911 *Gaudryina bradyi* Cushman, p. 67, text-fig. 107.
1937 *Karreriella bradyi* (Cushman); Cushman, p. 135, pl. 16, figs. 6-11.
1960 *Karreriella bradyi* (Cushman); Barker, p. 94, pl. 46, figs. 1-4.
1964 *Karreriella bradyi* (Cushman); LeRoy, p. 18, pl. 1, figs. 22-23.
1978 *Karreriella bradyi* (Cushman); Boltovskoy, p. 162, pl. 4, figs. 28-29.
1979 *Karreriella bradyi* (Cushman); Corliss, p. 5, pl. 1, figs. 5-6.
1980 *Karreriella bradyi* (Cushman); Keller, p. 854, pl. 1, figs. 9-10.
1980 *Karreriella bradyi* (Cushman); Boltovskoy, p. 171, pl. 4, figs. 7a-b.
1984b *Karreriella bradyi* (Cushman); Boersma, p. 1297, pl. 5, fig. 1.
1986 *Karreriella bradyi* (Cushman); Boersma, p. 1025, pl. 10, fig. 5.

1988 *Karreriella bradyi* (Cushman); Van Marle, p. 145, pl. 5, figs. 23-24.

Short description: Test stout, elongate, slightly compressed; margins rounded, tapering towards the initial end where they end bluntly. Early chambers circular in cross section, in trochoid spire of one or more whorls. Adult chambers biserially arranged, elliptical in cross section, overlapping, inflated; sutures deeply depressed. Wall finely agglutinated, smooth. Aperture rounded to oval, bordered by a lip or extended on a small neck.

Remarks: In the eastern Indonesian specimens the biserial stage was usually slightly twisted about its axis. According to Corliss (1979) the rate of expansion of the chambers, the number of chambers and the testsize are variable in specimens of this species.

Stratigraphic range: *K. bradyi* was found in Early - Middle Miocene (N8) and Late Miocene - Quaternary deposits (N17-22), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been described previously from Late Eocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *K. bradyi* has been found in waterdepths between 714 and 2119 m, with its DLO at 1090 m and its UDL at 495 m (Van Marle, 1988).

Corliss (1979) found this species in sediments between 2500 and 3100 m in the southeastern Indian Ocean. Lewis (1979) reported it in sediments from the continental margin of New Zealand between 625 and 2127 m. According to Van der Zwaan (1982) *K. bradyi* is an open marine, deep, dwelling species, with no substantial tolerance to salinity or oxygen depletion.

Superfamily *Hormosinacea* Haeckel, 1894
Family *Hormosinidae* Haeckel, 1894
Subfamily *Hormosininae* Haeckel, 1894
Genus *Hormosina* Brady, 1879

Hormosina globulifera Brady

1879 *Hormosina globulifera* Brady, p. 60, pl. 4, figs. 4-5
1884 *Hormosina globulifera* Brady, p. 326, pl. 39, figs. 1-6
1960 *Hormosina globulifera* Brady; Barker, p. 80, pl. 39, figs. 1-6.
1964 *Hormosina globulifera* Brady; Loeblich and Tappan, C215, figs. 128,4-5.
1980 *Hormosina globulifera* Brady; Haller, p. 227, pl. 1, fig. 4.
1980 *Hormosina globulifera* Brady; Ingle et al., p. 138, pl. 7, fig. 7.

Short description: Test a single globular chamber, terminating in a narrow tubular neck, or several of such chambers, uniserially arranged, enlarging slowly as added, overlapping, terminating in a narrow tubular neck. Sutures distinct, depressed. Wall finely agglutinated, thin, smooth. The opening at the end of the neck serves as the aperture.

Remarks: The test of *H. globulifera* is fragile and this species is therefore hardly ever preserved in fossil material; in the eastern Indonesian material only fragments have been found in well preserved samples. The test is similar to that of *Reophax*-species, but differs in having larger globular chambers and a finely agglutinated wall.

Stratigraphic range: *H. globulifera* was found in Middle - Late Miocene (N14-16) and Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been observed previously in Early Pliocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *H. globulifera* has only been found near Timor in waterdepths of 1954 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to have its UDL at 1170 m in the Peru-Chili Trench. Lewis (1979) observed this species in sediments from the continental margin of New Zealand in waterdepths between 329 and 2469 m.

Subfamily *Reophacinae* Cushman, 1910
Genus *Reophax* De Montfort, 1808

Reophax agglutinans Cushman

1884 *Reophax scorpiurus* Brady (not De Montfort), p. 291, pl. 30, fig. 18.
1913 *Reophax agglutinans* Cushman, p. 637, pl. 79, fig. 6.
1921 *Reophax agglutinans* Cushman, p. 73, pl. 14, figs. 2a-b.
1960 *Reophax agglutinans* Cushman; Barker, p. 62, pl. 30, fig. 18.
1964 *Reophax agglutinans* Cushman; LeRoy, p. 15, pl. 3, fig. 31.
1983 *Reophax agglutinans* Cushman; Coustillas, pl. 8, fig. 4.

Short description: Test large and stout, composed of several nearly globular or slightly pyriform chambers, irregular in size and shape, though overall increasing in size from first to last chamber. Sutures curved, obscured. Wall composed almost entirely of agglutinated foraminiferal tests or fragments, rough. Aperture terminal, rounded, on a slightly protuberant neck.

Remarks: The test of *R. agglutinans* is fragile and this species is therefore hardly ever preserved in fossil sections; in the fossil eastern Indonesian material only fragments have been found in well preserved samples.

According to Hofker (1978) *R. agglutinans* is built from minute globigerines throughout, and not from other kinds of foraminiferal tests or fragments.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Reophax* spp.: *R. agglutinans*, *R. guttifera*, and *R. nodulosus*. *Reophax* spp. were found in Early - Middle Miocene (N8), Middle - Late Miocene (N14-17), and Early Pliocene - Quaternary deposits (N19/20-23) on the eastern Indonesian islands.

R. agglutinans has been described previously from Late Miocene to Recent deposits.

Occurrence: According to LeRoy (1964) *R. agglutinans* prefers shallow waters. Coustillas (1983) found this species in sediments between 200 and 400 m in the Mahakam Delta.

Reophax guttifera Brady

1881 *Reophax guttifera* Brady, p. 49 (nomen nudum).
1884 *Reophax guttifera* Brady, p. 295, pl. 31, figs. 10-15.
1921 *Reophax guttifera* Brady; Cushman, p. 69, pl. 12, fig. 6.
1960 *Reophax guttifer* Brady; Barker, p. 64, pl. 31, figs. 10-15.
1975 *Reophax guttifer* Brady; Anderson, p. 92, pl. 1, figs. 18a-b.
1986 *Reophax guttifer* Brady; Schroeder, p. 637, pl. 2, fig. 8.

Short description: Test elongate, nearly straight, composed of 3-8 uniserially arranged chambers. Chambers variable in contour, pyriform, inflated, broadest near the truncate or concave base and tapering to a narrow stoloniferous tube at the point of union with the succeeding chamber. Wall coarsely agglutinated, rough, yellowish-brown in color. Rounded aperture at the end of a tubular neck.

Remarks: The test of *R. guttifera* is fragile and this species is therefore hardly ever preserved in fossil material; in the fossil eastern Indonesian material only fragments have been found in well preserved samples.

R. guttifera differs from *Reophax nodulosus* Brady in having a truncate or even concave chamber base, and stoloniferous tubes between the chambers.

Stratigraphic range: See *Reophax agglutinans* Cushman. *R. guttifera* has been observed previously in Recent sediments (see synonymy and Lewis, 1979).

Occurrence: See *Reophax agglutinans* Cushman. Lewis (1979) found *R. guttifera* in sediments from the continental margin of New Zealand in waterdepths between 304 and 2469 m.

Reophax nodulosus Brady

1879 *Reophax nodulosa* Brady, p. 52, pl. 4, figs. 7-8.
1884 *Reophax nodulosa* Brady, p. 294, pl. 31, figs. 1-9.
1960 *Reophax nodulosus* Brady; Barker, p. 64, pl. 31, figs. 1-9.
1983 *Reophax nodulosus* Brady; Coustillas, pl. 7, figs. 7-8.

Short description: Test long and slender, straight or slightly arcuate, consisting of several overlapping chambers, joined regularly end to end. Chambers oblong, rounded, oval or pyriform, inflated; initial chambers relatively large, the other ones enlarging slowly as added. Wall coarsely agglutinated, relatively smooth. Terminal, rounded aperture.

Remarks: The test of *R. nodulosus* is fragile and this species is therefore hardly ever preserved in fossil material; in the fossil eastern Indonesian material only fragments have been found in well preserved samples.

R. nodulosus differs from *Reophax guttifera* Brady in having a rounded, convex chamber base and overlapping chambers.

Stratigraphic range: See *Reophax agglutinans* Cushman. *R. nodulosus* has been observed previously in Recent sediments (see synonymy and Boichard et al., 1985).

Occurrence: See *Reophax agglutinans* Cushman. Bandy and Rodolfo (1964) reported *R. nodulosus* to have its UDL at 1860 m in the Peru-Chili Trench. Coustillas (1983) found this species in samples from waterdepths between 50 and 100 m in the Mahakam Delta and Boichard et al. (1985) at a depth of 490 m on the Pater Noster Platform.

Superfamily *Lituolacea* De Blainville, 1827
Family *Haplophragmoididae* Maync, 1952
Genus *Adercotryma* Loeblich and Tappan, 1952

Adercotryma glomerata (Brady)

1878 *Lituola glomerata* Brady, p. 433, pl. 20, figs. 1a-c.
1884 *Haplophragmium glomeratum* (Brady); Brady, p. 309, pl. 34, figs. 15-18.
1910 *Haplophragmium glomeratum* (Brady); Cushman, p. 104, text-figs. 158-161.
1949 *Haplophragmoides* aff. *glomeratus* (Brady); Boomgaart, p. 46, pl. 2, figs. 2a-b.
1952 *Adercotryma glomerata* (Brady); Loeblich and Tappan, p. 141.
1960 *Adercotryma glomeratum* (Brady); Barker, p. 70, pl. 34, figs. 15-18.
1964 *Adercotryma glomerata* (Brady); LeRoy, p. 17, pl. 1, fig. 32.
1964 *Adercotryma glomerata* (Brady); Loeblich and Tappan, C225, fig. 135,4.
1983 *Adercotryma glomeratum* (Brady); Coustillas, pl. 11, fig. 1.
1986 *Adercotryma glomerata* (Brady); Schroeder, p. 637, pl. 3, fig. 9.

Short description: Test subglobular or ovate, asymmetrical, planispiral, involute. Chambers broad and low, overlapping; sutures distinct, depressed. Wall coarsely agglutinated, rough. Aperture an interiomarginal, low slit or arch, asymmetrically placed near umbilicus.

Remarks: The eastern Indonesian specimens of *A. glomerata* strongly resemble the specimens figured by Brady (1884) and Barker (1960).

Stratigraphic range: *A. glomerata* was found in Early Pliocene - Quaternary deposits (N19/20-22) on the eastern Indonesian islands. It has been found previously in Late Miocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: Lewis (1979) observed *A. glomerata* in sediments from the continental margin of New Zealand in waterdepths between 1240 and 2469 m. Coustillas (1983) found this species in samples from waterdepths between 200 and 400 m in the Mahakam Delta.

Genus *Cribrostomoides* Cushman, 1910

Cribrostomoides scitulus (Brady)

1881 *Haplophragmium scitulum* Brady, p. 50 (nomen nudum).
1884 *Haplophragmium scitulum* Brady, p. 308, pl. 34, figs. 11-13.
1910 *Haplophragmoides scitulum* (Brady); Cushman, p. 103, text-figs. 153-155.
1960 *Alveolophragmium scitulum* (Brady); Barker, p. 70, pl. 34, figs. 11-13.
1986 *Recurvoides scitulum* (Brady); Schroeder, p. 637, pl. 3, fig. 6.

Short description: Test subglobular, compressed, excavated in the umbilical region, involute, with broadly rounded periphery. Chambers planispirally arranged in about 3 whorls, 8-10 broad and low chambers in last formed whorl; sutures distinct, slightly depressed. Wall agglutinated, smooth. Aperture a simple curved slit with bordering lips at the base of the final chamber.

Remarks: *C. scitulus* differs from *Cribrostomoides subglobosus* (G. Sars) in being more regularly built, and in having a regular, broadly rounded periphery.

In the fossil eastern Indonesian specimens no alveolar structures were observed below the imperforate outer layer. Closer examination of the Recent specimens of Van Marle (1988) proved the alveolar structures to be absent in those specimens as well. Hence, they were erroneously assigned to the genus *Alveolophragmium* Shchedrina (1936), and are hereby transferred to the genus *Cribrostomoides*.

Stratigraphic range: See *Cribrostomoides subglobosus* (M. Sars).

Occurrence: See *Cribrostomoides subglobosus* (M. Sars). Bandy and Rodolfo (1964) reported *C. scitulus* to have its UDL at 1860 m in the Peru-Chili Trench. Pflum and Frerichs (1976) and Poag (1981) reported this species to have its UDL at 500 m in the Gulf of Mexico.

Cribrostomoides subglobosus (M. Sars)
(pl. 25, figs. 7-9)

1869 *Lituola subglobosa* M. Sars, p. 250 (nomen nudum).
1884 *Haplophragmium latidorsatum* Brady (not Borneman), p. 307, pl. 34, figs. 7-8, 10 (not figs. 9, 14).
1910 *Haplophragmoides subglobosum* (M. Sars); Cushman, p. 105, text-figs. 162-164.
1960 *Alveolophragmium subglobosum* (M. Sars); Barker, p. 70, pl. 34, figs. 7-8, 10.
1964 *Cribrostomoides subglobosum* (M. Sars); Loeblich and Tappan, C225, figs. 136,1-2.
1980 *Alveolophragmium subglobosum* (M. Sars); Ingle et al., p. 130, pl. 3, fig. 10.
1986 *Cribrostomoides subglobosus* (M. Sars); Schroeder, p. 637, pl. 3, fig. 5.
1988 *Alveolophragmium subglobosum* (M. Sars); Van Marle, p. 137, pl. 5, figs. 26-27.

Short description: Test subglobose, periphery lobulated, umbilical region depressed. Planispiral, involute, consisting of two or more whorls, 5-8 chambers in final coil, broad and low; sutures slightly depressed, distinct. Wall agglutinated, rough, brownish in color. Aperture an elongated, curved slit at the base of the apertural face of the last chamber.

Remarks: *C. subglobosus* differs from *Cribrostomoides scitulus* (Brady) in being more irregularly built and in having a lobulated periphery.

In our fossil specimens no alveolar structures were observed below the imperforate outer layer. Closer examination of the Recent specimens of Van Marle (1988, p. 137, pl. 5, figs. 26-27) proved the alveolar structures to be absent in those specimens as well. Hence, they were erroneously assigned to the genus *Alveolophragmium* Shchedrina (1936), and are hereby transferred to the genus *Cribrostomoides.*

Stratigraphic range: Because both *C. scitulus* and *C. subglobosus* occur rarely in our material, they have during the countings been assembled in *Cribrostomoides* spp., found in Early Pliocene - Quaternary deposits (N19/20-22) from Seram, and in Recent sediments from eastern Indonesia (Van Marle, 1988).

C. subglobosus has been described previously from Recent sediments.

Occurrence: In Recent eastern Indonesian sediments *Cribrostomoides* spp. have their DLO at 1564 m and their UDL at 210 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported *C. subglobosus* to have its UDL at 1860 m in the Peru-Chili Trench. Pflum and Frerichs (1976) and Poag (1981) reported this species from middle bathyal to abyssal depths in the Gulf of Mexico.

Family *Lituolidae* De Blainville, 1827
Subfamily *Lituolinae* De Blainville, 1827
Genus *Ammobaculites* Cushman, 1910

Ammobaculites agglutinans (d'Orbigny)

1846 *Spirolina agglutinans* d'Orbigny, p. 137, pl. 7, figs. 10-12.
1884 *Haplophragmium agglutinans* (d'Orbigny); Brady, p. 301, pl. 32, figs. 19-21, 24-26 (not 22-23).
1960 *Ammobaculites agglutinans* (d'Orbigny); Barker, p. 66, pl. 32, figs. 19-21, 24-26.
1964 *Ammobaculites agglutinans* (d'Orbigny); Loeblich and Tappan, C241, fig. 151,6.
1985 *Ammobaculites agglutinans* (d'Orbigny); Papp and Schmid, p. 54, pl. 45, figs. 6-9.
1986 *Ammobaculites agglutinans* (d'Orbigny); Schroeder, p. 637, pl. 3, fig. 15.

Short description: Test elongate, compressed, rounded in section, peripheral margin rounded. Initial stage closely planispirally coiled, later portion (6-7 chambers) uncoiled and uniserially arranged. Chambers distinct; sutures flush. Wall agglutinated, with simple interior. Terminal, rounded aperture.

Remarks: In the fossil eastern Indonesian material only fragments of *A. agglutinans* have been found in well preserved samples.

A. agglutinans differs from *Ammobaculites foliaceus* (Brady) in being rounded in section and having flush sutures.

Stratigraphic range: Because both *A. agglutinans* and *A. foliaceus* occur infrequently in our material, they have during the countings been assembled in *Ammobaculites* spp., found in Late Miocene - Early Pliocene (N18) and Late Pliocene deposits (N21), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

A. agglutinans has been observed previously in Recent sediments (see synonymy and Coustillas, 1983).

Occurrence: In Recent eastern Indonesian sediments *Ammobaculites* spp. occur scattered deeper than 911 m (Van Marle, 1988).

Coustillas (1983) found *A. agglutinans* in sediments between 0 and 250 m in the Mahakam Delta.

Ammobaculites foliaceus (Brady)

1881 *Haplophragmium foliaceum* Brady, p. 50 (nomen nudum).
1884 *Haplophragmium foliaceum* Brady, p. 304, pl. 33, figs. 20-25.
1910 *Ammobaculites foliaceus* (Brady); Cushman, p. 116, text-figs. 177-179.
1949 *Ammobaculites foliaceus* (Brady); Boomgaart, p. 49, pl. 3, figs. 8a-b.
1960 *Ammomarginulina foliaceus* (Brady); Barker, p. 68, pl. 33, figs. 20-25.
1980 *Ammobaculites foliaceus* (Brady); Ingle et al., p. 130, pl. 3, fig. 11.

Short descriptions: Test elongate, much compressed, flattened on both sides, peripheral edge acute. Early portion closely planispirally coiled, consisting of 2-3 whorls, later portion uncoiled, uniserial, straight. Sutures distinct, not depressed. Wall coarsely agglutinated, rather smooth, yellowish-brown in color. Terminal, simple, rounded aperture.

Remarks: *A. foliaceus* possesses a thin fragile test (and therefore only fragments have been found in well preserved material), a closely coiled initial stage, whereas the later stage is uncoiled.

A. foliaceus differs from *Ammobaculites agglutinans* (d'Orbigny) in being flattened on both sides in cross section and in having distinct sutures.

Stratigraphic range: See *Ammobaculites agglutinans* (D'Orbigny). *A. foliaceus* has been described previously from Late Miocene to Recent deposits.

Occurrence: See *Ammobaculites agglutinans* (D'Orbigny).

Superfamily *Spiroplectamminacea* Cushman, 1927
Family *Spiroplectamminidae* Cushman, 1927
Subfamily *Spiroplectammininae* Cushman, 1927
Genus *Bolivinopsis* Yakovlev, 1891

Bolivinopsis cubensis (Cushman and Bermudez)
(pl. 24, figs. 16-17)

1884	*Spiroplecta annectans* Brady (not Parker and Jones), p. 376, pl. 45, figs. 22-23.
1937	*Spiroplectoides cubensis* Cushman and Bermudez, p. 13, pl. 1, figs. 44-45.
1960	*Spiroplectella earlandi* Barker, p. 92, pl. 45, figs. 22-23.
1961	*Bolivinopsis cubensis* (Cushman and Bermudez); De Hornibrook, p. 15, pl. 1, fig. 1.
1973	*Bolivinopsis cubensis* (Cushman and Bermudez); Douglas, p. 626, pl. 3, fig. 5.
1978	*Bolivinopsis cubensis* (Cushman and Bermudez); Boltovskoy, p. 154, pl. 1, figs. 30-32.
1980	*Bolivinopsis cubensis* (Cushman and Bermudez); Boltovskoy, p. 171, pl. 4, figs. 2a-b.
1984a	*Bolivinopsis cubensis* (Cushman and Bermudez); Boersma, p. 665, pl. 1, fig. 1.
1985	*Bolivinopsis cubensis* (Cushman and Bermudez); Thomas, p. 675, pl. 1, fig. 1.
1986	*Bolivinopsis cubensis* (Cushman and Bermudez); Boersma, p. 1018, pl. 3, figs. 1-2.

Short description: Test very elongate, slender, compressed; early portion planispirally coiled, evolute, later portion biserial, elongate and narrow, with nearly parallel sides. Chambers uniform in size; sutures distinct, slightly depressed, becoming strongly oblique in the later portion. Wall of agglutinated fine-grained calcareous particles, perforate. Terminal, elliptical aperture.

Remarks: Of most of the specimens of *B. cubensis* observed in the eastern Indonesian material, the fragile, terminal portion was broken off.

Stratigraphic range: *B. cubensis* was found in Early - Middle Miocene (N8) and Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia, though erroneously named *Spiroplectella* sp. cf. *S. earlandi* Barker (Van Marle, 1988).

B. cubensis has been observed previously in Paleocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *B. cubensis* shows a scattered depth distribution down from 60 m (Van Marle, 1988).

Subfamily *Vulvulininae* Saidova, 1981
Genus *Vulvulina* d'Orbigny, 1826

Vulvulina pennatula (Batsch)
(pl. 25, figs. 15-16)

1791 *Nautilus (Orthoceras) pennatula* Batsch, pl. 4, fig. 13.
1884 *Bigenerina capreolus* Brady (not d'Orbigny), p. 372, pl. 45, figs. 1-4.
1884 *Bigenerina pennatula* (Batsch); Brady, p. 373, pl. 45, figs. 5-8.
1932 *Vulvulina pennatula* (Batsch); Cushman, p. 76, pl. 10, figs. 1-5.
1949 *Vulvulina pennatula* (Batsch); Boomgaart, p. 54, pl. 3, figs. 10a-b; pl. 4, figs. 1-2.
1960 *Vulvulina pennatula* (Batsch); Barker, p. 92, pl. 45, figs. 1-8.
1964 *Vulvulina pennatula* (Batsch); Loeblich and Tappan, C253, figs. 163, 6-7.
1978 *Vulvulina pennatula* (Batsch); Boltovskoy, p. 173, pl. 8, fig. 44.
1980 *Vulvulina pennatula* (Batsch); Boltovskoy, p. 168, pl. 3, figs. 12a-b.
1988 *Vulvulina pennatula* (Batsch); Van Marle, p. 149, pl. 2, fig. 25.

Short description: Test flaring or elongate, lozenge-shaped or rhomboidal in section, lateral margins acutely angled. Early portion closely coiled, later chambers biserially arranged, final chambers uniserial. Chambers enlarging rapidly as added, broad and low, arched over the early coil, recurved laterally. Sutures distinct, thickened in early portion, later depressed. Wall finely agglutinated, smooth. Aperture in early stage a broad, low, interiomarginal arch, in uniserial stage an elongate, narrow, terminal slit.

Remarks: The uniserial stage is broken off in most of the eastern Indonesian specimens.

Stratigraphic range: *V. pennatula* was found in Early - Middle Miocene (N8), Late Miocene (N15), in Late Miocene - Quaternary deposits (N17-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988). It has been found previously in Late Oligocene to Recent deposits (see synonymy and De Hornibrook, 1961).

Occurrence: In Recent eastern Indonesian sediments *V. pennatula* occurs generally in waterdepths between 495 and 1760 m, with its DLO at 1290 m and its UDL at 344 m (Van Marle, 1988).

This species occurs frequent in laminated sediments from Crete, and therefore is assumed to show tolerance for oxygen deficiency (Jonkers, 1984).

Superfamily *Textulariacea* Ehrenberg, 1839
Family *Textulariidae* Ehrenberg, 1839
Subfamily *Textulariinae* Ehrenberg, 1839
Genus *Textularia* Defrance, 1824

Textularia agglutinans d'Orbigny

1839a *Textularia agglutinans* d'Orbigny, p. 144, pl. 1, figs. 17-18, 32-34.

1884 *Textularia agglutinans* d'Orbigny; Brady, p. 363, pl. 43, figs. 1-3.
1922 *Textularia agglutinans* d'Orbigny; Cushman, p. 7, pl. 1, figs. 4-5.
1935 *Textularia agglutinans* d'Orbigny; Keijzer, p. 128, figs. 25a-g.
1941b *Textularia agglutinans* d'Orbigny; LeRoy, p. 69, pl. 2, figs. 33-34.
1941c *Textularia agglutinans* d'Orbigny; LeRoy, p. 111, pl. 2, figs. 33-35.
1960 *Textularia agglutinans* d'Orbigny; Barker, p. 88, pl. 43, figs. 1-3.
1974 *Textularia agglutinans* d'Orbigny; Lutze, p. 12, pl. 3, figs. 40-41.
1985 *Textularia agglutinans* d'Orbigny; Thomas, p. 678, pl. 1, fig. 5.
1986 *Textularia agglutinans* d'Orbigny; Boersma, p. 1025, pl. 10, figs. 3-4.

Short description: Test elongate, irregular, slightly compressed, tapering, widest at apertural end, thickest along median portion, rhomboid in top view, peripheral margin rounded. Chambers biserially arranged, rounded, 7-9 pairs, increasing gradually in height as added, inflated. Sutures distinct, slightly depressed, nearly horizontal. Wall finely agglutinated. Aperture an elongate slit at the base of last chamber, with a small rim.

Remarks: *T. agglutinans* includes a wide, variable group of specimens with laterally compressed tests, a rounded periphery and slightly inflated chambers. Specimens of *T. agglutinans* are less strongly compressed than those of *Textularia sagitulla* Defrance, have rounded peripheral margins, and are more irregularly built.

Stratigraphic range: See *Textularia sagittula* Defrance. *T. agglutinans* has been recorded previously from Late Miocene to Recent deposits.

Occurrence: See *Textularia sagittula* Defrance. According to Hageman (1979) *T. agglutinans* is a mud-dweller (usually on silty-clayey strata) with tolerance for slightly hypersaline conditions.

Textularia goesii Cushman

1884 *Textularia trochus* Brady (not d'Orbigny), p. 366, pl. 44, figs. 1-2.
1911 *Textularia goesii* Cushman, p. 15, text-figs. 24a-b.
1922 *Textularia goesii* Cushman, p. 9, pl. 1, fig. 6.
1960 *Textularia goesii* Cushman; Barker, p. 90, pl. 44, figs. 1-2.
1978 *Textularia goesii* Cushman; Boltovskoy, p. 170, pl. 7, fig. 33.
1983 *Textularia goesii* Cushman; Coustillas, pl. 2, fig. 1.

Short description: Test broadly triangular in front view, subcircular in apertural view, tapering abruptly to the apex; peripheral margins convex. Chambers biserially arranged, low and broad, enlarging slowly as added, slightly overlapping. Sutures distinct, limbate, not depressed. Wall coarsely agglutinated, smooth. Aperture a low arch in a depression at the base of the inner margin of the final chamber.

Remarks: *T. goesii* is much more rounded in cross section than *Textularia agglutinans* d'Orbigny and *Textularia sagittula* Defrance, is more strongly tapering, and its aperture is situated in a depression.

Stratigraphic range: See *Textularia sagittula* Defrance. *T. goesii* has been observed previously in Early - Middle Miocene and Recent deposits.

Occurrence: See *Textularia sagittula* Defrance. Coustillas (1983) found *T. goesii* in sediments between 100 and 400 m in the Mahakam Delta.

Textularia sagittula Defrance
(pl. 25, fig. 10)

1824	*Textularia sagittula* Defrance, p. 177, pl. 13, fig. 5.
1884	*Textularia sagittula* Defrance; Brady, p. 361, pl. 42, figs. 17-18.
1960	*Textularia sagittula* Defrance; Barker, p. 86, pl. 42, figs. 17-18.
1964	*Textularia sagittula* Defrance; Loeblich and Tappan, C253, figs. 165,1-2.
1974	*Textularia sagittula* Defrance; Lutze, p. 12, pl. 3, figs. 48-49.
1983	*Textularia sagittula* Defrance; Coustillas, pl. 2, figs. 4-5.
1985	*Textularia sagittula* Defrance; Wang et al., p. 336, pl. 4, fig. 1.
1988	*Textularia sagittula* Defrance; Van Marle, p. 149, pl. 1, fig. 15.

Short descriptions: Test elongate, compressed, flat to oval in cross section, tapering; periphery acute or carinate. Chambers biserially arranged, closely appressed, slightly overlapping, low and broad; sutures slightly depressed, oblique. Wall finely agglutinated, smooth. Aperture a single low arch at the base of last chamber.

Remarks: *T. sagitulla* is more flattened in cross section than *Textularia agglutinans* d'Orbigny, has a sharp to carinate periphery and is more regularly built.

Stratigraphic range: Because individual species occur infrequently, the following species have during the countings been assembled in *Textularia* spp.: *T. agglutinans*, *T. goessi*, and *T. sagittula*, of which the last is most common. *Textularia* spp. were found in Early - Middle Miocene (N8) and Middle Miocene - Quaternary deposits (N14-23). All species gathered in *Textularia* spp. have also been observed in Recent sediments from eastern Indonesia (Van Marle, 1988).

T. sagitulla has been described previously from Late Miocene to Recent deposits (see synonymy; Boomgaart, 1949; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *Textularia* spp. occur generally in waterdepths between 60 and 1100 m, with their DLO at 244 m, but also show scattered deeper occurrences (Van Marle, 1988).

Lewis (1979) observed *T. sagitulla* in sediments from the continental margin of New Zealand in waterdepths between 183 and 1649 m. Coustillas (1983) found it from 30 m to over 400 m in the Mahakam Delta, with highest frequencies between 40 and 100 m.

Family *Valvulinidae* Berthelin, 1880
Genus *Martinottiella* Cushman, 1933

Martinottiella communis (d'Orbigny)

1826 *Clavulina communis* d'Orbigny, p. 268, mod. no. 4 (nomen nudum).
1846 *Clavulina communis* d'Orbigny, p. 196, pl. 12, figs. 1-2.
1884 *Clavulina communis* d'Orbigny; Brady, p. 394, pl. 48, figs. 3-4, 6-8 (not 1-2, 5 and 9-13).
1922 *Clavulina communis* d'Orbigny; Cushman, p. 84, pl. 16, figs. 4-5.
1960 *Martinottiella communis* (d'Orbigny); Barker, p. 98, pl. 48, figs. 3-4, 6-8.
1961 *Martinottiella communis* (d'Orbigny); De Hornibrook, p. 29, pl. 27, fig. 536.
1964 *Martinottiella communis* (d'Orbigny); Loeblich and Tappan, C282, figs. 188,10a-b.
1980 *Martinottiella communis* (d'Orbigny); Haller, p. 230, pl. 1, fig. 9.
1980 *Martinottiella communis* (d'Orbigny); Ingle et al., p. 140, pl. 4, figs. 14-15.
1984a *Martinottiella communis* (d'Orbigny); Boersma, p. 665, pl. 1, figs. 2-3.
1984b *Martinottiella communis* (d'Orbigny); Boersma, p. 1018, pl. 3, fig. 5.
1985 *Martinottiella communis* (d'Orbigny); Papp and Schmid, p. 74, pl. 66, figs. 1-8.

Short description: Test elongate, cylindrical, the early part fusiform. Initial chambers trochospirally arranged, with 4-5 chambers per whorl, progressively reduced to triserial, biserial and elongate, uniserial arrangement in adult stage. Chambers increasing gradually in diameter as added, slightly inflated, as broad as high; sutures distinct, slightly depressed. Wall relatively smooth. Aperture a terminal, elevated, elongate slit, sometimes arcuate, with bordering lip.

Stratigraphic range: *M. communis* was found in Late Miocene (N15-16) and Early - Late Pliocene deposits (N19/20), and in Recent sediments from eastern Indonesia (Van Marle). It has been observed previously in Early Eocene to Recent deposits (see synonymy and Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *M. communis* occurs scattered deeper than 711 m (Van Marle, 1988).

Bandy and Rodolfo (1964) reported this species to have its UDL at 1170 m in the Peru-Chili Trench. Lewis (1979) found it in sediments offshore New Zealand in waterdepths between 276 and 625 m.

Superfamily *Trochamminacea* Schwager, 1877
Family *Trochamminidae* Schwager, 1877
Subfamily *Trochammininae* Schwager, 1877
Genus *Trochammina* Parker and Jones, 1859

Trochammina nitida Brady

1881 *Trochammina nitida* Brady, p. 52 (nomen nudum).
1884 *Trochammina nitida* Brady, p. 339, pl. 41, figs. 5-6.
1920 *Trochammina nitida* Brady; Cushman, p. 75, pl. 15, fig. 2.
1960 *Trochammina nitida* Brady; Barker, p. 84, pl. 41, figs. 5-6.

Short description: Test small, trochoid, flattened above, convex below; periphery rounded. Chambers numerous, trochospirally arranged in about 3 coils, 9 in the last whorl; all chambers visible from the dorsal side, only those of the last whorl from the opposite side, enlarging gradually as added. Sutures straight or slightly curved, at nearly right angles to periphery, depressed. Wall agglutinated, smooth, with yellowish-brown color. Aperture a low, interiomarginal, extraumbilical-umbilical arch.

Remarks: The test of *T. nitida* is fragile, and therefore in the eastern Indonesian material only fragments and broken specimens have been found in well preserved samples.

Stratigraphic range: See *Trochammina squamata* Parker and Jones.

Occurrence: See *Trochammina squamata* Parker and Jones.

Trochammina squamata Parker and Jones

1860 *Trochammina squamata* Parker and Jones, p. 304 (nomen nudum).
1884 *Trochammina squamata* Parker and Jones; Brady, p. 337, pl. 41, figs. 3a-c.
1960 *Trochammina squamata* Parker and Jones; Barker, p. 84, pl. 41, figs. 3a-c.

Short description: Test circular in outline, strongly compressed, lobate; spiral side convex, umbilical side concave with deep umbilicus; peripheral margin rounded. Chambers trochospirally arranged in 2-3 whorls, quadrangular to curved on spiral side, kidney-shaped on umbilical side and terminating with triangular lobe near umbilicus, 6-10 chambers in final whorl. Sutures distinct, depressed. Wall thin, finely agglutinated, smooth, yellowish-brown in color. Aperture a narrow umbilical-extraumbilical slit.

Remarks: The test of *T. squamata* is fragile and therefore in the eastern Indonesian material only broken specimens and fragments have been found in well preserved samples.

According to Boltovskoy et al. (1980), *T. squamata* is a highly variable species, particularly with regard to the number and shape of the chambers and the nature of the umbilicus and sutures.

Stratigraphic range: Because both *T. nitida* and *T. squamata* occur rarely in our material, they have during the countings been assembled in *Trochammina* spp., found in Late Pliocene - Quaternary deposits (N22-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

T. squamata has been observed previously in Recent deposits (see synonymy; Lutze, 1974; Lewis, 1979).

Occurrence: In Recent eastern Indonesian sediments *Trochammina* spp. show a scattered depth distribution down from 60 m (Van Marle, 1988).

Lutze (1974) reported *T. squamata* to be cosmopolitan, and common in sediments between 18 and 200 m in the Persian Gulf. Lewis (1979) found this species in sediments offshore New Zealand in waterdepths between 18 and 1240 m.

Superfamily *Verneuilinacea* Cushman, 1911
Family *Pseudobolivinidae* Wiesner, 1931
Genus *Siphotextularia* Finlay, 1939

Siphotextularia concava (Karrer)
(pl. 25, fig. 11)

1868 *Plecanium concavum* Karrer, p. 129, pl. 1, fig. 3.
1884 *Textularia concava* (Karrer); Brady, p. 360, pl. 42, figs. 13-14.
1960 *Siphotextularia concava* (Karrer); Barker, p. 86, pl. 42, figs. 13-14.

Short description: Test quadrangular in section, compressed, tapering, with concave lateral sides and square peripheral edges. Chambers biserially arranged, enlarging gradually as added. Sutures distinct, oblique, slightly depressed. Wall agglutinated, smooth. Aperture interiomarginal, rounded, with small bordering lip, may be slightly extended.

Stratigraphic range: *S. concava* was found in Late Miocene (N17) and Late Pliocene - Quaternary deposits (N21-23), and in Recent sediments from eastern Indonesia (Van Marle, 1988).

Occurrence: In Recent eastern Indonesian sediments *S. concava* shows a scattered depth distribution down from 317 m (Van Marle, 1988).

Family *Verneuilinidae* Cushman, 1911
Genus *Gaudryina* d'Orbigny, 1839

Gaudryina atlantica (Bailey)
(pl. 25, fig. 12)

1851 *Textularia atlantica* Bailey, p. 12, figs. 38-43.
1884 *Verneuilina triquetra* Brady (not Munster), p. 383, pl. 47, figs. 18a-b (not 19-20).
1922 *Gaudryina atlantica* (Bailey); Cushman, p. 70, pl. 13, figs. 1-3.
1939 *Gaudryina* (*Pseudogaudryina*) *atlantica* (Bailey); Cushman and McCulloch, p. 93, pl. 8, figs. 9-10.

1960 *Gaudryina atlantica* (Bailey); Barker, p. 96, pl. 47, figs. 18a-b.
1964 *Gaudryina atlantica* (Bailey); Loeblich and Tappan, C269, figs. 179,6.

Short description: Test large, elongate, tapering, compressed, triangular in section. Initial stage short, triserial, with triangular chambers, later portion biserial, with higher, truncated chambers. Sutures depressed. Wall coarsely agglutinated, rugose. Aperture an interiomarginal arch.

Remarks: The eastern Indonesian specimens of *G. atlantica* closely resemble the specimens figured by Brady (1884) and Barker (1960).

Stratigraphic range: *G. atlantica* was found in Middle - Late Miocene (N14-16), Late Miocene - Early Pliocene (N18), and Late Pliocene - Quaternary deposits (N21-23) on the eastern Indonesian islands. It has been described previously from Recent sediments.

Occurrence: *G. atlantica* has in the eastern Indonesian material always been found in association with typical outer neritic - upper bathyal species.

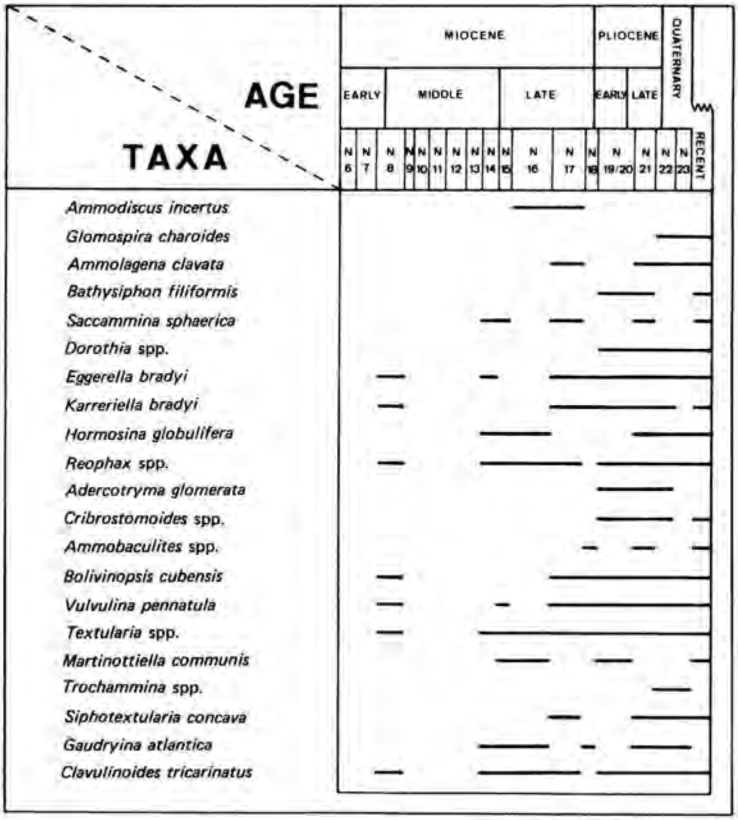

Fig. 26. Composite range chart of the suborder *Textulariina* in eastern Indonesia.

Genus *Clavulinoides* Cushman, 1936

Clavulinoides tricarinatus (LeRoy)
(pl. 25, figs. 13-14)

1884 *Tritaxia tricarinata* Brady (not Reuss), p. 389, pl. 49, figs. 8-9.
1941a *Clavulinoides tricarinatus* LeRoy, p. 20, pl. 3, figs. 92-93.
1949 *Clavulinoides tricarinatus* LeRoy; Boomgaart, p. 58, pl. 4, figs. 8-9.
1960 *Clavulinoides* aff. *instar* Barker (not Finlay), p. 100, pl. 49, figs. 8-9.
1983 *Tritaxia* sp. Coustillas, pl. 6, fig. 1.

Short description: Test elongate, triangular in transverse section; initial end bluntly pointed, sides flat to slightly concave, peripheral edges carinate and parallel to somewhat diverging towards the apertural end. Initial stage triserial, comprising most of the test, last portion uniserial, compressed. Chambers numerous, rather uniform in shape; sutures flush to slightly depressed, curved. Wall finely agglutinated. Interiomarginal aperture in triserial stage, terminal and slightly extended in adult stage.

Remarks: Though Loeblich and Tappan (1964, p. 272) placed the genus *Clavulinoides* in the synonymy of the genus *Tritaxia* Reuss (1860), this is still under discussion (see Banner and Desai, 1985). Until this problem is solved we prefer to maintain the original status.

According to Boomgaart (1949) *Clavulinoides javanicus* Van der Sluis and De Vletter is a junior synonym of *C. tricarinatus*.

Stratigraphic range: *C. tricarinatus* was found in Early - Middle Miocene (N8), Middle - Late Miocene (N14-17), and Early Pliocene - Quaternary deposits (N19/20-23), and in Recent deposits from eastern Indonesia (Van Marle, 1988) as *Tritaxia* sp. cf. *T. tricarinata* (Reuss). It has been found previously in Late Miocene to Recent deposits.

Occurrence: In Recent eastern Indonesian sediments *C. tricarinatus* shows a scattered depth distribution down from 92 m (Van Marle, 1988). Coustillas (1983) found this form in sediments between 0 and 404 m in the Mahakam Delta.

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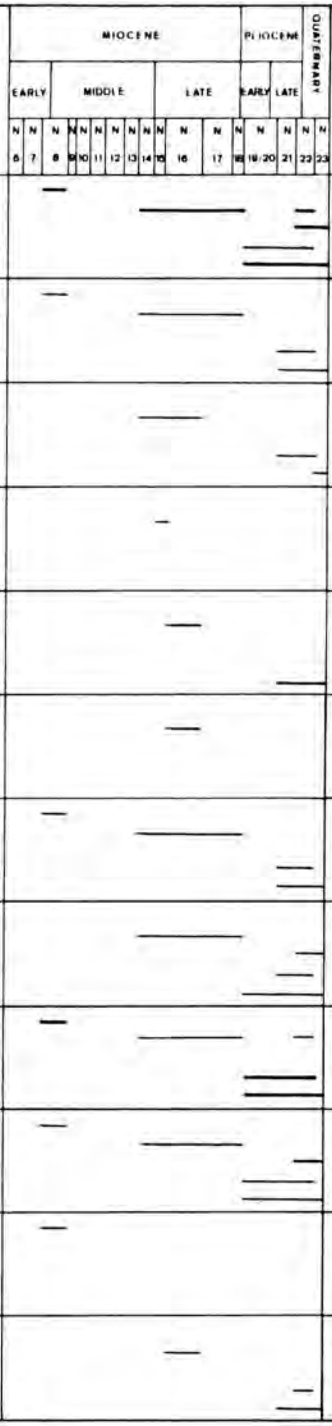
Plates

PLATE 1

RARE
COMMON
ABUNDANT



FIGURES	TAXA	ISLANDS	REMARKS
1	*Lenticulina gibba* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	1. Sample G5-6-155B (Recent); 50x Note distinct apertures of earlier chambers
2	*Lenticulina peregrina* (Schwager)	BURU BUTON KAI SERAM TIMOR	2. Sample G5-4-82B (Recent); 100x
3	*Lenticulina costata* (Fichtel and Moll)	BURU BUTON KAI SERAM TIMOR	3. Sample GF1A T192; 35x
4 + 9	*Planularia gemmata* (Brady)	BURU BUTON KAI SERAM TIMOR	4. Sample GF1A-B293; 65x 9. Sample GF1A-B293; 65x Note characteristic ornament of **exogenous** beads upon or parallel to the sutures.
5 – 6	*Marginulina glabra* d'Orbigny	BURU BUTON KAI SERAM TIMOR	5. Sample GF1A-B293; 50x 6. Sample GF1A-B293; 80x
7	*Vaginulopsis sublegumen* Parr	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-B293; 50x Note flush sutures.
8	*Astacolus crepidulus* (Fichtel and Moll)	BURU BUTON KAI SERAM TIMOR	8. Sample GF1A-T192; 55x
10 – 12	*Plectofrondicularia* spp	BURU BUTON KAI SERAM TIMOR	10. *Plectofrondicularia helenae* (Chapman) Sample GF1A-B293; 50x 11. Idem. Sample GF1A-T63; 40x 12. *Plectofrondicularia advena* (Cushman) Sample GF2A-K201; 40x
13 – 15	*Dentalina* spp.	BURU BUTON KAI SERAM TIMOR	13. *Dentalina advena* (Cushman). Sample GF1A-T179 65x 14. *Dentalina filiformis* (d'Orbigny) Sample G5-6-155B (Recent); 40x 15. *Dentalina subsoluta* (Cushman) Sample G5-6-155B (Recent); 40x
16 – 18	*Pseudonodosaria* spp.	BURU BUTON KAI SERAM TIMOR	16. *Glandulina laevigata* d'Orbigny. Sample GF1A-B293; 55x 17. *Pseudonodosaria radicula* (Linnaeus) Sample GF1A-T192; 40x 18. *Pseudonodosaria aequalis* Sample G5-6-155B (Recent); 80x
19	*Pyrulina fusiformis* (Roemer)	BURU BUTON KAI SERAM TIMOR	19. Sample GF2A-S116; 75x
20	*Globulina australis* d'Orbigny	BURU BUTON KAI SERAM TIMOR	20. Sample GF1A-B293; 55x Note striate basal part.

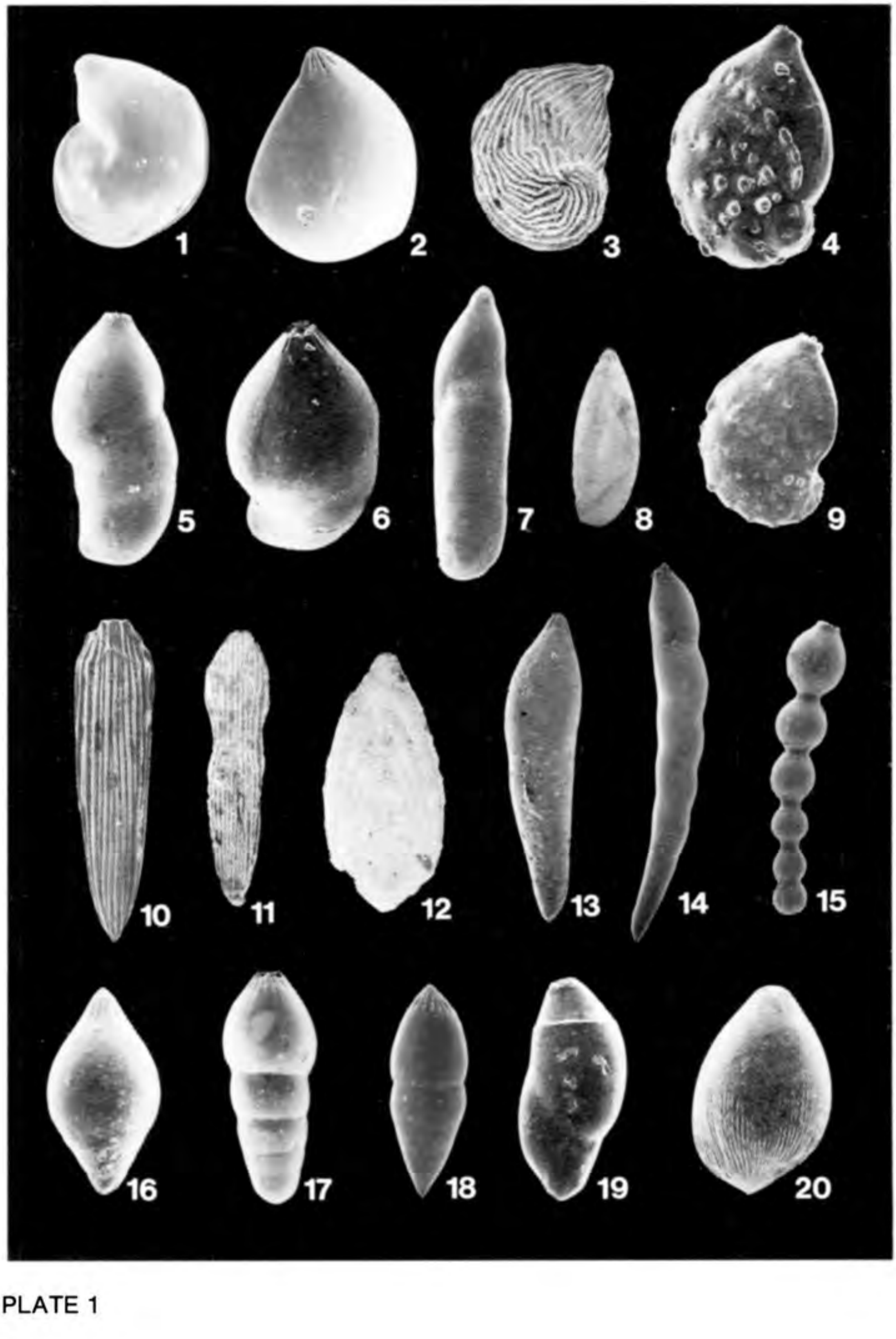


PLATE 1

PLATE 2

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FIGURES	TAXA	ISLANDS	REMARKS
1 – 2	*Orthomorphina challengeriana* (Thalmann)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T143; 100x 2. Sample GF1A-T143; 100x
3 – 4	*Amphicoryna scalaris* (Batsch)	BURU BUTON KAI SERAM TIMOR	3. Sample GF1A-B293; 65x 4. Sample GF1A-B293; 65x
5 – 6	*Nodosaria* spp.	BURU BUTON KAI SERAM TIMOR	5. *Nodosaria simplex* Silvestri Sample GF1A-T143; 80x 6. *Nodosaria longiscata* d'Orbigny Sample GF1A-T192; 35x
7–10	*Lagena* spp.	BURU BUTON KAI SERAM TIMOR	7. *Lagena gracilis* Williamson Sample GF2A-S116; 65x 8. *Lagena striata* (d'Orbigny) Sample GF1A-T201; 100x 9. *Lagena perlucida* (Montagu) Sample GF1A-T192; 70x 10. *Lagena sulcata* (Walker and Jacob) Sample GF1A-T145; 100x
11	*Oolina hexagona* (Williamson)	BURU BUTON KAI SERAM TIMOR	11. Sample GF1A-B293; 140x Note regular, reticulate pattern of hexagonal depressions as ornament.
12–18	*Fissurina* spp.	BURU BUTON KAI SERAM TIMOR	12. *Fissurina laevigata* Reuss. Sample GF2A-S116; 100x 13. *Fissurina submarginata* (Boomgaart) Sample GF1A-T179; 100x 14. Idem. Sample GF1A-T145; 100x 15. Idem. Sample GF1A-T179; 110x 16. *Fissurina revertens* (Heron-Allen and Earland) Sample GF1A-T204; 140x 17. *Fissurina wrightiana* (Brady). Sample GF2A-S116. 18. *Parafissurina lateralis* (Cushman) Sample GF1A-T179; 140x Note characteristic teardrop form.

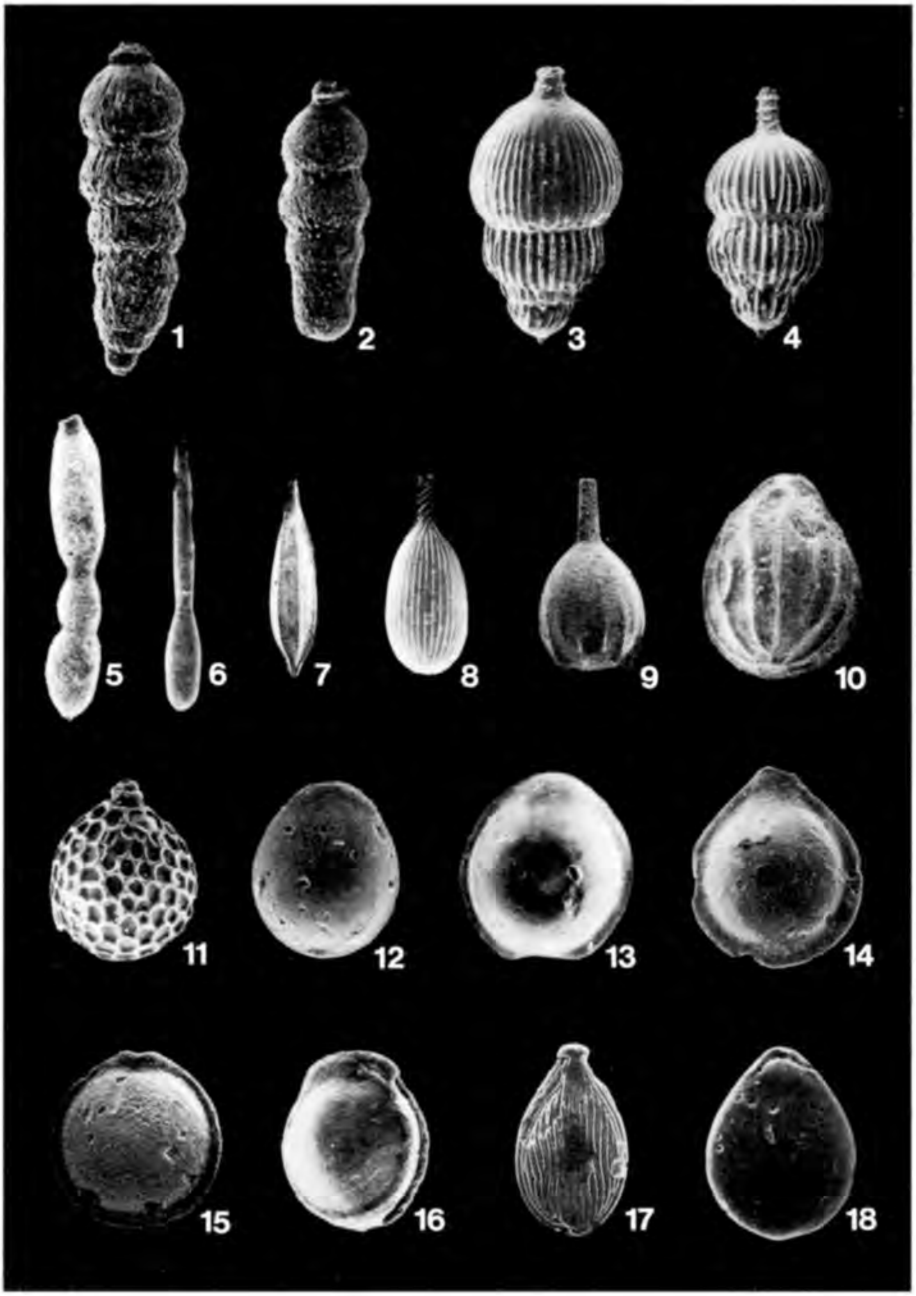
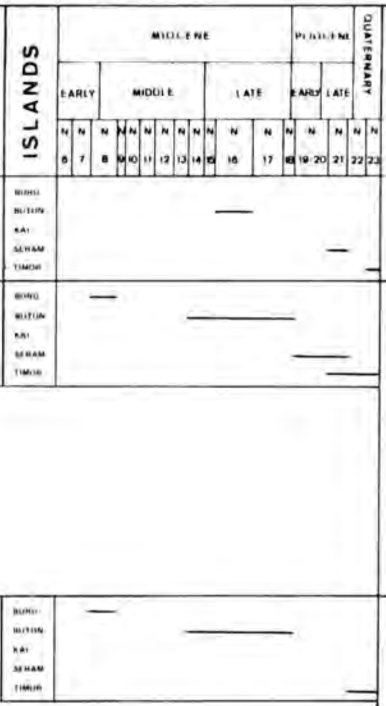


PLATE 2

PLATE 3

FIGURES | TAXA | REMARKS



1 *Massilina arenaria* (Brady)

1. SampleGF1A-T215; 35x

2 - 7 *Pyrgo* spp.

2. *Pyrgo comata* (Brady)
Sample G5-4-74B (Recent); 50x
Note numerous longitudinal striae.
3. *Pyrgo murrhina* (Schwager)
Sample G5-4-77B (Recent); 50x
Note the rounded aperture
4. *Pyrgo subsphaerica* (d'Orbigny)
Sample GF1A-T215; 140x
5. Idem. Sample GF1A-T145; 60x
6. *Pyrgo vespertilio* (Schlumberger)
Sample GF1A-T145; 25x
7. Idem. GF1A-T145; 35x

8 - 16 *Quinqueloculina* spp.

8. *Quinqueloculina boueana* d'Orbigny
Sample GF1A-T196; 150x
Note the characteristic ornament of parallel striae.
9. *Quinqueloculina pseudoreticulata* Parr
Sample G5-4-74B (Recent); 30x
Note the characteristic reticulate ornament
10. Idem. Sample G5-4-74B (Recent); 35x
11. *Quinqueloculina seminulum* (Linnaeus)
Sample GF1A-T215; 150x
12. Idem. Sample G5-4-74B (Recent); 100x
13. Idem. Sample GF1A-T215; 90x
14. *Quinqueloculina venusta* Karrer
Sample GF1A-T201; 60x
Note the sharp, slightly carinate periphery.
15. Idem. Sample G5-4-74B (Recent); 65x
16. Idem. Sample GF1A-T143; 120x

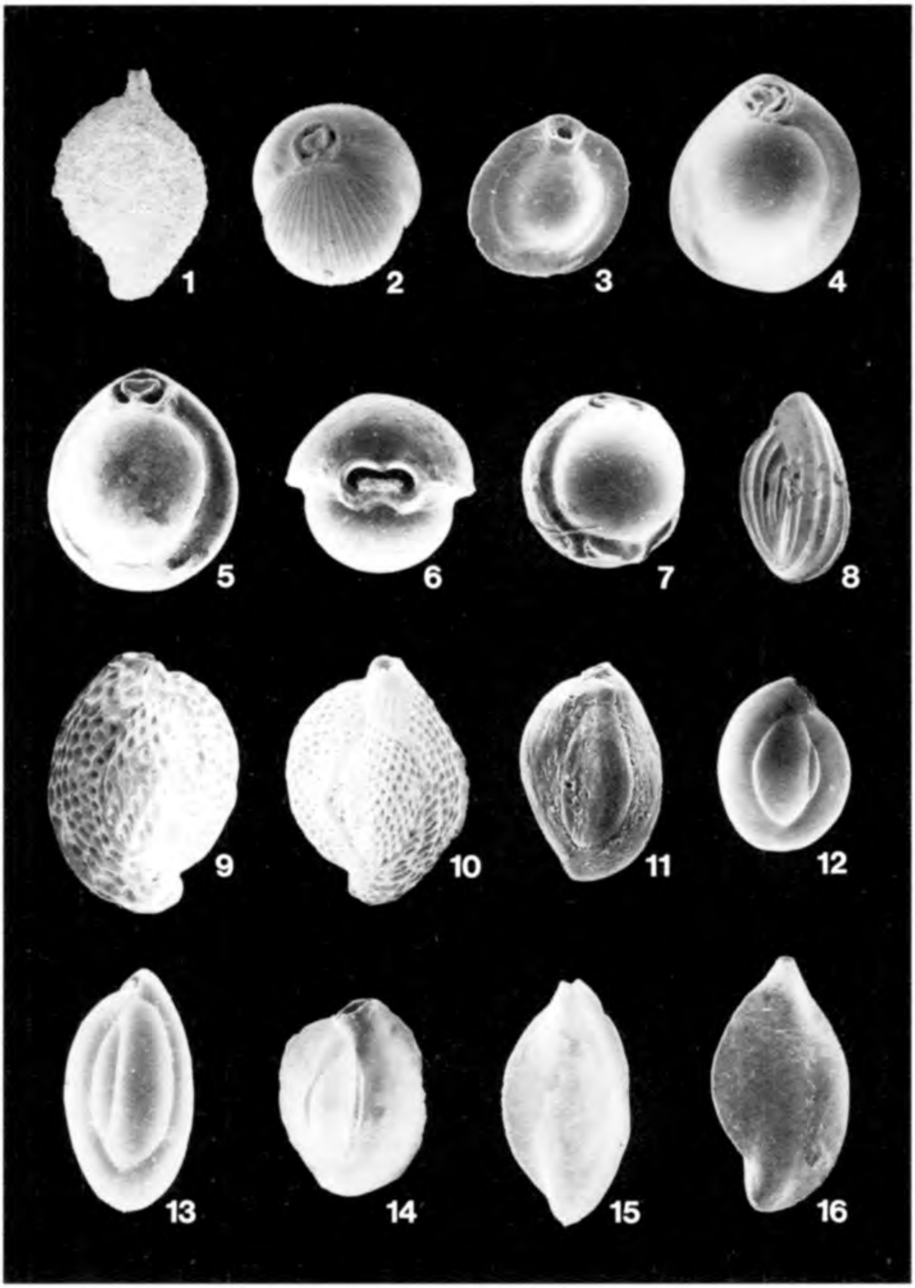


PLATE 3

PLATE 4

FIGURES	TAXA	ISLANDS	REMARKS
1 – 2	*Triloculina tricarinata* d'Orbigny	BURU BUTON KAI SERAM TIMOR	1. Sample G5-4-74B (Recent); 80x 2. Sample G5-4-74B (Recent); 80x Note the tricarinate form and semicircular aperture with distinct bifid tooth.
3	*Nummoloculina irregularis* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	3. Sample GF1A-T215; 110x
4	*Sigmoilopsis schlumbergeri* (Silvestri)	BURU BUTON KAI SERAM TIMOR	4. Sample G5-4-84B (Recent); 100x
5 – 8	*Spiroloculina* spp.	BURU BUTON KAI SERAM TIMOR	5. *Spiroloculina communis* Cushman and Todd Sample G5-6-161B (Recent); 65x Note raised peripheral margins of earlier chambers. 6. Idem. Sample GF1A-T215; 65x 7. *Spiroloculina depressa* d'Orbigny Sample GF1A-B320; 100x Note the typical elliptical form 8. *Spiroloculina rotunda* d'Orbigny Sample GF1A-T145; 50x Note the typical circular form.
9 – 10	*Peneroplis* spp.	BURU BUTON KAI SERAM TIMOR	9. *Peneroplis planatus* (Fichtel and Moll) Sample G5-2-67B (Recent); 50x 10. *Peneroplis pertusus* (Forskal) Sample G5-2-67B (Recent); 35x
11 – 12	*Ceratobulimina pacifica* Cushman and Harris	BURU BUTON KAI SERAM TIMOR	11. Sample G5-4-84B (Recent); 95x Note the distinct and elongate aperture extending as a straight slit into the apertural face. 12. Sample G5-6-152B (Recent); 105x
13	*Lamarckina ventricosa* (Brady)	BURU BUTON KAI SERAM TIMOR	13. Sample GF2A-S182; 120x
14 – 16	*Hoeglundina elegans* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	14. Sample G5-6-154B (Recent); 60x 15. Sample GF1A-T143; 65x 16. Sample G5-6-154B (Recent); 55x Note the supplementary apertures of earlier chambers visible as scars along the periphery.

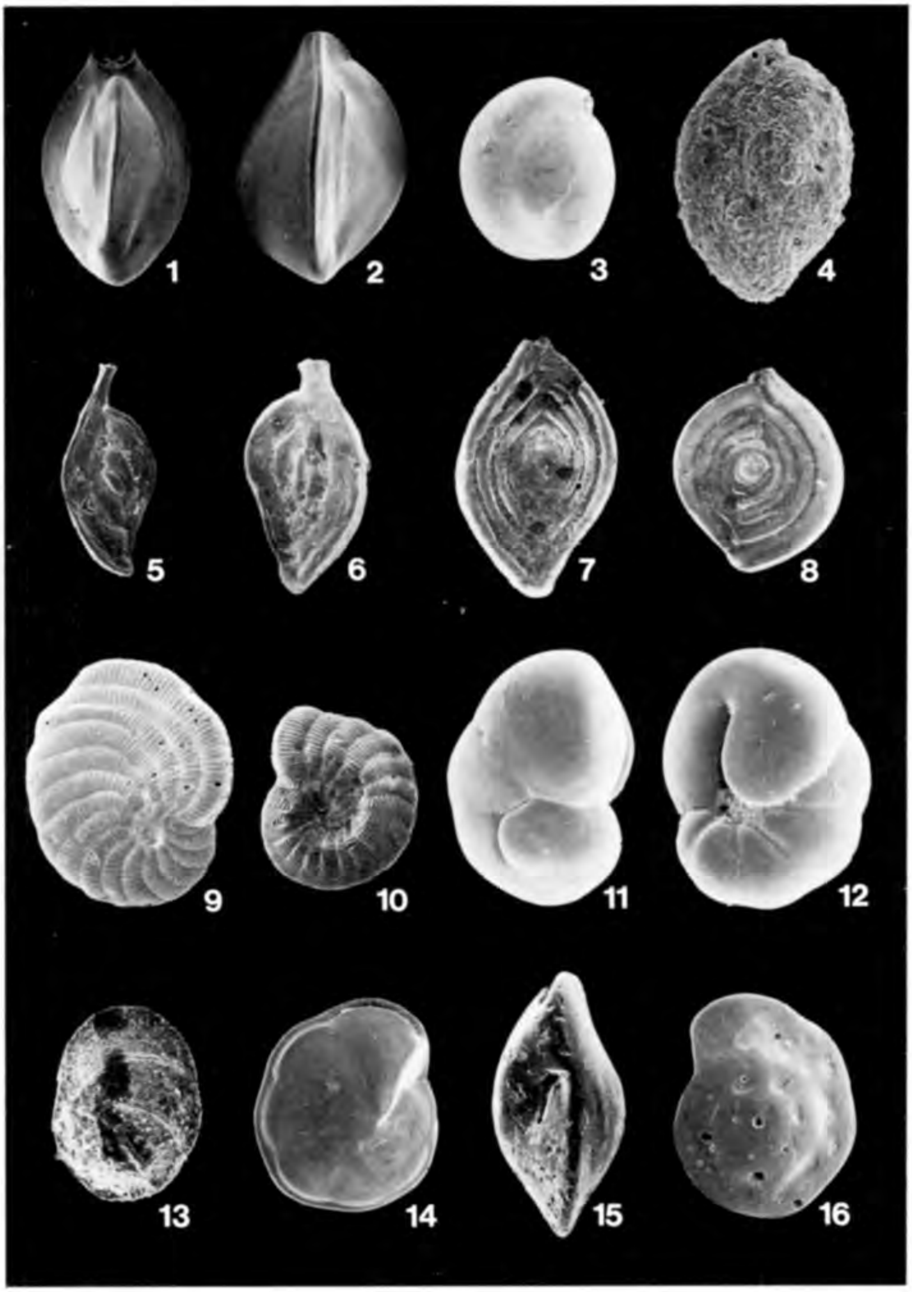
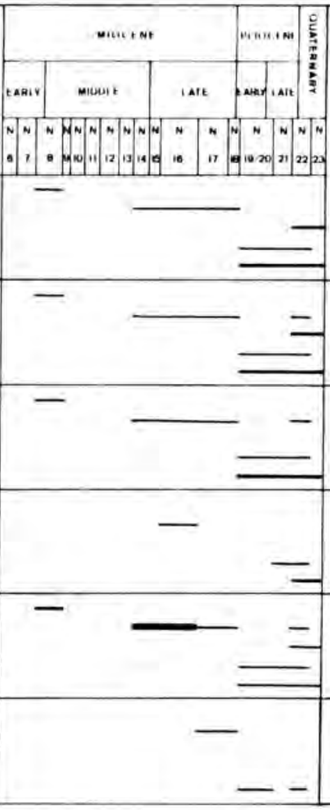


PLATE 4

PLATE 5



FIGURES	TAXA	ISLANDS	REMARKS
1 – 2	*Bulimina alazanensis* Cushman	BURU BUTON KAI SERAM TIMOR	1. Sample G5-6-154B (Recent); 150x 2. Sample GF1A-T143; 140x Note the distinct, longitudinal, continuous costae.
3 – 5	*Bulimina aculeata* d'Orbigny	BURU BUTON KAI SERAM TIMOR	3. Sample GF1A-T90; 90x 4. Sample GF2A-S179; 80x 5. Sample G5-6-151B (Recent); 70x Note the series of spines fringing the outer margins of the chambers.
6 – 8	*Bulimina striata* d'Orbigny	BURU BUTON KAI SERAM TIMOR	6. Sample GF1A-T145; 90x 7. Sample G5-4-74B (Recent); 65x 8. Sample G5-4-78B (Recent); 80x Note the elongated test (apparently this is *B. striata* var. *costata* d'Orbigny).
9 – 10	*Bulimina marginata* d'Orbigny	BURU BUTON KAI SERAM TIMOR	9. Sample G5-4-78B (Recent); 120x 10. Sample GF1A-T90; 50x Note the sharply undercut chamber margins with serrate edges.
11 – 14	*Globobulimina* spp.	BURU BUTON KAI SERAM TIMOR	11. *Globobulimina pacifica* Cushman Sample G5-2-61B (Recent); 40x 12. Idem. Sample G5-2-61B (Recent); 40x 13. *Praeglobobulimina pupoides* (d'Orbigny) Sample GF1A-B293; 65x 14. Idem. Sample GF1A-T143; 55x
15 – 16	*Praeglobobulimina spinescens* (Brady)	BURU BUTON KAI SERAM TIMOR	15. Sample GF1A-T192; 55x 16. Sample GF1A-T192; 65x Note the small spinose projections.

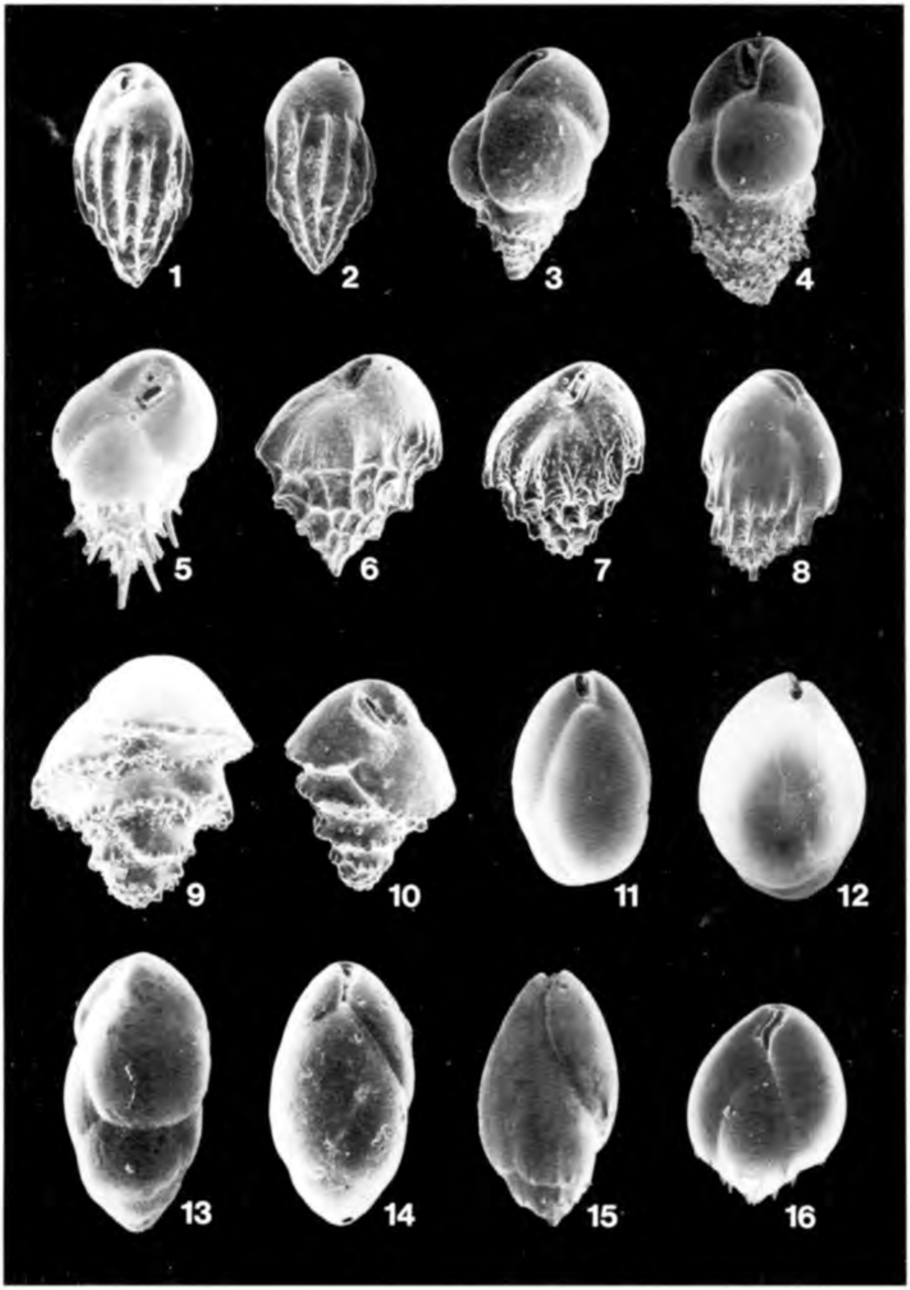


PLATE 5

PLATE 6

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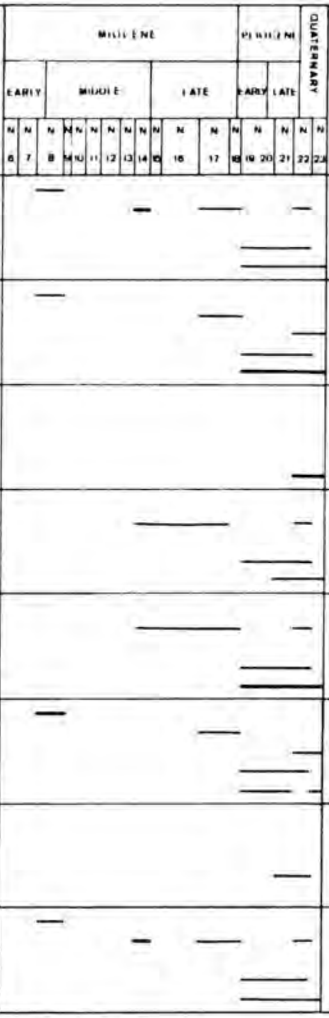

FIGURES	TAXA	ISLANDS	REMARKS
1 – 3	*Reussella simplex* (Cushman)	BURU BUTON KAI SERAM TIMOR	1. Sample G5-6-161B (Recent); 100x 2. Sample G5-6-161B (Recent); 100x 3. Sample GF2A-S116; 110x Note the hardly spinose angles.
4 – 6	*Bolivinita quadrilatera* (Schwager)	BURU BUTON KAI SERAM TIMOR	4. Sample GF1A-T143; 40x 5. Sample GF1A-T216; 100x 6. Sample GF1A-T185; 60x Note the characteristic quadrate form.
7 – 8	*Bolivinita subangularis* (Brady)	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-T220; 140x 8. Sample GF1A-T81; 140x Note the wide, deep, longitudinal central depression bordered by costae.
9 11	*Rectobolivina bifrons* (Brady)	BURU BUTON KAI SERAM TIMOR	9. Sample G5-4-75B (recent); 55x 10. Sample GF2A-S116; 40x 11. Sample GF2A-S116; 50x Note the characteristic central depression at the base of each chamber.
12–13	*Rectobolivina columellaris* (Brady)	BURU BUTON KAI SERAM TIMOR	12. Sample G5-6-158B (Recent); 65x 13. Sample GF1A-T192; 65x Note the typical, cylindrical uniserial stage.
14–15	*Rectobolivina dimorpha* (Parker and Jones)	BURU BUTON KAI SERAM TIMOR	14. Sample G5-4-77B (Recent); 60x 15. Sample G5-4-77B (recent); 60x Note the characteristic reticulate ornamant.
16	*Rectobolivina indica* (LeRoy)	BURU BUTON KAI SERAM TIMOR	16. Sample GF1A-T215; 80x Note the extended uvigerine-like aperture with broad lip.
17–18	*Rectobolivina limbata* (Brady)	BURU BUTON KAI SERAM TIMOR	17. Sample GF1A-B272; 40x 18. Sample GF1A-B338; 50x Note the characteristic limbate sutures.

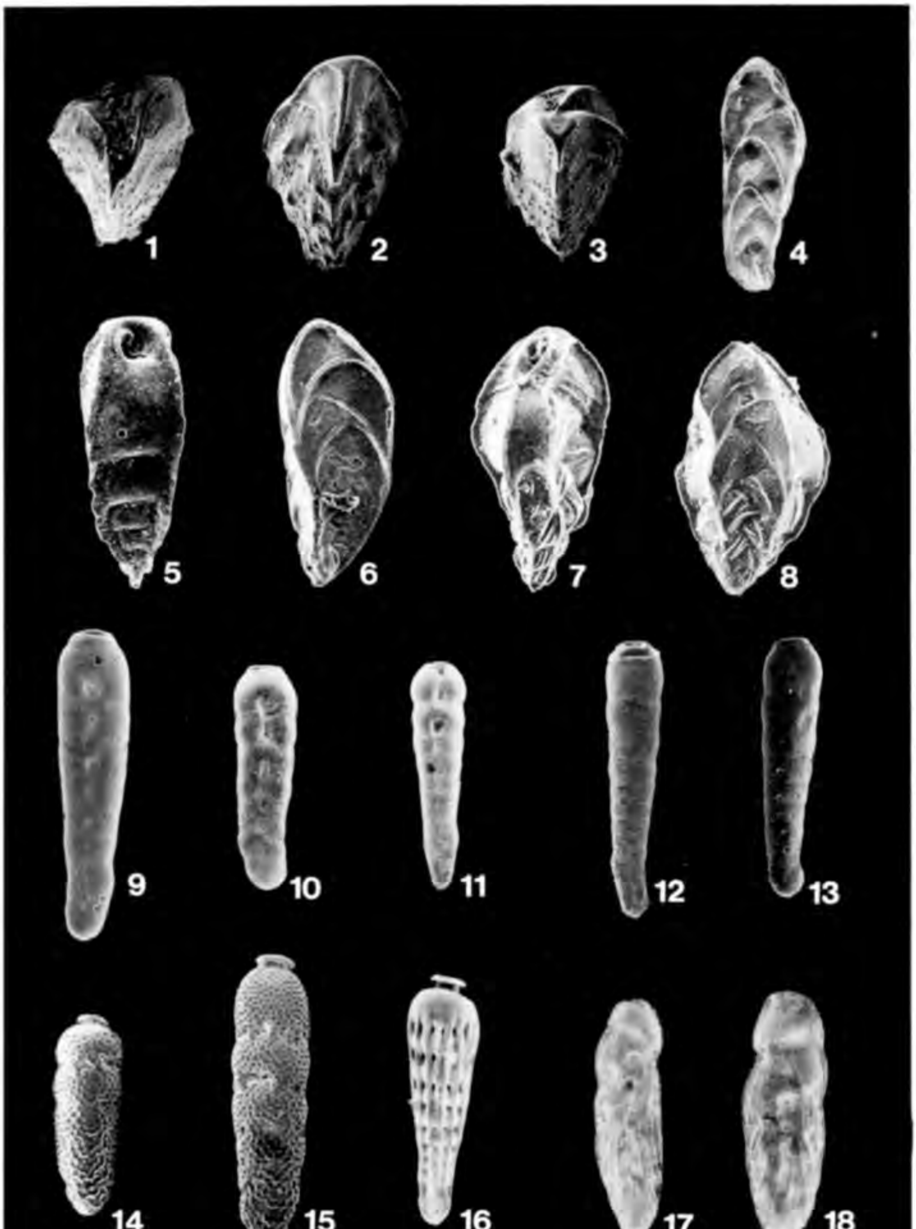

PLATE 6

PLATE 7

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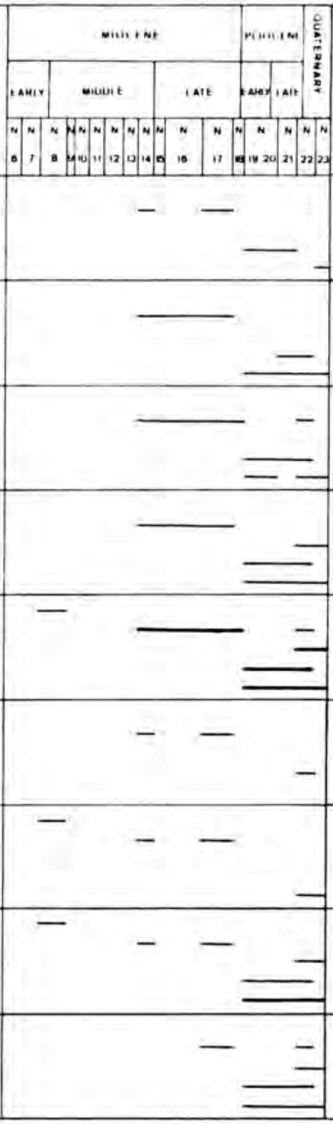

FIGURES	TAXA	ISLANDS	REMARKS
1	*Rectobolivina tenuicostata* Belford	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T143; 100x
2 – 3	*Siphogenerina costata* Schlumberger	BURU BUTON KAI SERAM TIMOR	2. Sample GF1A-B293; 45x 3. Sample GF1A-B293; 45x
4 – 5	*Rectuvigerina striata* (Schwager)	BURU BUTON KAI SERAM TIMOR	4. Sample GF1A-B301; 55x 5. Sample GF1A-B301; 55x Note the characteristic ornament of fine closely spaced, regular, discontinuous striae.
6 – 7	*Angulogerina angulosa* (Williamson)	BURU BUTON KAI SERAM TIMOR	6. Sample GF1A-B293; 100x 7. Sample G5-4-80B (Recent); 140x
8 – 9	*Trifarina bradyi* Cushman	BURU BUTON KAI SERAM TIMOR	8. Sample G5-4-74B (Recent); 125x 9. Sample G5-4-78B (Recent); 140x Note regular and symmetrically triangular smooth test.
10 – 11	*Trifarina reussi* (Cushman)	BURU BUTON KAI SERAM TIMOR	10. Sample GF1A-B293; 100x 11. Sample GF2A-S163; 70x
12 – 13	*Uvigerina crassicostata* Schwager	BURU BUTON KAI SERAM TIMOR	12. Sample GF1A-T103; 50x 13. Sample G5-4-75B (Recent); 70x Note the characteristic platy costae.
14 – 15	*Uvigerina peregrina* Cushman	BURU BUTON KAI SERAM TIMOR	14. Sample GF1A-B293; 80x 15. Sample G5-6-155B (Recent); 110x Note the typical costate form.
16 – 17	*Uvigerina peregrina* Cushman var. *dirupta* Todd	BURU BUTON KAI SERAM TIMOR	16. Sample GF1A-T179; 80x 17. Sample G5-4-80B (Recent); 65x Note the spinose last chamber, opposed to the costate earlier ones.

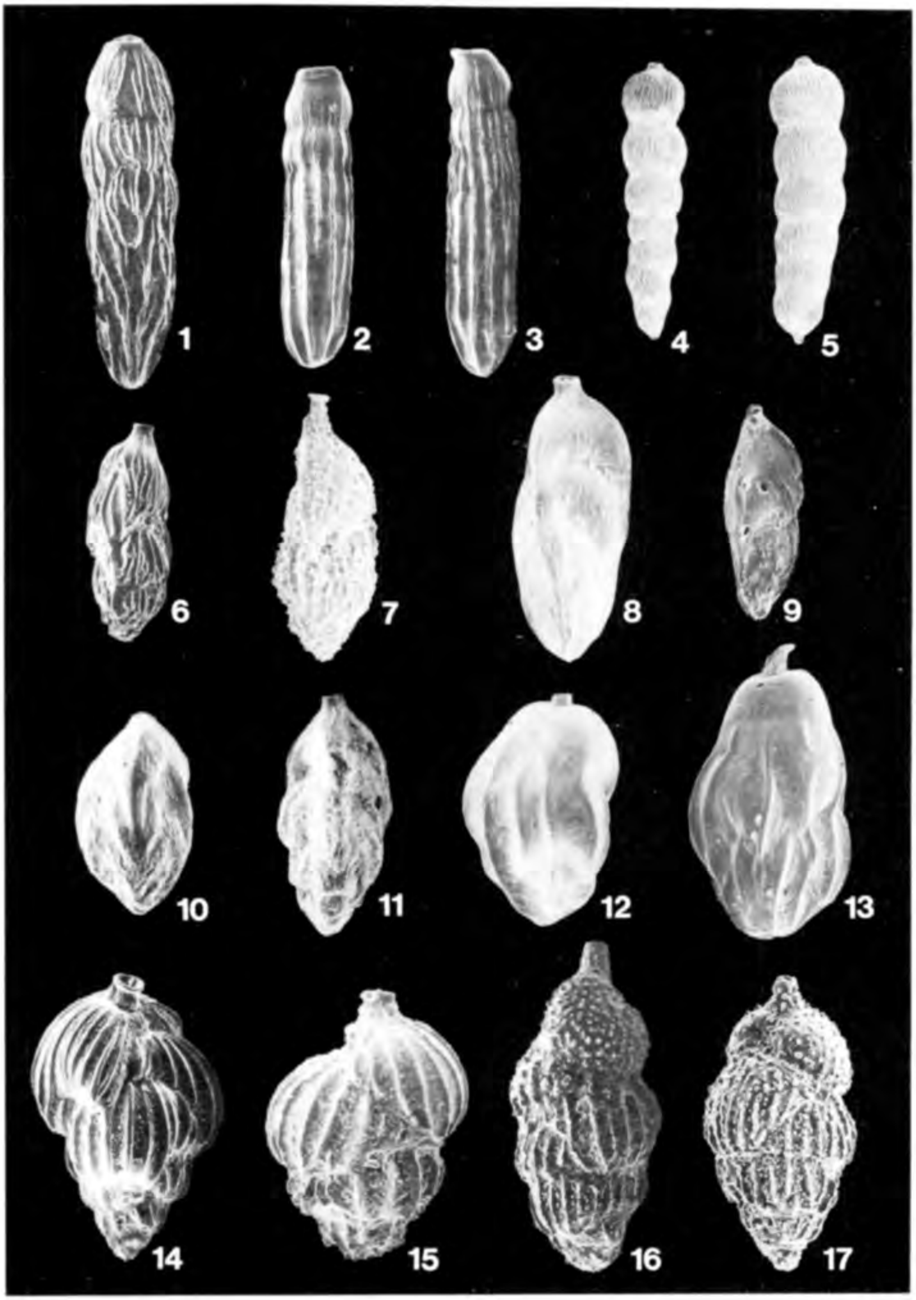

PLATE 7

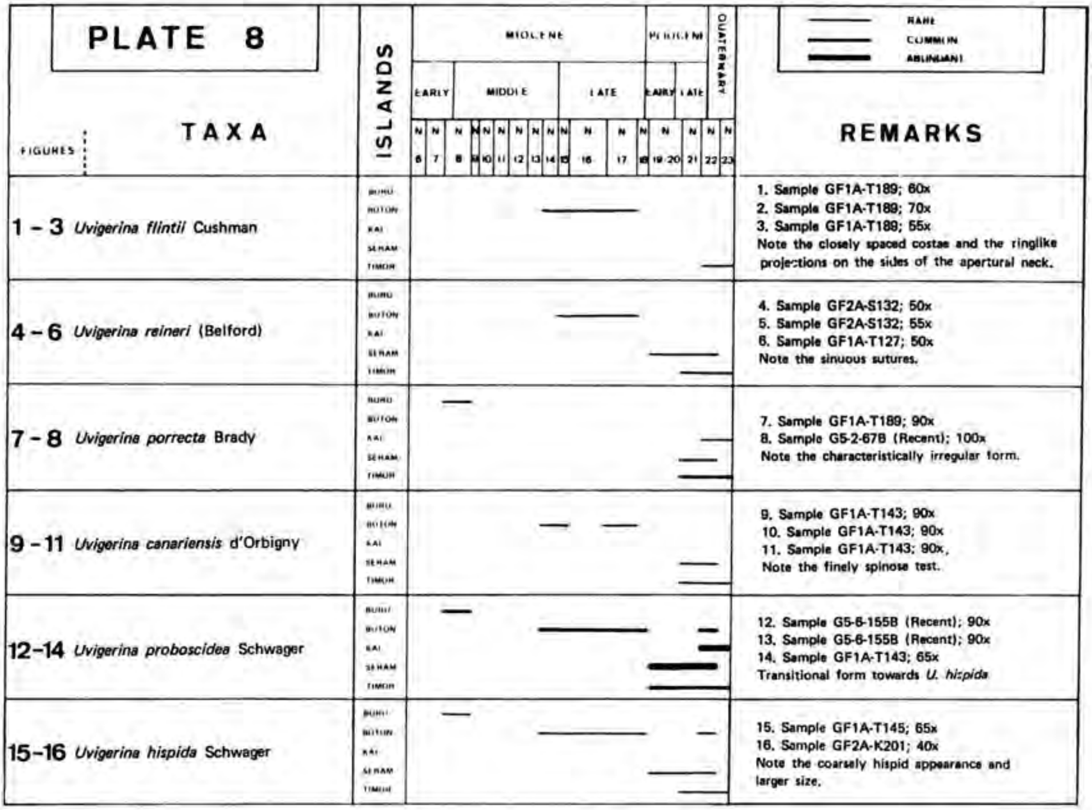

PLATE 8

FIGURES	TAXA	ISLANDS	REMARKS
1 – 3	*Uvigerina flintii* Cushman	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T189; 60x 2. Sample GF1A-T189; 70x 3. Sample GF1A-T189; 55x Note the closely spaced costae and the ringlike projections on the sides of the apertural neck.
4 – 6	*Uvigerina reineri* (Belford)	BURU BUTON KAI SERAM TIMOR	4. Sample GF2A-S132; 50x 5. Sample GF2A-S132; 55x 6. Sample GF1A-T127; 50x Note the sinuous sutures.
7 – 8	*Uvigerina porrecta* Brady	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-T189; 90x 8. Sample G5-2-67B (Recent); 100x Note the characteristically irregular form.
9 – 11	*Uvigerina canariensis* d'Orbigny	BURU BUTON KAI SERAM TIMOR	9. Sample GF1A-T143; 90x 10. Sample GF1A-T143; 90x 11. Sample GF1A-T143; 90x. Note the finely spinose test.
12–14	*Uvigerina proboscidea* Schwager	BURU BUTON KAI SERAM TIMOR	12. Sample G5-6-155B (Recent); 90x 13. Sample G5-6-155B (Recent); 90x 14. Sample GF1A-T143; 65x Transitional form towards *U. hispida*
15–16	*Uvigerina hispida* Schwager	BURU BUTON KAI SERAM TIMOR	15. Sample GF1A-T145; 65x 16. Sample GF2A-K201; 40x Note the coarsely hispid appearance and larger size.

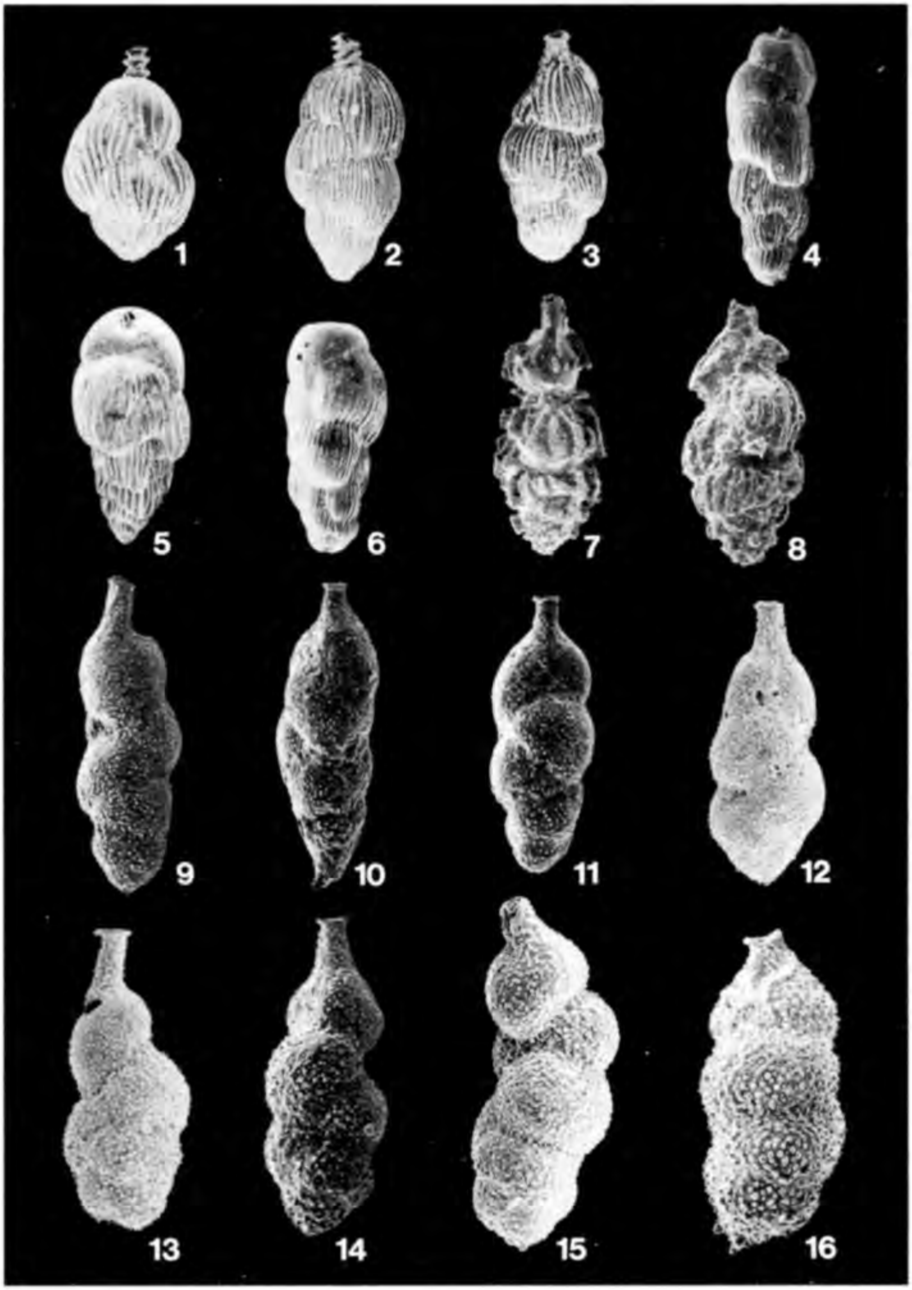

PLATE 8

PLATE 9

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FIGURES	TAXA	ISLANDS	REMARKS
1–2	*Bolivinella elegans* Parr	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T66; 65x 2. Sample GF1A-T68; 105x Note the characteristic flabelliform shape.
3–4	*Ehrenbergina pacifica* Cushman	BURU BUTON KAI SERAM TIMOR	3. Sample G5-6-151B (Recent); 60x 4. Sample G5-6-151B (Recent); 60x
5–6	*Ehrenbergina pupa* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	5. Sample GF1A-T203; 100x 6. Sample GF1A-B278; 95x Note the characteristic compressed form.
7	*Ehrenbergina hystrix* Brady	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-B317; 55x Note the strongly developed lateral spines.
8	*Cassidulina delicata* Cushman var. *sulcata* Belford	BURU BUTON KAI SERAM TIMOR	8. Sample GF1A-T143; 140x Note the characteristic fine grooves.
9–10	*Cassidulina carinata* Silvestri	BURU BUTON KAI SERAM TIMOR	9. Sample GF1A-T210; 90x 10. Sample G5-4-82B (Recent); 165x Note the characteristic keel.
11–12	*Cassidulina laevigata* d'Orbigny	BURU BUTON KAI SERAM TIMOR	11. Sample GF1A-B293; 140x 12. Sample GF1A-B293; 140x Note the absence of a keel.
13–15	*Cassidulina crassa* d'Orbigny	BURU BUTON KAI SERAM TIMOR	13. Sample GF1A-T143. 140x 14. Sample GF1A-T143; 165x 15. Sample GF1A-T143; 140x
16	*Cassidulina elegans* Sidebottom	BURU BUTON KAI SERAM TIMOR	16. Sample GF1A-T166; 105x Note the characteristic raised upper portion portion of the chambers.

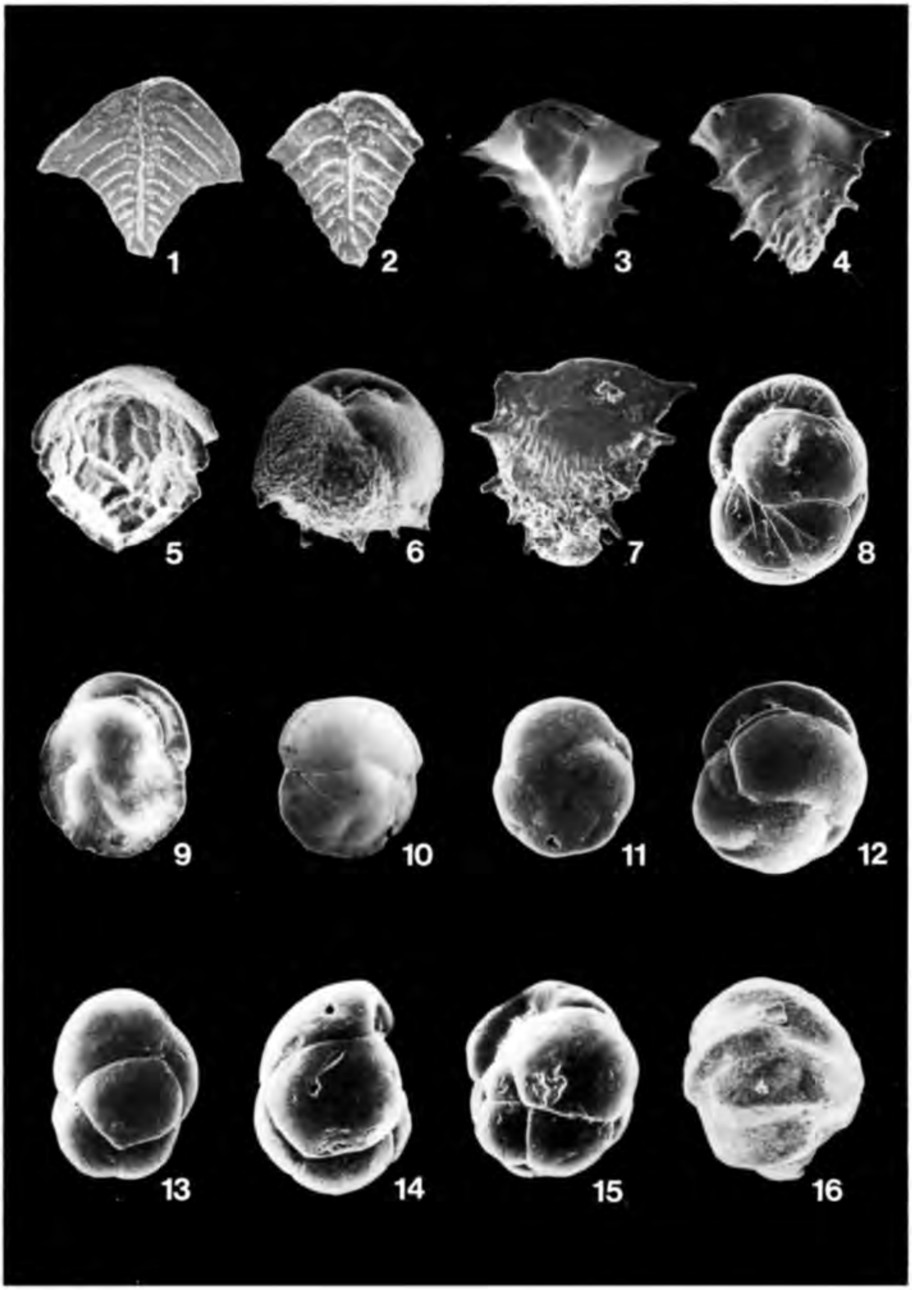

PLATE 9

PLATE 10

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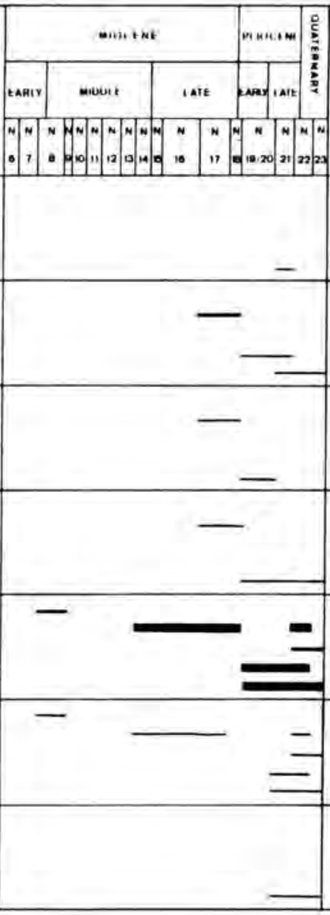


FIGURES	TAXA	ISLANDS	REMARKS
1 – 2	*Favocassidulina favus* (Brady)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T9; 50x 2. Sample GF1A-T9; 50x Note characteristic raised, reticulate ornament.
3 – 5	*Globocassidulina murrhyna* (Schwager)	BURU BUTON KAI SERAM TIMOR	3. Sample GF1A-T201; 85x 4. Sample GF2A-S116; 90x 5. Sample GF1A-B286; 100x Note the large semicircular aperture.
6 – 7	*Globocassidulina bicornis* (Brady)	BURU BUTON KAI SERAM TIMOR	6. Sample GF1A-T26; 50x 7. Sample GF1A-t26; 45x
8 – 9	*Globocassidulina oblonga* (Reuss)	BURU BUTON KAI SERAM TIMOR	8. Sample G5-6-150B (Recent); 120x 9. Sample GF1A-B293; 115x Note the somewhat enrolled test.
10 – 11	*Globocassidulina subglobosa* (Brady)	BURU BUTON KAI SERAM TIMOR	10. Sample GF1A-T145; 120x 11. Sample G5-6-152B (Recent); 100x Note the aperture situated perpendicular to the last suture.
12 – 13	*Chilostomella oolina* Schwager	BURU BUTON KAI SERAM TIMOR	12. Sample GF1A-T192; 100x 13. Sample GF1A-T123; 95x Note the elongate-ovate form.
14 – 15	*Allomorphina pacifica* Cushman and Todd	BURU BUTON KAI SERAM TIMOR	14. Sample GF2A-S179; 150x 15. Sample GF2A-S179; 105x

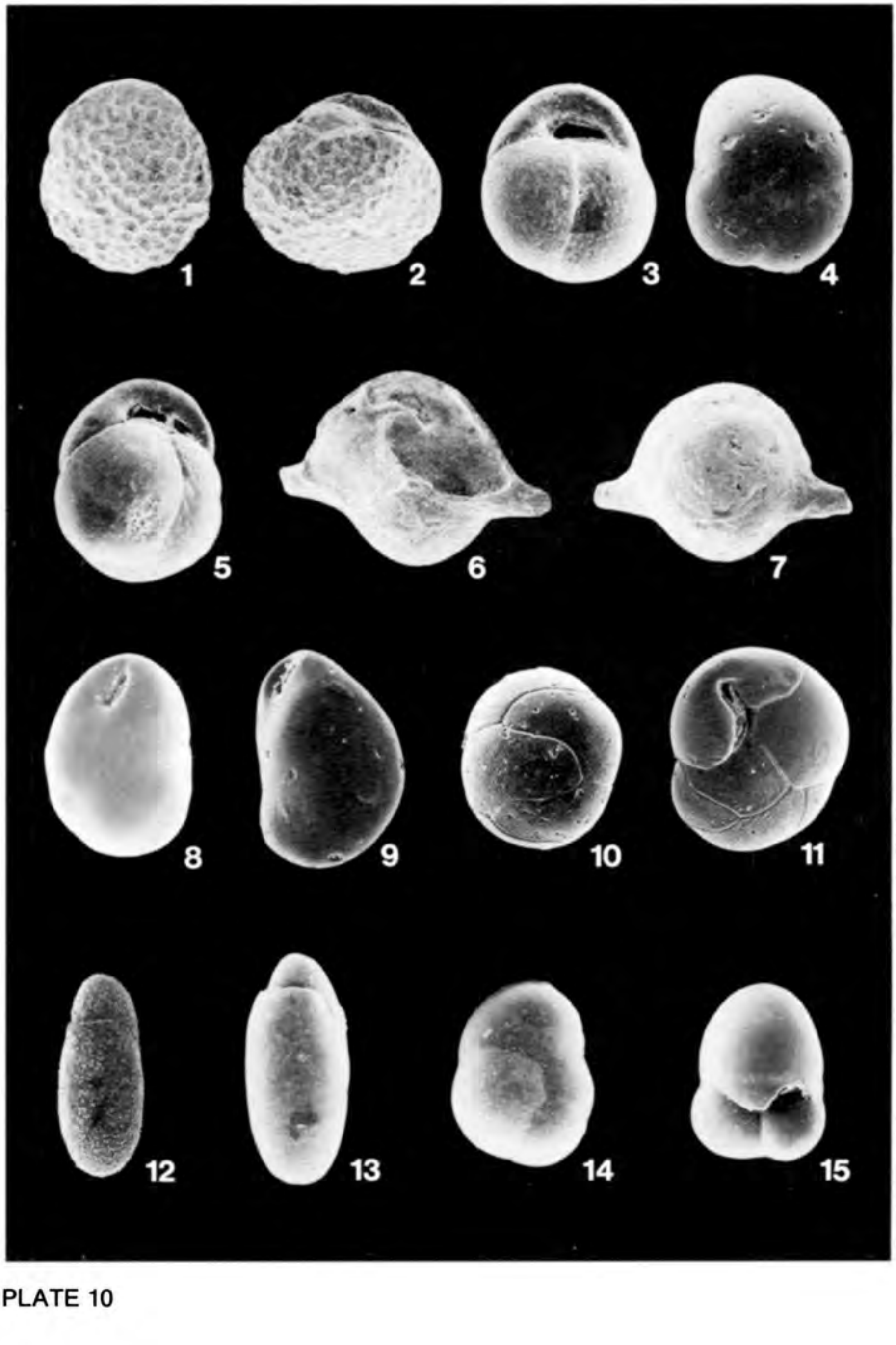
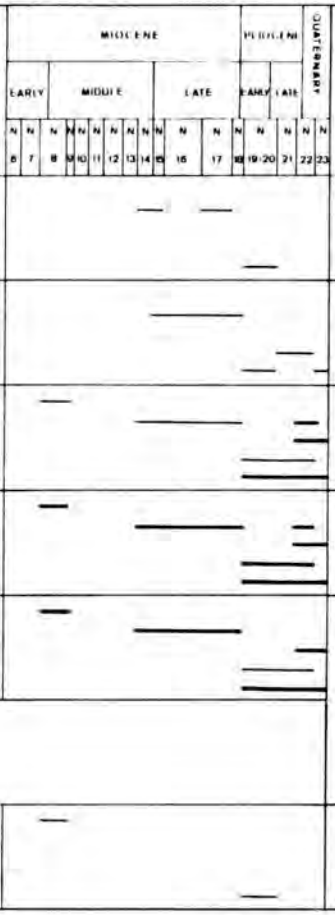


PLATE 10

PLATE 11



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FIGURES	TAXA	ISLANDS	REMARKS
1 – 4	*Quadrimorphina laevigata* (Phleger and Parker)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-B293; 105x 2. Sample GF1A-B291; 95x 3. Sample GF1A-B293; 140x 4. Sample G5-4-78B (Recent); 140x Note the umbilical flap covering the aperture.
5 – 7	*Svratkina tubulifera* (Heron-Allen and Earland)	BURU BUTON KAI SERAM TIMOR	5. Sample GF1A-B270; 100x 6. Sample GF2A-S123; 120x 7. Sample GF1A-T63; 80x Note the characteristic large pores opening into tubercles at the surface.
8–10	*Gyroidina orbicularis* d'Orbigny	BURU BUTON KAI SERAM TIMOR	8. Sample GF1A-T143; 115x 9. Sample GF1A-T143; 95x 10. Sample G5-6-151B (Recent); 100x Note relatively flat form.
11–12	*Gyroidina neosoldanii* Brotzen	BURU BUTON KAI SERAM TIMOR	11. Sample GF1A-T192; 80x 12. Sample GF1A-T143; 120x Note highly convex form.
13–15	*Oridorsalis umbonatus* (Reuss)	BURU BUTON KAI SERAM TIMOR	13. Sample G5-6-152B (Recent); 65x 14. Sample G5-6-152B (Recent); 65x 15. Sample G5-6-151B (Recent); 70x Note the strongly convex umbilical side and flattened spiral side. Supplementary openings are present on both sides.
16	*Osangularia bengalensis* (Schwager)	BURU BUTON KAI SERAM TIMOR	16. Sample GF1A-T26; 60x

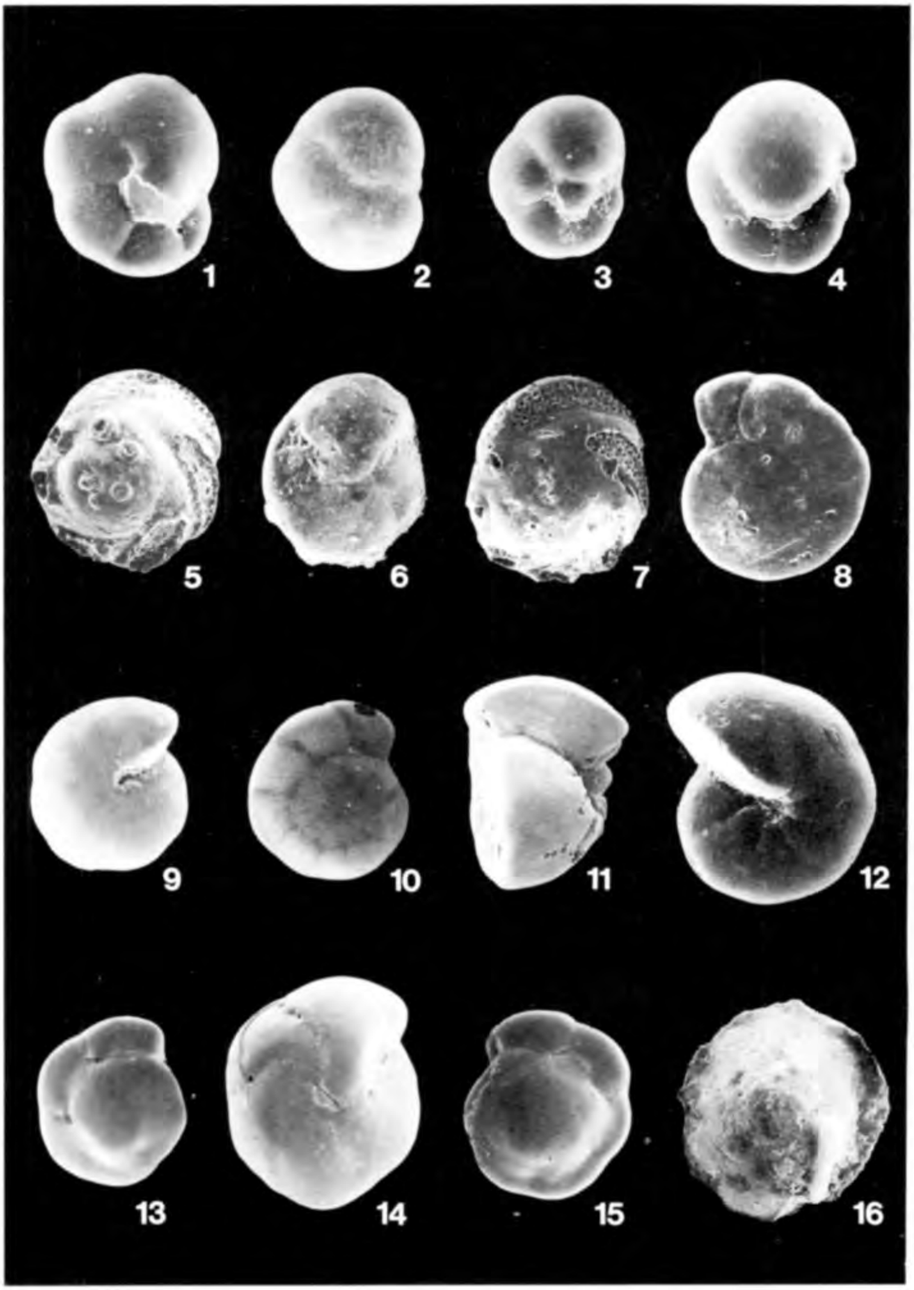

PLATE 11

PLATE 12

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FIGURES	TAXA	ISLANDS	REMARKS
1	*Osangularia bengalensis* (Schwager)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T26; 65x
2 – 4	*Osangularia culter* (Parker and Jones)	BURU BUTON KAI SERAM TIMOR	2. Sample GF1A-B291; 75x 3. Sample GF1A-B291; 80x 4. Sample G5-4-82B (Recent); 60x Note the sharp keel and characteristic aperture.
5 – 7	*Hanzawaia nipponica* Asano	BURU BUTON KAI SERAM TIMOR	5. Sample GF1A-T192; 80x 6. Sample G5-6-160B (Recent); 100x 7. Sample GF2A-S132; 125x
8 – 10	*Cibicidoides mediocris* (Finlay)	BURU BUTON KAI SERAM TIMOR	8. Sample GF1A-T190; 65x 9. Sample G5-6-158B (Recent); 65x 10. Sample G5-6-158B (Recent); 80x
11 – 13	*Cibicidoides dutemplei* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	11. Sample G5-6-160B (Recent); 35x 12. Sample GF1A-T201; 50x 13. Sample GF1A-T201; 75x Note the highly convex umbilical side.
14–16	*Cibicidoides bradyi* (Trauth)	BURU BUTON KAI SERAM TIMOR	14. Sample GF1A-T179; 110x 15. Sample GF1A-T143; 120x 16. Sample GF1A-T143; 100x Note biconvex test and coarse perforations on the spiral side.

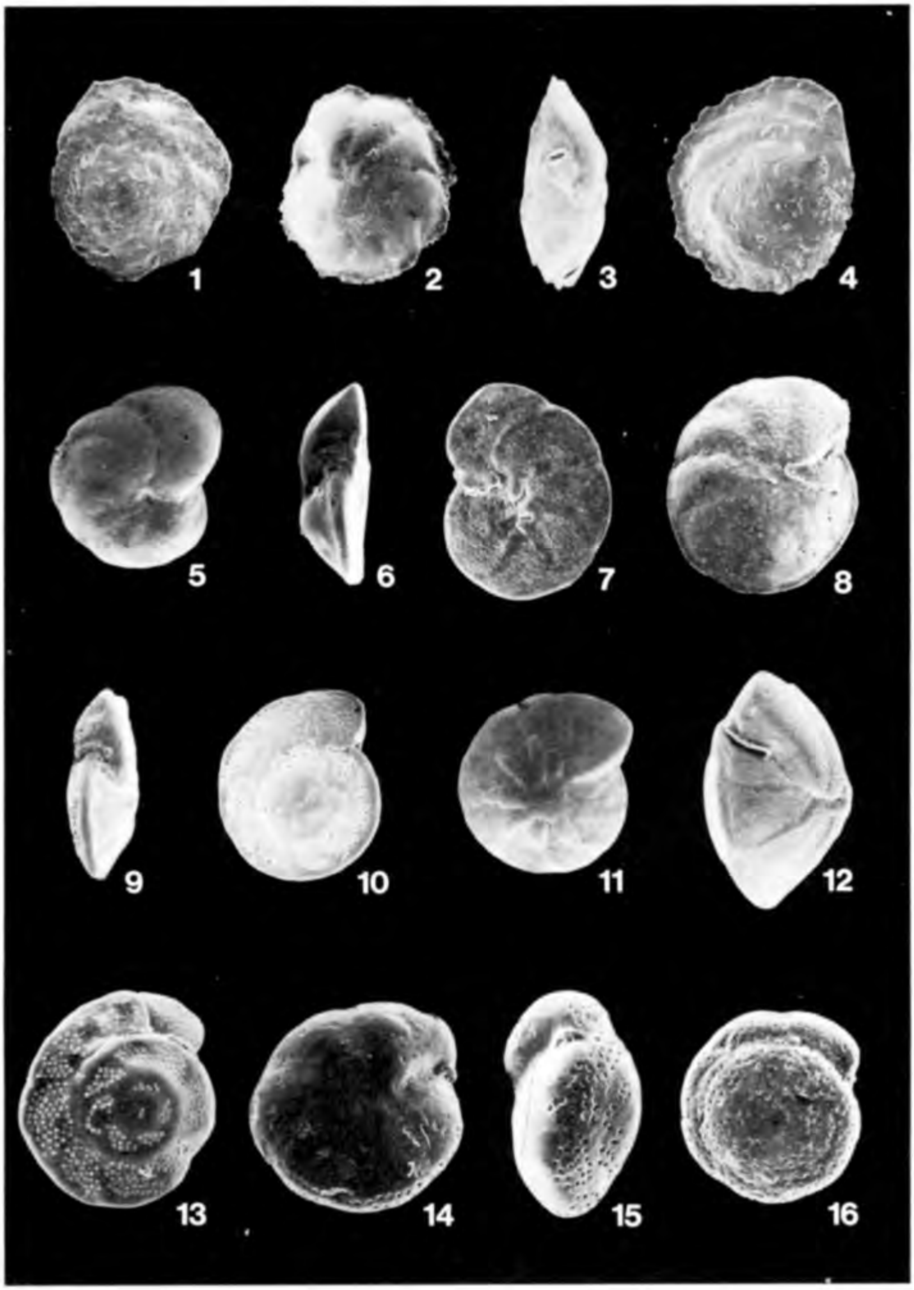
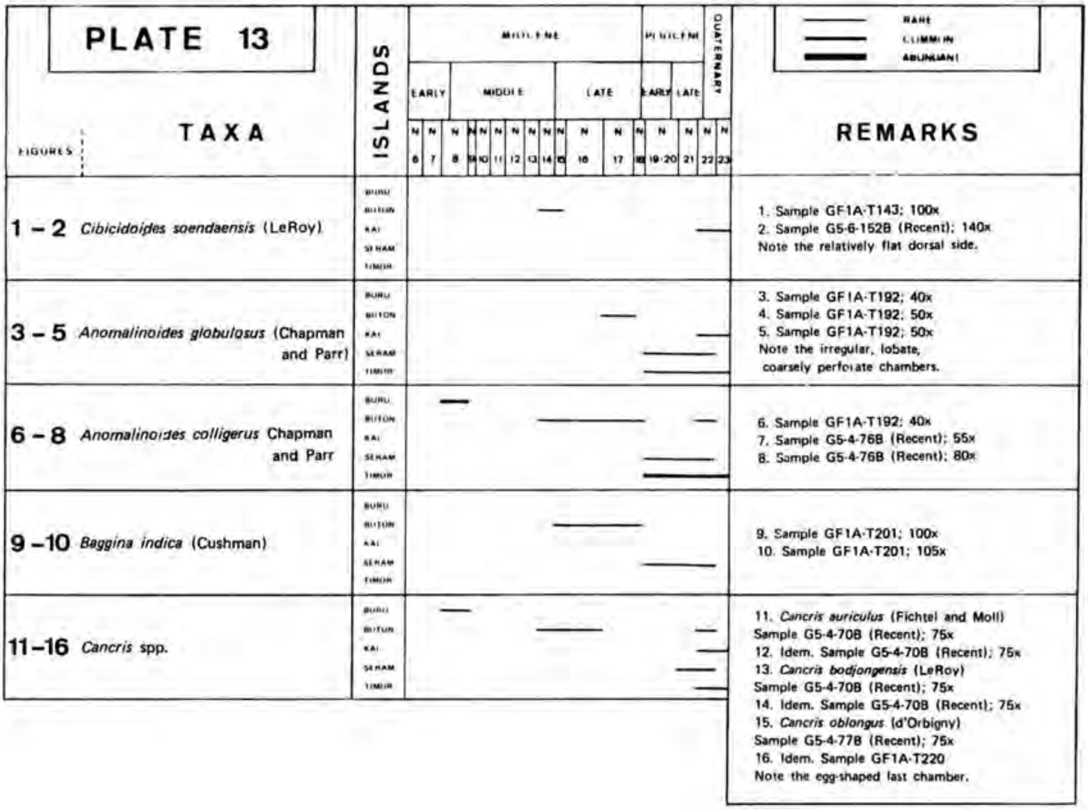


PLATE 12

PLATE 13



FIGURES	TAXA	ISLANDS	REMARKS
1 – 2	*Cibicidoides soendaensis* (LeRoy)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T143; 100x 2. Sample G5-6-152B (Recent); 140x Note the relatively flat dorsal side.
3 – 5	*Anomalinoides globulosus* (Chapman and Parr)	BURU BUTON KAI SERAM TIMOR	3. Sample GF1A-T192; 40x 4. Sample GF1A-T192; 50x 5. Sample GF1A-T192; 50x Note the irregular, lobate, coarsely perforate chambers.
6 – 8	*Anomalinoides colligerus* Chapman and Parr	BURU BUTON KAI SERAM TIMOR	6. Sample GF1A-T192; 40x 7. Sample G5-4-76B (Recent); 55x 8. Sample G5-4-76B (Recent); 80x
9 –10	*Baggina indica* (Cushman)	BURU BUTON KAI SERAM TIMOR	9. Sample GF1A-T201; 100x 10. Sample GF1A-T201; 105x
11–16	*Cancris* spp.	BURU BUTON KAI SERAM TIMOR	11. *Cancris auriculus* (Fichtel and Moll) Sample G5-4-70B (Recent); 75x 12. Idem. Sample G5-4-70B (Recent); 75x 13. *Cancris bodjongensis* (LeRoy) Sample G5-4-70B (Recent); 75x 14. Idem. Sample G5-4-70B (Recent); 75x 15. *Cancris oblongus* (d'Orbigny) Sample G5-4-77B (Recent); 75x 16. Idem. Sample GF1A-T220 Note the egg-shaped last chamber.

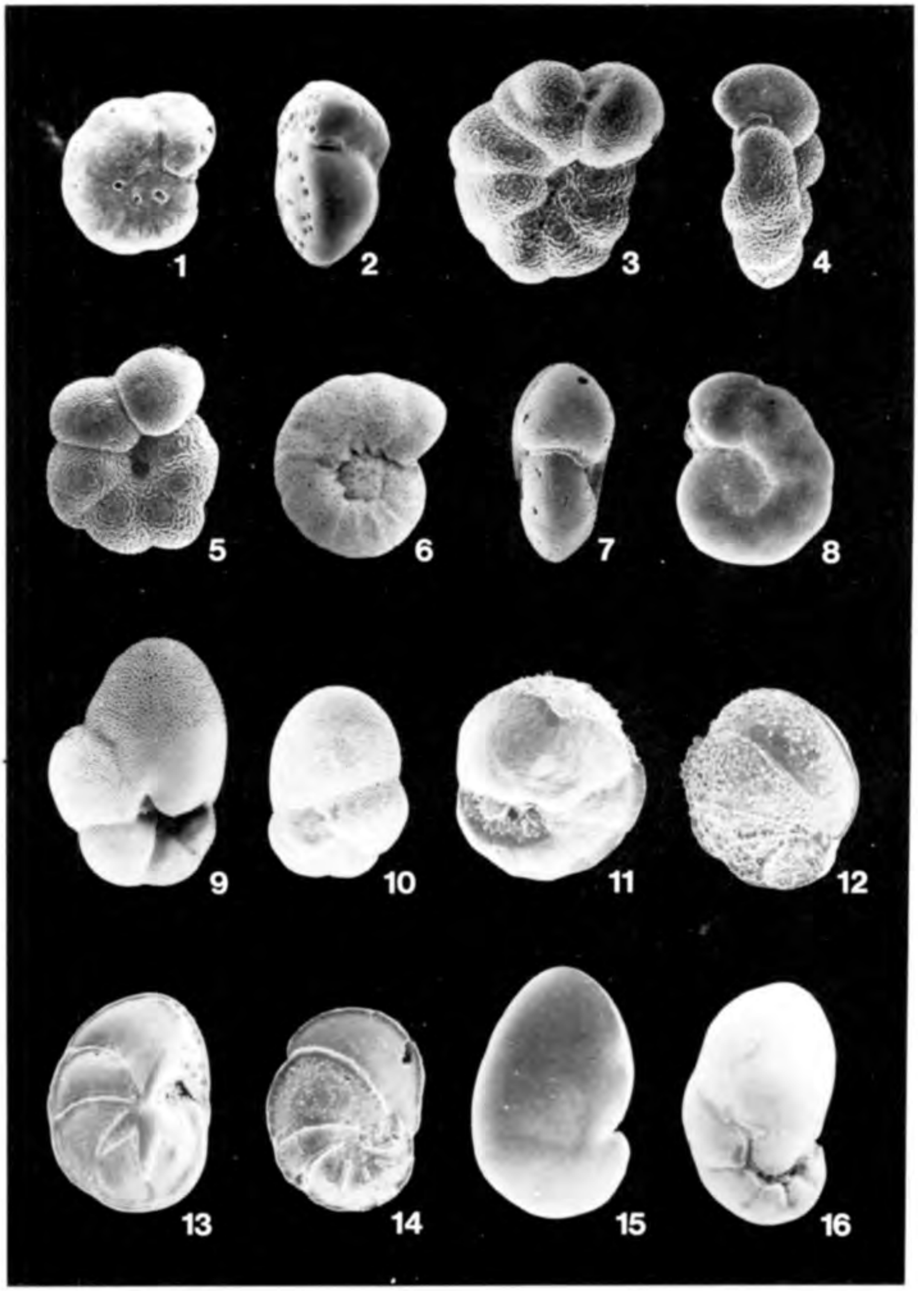


PLATE 13

PLATE 14

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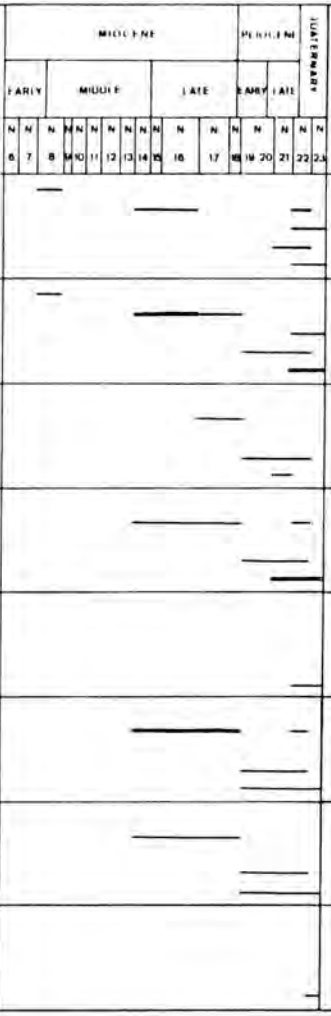

FIGURES	TAXA	ISLANDS	REMARKS
1	*Cancris* spp.	BURU BUTON KAI SERAM TIMOR	1. *Cancris oblongus* (d'Orbigny) Sample GF1A-T192; 40x
2 – 4	*Valvulineria javana* LeRoy	BURU BUTON KAI SERAM TIMOR	2. Sample GF1A-T220; 110x 3. Sample G5-4-78B (Recent); 165x 4. Sample GF1A-B293; 140x
5 – 7	*Bueningia butonensis* (Keijzer)	BURU BUTON KAI SERAM TIMOR	5. Sample GF1A-T143; 120x 6. GF1A-B278; 120x 7. GF1A-T143; 120x
8	*Discorbis australis* Parr	BURU BUTON KAI SERAM TIMOR	8. Sample GF1A-T66; 140x
9	*Discorbis rosacea* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	9. Sample GF1A-T90; 120x Note the umbilical flaps coälescing in the center into an umbilical plug.
10 – 12	*Gavelinopsis lobatulus* (Parr)	BURU BUTON KAI SERAM TIMOR	10. Sample G5-4-80B (Recent); 140x 11. Sample G5-4-80B (Recent); 100x 12. Sample G5-4-80B (Recent); 100x Note the prominent umbilical plug.
13 – 14	*Rosalina vilardeboana* d'Orbigny	BURU BUTON KAI SERAM TIMOR	13. Sample G5-6-156B (Recent); 100x 14. Sample G5-6-156B (Recent); 100x Note the darker tint of the early chambers.
15 – 16	*Neoconorbina terquemi* (Rzehak)	BURU BUTON KAI SERAM TIMOR	15. Sample G5-6-161B (Recent); 80x 16. Sample G5-6-161B (Recent); 80x

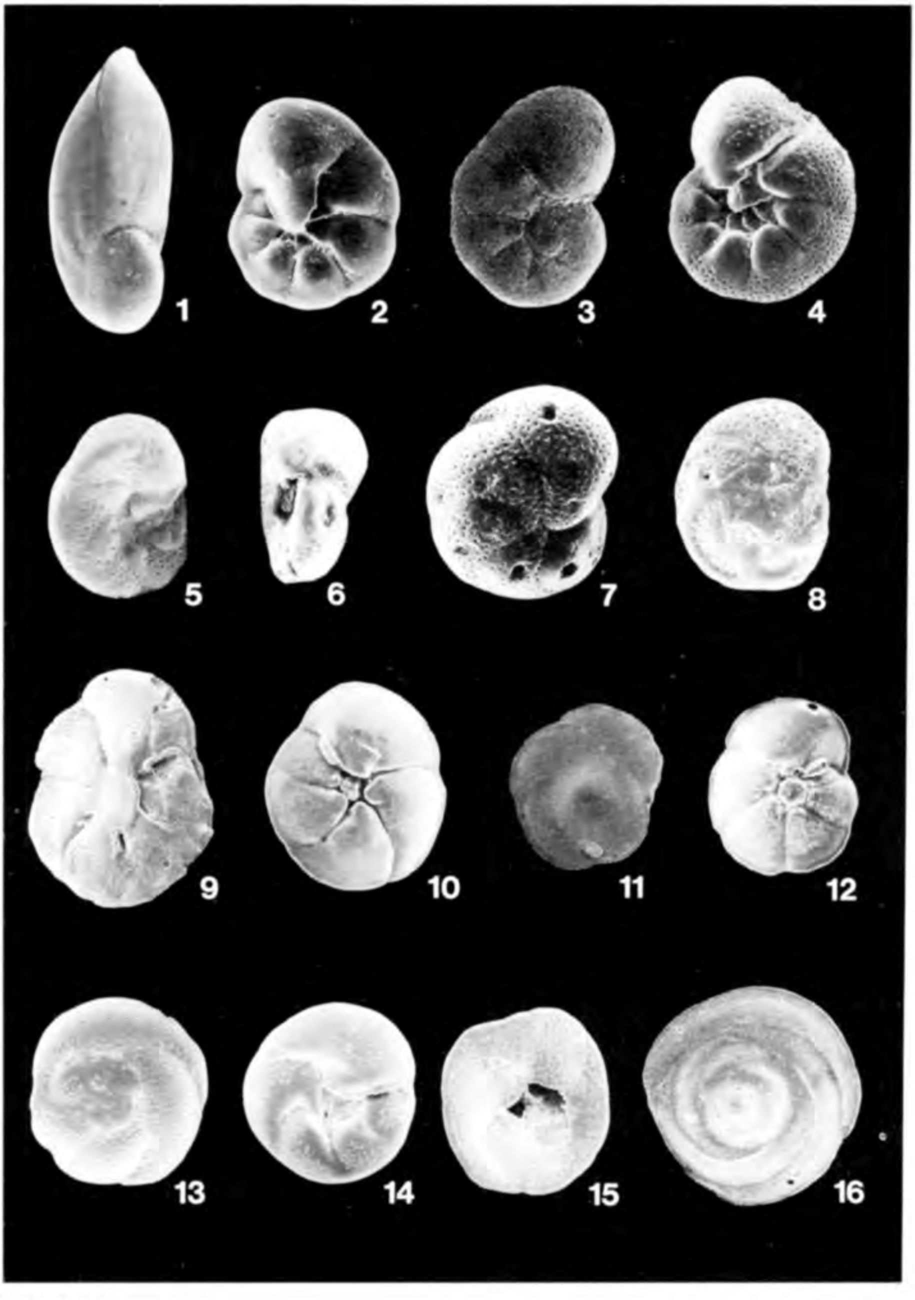

PLATE 14

PLATE 15

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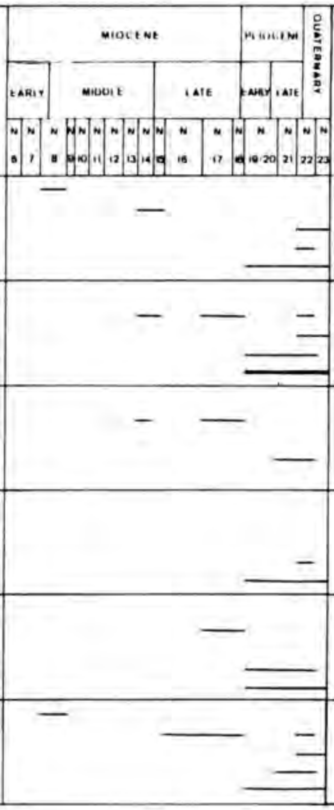

FIGURES	TAXA	ISLANDS	REMARKS
1 - 3	*Neoeponides berthelotianus* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-B313; 70x 2. Sample GF1A-T192; 25x 3. Sample GF1A-B313; 100x
4 - 6	*Epistominella exigua* (Brady)	BURU BUTON KAI SERAM TIMOR	4. Sample G5-4-70B (Recent); 120x 5. Sample G5-6-151B (Recent); 105x 6. Sample G5-6-151B (Recent); 110x
7 - 9	*Epistominella pulchra* (Cushman)	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-T202; 100x 8. Sample G5-4-70B (Recent); 110x 9. Sample G5-4-75B (Recent); 100x
10	*Epistominella umbonifera* (Cushman)	BURU BUTON KAI SERAM TIMOR	10. Sample G5-4-78B; 170x Note the umbonal plug and crinkled periphery.
11 - 12	*Patellinella jugosa* (Brady)	BURU BUTON KAI SERAM TIMOR	11. Sample G5-6-161B (Recent); 140x 12. Sample G5-4-74B (Recent); 150x Note the characteristic raised sutures.
13 - 15	*Laticarinina pauperata* (Parker and Jones)	BURU BUTON KAI SERAM TIMOR	13. Sample GF1A-T185; 50x 14. Sample G5-6-152B (Recent); 60x 15. Sample G5-6-152B (Recent); 50x Note the distinct keel and apertures visible as elongated extensions of the inner ventral margins.

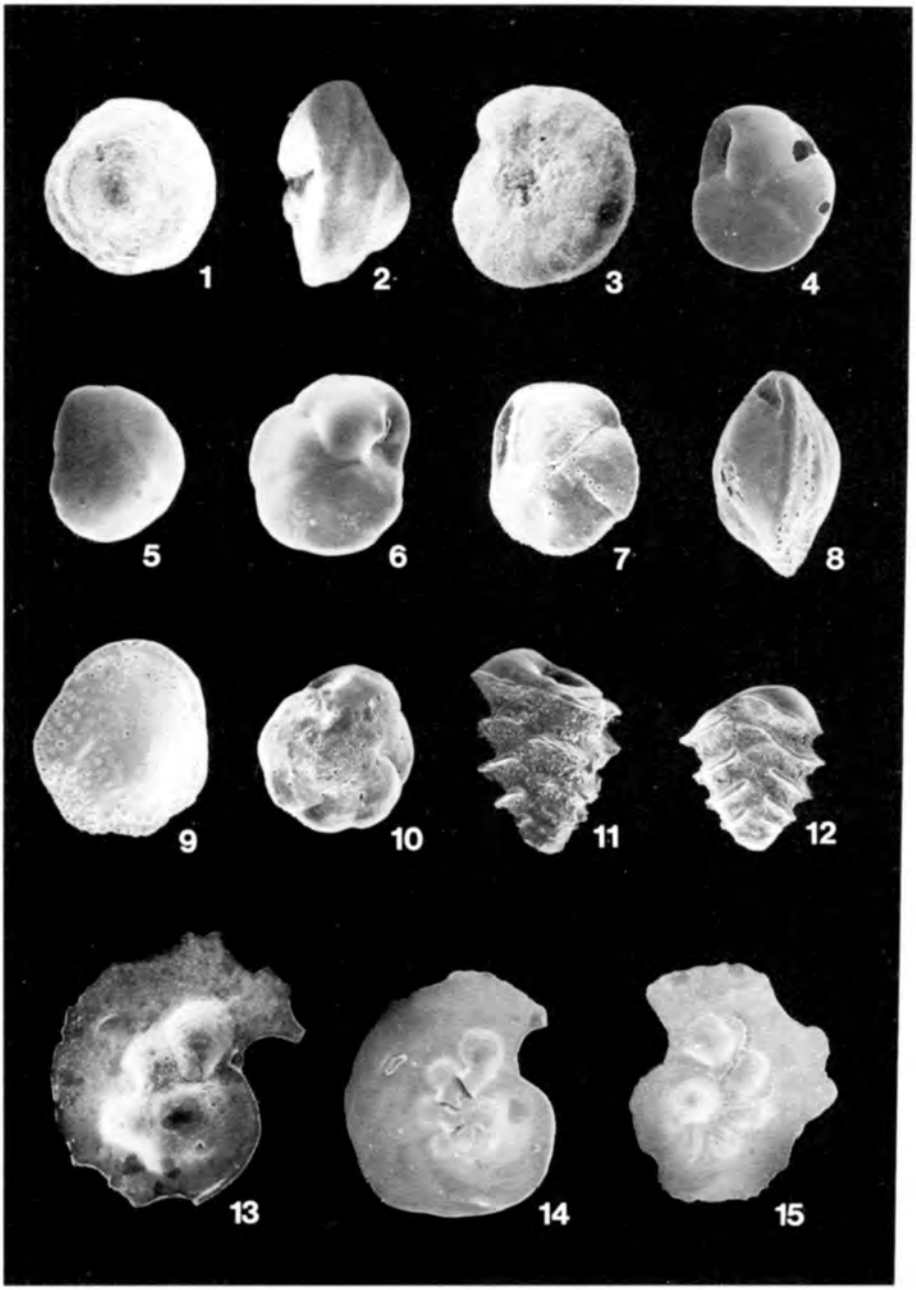

PLATE 15

PLATE 16

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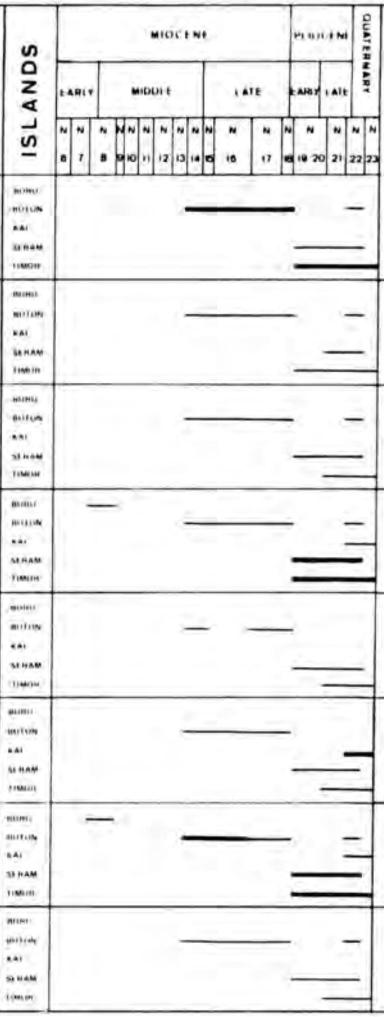


FIGURES	TAXA	REMARKS
1–3	*Bolivina arta* Macfadyen	1. Sample G5-6-160B (Recent); 50x 2. Sample GF2A-S179; 50x 3. Sample GF1A-T220; 55x
4–5	*Bolivina* sp. cf. *B. asanoi* Uchio	4. Sample GF2A-S116; 100x 5. Sample GF2A-S116; 100x Note the sutures marked by raised bands of clear shell material.
6–7	*Bolivina schwageriana* Brady	6. Sample GF2A-S116; 55x 7. Sample GF2A-S179; 60x
8–9	*Bolivina robusta* Brady	8. Sample GF1A-T143; 65x 9. Sample GF1A-T143; 65x Note the retral processes.
10–11	*Bolivina lobata* Brady	10. Sample GF1A-B256; 100x 11. Sample GF1A-B320; 85x Note the relatively angular chamber margins.
12–14	*Bolivina subspinescens* Cushman	12. Sample GF2A-S132; 80x 13. Sample GF2A-S132; 80x 14. Sample G5-6-150B (Recent); 140x
15–16	*Bolivina spathulata* (Williamson)	15. Sample GF1A-B293; 100x 16. Sample GF1A-B293; 100x Note the straight sutures.
17–19	*Bolivina tortuosa* Brady	17. Sample G5-4-74B (Recent); 100x 18. Sample GF1A-T143; 100x 19. Sample GF1A-T143; 100x Note the characteristic twisted test.

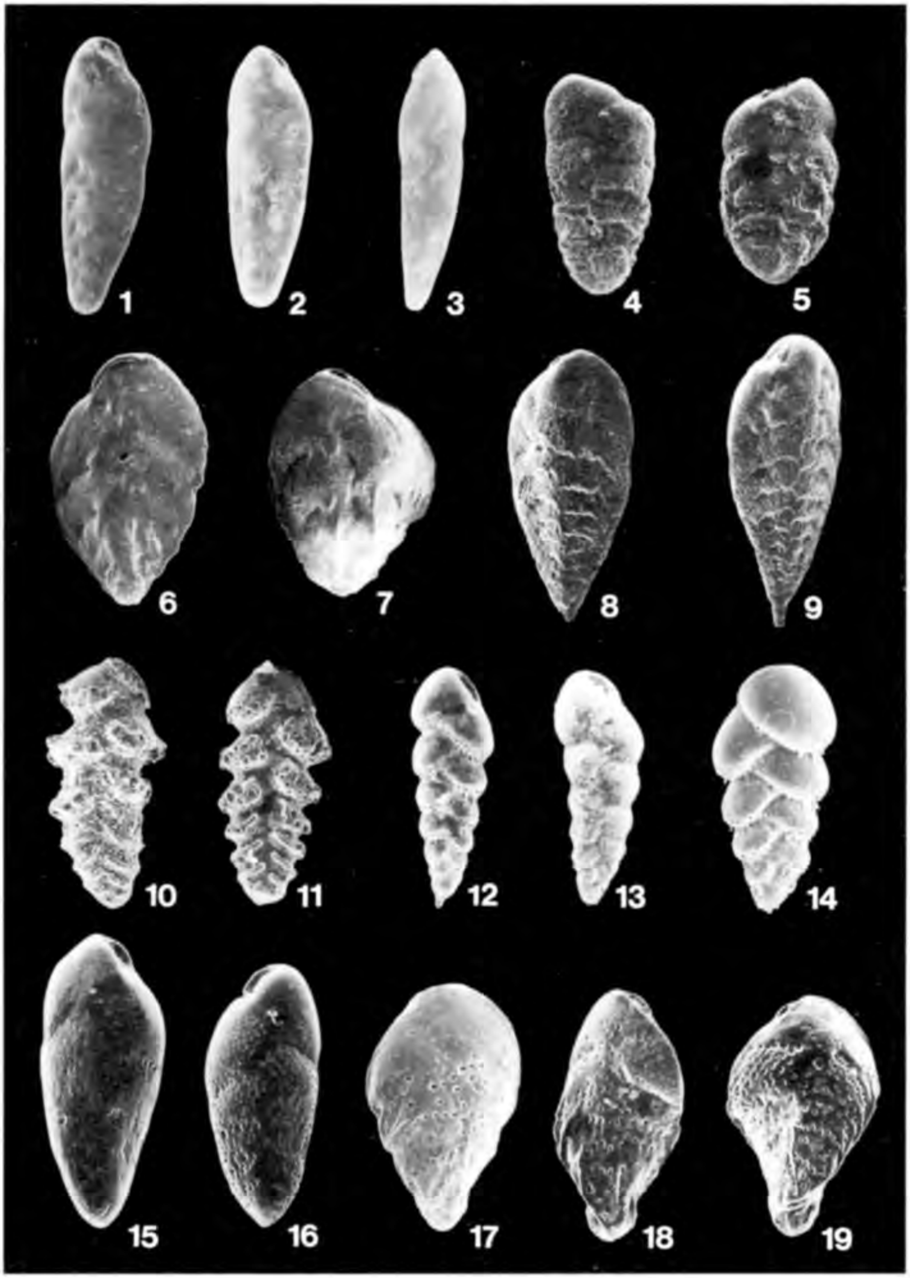
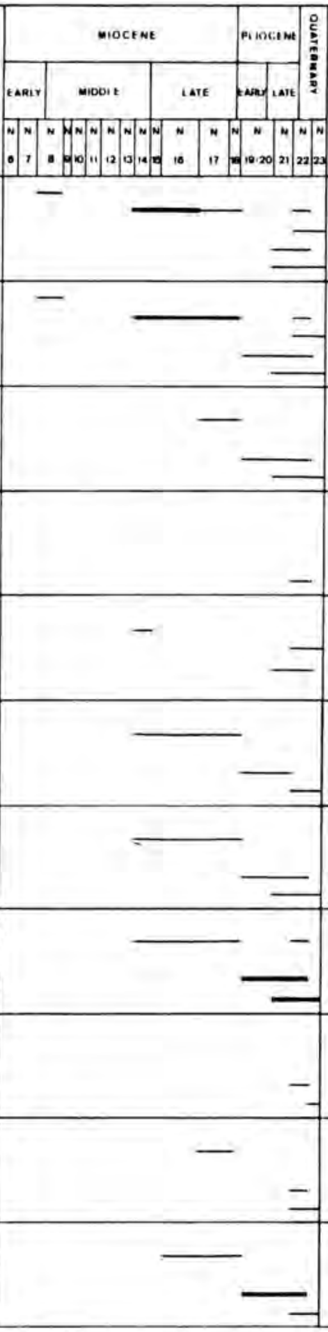


PLATE 16

PLATE 17



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FIGURES	TAXA	ISLANDS	REMARKS
1 - 2	*Brizalina alata* (Seguenza)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T215; 65x 2. Sample GF1A-T210; 65x
3 - 4	*Brizalina plicatella* (Cushman)	BURU BUTON KAI SERAM TIMOR	3. Sample GF1A-T143; 100x 4. Sample GF1A-T143; 100x Note the coarsely perforate surface and the irregular depressions.
5	*Brizalina hastula* Belford	BURU BUTON KAI SERAM TIMOR	5. Sample GF1A-B293; 70x Note the retral processes.
6 - 7	*Brizalina pseudobeyrichi* (Cushman)	BURU BUTON KAI SERAM TIMOR	6. Sample G5-4-82B (Recent); 55x 7. Sample G5-4-82B (Recent); 60x
8 - 10	*Brizalina multilineata* Belford	BURU BUTON KAI SERAM TIMOR	8. Sample GF1A-T201; 60x 9. Sample GF1A-T201; 65x 10. Sample GF1A-T201; 80x
11 - 12	*Brizalina semicarinata* Belford	BURU BUTON KAI SERAM TIMOR	11. Sample G5-6-150B (Recent); 100x 12. Sample GF1A-T143; 100x
13	*Brizalina macella* Belford	BURU BUTON KAI SERAM TIMOR	13. Sample G5-6-150B (Recent); 90x
14 - 15	*Brizalina semilineata* Belford	BURU BUTON KAI SERAM TIMOR	14. Sample G5-6-150B (Recent); 125x 15. Sample G5-6-150B (Recent); 125x
16	*Brizalina vescistriata* Belford	BURU BUTON KAI SERAM TIMOR	16. Sample GF1A-T192; 85x
17 - 18	*Brizalina pygmaea* (Brady)	BURU BUTON KAI SERAM TIMOR	17. Sample GF1A-T148; 100x 18. Sample G5-4-75B (Recent); 140x
19 - 20	*Brizalina seranensis* (Germeraad)	BURU BUTON KAI SERAM TIMOR	19. Sample GF2A-S116; 80x 20. Sample GF2A-S116; 100x Note the striate basal part.

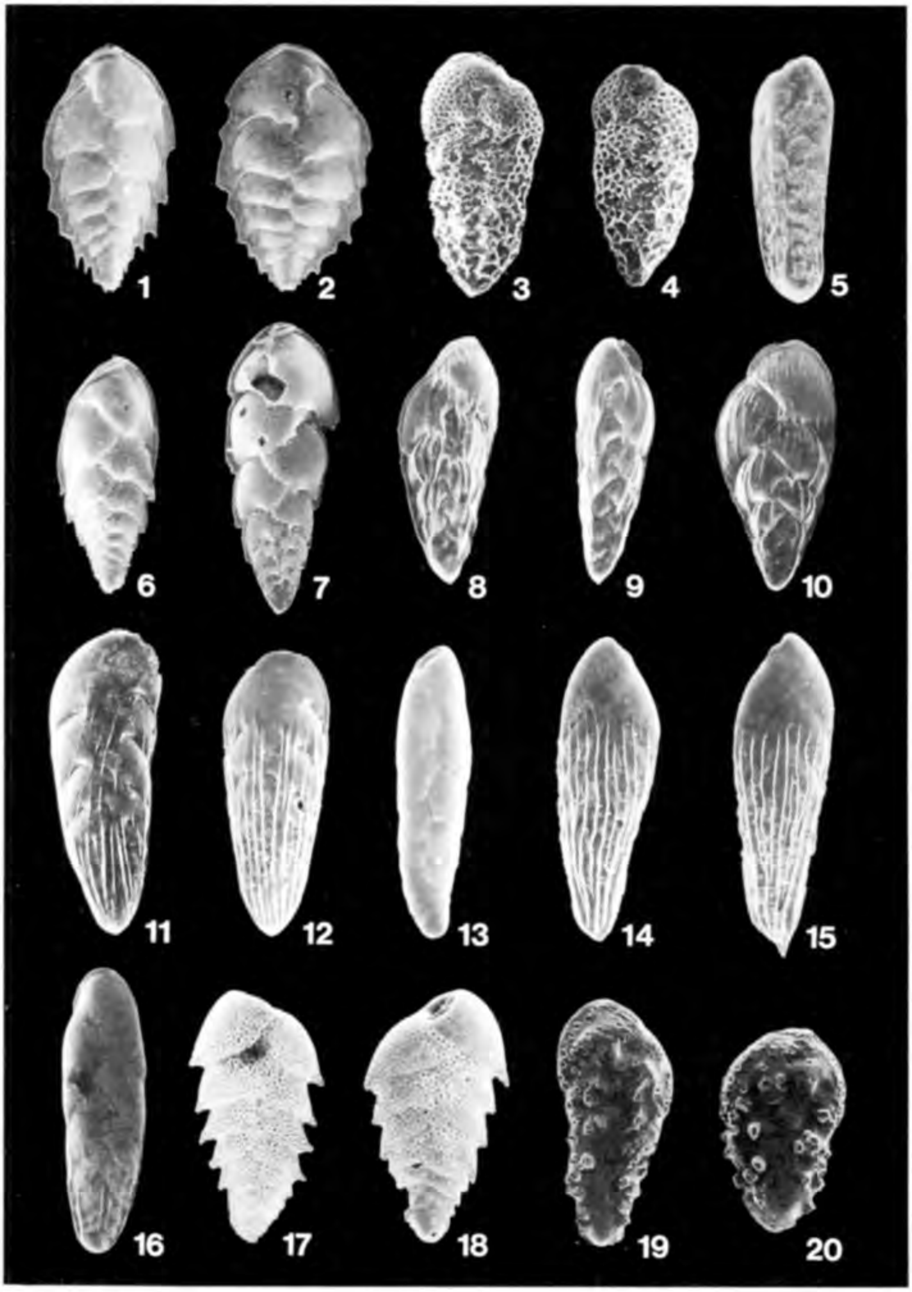

PLATE 17

PLATE 18

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FIGURES	TAXA	ISLANDS	REMARKS
1 - 3	*Brizalina subreticulata* (Parr)	BURU BUTON KAI SERAM TIMOR	1. Sample GF2A-S116; 100x 2. Sample GF2A-S116; 100x 3. Sample G5-6-150B (Recent); 125x Note the characteristic reticulate ornament.
4 - 6	*Brizalina karreriana* (Brady)	BURU BUTON KAI SERAM TIMOR	4. Sample GF1A-T143; 100x 5. Sample GF1A-T143; 100x 6. Sample GF1A-T203; 130x
7 - 9	*Laterostomella voluta* Belford	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-B286; 80x 8. Sample GF1A-B286; 80x 9. Sample GF1A-B286; 80x
10	*Cassidulinoides bradyi* (Norman)	BURU BUTON KAI SERAM TIMOR	10. Sample G5-6-154B (Recent); 140x
11 - 14	*Stilostomella* spp.	BURU BUTON KAI SERAM TIMOR	11. *Stilostomella bradyi* (Cushman) Sample GF1A-B286; 100x 12. *Stilostomella antillea* (Cushman) Sample GF1A-T143; 100x 13. Idem. Sample GF1A-T179; 40x 14. Idem. Sample GF1A T179; 100x
15 - 17	*Fursenkoina bradyi* (Cushman)	BURU BUTON KAI SERAM TIMOR	15. Sample G5-6-154B (Recent); 60x 16. Sample G5-6-154B (Recent); 60x 17. Sample G5-6-154B (Recent); 50x
18	*Acervulina inhaerens* Schultze	BURU BUTON KAI SERAM TIMOR	18. Sample GF1A-B293; 60x

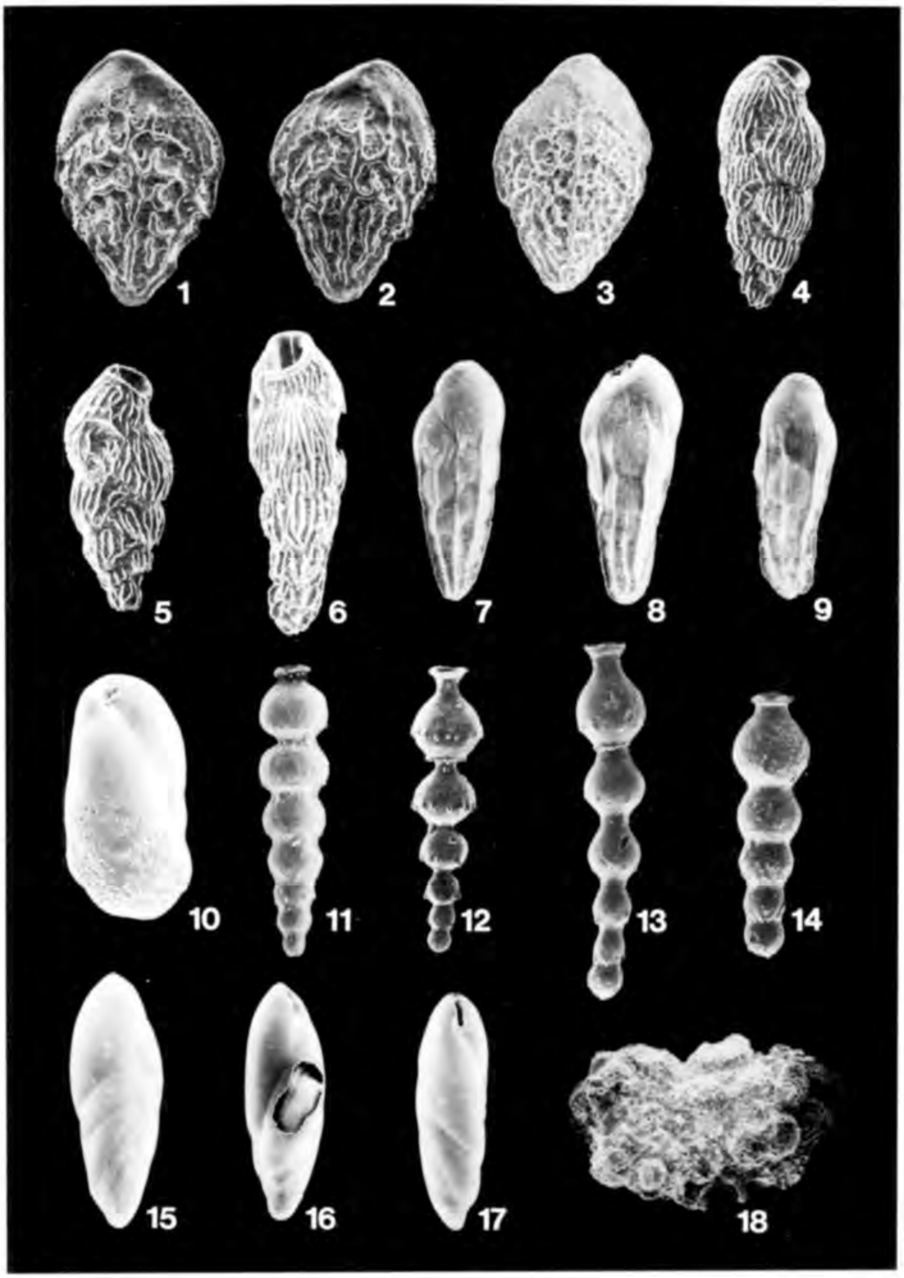

PLATE 18

PLATE 19

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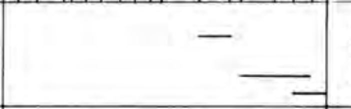
FIGURES	TAXA	ISLANDS	MIOCENE: EARLY (N 6, N 7), MIDDLE (N 8, N 9, N 10, N 11, N 12, N 13, N 14, N 15), LATE (N 16, N 17); PLIOCENE: EARLY (N 18, N 19, N 20), LATE (N 21); QUATERNARY (N 22, N 23)	REMARKS
1 - 4	*Glabratella australensis* (Heron-Allen and Earland)	BURU BUTON KAI SERAM TIMOR		1. Sample GF1A-T66; 140x 2. Sample GF1A-T66; 115x 3. Sample GF1A-T66; 170x 4. Sample GF1A-T66; 200x
5 - 7	*Heronallenia lingulata* (Burrows and Holland)	BURU BUTON KAI SERAM TIMOR		5. Sample G5-6-156B (Recent); 110x 6. Sample GF2A-S154; 110x 7. Sample GF2A-S116; 110x Note the planoconvex form and less prominent square and limbate periphery.
8	*Buliminoides williamsonianus* (Brady)	BURU BUTON KAI SERAM TIMOR		8. Sample GF1A-T203; 60x
9 - 10	*Planulinoides biconcavus* (Jones and Parker)	BURU BUTON KAI SERAM TIMOR		9. Sample GF1A-T220; 110x 10. Sample GF1A-T204; 110x Note biconcave test and limbate sutures on dorsal side.
11 - 12	*Discorbinella bertheloti* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR		11. Sample G5-6-158B (Recent); 90x 12. GF2A-S179; 85x
13 - 14	*Siphonina bradyana* Cushman	BURU BUTON KAI SERAM TIMOR		13. Sample GF1A-T192; 70x 14. Sample GF1A-T192; 65x
15 - 16	*Siphonina tubulosa* Cushman	BURU BUTON KAI SERAM TIMOR		15. Sample GF1A-T63; 70x 16. Sample GF1A-T57; 90x Note the characteristic spinose, tubular projections.

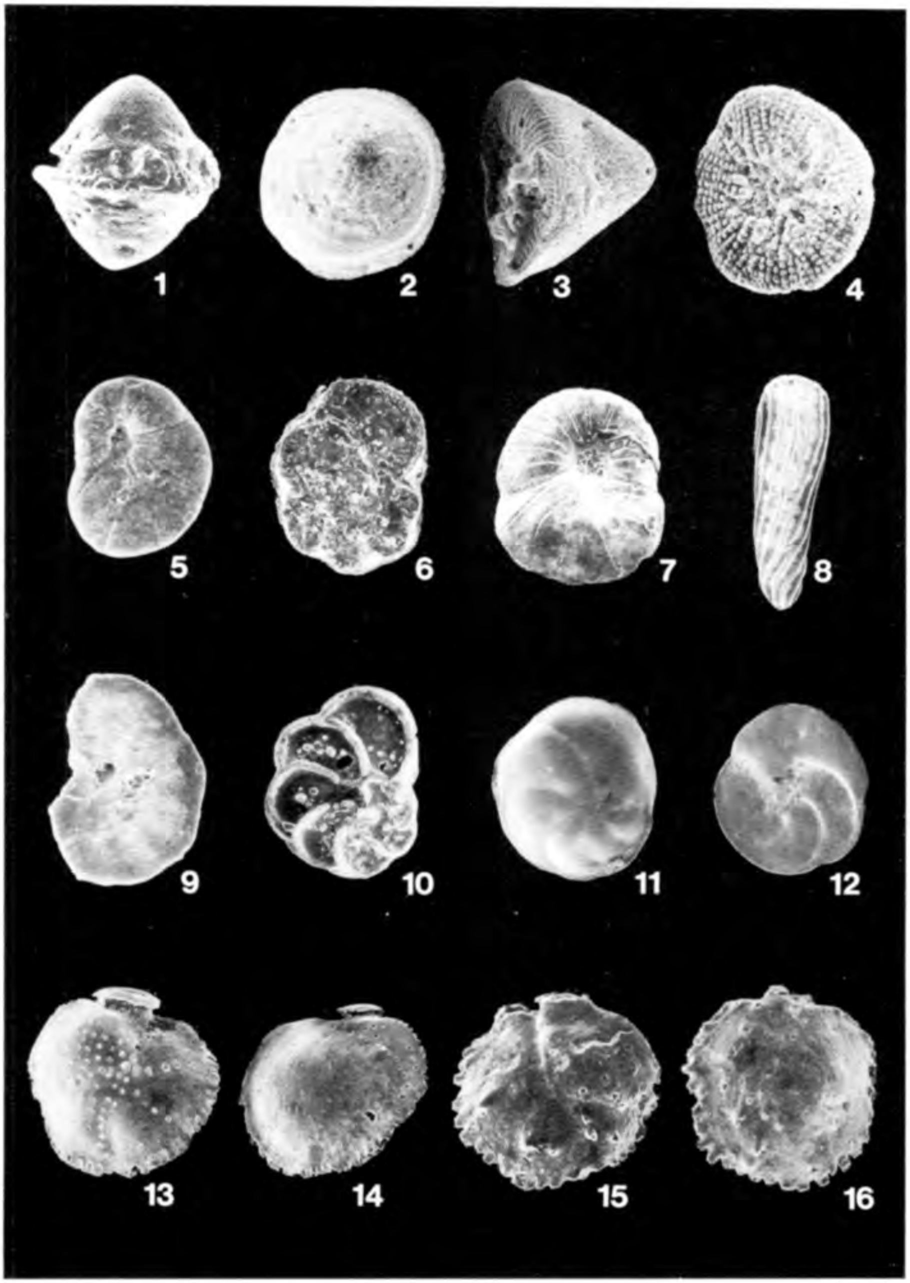
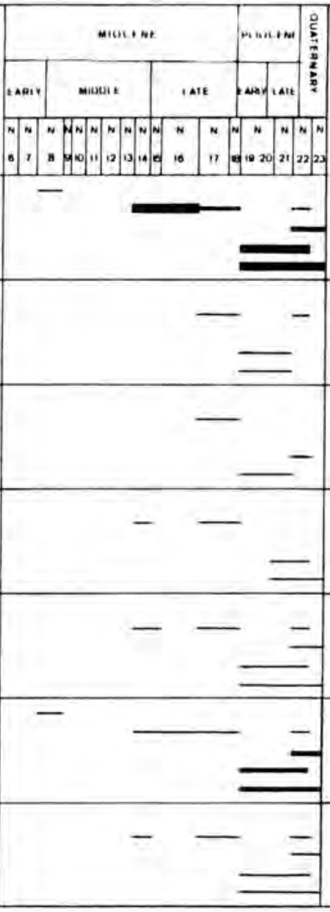


PLATE 19

PLATE 20



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FIGURES	TAXA	ISLANDS	REMARKS
1 - 3	*Melonis affinis* (Reuss)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T143; 100x 2. Sample G5-6-152B (Recent); 100x 3. Sample G5-6-150B (Recent); 100x
4 - 6	*Melonis pompilioides* (Fichtel and Moll)	BURU BUTON KAI SERAM TIMOR	4. Sample GF1A-B301; 70x 5. Sample GF1A-B301; 80x 6. Sample GF1A-B301; 55x Note the characteristic width of the chambers and coarse perforations.
7 - 8	*Melonis soldanii* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-T179; 70x 8. Sample GF1A-T143; 65x Note the lesser width of the chambers compared to ***M. pompilioides.***
9 - 10	*Anomalinella rostrata* (Brady)	BURU BUTON KAI SERAM TIMOR	9. Sample GF1A-B293; 45x 10. Sample G5-4-74B (Recent); 65x Note the characteristic supplementary aperture paralleling the peripheral keel.
11 - 12	*Pullenia quinqueloba* (Reuss)	BURU BUTON KAI SERAM TIMOR	11. Sample G5-6-150B (Recent); 70x 12. Sample G5-6-150B (Recent); 85x
13 - 15	*Pullenia bulloides* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	13. Sample GF1A-T179; 100x 14. Sample GF1A-T179; 100x 15. Sample G5-6-150B (Recent); 85x
16	*Nonion depressulum* (Walker and Jacob)	BURU BUTON KAI SERAM TIMOR	16. Sample GF1A-T220; 140x Note the characteristic, depressed sutures.

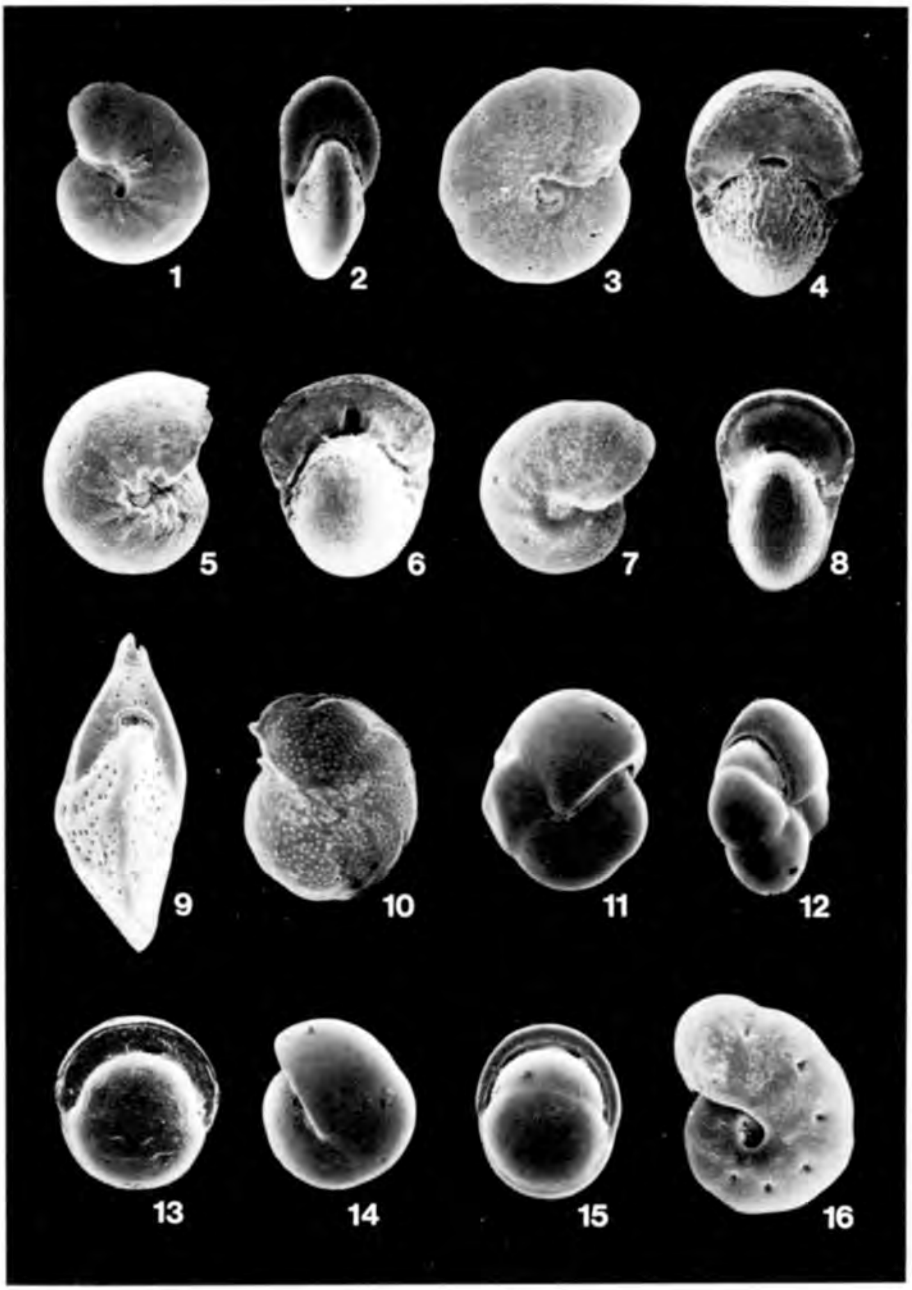
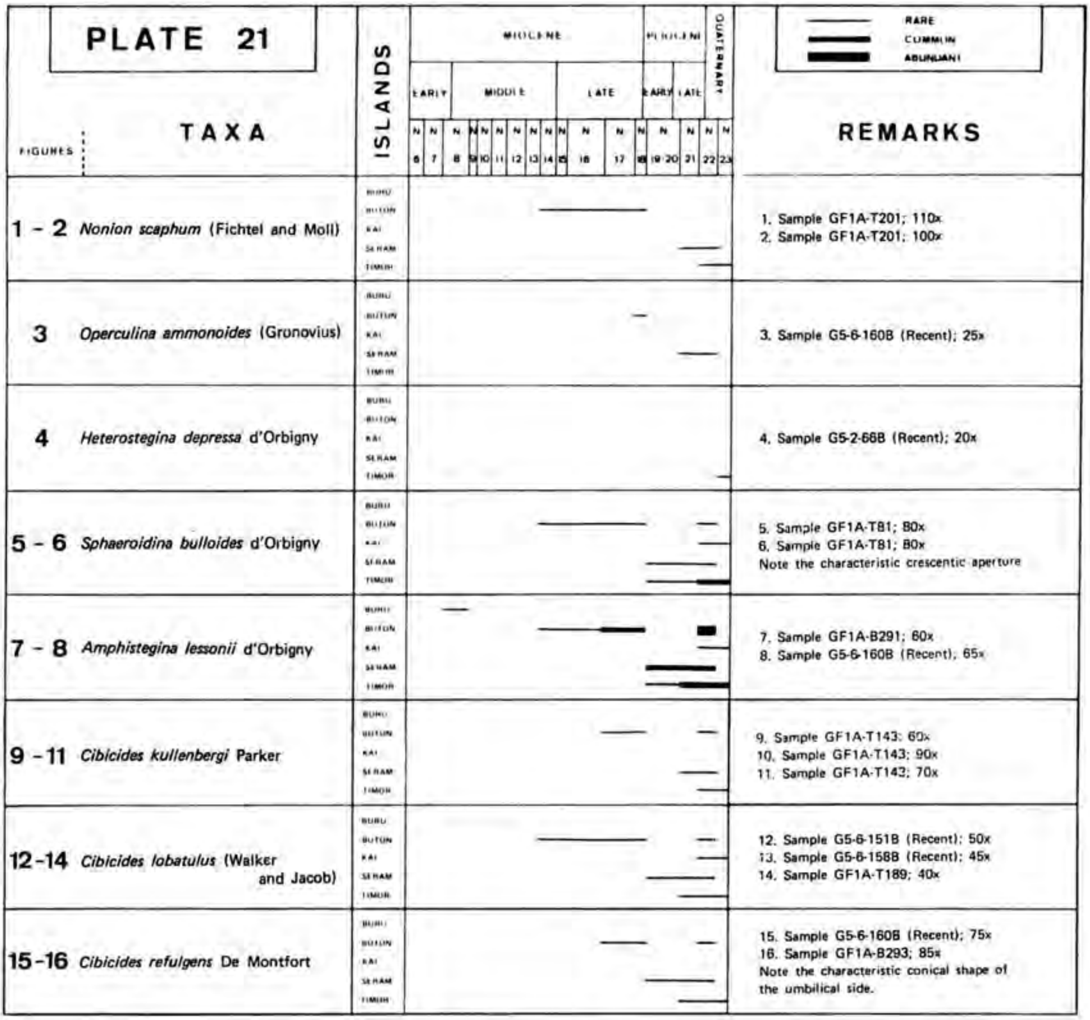


PLATE 20

PLATE 21



FIGURES	TAXA	ISLANDS	REMARKS
1 - 2	*Nonion scaphum* (Fichtel and Moll)	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T201; 110x 2. Sample GF1A-T201; 100x
3	*Operculina ammonoides* (Gronovius)	BURU BUTON KAI SERAM TIMOR	3. Sample G5-6-160B (Recent); 25x
4	*Heterostegina depressa* d'Orbigny	BURU BUTON KAI SERAM TIMOR	4. Sample G5-2-66B (Recent); 20x
5 - 6	*Sphaeroidina bulloides* d'Orbigny	BURU BUTON KAI SERAM TIMOR	5. Sample GF1A-T81; 80x 6. Sample GF1A-T81; 80x Note the characteristic crescentic aperture
7 - 8	*Amphistegina lessonii* d'Orbigny	BURU BUTON KAI SERAM TIMOR	7. Sample GF1A-B291; 60x 8. Sample G5-6-160B (Recent); 65x
9 - 11	*Cibicides kullenbergi* Parker	BURU BUTON KAI SERAM TIMOR	9. Sample GF1A-T143; 60x 10. Sample GF1A-T143; 90x 11. Sample GF1A-T143; 70x
12-14	*Cibicides lobatulus* (Walker and Jacob)	BURU BUTON KAI SERAM TIMOR	12. Sample G5-6-151B (Recent); 50x 13. Sample G5-6-158B (Recent); 45x 14. Sample GF1A-T189; 40x
15-16	*Cibicides refulgens* De Montfort	BURU BUTON KAI SERAM TIMOR	15. Sample G5-6-160B (Recent); 75x 16. Sample GF1A-B293; 85x Note the characteristic conical shape of the umbilical side.

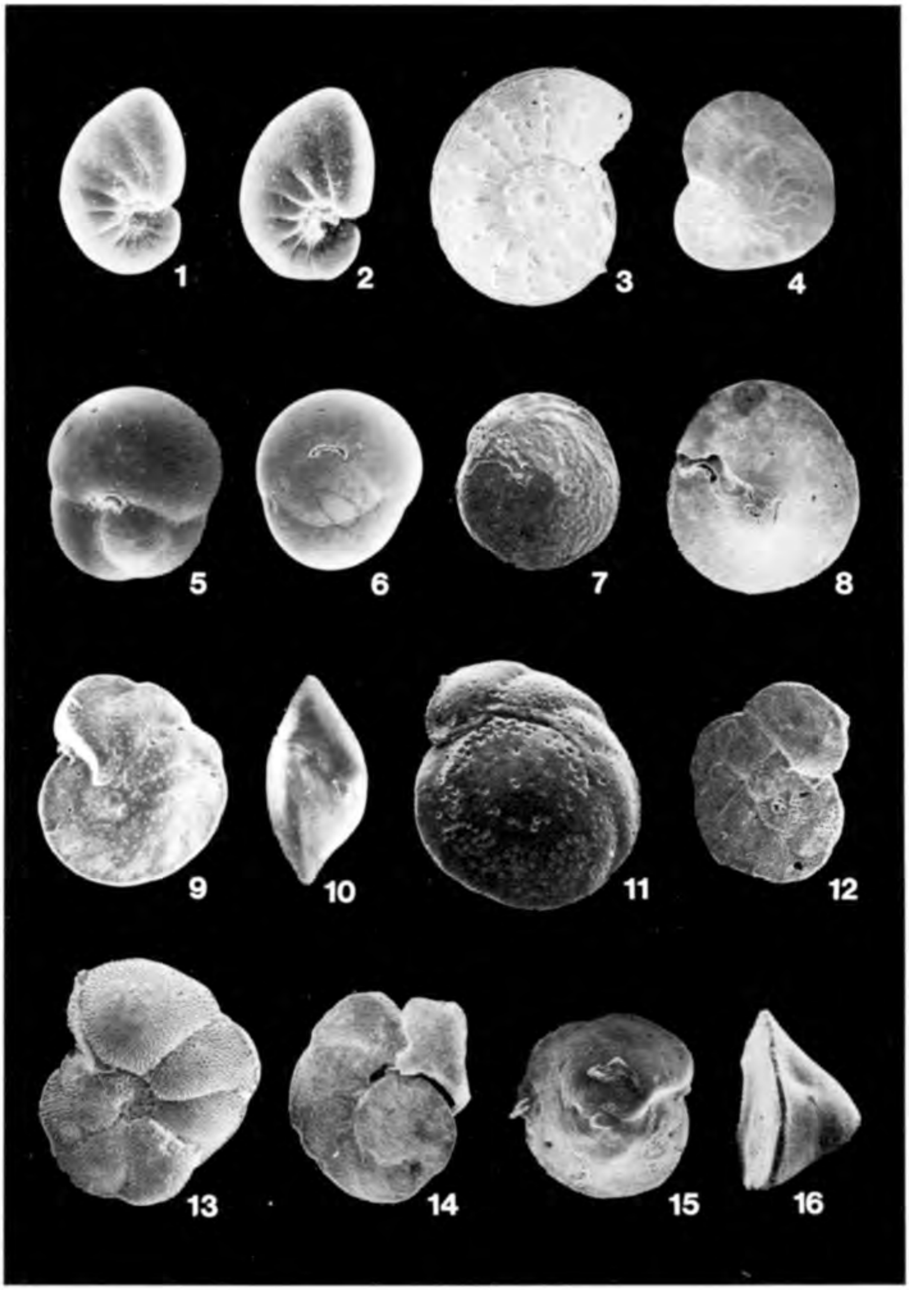


PLATE 21

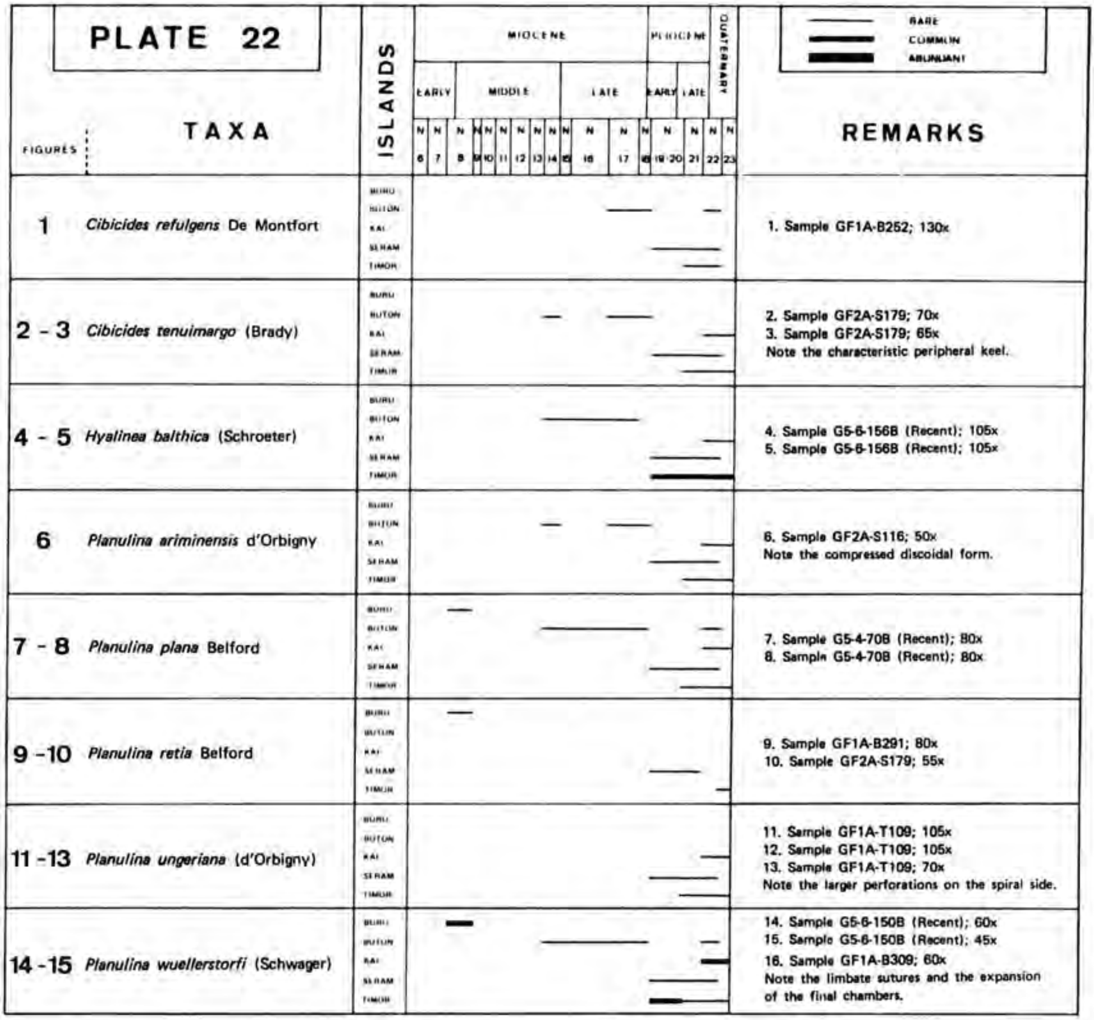


PLATE 22

FIGURES	TAXA	ISLANDS	REMARKS
1	*Cibicides refulgens* De Montfort	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-B252; 130x
2 - 3	*Cibicides tenuimargo* (Brady)	BURU BUTON KAI SERAM TIMOR	2. Sample GF2A-S179; 70x 3. Sample GF2A-S179; 65x Note the characteristic peripheral keel.
4 - 5	*Hyalinea balthica* (Schroeter)	BURU BUTON KAI SERAM TIMOR	4. Sample G5-6-156B (Recent); 105x 5. Sample G5-6-156B (Recent); 105x
6	*Planulina ariminensis* d'Orbigny	BURU BUTON KAI SERAM TIMOR	6. Sample GF2A-S116; 50x Note the compressed discoidal form.
7 - 8	*Planulina plana* Belford	BURU BUTON KAI SERAM TIMOR	7. Sample G5-4-70B (Recent); 80x 8. Sample G5-4-70B (Recent); 80x
9 - 10	*Planulina retia* Belford	BURU BUTON KAI SERAM TIMOR	9. Sample GF1A-B291; 80x 10. Sample GF2A-S179; 55x
11 - 13	*Planulina ungeriana* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	11. Sample GF1A-T109; 105x 12. Sample GF1A-T109; 105x 13. Sample GF1A-T109; 70x Note the larger perforations on the spiral side.
14 - 15	*Planulina wuellerstorfi* (Schwager)	BURU BUTON KAI SERAM TIMOR	14. Sample G5-6-150B (Recent); 60x 15. Sample G5-6-150B (Recent); 45x 16. Sample GF1A-B309; 60x Note the limbate sutures and the expansion of the final chambers.

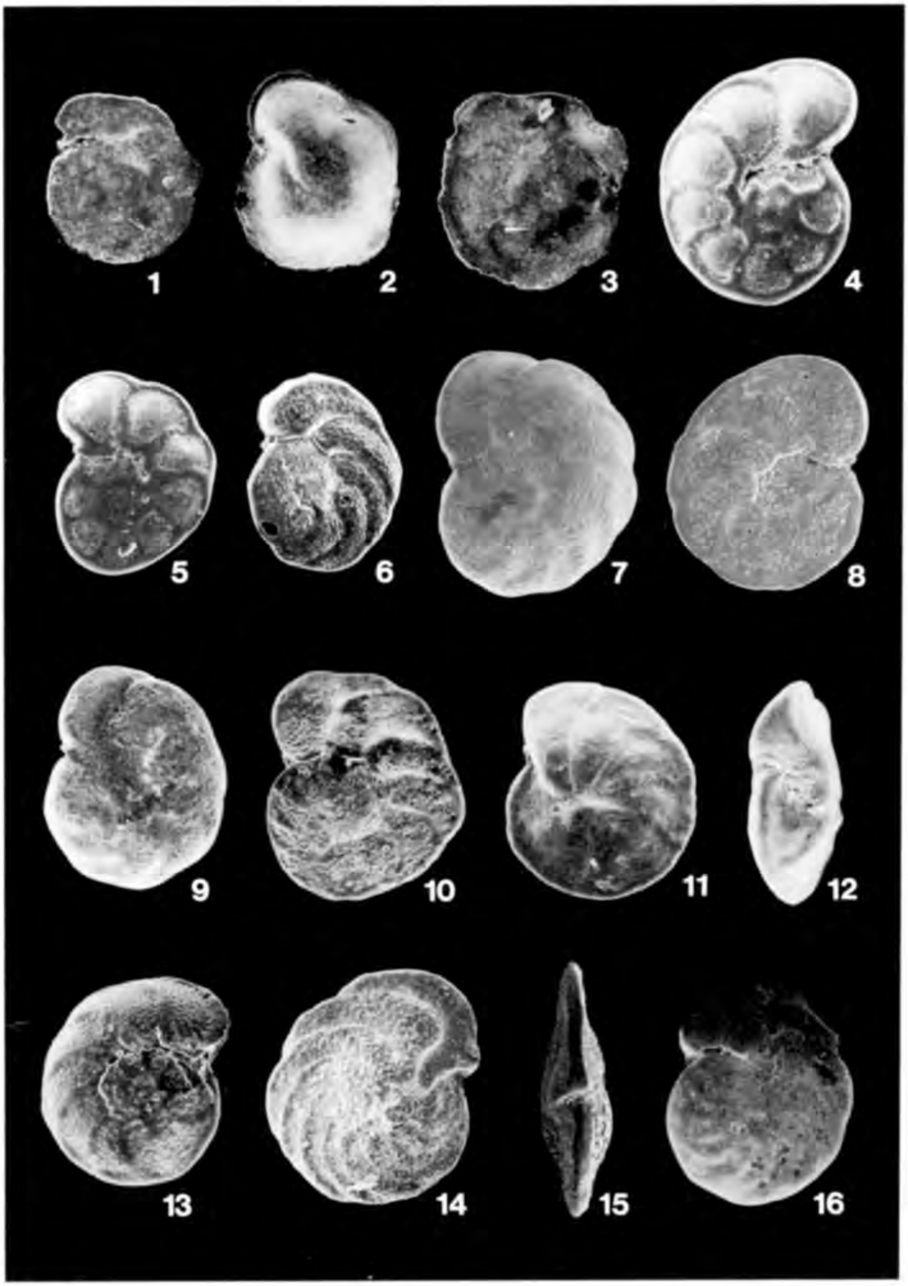


PLATE 22

PLATE 23

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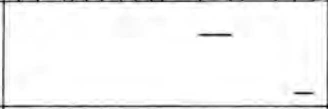
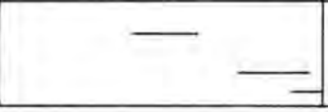
FIGURES	TAXA	ISLANDS	MIOCENE EARLY MIDDLE LATE PLIOCENE EARLY LATE QUATERNARY N 6 N 7 N 8 N 9 N 10 N 11 N 12 N 13 N 14 N 15 N 16 N 17 N 18 N 19-20 N 21 N 22 N 23	REMARKS
1 - 2	*Cymbaloporetta bradyi* (Cushman)	BURU BUTON KAI SERAM TIMOR		1. Sample GF1A-T215; 125x 2. Sample GF1A-T215; 60x
3 - 4	*Planorbulina mediterranensis* d'Orbigny	BURU BUTON KAI SERAM TIMOR		3. Sample GF2A-S179; 45x 4. Sample GF2A-S179; 45x
5	*Calcarina spengleri* (Gmelin)	BURU BUTON KAI SERAM TIMOR		5. Sample G5-2-66B (Recent); 20x
6 - 10	*Elphidium* spp.	BURU BUTON KAI SERAM TIMOR		6. *Elphidium advenum* (Cushman) Sample G5-6-160B (Recent); 50x 7. *Elphidium crispum* (Linnaeus) Sample G5-6-160B (Recent); 55x 8. *Elphidium incertum* (Williamson) Sample GF1A-T196; 150x Note the scattered retral processes parallel to the sutures. 9. *Elphidium macellum* (Fichtel and Moll) Sample GF2A-S116; 70x 10. Idem. Sample GF1A-T204; 95x Note the depressed umbilical region.
11 - 12	*Ammonia beccarii* (Linnaeus) s.l.	BURU BUTON KAI SERAM TIMOR		11. Sample G5-4-74B (Recent); 100x 12. Sample G5-4-74B (Recent); 105x
13 - 15	*Ammonia supera* Belford	BURU BUTON KAI SERAM TIMOR		13. Sample GF2A-K208A; 70x 14. Sample GF2A-K208A; 65x 15. Sample GF2A-K208A; 60x
16	*Asterorotalia gaimardii* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR		16. Sample GF1A-T123; 65x

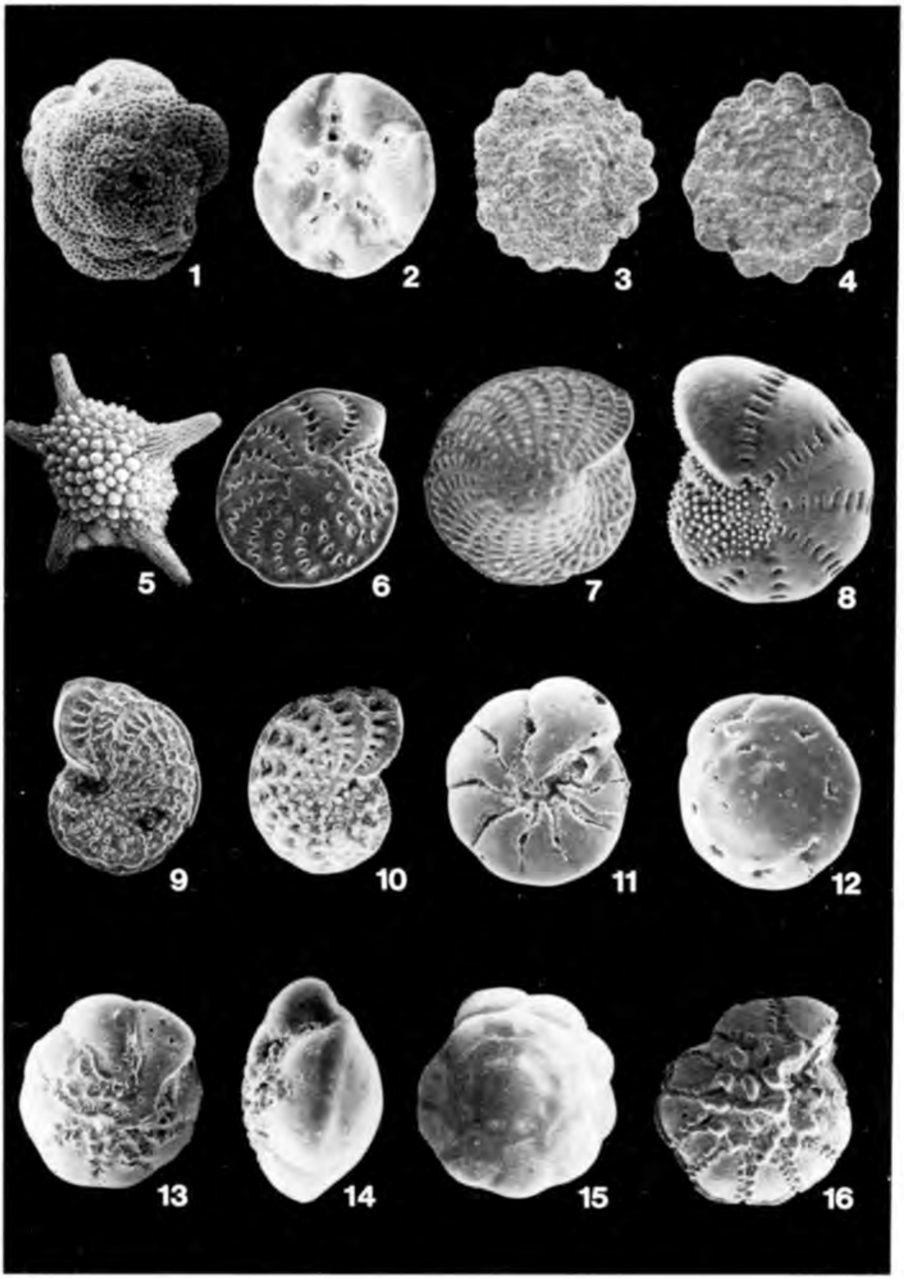
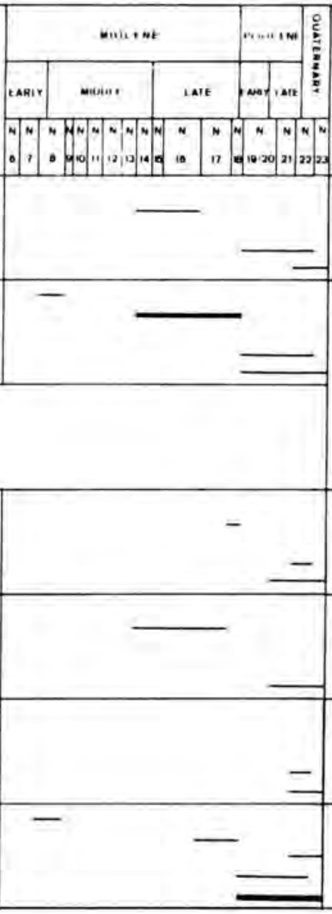


PLATE 23

PLATE 24



FIGURES	TAXA	ISLANDS	REMARKS
1–3	*Asterorotalia gaimardii* (d'Orbigny)	BURU BUTON KAI SERAM TIMOR	1. Sample G5-4-71B (Recent); 60x 2. Sample G5-4-71B (Recent); 55x 3. Sample GF1A-T123; 100x Note the characteristic heavy ornament.
4–9	*Pleurostomella* spp.	BURU BUTON KAI SERAM TIMOR	4. *Pleurostomella brevis* Schwager Sample GF1A-T189; 55x 5. Idem. Sample GF1A-B293; 120x 6. *Pleurostomella acuminata* Cushman Sample GF1A-B301; 55x 7. Idom. Sample GF1A-T143; 100x 8. *Pleurostomella alternans* Schwager Sample GF1A-B301; 55x 9. Idem. Sample GF1A-T123; 90x
10–12	*Patellina corrugata* Williamson	BURU BUTON KAI SERAM TIMOR	10. Sample GF1A-T50; 140x 11. Sample GF1A-T56; 110x 12. Sample GF2A-S142; 140x
13	*Spirillina vivipara* Ehrenberg	BURU BUTON KAI SERAM TIMOR	13. Sample GF1A-T66; 140x
14–15	*Glomospira charoides* (Jones and Parker)	BURU BUTON KAI SERAM TIMOR	14. Sample G5-6-151B (Recent); 100x 15. Sample G5-6-151B (Recent); 100x Note the streptospirally arranged and irregular second chamber.
16–17	*Bolivinopsis cubensis* (Cushman and Bermudez)	BURU BUTON KAI SERAM TIMOR	16. Sample GF1A-B338; 70x 17. Sample GF1A-T53; 100x

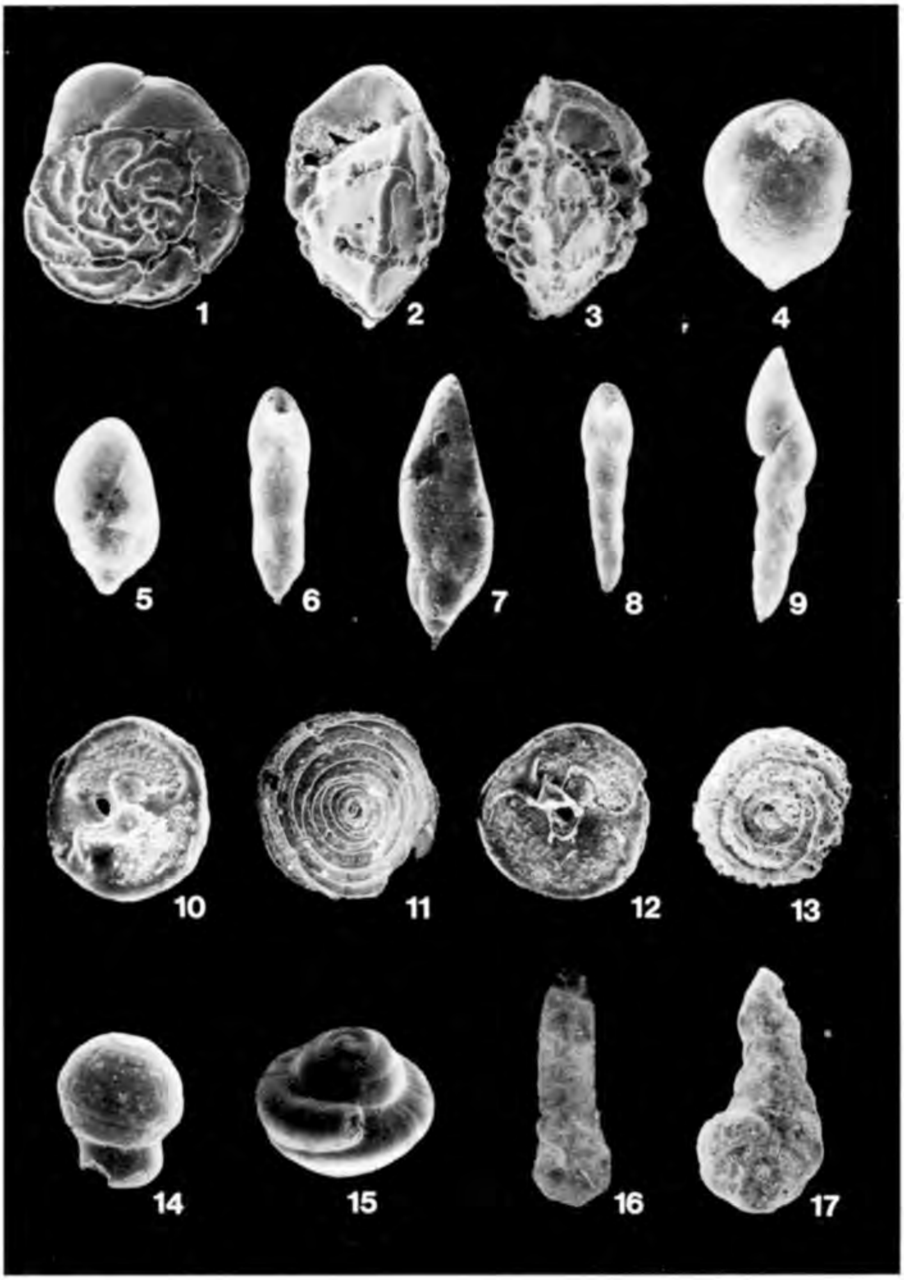


PLATE 24

PLATE 25

— RARE
▬ COMMON
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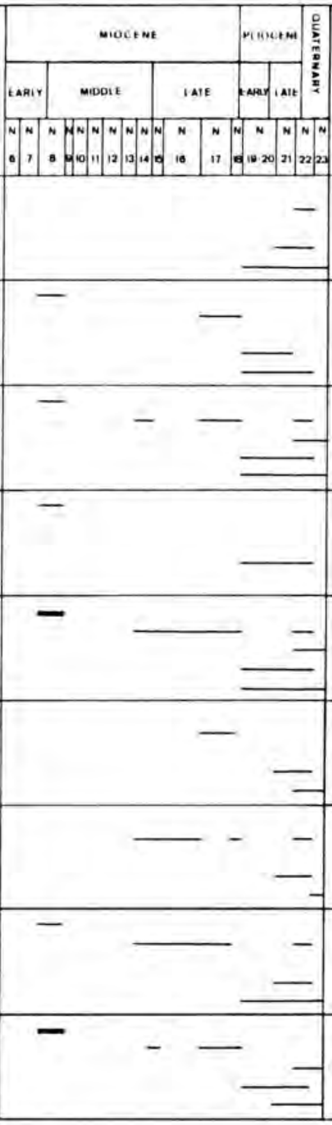

FIGURES	TAXA	ISLANDS	REMARKS
1	*Dorothia bradyana* Cushman	BURU BUTON KAI SERAM TIMOR	1. Sample GF1A-T26; 40x Note the distinct biserial stage.
2 - 4	*Karreriella bradyi* (Cushman)	BURU BUTON KAI SERAM TIMOR	2. Sample GF1A-T143; 40x 3. Sample G5-6-150B (Recent); 50x 4. Sample G5-6-150B (Recent); 50x
5 - 6	*Eggerella bradyi* (Cushman)	BURU BUTON KAI SERAM TIMOR	5. Sample GF2A-S116; 140x 6. Sample GF2A-S116; 140x
7 - 9	*Cribrostomoides subglobosus* (Sars)	BURU BUTON KAI SERAM TIMOR	7. Sample G5-6-151B (Recent); 100x 8. Sample G5-6-151B (Recent); 80x 9. Sample G5-6-151B (Recent); 90x
10	*Textularia sagitulla* Defrance	BURU BUTON KAI SERAM TIMOR	10. Sample G5-6-156B (Recent); 100x
11	*Siphotextularia concava* (Karrer)	BURU BUTON KAI SERAM TIMOR	11. Sample G5-6-158B (Recent); 140x
12	*Gaudryina atlantica* (Bailey)	BURU BUTON KAI SERAM TIMOR	12. Sample GF1A-T143; 70x
13-14	*Clavulinoides tricarinatus* (LeRoy)	BURU BUTON KAI SERAM TIMOR	13. Sample GF1A-B294; 40x 14. Sample GF1A-B293; 55x
15-16	*Vulvulina pennatula* (Batsch)	BURU BUTON KAI SERAM TIMOR	15. Sample G5-4-82B (Recent); 55x 16. Sample GF1A-T143; 50x

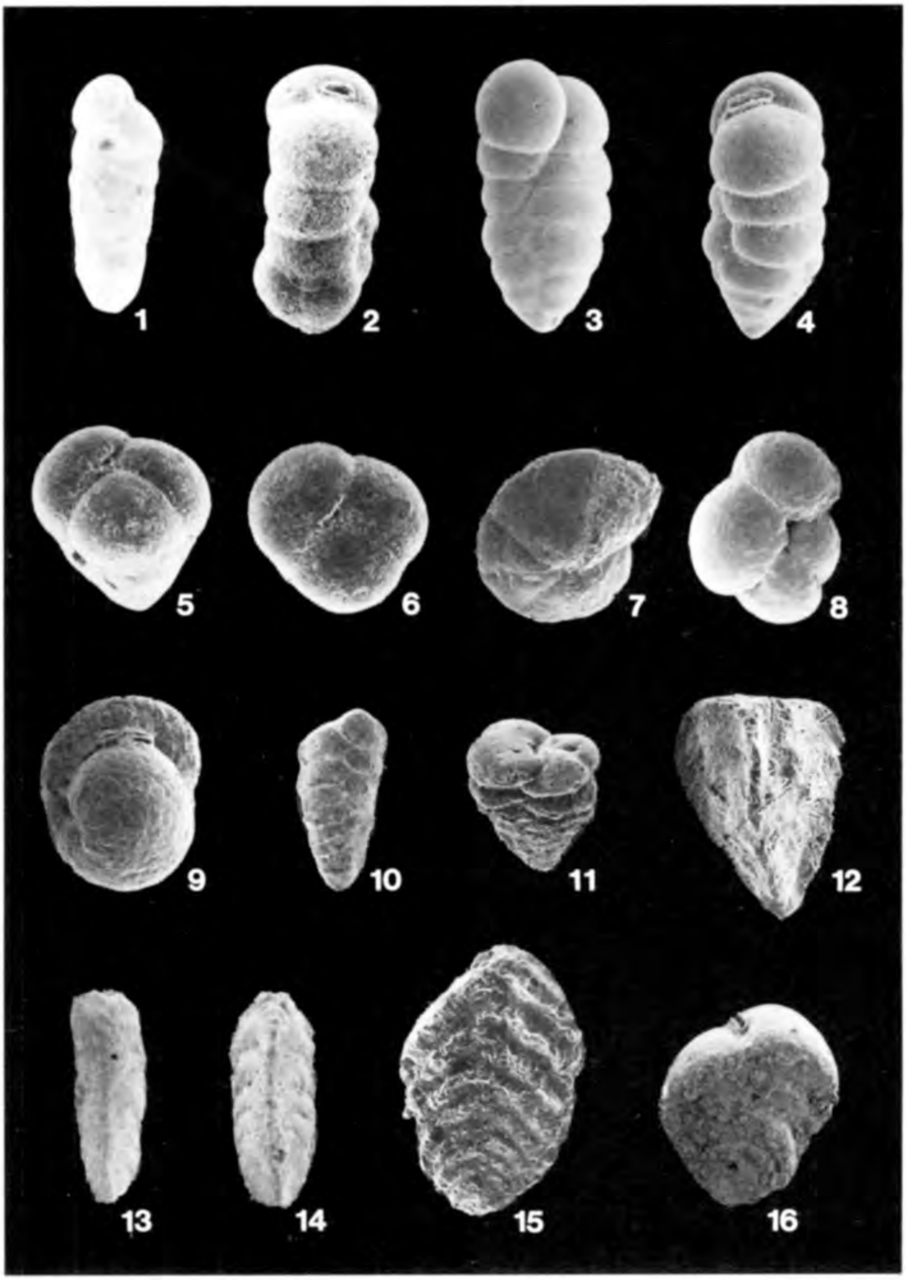

PLATE 25

Species index