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Ecological Analysis of Benthonic Foraminifera in Kagoshima Bay, South Kyūshū, Japan

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Abstract

The assemblages of benthonic foraminifera in Kagoshima Bay, South Kyūshū, Japan were quantitatively analyzed from a paleoecological point of view.

Eighty-six of 146 bottom surface samples collected by gravity corer (PHLEGER's bottom sampler) were used for the ecological analysis of benthonic foraminifera. Living specimens were discriminated by the Rose Bengal staining method. One hundred and thirty-six samples were used for the mechanical analysis (EMERY settling-tube and pipette settling methods). Oceanographic observation on Kagoshima Bay has been carried out in alternate months from 1975 through 1979 by the staff of the Faculty of Fisheries, Kagoshima University. Those data were used for scrutinizing the environmental factors concerning the sea water characteristics in the area.

The intensity and direction of the bottom currents were inferred from the results of mechanical analyses of the bottom sediments and the oceanographic data. For all the species of which living specimens were recognized to occur, the ratio of the number of living specimens to the total (dead and living) number of individuals (L/Tl value) was calculated. Based on the L/Tl value, the relative rate of sedimentation at each sampling station was estimated. It has been pointed out that the L/Tl value well corresponds to the sedimentary environment inferred from the bottom current movement and the distribution of sediments, and it is a good index for sedimentary environment (ŌKI, 1986b, 1988). Taking the L/Tl value into consideration, the distribution patterns of number of individuals of planktonic foraminifera, of radiolaria and of benthonic foraminifera were illustrated (Figs. 19, 20 and 24). Further, the ratio of planktonic foraminifera to the total foraminifera was calculated on each sample and was discussed in relation to water depth.

The total (dead and living) benthonic foraminiferal specimens were divided into six groups through the cluster analysis (DAVIS, 1973) based on the percentage frequency data. The relationship between each clustered group and the environmental condition of its distribution area was discussed.

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Based on the oceanographic data, results of mechanical analyses of bottom sediments and of cluster analysis of benthonic foraminifera, the following five populations of benthonic foraminifera corresponding to the distribution of the water masses were discriminated.

1) Population A: Inhabiting the area under the influence of the open-sea water mass. Predominant species are *Cibicidoides pseudoungerianus, Globocassidulina oriangulata, Paracassidulina quasicarinata, Florilus pauperatus* and *Discorbis mira*.

2) Population B: Inhabiting the area under the influence of the hyposaline water mass. Predominant species are *Cymbaloporetta hemisphaerica, Buliminella elegantissima, Bolivina ordinaria, Protelphidium schmitti* and *Pseudononion japonicum*.

3) Population C: Inhabiting the boundary area between the water masses different in salinity from each other. Predominant species are *Uvigerina vadescens, Bulimina marginata* and *Globocassidulina oriangulata*.

4) Population D: In habiting the basin bottom under the influence of relatively stagnant water mass slightly mixed with the open-sea water. Predominant species is *Bulimina marginata*.

5) Population E: Inhabiting the basin bottom under the influence of the water mass being stagnant through the year and scarcely exchanged with the open-sea water. Predominant species is *Eggerella scabra*.

These populations of benthonic foraminifera in Kagoshima Bay were compared with the similar ones hitherto reported from the seas around Japan.

All the species treated here including twelve new species and two subspecies were described systematically.

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Introduction

The ecological studies on benthonic foraminifera started by PHLEGER and WALTON in the early 1950's have been successfully continued by many authors. Since the discrimination of living specimens by dyeing the protoplasm became possible, even seasonal changes of living population have been studied in detail (LUTZE, 1968; DANIELS, 1970, etc.). The international sysmposium (BENTHONICS '75) held in Halifax, Canada in 1975 has promoted the studies on benthonic foraminifera throughout the world.

In Japan, ecological studies on the Recent foraminifera also started in the early 1950's by ISHIWADA (1950), KUWANO (1953, 1954), NAGAHAMA (1951, 1954) and TAKAYANAGI (1955) and continued by MATSUDA (1957), ISHIWADA (1958, 1964), KUWANO (1962, 1963), UCHIO (1962b), CHIJI and LOPEZ (1968), CHIJI and KONDA (1970), IKEYA (1970, 1971, 1977), MATOBA (1970, 1975, 1976a-c) and MATOBA and NAKAGAWA (1972). Paleoecological studies on the fossil foraminifera in comparison with the Recent foraminifera were carried out by AOSHIMA (1978) and HASEGAWA (1979). During the 55 years from 1925 to 1981, 79 articles dealing with the Recent benthonic foraminifera have been published (NOMURA, 1981-1982). However, only a few papers among them are concerned in the relation between population and environmental condition. Another difficulty is that, as MATOBA (1970) already mentioned, the differences in methods of sampling and of treating samples between the authors have brought about a problem in comparing the populations.

To get fundamental data on the ecology of the benthonic foraminifera of shallow water areas around southern Kyūshū, and at the same time, to determine a method of population analysis, I have continuously studied the Recent foraminiferal specimens preserved in the bottom sediments of Kagoshima Bay in South Kyūshū since 1977. Fortunately, oceanographic data on Kagoshima Bay sufficient for the present study have been accumulated by the staff of the Faculty of Fisheries, of Technology and of Science, Kagoshima University.

In the present article, assemblage of benthonic foraminifera (Tables 11 and 12) is treated from the paleoecological point of view and the systematic description of them is also given. The writer wishes to utilize the results of the present study as the fundamental information for the paleoecological analyses of fossil assemblages of foraminifera in future.

Acknowledgements

I will take this opportunity to express my deep gratitude to Professor Yokichi TAKAYANAGI of the Institute of Geology and Paleontology, Tohoku University, who first introduced me to the study of foraminifera, for his contiguous guidance and supervision during the present study. Deep appreciation is due to Professor Shozo HAYASAKA of the Institute of Earth Sciences, Kagoshima University, who instructed me in his introduction to the actuopaleontological study on benthonic foraminifera and other related problems in the fields and laboratory, for his invaluable guidance and advice throughout the course of this study and reviewing the manuscript. I am also indebted to Professor Yasumochi MATOBA of the Institute of Mining Geology, Akita University, for his valuable suggestions concerning the classification of benthonic foraminifera.

Particular thanks are due to Dr. Kunihiro ISHIZAKI of the Institute of Geology and Paleontology, Tohoku University, for valuable suggestions concerning the statistical analysis of the foraminiferal assemblage; to Dr. Hiroyuki OTSUKA of the Institute of Earth Sciences, Kagoshima University, for his advice and help in field work; to Professor Tomio HENMI, the former captain of R.V. Keiten-maru; and to Associate Professor Seiji HIGASHIKAWA, the captain of R.V. Kagoshima-maru, both of the Faculty of Fisheries, Kagoshima University, for their kind help in field operations and their encouragement.

I am also indebted to Dr. Masahiko YAMAMOTO and Professor Toshiki KAKUTA of the Institute of Earth Sciences, Kagoshima University, for their help with the computer and to Mr. Tsuyoshi NISHI-INOUÉ for his help in the illustrations.

Outline of Kagoshima Bay

1. Geography and climate

Kagoshima Bay occupies the central part of Kagoshima Prefecture, which is located in a quadrangle roughly outlined by the lines of 30° 59'N and 32° 11'N Lat. and 130° 06'E to 131° 12'E Long. (Fig. 1) and divided by the existence of the bay into the following three areas; the Hokusatsu area (northern part), the Satsuma Peninsula (southwestern part) and the Ōsumi Peninsula (southeastern part). Kagoshima Bay, lying between the Satsuma and the Ōsumi Peninsulas, is elongate and southward-opening with a length of about 75 km from north to south and a width of about 25 km. The coast-lines of both peninsulas are slightly sinuous and nearly parallel to each other.

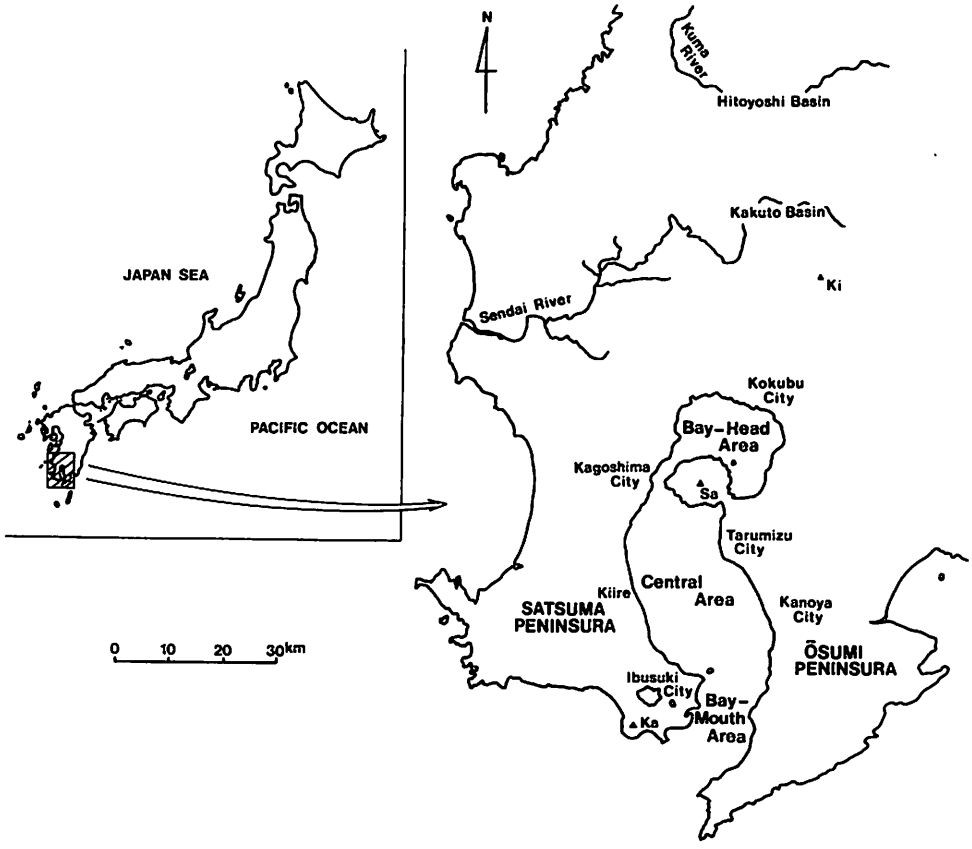

Fig.1. Index map of the studied area (Ki: Mt. Kirishima; Sa: Mt. Sakurajima; Ka: Mt. Kaimon-dake).

Sakurajima, a volcanic island connected to the northern part of the Ōsumi Peninsula to the east, is facing to Kagoshima City (population 500,000) across the West-Sakurajima Passage. Mt. Sakurajima, 1110 m in altitude, has continuously erupted since 1955 attended with heavy ash fall on the lee side neighbouring areas. The Kirishima massif composed of 23 Quaternary volcanic cones is situated to the north of Kagoshima Bay (the Hokusatsu area). Another group of Quaternary volcanoes (the Ibusuki volcanoes) is distributed in the southernmost part of the Satsuma Peninsula.

The climate of Southwest Japan, in which Kagoshima Prefecture is the southern extremity, has been classified as Humid Mesothermal (Subtropical) Climate (Finch and Trewartha, 1949). Temperature data through 30 years (1951-1980) in Kagoshima City indicate that the yearly mean temperature is 17.3 °C, mean temperature in winter is 8.1 °C and that in summer is 26.0 °C. The maximum temperature is in August when the daytime temperature frequently exceeds 30 °C. The highest yearly mean precipitation during the past 30 years (1951-1980) is 2374.6 mm, and the monthly mean precipitation is lowest in December (79.5 mm) and highest in June (474.7 mm), the rainy season in Japan (Kasamura, 1983).

2. Geologic setting

Many stratigraphic units distributed in South Kyūshū can be grouped into five major geological units as follows: 1) The Mesozoic and Palaeogene sedimentary rocks (the Shimanto and the Nichinan Groups) consist mostly of sandstone and shale, which form the basement of the area; 2) granitic rocks intruding into the basement rocks mentioned above (12-16 Ma); 3) The Neogene and Quaternary volcanic rocks and pyroclastic flow deposits; 4) Several late Quaternary pyroclastic flow deposits which resulted from the formation of caldera and the interbedded marine strata; and 5) The volcanic and pyroclastic rocks erupted from the volcanoes (the Kirishima Volcanoes, Sakurajima Volcano and the Ibusuki Volcanoes), of which activity started in the late Pleistocene and continues to the Recent times.

MATUMOTO(1943) proposed the existence of two gigantic calderas within Kagoshima Bay based on detailed studies on the topographic features and the pyroclastic flow deposits around the bay (Fig. 2). One is Aira Caldera at the bay head area and the other is Ata Caldera at the bay mouth area. He also mentioned that the steep slopes on both sides of the bay are fault scarps, so called caldera-walls. Based on his proposal, many geologists assumed that Kagoshima Bay is genetically related to the formation of these calderas. However, it has been recently proposed that Kagoshima Bay is ascribed to the formation of graben, namely "Kagoshima Graben", which is extended northward from the bay mouth area to Hitoyoshi Basin for a distance of about 110 km (OTA *et al.*, 1967; TSUYUKI, 1969; HAYASAKA and ŌKI, 1971; HAYASAKA, 1987). The graben probably formed after the Terukuni Pyroclastic Flow (2.90 ± 0.25 Ma age: SHIBATA *et al.*, 1978) which directly covers the basement rocks (the Shimanto Group). The present

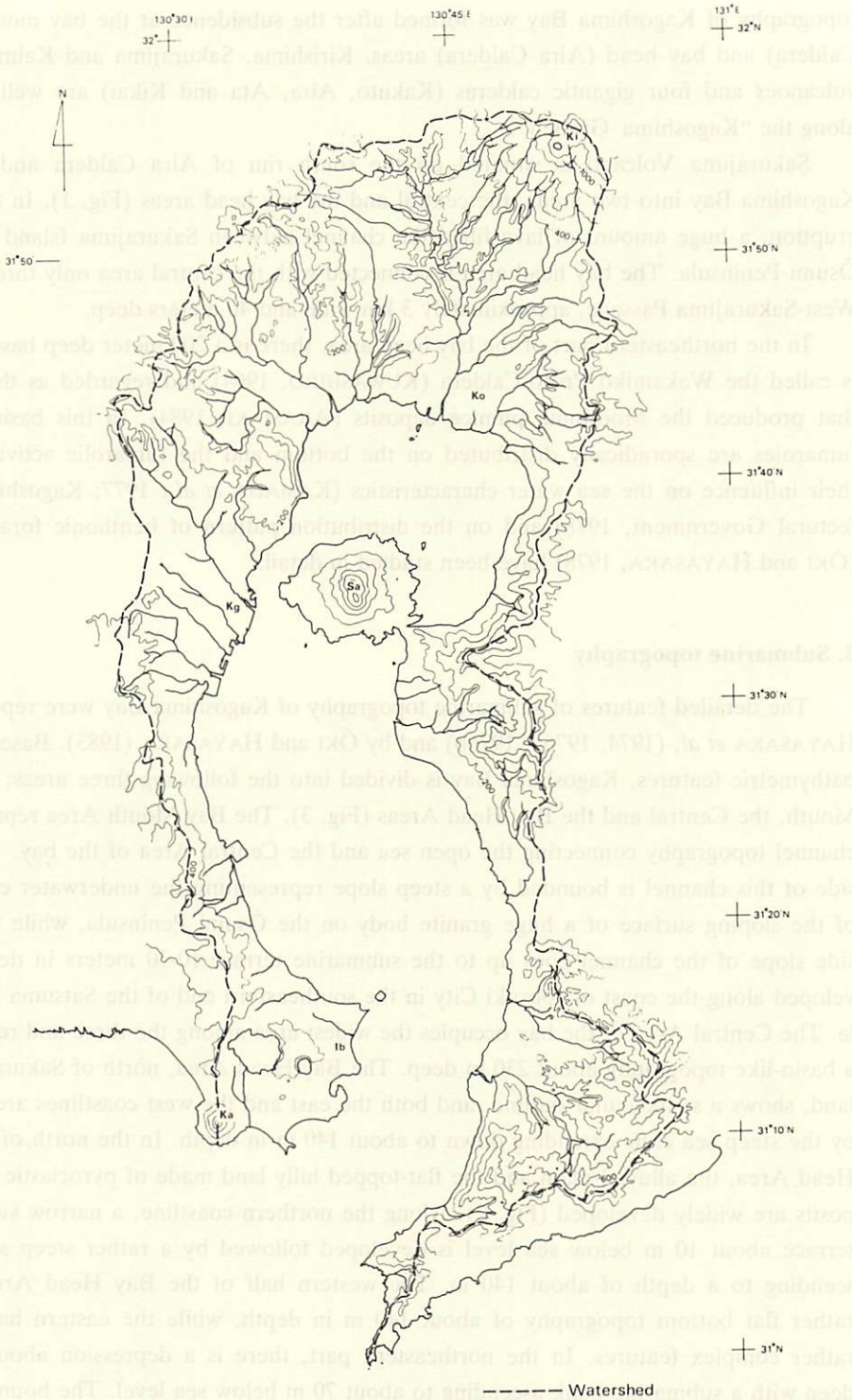

Fig. 2. Map showing the rivers flowing into Kagoshima Bay and their catchment area.

topography of Kagoshima Bay was formed after the subsidence at the bay mouth (Ata Caldera) and bay head (Aira Caldera) areas. Kirishima, Sakurajima and Kaimon-dake volcanoes and four gigantic calderas (Kakuto, Aira, Ata and Kikai) are well aligned along the "Kagoshima Graben".

Sakurajima Volcano is situated on the south rim of Aira Caldera and divides Kagoshima Bay into two areas, the central and the bay head areas (Fig. 1). In the 1914 eruption, a huge amount of lava filled the channel between Sakurajima Island and the Ōsumi Peninsula. The bay head area is connected with the central area only through the West-Sakurajima Passage, approximately 3 km wide and 40 meters deep.

In the northeastern part of the bay head area, there is a 200 meter deep basin which is called the Wakamiko Proto-Caldera (KUWASHIRO, 1964) and regarded as the crater that produced the Moeshima pumice deposits (ARAMAKI, 1984). In this basin, many fumaroles are sporadically distributed on the bottom and the fumarolic activities and their influence on the sea water characteristics (KAMADA *et al.*, 1977; Kagoshima Prefectural Government, 1978) and on the distribution pattern of benthonic foraminifera (ŌKI and HAYASAKA, 1978) have been studied in detail.

3. Submarine topography

The detailed features of submarine topography of Kagoshima Bay were reported by HAYASAKA *et al.* (1974, 1976a, 1976b) and by ŌKI and HAYASAKA (1983). Based on the bathymetric features, Kagoshima Bay is divided into the following three areas; the Bay Mouth, the Central and the Bay Head Areas (Fig. 3). The Bay Mouth Area represents a channel topography connecting the open sea and the Central Area of the bay. The east side of this channel is bounded by a steep slope representing the underwater extension of the sloping surface of a huge granite body on the Ōsumi Peninsula, while the west side slope of the channel goes up to the submarine terrace (0-20 meters in depth) developed along the coast of Ibusuki City in the southeastern end of the Satsuma Peninsula. The Central Area of the bay occupies the widest area among the three and represents a basin-like topography about 230 m deep. The Bay Head Area, north of Sakurajima Island, shows a semicircular outline, and both the east and the west coastlines are formed by the steep sea cliffs extending down to about 140 m in depth. In the north of the Bay Head Area, the alluvial plain and the flat-topped hilly land made of pyroclastic flow deposits are widely developed (Fig. 2). Along the northern coastline, a narrow submarine terrace about 10 m below sea level is developed followed by a rather steep slope descending to a depth of about 140 m. The western half of the Bay Head Area has a rather flat bottom topography of about 140 m in depth, while the eastern half shows rather complex features. In the northeastern part, there is a depression about 200 m deep with a submarine bank ascending to about 70 m below sea level. The boundary between the eastern and western parts of the Bay Head Area is represented by a step-like topography deepening from the west eastwards.

4. Oceanography

Oceanographic observations in Kagoshima Bay have been carried out in alternate months by the Faculty of Fisheries, Kagoshima University. The following is a summary of water temperature, salinity, DO, pH, transparency and the main current based on the unpublished data kindly offered by Prof. Koji NOZAWA of the Faculty of Fisheries, Kagoshima University and the data published by KAMADA *et al.* (1977).

(1) Water temperature

The ranges of temperature (°C) and salinity (‰) at each depth (0, 10, 25, 50, 75, 100, 150 and 200 m) throughout Kagoshima Bay are shown in Figure 4. Figure 4 shows that the water temperature decreases as depth increases and is rather stable throughout the year between 14-18 °C below 150 m. Further, the water temperature at a depth of 100 m is as stable as that at 150 m in depth showing 14-18 °C throughout the year. The water temperature at 100 m in depth in the Central and the Bay Head Areas is around 20°C in summer and autumn and it has a slight difference between winter and summer seasons. On the contrary, the temperature of water shallower than 75 m has rather large seasonal fluctuations; the results of observation carried out from 1975 through 1979 show a wide range from 14.2 to 30.2°C throughout the bay. In the Bay Mouth Area, however, the water temperature does not go below 16°C at the 25 m depth, 15°C at 10 m and 17°C at the sea surface even in winter. In February, the coldest period of the year, the water temperature in the Central and the Bay Head Areas becomes uniform from the surface to the bottom owing to a weak convection in the water mass of these areas (TAKAHASHI, 1981).

(2) Salinity

Although the salinity of water below 50 m tends to decrease from the Bay Mouth to the Bay Head Area, the differences between the three areas of the bay are very slight. Particularly, the salinity of the water below 150 m is very stable at 33.6 to 34.8‰ throughout the year (Fig. 4).

The ranges of the observed values of the salinity at the 50 m depth in each area are as follows:

Area	Salinity range (‰)
Bay Mouth	33.2 - 34.7
Central	33.1 - 34.8
Bay Head	32.9 - 34.3

The salinity of water shallower than 25 m was different from area to area and showed a wide seasonal fluctuation. The ranges of the observed values of salinity in each area in winter and summer are as follows:

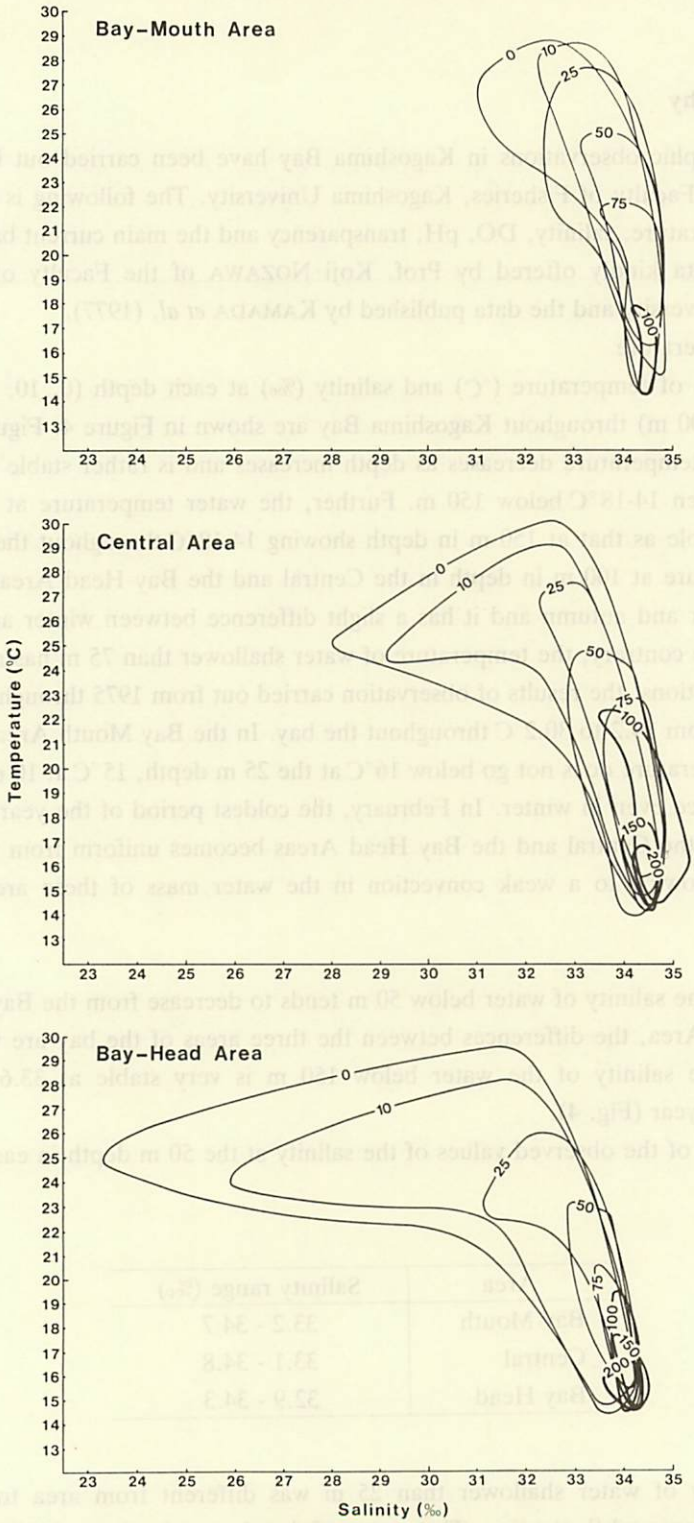

Fig. 4. Ranges of annual variation of water temperature and salinity at various depths (0, 10, 25, 50, 75, 100, 150 and 200 m)(Faculty of Fisheries, Kagoshima University, 1975-1977).

Area	Salinity range (‰)	
	Winter	Summer
Bay Mouth	34.0 - 34.9	31.2 - 34.0
Central	33.9 - 34.8	28.0 - 33.2
Bay Head	33.0 - 34.3	23.3 - 32.7

Although there is a tendency in winter for salinity to decrease toward the Bay Head Area, the values as a whole are not so different from that of open-sea water. In summer, however, the lowering of salinity toward the bay head is striking. Considering that this period of time is the rainy season or the season of heavy rain fall in this area and that the volume of water flowing into the Bay Head Area from the rivers is up to 50% of total volume of water flowing into the bay (Coastal Oceanography Research Committee, the Oceanographical Society of Japan, 1985), the lowering of salinity in the West-Sakurajima Passage and the Bay Head Area is thought to be the results of dilution of surface water by the fresh water supplied as rain and from the rivers flowing into these areas.

SAKURAI and MAEDA (1980) and NOZAWA and SAISHO (1980) studied the horizontal distribution of surface water salinity in the bay based on oceanographic observations made by the Faculty of Fisheries, Kagoshima University. According to them, the salinity of water in this bay is higher on the east side (the Ōsumi Peninsula side) than on the west side (the Satsuma Peninsula side). This tendency is particulaly remarkable in the summer when the water mass in the bay stratifies and the effect of the Kuroshio Current increases. This can be seen in the east- west profile of water salinity shown in Figure 5.

(3) Dissolved oxygen

The DO value is generally high from February through June and low from August through December. In the former period, the DO value ranges from 2.3 to 6.8 ml/l, and in the latter period, it ranges from 0.3 to 5.6 ml/l. The DO value of water shallower than 75 m in the former period, is always above 4.2 ml/l, and in the latter period, it is above 3.0 ml/l.

During the period from August through December, the mean DO values of water at every depth are as shown in Table 1.

As seen in Table 1, the DO values, as a whole, tend to decrease as the water depth increases, though a few partial inversions were observed. The lateral change in DO is not remarkable in the water shallower than 75 m. At more than 100 m however, it is rather distinct; the DO value decreases toward the bay head, and the stations where values of less than 2.5 ml/l were measured are restricted to the Bay Head Area. Especially the deep water in the 200 m deep basin in the Bay Head Area has very low DO values throughout the year except for the coldest season. Concerning this phenomena, KAMADA *et al.* (1977) mentioned that the exceptionally low DO values of water deeper than 100 m in the 200 m deep basin in the Bay Head Area may be caused by the con-

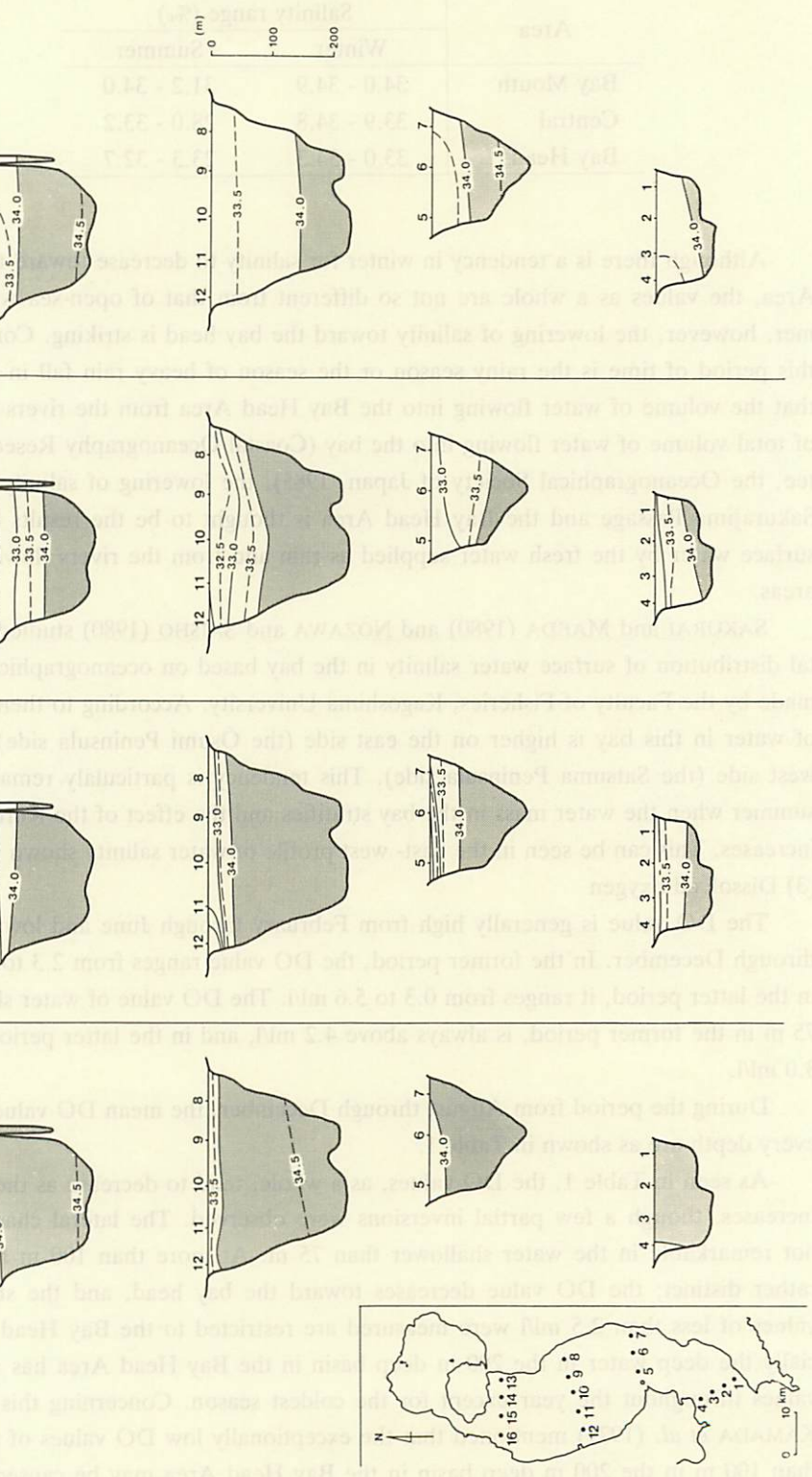

Fig. 5. Distribution of sea water salinity (‰) in the transverse profiles of Kagoshima Bay (May, July, September and November in 1975 (Faculty of Fisheries, Kagoshima University).

Table 1. Mean DO value measured at every depth of water during the period from August through December. The numerals in parenthesis are the mean values excepting the Bay Head Area. The minimum values indicate the strong influence of the extremely low DO value of the deep water in the Bay Head Area.

Depth (m)	DO value (ml/l)	
	Minimum value	Maximum value
0	3.64 (3.64)	5.58 (5.58)
10	3.63 (3.63)	5.48 (5.22)
25	2.81 (3.71)	5.40 (4.99)
50	2.80 (3.14)	5.22 (4.89)
75	1.88 (2.71)	4.34 (4.22)
100	1.96 (2.66)	5.29 (4.06)
150	0.58 (2.68)	5.09 (3.85)
200	0.28 (2.54)	3.70 (3.70)

sumption of oxygen through chemical reactions between sea water and reductive volcanic gases supplied from the fumaroles on the sea bottom of this area.

(4) pH value

The pH values measured through a year at every layer from the surface to the 200 m deep bottom in the Central Area of Kagoshima Bay ranged from 7.9 to 8.3. The pH value of the water in the Bay Head Area rapidly decreases as the depth increases from the 100 m depth layer resulting in an extraordinary low value less than 7.0 near the bottom (Fig. 6)*). This suggests the occurrence of an acidic water mass below 100 m in this area and the genesis of this acidic water mass is explained as follows.

According to the Kagoshima Prefectural Government (1978), the principal component of gases collected directly from fumaroles by submersible is carbon dioxide, which has been measured to be 75-93%. However, carbon dioxide has never been detected from gases collected from bubbles at the sea surface above the fumaroles. This may imply the perfect dissolving of carbon dioxide in the water on the way from the fumaroles at the 200 m deep bottom to the sea surface.

*) The lowest pH value (5.15) was observed near the fumaroles, and mercury, arsenic, montmorillonite, dolomite and stevensite were detected in the bottom sediment near the fumaroles (Kagoshima Prefectural Government, 1978).

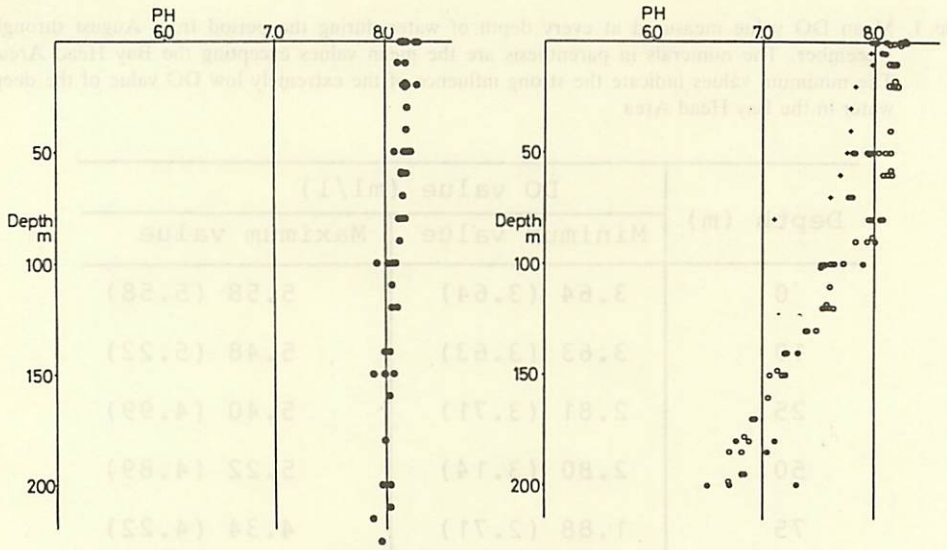

Fig. 6. Graph showing the relation between pH-value and depth of water at the Central (left) and the Bay Head (right) Areas through the period of sea-water layering from spring through autumn (after KAMADA *et al.*, 1977).

(5) Transparency

Generally speaking, the transparency of water in the Bay Head Area is lower than that in the Bay Mouth and the Central Areas. The values of transparency observed in each area is 4.0-22.0 m in the Bay Mouth Area, 2.0-18.1 m in the Central Area and 2.0-19.5 m in the Bay Head Area. In the Bay Mouth Area, transparency is rather stable and 92% of the observed values exceed 10 m. On the other hand, in the Central Area, values higher than 10 m represent only 32.3% of all the observed values. The same figures are strikingly low in the Bay Head Area showing only 12.5%. In winter the value of transparency is rather high ranging from 10.7 to 18.0 m and from spring to autumn it is rather low ranging from 2.0 to 22.0 m.

The available data along the east-west lines are restricted to those obtained in May, July, September and November, 1975, representing a period of low transparency. The mean values of the data obtained through the four times observation at each station provided the equivalent lines shown in Figure 7. In the Bay Mouth Area the values ranged from 13 to 18 m with the higher values in the eastern half (on the Ōsumi Peninsula side) than in the western half (on the Satsuma Peninsula side). In the Central Area, the 10 m equivalent line is drawn in the direction of NNE to SSW, namely, from off Tarumizu City on the Ōsumi Peninsula to off Kiiré-chō on the Satsuma Peninsula. In the vast area east of this line, values of about 12 m are known to occur, but, in the near-shore area along the coast from Kagoshima City to Kiiré-chō, west of the above-mentioned line, transparency rapidly decreases down to less than 6 m off Kagoshima City.

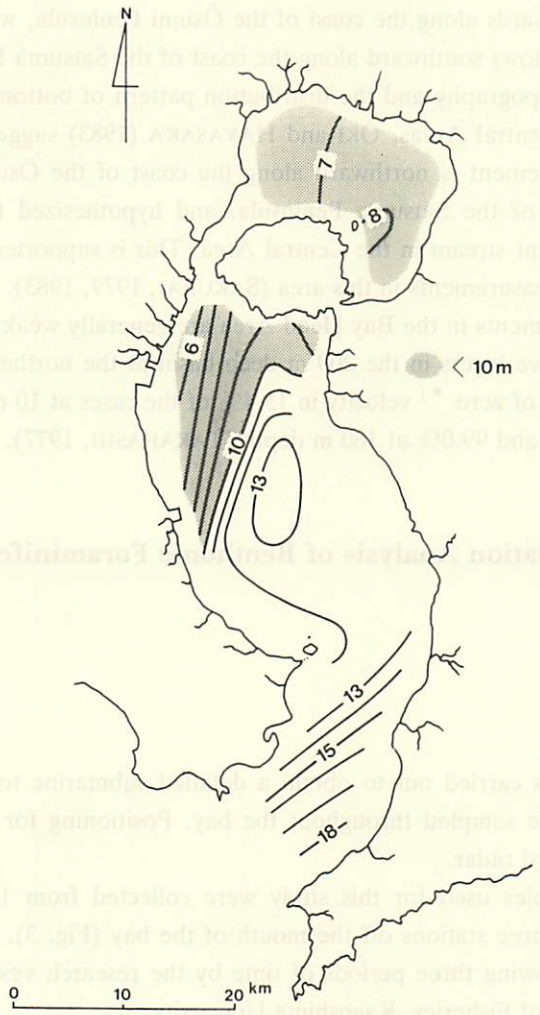

Fig. 7. Distribution of mean values (meter) of the water transparency through the period from May through November, 1975 (Faculty of Fisheries, Kagoshima University, 1975-1977).

(6) Main currents

The surface currents in the Central and the Bay Mouth Areas of Kagoshima bay were estimated based on the distribution pattern of the surface temperature, salinity and transparency obtained through the repeated observations for the past five years by the Faculty of Fisheries, Kagoshima University (SAKURAI and MAEDA, 1980). Based on the fact that the salinity of the water along the Ōsumi Peninsula is higher than that along the

Satsuma Peninsula regardless of season, SAKURAI and MAEDA (1980) concluded that the high salinity open-sea water enters into the bay along the east coast of the Bay Mouth Area and flows northwards along the coast of the Ōsumi Peninsula, while the low salinity embayment water flows southward along the coast of the Satsuma Peninsula. Judging from the submarine topography and the distribution pattern of bottom sediments in the Bay Mouth and the Central Areas, ŌKI and HAYASAKA (1983) suggested that the predominant current movement is northward along the coast of the Ōsumi Peninsula and southward along that of the Satsuma Peninsula, and hypothesized the presence of a counterclockwise current stream in the Central Area. This is supported by the results of the current velocity measurements in this area (SAKURAI, 1979, 1983).

The current movements in the Bay Head Area are generally weak. Current observations at four consecutive layers in the 200 m deep basin at the northeastern part of this area revealed currents of zero *) velocity in 15.4% of the cases at 10 m depth, 57.1% at 40 m, 38.4% at 100 m and 99.0% at 180 m depth (TAKAHASHI, 1977).

Population Analysis of Benthonic Foraminifera

1. Methods

(1) Field work

Echosounding was carried out to obtain a detailed submarine topography and the bottom sediments were sampled throughout the bay. Positioning for the sounding was determined by on-board radar.

The bottom samples used for this study were collected from 143 stations within Kagoshima Bay and three stations off the mouth of the bay (Fig. 3). The sampling was performed in the following three periods of time by the research vessel "Keiten-maru" owned by the Faculty of Fisheries, Kagoshima University.

20th-26th January, 1972	Bay Head Area (Stn. 1-65) and Bay Mouth Area (Stn. 106-142)
20th-22nd February, 1979	Central Area (Stn. 66-105)
4th August, 1978	Outside the bay (Stn. 143-146)

All samples were taken using PHLEGER's gravity corer. The top one centimeter of sediment core, approximately 10 cc of wet sediment, was cut off from each core and preserved in buffered formalin and Rose Bengal, a protein-specific dye for foraminiferal study. The main body of the core sample was wrapped in plastic to keep it from drying.

*) The current meter used here is designed so as to indicate zero value when the velocity is less than 1.2 cm/s.

(2) Laboratory work

A. Bottom sediments

Among 146 samples of bottom sediments collected by the gravity corer from the Kagoshima Bay area, all but ten were sufficient for mechanical analysis. Their upper three centimeters were divided lengthwise and halves were used for mechanical analysis (1 to 4 cm in depth from the surface; a volume of about 15 cc).

Gravels were collected by sieving and weighed in dry condition. The EMERY settling-tube method and pipette technique (KRUMBEIN and PETTIJONE, 1938) were utilized in determining the relative proportions of sand, silt and clay (Table 2); and the textural relations among sediments were plotted on SHEPARD's triangle. Median diameter (Md, Mdϕ), mud content (%), sorting coefficient (So, $\sigma\phi$), and skewness (Sk, $\alpha\phi$) were obtained graphically from the cumulative curve (TRASK, 1932; INMAN, 1952).

Further, based on the grain size composition (ϕ scale), a dendrogram was obtained through cluster analysis after DAVIS (1973), and the samples were grouped according to similarity indicated by the distance coefficient.

B. Foraminifera

The top one centimeter, which was cut off from the top of core sample and preserved in buffered formalin and Rose Bengal, was washed through a 200-mesh (0.074 mm openings) sieve, and ovendried after removal of dye stuff (Rose Bengal). Dry samples were split with a microsplitter to yield an aliquot containing more than 200 specimens. All specimens were then picked from the aliquot. Aliquots containing less than 200 individuals of benthonic foraminifera were supplemented by additional splits. Specimens were spread on a tray, and all specimens of benthonic species were identified and counted. Specimens of planktonic foraminifera and radiolaria within each aliquot were counted without specific identification. SEM micrographs were made of selected benthonic species using a JSM-25S11 (Nihon Denshi Co. Ltd.) at the Institute of Earth Sciences, Faculty of Science, Kagoshima University.

2. Bottom sediments analyses

The results of mechanical analysis of the 136 samples from Kagoshima Bay (Table 2) were already reported by ŌKI and HAYASAKA (1983) and its outline, including additional data, will be presented here along, with the results of a cluster analysis on them.

(1) Results of mechanical analysis

The median diameter (Mdϕ)(Fig. 8), mud content (%)(Fig. 9), sorting coefficient (So)(Fig. 10) and skewness ($\alpha\phi$)(Fig. 11) were determined and used to clarify the following:

a) General features of the bottom sediments in Kagoshima Bay are characterized in the Bay Mouth Area as being predominantly sand and gravel (Mdϕ : -2 ~ 4 ϕ) and in the Bay Head Area occupied by rather stagnant water as sandy or clayey silt. Therefore the bottom sediment character of each area is harmonized quite well with the mean

Table 2. Results of mechanical analysis of the bottom sediments.

Station	Latitude	Longitude	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Mdø	Md	Trask(1932) So	Trask(1932) Sk	Inman(1952) ø	Inman(1952) ø	Bottom Character
1	31°-42'5N	130°-39'2E	102	0.69	35.97	51.22	12.12	5.095	0.029	2.790	1.815	2.180	-0.125	Sandy Silt
2	31°-42'4N	130°-40'4E	135	0.27	47.75	38.51	13.47	4.147	0.056	3.926	0.708	2.761	0.195	Silty Sand
3	31°-42'7N	130°-41'9E	130	0.16	29.98	50.54	19.31	5.268	0.026	3.288	1.040	2.966	0.134	Sandy Silt
4	31°-42'6N	130°-42'9E	116	4.07	43.99	39.91	12.03	4.105	0.058	4.509	1.360	2.953	-0.046	Silty Sand
5	31°-41'6N	130°-37'9E	128	0	20.05	56.51	23.44	5.526	0.022	3.426	0.523	(2.619)	(0.307)	Sand-Silt-Clay
6	31°-41'9N	130°-38'7E	138	1.72	47.21	27.54	23.53	4.079	0.059	6.293	0.284	(3.605)	(0.365)	Sand-Silt-Clay
7	31°-42'0N	130°-40'0E	144	5.05	76.91	11.63	6.42	2.158	0.223	2.040	0.804	1.695	0.267	Sand
8	31°-41'9N	130°-41'3E	146	0.28	18.96	58.75	22.01	6.047	0.015	2.974	1.063	2.684	0.100	Clayey Silt
9	31°-41'9N	130°-42'3E	136	0.05	19.70	54.82	25.43	6.026	0.015	3.448	0.695	(2.708)	(0.110)	Clayey Silt
10	31°-41'7N	130°-43'5E	120	0	25.70	59.17	15.13	4.911	0.033	2.143	0.812	1.711	0.068	Sandy Silt
11	31°-41'6N	130°-44'6E	117	0.36	16.79	75.12	7.74	4.579	0.042	1.414	0.889	0.798	0.221	Silt
12	31°-41'5N	130°-45'7E	122	0.90	25.01	57.93	16.16	4.984	0.032	2.968	0.483	2.442	0.242	Sandy Silt
13	31°-41'5N	130°-46'7E	124	0	28.93	59.81	11.26	4.784	0.037	1.892	0.970	1.263	0.088	Sandy Silt
14	31°-41'2N	130°-38'9E	148	0	29.05	51.68	19.27	5.521	0.022	3.818	1.068	2.890	-0.027	Sandy Silt
15	31°-40'8N	130°-40'1E	152	0.38	26.51	54.14	18.97	5.832	0.017	3.399	1.490	2.703	-0.071	Sandy Silt
16	31°-40'8N	130°-41'1E	150	0.15	17.31	59.06	23.49	6.395	0.012	3.080	1.036	(2.513)	(-0.041)	Clayey Silt
17	31°-40'9N	130°-42'3E	146	0.44	25.28	54.82	19.46	5.753	0.018	3.266	1.134	2.748	-0.044	Sandy Silt
18	31°-41'1N	130°-43'5E	136	0	18.51	65.62	15.88	5.579	0.021	2.321	0.852	2.087	0.142	Sandy Silt
19	31°-41'0N	130°-44'6E	154	0	34.11	56.05	9.85	4.484	0.044	1.852	1.420	1.447	-0.225	Sandy Silt
20	31°-40'9N	130°-45'8E	176	7.78	23.89	56.34	11.99	4.553	0.04	1.902	1.248	1.729	0.035	Sandy Silt
21	31°-40'9N	130°-46'9E	185	0	9.43	79.80	10.77	4.647	0.04	1.178	0.974	0.561	0.427	Silt
22	31°-40'3N	130°-37'3E	144	0	14.97	49.10	35.94	6.658	0.010	(4.0	) (0.367)	(2.566)	(0.077)	Clayey Silt
23	31°-39'9N	130°-37'7E	148	0.36	14.56	63.92	21.17	6.484	0.011	2.561	1.131	2.129	-0.102	Clayey Silt
24	31°-39'8N	130°-39'0E	156	0.26	31.02	44.33	24.39	5.895	0.017	4.880	1.543	(3.15	) (-0.053)	Sand-Silt-Clay
25	31°-39'9N	130°-40'3E	152	0.41	35.18	33.36	31.05	5.947	0.016	(8.660)	(1.035)	(3.611)	(-0.063)	Sand-Silt-Clay
26	31°-39'9N	130°-41'1E	150	0	25.26	44.07	30.69	6.395	0.012	(4.743)	(1.267)	(3.053)	(-0.112)	Sand-Silt-Clay
27	31°-40'0N	130°-43'4E	140	1.02	21.53	42.00	35.45	7.184	0.007	(2.822)	(1.255)	(2.919)	(-0.372)	Sand-Silt-Clay
28	31°-40'1N	130°-44'4E	143	9.03	53.45	31.32	6.20	2.326	0.199	5.809	0.550	3.079	0.113	Silty Sand
29	31°-40'0N	130°-45'6E	230	0	12.18	46.56	41.26	6.579	0.011	(3.525)	(0.337)	(2.500)	(0.162)	Clayey Silt
30	31°-40'1N	130°-47'1E	225	0	5.68	91.26	3.06	5.795	0.018	2.152	0.661	1.442	0.230	Silt
31	31°-38'6N	130°-37'0E	140	0	22.33	32.85	44.81	7.484	0.006	(5.283)	(2.729)	(3.053)	(-0.341)	Sand-Silt-Clay
32	31°-38'9N	130°-37'8E	156											
33	31°-38'9N	130°-39'0E	152	0.18	54.17	26.39	19.34	3.584	0.086	4.697	0.138	3.003	0.599	Silty Sand
34	31°-38'8N	130°-40'1E	149											
35	31°-38'9N	130°-42'4E	140	0.32	19.28	24.78	55.63	8.789	0.002	(5.41	) (8.98	) (3.140)	(-0.691)	Silty Clay
36	31°-38'9N	130°-43'8E	152	15.32	20.78	39.32	24.58	5.5	0.022	7.246	1.736	(4.85	) (-0.295)	Sand-Silt-Clay
37	31°-38'8N	130°-45'1E	124	4.66	37.67	39.00	18.67	4.816	0.034	5.536	1.019	3.334	0.037	Sandy Silt
38	31°-39'2N	130°-45'8E	225	0.02	23.09	66.88	10.02	4.632	0.041	1.428	1.084	0.979	0.043	Sandy Silt
39	31°-39'3N	130°-46'1E	225	0.17	27.04	59.57	13.22	4.474	0.045	1.445	1.192	1.829	0.137	Sandy Silt
40	31°-39'2N	130°-47'0E	228	0.05	18.23	61.37	20.36	4.947	0.032	1.706	0.822	(2.519)	(0.498)	Clayey Silt
41	31°-38'9N	130°-48'0E	182	0	11.13	59.55	29.32	6.684	0.010	3.684	1.131	(2.376)	(0.030)	Clayey Silt
42	31°-39'2N	130°-48'9E	170	0	19.54	61.54	18.92	5.5	0.022	2.455	0.576	(2.677)	(0.036)	Sandy Silt
43	31°-38'1N	130°-36'7E	140	0.30	32.31	37.51	29.88	5.632	0.02	7.86	1.89			Sand-Silt-Clay
44	31°-38'1N	130°-37'5E	144	0.06	36.58	48.78	14.58	5.237	0.027	3.00	1.567	2.432	0.054	Sandy Silt
45	31°-37'9N	130°-38'9E	134	0.42	31.73	45.06	22.78	5.074	0.029	3.271	0.941	3.187	0.196	Sand-Silt-Clay
46	31°-37'9N	130°-40'2E	128	0	34.05	50.21	15.74	5.053	0.03	3.69	1.32			Sandy Silt
47	31°-37'9N	130°-42'4E	108	0.09	28.50	48.42	22.98	5.474	0.02	4.08	0.76			Sand-Silt-Clay
48	31°-37'9N	130°-44'8E	154	1.33	40.09	29.02	29.57	5.358	0.024	(7.268)	(0.633)	(3.582)	(0.090)	Sand-Silt-Clay
49	31°-37'9N	130°-45'8E	112	21.35	50.63	16.32	11.70	1.984	0.52	7.616	0.193	3.974	0.857	Silty Sand
50	31°-38'1N	130°-48'0E	154	0.43	23.78	50.71	25.08	6.263	0.013	3.731	1.286	(3.111)	(-0.030)	Sand-Silt-Clay
51	31°-37'0N	130°-44'8E	134	9.39	48.79	20.30	21.52	3.158	0.113	7.625	0.337	(4.532)	(0.273)	Sand-Silt-Clay
52	31°-37'0N	130°-45'9E	144	0.80	60.18	26.82	12.20	3.179	0.11	4.058	0.393	2.913	0.36	Silty Sand
53	31°-36'9N	130°-47'2E	94	34.05	46.82	5.42	13.71	0.158	0.890	4.551	0.422	3.219	0.436	Clayey Sand
54	31°-36'2N	130°-43'6E	125	2.13	42.47	35.78	19.61	5.105	0.029	5.751	1.662	3.613	-0.024	Sand-Silt-Clay
55	31°-35'8N	130°-44'9E	144	1.60	22.00	56.90	19.50	5.874	0.017	3.470	0.971			Sandy Silt
56	31°-36'4N	130°-46'0E	144	0	17.39	31.31	51.30	8.505	0.003	(3.717	(13.329)	(2.945)	(-0.593)	Silty Clay
57	31°-34'9N	130°-45'0E	144	0	37.8	38.3	23.9	5.621	0.020	5.538	1.469			Sand-Silt-Clay
58	31°-35'1N	130°-46'0E	142	0.14	26.93	58.63	14.30	5.211	0.027	2.058	1.679	2.358	0.045	Sandy Silt
59	31°-35'1N	130°-47'0E	116	1.89	43.53	36.36	18.22	4.658	0.039	5.000	0.852	3.292	0.100	Silty Sand
60	31°-34'4N	130°-43'7E	132	1.71	45.16	35.81	17.32	4.068	0.059	4.134	0.672	2.977	0.211	Silty Sand
61	31°-34'0N	130°-44'4E	138	1.23	36.37	52.76	9.64	5.437	0.023	3.524	2.119	2.329	-0.227	Sandy Silt
62	31°-34'0N	130°-45'7E	138	0.29	63.73	24.06	11.92	3.105	0.116	3.416	0.281	2.903	0.51	Silty Sand
63	31°-36'9N	130°-36'4E	138	6.14	93.04	(0.82)		1.983	0.253	1.685	1.267	1.192	-0.310	Sand
64	31°-36'1N	130°-35'6E	66	26.65	73.36	0	0	-0.121	1.08	1.238	0.889	1.882	0.063	Sand
65	31°-35'1N	130°-34'8E	39	10.22	86.80	2.98	0	1.884	0.266	1.795	1.475	1.474	-0.421	Sand
66	31°-32'0N	130°-35'4E	130	0	32.15	47.09	20.75	5.274	0.026	3.821	0.857	(3.434)	(0.001)	Sand-Silt-Clay
67	31°-31'9N	130°-37'6E	165	0	39.25	46.44	14.31	4.632	0.040	3.561	0.750	2.808	0.084	Sandy Silt
68	31°-32'0N	130°-40'0E	162	0	50.18	43.14	6.67	3.974	0.063	2.693	1.046	2.132	0.124	Silty Sand
69	31°-31'8N	130°-41'0E	150	3.93	70.89	19.52	5.66	2.579	0.169	2.412	0.722	2.132	0.407	Silty Sand
70	31°-30'0N	130°-33'2E	23	20.12	60.78	15.37	3.73	2.105	0.231	2.834	1.260	2.426	-0.148	Sand
71	31°-29'9N	130°-35'4E	88	21.07	47.05	25.17	6.70	2.947	0.130	7.533	0.673	3.211	-0.492	Silty Sand
72	31°-29'8N	130°-37'8E	216	0.32	54.82	26.77	18.09	3.553	0.085	3.606	0.264	(3.095)	(2.211)	Silty Sand
73	31°-30'2N	130°-40'0E	80	6.86	63.05	25.41	4.67	2.895	0.137	2.401	0.656	1.971	0.295	Silty Sand
74	31°-27'9N	130°-32'2E	28	0.60	71.71	22.57	5.11	2.868	0.137	2.047	0.624	1.658	0.413	Silty Sand
75	31°-27'7N	130°-35'4E	93	5.89	49.18	34.98	9.94	3.658	0.079	2.968	0.726	2.374	0.253	Silty Sand
76	31°-27'8N	130°-37'8E	220	0	35.36	41.6	23.04	5.184	0.028	4.366	0.571	(3.021)	(0.272)	Sand-Silt-Clay
77	31°-27'8N	130°-39'9E	196	0	46.61	28.46	24.93	4.716	0.038	6.418	0.410	(3.432)	(0.293)	Sand-Silt-Clay
78	31°-26'1N	130°-33'0E	40	3.19	64.40	22.44	9.97	3.368	0.096	2.113	0.774	2.087	0.412	Silty Sand
79	31°-25'8N	130°-35'4E	100	4.24	54.36	30.86	10.54	3.474	0.09	2.992	0.728	2.408	0.187	Silty Sand
80	31°-25'5N	130°-37'8E	225	1.01	49.87	31.55	17.57	3.947	0.065	4.637	0.326	3.053	0.405	Silty Sand
81	31°-25'9N	130°-39'9E	220	0	44.68	35.8	19.52	4.579	0.042	4.251	0.710	(3.211)	(0.312)	Silty Sand
82	31°-25'8N	130°-42'4E	150	0	38.86	39.45	21.69	4.816	0.035	4.012	0.878	(3.276)	(0.293)	Sand-Silt-Clay
83	31°-24'0N	130°-33'3E	36	0.35	72.46	22.54	4.65	3.526	0.087	1.524	0.962	1.171	0.214	Silty Sand
84	31°-24'1N	130°-35'3E	88	9.66	67.73	17.61	5.00	2.658	0.158	2.115	0.928	1.790	0.147	Silty Sand
85	31°-23'9N	130°-37'6E	220	0.20	41.23	30.86	20.73	4.868	0.035	4.782	0.715	(3.224)	(0.225)	Sand-Silt-Clay
86	31°-24'1N	130°-40'2E	165	5.86	54.60	29.46	10.09	3.358	0.098	2.993	0.542	2.461	0.331	Silty Sand
87	31°-24'1N	130°-42'4E	182	1.32	36.06	37.64	24.98	4.842	0.035	5.401	0.563	(3.395)	(0.264)	Sand-Silt-Clay
88	31°-23'9N	130°-44'4E	78	2.67	76.96	15.46	4.92	2.790	0.143	1.826	0.919	1.487	0.150	Sand
89	31°-22'0N	130°-35'2E	95	0.05	42.47	40.13	17.34	4.526	0.043	4.061	0.838	(3.145)	(0.223)	Silty Sand

90	31°-21'9N	130°-37'8E	215	0.14	45.28	31.65	22.93	4.463	0.045	6.036	0.429	(3.421)(| 0.295)	Sand-Silt-Clay
91	31°-21'7N	130°-40'0E	207	0.15	43.98	35.90	19.98	4.474	0.045	4.457	0.552	3.179	0.305	Sand-Silt-Clay
92	31°-21'9N	130°-42'6E	185	0	43.93	34.52	21.55	4.505	0.044	5.044	0.437	(3.132)(| 0.343)	Sand-Silt-Clay
93	31°-21'8N	130°-44'5E	142	0	5.14	63.45	31.42	6.084	0.015	(3.500)	(0.361)	(2.253)(| 0.379)	Clayey Silt
94	31°-20'0N	130°-35'5E	105	0.10	50.63	33.52	15.74	3.911	0.066	3.660	0.539	2.782	0.338	Silty Sand
95	31°-20'0N	130°-37'6E	170	0.66	40.76	35.93	22.55	4.921	0.033	5.222	1.092	(3.408)(| 0.127)	Sand-Silt-Clay
96	31°-20'1N	130°-39'7E	188	0.71	36.37	40.37	22.55	5	0.034	5	0.581	(3.237)(| 0.195)	Sand-Silt-Clay
97	31°-19'9N	130°-42'0E	170	1.34	51.09	31.66	15.92	3.737	0.075	4.532	0.526	3.142	0.355	Silty Sand
98	31°-19'7N	130°-44'3E	145	0.27	50.62	37.42	11.69	3.916	0.066	3.292	1.025	2.595	0.172	Silty Sand
99	31°-19'9N	130°-46'2E	42	2.37	87.76	6.48	3.39	1.511	0.35	1.738	0.933	1.308	0.163	Sand
100	31°-18'1N	130°-37'5E	75	0.08	82.04	13.25	4.64	2.726	0.152	1.905	0.968	1.356	0.037	Sand
101	31°-18'1N	130°-40'0E	119	1.26	56.17	24.38	18.20	3.063	0.12	4.022	0.325	(3.461)(| 0.564)	Silty Sand
102	31°-18'6N	130°-42'3E	162	0	38.64	43.29	18.07	4.790	0.036	3.881	0.839	(2.921)(| 0.234)	Sandy Silt
103	31°-17'9N	130°-44'6E	175	0.61	58.29	27.82	13.28	3.395	0.095	3.299	0.449	2.942	0.460	Silty Sand
104	31°-18'0N	130°-46'9E	38	0.39	64.63	28.64	6.35	3.684	0.078	1.531	0.834	0.982	0.303	Silty Sand
105	31°-17'0N	130°-45'7E	97	0.13	39.40	48.06	12.41	4.474	0.045	3.112	1.200	2.5	0.099	Sandy Silt
106	31°-15'8N	130°-41'3E	40											
107	31°-15'9N	130°-42'4E	96											
108	31°-15'9N	130°-43'4E	120	17.00	51.18	9.24	22.58	1.674	0.305	10.868	0.171	(5.037)(| 0.457)	Clayey Sand
109	31°-16'1N	130°-44'5E	124	9.73	69.21	15.14	5.92	2.211	0.215	2.887	1.462			Sand
110	31°-16'3N	130°-45'4E	110											
111	31°-14'9N	130°-42'4E	90	12.81	68.44	12.50	6.25	1.784	0.290	3.410	0.81			Sand
112	31°-15'1N	130°-43'4E	102	6.55	45.00	3.96	44.49	3.484	0.09	(19.664)	(0.107)	(4.855)(| 0.269)	Clayey Sand
113	31°-15'0N	130°-44'5E	100											
114	31°-15'3N	130°-46'0E	70	6.80	65.96	19.27	7.98	2.64	0.16	3.368	1.198	2.56	-0.031	Clayey Sand
115	31°-15'2N	130°-46'7E	44	11.11	72.55	11.19	5.15	2.274	0.206	3.162	2.039			Sand
116	31°-14'1N	130°-41'4E	61	14.4	76.9	3.3	5.2	-0.368	1.29	7.497	0.127			Sand
117	31°-14'0N	130°-42'2E	95	11.40	78.80	4.10	5.70	1.6	0.33	2.982	1.119			Sand
118	31°-14'0N	130°-43'4E	101	10.34	59.37	12.68	17.61	1.384	0.38	8.424	0.118	4.447	1.398	Clayey Sand
119	31°-14'0N	130°-44'7E	86	24.21	62.60	9.59	3.60	0.579	0.677	2.454	0.43	2.671	0.123	Sand
120	31°-14'3N	130°-45'7E	60	0	67.17	22.20	10.64	3.305	0.101	2.080	0.470	1.932	0.602	Silty Sand
121	31°-12'9N	130°-42'3E	111	20.76	40.31	9.84	29.08	2.326	0.2	(25.140)	(0.099)	(5.645)(| 1.131)	Clayey Sand
122	31°-12'9N	130°-43'3E	100	22.7	66.00	6.00	5.30	-0.042	1.03	2.126	0.753			Sand
123	31°-13'2N	130°-44'8E	70	21.86	71.20	5.12	1.82	0.379	0.77	2.51	0.834	2.108	0.517	Sand
124	31°-11'9N	130°-40'3E	20											
125	31°-11'9N	130°-42'6E	140	26.65	27.13	13.51	32.70	1.474	0.36	28.756	0.043	(5.376)(| 0.429)	Sandy Clay
126	31°-11'9N	130°-43'2E	112	14.32	20.00	63.73	1.95	4.5	0.044	4.294	14.460			Sandy Silt
127	31°-12'0N	130°-44'4E	74	18.21	67.24	8.56	5.99	0.884	0.54	3.541	0.469			Sand
128	31°-11'1N	130°-42'5E	112	21.75	68.51	(9.74)		0.51	0.7	3.29	0.59	2.39	0.24	Sand
129	31°-11'0N	130°-43'3E	102	46.03	40.70	13.09	0.18	-0.516	1.43	9.713	46.13			Sand
130	31°-10'7N	130°-45'1E	52	46.96	29.02	11.62	12.40	-0.78	1.7	8.19	0.11	4.37	0.60	Sand-Silt-Clay
131	31°-09'8N	130°-38'9E	90	24.25	44.56	30.18	1.01	3.053	0.12	6.95	5.36	4.505	0.680	Silty Sand
132	31°-10'0N	130°-40'5E	100	4.09	67.98	18.76	9.18	3.53	0.087	1.612	0.859	1.983	0.228	Silty Sand
133	31°-10'0N	130°-41'3E	108	24.24	61.82	8.68	5.26	0.184	0.89	3.055	0.520	2.637	0.331	Sand
134	31°-10'0N	130°-42'2E	112											
135	31°-10'0N	130°-43'2E	84	52.05	44.32	2.19	1.43	-1.068	2.10	1.925	0.874			Sand
136	31°-10'1N	130°-44'4E	60	27.30	71.82	(0.88)		-0.12	1.08	2.10	0.87	1.625	0.182	Sand
137	31°-08'8N	130°-37'6E	106											
138	31°-09'0N	130°-38'9E	100	16.84	50.99	16.99	15.19	1.395	0.38	5.92	0.39	4.358	0.436	Silty Sand
139	31°-09'0N	130°-40'5E	105											
140	31°-08'9N	130°-42'2E	95	0.06	59.19	27.49	13.26	3.505	0.09	3.742	0.209	2.640	0.564	Silty Sand
141	31°-08'8N	130°-43'4E	60	33.02	66.98	0	0	-0.342	1.25	2.070	0.971	1.506	0.073	Sand
142	31°-09'1N	130°-44'4E	55	10.78	87.67	(1.55)		1.921	0.26	0.830	1.75	1.929	0.377	Sand
143	31°-08'5N	130°-41'0E	96	19.00	68.59	9.39	3.02	0.405	0.760	2.112	1.057	1.919	0.163	Sand
144	31°-05'9N	130°-36'1E	105	15.22	79.29	2.97	2.52	0.353	0.783	1.830	0.914	1.24	-0.041	Sand
145	31°-05'3N	130°-34'2E	155	1.64	86.43	7.81	4.12	2.689	0.155	1.630	1.019	1.084	-0.063	Sand
146	31°-03'8N	130°-32'5E	213	1.64	80.75	11.67	5.94	3.305	0.102	1.437	1.147	0.921	-0.074	Sand

strength of current. The mean value of median diameter (Mdϕ) in each area is as follows; Bay Mouth Area: 0.70 ϕ; Central Area: 3.89 ϕ; Bay Head Area: 5.14 ϕ and West-Sakurajima Passage (Stn. 63 - 65): 1.25 ϕ. At the three open sea stations (Stn. 144 - 146), median diameters change from fine to coarse as the depth decreases (Mdϕ: 3.3 to 0.4 ϕ).

b) Judging from the submarine topography and sediment distribution in the Bay Mouth Area, it is reasonable to say that the predominant surface current flows northward along the Ōsumi Peninsula, while it flows southward along the Satsuma Peninsula.

c) Similar current directions are suggested to occur in the Central Area of the bay and also a counterclockwise current stream is assumed to occur at the northern margin of this area.

d) The longshore current flowing southward along the Satsuma Peninsula is forced to change its direction by the existence of a vast area of reclaimed land off the coast of Kiiré-chō influencing the sediment distribution in that area (Figs. 8, 9 and 13).

e) Correlation between the grain-size composition of sediments and the water depth was scarcely recognized in the Bay Head Area. This suggests that the sediment distribu-

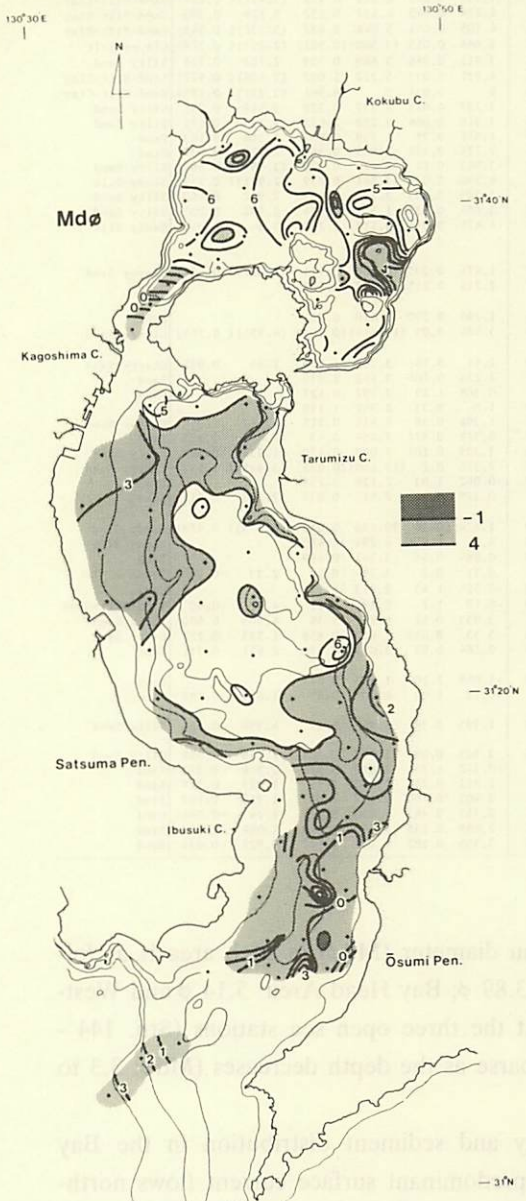

Fig. 8. Distribution of the median diameter (Md ϕ) of bottom surface sediments.

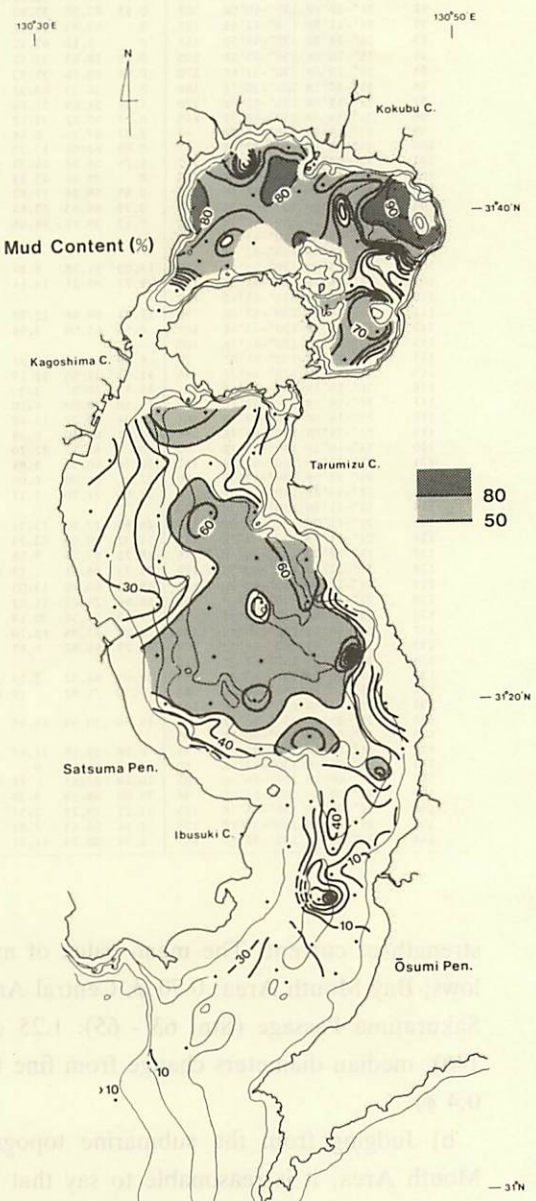

Fig. 9. Distribution of the mud content (%) of bottom surface sediments.

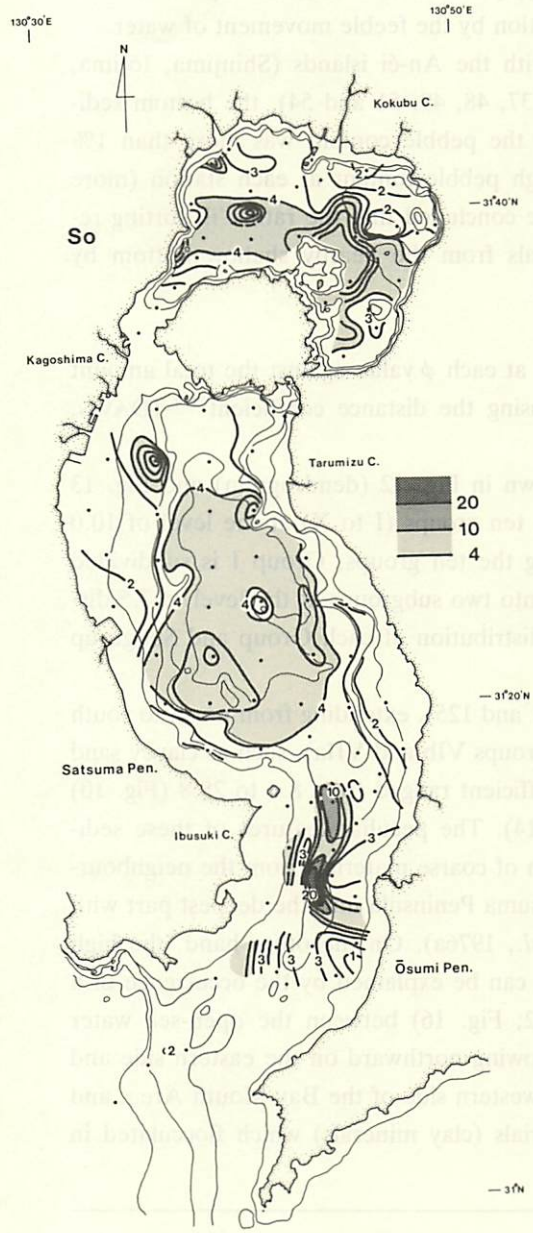

Fig. 10. Distribution of the sorting coefficient (So) of bottom surface sediments.

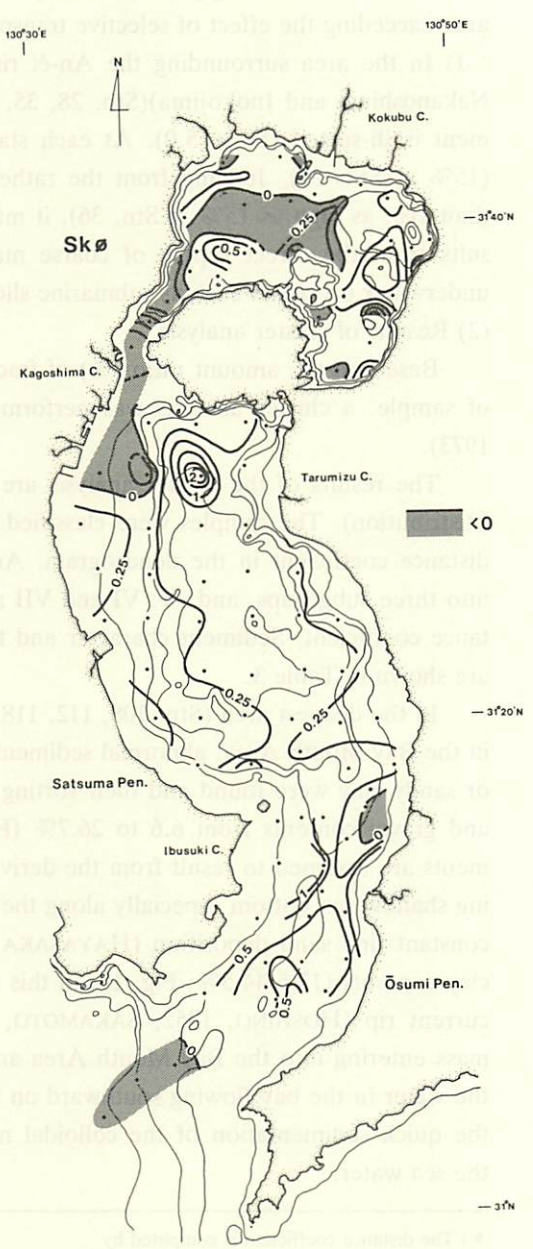

Fig. 11. Distribution of the skewness ($\alpha\phi$) of bottom surface sediments.

tion in this area is strongly influenced by the supply of materials from nearby shallow sea area exceeding the effect of selective transportation by the feeble movement of water.

f) In the area surrounding the An-éi rise with the An-éi islands (Shinjima, Iōjima, Nakanoshima and Inokojima)(Stn. 28, 35, 36, 37, 48, 49, 51 and 54), the bottom sediment is ill-sorted ($So > 5.0$). At each station the pebble content was more than 1% (15% at Stn. 36). Judging from the rather high pebble-content at each station (more than 1%; as high as 15% at Stn. 36), it may be concluded that the rather ill sorting results from the direct supply of coarse materials from the nearby shallow bottom by underwater processes such as submarine sliding.

(2) Results of cluster analysis

Based on the amount ratio (%) of fraction at each ϕ value against the total amount of sample, a cluster analysis was performed using the distance coefficient *) (DAVIS, 1973).

The results of the cluster analysis are shown in Fig. 12 (dendrogram) and Fig. 13 (distribution). The samples were classified into ten groups (I to X) at the level of 10.0 distance coefficient in the dendrogram. Among the ten groups, Group I is subdivided into three subgroups, and IV, VI and VII are into two subgroups at the level of 7.5 distance coefficient. Sediment character and the distribution of each Group and Subgroup are shown in Table 3.

In the deepest area (Stn. 108, 112, 118, 121 and 125), extending from north to south in the Bay Mouth Area, abnormal sediments (groups VIb and VIIa), such as clayey sand or sandy clay were found and their sorting coefficient ranged from 8.4 to 28.8 (Fig. 10) and gravel contents from 6.6 to 26.7% (Fig. 14). The peculiar features of these sediments are assumed to result from the derivation of coarse materials from the neighbouring shallow sea bottom especially along the Satsuma Peninsula into the deepest part with constant fine sand deposition (HAYASAKA *et al.*, 1976a). On the other hand, the high clay contents (17.6-44.5%; Fig. 15) in this area can be explained by the occurrence of a current rip (HOSHINO, 1952; SAKAMOTO, 1982; Fig. 16) between the open-sea water mass entering into the Bay Mouth Area and flowing northward on the eastern side and the water in the bay flowing southward on the western side of the Bay Mouth Area, and the quick sedimentation of the colloidal materials (clay minerals) which flocculated in the sea water.

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*) The distance coefficient is computed by

$$d_{ij} = \sqrt{\frac{\sum_{k=1}^{m}(X_{ik}-X_{jk})^2}{m}}$$

where X_{ik} denotes the kth variable measured on object i and and X_{ik} is the kth variable measured on object j. In all, m variables are measured on each object, and d_{ij} is the distance between object i and object j (DAVIS, 1973).

Table 3. Results of cluster analysis of the grain-size composition of sediment samples.

Group	Characteristics of sediment	Distribution
I	Ill-sorted sediments composed of medium sand to clay.	
	Ia: Having a little higher (10-31%) clay contents without remarkable peak.	Most parts of deep basin bottom in the Bay Head and the Central Areas.
	Ib: Coarse silt, fine and clay fractions show peaks of about 20%.	Basin bottom in the northeastern part of the Bay Head Area (Stn. 12, 41).
	Ic: Very fine sand to medium silt occupy 62-80% of the total weight, and clay contents are 10-15%.	Basin bottom in the northern part of the Bay Head Area (Stn. 10, 13, 19, 20).
II	The sediments with 91% silt contents.	Deep basin bottom in the northeastern part of the Bay Head Area (Stn. 30).
III	The sediments with coarse and medium silt up to 55-77%.	Basin bottom in the northeastern part of the Bay Head Area (Stn. 11, 21, 39).
IV	Sand-dominate sediments.	
	IVa: Sand contents 77-94%, well-sorted.	The area with rather high velocity of longshore current along the Ōsumi Peninsula and West-Sakurajima Passage with rather strong tidal currents. Besides, an exceptional occurrence was found at Station 7 inharmoniously surrounded by the Group Ia sediments*).
	IVb: Medium to very fine sand contents up to 40-80%. Containing small amount of gravel, silt and clay, and rather ill-sorted.	Mainly on the slopes descending to the deepest part in the Central and the Bay Mouth Areas. At the northern part of the Central Area, IVb is distributed from off Kagoshima City to off the coast of Kiiré-chō across the basin bottom covered with fine-grained sediments of the Group I.
V	Very fine sand contents up to 46%, well sorted.	Nearshore areas in the Central and Bay Mouth Areas (Stn. 83, 104, 132) and open sea area (Stn. 146).
VI	Characterized by clay contents of more than 29%.	
	VIa: Mainly composed of silt and clay. Clay contents up to 35-46%.	Basin bottom in the Bay Head Area.
	VIb: Showing bimodal distribution; gravel to coarse sand: 28-48%; clay: 18-44%.	Deepest bottom of channel topography in the Bay Mouth Area.
VII	Sediments characterized by gravels and sands.	
	VIIa: Gravel to coarse sand contents up to 43-79%.	A bank in the Bay Head Area (Stn. 49), shallow bottom in West-Sakurajima Passage (Stn. 64) and the deep bottom of channel topography in the Bay Mouth Area.
	VIIb: Coarse to medium sand contents up to 77% and gravel contents to 15%.	Open sea area (Stn. 144).
VIII	Showing bimodal distribution; gravel and very coarse sand: 59%; clay: 12%.	Shallow bottom in the eastern part of the Bay Mouth Area (Stn. 130).
IX	Showing trimodal distribution; granule and very coarse to coarse sand: 61%; coarse silt: 30%; clay: 14%.	Nearshore area in the eastern part of the Bay Head Area (Stn. 53).
X	Showing trimodal distribution; granule: 21%; very fine sand: 19%; very fine silt: 21%.	Nearshore area in the western part of the Bay Mouth Area (Stn. 131).

*) The sediments at Station 7 consist mostly of pumices and volcanic glasses and comprise far fewer benthonic foraminifera than those at the neighbouring stations and a few shallow water benthonic foraminifera. These features suggest that the sediments at Station 7 were derived directly from shallow water bottoms with rather rapid rate of sedimentation by some underwater processes, such as, submarine sliding.

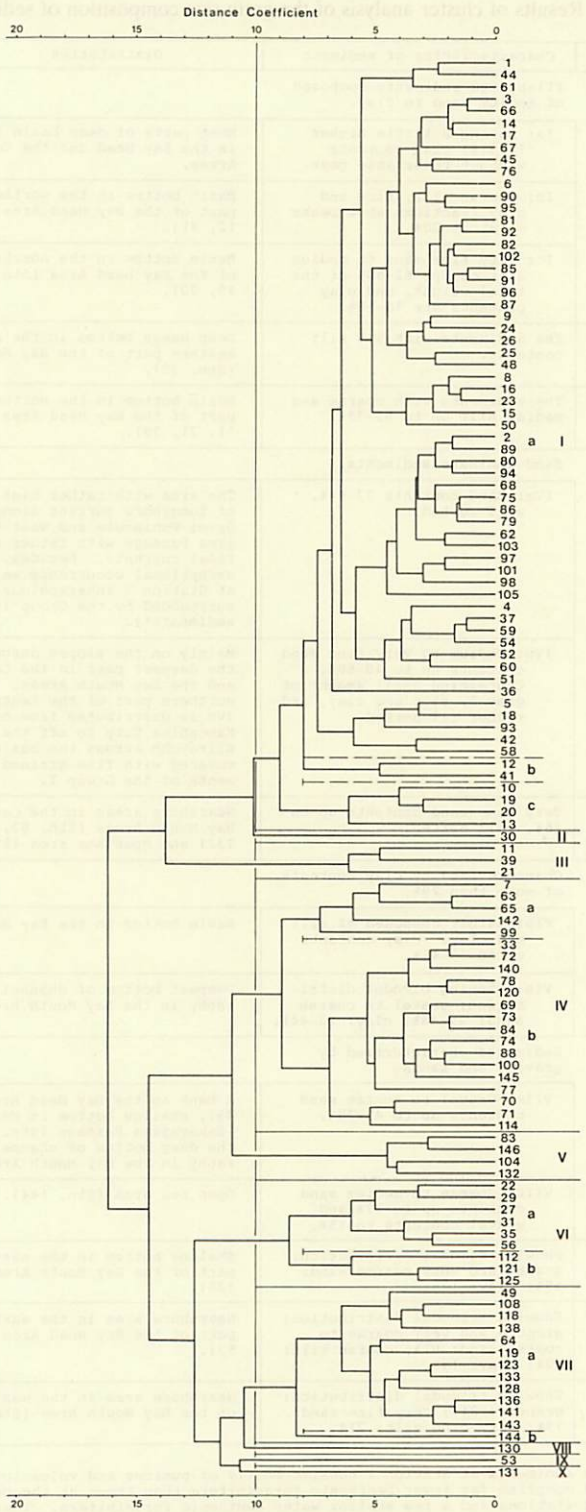

Fig. 12. Dendrogram for the bottom sediments.

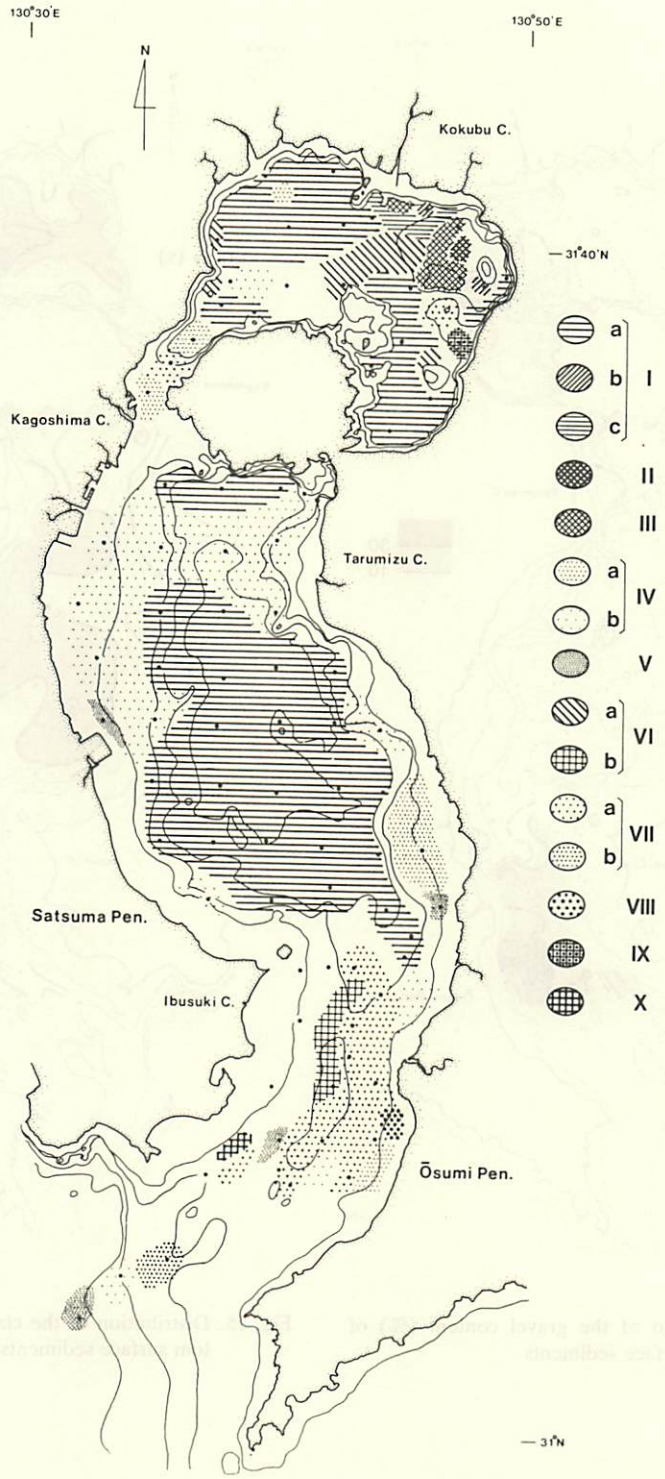

Fig. 13. Distribution of the groups of sediments recognized by cluster analysis.

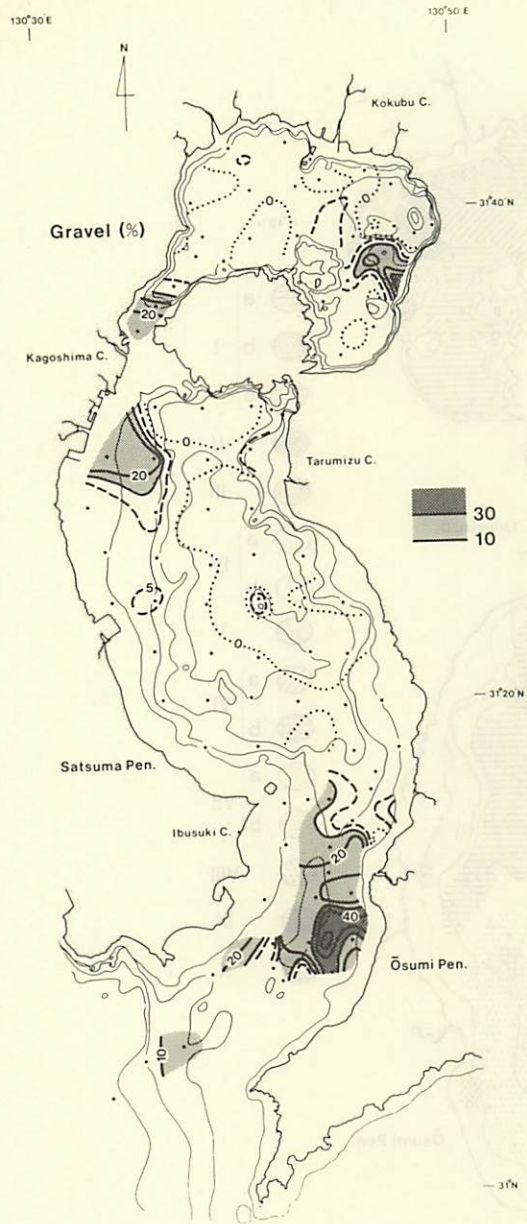

Fig. 14. Distribution of the gravel content (%) of bottom surface sediments.

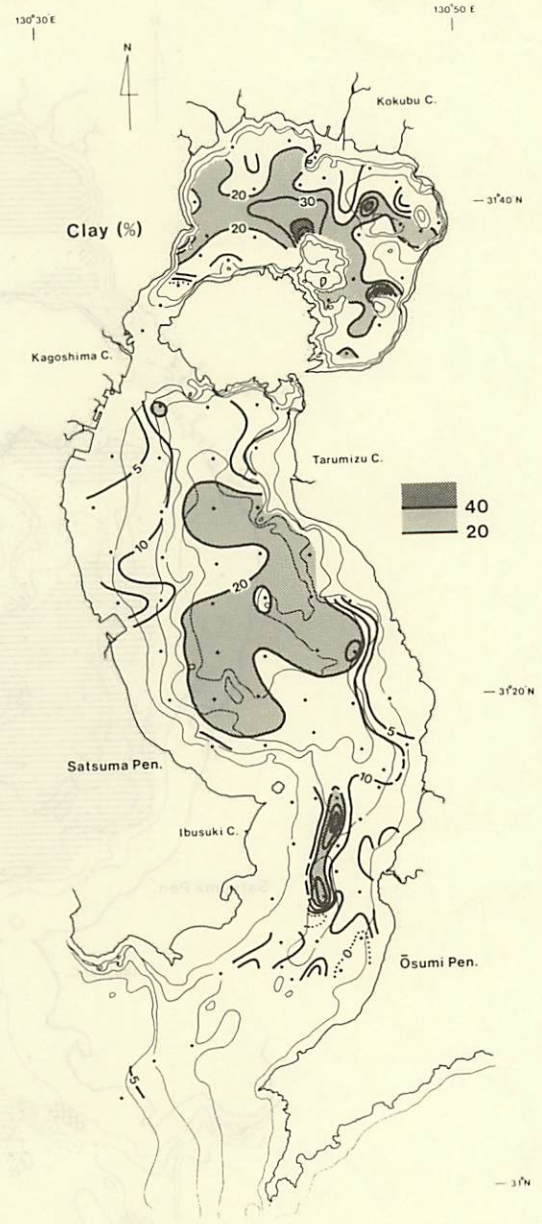

Fig. 15. Distribution of the clay content (%) of bottom surface sediments.

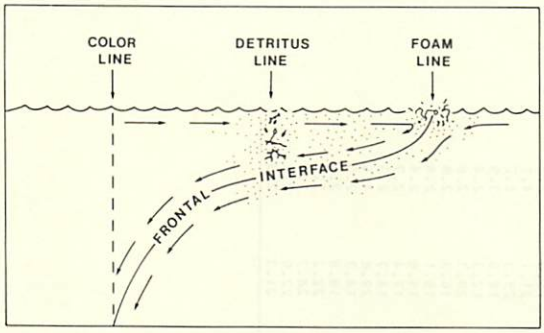

Fig. 16. Schematic distribution of suspended detritus in a current rip area (BOWMAN and IVERSON, 1978 *in* SAKAMOTO, 1982).

3. Rate of sedimentation and relative amount of the derived dead tests

(1) L/Tl value

In 1951, PHLEGER pointed out that the relative rate of sedimentation between sampling stations can be inferred from the ratio of living specimens to the total assemblage of benthonic foraminifera contained in the surface sediments, which has been termed the L/T value by subsequent authors (UCHIO, 1960; MATOBA, 1970). However, the L/T value must be smaller at stations where dead benthonic foraminifera are derived from surrounding areas by bottom currents, and results in under estimation of the sedimentation rate. To correct for this, I proposed to use the number of individuals only of the living species recognized at each station and to designate it Tl instead of T (ŌKI, 1986b, 1988). In addition, the ratio of L/Tl value to the L/T value indicates the relative amount of dead tests derived from outside the sampling station. The L/Tl values of the sediments from Kagoshima Bay are shown in Table 4 and their equivalent lines in Figure 17. The distribution of the ratios of L/Tl to L/T values is shown in Figure 18.

(2) The high L/Tl value areas

On the map showing the equivalent lines of the L/Tl value (Fig. 17), the five areas with a high rate of sedimentation can be seen, namely, 1) outside the bay (Stn. 137, 144, 145 and 146), 2) off Ibusuki City, 3) the boundary area between the Bay Mouth and the Central Areas, 4) near-shore area along the coast between Kagoshima City and Kiiré-chō, and 5) surroundings of the An-éi rise in the Bay Head Area.

a) Outside the bay (open sea) and the boundary area between the Bay Mouth and the Central Areas

The Bay Mouth Area, having a rather narrow channel topography can, at the same time, be regarded as a saddle topography between the deepening both in the north and the south of it. The rather rapid bottom current in the Bay Mouth Area slows down both in the north (Stn. 97, 98, 103 and 108) and the south (Stn. 137, 144, 145 and 146) where the water depth increases resulting in the deposition of fine materials suspendid in

Table 4. Data on the L/T and the L/Tl values and the number of total and living specimens.

Station	Number of Individuals Total*)	Living*)	L/Tl Value	L/Tl Value	L/Tl value / L/T value
1	132	1	0.8	2.0	2.6
3	158	13	8.2	11.4	1.4
12	100	5	5.0	7.6	1.5
15	103	3	2.9	5.9	2.0
17	222	11	5.0	6.2	1.3
18	88	9	10.2	18.2	1.8
21	81	4	4.9	14.8	3.0
22	269	15	5.6	6.9	1.2
32	242	22	9.1	23.7	2.6
34	331	13	3.9	5.2	1.3
35	136	39	28.7	33.3	1.2
37	275	48	17.5	20.4	1.2
40	86	17	19.8	23.0	1.2
41	121	6	5.0	11.9	2.4
42	313	11	3.5	6.4	1.8
44	304	10	3.3	7.6	2.3
45	213	23	10.8	15.7	1.5
51	115	32	27.8	34.1	1.2
53	182	7	3.9	5.8	1.5
54	156	42	26.9	35.0	1.3
58	68	14	20.6	33.3	1.6
61	109	6	5.5	6.7	1.2
63	418	26	6.2	20.8	3.3
64	322	22	6.8	22.7	3.3
65	653	32	4.9	10.5	2.1
66	236	32	13.6	28.4	2.1
67	211	11	5.2	10.0	1.9
68	226	44	19.5	23.2	1.2
69	229	29	12.7	16.6	1.3
70	250	14	5.6	28.2	5.0
71	258	4	1.6	4.4	2.8
72	244	6	2.5	3.9	1.6
73	394	17	4.3	17.2	4.0
74	419	32	7.6	16.7	2.2
75	431	40	9.3	13.7	1.5
76	262	21	8.0	21.8	2.7
77	247	10	4.0	5.9	1.5
78	253	25	9.9	31.2	3.2
79	330	20	6.1	12.1	2.0
80	324	22	9.9	14.9	1.5
81	249	31	12.4	17.9	1.4
82	310	25	8.1	12.4	1.5
83	335	23	6.9	22.3	3.2
84	280	36	12.9	25.4	2.0
85	241	26	10.8	19.5	1.8
86	376	47	12.5	21.7	1.7
87	347	31	8.9	19.2	2.1
88	295	25	8.5	24.3	2.9
89	265	16	6.0	11.8	2.0
90	224	20	8.9	17.5	2.0
91	216	27	12.5	24.3	1.9
92	258	11	4.3	19.6	4.6
93	334	23	6.9	13.6	2.0
94	242	13	5.4	11.3	2.1
95	204	25	12.3	22.0	1.8
96	246	31	12.6	21.4	1.7
97	199	24	12.1	28.9	2.4
98	215	20	9.3	25.3	2.7
99	274	26	9.5	25.3	2.7
100	228	17	7.5	23.9	3.2
101	276	17	6.2	16.2	2.6
102	228	16	7.0	17.8	2.5
103	205	4	2.0	80.0	41.0
104	308	17	5.5	20.5	3.7
105	222	14	6.3	16.3	2.6
106	225	15	6.7	23.9	3.6
107	278	8	2.9	12.3	4.3
108	224	15	6.7	31.1	4.6
110	329	22	6.7	15.0	2.2
113	295	15	5.1	21.1	4.1
116	214	25	11.7	25.3	2.2
118	216	9	4.2	14.5	3.5
122	295	15	5.1	12.3	2.4
124	215	17	7.9	20.7	2.6
125	240	14	5.8	16.3	2.8
127	329	18	5.5	15.1	2.8
132	364	22	6.0	14.8	2.4
134	249	16	6.4	17.4	2.7
136	388	25	6.4	14.7	2.3
137	230	15	6.5	29.8	4.6
139	884	64	7.2	14.2	2.0
141	265	19	7.2	18.8	2.6
143	313	29	9.3	22.2	2.4
144	334	63	19.2	28.7	1.5
145	189	19	10.1	22.0	2.2
146	252	19	7.5	21.3	2.8

*) Numbers are actually counted.

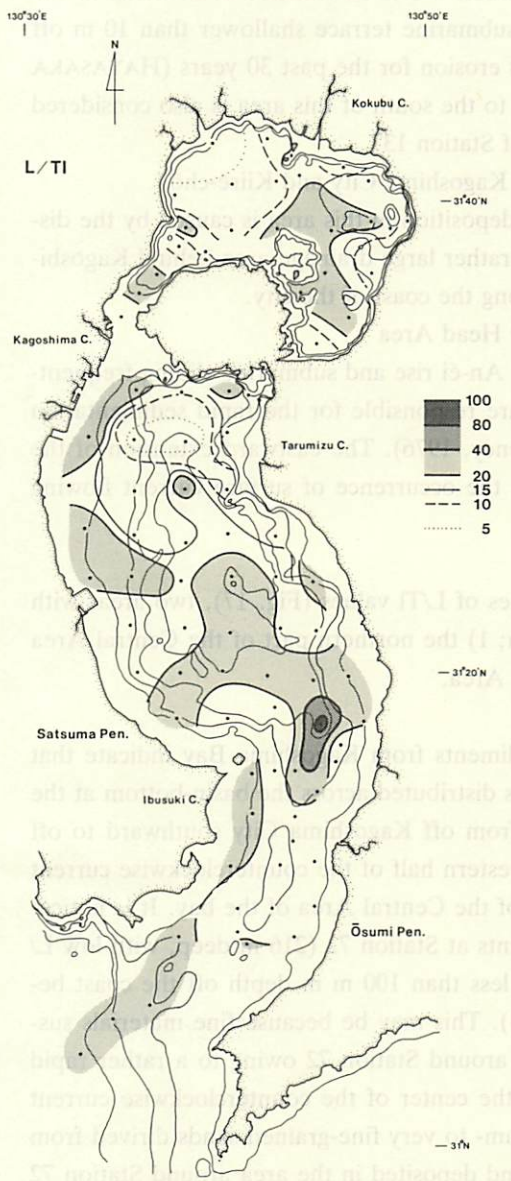

Fig. 17. Distribution of the L/Tl values.

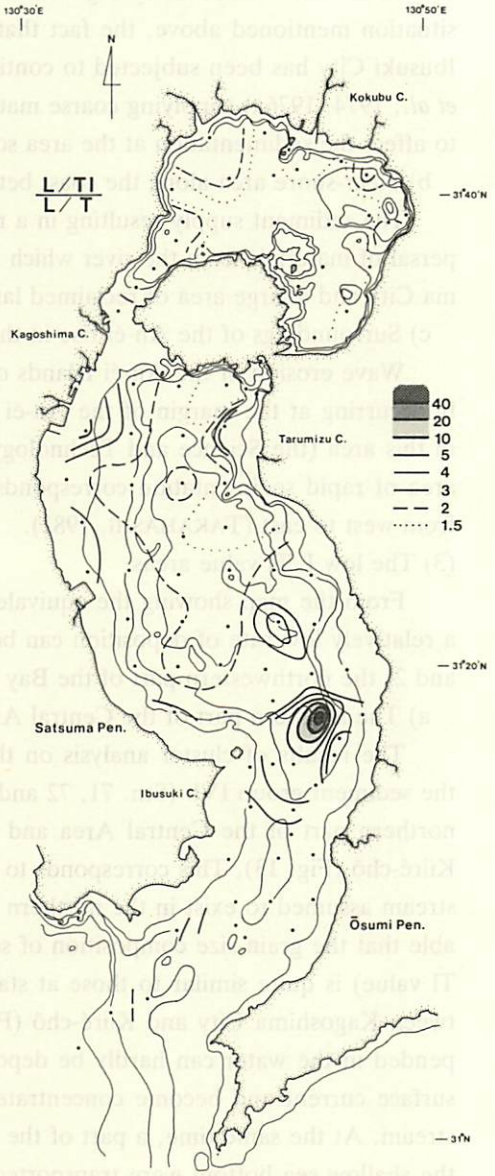

Fig. 18. Distribution of the ratios of L/Tl to L/T values.

the water. An extraordinary high value at Station 103 is noticeable. In addition to the situation mentioned above, the fact that the submarine terrace shallower than 10 m off Ibusuki City has been subjected to continuous erosion for the past 30 years (HAYASAKA *et al.*, 1974, 1976a) supplying coarse materials to the south of this area is also considered to affect the sedimentation at the area south of Station 137.

b) Near-shore area along the coast between Kagoshima City and Kiiré-chō

The sediment supply resulting in a rapid deposition in this area is caused by the dispersal of materials from the river which has a rather large drainage area behind Kagoshima City and a large area of reclaimed land along the coast of the city.

c) Surroundings of the An-éi rise in the Bay Head Area

Wave erosion of the An-éi Islands on the An-éi rise and submarine sliding frequently occurring at the margin of the An-éi rise are responsible for the rapid sedimentation in this area (the Science and Technology Agency, 1976). The eastward extension of the area of rapid sedimentation corresponds with the occurrence of surface current flowing from west to east (TAKAHASHI, 1981).

(3) The low L/Tl value areas

From the map showing the equivalent lines of L/Tl values (Fig. 17), two areas with a relatively low rate of deposition can be seen; 1) the northern part of the Central Area and 2) the northwestern part of the Bay Head Area.

a) The northern part of the Central Area

The results of cluster analysis on the sediments from Kagoshima Bay indicate that the sediment group IVb (Stn. 71, 72 and 77) is distributed across the basin-bottom at the northern part of the Central Area and also from off Kagoshima City southward to off Kiiré-chō (Fig. 13). This corresponds to the western half of the counterclockwise current stream assumed to exist in the northern part of the Central Area of the bay. It is noticeable that the grain-size composition of sediments at Station 72 (216 m deep, with low L/Tl value) is quite similar to those at stations less than 100 m in depth off the coast between Kagoshima City and Kiiré-chō (Fig. 13). This may be because fine materials suspended in the water can hardly be deposited around Station 72 owing to a rather rapid surface current and become concentrated at the center of the counterclockwise current stream. At the same time, a part of the medium- to very fine-grained sands dirived from the shallow sea bottom were transported to and deposited in the area around Station 72 when the surface currents are strong. These explanations are endorsed by the fact that the L/Tl value at Station 76 near the center of the counterclockwise stream is rather high (21.8), the median diameter is 5.2 ϕ and the mud-content up to 64.6%. At Station 71, on the other hand, the rate of sedimentation is rather low compared with the sorrounding areas because of the lack of sediment supply from the east, and the westward-flowing surface current acting as an obstacle to the sediment supply from the shallow sea bottom to the west.

b) The northwestern part of the Bay Head Area

The rather small amount of sedimentary materials supplied to this area may be ex-

plained by the fact that the drainage areas of rivers flowing into this area are rather flat in topography and the slopes of river beds are gentle.

(4) Distribution of the ratio of the L/Tl value to the L/T value

The ratio of the L/Tl value to the L/T value (Fig. 18) can potentially indicate the relative amount of dead tests of benthonic foraminifera derived from outside the stations, namely, the larger the ratio, the more the dead tests transported from the other site.

The areas with rather large ratios are as follows:

1) southwestern part of the Bay Mouth Area (Stn. 137), 2) boundary area between the Bay Mouth and the Central Areas (Stn. 103, 104, 106, 107, 108, 113 and 118), 3) off the reclaimed land in Kiiré-chō (Stn. 83), 4) off Tarumizu City, 5) off Taniyama, Kagoshima City (Stn. 70) and 6) West-Sakurajima Passage. The common feature of these areas is their situation, namely, down stream of rapid surface currents. For example, the foraminiferal dead tests moving northward by the bottom current with clastic materials along the Ōsumi Peninsula must be deposited and concentrated because of a sudden slowing of the current velocity in the boundary area between the Bay Mouth (about 100 m deep) and the Central Areas (about 200 m deep).

4. Planktonic foraminifera

For the planktonic foraminifera, which was not the main subject of this study and therefore treated without specific identification, the number of individuals and their percentages of the total number of individuals of both benthonic and planktonic foraminifera (designated as Pl/Pl + Be value in the following lines), and of planktonic foraminifera plus radiolaria (Pl/Pl + Rads value) was determine.

Considering the L/Tl value of each station, the theoretical number of individuals regarded to have been accumulated during a relative unit of time was estimated based on the actual number of individuals contained in 10cc of surface sediments.

(1) Distribution of planktonic foraminifera throughout the studied area

The number of planktonic foraminifera at each station is shown in Table 5 and the distribution of equivalent lines is in Figure 19.

At the three open sea stations, the individual numbers of planktonic foraminifera seemed to correspond to water depth, namely, the deeper the water, the more abundant the planktonic foraminifera; 654 at Station 144 (105 m), 10,250 at Station 145 (155 m), 20,830 at Station 146 (213 m).

At the Bay Mouth Area, the individual numbers of planktonic foraminifera were rather small (121-1,208) in the channel. This corresponds to the saddle-like topography between the open sea and the Central Area of the bay. This may be caused by rather strong current in the channel. On the other hand, those on the steep slopes north and south of the channel are rather large (1,970-6,744). This is also the case with radiolaria.

At the Central Area of the bay the number of individual planktonic foraminifera tended to decrease in the northeastern part (less than 300) and increase in the western

Table 5. Data on planktonic foraminifera and radiolaria.

Station	Depth (m)	Planktonic Foraminifera Number of Individuals	Pl / Pl + Be	Pl / Pl + Rads	Radiolaria Number of Individuals
1	102	0	- %	- %	+
3	130	0	-	-	10
12	122	+	1.0	1.0	16
15	152	+	1.9	2.5	9
17	146	0	-	-	7
18	136	+	1.1	2.6	13
21	185	0	-	-	14
22	144	2	4.3	17.6	8
32	156	9	2.0	62.5	6
34	149	6	7.8	35.0	11
35	140	0	-	-	18
37	124	0	-	-	18
40	228	0	-	-	5
41	182	0	-	-	5
42	170	+	0.6	4.9	5
44	144	1	0.7	20.0	5
45	134	0	-	-	4
51	134	0	-	-	19
53	94	0	-	-	6
54	125	0	-	-	41
58	142	0	-	-	33
61	138	0	-	-	4
63	138	7	2.1	28.1	19
64	66	25	4.2	100	0
65	39	7	2.5	100	0
66	130	245	10.3	75.0	82
67	165	66	28.2	65.4	35
68	162	1	1.3	12.5	5
69	150	64	9.5	77.4	19
70	23	433	4.6	85.7	72
71	88	335	31.6	88.1	45
72	216	24	24.0	57.5	18
73	80	1233	36.3	89.6	143
74	28	331	6.9	83.8	64
75	93	850	31.0	91.1	83
76	220	453	49.8	74.5	155
77	196	18	23.3	49.7	18
78	40	1078	9.6	87.1	160
79	100	1440	36.0	87.7	201
80	225	233	54.7	71.9	91
81	220	207	53.7	69.6	90
82	150	268	30.3	72.2	103
83	36	571	5.6	90.9	57
84	88	3706	28.9	95.0	195
85	220	345	47.8	72.2	133
86	165	1050	61.7	86.6	163
87	182	450	45.8	72.7	169
88	78	1944	29.8	95.4	93
89	95	680	25.4	82.6	143
90	215	323	50.8	83.1	66
91	207	610	59.2	81.8	136
92	185	731	46.2	79.3	191
93	142	568	43.9	86.4	89
94	105	354	16.8	74.2	123
95	170	252	41.2	79.0	67
96	188	801	48.8	71.6	318
97	170	809	46.8	78.1	227
98	145	2688	43.6	86.0	437
99	42	378	11.3	100	-
100	75	1315	15.9	95.6	61
101	119	472	24.8	84.3	88
102	162	1099	46.0	81.8	245
103	175	800	37.9	89.9	90
104	38	328	7.5	83.3	66
105	97	1074	31.7	78.0	303
106	40	795	5.5	86.7	122
107	96	735	11.2	100	-
108	120	1970	30.7	100	-
110	110	3437	35.2	93.7	230
113	100	270	35.2	97.0	8
116	61	810	10.5	96.2	32
118	101	278	35.7	100	-
122	100	579	33.3	89.1	71
124	20	3	3.2	77.8	1
125	140	121	27.9	93.9	8
127	74	1208	27.5	96.2	48
132	100	6744	32.8	93.7	455
134	112	830	37.4	93.1	61
136	60	616	25.2	99.2	5
137	106	2975	25.3	96.3	114
139	105	2436	37.7	96.9	77
141	60	547	25.6	97.8	12
143	96	4802	35.1	92.3	398
144	105	654	46.0	84.8	117
145	155	10250	49.2	96.3	394
146	213	20830	60.3	98.5	327

Number of Individuals =
(Number of individuals in 10cc) x (L/Tl value) / 100
Pl: Planktonic foraminifera; Be: Benthonic foraminifera;
Rads: Radiolaria.

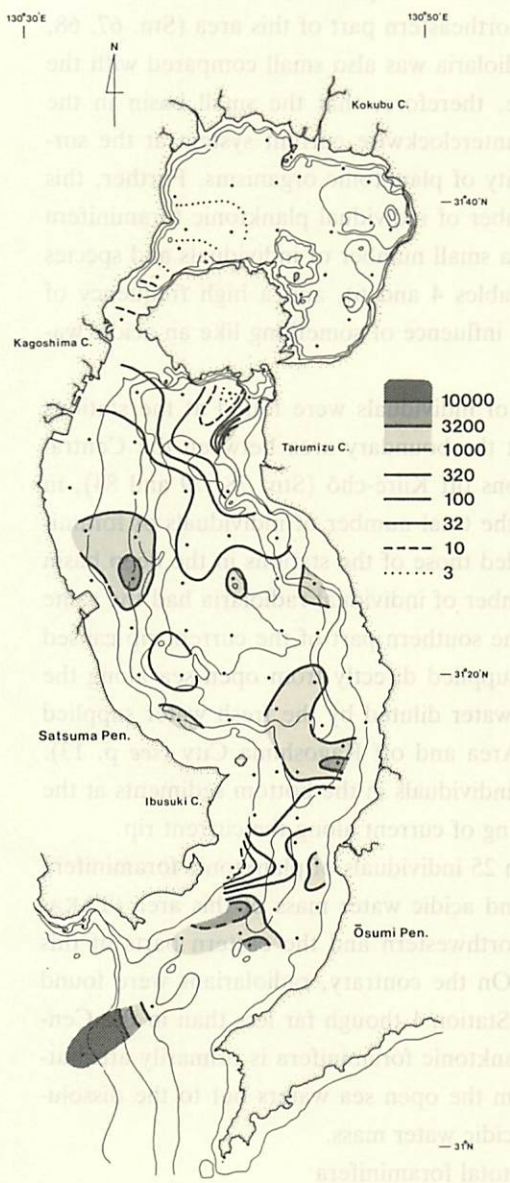

Fig. 19. Distribution of the number of individuals of planktonic foraminifera.

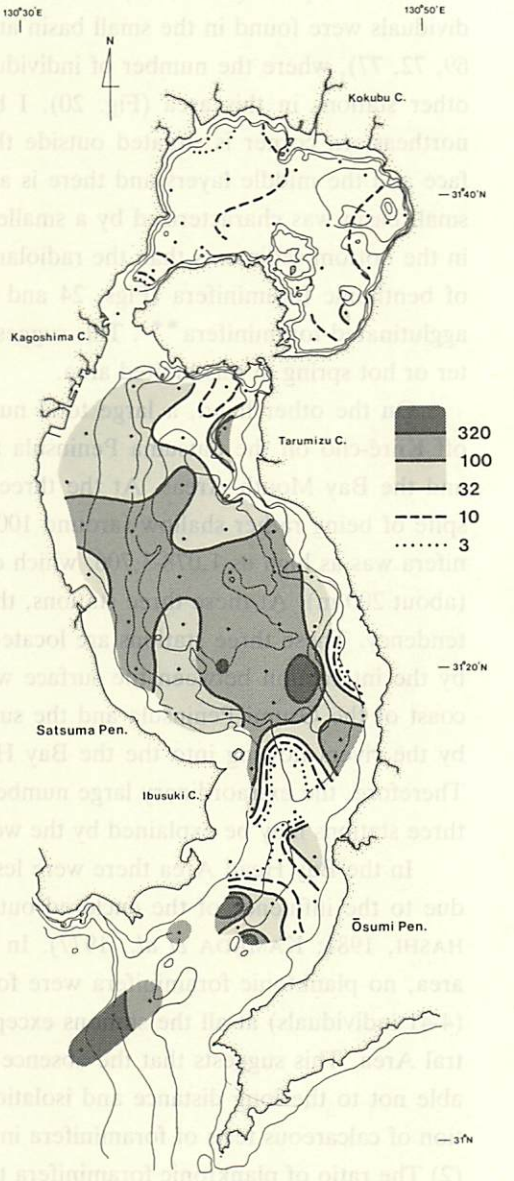

Fig. 20. Distribution of the number of individuals of radiolaria.

and southern parts (300-3,706). Stations which had an exceptionally small number of individuals were found in the small basin at the northeastern part of this area (Stn. 67, 68, 69, 72, 77), where the number of individual radiolaria was also small compared with the other stations in this area (Fig. 20). I believe, therefore, that the small basin in the northeastern corner is situated outside the counterclockwise current system at the surface and the middle layers and there is a scarcity of planktonic organisms. Further, this small basin was characterized by a smaller number of individual planktonic foraminifera in the bottom sediments than the radiolaria*), a small number of individuals and species of benthonic foraminifera (Figs. 24 and 25; Tables 4 and 6), and a high frequency of agglutinated foraminifera**). This suggests the influence of something like an acidic water or hot spring in this limited area.

On the other hand, a large total number of individuals were found at the stations off Kiiré-chō on the Satsuma Peninsula and at the boundary area between the Central and the Bay Mouth Areas. At the three stations off Kiiré-chō (Stn. 78, 79 and 84), in spite of being rather shallow (around 100 m), the total number of individuals of foraminifera was as high as 1,078-3,706, which exceeded those of the stations in the deep basin (about 200 m). At these three stations, the number of individual radiolaria had the same tendency. These three stations are located at the southern part of the current rip caused by the interaction between the surface water supplied directly from open sea along the coast of the Ōsumi Peninsula and the surface water diluted by the fresh water supplied by the rivers flowing into the the Bay Head Area and off Kagoshima City (*see* p. 13). Therefore, the extraordinary large numbers of individuals in the bottom sediments at the three stations may be explained by the weakening of current along the current rip.

In the Bay Head Area there were less than 25 individuals of planktonic foraminifera due to the influence of the enclosed outline and acidic water mass of this area (TAKAHASHI, 1981; KAMADA *et al.*, 1977). In the northwestern and the eastern parts of this area, no planktonic foraminifera were found. On the contrary, radiolarians were found (4-41 individuals) at all the stations except for Station 1 though far less than in the Central Area. This suggests that the absence of planktonic foraminifera is primarily attributable not to the long distance and isolation from the open sea waters but to the dissolution of calcareous tests of foraminifera in the acidic water mass.

(2) The ratio of planktonic foraminifera to the total foraminifera

Planktonic foraminifera contents in the sediments of the Bay Mouth and the Central Areas (Fig. 21) were directly related to water depth. As shown in Figure 22, the data of almost all the stations are plotted on or near the parabolic line drawn in relation to water depth. As seen in Figure 22, the stations where the planktonic foraminifera contents were far less than the values at the corresponding depth on the parabolic line are in the northeastern part of the Central Area and in the area ranging from the southwestern part of the Central Area to the northwestern part of the Bay Mouth Area (Fig. 23).

*) At Stations 68, 72 and 77, the Pl/Pl+Rads values range from 12.5 to 57.5 (Table 5).

**) At Station 68 off the Furusato Spa, the frequency of agglutinated foraminifera attains to 96.9%.

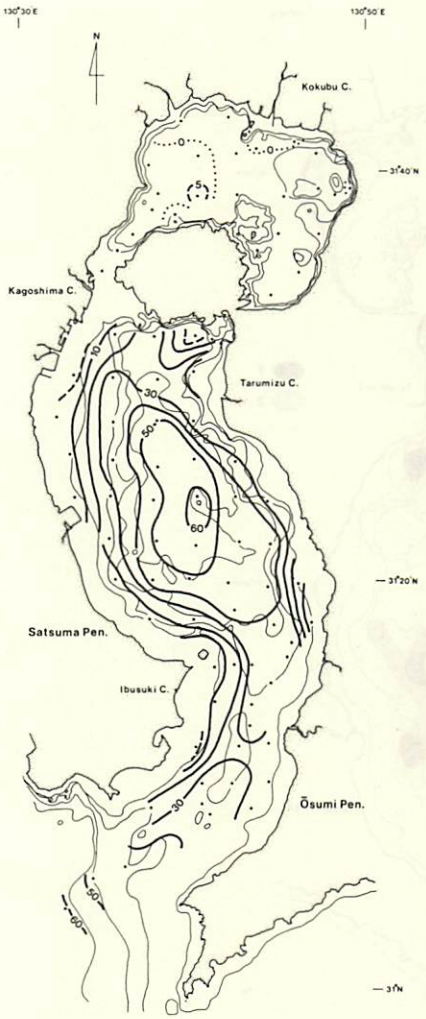

Fig. 21. Distribution of the ratios of planktonic foraminifera to the total foraminifera.

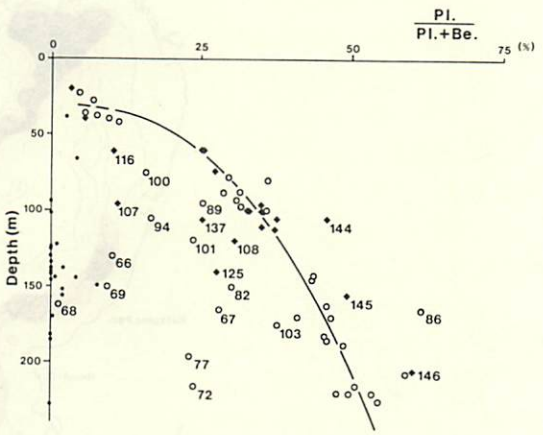

Fig. 22. Correlation between the frequency of planktonic foraminifera in the bottom sediments and the water depth (◆: Bay Mouth Area; ○ : Central (Area; • ; Bay Head Area). Parabolic line was drown omitting the stations of extremely low ratios.

Both areas are situated outside of the counterclockwise current system assumed to exist in the Central Area of the bay.

The planktonic foraminifera contents in the Bay Head Area were quite abnormal reflecting the existence of the acidic water mass. The sediments of almost all the stations in the Bay Head Area did not contain the test of planktonic foraminifera, except for the 11 stations in the West-Sakurajima Passage and the western, northern and northeastern parts of the Bay Head Area, where low values of planktonic foraminifera contents (0.6-7.8%) were obtained.

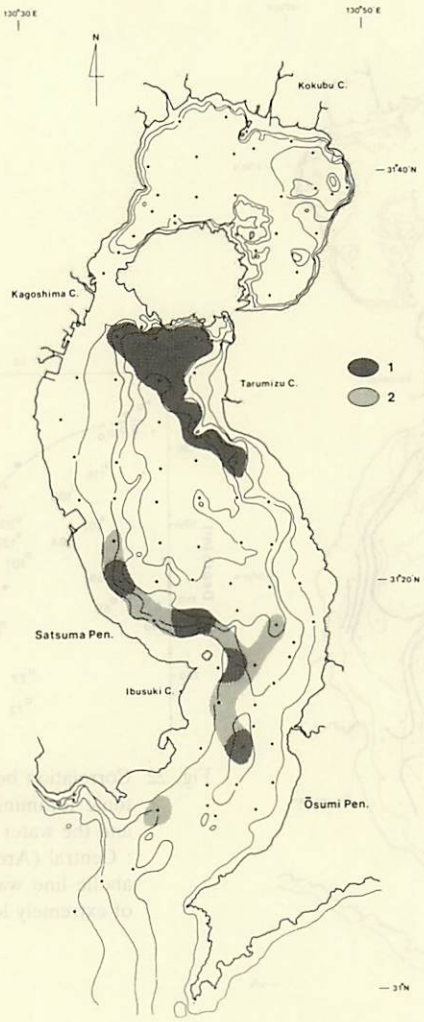

Fig. 23. Areas of the low ratio of planktonic foraminifera to the total foraminifera at the corresponding depth compared with the values on the parabolic line (Fig.22) except for the Bay Head Area (1: extraordinary low ratio; 2: low ratio).

5. Benthonic foraminifera

(1) General features of benthonic foraminifera

a) Number of individuals

The number of individuals at each station was estimated considering the rate of sedimentation (*see* p. 29) and is shown in Table 4 and their corresponding curves are shown in Figure 24.

In the open sea area, the number of individuals was 767 at Station 144 (105 m deep) and more than 10,000 at Stations 145 and 146 (both deeper than 155 m).

In the Bay Mouth Area, the stations which had rather large numbers of individuals (Stn. 106, 107, 116, 132, 137 and 143) were distributed in the northwestern (off Ibusuki City) and the southern part facing the open sea, and those which had rather small numbers (Stn. 113, 118, 124 and 125) were at the deepest part of the channel topography.

The number of individuals in the Central Area corresponded indirectly with the water depth, namely, generally larger in the shallow water part along the coast and smaller at the basin bottom. At the basin bottom, it decreased from south to north, and particularly, at Stations 68, 72 and 77 in the northeastern part supposed to be occupied by a water mass with some peculiar property (*see* p. 36), numbers of individuals were exceptionally small (52-76). On the other hand, the stations showing conspicuously large numbers of individuals were, without exception, in the shallow water along the coastline: from 9,103 to 10,104 at Stations 78, 83 and 84 off Kiiré and 8,873 at Station 99 in the southeastern part of the Central Area. This is interpreted as the influence of nutritious water mass mixed with sewage of human life (NOZAWA and SAISHO, 1980).

In the Bay Head Area, the number of individuals was generally less than 120, except for the six stations in the West-Sakurajima Passage and its environs where it ranged from 130 to 600. The small numbers in this area probably resulted from the existence of an acidic water mass caused by the sea bottom fumaroles of this area.

b) Number of species

Through the present study, 317 species of benthonic foraminifera belonging to 130 genera were collected from the 86 stations within Kagoshima Bay and the three stations outside the bay. For comparison, number of species recognized in 200 individuals picked up at random from each sample is shown in Table 6 and the equivalent curves are in Figure 25.

As seen in Table 6, the numbers of species in the open sea and the Bay Mouth Areas are large (about 60 species) and tend to decrease toward the Bay Head Area.

In the Central Area, most stations had about 50 species, except for the seven stations (Stn. 88, 92, 98, 99, 100, 101 and 102) in the southeastern part which had more than 60 species and the four stations (Stn. 68, 72, 77 and 82) in the northeastern part which had less than 30 species.

In the Bay Head Area, the number of species ranged from 37 to 49 among the four stations (Stn. 44, 63, 64 and 65) in the West-Sakurajima Passage and was less than 30 at

Table 6. Number of species, species diversity and equitability of benthonic foraminifera and the frequency of each type of the test.

Station	Number of Species	Number of Individuals	Diver.	Equi.	Agglu. Tests (%)	Porcel. Tests (%)	Hyaline Tests (%)
1	10	5	1.61	0.50	100	0	0
3	13	36	1.21	0.26	100	0	0
12	14	15	1.82	0.44	98.0	1.0	1.0
15	9	12	1.42	0.46	78.6	0	21.4
17	20	28	1.67	0.26	45.5	0	54.5
18	12	32	1.62	0.42	90.9	0	9.1
21	12	24	1.90	0.56	100	0	0
22	24	37	1.85	0.26	21.6	0	78.4
32	28	459	2.23	0.33	40.5	0	59.5
34	34	69	2.22	0.27	7.6	0.8	91.6
35	13	91	1.41	0.31	100	0	0
37	23	112	1.65	0.23	100	0	0
40	10	40	1.68	0.54	100	0	0
41	18	29	2.33	0.57	95.9	0	4.1
42	30	40	2.74	0.51	97.5	0	2.5
44	46	185	2.79	0.35	36.8	0	63.2
45	30	134	2.24	0.31	48.8	0	51.2
51	14	78	1.54	0.33	100	0	0
53	20	21	1.76	0.29	40.9	0.6	58.5
54	16	109	1.42	0.26	97.4	0	2.6
58	16	45	1.76	0.36	100	0	0
61	12	15	1.43	0.35	100	0	0
63	65	348	3.50	0.51	24.4	0	75.6
64	60	585	3.19	0.14	5.9	14.3	79.8
65	66	274	3.36	0.44	5.8	4.7	89.5
66	57	2145	3.54	0.61	32.2	0.8	67.0
67	52	169	2.92	0.36	24.6	0.5	74.9
68	22	52	1.81	0.28	96.9	0	3.1
69	34	608	2.34	0.31	34.5	0	65.5
70	55	9024	3.55	0.63	8.0	10.8	81.2
71	57	727	3.24	0.45	7.8	0.3	91.9
72	42	76	2.51	0.29	29.5	0.8	69.7
73	79	2169	3.82	0.58	9.6	1.3	89.1
74	65	4478	3.70	0.62	3.8	5.5	90.7
75	60	1890	3.10	0.37	8.4	0.5	91.1
76	53	457	3.16	0.44	17.2	2.7	80.1
77	36	58	2.64	0.39	39.3	0.4	60.3
78	49	10104	3.43	0.63	7.1	7.5	85.4
79	60	2556	3.20	0.41	3.9	1.5	94.6
80	54	193	3.11	0.42	20.7	0.9	78.4
81	54	178	2.94	0.35	27.7	2.0	70.3
82	48	615	2.81	0.35	31.3	0.3	68.4
83	66	9562	3.66	0.59	7.5	4.8	87.7
84	54	9103	3.33	0.52	3.6	0.7	95.7
85	50	376	3.17	0.48	30.7	0.4	68.9
86	75	653	3.67	0.52	18.6	1.3	80.1
87	73	533	3.63	0.52	10.4	1.2	88.4
88	78	4588	3.91	0.64	7.8	1.0	91.2
89	54	2001	3.15	0.43	7.5	0.4	92.1
90	55	314	3.25	0.47	21.0	3.1	75.9
91	60	420	3.41	0.51	18.5	0.9	80.6
92	74	809	3.87	0.65	13.6	0	86.4
93	69	727	3.58	0.52	7.2	2.1	90.7
94	55	1750	3.40	0.54	7.9	0.4	91.7
95	41	359	2.89	0.44	15.7	0	84.3
96	52	842	3.29	0.52	19.1	1.2	79.7
97	54	920	3.44	0.58	18.6	0.5	80.9
98	66	3481	3.69	0.61	7.4	0	92.6
99	70	8873	3.68	0.57	13.9	8.0	78.1
100	63	6975	3.73	0.66	7.5	2.2	90.3
101	74	1431	3.66	0.53	8.0	3.6	88.4
102	63	1299	3.58	0.57	8.3	0	91.7
103	55	1312	3.48	0.59	10.2	0.3	89.5
104	68	4041	3.73	0.61	11.4	5.5	83.1
105	53	2316	3.46	0.60	7.7	1.8	90.5
106	58	13766	3.65	0.66	3.6	13.8	82.6
107	65	5847	3.63	0.58	2.5	5.8	91.7
108	64	4459	3.57	0.55	2.2	7.6	90.2
110	69	6317	3.61	0.53	2.7	2.7	94.6
113	69	498	3.66	0.56	8.1	4.1	87.8
116	61	6930	3.65	0.63	2.3	6.5	91.2
118	64	501	3.72	0.64	6.0	7.4	86.6
122	68	1161	3.69	0.59	4.7	3.7	91.6
124	48	89	3.31	0.57	7.0	20.5	72.5
125	61	313	3.52	0.55	6.7	4.2	89.1
127	65	3179	3.68	0.61	7.6	8.2	84.2
132	76	13791	3.68	0.52	3.6	2.7	93.7
134	65	1386	3.63	0.58	3.6	0.4	96.0
136	78	1825	3.85	0.60	10.8	5.7	83.5
137	77	8773	3.88	0.63	4.8	10.0	85.2
139	103	4017	3.99	0.53	3.5	5.1	91.4
141	65	1594	3.67	0.60	7.2	8.3	84.5
143	81	8894	3.84	0.57	7.0	5.1	87.9
144	78	767	3.93	0.65	14.4	10.8	74.8
145	57	10645	3.56	0.62	9.5	13.8	76.7
146	65	13741	3.67	0.61	8.3	8.7	83.0

Number of Individuals = (Number of individuals in 10cc) x (L/Tl value) / 100
Diver.: Diversity; Equi.: Equitability; Agglu.: Agglutinated; Porcel.: Porcelaneous

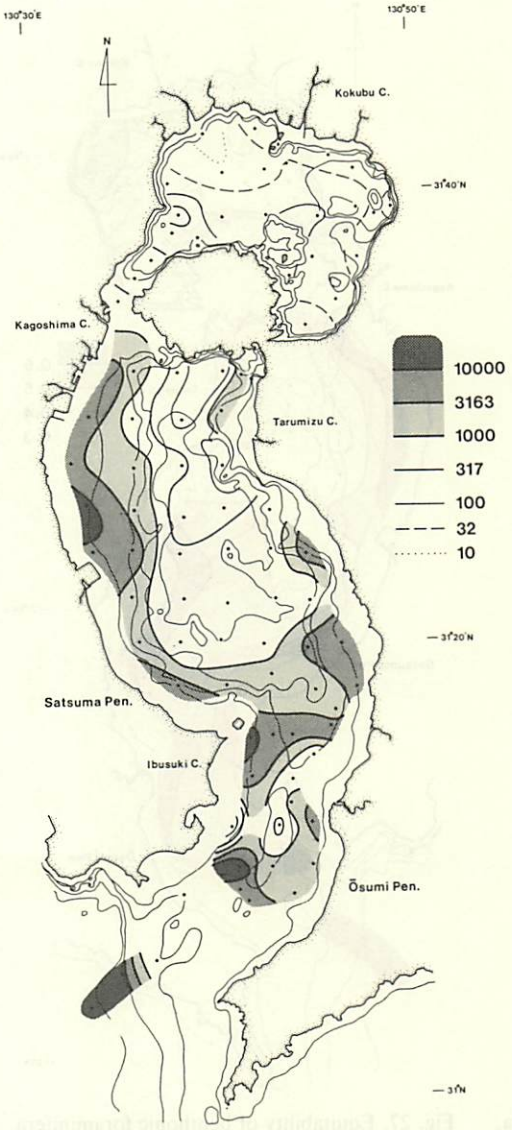

Fig. 24. Distribution of the number of individuals of benthonic foraminifera (N = L/Tl × number of individuals in 10 cc of bottom sediments).

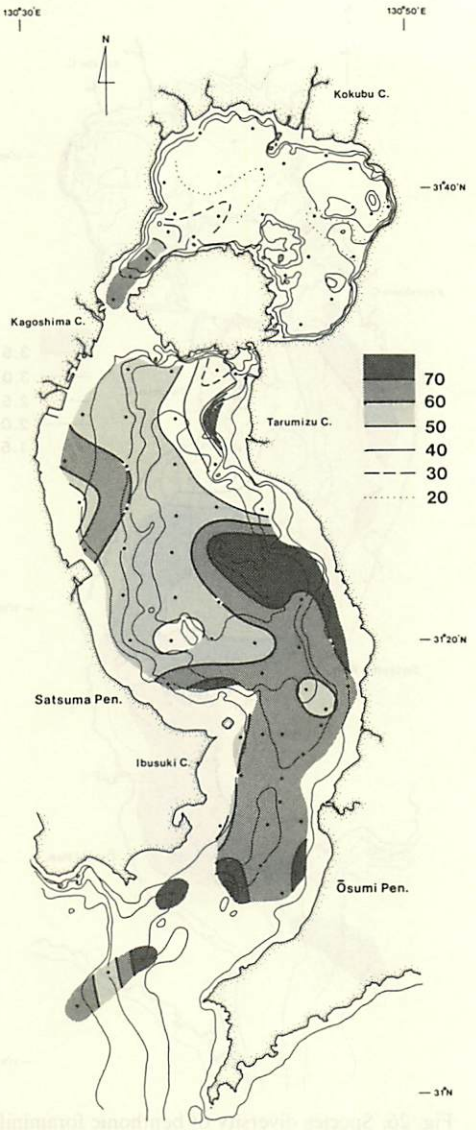

Fig. 25. Number of benthonic foraminiferal species.

the rest of the stations. Particularly, the six stations (Stn. 1, 3, 15, 17, 18 and 35) in the northwestern part, Station 40 at the 200 m deep basin and Station 61 at the innermost part of the Bay Head Area had a remarkably small number of species of less than 10.

c) Species diversity and equitability

Species diversity and equitability*) are shown in Table 6, and the equivalent diversity curves are in Figure 26 and those of equitability are in Figure 27. The relation-

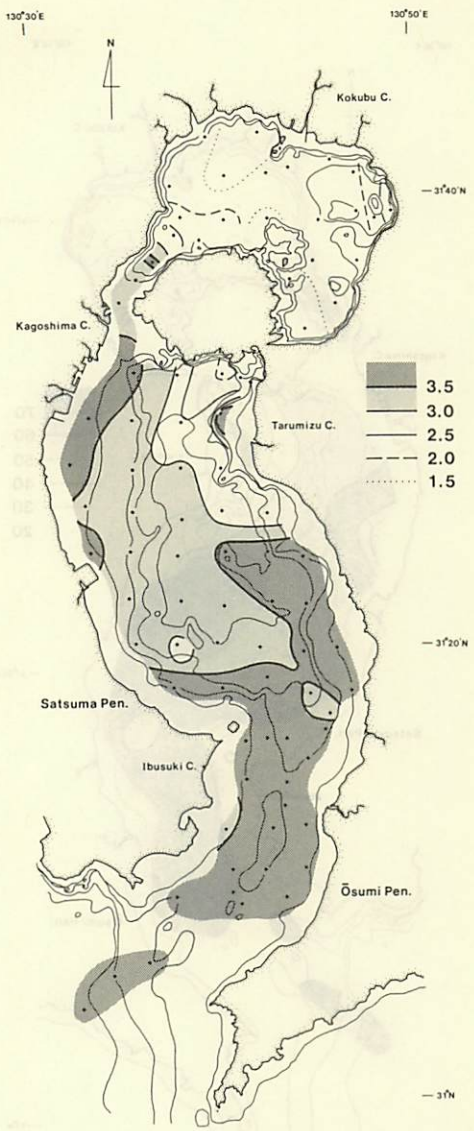

Fig. 26. Species diversity of benthonic foraminifera.

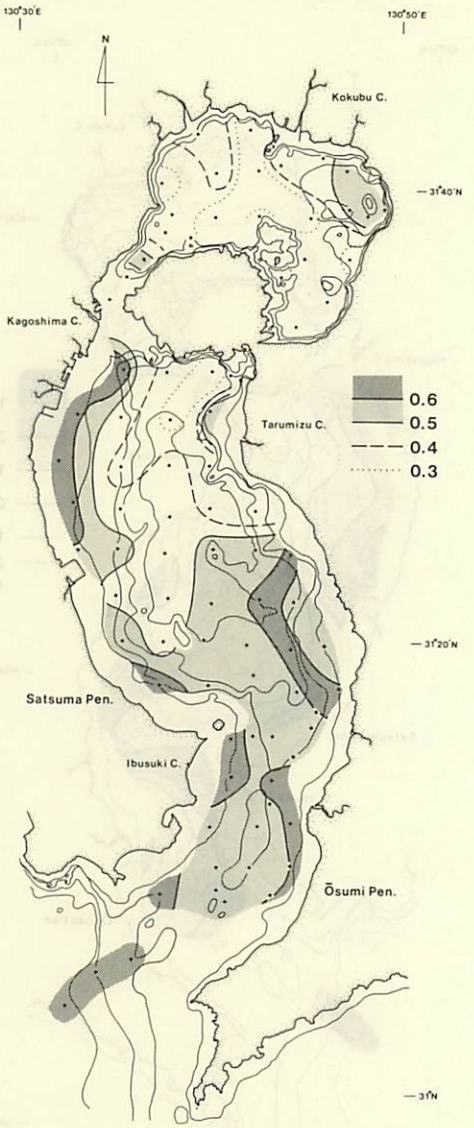

Fig. 27. Equitability of benthonic foraminifera.

ships between water depth and each of the three parameters (species diversity, equitability and number of species) are shown in Figure 28.

As seen in Figure 26, the distribution pattern of the species diversity tends to be much the same as that of the numbers of species (Fig. 25).

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*) SHANNON-WEAVER's function as somewhat revised by BUZAS and GIBSON (1969) is available for calculating of species diversity and equitability (ISHIZAKI and TANIMURA, 1985).
Species diversity and equitability are computed by

$$H = -\sum_{i=1}^{S} p_i \log(p_i), \text{ and } E = \exp(H)/S$$

where p stands for the proportion of the th species in a sample, and S the number of species.

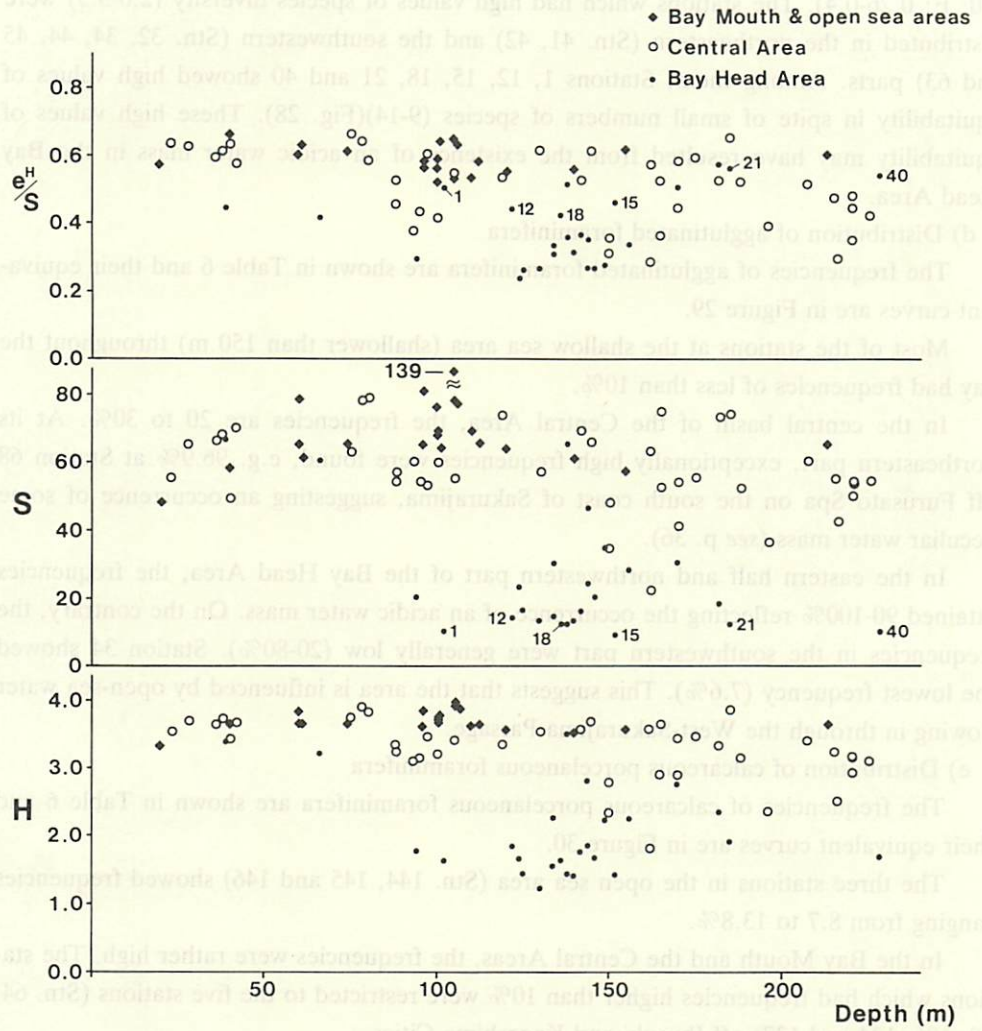

Fig. 28. Diagram showing the relationships between water depth and each of the three parameters; number of species(S), species diversity(H) and equitability.

In the Bay Mouth Area, the values of species diversity were more than 3.5 except for one station (Stn. 124), and the values of equitability were more than 0.5. The five stations (Stn. 136, 137, 139, 143 and 144) which had species diversity values of more than 3.8 were distributed in the boundary between the open sea and Bay Mouth areas.

In the Central Area, the stations showing rather high values of species diversity and equitability (D: 3.5; E: 0.5) were distributed in the southeastern and northwestern parts. The stations (Stn. 67, 68, 69, 72, 77, 81 and 82) which had low values (D: 1.8-3.0; E:< 0.4) were distributed in the northeastern part situated outside of the counterclockwise current system as already mentioned in the preceding chapter (*see* p.18, 37).

In the Bay Head Area, the diversity and equitability values were rather low (D: 1.2-

2.0; E: 0.26-0.4). The stations which had high values of species diversity (2.0-3.5) were distributed in the northeastern (Stn. 41, 42) and the southwestern (Stn. 32, 34, 44, 45 and 63) parts. Among them, Stations 1, 12, 15, 18, 21 and 40 showed high values of equitability in spite of small numbers of species (9-14)(Fig. 28). These high values of equitability may have resulted from the existence of an acidic water mass in the Bay Head Area.

d) Distribution of agglutinated foraminifera

The frequencies of agglutinated foraminifera are shown in Table 6 and their equivalent curves are in Figure 29.

Most of the stations at the shallow sea area (shallower than 150 m) throughout the bay had frequencies of less than 10%.

In the central basin of the Central Area, the frequencies are 20 to 30%. At its northeastern part, exceptionally high frequencies were found, e.g. 96.9% at Station 68 off Furusato Spa on the south coast of Sakurajima, suggesting an occurrence of some peculiar water mass (*see* p. 36).

In the eastern half and northwestern part of the Bay Head Area, the frequencies attained 90-100% reflecting the occurrence of an acidic water mass. On the contrary, the frequencies in the southwestern part were generally low (20-80%). Station 34 showed the lowest frequency (7.6%). This suggests that the area is influenced by open-sea water flowing in through the West-Sakurajima Passage.

e) Distribution of calcareous porcelaneous foraminifera

The frequencies of calcareous porcelaneous foraminifera are shown in Table 6 and their equivalent curves are in Figure 30.

The three stations in the open sea area (Stn. 144, 145 and 146) showed frequencies ranging from 8.7 to 13.8%.

In the Bay Mouth and the Central Areas, the frequencies were rather high. The stations which had frequencies higher than 10% were restricted to the five stations (Stn. 64, 70, 106, 124 and 137) off Ibusuki and Kagoshima Cities.

The frequencies were 0 to 3.6% at the bottom of the Central Area deeper than 100 m and 0 to 1.0% at the basin bottom in the Bay Head Area.

(2) Recognition of the species groups of benthonic foraminifera by cluster analysis and their distribution

Based on the frequencies of the 122 predominant species (Table 7) collected from Kagoshima Bay, a cluster analysis was carried out and a dendrogram (Fig. 31) was obtained based on the frequencies (%) of each species. As a result, the samples collected from the 86 stations were grouped into six groups at the level of 3.0 distance coefficient (Figs. 31 and 32). At the level of 2.0 distance coefficient, Group I was subdivided into three Subgroups (Ia-c), Group II into four Subgroups (IIa-d) and Group V into six Subgroups (Va-f). Further, Subgroup Vd was divided into four minor groups (Vd1-Vd4) at the level of 1.6 distance coefficient and Ve into three minor groups at the level of 1.5 distance coefficient (Ve1-Ve3). The predominant species and the distribution

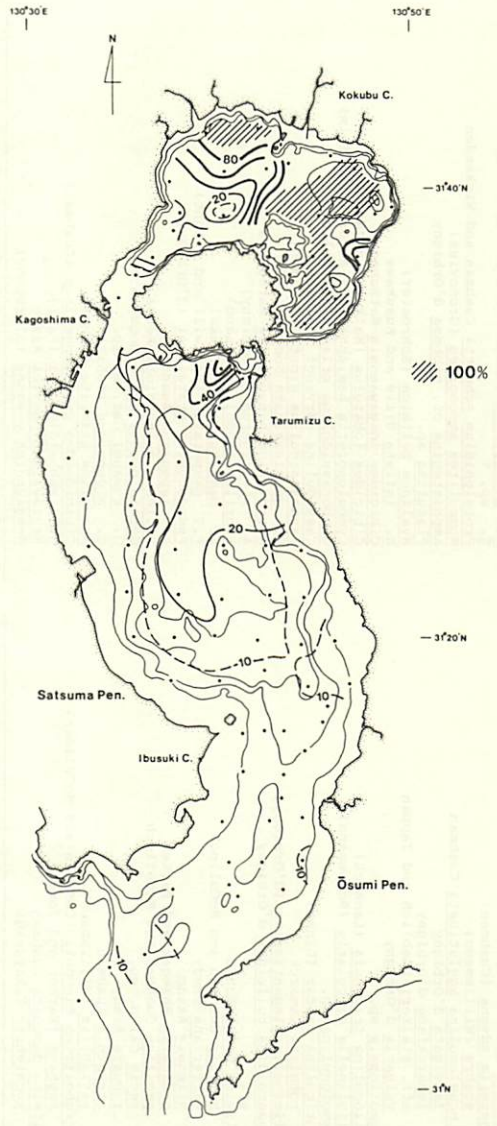

Fig. 29. Distribution of the frequencies (%) of agglutinated foraminifera.

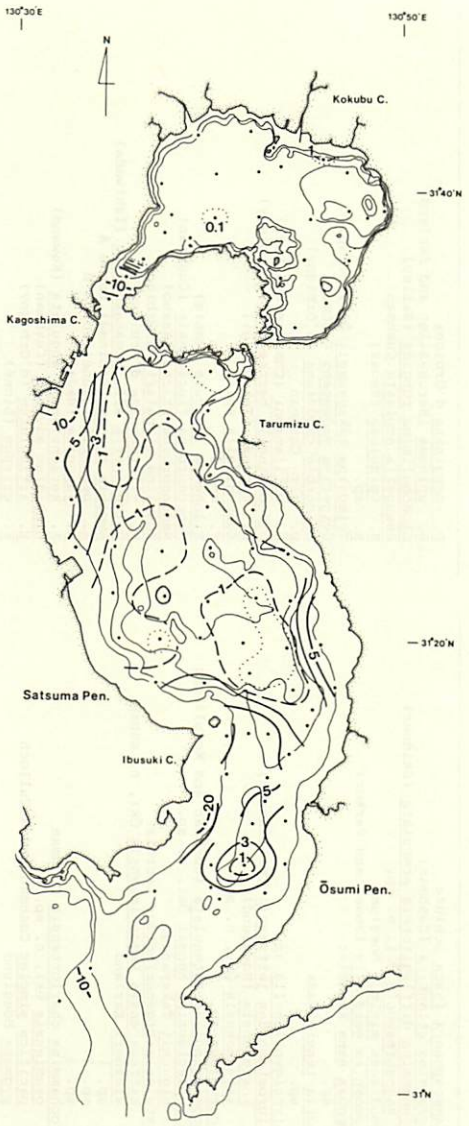

Fig. 30. Distribution of the frequencies of calcareous porcelaneous foraminifera.

Table 7. List of the predominant species used for cluster analysis.

Psammosphaera fusca Schluze
Saccammina atlantica (Cushman)
Lagenammina difflugiformis arenulata (Skinner)
L. kagoshimaensis Ōki, n. sp.
Ammodiscus minimus Hoeglund
Glomospira gordialis (Jones and Parker)
Reophax nana Rhumbler
R. sp.
Nouria tenuis Hada
N. sp.
Spirosigmoilinella sp.
Cribrostomoides jeffreysii (Williamson)
C. kosterensis (Hoeglund)
C. satsumaensis Ōki, n. sp.
Recurvoides sp.
Ammomarginulina catenulata (Cushman and McCulloch)
Spiroplectammina henmii Ōki, n. sp.
S. higuchii Takayanagi
Textularia bigenerinoides Lacroix
T. kattegatensis kagoshimaensis Ōki, n. subsp.
T. wiesneri Earland
T. sp. 1
T. sp. 2
T. sp. 3
Trochammina charlottensis Cushman
T. osumiensis Ōki, n. sp.
T. pacifica simplex Cushman and McCulloch
T. pygmaea Hoeglund
T. sp. 1
Gaudryina nitida Haque
Dorothia sp.
Eggerella advena (Cushman)
E. scabra (Williamson)
Quinqueloculina agglutinata Cushman
Q. laevigata d'Orbigny
Q. lamarckiana d'Orbigny
Q. aff. stalkeri Loeblich and Tappan
Q. vulgaris d'Orbigny
Sigmoilopsis sp.
Triloculina trigonula (Lamarck)
Miliolinella circularis (Bornemann)
Nummoloculina sp.
Lenticulina calcar (Linné)
L. rotulata Lamarck
Buliminella elegantissima (d'Orbigny)
Sphaeroidina bulloides d'Orbigny
S. sp.
Bolivina hadai Uchio
B. humilis Cushman and McCulloch
B. karreriana Brady
B. kiiensis Asano
B. ordinaria Phleger and Parker
B. pacifica Cushman and McCulloch
B. retia Ōki n. sp.
B. robusta Brady
B. striatula Cushman
B. variabilis (Williamson)
Rectobolivina hancocki (Cushman and McCulloch)
R. raphana (Parker and Jones)
Bulimina denudata Cushman
B. kochiensis Takayanagi
B. marginata d'Orbigny
B. spinosa (Heron-Allen and Earland)
Globobulimina turgida (Bailey)
Reussella aculeata Cushman
R. spinulosa (Reuss)
R. sp.
Trimosina takayanagii Ōki, n. sp.
Uvigerina vadescens Cushman
Discorbis candeiana (d'Orbigny)
D. mira Cushman
D. williamsoni (Chapman and Parr)
Discorbinella bertheloti (d'Orbigny)
D. convexa (Takayanagi)
Eoeponidella sp. 1
E. sp. 3
Eilohedra levicula (Resig)
Neoconorbina floridensis (Cushman)
Neoconorbina stachi (Asano)
Rosalina globularis d'Orbigny
R. vilardeboana d'Orbigny
Valvulineria aff. hamanakoensis (Ishiwada)
Ammonia beccarii (Linné) forma A
A. beccarii (Linné) forma B
A. japonica (Hada)
A. ketienziensis angulata (Kuwano)
Elphidium advenum (Cushman)
E. articulatum (d'Orbigny)
E. crispum (Linné)
E. depressulum Cushman
E. jenseni (Cushman)
E. selseyensis (Heron-Allen and Earland)
E. sp. 1
Protelphidium schmitti Cushman and Wickenden
Nummulites ammonoides (Gronovius)
Amphistegina cf. gibbosa d'Orbigny
Planulina sp.
Hyalinea balthica (Schroeter)
H. inflata Ujiié and Kusukawa
Cibicides inagawaensis Matsunaga
Cibicides lobatulus (Walker and Jacob)
Cymbaloporetta hemisphaerica Accordi and Selmi
Globocassidulina oriangulata Belford
Cassidulina nørvangi Thalmann
Paracassidulina minuta (Cushman)
P. quasicarinata Nomura
Astrononion hanyudaense Matsunaga
A. stelligerum (d'Orbigny)
Florilus japonicus (Asano)
F. manpukuziense (Otuka)
F.? pauperatus (Balkwill and Wright)
Pseudononion grateloupi (d'Orbigny)
P. japonicum Asano
Pullenia quinqueloba Reuss
Gyroidinoides acuta Boomgaart
G. kuwanoi Ōki, n. sp.
G. nipponicus (Ishizaki)
Anomalina glabrata Cushman
Cibicidoides pseudoungeriana (Cushman)
C.? subhaidingerii (Parr)
Hanzawaia nipponica Asano
Hoeglundina elegans (d'Orbigny)

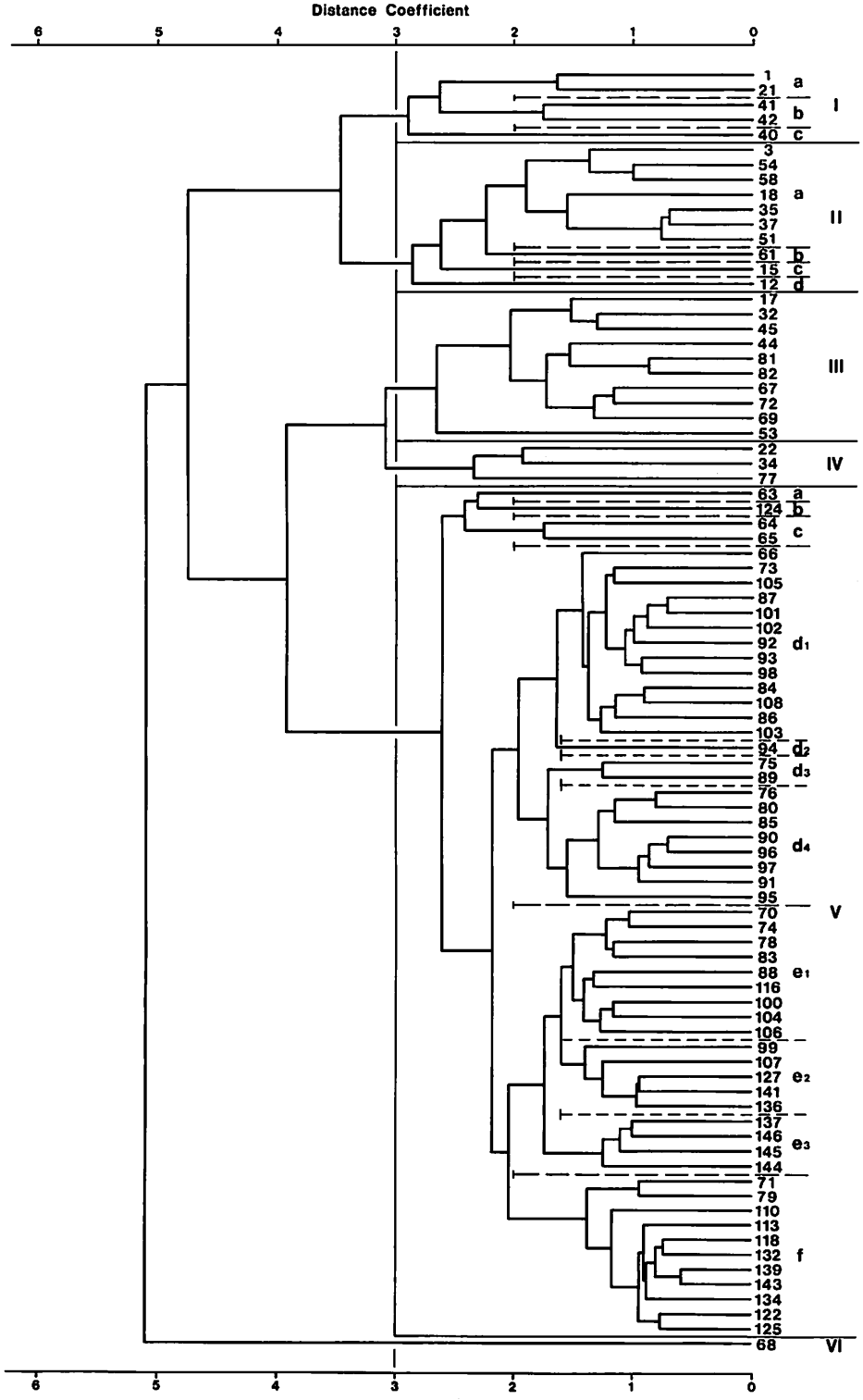

Fig. 31. Dendrogram for benthonic foraminifera.

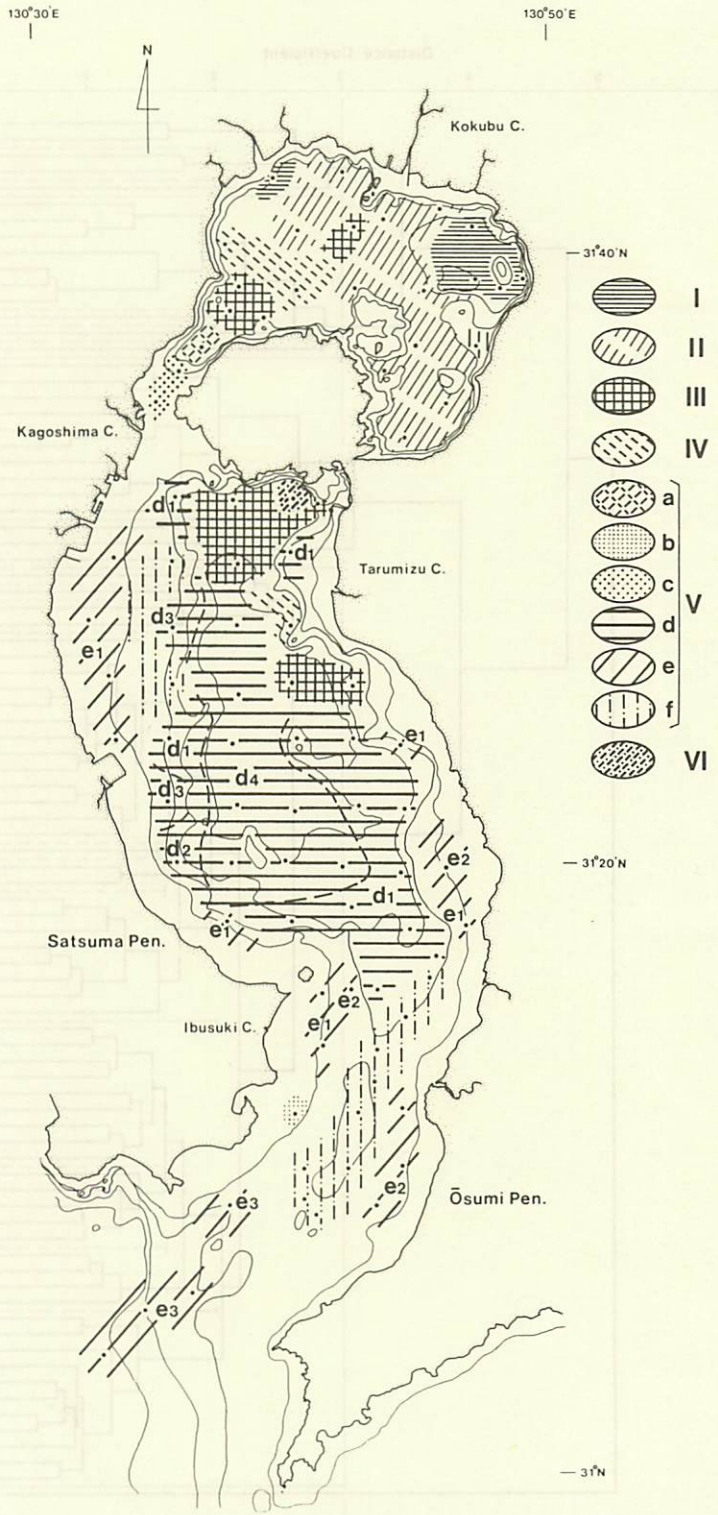

Fig.32. Distribution of the groups of benthonic foraminifera recognized by cluster analysis.

of each Group, Subgroup or minor group are shown in Table 8.

On the 122 species of benthonic foraminifera used for cluster analysis, the frequency of each species in each group is shown in Figure 33.

6. Relation between the number of individuals in each group and the water depth of their habitat

As already mentioned (p.11-13), water temperature and salinity in Kagoshima Bay showed a striking contrast between the water masses above and below a depth of about 100 m. The water mass deeper than 100 m showed rather stable water temperature (14-18°C) and salinity (34.00-34.80‰) throughout the year, while the water shallower than 75 m showed remarkable seasonal changes in water temperature and salinity (Figs. 4 and 5). This may be related to some extent to the existence of the saddle-like topography at the Bay Mouth Area at about 100 m. The open-sea water flowing into the bay through the bay mouth strongly influences the water characters of middle and surface layers, which are shallower than the deepest area at the Bay Mouth (TAKAHASHI, 1981). On the contrary, it does not influence the stagnant water mass having larger specific gravity (Faculty of Fisheries, Kagoshima University, 1975-1977; NOZAWA and SAISHO, 1980; TAKAHASHI, 1981) at the depths greater than 100 m in the Central Area.

On the other hand, the assemblages of benthonic foraminifera in Kagoshima bay indicated a clear difference in species composition between the areas shallower and deeper than 100 m. This seemed to correspond to the differences in water temperature and salinity mentioned above. Therefore, I tried to arrange the groups discriminated by the cluster analysis based on the depth of occurrence. As a result, the groups were grouped into three major groups bounded by and striding over the depth of 100 m. These three major groups are shown in Table 9 with the number of individuals in the unit sample of each group.

As seen in Table 9, the number of individuals in each group of foraminifera tended to be large in the shallow areas and decreased as the water depth increased, except for a few groups which could be explained by the existence of some controlling factors other than the water depth.

(1) The groups which occurred below 100 m in depth

a) The groups which had less than 920 individuals

a-1) The groups which occurred in stagnant water in the deep basin at the Bay Head Area and on the basin bottom at the northeastern part of the Central Area (Groups I, II, IV and VI). The number of individuals ranged from 5 to 112.

a-2) The group distributed on the deepest bottom at the West-Sakurajima Passage (Group Va).

a-3) The group which occupied the basin bottom in the Central Area except for its northeastern part (Group Vd4).

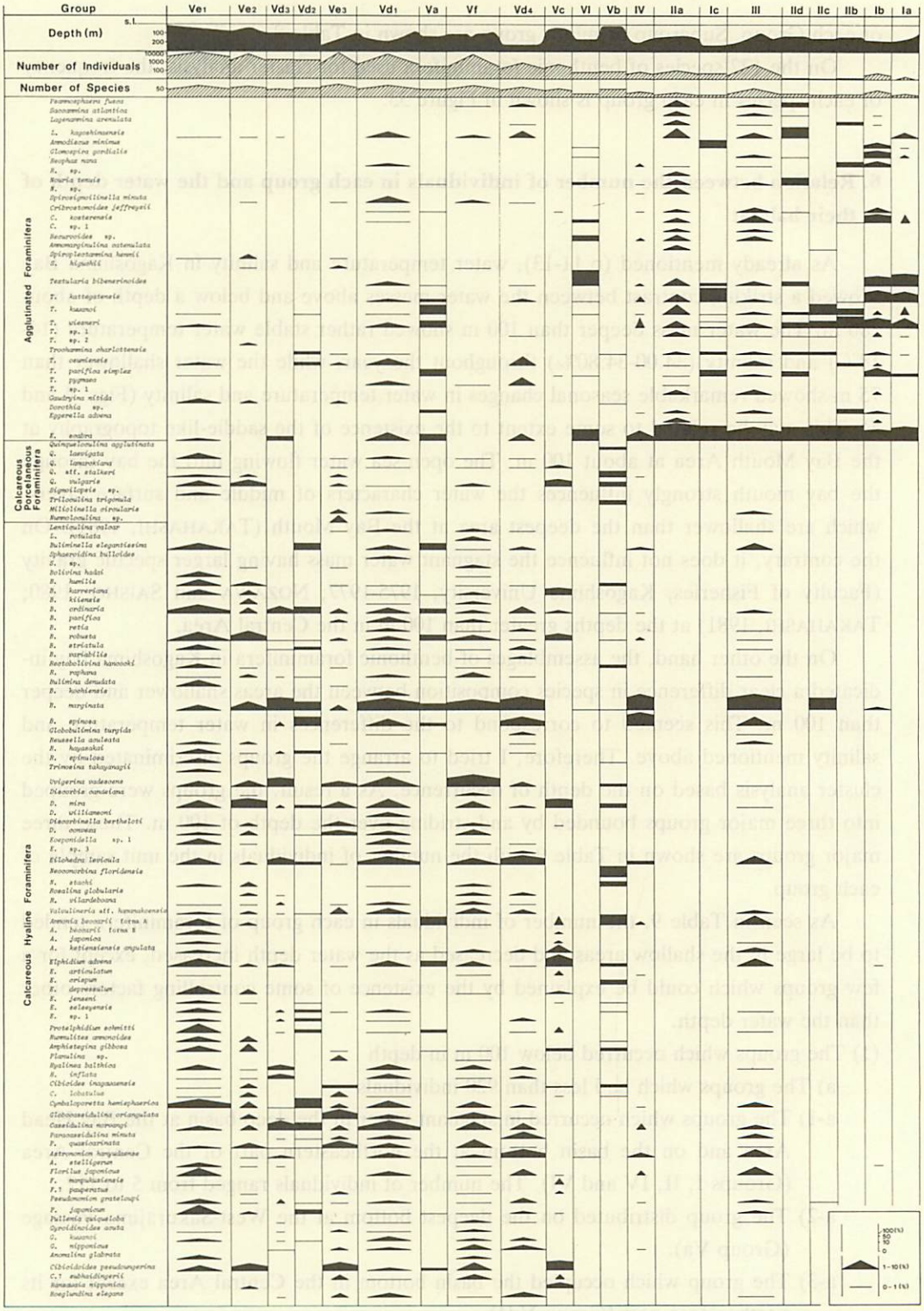

Fig. 33. Frequency of predominant species in each group. The groups are arranged in order of the number of benthonic foraminifera.

b) The groups which had an exceptionally large number of individuals

b-1) The group which occurred on the slope coming down to the basin bottom in the southwestern part of the Central Area, an area influenced by different water masses in each season resulting in a mixture of species of different ecology (Group Vd2).

b-2) The group which inhabited the open-sea bottom and the bottom in the southwestern part of the Bay Mouth under the influence of the Kuroshio Current throughout the year (Group Ve3).

(2) The groups which occurred above 100 m in depth

a) The groups which had more than 1,500 individuals

a-1) The group which occurred at the marginal part of the flat submarine terrace developed along the Satsuma Peninsula, which corresponds to the boundary between the two water masses (Group vd3).

a-2) The groups which inhabited the shallow bottom along the Satsuma Peninsula under the influence of the low salinity and highly nutritious water (NOZAWA and SAISHO, 1980)(Groups Ve1 and Ve2).

b) The groups which had an exceptionally small number of individuals

b-1) The group recognized at Station 124 (24 m in depth) in the shallow area off Yamakawa. The small number of individuals were judged resulted from the destruction of foraminiferal tests by a strong bottom current suggested by the coarse bottom sediments (pebbly sands)(Group Vb).

b-2) The group which occurred on the shallow pebbly sand bottom in the West-Sakurajima Passage, where the strongest tidal current throughout the bay was observed.

(3) The groups distributed across the depth of 100 m

Bulimina marginata having a wide depth range of habitat was recognized as the predominant species in each group. The total numbers of individuals showed a wide range because the distribution covered two different water masses.

a) The group which occupied the basin bottom and the surrounding slopes in the southwestern part of the Bay Head Area and the northeastern part of the Central Area (Group III).

b) The group recognized to occur on the slope (80-185 m in depth) surrounding the basin bottom in the Central Area (Group Vd1).

c) The group which occurred at the margin of the shallow submarine terrace along the Satsuma Peninsula, which corresponds to the boundary between the two water masses different in salinity, and on the deepest bottom of the channel topography in the Bay Mouth Area (Group Vf).

Table 9. Groups of benthonic foraminifera arranged after the water depth of their habitat and the number of individuals in each group.

Depth (m)		Relative abundance of the representative species	Number of Individuals in each Bottom Sample	Environmental Condition and Distribution Area
	102-185	I a: Es(31-39%)-Tb(23-25%)-Tk(7-14%)-Tw(3-12%)	5- 24	a-1) Stagnant water in the deep basin (Bay Head Area;
	170-182	I b: Es(15-18%)-Tk(10-23%)-Tb(9-11%)-Tw(7-17%)-Ck-Gg	29- 40	NE part of the Central Area).
	228	I c: Es(40%)-Tk(29%)-Am-Gg	40	
	124-142	IIa: Es(50-70%)	32- 112	
	138	IIb: Es(56%)-Tw(20%)	15	
100	152	IIc: Es(48%)-Bm(20%)-T1(17%)	12	
	122	IId: Es(38%)-Lk(18%)	15	
	144-196	IV : Bm(24-41%)-Bs(15-30%)-Es(3-16%)	37- 69	
	162	VI : Tb(48%)-Es(20%)-Tw	52	
	138	V a: T1(11%)-Ab	348	a-2) Deepest bottom at the West-Sakurajima Passage.
	170-225	Vd4: Bm(16-27%)-El-Bs	193- 920	a-3) Main part of the basin bottom (Central Area).
	105	Vd2: Ch(11%)-Bs(10%)-Bm-Cn	1750	b-1) Influenced by different water mass in each season. Slope surface (SW part of the Central Area).
	105-213	Ve3: Go(4-11%)-Cp	767-13741	b-2) Influenced by Kuroshio Current throughout the year. (SW part of the Central Area).
	94-220	III : Bm(20-54%)-Es(10-35%)	21- 615	a) Basin bottom and the surrounding slope (SW part of the Bay Head Area; NE part of the Central Area).
Transition	80-185	Vd1: Bm(7-18%)-Cn(2-13%)-El	533- 9103	b) Slope surrounding the main part of basin (Central Area).
	88-140	V f: Uv(8-21%)-Bm(7-16%)	313-13791	c) Boundary between the two water masses at the margin of submarine terrace (west Central Area).
	93- 95	Vd3: Bm(20-27%)-Uv(8-10%)-Cn(5-13%)	1890- 2001	a-1) Boundary between the two water masses at the margin of submarine terrace (west Central Area).
	23- 40	Ve1-1: Ps-Boo-Ea-Ch-Bor-Fj	4478-10104	a-2) Influence by the low salinity and nutritious water. Shallow bottom along the Satsuma Peninsula (west Central Area).
100	61- 78	Ve1-2: Boo(6-10%)-Bm-Ch-Uv	4588-13766	
	38- 75	Ve1-3: Ch(7-10%)-Dm	4041-13766	
	42- 96	Ve2: Dm(6-12%)-Bor(3-11%)-Cp	1594- 8873	
	20	V b: Nf(14%)-Ab(12%)-Qs	89	b-1) Shallow pebbly sand bottom off Yamakawa.
	39- 66	V c: Ea(6-18%)-Cp(9-11%)-Dm	274- 585	b-2) Shallow pebbly sand bottom in the West-Sakurajima Passage.

Es: Eggerella scabra, Tb: Textularia bigenerinoides, Tk: T. kattegatensis,
Tw: T. wiesneri, Ck: Cribrostomoides kosterensis, Gg: Glomospira gordialis,
Am: Ammodiscus minimus, Bm: Bulimina marginata, T1: Textularia sp. 1,
Lk: Lagenammina kagoshimaensis, Bs: Bulimina spinosa, Ab: Ammonia beccarii forma A, El: Eilohedra levicula, Ch: Cymbaloporetta hemisphaerica,
Cn: Cassidulina norvangi, Go: Globocassidulina orianqulata, Cp: Cibicidoides pseudoungerianus, Uv: Uvigerina vadescens, Ps: Protelphidium schmitti,
Boo: Bolivina ordinaria, Ea: Elphidium advena, Bor: Bolivina robusta,
Fj: Florilus japonicus, Dm: Discorbis mira, Nf: Neoconorbina floridensis,
Qs: Quinqueloculina stalkeri.
Ve1-2: Stn. 88 and 116.
Ve1-3: Stn. 100, 104 and 106.
Ve1-1: Stn. 70, 74, 78 and 83.

7. Recognition of the foraminiferal populations*) and their distribution in relation to environmental factors

In Kagoshima Bay, five kinds of water masses are assumed to occur based on the results of oceanographic observation (p. 11-18; Table 10 and Fig. 34).

Judging from the character of each water mass and the distribution patterns of benthonic foraminifera, the Kagoshima Bay area was divided into seven areas of different environment. The characteristics of the bottom sediments is one of the factors controlling the distribution of benthonic foraminifera. In Kagoshima Bay, the correspondence to the bottom character was often observed at the species level. However it was not necessarily ubiquitous; many species were distributed over the different substrata or had biased distributions within an area of the same kind of bottom sediments. For considering the population being a combination of several species, the bottom sediment alone was not regarded to be inadequate as the principal factor controlling the distribution of foraminiferal populations. On the other hand, the water characteristics and the distribution of each water mass were judged to be closely related to the distribution of foraminiferal populations. As shown in Table 10, the five populations of benthonic foraminifera are discriminated in Kagoshima Bay corresponding to the seven divisions of the marine environment.

(1) *Population A*

Predominant species: *Cibicidoides pseudoungerianus, Globocassidulina oriangulata, Paracassidulina quasicarinata, Florilus pauperatus* and *Discorbis mira* (Groups Ve2 and Ve3).

Location: The open sea area (106-213 m in depth) and the coastal water along the Ōsumi Peninsula in the Bay Mouth Area and the southeastern part of the Central Area (43-96 m in depth).

Salinity of water near the bottom where the present population occurred was rather high throughout the year, namely higher than 33.2‰ at 50 m, 33.5‰ at 75 m and 34.2‰ at 100 m (Faculty of Fisheries, Kagoshima University, 1975-1977).

Water temperature at the depth of 50 m changes between 14.2 and 25.0°C through the year, while at the depth of 100 m it shows a very little annual change between 14.4 and 17.7°C.

Bottom sediments of the area were represented by sands (Md ϕ: -0.3 to 3.3) reflecting a rather strong current of the open-sea water flowing into the bay.

(2) *Population B*

Predominant species: *Cymbaloporetta hemisphaerica, Buliminella elegantissima, Bolivina ordinaria, Protelphidium schmitti* and *Pseudononion japonicum* (Groups Vd2 and Ve1).

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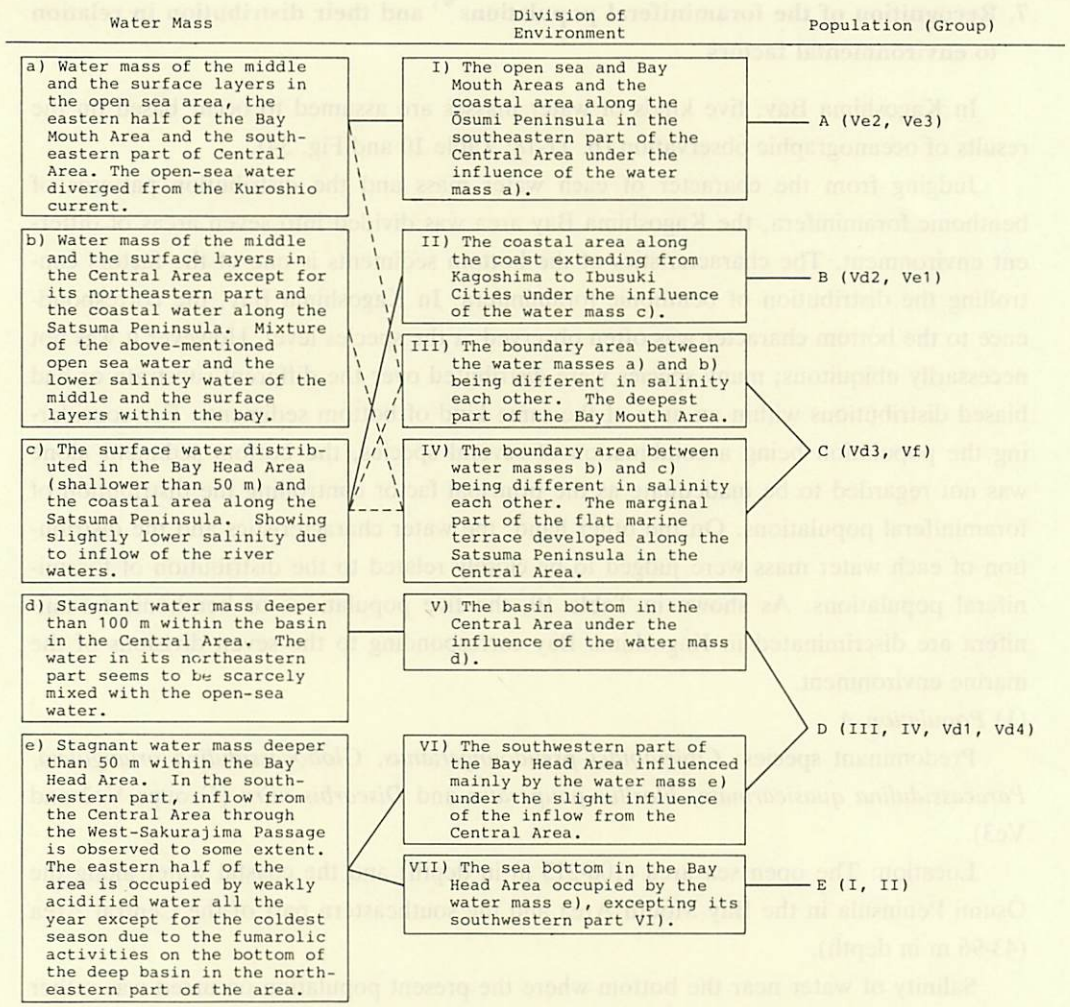
*) Not the "Species Population", but the "Inter-species Population" (ODUM, 1953) mainly based on the number of individuals of several species (MIYADI *et al.*, 1961) of foraminifera.

Table 10. Process for recognizing the foraminiferal populations in Kagoshima Bay.



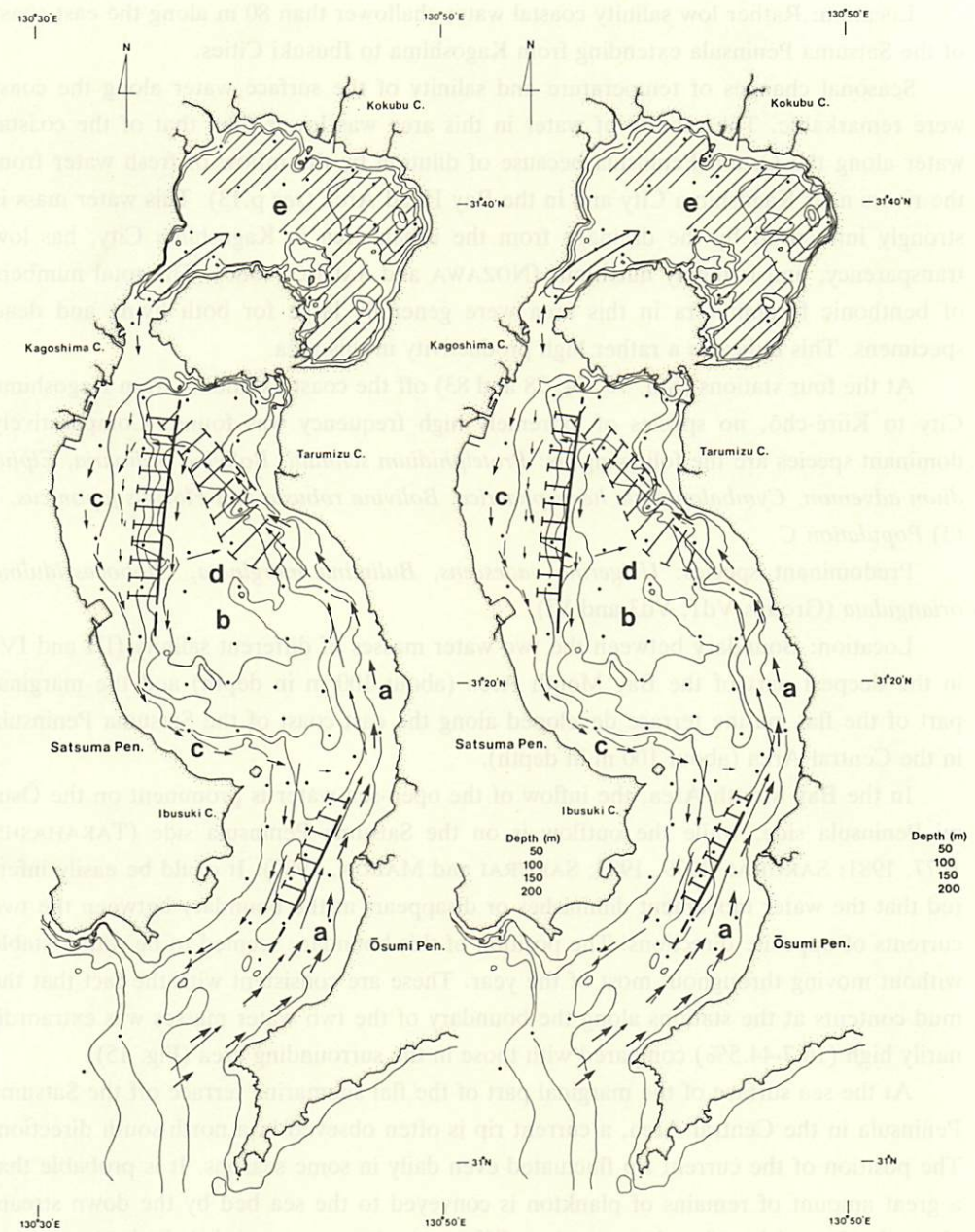


Fig. 34. Distribution of the water masses and the current system in Kagoshima Bay (stereoscopic map).

Location: Rather low salinity coastal water shallower than 80 m along the east coast of the Satsuma Peninsula extending from Kagoshima to Ibusuki Cities.

Seasonal changes of temperature and salinity of the surface water along the coast were remarkable. The salinity of water in this area was lower than that of the coastal water along the Ōsumi Peninsula because of dilution by the inflow of fresh water from the rivers near Kagoshima City and in the Bay Head Area (*see* p.13). This water mass is strongly influenced by the drainage from the urban area in Kagoshima City, has low transparency, and is highly nutritious (NOZAWA and SAISHO, 1980). The total numbers of benthonic foraminifera in this area were generally large for both living and dead specimens. This indicates a rather high productivity in this area.

At the four stations (Stn. 70, 74, 78 and 83) off the coast extending from Kagoshima City to Kiiré-chō, no species of extremely high frequency was found. Comparatively dominant species are the following six: *Protelphidium schmitti, Bolivina ordinaria, Elphidium advenum, Cymbaloporetta hemisphaerica, Bolivina robusta* and *Florilus japonicus.*

(3) *Population C*

Predominant species: *Uvigerina vadescens, Bulimina marginata, Globocassidulina oriangulata* (Groups Vd1, Vd3 and Vf).

Location: Boundary between the two water masses of different salinity (III and IV) in the deepest part of the Bay Mouth Area (about 100 m in depth) and the marginal part of the flat marine terrace developed along the east coast of the Satsuma Peninsula in the Central Area (about 100 m in depth).

In the Bay Mouth Area, the inflow of the open-sea water is prominent on the Ōsumi Peninsula side, while the outflow is on the Satsuma Peninsula side (TAKAHASHI, 1977, 1981; SAKURAI, 1979, 1983; SAKURAI and MAEDA, 1980). It could be easily inferred that the water movement diminishes or disappears at the boundary between the two currents of opposite directions. The position of this boundary seemed to be rather stable without moving throughout most of the year. These are consistent with the fact that the mud contents at the stations along the boundary of the two water masses was extraordinarily high (16.7-44.5%) compared with those in the surrounding area (Fig. 15).

At the sea surface of the marginal part of the flat submarine terrace off the Satsuma Peninsula in the Central Area, a current rip is often obseved in a north-south direction. The position of the current rip fluctuated even daily in some seasons. It is probable that a great amount of remains of plankton is conveyed to the sea bed by the down stream along the frontal interface between two different water masses, and their decomposition consumes oxygen resulting in the low dissolved oxygen near the bottom. It is still in question, however, whether the distribution of *Uvigerina vadescens, Globocassidulina oriangulata* and *Paracassidulina quasicarinata* implys their adaptation to the environment of low dissolved oxygen.

(4) *Population D*

Predominant species: *Bulimina marginata* (Groups III, IV, Vd1 and Vd4).

Location: Deep basin bottom deeper than 100 m in the Central Area filled with

stagnant water (Water mass d), and the sea bottom in the southwestern part of the Bay Head Area (Water mass e).

At the shallowest part of this water mass (about 100 m in depth), water temperature fluctuated between 14.5 and 22.4 °C and salinity between 33.5 and 35.3‰ through the year showing considerable seasonal changes. On the contrary, slight seasonal changes were observed at the depth of 150 m in water temperature (14.4-17.8°C) and salinity (34.0-34.8‰)(Fig. 4).

This population was distributed in the three isolated areas accompanied by a distinctive predominant species coexisting with *Bulimina marginata*. Namely, the population on the slope descending to the basin bottom in the Central Area (80 to 185 m in depth) is characterized by *Cassidulina nørvangi* (Group Vd1); the one on the deep basin bottom of about 200 m in depth in the Central Area except for its northeastern part is characterized by *Eilohedra levicula* and *Astrononion hanyudaense* (Group Vd4); and the other one on the basin bottom in the northeastern part of the Central Area is characterized by *Eggerella scabra* (Group III). The difference in the predominant species associated with *Bulimina marginata* between most of the basin bottom in the Central Area and its northeastern part is attributable to the fact that the latter area is located outside of the counterclockwise current system assumed to occur in the Central Area (*see* p. 18).

(5) *Population E*

Predominant species: *Eggerella scabra* (Groups I, II and III).

Location: Deep basin bottom in the Bay Head Area, occupied by stagnant water (Water mass e).

The temperature and the salinity of the water mass deeper than 50 m are rather stable through the year as follows:

Water Depth	Temperature (°C)	Salinity (‰)
Shallower than 25 m	14.4 - 29.5	23.35 - 34.10
50m	15.5 - 20.4	33.50 - 34.30
Deeper than 150 m	14.5 - 17.6	33.60 - 34.50

Near the basin bottom, the DO of the water changed considerably throughout the year. From summer to winter, the DO decreases from 3.00 to 0.28 (*see* p. 15).

As already mentioned, in the eastern half of the Bay Head Area the water mass is acidified due to the fumarolic activity on the bottom. Among the agglutinated foraminifera predominating in this area, frequencies of *Textularia kattegatensis, Ammodiscus minimus* and *Glomospira gordialis* (Stn. 21, 40, 41 and 42) increased toward the fumaroles (Station 40 being closest).

The bottom sediments near Station 40 contains H_2S (Kagoshima Prefectural Government, 1978). This suggests the presence of a reductive condition near the bottom of this deep basin. It is still unknown, however, whether the above-mentioned three species

are adapted to this peculiar environment or not.

In addition to the foregoing populations, only a single peculiar assemblage of benthonic foraminifera (Group VI) was found at Station 69 off Furusato Spa on the south coast of Sakurajima, the northeastern part of the Central Area. The assemblage (Group VI) is characterized by extraordinary high frequencies of *Textularia bigenerinoides* (48%) and *Eggerella scabra* (20%). This type of species composition was not found at the other stations in Kagoshima Bay. The species composition of this assemblage shows some similarity to that of population E, but differs from the latter because it contained a few species of calcareous hyaline foraminifera. This suggests the influence not of acidic water as seen in the Bay Head Area, but of some peculiar environmental factors, such as hot spring water known to well out at the shallow bottom below low tide line near the Furusato Spa. I regard this unusual assemblage as an exceptional occurrence in Kagoshima Bay.

Discussion

Comparison between the results of population analysis of the benthonic foraminifera in Kagoshima Bay and those in other Japanese waters will be given in the present chapter.

1. Distribution of planktonic foraminifera and radiolaria

Through the estimation using the L/Tl value (*see* p. 29), it was made clear that the numbers of individuals of the planktonic foraminifera and radiolaria preserved in sediments were scarcely related to the water depth (Figs. 19 and 20), but were controlled by the movement and structure of water masses.

It was particularly noticeable that the numbers of individuals of planktonic foraminifera and radiolaria below the current rip in the northeastern part of the Central Area, was two to ten times of those on the basin bottom in the Central Area. PHLEGER (1951) mentioned that mixing of water at the edges of the currents of different productivity may cause deposition of specimens which are killed because of unfavorable ecological conditions. HOSHINO (1952) and SAKAMOTO (1982) also reported on the precipitation and dep osition of suspended matters by the down stream developed at the frontal interface between two water masses.

2. Planktonic ratio

GRIMSDALE and MORKHOVEN (1955) demonstrated the change in the relative proportion of planktonic and benthonic foraminifera with water depth in Recent sediments in the Gulf of Mexico. ŌKI (1983, 1985) reported that the planktonic foraminifera con-

tents (Planktonic ratio) in the bottom sediments in the Tañon Strait, the Philippines and off the southeast coast of Viti Levu Island, Fiji are plotted around a parabolic line on the graph of abundance against water depth.

In the Bay Mouth and the Central Areas of Kagoshima Bay, the planktonic ratios were generally related to water depth but there was no relationship between the number of individuals of the planktonic foraminifera in sediments and water depth (Figs. 21 and 22). A rather good interrelation between the planktonic ratio and water depth exists in deep embayments or open sea stable environments (KUWANO, 1953; MATOBA, 1976a).

3. Peculiar occurrence of benthonic foraminifera

In his pioneer work on the Recent foraminifera in Kagoshima Bay, KUWANO (1962-63) mentioned that the numbers of individuals both of living and total populations in Kagoshima Bay are larger than those in the bay mouth area of Tokyo Bay and off the Bōsō Peninsula. On the other hand, I recognized generally smaller sizes of the foraminifera specimens from Kagoshima Bay, and presume that they have alternation of generation at the earlier growth stages. The foregoing features of the benthonic foraminifera strongly suggests that Kagoshima Bay furnishes an environment suited to the survival of the benthonic foraminifera.

Only a few authors discussed the relation between the numbers of living individuals and of the total (living and dead) individuals. MATOBA (1970) reported that in Matsushima Bay these two values do not have a positive correlation with each other. This must be due to the very shallow depths (less than 12.5 m) of Matsushima Bay, which results in extreme seasonal changes in sea condition and in number of living individuals.

In embayments or the open sea deeper than 50 m having rather stable water masses, the distribution pattern of benthonic foraminifera does not seem to change seasonally. Generally speaking, unless the post-mortem movement is taken into consideration, the numbers of living and dead individuals of the benthonic foraminifera must be directly related.

The high frequencies of the agglutinated foraminifera among the total benthonic foraminifera usually occur in the open sea area ranging from the continental shelf to the ocean floor (BOLTOVSKOY and WRIGHT, 1970). It is also known, however, that rather high frequencies of the agglutinated foraminifera occur in the inner bay and the brackish-water lakes characterized by a rather scanty occurrence of calcareous foraminifera. Many believe that assemblages dominated by agglutinated forms or a poor population of calcareous benthonic foraminifera may be caused by the oligo-oxygen status (ISHIWADA, 1964). MATOBA (1970) also mentioned that the assemblages showing high frequencies of agglutinated foraminifera are influenced by river waters, either directly or indirectly, namely, under the influence of lower chlorinity and/or deep penetration of embayments into the land.

As already mentioned, in the Bay Head Area of Kagoshima Bay, especially in its

eastern half, the agglutinated foraminifera make up the greatest part of the population under the influence of acidic water mass caused by submarine fumarolic activities (*see* p. 15). In their study on the foraminiferal decimation and repopulation in an active volcanic caldera on Deception Island, Antactica, FINGER and LIPPS (1981) reported that foraminifera were rare and almost exclusively arenaceous in shallow water samples obtained near fumaroles. KITAZATO (1979) applied the information on the unusual occurrence of benthonic foraminifera in the Bay Head Area of Kagoshima Bay to the explanation of sedimentary environment of the "Kuroko-deposits" in relation to the fossils of benthonic foraminifera.

4. Distribution of foraminiferal populations and the environmental factors

In this section, each of the five populations of foraminifera found in Kagoshima Bay will be compared with those mainly from the Japanese waters in relation to the environmental factors.

(1) Population A (predominant species: *Cibicidoides pseudoungerianus, Globocassidulina oriangulata, Paracassidulina quasicarinata, Florilus pauperatus, Discorbis mira*)

Cibicidoides pseudoungerianus occurs in many places on the continental shelf and slope around the Japanese Islands. *Globocassidulina oriangulata, Paracassidulina quasicarinata*, and *Florilus pauperatus* are regarded to be the species characteristic of the Kuroshio area, but hitherto unknown from north of Kyūshū. *Discorbis mira* distributed in the low saline coastal water along the Satsuma Peninsula is also a common inhabitant in the coastal water under the influence of the Kuroshio Current.

(2) Population B (predominant species: *Cymbaloporetta hemisphaerica, Buliminella elegantissima, Bolivina ordinaria, Protelphidium schmitti, Pseudononion japonicum*)

Buliminella elegantissima seems to be abundant in the nearshore and bay areas, and its high frequencies are known in areas near the outfall of sewage. The geographic distribution of this species may be divided into two areas: one is around northeast Japan (37° to 45°N) and the other is around southwestern Japan (31° to 35°N). This biogeographic information leads to the following two different hypotheses: 1) this form is originally a cold water species, and its southwestern counterpart became isolated in the postglacial age; 2) this form is a cosmopolitan species and has a sporadic distribution off Japan (ŌKI, 1989).

Pseudononion japonicum has been known to occur in the shallow water to the continental shelf around Japan. *Cymbaloporetta hemisphaerica, Bolivina ordinaria, Protelphidium schmitti* have been unknown around Japan, were found from Kagoshima Bay for the first time.

(3) Population C (predominant species: *Uvigerina vadescens, Bulimina marginata, Globocassidulina oriangulata*)

ISHIWADA (1964) recorded the occurrence of assemblage composed of *Bulimina marginata* and *Uvigerina vadescens* at the edge of the continental shelf (120-280 m in

depth) off Tosa Bay. Judging from the environment of Population C in Kagoshima Bay, the above-mentioned assemblage off Tosa Bay is probably located at the boundary between the coastal water in Tosa Bay and the open-sea water of the Kuroshio Current.

(4) Population D (predominant species: *Bulimina marginata*)

Bulimina marginata is reported to occur in the coastal area and the continental shelf (about 50 to 150 m in depth) ranging from Hokkaido to Kyūshū. The occurrence of the present species in Kagoshima Bay suggests that the water in the Bay Mouth and Central Areas is strongly influenced by the open-sea water.

(5) Population E (predominant species: *Eggerella scabra*)

Eggerella scabra occurs from the southern part of Okhotsk Sea (KUWANO, 1953, 1954), off Niigata (UCHIO, 1962b), Toyama Bay (ISHIWADA, 1950) and Kamaé Bay, Ōita Prefecture (KAMEYAMA, 1984). However, in such high frequencies as in the present study (50%) in natural assemblage has never been reported. DANIELS (1970) studied the seasonal changes of living a population in Limski Canal, the northwesternmost part of Yugoslavia and reported that *Eggerella scabra* seasonally changed in frequency from 10 to 20% at Station 52 located at the innermost part of the bay. There is no distinct difference in water temperature (10-23°C), salinity (35.5-38.1‰) and pH value (8.0-8.5) between Limski Canal and Kagoshima Bay. Although there are no comment on the sea water movement, the elongate outline (11 km long and 1 km wide) of Limski Canal suggests that sea water exchange is poor similar to Kagoshima Bay. The high frequencies (around 50%) of *Eggerella scabra* seem to be realized under stagnant water conditions in conjunction with restricted sea water exchange.

Summary and Conclusion

For ecological analysis, I treated the living and dead specimens of foraminifera in the uppermost 1 cm of bottom sediment cores collected mainly in winter season. It is recognized, however, that the contents of living benthonic foraminifera in each sample is unexpectedly low (Tables 4 and 12) and judged to be insufficient for their population analysis. For the population analysis of living benthonic foraminifera, it is necessary to accumulate many more individuals of living specimens representing two to four seasons in a year. I will reserve this problem for future study.

The results of the present study are summarized in the following lines.

(1) The L/Tl value (ŌKI, 1986b) indicating the relative rate of sedimentation between two stations is useful as the criteria for the direction and strength of the bottom current if the grain size distribution in the area is taken into consideration. The ratio between the L/Tl and the L/T (PHLEGER, 1951) values indicates the approximate amount of dead tests transported from outside.

(2) In the Bay Mouth and the Central Areas, the ratios of planktonic foraminifera to the total foraminifera are directly related to water depth (Fig. 21 and 22). At the northern

part of the Central Area and the southwestern part of the Bay Head Area where the sea water exchange is restricted, the dead tests of planktonic foraminifera are rare in the bottom sediments. In the eastern half and the northwestern part of the Bay Head Area, the dead tests of planktonic foraminifera are entirely absent in the bottom sediments, probably due to the influence of the acidic water mass and partly to the restricted sea water exchange.

(3) As shown in the following table, the number of individuals of benthonic foraminifera is large in the open sea area and decrease toward the bay head. In the Bay Head Area, it is extremely small reflecting the influence of the acidic water in addition to the topographically restricted sea water exchange.

Open sea	: 767 - 13741*)
Bay Mouth Area	: 89 - 13791
Southern part of the Central Area	: 314 - 8873
Northern part of the Central Area	: 52 - 10104
Bay Head Area	: 5 - 585

(4) The number of species decreases toward the bay head and this tendency is the same as the case of the number of individuals (Table).

Open sea	: 58 - 60
Bay Mouth Area	: 49 - 72
Southern part of the Central Area	: 40 - 63
Northern part of the Central Area	: 21 - 56
Bay Head Area	: 11 - 49

(5) The frequency of the agglutinated foraminifera has a tendency to increase toward the bay head. In the open sea, the Bay Mouth and the Central Areas, it ranged from 2.2 to 14.4% and at the basin bottom except for Station 68 off Furusato Spa, it ranged from 10.4 to 34.5%. At Station 68, it reached up to 96.9%, probably under the influence of hot spring or acidic waters. In the Bay Head Area, it ranged from 7.6 to 48.8% in the southwestern part under the influence of water mass flowing in from the Central Area, and 40.9-100% in the eastern half and the northwestern part reflecting the influence of the acidic water mass.

(6) The frequency of the porcelaneous foraminifera reached up to 4.8-20.5% in the coarse-grained bottom sediments (Mdϕ: 0-3 ϕ) of the open sea area, the Bay Mouth

*) Number of individual (in 10cc)×L/Tl value

Area except for its deepest part, and in the shallow coastal area of the Central Area (including the West-Sakurajima Passage).

(7) Based on the frequency of each species, the total benthonic foraminiferal assemblage was divided into six groups and 13 subgroups through a cluster analysis.

(8) Based on the data of the oceanographic observation and the grain-size distribution of bottom sediments, five water masses different in quality were recognized to develop in Kagoshima Bay (Table 10, Fig. 34).

(9) Considering the bottom topography and the distribution pattern of foraminifera in addition to the five water masses, Kagoshima Bay was divided into seven marine environments (Table 10).

(10) In relation to the seven divisions of the marine environment, the foraminiferal assemblages in Kagoshima Bay were grouped into the following five populations:

(11) The populations predominated by *Bulimina marginata, Uvigerina vadescens* and *Globocassidulina oriangulata* (Population C) were found to occur in the vicinities of the boundary between two different water masses (Tables 9 and 10). It is probable that the

Population	Predominant Species	Distribution	Environmental Factors
A	*Cibicidoides pseudoungerianus* *Globocassidulina oriangulata* *Paracassidulina quasicarinata* *Florilus pauperatus* *Discorbis mira*	The open sea area and the eastern half of the Bay Mouth Area.	Strongly influenced by the open-sea water.
B	*Cymbaloporetta hemisphaerica* *Buliminella elegantissima* *Bolivina ordinaria* *Protelphidium schmitti* *Pseudononion japonicum*	Shallow coastal water along the coast of the Satsuma Peninsula ranging from the Central to the Bay Mouth Areas.	Showing rather low salinity reflecting the influence of river waters flowing into the northern part of the area.
C	*Uviqerina vadescens* *Bulimina marginata* *Globocassidulina oriangulata*	The deepest part of the Bay Mouth Area and the marginal part of the flat submarine terrace shallower than 100m developed off the coast between Kagoshima City and Kiiré-chō, western part of the Central Area.	Boundary area between the two water masses differnt in salinity from each other.
D	*Bulimina marginata*	The basin bottom at the central part of the Central Area.	Relatively stagnant water mass weakly mixed with the open-sea water.
E	*Eggerella scabra*	The Bay Head Area.	The water mass being stagnant throughout the year except for the coldest season and strongly restricted in exchange with the open-sea water.

occurrence of *U. vadescens* and *G. oriangulata* limited to the boundary areas between two different water masses signify their adaptation to the lowering of dissolved oxygen near the bottom of the boundary area between the water masses resulting from the consumption of oxygen through the decomposition of organic remains accumulated in this area.
(12) Abundancy of *Bulimina marginata* in the coastal water and on the continental shelf ranging from Hokkaido to Kyūshū indicates that Kagoshima Bay is influenced by the open-sea water.
(13) Although the reports on the occurrences of *Eggerella scabra* are very few, it is expected that the species inhabits the embayments and the coastal waters with poor sea water exchange in other areas of the Japanese Islands.
(14) In 1962, KUWANO reported some occurrences of benthonic foraminifera with calcareous test from the eastern half of the Bay Head Area while at present the area is barren of them. This suggests that the development of the acidic water in this area has progressed since the time of KUWANO's study (1962-1963), in other words, the submarine fumarolic activity has been increasing. At the stations close to the fumaroles, high frequencies of *Textularia kattegatensis kagoshimaensis, Ammodiscus minimus* and *Glomospira gordialis* were found.

As pointed out by MATOBA (1970), there has been some difficulty in comparing the assemblages of foraminifera in the surface layer of the bottom sediments of different areas studied by different authors. This stems from the different methods of sampling and treating samples. To avoid this difficulty in the study of foraminifera, the following methods applied by MATOBA in a series of his studies (1970, 1972 and 1976a-c) are most recommendable for the qualitative and quantitative analyses of foraminiferal assemblages.

a) The uppermost 1 cm (ca. 10cc) of the sample collected by core sampler should be used for study.

b) The sample for study should be preserved with neutralized formalin to prevent the pH value from decreasing to less than 7.0.

c) To discriminate the living specimens, the uppermost 1 cm of the sample should be dyed with Rose Bengal. The succeeding 5 cm samples should be checked as well.

d) For cleaning specimens, a 200 mesh screen should be used.

In conclusion, I would like to mention that population analyses of benthonic foraminiferal assemblages should be performed in consideration with the environmental factors such as the physico-chemical properties of the bottom sediments and the oceanographic data on the quality and structure of the sea water masses.

The accumulated information on ecology and taphonomy of the Recent benthonic foraminifera will serve as a valuable base for paleoecological studies on fossil foraminifera.

Systematic Description

Order FORAMINIFERIDA EICHWALD, 1830
Suborder TEXTULARIINA DELAGE and HÉROUARD, 1896
Superfamily AMMODISCACEA REUSS, 1862
Family SACCAMMINIDAE BRADY, 1884
Subfamily PSAMMOSPHAERINAE HAECKEL, 1894
Genus *Psammosphaera* SCHULZE, 1975

Psammosphaera fusca SCHULZE

Psammosphaera fusca SCHULZE, 1875, Comm. Wiss. Unter-suchung Deutsch. Meer in Kiel, Jahresber., Jahrg. 2-3, p. 113, pl. 2, figs. 8a-f; CUSHMAN, 1910, p. 35, figs. 25-28; CUSHMAN, 1918, p. 35, pl. 13, figs. 1-6, pl. 14, figs. 1-3; HADA, 1931, p. 51, text-fig. 2; BARKER, 1960, no. 9, p. 36, pl. 18, fig. 1; COLE, 1981, p. 12, pl. 3, fig. 4; MAIYA and INOUÉ, 1982, no. 16, p. 13, pl. 1, fig. 11.

Occurrence and Repository: Bay Head Area (Stn. 12, 22, 35, 37, 51, 53, 54: 94-144 m in depth); Central Area (Stn. 66, 69, 71, 80, 85: 88-225 m); Bay Mouth Area (Stn. 108, 118, 143: 96-120 m); ESK*) Reg. no. F-7001 - 7015.

*Geographic Distribution***): Off the west coast of Hokkaido and the northeast coast of Honshū; 5)***); 6) 610-1350 m; 18) 27.5-36.6 m; 28) 14 m.

Remarks: At the three stations (Stn. 35, 37 and 51) surrounding the An-éi rise, rather high (3-6%) frequencies were found. This species has never been reported from the Kuroshio area and seems to be widely distributed in the cold water around Japan. Outside of Japanese waters, however, HERON-ALLEN and EARLAND (1915) reported this species from the warm and shallow water of the Kerimba Archipelago.

Subfamily SACCAMMININAE BRADY, 1884
Genus *Saccammina* M. SARS in CARPENTER, 1869

Saccammina atlantica (CUSHMAN)

Pl. 1, figs. 1a-b

Proteonina atlantica CUSHMAN, 1944, Cushman Lab. Foram. Res., Spec. Publ., no. 12, p. 5, pl. 1, fig. 4; BANDY, 1953, v. 27, p. 29, pl. 21, figs. 5a-b.

Saccammina atlantica (CUSHMAN). MURRAY, 1973, p. 53, 129, 131, pl. 6, figs. 4-6; COLE, 1981, p. 13, pl. 3, fig. 2.

Occurrence and Repository: Bay Head Area (Stn. 12, 35, 37, 41, 51, 53, 58, 65: 39-182 m; living 182 m); Central Area (Stn. 73, 82, 94: 80-150 m); Bay Mouth Area (Stn. 110, 141: 60-110 m); ESK Reg. no. F-7016 - 7028; hypotype in fig. 1a, ESK Reg. no. F-7029 from Stn. 37 and in fig. 1b, ESK Reg. no. F-7027 from Stn. 110.

Remarks: Only a single, oval- or pyriform-chambered specimen without a distinct neck is in the collection. The size of clastic material is variable, but rather fine-grained

*) Abbreviation for the Institute of Earth Sciences, Faculty of Science, Kagoshima University.
**) The geographic distribution described here is restricted to the area around the Japanese Islands.
***) The number of the distribution areas is listed in Appendix I together with the references.

as a whole, and the surface of the test is smooth. This is the first record of the present species in the Japanese waters. In Kagoshima Bay, this species occurs in near shore areas irrespective of water depth.

Genus *Lagenammina* RHUMBLER, 1911

Lagenammina difflugiformis arenulata (SKINNER)

Reophax difflugiformis BRADY subsp. *arenulata* SKINNER, 1961, Jour. Pal., Tulsa, Okla., v. 35, no. 6, p. 1239.

Occurrence and Repository: Bay Head Area (Stn. 32, 37, 42, 61, 63: 124-170 m; living 124 m); Central Area (Stn. 67, 69, 91: 150-207 m); Bay Mouth Area (Stn. 113: 100 m); ESK Reg. no. F-7030 - 7038.

Remarks: The specimen in the collection has a single chamber and is identified with *Reophax difflugiformis arenulata* SKINNER being a single-chambered form (SKINNER, 1961). However, this subspecies, having a single chamber, should be allocated to the genus *Lagenammina*, not to the multiple-chambered genus *Reophax*. This is the first record of the present species in Japanese waters.

Lagenammina kagoshimaensis ŌKI, n. sp.

Pl. 1, figs. 2a-c

Test free, consisting of a single, oval- or pyriform- chamber with a distinct tubular neck made of very fine materials; chamber undivided; wall composed of closely cemented volcanic glasses of variable sizes; aperture simple, terminal.

Types and Dimensions: Holotype in fig. 2a, ESK Reg. no. F-7039 from Stn. 12, length 0.37 mm, breadth 0.23 mm; paratype in fig. 2b, ESK Reg. no. F-7040 from Stn. 12, length 0.37, breadth 0.28 mm; paratype in fig. 2c, ESK Reg. no. F-7041 from Stn. 113, length 0.25, breadth 0.16 mm.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 12, 17, 18, 21, 22, 32, 34, 35, 37, 42, 44, 45, 51, 53: 94-185 m; living 122-140 m); West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m; living 39-138 m); Central Area (Stn. 66, 72, 73, 75, 76, 78, 80, 81, 82, 85, 86, 87, 88, 89, 90, 91, 92, 93, 95, 96, 97, 99, 100, 101, 102, 103: 40-225 m; living 42-225 m); Bay Mouth Area (Stn. 107, 113, 118, 132: 96-101 m; living 100 m); open sea area (Stn. 144: 105 m; living); ESK Reg. no. F-7042 - 7092.

Remarks: All the specimens abundantly collected from Kagoshima Bay are single chambered. KUWANO (1962) reported *Reophax difflugiformis* BRADY from Kagoshima Bay. Judging from the figures in his paper, his specimens are also single-chambered and are hardly identified as the genus *Reophax*. The general features of KUWANO's specimens suggest the identity with the present new species. The specimen closely allied to the present new species has been reported by HADA (1931) from Mutsu Bay in Aomori Prefecture, Northeast Japan under the name of *Proteonina difflugiformis* (BRADY). It was described as single chambered, and therefore, the generic position must not be *Proteonina*, but *Lagenammina*. The specimens from Mutsu Bay are generally smaller than those from Kagoshima Bay and have tests composed of mica flakes and sand grains smoothly cemented. A detailed comparison between the Mutsu Bay and the Kagoshima

Bay specimens is necessary in the future.

Lagenammina lagenaria (BERTHELIN)

Haplophragmium lagenarium BERTHELIN, 1880, Mem. Soc. Geol. France, ser. 3, v. 1, no. 5, p. 21, pl. 4, figs. 2a-b.

Proteonina lagenaria (BERTHELIN). PHLEGER, 1954, p. 643, pl. 2, fig. 33; ISHIWADA, 1958, p. 9, pl. 1, fig. 4.

Occurrence and Repository: Bay Mouth Area (Stn. 116: 61 m; living); ESK Reg. no. F-7093.

Geographic Distribution: Ishikari Bay and Lake Hamanako; 5); 50) 1-7 m.

Genus *Pelosina* BRADY, 1879

Pelosina fusiformis (WILLIAMSON)

Pl. 1, fig. 3

Proteonina fusiformis WILLIAMSON, 1858, Recent Foraminifera of Great Britain, p. 1, pl. 1, fig. 1.

Proteonina fusiformis WILLIAMSON. BRADY, 1884, p. 289, pl. 30, fig. 11.

Reophax fusiformis (WILLIAMSON). BARKER, 1960, p. 62, pl. 30, fig. 11.

Occurrence and Repository: Central Bay (Stn. 75, 89, 97, 104: 38-170 m; living 93-95 m); ESK Reg. no. F-7094 - 7097; hypotype in fig. 3, ESK Reg. no. F-7097 from Stn. 104.

Remarks: Under the name of *Proteonina fusiformis* BRADY (1884) reported specimens having a wall composed of coarse sand from the North Atlantic and specimens having a wall composed of tiny shell fragments from the Philippine Islands. CUSHMAN (1918) also reported specimens having a wall composed of coarse sand from the Atlantic as *P. fusiformis*. The specimens collected from Kagoshima Bay have tests composed of only tiny shell fragments and closely resemble the specimens reported by BRADY from the Philippines. It seems that the two types of test material imply geographic variation or speciation between the Atlantic and the Pacific areas. This is the first record of the present species in Japanese waters.

Subfamily HEMISPHAERAMMININAE LOEBLICH and TAPPAN, 1961

Genus *Hemisphaerammina* LOEBLICH and TAPPAN, 1957

Hemisphaerammina bradyi LOEBLICH and TAPPAN

Webbinella hemisphaerica JONES, PARKER and BRADY. BRADY, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 350, pl. 41, fig. 11.

Hemisphaerammina bradyi LOEBLICH and TAPPAN, 1957, U.S. Nat. Mus., Bull., no. 215, p. 224, pl. 72, figs. 2a-b; BARKER, 1960, p. 84, pl. 41, fig. 11.

Occurrence and Repository: Bay Head Area (Stn. 61, 65: 39- 138 m); Central Area (Stn. 88, 89: 78-95 m): ESK Reg. no. F-7098 - 7101.

Remarks: LOEBLICH and TAPPAN (1957) regarded the genus *Webbinella* RHUMBLER, 1904 as an attached calcareous polymorphinid. They proposed the genus *Hemisphaerammina* for agglutinated forms such as the specimen figured by BRADY, and referred to them as *H. bradyi*. The specimens in the collection are less than 0.1 mm in size and far smaller than the holotype (LOEBLICH and TAPPAN, 1957) and the specimen reported by BRADY. This is the first record of the present species in Japanese waters.

Family AMMODISCIDAE REUSS, 1862

Subfamily AMMODISCINAE REUSS, 1862

Genus *Ammodiscus* REUSS, 1862

Ammodiscus incertus (D'ORBIGNY)

Pl. 1, fig. 4

Operculina incerta D'ORBIGNY, 1839, *in* DE LA SAGRA, Hist. Fis. Pol. Nat. Cuba, "Foraminiferes", p. 49, pl. 6, figs. 16-17.

Ammodiscus incertus (D'ORBIGNY). CUSHMAN, 1918, p. 95, pl. 39, fig. 1-8; CUSHMAN, 1921, p. 62, pl. 5, figs. 1-2; CHIJI and KONDA, 1970, pl. 1, fig. 9.

Ammodiscus arenaceus (WILLIAMSON). TODD and LOW, 1967, p. A14, pl. 2, fig. 12.

Occurrence and Repository: Bay Head Area (Stn. 37, 53: 94- 124 m); Central Area (Stn. 78: 40 m; living); ESK Reg. no. F-7102 - 7104; hypotype in fig. 4, ESK Reg. no. F-7105 from Stn. 78.

Geographic Distribution: Off the north coast of Hokkaido and Toyama Bay; 1) 165-850 m; 6) 265-2285 m; 42) 142 m.

Remarks: This species has been reported from the sea around Hokkaido (KUWANO, 1953-1954; CHIJI and KONDA, 1970) and from Toyama Bay (ISHIWADA, 1950). This is the second record of the present species in the warm water area came after Toyama Bay.

Ammodiscus minimus HÖGLUND

Pl. 1, fig. 5

Ammodiscus minimus HÖGLUND, 1947, Uppsala, Univ., Zoolgiska Bidrag, v. 26, p. 124, pl. 8, figs. 5a-b, 10; p. 110, tfs. 90a-b.

Occurrence and Repository: Bay Head Area (Stn. 21, 40, 41, 42, 63: 138-228 m; living 228 m); Central Area (Stn. 68, 75, 82, 86, 88: 78-165 m; living 162-165 m); Bay Mouth Area (Stn. 113, 141: 60-100 m); ESK Reg. no. F-7106 - 7117; hypotype in fig. 5, ESK Reg. no. F-7118 from Stn. 42.

Remarks: This species is characterized by small greyish white coloured agglutinated tests. This is the first record of the present species in Japanese waters.

Genus *Glomospira* RZEHAK, 1885

Glomospira gordialis (JONES and PARKER)

Pl. 1, figs. 6a, b

Trochammina squamata JONES and PARKER var. *gordialis* JONES and PARKER, 1860, Geol. Soc. London, Quart. Jour., v. 16, p. 304.

Gordiammina gordialis (JONES and PARKER). CUSHMAN, 1910, p. 76, text-figs. 98-100.

Glomospira gordialis (JONES and PARKER). CUSHMAN, 1918, p. 99, pl. 36, figs. 7-9; HADA, 1931, p. 62, text-fig. 14; KUWANO, 1962, pl. 18, figs. 3-4.

Occurrence and Repository: Bay Head Area (Stn. 12, 21, 32, 35, 40, 41, 42, 44, 45, 53, 54: 94-228 m; living 125-228 m); Central Area (Stn. 68, 81, 85: 162-220 m; living 162-220 m); Bay Mouth Area (Stn. 144: 105 m; living); ESK Reg. no. F-7119 - 7133; hypotype in fig. 6a, ESK Reg. no. F-7134 from Stn. 42; hypotype in fig. 6b, ESK Reg. no. F-7135 from Stn. 42.

Geographic Distribution: Off the coast of North Honshū, and Tōkyō and Tanabe Bays; 18) 33 m; 23) 150-875 m, living 150-570 m); 24) 10-150 m, living 30-150 m; 27) 10-45 m; 31); 37) 52 m; 59) 2.9-8.6 m.

Subfamily TOLYPAMMININAE CUSHMAN, 1928

Genus *Ammolagena* EIMER and FICKERT, 1899

Ammolagena clavata (JONES and PARKER)

Trochammina clavata JONES and PARKER, 1860, Geol. Soc. London, Quart. Jour., v. 16, p. 304. pl. 2, figs. 5-6.
Ammolagena clavata (PARKER and JONES). BARKER, 1960, p. 84, pl. 41, figs. 12-16.
Ammolagena clavata (JONES and PARKER). BROOKS, 1973, p. 395, pl. 9, fig. 1; LEROY and HODGKINSON, 1975, p. 432, pl. 2, fig. 6; MAIYA and INOUÉ, 1982, p. 12, pl. 4, fig. 9.

Occurrence and Repository: open sea area (Stn. 144, 145: 105-155 m; living 105-155 m); ESK Reg. no. F-7136 - 7137.

Remarks: This is the first record of the present species in Japanese waters.

Superfamily LITUOLACEA DE BLAINVILLE, 1825

Family HORMOSINIDAE HAECKEL, 1894

Subfamily HORMOSININAE HAECKEL, 1894

Genus *Reophax* MONTFORT, 1808

Reophax catella HÖGLUND

Reophax catella HÖGLUND, 1947, Uppsala, Univ., Zool. Bidrag, Bd. 26, p. 97-98, tfs. 77-78.

Occurrence and Repository: Bay Head Area (Stn. 21, 42: 170-185 m; living 185 m); Central Area (Stn. 77, 79: 100-196 m; living 100 m); ESK Reg. no. F-7138 - 7141.

Remarks: This is the first record of the present species in Japanese waters.

Reophax catenata HÖGLUND

Reophax catenata HÖGLUND, 1947, Uppsala, Univ., Zool. Bidrag, Bd. 26, p. 99, p. 98, tfs. 75-76; Cole, 1981, p. 23, pl. 2, fig. 18.

Occurrence and Repository: Bay Head Area (Stn. 58: 142 m); ESK Reg. no. F-7142.

Remarks: This is the first record of the present species in Japanese waters.

Reophax gracilis (KIAER)

Pl. 1, fig. 7

Nodulina gracilis KIAER, 1900, Norweigan Fish. Mar. Invest., Rep., v. 1, no. 7, p. 24, text-figs. 1-2.
Reophax gracilis (KIAER). MATOBA, 1970, p. 60, pl. 1, fig. 2.

Occurrence and Repository: Bay Head Area (Stn. 21, 41, 42, 63: 138-185 m; living 185 m); Central Area (Stn. 68, 73, 86, 103, 105: 80-175 m); ESK Reg. no. F-7143 - 7151; hypotype in fig. 7, ESK Reg. no. F-7147 from Stn. 68.

Geographic Distribution: Off the coast of North Honshū, Ishikari Bay, Lake Hamanako, Tanabe Bay, and the Seto Inland Sea; 5); 23) 150-875 m, living 150 m; 24) 48-69 m, living 69 m; 28) 25-37 m; 29) 3.2 m; 41) 27-65 m; 50); 54) living 23 m; 56) 7-9 m; 64) 22-39 m, living 32 m.

Remarks: HADA (1931) reported *Reophax gracilis* (KIAER) from Mutsu Bay, but it should be identified as *R. scottii* judging from the original description mentioning that *R. gracilis* differs from *R. scottii* (CHASTER) in having cone-shaped chambers.

Reophax guttifer BRADY

Lituola guttifera BRADY, 1881, Quart. Jour. Micr. Sci., n.s., v. 21, p. 49.
Reophax guttifer BRADY, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 295, pl. 31, figs. 5, 10-12; BARKER, 1960, p. 64, pl. 31, figs. 10-12.

Occurrence and Repository: Central Area (Stn. 79, 98: 100- 145 m; living 100 m);

ESK Reg. no. F-7152 - 7153.

Geographic Distribution: Off the northwest coast of North Honshū; 23) 48-875 m, living 150 m; 24) 100-202 m, living 120-150 m.

Reophax nana RHUMBLER

Pl. 1, fig. 8

Reophax nana RHUMBLER, 1911, Ergeb. Plankton-Exped. Humboldt-Stiftung, v. 3, pt. 1 (1909), pl. 18, figs. 6-12; MATOBA, 1970, p. 60, pl. 1, fig. 1.

Occurrence and Repository: Bay Head Area (Stn. 17, 37, 41, 42, 44, 45, 51, 54, 58, 61, 63: 124-182 m; living 138-146 m); Central Area (Stn. 66, 68, 69, 72, 76, 77, 82, 83, 85, 93, 96, 97, 101, 103, 104: 36-220 m; living 36-130 m); ESK Reg. no. F-7154 - 7179; hypotype in fig. 8, ESK Reg. no. F-7180 from Stn. 63.

Geographic Distribution: Matsushima Bay and Lake Hamanako; 29) 2.5-2.7 m; 50).

Remarks: The stations showing high frequency (4-6%) of the present species were distributed in the northeastern and the southwestern parts of the Bay Head Area.

Reophax scorpiurus MONTFORT

Pl. 1, fig. 9

Reophax scorpiurus MONTFORT, 1808, Conch. Syst., tome 1, p. 331, p. 130, tf; HADA, 1931, p. 55-56, text-fig. 6; CHIJI and KONDA, 1970, p. 49, pl. 7, fig. 2; MURRAY, 1971, p. 19, pl. 2, figs. 5-8; NOMURA, 1983, p. 226, pl. 1, fig. 2.

Occurrence and Repository: Bay Head Area (Stn. 17, 32, 35, 37: 124-156 m); Central Area (Stn. 68, 76, 82, 97, 101: 119-220 m; living 150 m); Bay Mouth Area (Stn. 124, 125, 143, 144: 20-140 m; living 96-140 m); ESK Reg. no. F-7181 - 7193; hypotype in fig. 9, ESK Reg. no. F-7185 from Stn. 68.

Geographic Distribution: Off the coast of Hokkaido, the northwest coast of North Honshū and the Pacific coast from Central Honshū to Kyūshū, and the Seto Inland Sea; 1) 168, 850 m; 5); 6) 1230 -1540 m; 11) 56 m with living specimens; 13) 84-430 m; living 430 m; 17) 985 m; 18) 7.3-60.4 m; 23) 40-150 m, living 48-73 m; 24) 94-200 m, living 94-98 m; 41) 33-63 m; 42) 142, 1203 m; 48) 40-597 m with living specimens; 51) 43-422 m with living specimens; 52) 31-585 m with living specimens; 60) 50-97.5 m; 61) 59 m; 62) 96 m with living specimens; 64) 60 m; 70) 808 m with living specimens; 77) 122 m with living specimens.

Reophax scottii CHASTER

Pl. 1, fig. 10

Reophax scottii CHASTER, 1892, Southport Soc. Nat. Sci. Rept., 1st Rept. (1890-1891), Append,. p. 57, pl. 1, fig. 1; MURRAY, 1971, p. 17, pl. 1, figs. 6-9; SEIBOLD, 1975, p. 177, pl. 2, figs. 1a-b; COLE, 1981, p. 26, pl. 2, fig. 17.

Reophax gracilis (KIAER). HADA, 1931, p. 61, text-fig. 13.

Occurrence and Repository: Bay Head Area (Stn. 1, 41, 42: 102-182 m; living 182 m); northern part of the Central Area (Stn. 70, 74: 23-28 m); southern part of the Central Area (Stn. 90, 91: 207-215 m); ESK Reg. no. F-7194 - 7200; hypotype in fig. 10, ESK Reg. no. F-7195 from Stn. 41.

Geographic Distribution: Mutsu and Tanabe Bays; 18) 33 m; 59) 2.9-8.6 m.

Remarks: In the southern part of the Central Area and the Bay Head Area, this

species is distributed on rather deep bottom, while in the northern part of the Central Area it is in the coastal shallow area influenced by drainage from the Kagoshima City area.

Reophax sp.

Occurrence and Repository: Central Area (Stn. 67, 68, 87: 162-182 m; living 162 m); ESK Reg. no. F-7201 - 7203.

Remarks: The present species is characterized by large-sized tests (length up to 1 mm) composed of coarse materials, but the number of specimens at hand is insufficient for specific identification.

Family NOURIIDAE CHAPMAN and PARR, 1936

Genus *Nouria* HERON-ALLEN and EARLAND, 1914

Nouria tenuis HADA

Nouria tenuis HADA, 1931, Tohoku Imp. Univ., Sci. Rep., 4th ser. (Biol.), v. 6, no. 1, p. 94-95, text-figs. 47a-b.

Occurrence and Repository: Bay Head Area (Stn. 3, 12, 17, 34, 37, 45, 51, 58, 63: 122-149 m; living 122 m); Central Area (Stn. 67, 68, 72, 81: 162-220 m; living 162 m); ESK Reg. no. F- 7204 - 7216.

Geographic Distribution: Off the northwest coast of North Honshū and Tokyo Bay; 18); 24) 120-150 m, living 120-135 m; 37) 18-70 m.

Remarks: The distribution of the present species is restricted to the Bay Head Area and the northeastern part of the Central Area which is less influenced by the open sea water.

Nouria textulariformis HADA

Pl. 1, fig. 11

Nouria textulariformis HADA, 1931, Tohoku Imp. Univ., Sci. Rep., 4th ser. (Biol.), v. 6, no. 1, p. 93-94, text-figs. 46a-b.

Occurrence and Repository: Bay Head Area (Stn. 15, 35, 37, 61: 124-152 m; living 140-152 m); Central Area (Stn. 85, 90, 92, 97: 170-220 m; living 170-220 m); ESK Reg. no. F-7217 - 7224; hypotype in fig. 11, ESK Reg. no. F-7220 from Stn. 61.

Geographic Distribution: Off the northwest coast of North Honshū; 18) 31.1-45.8 m; 24) 50 m with living specimens; 41) 33-50 m.

Nouria? sp.

Pl. 1, figs. 12a-b

Occurrence and Repository: Central Area (Stn. 91, 96, 103, 104: 38-207 m; living 207 m); Bay Mouth Area (Stn. 122, 125: 100- 140 m); ESK Reg. no. F-7225 - 7230; hypotype in fig. 12a, ESK Reg. no. F-7231 from Stn. 96; hypotype in fig. 12b, ESK Reg. no. F-7232 from Stn. 96.

Remarks: The specimens at hand have tests composed of coarse clastic materials with indistinct sutures. For definite identification, it is necessary to examine their internal structure.

Family RZEHAKINIDAE CUSHMAN, 1933

Genus *Spirosigmoilinella* MATSUNAGA, 1955

Spirosigmoilinella sp.

Pl. 1, figs. 13a-c

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Central Area (Stn. 71, 72, 73, 74, 75, 79, 80, 84, 85, 86, 87, 91, 92, 96, 105: 28-225 m; living 165-225 m); Bay Mouth Area (Stn. 108, 110, 113, 118, 125, 132, 134, 136, 137, 139, 141, 143: 60-140 m; living 96 m); ESK Reg. no. F-7233 - 7260; hypotype in fig. 13a, ESK Reg. no. F-7261 from Stn. 143; hypotype in fig. 13b, ESK Reg. no. F-7262 from Stn. 139; hypotype in fig. 13c, ESK Reg. no. F-7263 from Stn. 139.

Remarks: The specimens in the collection are characterized by small agglutinated tests, and rounded, toothless apertures on the short neck. They closely resemble one of the specimens described by BRADY (1884; Plate 8, fig. 14) under the name of *Spiroloculina asperula* KARRER. However, BRADY's figure of this specimen indicates a rounded, toothless aperture on the short neck. This suggests that the generic position of this specimen should be refered to not as *Spiroloculina* but as *Spirosigmoilinella*.

Family LITUOLIDAE DE BLAINVILLE, 1825

Subfamily HAPLOPHRAGMOIDINAE MAYNC, 1952

Genus *Haplophragmoides* CUSHMAN, 1910

Haplophragmoides bradyi (ROBERTSON)

Trochammina bradyi ROBERTSON, 1891, Ann. Mag. Nat. Hist., ser. 6, v. 7, p. 388; CUSHMAN, 1920, p. 76-77, pl. 15, fig.5.

Haplophragmoides bradyi (ROBERTSON). KUWANO, 1962, p. 129, pl. 18, figs. 9a-b, 10a-b, 11; ISHIWADA, 1964, p. 34, pl. 1, fig. 1; MURRAY, 1971, p. 25, pl. 5, figs. 1-2.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63: 138 m; living); Central Area (Stn. 67, 68, 81, 91, 97: 162-220 m; living 207 m); Bay Mouth Area (Stn. 134, 139, 143: 96-112 m; living 96-105 m); ESK Reg. no. F-7264 - 7272.

Geographic Distribution: Off the coast of Hokkaido and the northeast coast of North Honshū; 5); 11) 320-660 m with living specimens; 12) 56-80 m; 13) 84-640 m with living specimens; 14) living 505 m; 15) living 510 m; 17) 100 m.

Remarks: This species is characterized by 5.5 or 6 inflated chambers forming the last whorl, and by a finely arenaceous, smooth and polished wall of brownish yellow.

Genus *Cribrostomoides* CUSHMAN, 1910

Cribrostomoides jeffreysii (WILLIAMSON)

Pl. 1, figs. 14a-b

Nonionina jeffreysii WILLIAMSON, 1858, Foram. Gr. Brit., Ray Soc., p. 34, pl. 3, figs. 72-73.

Cribrostomoides jeffreysii (WILLIAMSON). MURRAY, 1973, p. 23, pl. 4, figs. 1-5; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 25, pl. 10, figs. 4-7; FINGER and LIPPS, 1981, p. 129, pl. 1, figs. 15a-b.

Occurrence and Repository: Bay Head Area (Stn. 12, 35, 37, 41, 42, 45, 51, 53, 58, 63, 65: 39-182 m; living 39-140 m); Central Area (Stn. 66, 73, 77: 80-196 m; living 130 m); Bay Mouth Area (Stn. 124, 137, 139: 20-106 m; living 20-106 m); open sea area (Stn. 144: 105 m; living): ESK Reg. no. F-7273 - 7290; hypotype in fig. 14a, ESK Reg. no. F-7289 from Stn. 139; hypotype in fig. 14b, ESK Reg. no. F-7287 from Stn. 124.

Geographic Distribution: Off the west coast of Hokkaido and the northeast coast of

North Honshū, and Kii Strait; 6) 1240-1350 m; 28) 33-39 m; 32); 60) 50 m.

Remarks: The stations showing high frequency (2-3%) of the present species are around the An-éi rise in the Bay Head Area.

Cribrostomoides kosterensis (HÖGLUND)

Pl. 2, figs. 1a-b

Labrospira kosterensis HÖGLUND, 1947, Univ., Zool. Bidrag, Uppsala, v. 26, p. 147, pl. 11, figs. 4a-b, tfs. 130-131.

Occurrence and Repository: Bay Head Area (Stn. 3, 21, 37, 41, 42, 45, 61, 63: 124-185 m; living 124-170 m); Central Area (Stn. 66, 68, 69, 75, 77, 83, 88: 36-196 m; living 78-150 m); open sea area (Stn. 144: 105 m); ESK Reg. no. F-7291 - 7306; hypotype in fig. 1a, Reg. no. F-7307 from Stn. 69; hypotype in fig. 1b, Reg. no. F-7308 from Stn. 3.

Remarks: This is the first record of the present species in Japanese waters.

Cribrostomoides satsumaensis ŌKI, n. sp.

Pl. 2, figs. 2a-b

Test small, compressed, planispiral, evolute; chambers very inflated, four in final whorl, periphery rounded; sutures distinct, depressed; wall fine arenaceous, smooth; aperture interio-areal, upper and lower lips well developed; brown coloured. Diameter up to 0.18 mm; thickness about 1/2 of diameter.

Types and Dimensions: Holotype in fig. 2a, ESK Reg. no. F-7309 from Stn. 86, maximum diameter 0.17 mm, thickness 0.08 mm; paratype in fig. 2b, ESK Reg. no. F-7310 from Stn. 86, maximum diameter 0.14, thickness 0.07 mm.

Occurrence and Repository: Central Area (Stn. 86, 87, 88, 95, 101: 78-182 m; living 78-165 m); Bay Mouth Area (Stn. 122: 100 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 105- 213 m); ESK Reg. no. F-7311 - 7319.

Remarks: The present species is distinguished from many other species of *Cribrostomoides* in having a small test composed of a few inflated chambers.

Cribrostomoides sp. 1

Pl. 2, figs. 3a-b

Occurrence and Repository: Bay Head Area (Stn. 18, 32, 35, 37, 51: 124-156 m; living 134-156 m); Central Area (Stn. 68, 75: 93-162 m); Bay Mouth Area (Stn. 137: 106 m; living); ESK Reg. no. F-7320 - 7327; hypotype in fig. 3a, ESK Reg. no. F-7328 from Stn. 37; hypotype in fig. 3b, ESK Reg. no. F-7329 from Stn. 37.

Remarks: The specimens in the collection are characterized by broad and round periphery and sutures not depressed, and a maximum diameter of 0.5 mm.

Cribrostomoides sp. 2

Pl. 2, fig. 4

Occurrence and Repository: Bay Head Area (Stn. 18: 136 m); Central Area (Stn. 99, 101, 104: 38-119 m; living 99-119 m); ESK Reg. no. F-7330 - 7333; hypotype in fig. 4, ESK Reg. no. F-7334 from Stn. 99.

Remarks: The specimens in the collection are characterized by inflated chambers and distinct sutures. The number of individuals at hand is insufficient for the specific

identification.

Cribrostomoides sp. 3

Pl. 2, fig. 5

Occurrence and Repository: Bay Head Area (Stn. 42, 44: 144-170 m; living); ESK Reg. no. F-7335 - 7336; hypotype in fig. 5, ESK Reg. no. F-7337 from Stn. 42.

Remarks: The specimens in the collection have obscure sutures and umbilicus covered with fine material. Only seven juvenile specimens are in the collection.

Genus *Recurvoides* EARLAND, 1934

Recurvoides sp.

Occurrence and Repository: Central Area (Stn. 67, 68, 69, 77, 86: 150-196 m; living 165 m); ESK Reg. no. F-7338 - 7342.

Remarks: The specimens in the collection are characterized by spherical tests composed of coarse material.

Subfamily LITUOLINAE DE BLAINVILLE, 1825

Genus *Ammomarginulina* WIESNER, 1931

Ammomarginulina catenulata (CUSHMAN and MCCULLOCH)

Pl. 2, fig. 6

Ammobaculites catenulata CUSHMAN and MCCULLOCH, 1939, Southern California, Univ., Publ., Allan Hancock Pacific Exped., v. 6, p. 90, pl. 7, figs. 11-14.

Ammobaculites catenulatus CUSHMAN and MCCULLOCH. MATSUNAGA, 1963, pl. 24, fig. 6.

Occurrence and Repository: Bay Head Area (Stn. 3, 15, 18, 35, 37: 124-152 m; living 140 m); Central Area (Stn. 70, 74, 81, 89, 90: 23-220 m; living 23-220 m); Bay Mouth Area (Stn. 118, 127, 136, 139, 143: 60-105 m; living 60-96 m); ESK Reg. no. F-7343 - 7357; hypotype in fig. 6, ESK Reg. no. F-7353 from Stn. 118.

Remarks: This is the first record of the present species in Japanese waters.

Family TEXTULARIIDAE EHRENBERG, 1838

Subfamily SPIROPLECTAMMININAE CUSHMAN, 1927

Genus *Spiroplectammina* CUSHMAN, 1927

Spiroplectammina biformis (PARKER and JONES)

Textularia agglutinans D'ORBIGNY var. *biformis* PARKER and JONES, 1865, Roy, Soc. London, Philos. Trans., v. 155, p. 370, pl. 15, figs. 23a-b, 24.

Spiroplectammina biformis (PARKER and JONES). TAKAYANAGI, 1955, table 1, pl. 1, fig. 4; LOEBLICH and TAPPAN, 1964, p. C251, fig. 163, 1a-b; CHIJI and Lopez, 1968, p. 112, pl. 6, fig. 5; MATOBA, 1970, p. 61, pl. 1, figs. 19a-c; INGLE, KELLER and KOLPACK, 1980, p. 144, pl. 5, fig. 9; FINGER and LIPPS, 1981, p. 132, pl. 1, figs. 17a-b.

Occurrence and Repository: Bay Head Area (Stn. 58: 142 m); ESK Reg. no. F-7358.

Geographic Distribution: Off the northwest coast of Hokkaido and the coast of North Honshū, and Tanabe Bay; 5); 23) 40-67 m, living 67 m; 29) 0.7 m; 31); 32); 56) 7-25 m, living 7 m.

Spiroplectammina henmii ŌKI, n. sp.

Pl. 2, figs. 7a-b

Test elongate, biserial, about two times as long as broad, the apical end triangular,

apertural end rounded or slightly angular, periphery sharp, test thickest near the middle, rhomboid in end view; chambers numerous, distinct, concave toward the inferior margin; sutures slightly depressed, wall coarsely arenaceous, roughened, especially over the sutures, united in the center to form a high ridge; aperture semicircular, at the base of the inner margin of the last-formed chamber; color grey.

Types and Dimensions: Holotype in fig. 7a, ESK Reg. no. F- 7359 from Stn. 99, length 0.92 mm, maximum breadth 0.51 mm, thichness 0.30 mm; paratype in fig. 7b, ESK Reg. no. F-7360 from Stn. 136, length 1.03 mm, maximum breadth 0.57 mm, thickness 0.34 mm.

Occurrence and Repository: Central Area (Stn. 70, 99: 23-42 m); Bay Mouth Area (Stn. 116, 125, 127, 134, 136, 137, 139, 141, 143: 60-140 m; living 60-96 m); open sea area (Stn. 144, 145, 146: 105-213 m); ESK Reg. no. F-7361 - 7372.

Remarks: The specimens in the collection resemble *Textularia sagittula* DEFRANCE var. *atrata* CUSHMAN (1911) with coarse material along the sutures, but are different therefrom in their high ridge in the center and rhomboid outline. The present species is distributed in the open sea, the Bay Mouth and the Central Areas under the influence of open-sea water.

Spiroplectammina higuchii TAKAYANAGI

Pl. 2, figs. 8a-d

Spiroplectammina higuchii TAKAYANAGI, 1953, Tohoku Univ., Inst. Geol. Pal., Short Papers, no. 5, p. 27, pl. 4, figs. 1a-b; 1955, p. 40, pl. 1, fig. 5; ISHIWADA, 1964, pl. 1, fig. 8.

Occurrence and Repository: Central Area (Stn. 99: 42 m); Bay Mouth Area (Stn. 110, 113, 127, 132: 74-110 m; living 74 m); open sea area (Stn. 145, 146: 155-213 m); ESK Reg. no. F-7373 - 7379; hypotype in fig. 8a, ESK Reg. no. F-7380 from Stn. 146; hypotype in fig. 8b, ESK Reg. no. F-7381 from Stn. 146; hypotype in fig. 8c, ESK Reg. no. F-7382 from Stn. 146; hypotype in fig. 8d, ESK Reg. no. F-7383 from Stn. 145.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the Pacific coast from Central Honshū to Shikoku; 23) 40-50 m; 24) 14-78 m; 32); 36) living 80-276 m; 45); 68) 193 m.

Remarks: The present species is distributed along the coast of the Ōsumi Peninsula in the open sea area and the southeastern part of the Central Area, where the influence of open sea water is remarkable.

Subfamily TEXTULARIINAE EHRENBERG, 1838

Genus *Textularia* DEFRANCE in DE BLAINVILLE, 1824

Textularia bigenerinoides LACROIX

Pl. 2, figs. 9a-b

Textularia bigenerinoides LACROIX, 1932, Bull. Inst. Oceanogr. Monaco, no. 591, p. 24, figs. 27-31; KUWANO, 1962, pl. 23, fig. 5; KUWANO, 1963, fig. 12; DANIELS, 1970, p. 70, taf. 2, fig. 3.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 12, 17, 18, 21, 32, 40, 41, 42, 44, 45, 54, 58, 63: 102-228 m; living 125-182 m); Central Area (Stn. 66, 67, 68, 69, 72, 73, 77, 80, 81, 82, 85, 87, 90, 92, 93, 95, 97, 98, 101, 102: 80-228 m; living 130-220 m); ESK Reg. no. F-7384 - 7418; hypotype in fig. 9a, ESK Reg. no. F-7419 from Stn.

68; hypotype in fig. 9b, ESK no. F-7420 from Stn. 68.

Geographic Distribution: Off the Bōsō Peninsula; 36) living 208 m.

Textularia conica D'ORBIGNY

Textularia conica D'ORBIGNY, 1839, *in* DE LA SAGRA, Hist. Fis. Pol. Nat. Cuba, "Foraminiferes", p. 143, pl. 1, figs. 19-20; BARKER, 1960, p. 88, pl. 43, figs. 13a-c, 14a-b; CHIJI and LOPEZ, 1968, p. 112, pl. 6, figs. 8a-b.

Occurrence and Repository: Bay Head Area (Stn. 64: 66 m); Central Area (Stn. 71, 99: 42-88 m; living 42 m); Bay Mouth Area (Stn. 124, 136, 137, 141: 20-106 m; 20 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-7421 - 7428.

Geographic Distribution: Off the northwest coast of North Honshū, the Pacific coast from Honshū to Kyūshū and the north coast of Kyūshū, and the Seto Inland Sea; 23) 50 m; 24) 8-30 m, living 14 m; 27) about 45 m; 35); 37) 10-70 m; 38); 40); 45); 51) 43-232 m, living 43-155 m; 52) 31-80 m with living specimens; 53); 54) 23 m; 55) 20-63 m; 56) 9-38 m; 58); 60) 50-97.5 m; 61) 60 m; 62) 96 m; 63) 5-20 m; 64) 46 m with living specimens; 65) 6.5-33 m; 66) 20-25 m; 71) 17-27 m; 72); 73) less than 39 m; 76) 7-62 m.

Textularia foliacea HERON-ALLEN and EARLAND

Pl. 2, fig. 10

Textularia foliacea HERON-ALLEN and EARLAND, 1915, Zool. Soc. London, Trans., v. 20 (1912-15), pt. 17, p. 628, pl. 47, figs. 17-20.

Occurrence and Repository: Central Area (Stn. 99: 42 m); ESK Reg. no. F-7429; hypotype in fig. 10, ESK Reg. no. F-7430 from Stn. 99.

Geographic Distribution: Off the Pacific coast from Central Honshū to Kyūshū and the Seto Inland Sea; 37) 18-53 m; 48) 40 m; 51) 23-232 m, living 72-155 m; 55) 20-42 m; 56) 7-33 m; 60) 50-97.5 m; 63) 5-10 m; 64) 46 m; 70) 70 m with living specimens; 72); 77) 35 m.

Textularia goesii CUSHMAN

Pl. 3, figs. 1a-b

Textularia goesii CUSHMAN, 1911, p. 15, figs. 24a-b; BARKER, 1960, p. 90, pl. 44, figs. 1a-b, 2.

Occurrence and Repository: Open sea area (Stn. 144: 105 m); ESK Reg. no. F-7431; hypotype in fig. 1a, ESK Reg. no. F-7432 from Stn. 144; hypotype in fig. 1b, ESK Reg. no. F-7433 from Stn. 144.

Remarks: This is the first record of the present species in Japanese waters.

Textularia kattegatensis HÖGLUND

kagoshimaensis ŌKI, n. subsp.

Pl. 3, figs. 2a-b

Test small, elongate, usually straight, sometimes slightly curved, about 3 times as long as broad, oval in section, greatest breadth toward the apertural end, which is broadly rounded, gradually tapering to the pointed initial end; chambers slightly inflated, having up to eleven biserial pairs; sutures distinct, depressed; aperture interiomarginal forming a semicircular slit at the inner margin of the last chamber; test finely arenaceous, well cemented; colour brown. Length 0.10-0.31 mm; width 0.08-0.12 mm; thickness 0.06-0.10 mm.

Types and Dimensions: Holotype in fig. 2a, ESK Reg. no. F-7434 from Stn. 42,

length 0.23 mm, maximum breadth 0.09 mm, thickness 0.06 mm; paratype in fig. 2b, ESK Reg. no. F-7435 from Stn. 42, length 0.21 mm, maximum breadth 0.08 mm, thickness 0.05 mm.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 21, 22, 40, 41, 42, 44, 53, 54, 58, 61, 63, 65: 39-228 m; living 94-228 m); northern part of the Central Area (Stn. 66, 67, 68, 72, 77, 80, 82, 85: 130-225 m; living 130-225 m); southern part of the Central Area (Stn. 86, 92, 93, 95, 96, 97, 102, 104, 105: 38-188 m; living 142-165 m); ESK Reg. no. F-7436 - 7466.

Remarks: The specimens in the collection are characterized by more elongate chambers in the adult stage than those of *Textularia kattegatensis*. They are distinguishable from *T. kattegatensis* by their elongate chambers in the adult stage and brown colours.

Textularia kuwanoi ŌKI, n. sp.

Pl. 3, fig. 3

Test small, very elongate, slender, usually straight, about 2.5 times as long as broad, oval in section, greatest breadth toward the apertural end, which is broadly rounded, gradually tapering to the pointed initial end, edges straight, broadly rounded; chambers numerous, up to 8 or more pairs in a biserial arrangement, increasing in size as added; sutures distinct, the depressions filled up with very fine, secondary wall material; wall rather fine, surface smooth; aperture interio-marginal forming a semicircular slit at the inner margin of the last chamber; colour brownish grey.

Types and Dimensions: Holotype in fig. 3, ESK Reg. no. F-7467 from Stn. 15, length 0.22 mm, maximum breadth 0.10 mm, thickness 0.06 mm.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 12, 15, 17, 18, 22, 35, 37, 40, 42, 51, 54, 58, 61, 63: 102-228 m; living 125-144 m); northern part of the Central Area (Stn. 66, 67, 68, 74, 77, 80, 82: 28-225 m); southern part of the Central Area (Stn. 93, 94, 101: 105-142 m); ESK Reg. no. F-7468 - 7493.

Remarks: The specimens in the collection are identical with the ones identified as *Textularia* cf. *parvula* CUSHMAN by KUWANO (1962). But they are different from *T. parvula* in having coarse material on the test walls. *T. wiesneri* also resembles the present specimens, but the latter have the test walls composed of coarser material and depressed sutures.

Textularia wiesneri EARLAND

Pl. 3, figs. 4a-b

Textularia wiesneri EARLAND, 1933, Discovery Repts., Cambridge, v. 7, p. 95, pl. 3, figs. 18-20; FINGER and LIPPS, 1981, v. 27, no. 2, p. 132, pl. 1, fig. 18.
Textularia tenuissima EARLAND. KUWANO, 1962, pl. 23, fig. 8.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 12, 15, 17, 21, 22, 32, 35, 37, 40, 41, 42, 44, 45, 54, 58, 61, 63: 102-228 m; living 122-170 m); Central Area (Stn. 66, 67, 68, 69, 70, 72, 73, 77, 78: 23-216 m; living 23-216 m); ESK Reg. no. F-7494 - 7521; hypotype in fig. 4a, ESK Reg. no. F-7522 from Stn. 42; hypotype in fig. 4b, ESK Reg. no. F-7523 from Stn. 35.

Remarks: This species differs from *Textularia earlandi* PARKER in its brown colour

of the test without the primary spiroplectine coil. This is the first record of the present species in Japanese waters.

Textularia sp. 1

Occurrence and Repository: Bay Head Area (Stn. 12, 15, 21, 32, 34, 37, 40, 42, 44, 51, 53, 54, 58: 94-228 m; living 94-170 m); Central Area (Stn. 66, 81, 91, 92, 94, 96, 98, 102, 105: 97-220 m; living 105-220 m); Bay Mouth Area (Stn. 139: 105 m); ESK Reg. no. F-7524 - 7546.

Remarks: The present specimens resemble *T. bigenerinoides* in having very thin tests, but differ therefrom in their small and numerous chambers.

Textularia sp. 2

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 83, 99, 104: 36-42 m); Bay Mouth Area (Stn. 106, 107: 40-96 m; living 40 m); ESK Reg. no. F-7547- 7552.

Remarks: The specimens in the collection are characterized by relatively small tests (length up to 0.47 mm) and thick walls composed of very coarse material (more than 0.15 mm).

Textularia sp. 3

Pl. 3, figs. 5a-b

Occurrence and Repository: Bay Mouth and open sea areas (Stn. 106, 136, 146: 40-213 m); ESK Reg. no. F-7553 - 7555; hypotype in figs. 5a-b, ESK Reg. no. F-7556 from Stn. 136.

Remarks: The specimens at hand are distinguishable from all other species or specimens of *Textularia* by their flat test surface and obscure sutures.

Textularia sp. 4

Occurrence and Repository: Bay Mouth and open sea areas (Stn. 137, 143, 144, 145: 96-155 m); ESK Reg. no. F-7557 - 7560.

Remarks: The specimens in the collection are characterized by large tests (more than 1 mm), but the chambers of the adult stage of every specimen are imperfect.

Subfamily PSEUDOBOLIVININAE WIESNER, 1931

Genus *Siphotextularia* FINLAY, 1939

Siphotextularia rolshauseni PHLEGER and PARKER

otsukai ŌKI, n. subsp.

Pl. 3, figs. 6a-c

Test tapering, becoming broad in the adult, compressed, broad faces often distinctly concave; chambers low and broad, becoming inflate in the adult; sutures not distinct, slightly depressed; aperture a narrowly elliptical opening, surrounded by a raised lip, somewhat above the base of the inner wall of the chamber.

Types and Dimensions: Holotype in fig. 6a, ESK Reg. no. F-7561 from Stn. 146, length 0.37 mm, breadth 0.29, thickness 0.12 mm; paratype in fig. 6b, ESK Reg. no. F-7562 from Stn. 144, length 0.19, breadth 0.15 mm, thickness 0.06; paratype in fig. 6c, ESK Reg. no. F-7563 from Stn. 91, length 0.22, breadth 0.17 mm, thickness 0.11.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); northern part of the Central Area (Stn. 71, 76, 78, 79, 80: 40-225 m); southern part of the Central Area (Stn. 86, 87, 91, 92, 94, 95, 97, 98, 101, 104: 38-207 m; living 165 m); Bay Mouth Area (Stn. 110, 113, 127, 132, 134, 139: 74-112 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-7564 - 7584.

Remarks: The present specimens are similar in outline to *Siphotextularia concave* (KARRER), but differs therefrom in the coarse material composing the test walls.

Family TROCHAMMINIDAE SCHWAGER, 1877

Subfamily TROCHAMMININAE SCHWAGER, 1877

Genus *Trochammina* PARKER and JONES, 1859

Trochammina charlottensis CUSHMAN

Pl. 3, figs. 7a-d

Trochammina charlottensis CUSHMAN, 1925, Cushman Lab. Foram. Res., Sharon, Mass., v. 1, no. 11, p. 39, pl. 6, figs. 4a-b; TAKAYANAGI, 1955, pl. 1, figs. 16a-b.

Trochammina charlottensis CUSHMAN var. KUWANO, 1962, pl. 24, figs. 1a-c, 2.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 12, 15, 17, 34, 37, 40, 41, 42, 44, 51, 53, 58: 94-228 m; living 146-228 m); Central Area (Stn. 66, 69, 74, 83, 93, 94, 104: 28-150 m; living 36-130 m); Bay Mouth and open sea areas (Stn. 124, 125, 139, 144: 20-140 m; living 20-140 m); ESK Reg. no. F-7585 - 7609; hypotype in fig. 7a, ESK Reg. no. F-7610 from Stn. 40; hypotype in fig. 7b, ESK Reg. no. F-7611 from Stn. 54; hypotype in fig. 7c, ESK Reg. no. F-7612 from Stn. 54; hypotype in fig. 7d, ESK Reg. no. F-7613 from Stn. 54.

Geographic Distribution: Off the west and south coasts of Hokkaido and the northwest coast of North Honshū; 5); 6) 1230-1285 m; 12) 22-70 m; 23) 40-173 m, living 40-73 m; 24) 14-202 m, living 14-50 m.

Remarks: This species has been reported mainly from the cold water around northern Japan.

Trochammina inflata (MONTAGU)

Nautilus inflatus MONTAGU, 1808, Test. Britannica, Suppl., p. 81, pl. 18, fig. 3.

Trochammina inflata (MONTAGU). HADA, 1931, p. 90-91, text-figs. 43a-b; TAKAYANAGI, 1955, p. 42, pl. 1, figs. 19a-c; BARKER, 1960, p. 84, pl. 41, figs. 4a-c.

Occurrence and Repository: Bay Head Area (Stn. 42: 170 m); ESK Reg. no. F-7614.

Geographic Distribution: Off the north and west coasts of Hokkaido, the Pacific coast of Honshū, the north coast of Central Honshū and the northwest coast of Kyūshū, and the Seto Inland Sea; 1) 165-850 m; 5); 6) 714-1540 m; 18) 7.3-60.4 m; 29) 0.5-2.2 m; 31); 32); 37) 10-70 m; 42) 1203 m; 53); 55) 64 m; 56) 7 m; 61) 21-50 m; 65) 4.1-33 m; 66) 12-25 m; 73).

Remarks: The present species is characterized by brown tests with a dark pattern on the central portion.

Trochammina japonica ISHIWADA

Trochammina japonica ISHIWADA, 1950, Geol. Surv. Japan, Bull., v.1, no.4, p. 9-10, pl., figs.2a-c.

Occurrence and Repository: Bay Head Area (Stn. 37, 64: 66-124 m; living 66 m); open sea area (Stn. 145: 155 m; living); ESK Reg. no. F-7615 - 7617.

Geographic Distribution: Off the Pacific coast from Hokkaido to Kyūshū, the southwest coast of Hokkaido and the northwest coast of Honshū, and the Seto Inland Sea; 3) 9-17.5 m; 6) 265-2285 m; 9) 82-276 m; 10) 720-800 m; 11) 56-660 m with living specimens; 13) 54-430 m, living 84-430 m; 15) 510-840 m, living 510-695 m; 17) 100-690 m; 23) 570-875 m with living specimens; 25) 335-630 m with living specimens; 42) 468-1203 m; 43) 60-1020 m; 54) 23 m with living specimens; 62) 96 m with living specimens; 64) 22-60 m, living 22-39 m; 70) 202 m with living specimens; 77) 745 m.

Trochammina nitida BRADY

Pl. 3, figs. 8a-b

Trochammina nitida BRADY, 1881, Quart. Journ. Micr. Sci., v. 21, p. 52; 1881, Denkschr. Akad. Wiss Wien, v. 43, p. 100; 1884, p. 339, pl. 41, figs. 5-6; CUSHMAN, 1920, p. 75, pl. 15, fig. 2; BARKER, 1960, p. 84, pl. 41, figs. 5a-c, 6.

Occurrence and Repository: Bay Head Area (Stn. 44, 63: 138-144 m); Central Area (Stn. 82, 90, 94: 105-215 m; living 94 m); ESK Reg. no. F-7618 - 7622; hypotype in fig. 8a, ESK Reg. no. F-7619 from Stn. 63; hypotype in fig. 8b, ESK Reg. no. F-7622 from Stn.94.

Geographic Distribution: Off the southeast coast of Hokkaido, the northwest coast of North Honshū and the Pacific coast from Central Honshū to Shikoku; 7); 23) 69-173 m; 24) 135 m; 48) 124-235 m with living specimens; 51) 102 m; 52) 80 m; 70) 70-475 m with living specimens.

Trochammina osumiensis ŌKI, n. sp.

Pl. 3, figs. 9a-b

Test small, trochoid, usually wider than high; test composed of two or three volutions, the last formed one usually of three chambers, rapidly increasing in size progressively as added; chambers inflate; sutures not distinct, slightly depressed; wall composed of very coarse materials (maximum 0.8 mm); aperture not distinct, usually apertural area covered with fine secondary materials; color of the test brownish grey.

Types and Dimensions: Holotype in fig. 9a, ESK Reg. no. F-7623 from Stn. 75; paratype in fig. 9b, ESK Reg. no. F-7624 from Stn. 100.

Occurrence and Repository: Bay Head Area (Stn. 17, 18, 42, 53, 58, 61: 94-170 m); Central Area (Stn. 66, 67, 69, 72, 73, 74, 75, 76, 77, 83, 84, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 100, 101, 103, 104: 28-220 m; living 28-207 m); Bay Mouth and open sea areas (Stn. 107, 113, 122, 139, 145: 96-155 m; living 100-155 m); ESK Reg. no. F-7625 - 7662.

Remarks: The present species resembles *Trochammina pygmaea* in its shape and size, but differs therefrom in the coarser grains forming its tests and less inflated chamber.

Trochammina pacifica simplex CUSHMAN and MCCULLOCH

Pl. 3, figs. 10a-b

Trochammina pacifica simplex CUSHMAN and MCCULLOCH, 1939, Allan Hancock Pacific Exped., v. 6, no. 1, p.

104, pl. 11, fig. 4.

Trochammina pacifica CUSHMAN var. *simplex* CUSHMAN and MCCULLOCH. CHIJI and LOPEZ, 1968, p. 113, pl. 7, figs. 2a-b.

Trochammina pacifica CUSHMAN. ISHIWADA, 1964, pl. 2, figs. 20-21.

Trochammina sp. cf. *pacifica* CUSHMAN. UCHIO, 1962b, p. 388, pl. 18, figs. 8a-c.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 12, 18, 21, 32, 40, 41, 42, 44, 45, 54, 63, 64, 65: 39-228 m; living 39-144 m); Central Area (Stn. 68, 70, 73, 88, 98, 104: 23-162 m; living 38-162 m); Bay Mouth and open sea areas (Stn. 124, 146: 20-213 m; living); ESK Reg. no. F-7663-7685; hypotype in fig. 10a, ESK Reg. no. F-7686 from Stn. 73; hypotype in fig. 10b, ESK Reg. no. F-7671 from Stn. 42.

Geographic Distribution: Off the west coast of Hokkaido and the Seto Inland Sea; 6) 1230-1285 m; 55) 33-64 m.

Trochammina pusilla HÖGLUND

Trochammina pusilla HÖGLUND, 1947, Uppsala, Univ., Zool. Bidrag, Bd. 26, p. 201, pl. 17, figs. 4a-c; p. 200, tfs. 183-184.

Trochammina vesicularis GOES, KUWANO, 1962, pl. 24, figs. 6 and 7.

Occurrence and Repository: Bay Head Area (Stn. 37, 45, 65: 39-134 m; living 124 m); Central Area (Stn. 81: 220 m; living); Bay Mouth Area (Stn. 122: 100 m); ESK Reg. no. F-7687 - 7691.

Remarks: The specimens in the collection are identical with the ones identified as *Trochammina vesicularis* by KUWANO (1962). However, judging from HÖGLUND's original description, dimensions and figures, these specimens should be identical with *T. pusilla*. This is the first record of the present species in Japanese waters.

Trochammina pygmaea HÖGLUND

Pl. 3, figs. 11a-c

Trochammina globigeriniformis (PARKER and JONES) var. *pygmaea* HÖGLUND, 1947, Uppsala, Univ., Zool. Bidrag, Bd. 26, p. 200, pl. 17, figs. 3a-c; tf. 182.

Trochammina globigeriniformis (PARKER and JONES). KUWANO, 1962, pl. 24, figs. 3a-c.

Occurrence and Repository: Bay Head Area (Stn. 42, 51, 54, 64: 66-170 m; living 66-134 m); Central Area (Stn. 66, 71, 72, 73, 75, 76, 80, 82, 85, 86, 87: 80-225 m; living 130-220 m); ESK Reg. no. F-7692 - 7706; hypotype in fig. 11a, ESK Reg. no. F-7707 from Stn. 73; hypotype in fig. 11b, ESK Reg. no. F-7708 from Stn. 73; hypotype in fig. 11c, ESK Reg. no. F-7709 from Stn. 73.

Remarks: HÖGLUND (1947) mentioned that *Trochammina pygmaea* is 0.15-0.24 mm in diameter and can be regarded as a dwarf form of *T. globigeriniformis*. The specimens in the collection are less than 0.15 mm in diameter. This is the first record of the present species in Japanese waters.

Trochammina sp. 1

Occurrence and Repository: Bay Head Area (Stn. 22, 42, 44, 53, 54, 63: 94-170 m; living 144-170 m); Central Area (Stn. 74, 93: 28-142 m; living 28 m); ESK Reg. no. F-7710 - 7717.

Remarks: The specimens in the collection are characterized by small tests (length up to 0.1 mm) having flat surfaces on the dorsal and ventral sides.

Trochammina sp. 2

Pl. 4, figs. 1a-c

Occurrence and Repository: Central Area (Stn. 103: 175 m; open sea area (Stn. 144: 105 m); ESK Reg. no. F-7721 - 7722, hypotype in fig. 1a, ESK Reg. no. F-7722 from Stn. 144; hypotype in fig. 1b, ESK Reg. no. F-7721 from Stn. 103; hypotype in fig. 1c, ESK Reg. no. F-7723 from Stn. 144.

Remarks: The present species is characterized by walls composed of nanno-plankton tests.

Genus *Tiphotrocha* SAUNDERS, 1957

Tiphotrocha kellettae (THALMANN)

Pl. 4, fig. 2

Trochammina kellettae THALMANN, 1932, Eclog, Geol. Helv., v. 25, no. 2, p. 313; TAKAYANAGI, 1955, pl. 1, figs. 18a-b.
Tiphotrocha kellettae (THALMANN). MATOBA, 1970, p. 61, pl. 1, figs. 19a-c.

Occurrence and Repository: Bay Head Area (Stn. 1, 3: 102-130 m); southern part of the Central, Bay Mouth and open sea areas (Stn. 105, 113, 137, 144: 97-106 m; living 97-106 m); ESK Reg. no. F-7724 - 7729; hypotype in fig. 2, ESK Reg. no. F-7730 from Stn. 105.

Geographic Distribution: Off the west and south coasts of Hokkaido, the coast of North Honshū and the south coast of Central Honshū; 5); 11) 56-902 m, living 56-512 m; 13) 54-135 m, living 135 m; 14) 598-735 m, living 735 m; 15) 300-510 m; 17) 690 m; 23) 64-875 m, living 67 m; 24) 10-150 m, living 10-94 m; 28) 39 m; 29) 0.4-12.5 m, living 8.7 m; 30); 50).

Genus *Tritaxis* SCHUBERT, 1921

Tritaxis fusca (WILLIAMSON)

Rotalina fusca WILLIAMSON, 1858, Rec. Foram. Great Britain, p. 55, pl. 5, figs. 114-115.
Valvulina fusca (WILLIAMSON). CUSHMAN, 1911, p. 59, text-figs. 94, 95a-c.
Tritaxis fusca (WILLIAMSON). LOEBLICH and TAPPAN, 1964, p. C266, figs. 177, 2a-c, 3.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63: 138 m); Central Area (Stn. 66: 130 m); Bay Mouth Area (Stn. 113: 100 m; living); ESK Reg. no. F-7731 - 7733.

Family ATAXOPHRAGMIIDAE SCHWAGER, 1877

Subfamily VERNEUILININAE CUSHMAN, 1911

Genus *Gaudryina* D'ORBIGNY, 1839

Gaudryina exilis CUSHMAN and BRONNIMANN

Pl. 4, figs. 3a-c

Gaudryina exilis CUSHMAN and BRONNIMANN, 1948, Cushman Lab. Foram. Res., Contr., v. 24, p. 40, pl. 7, figs. 15a-b, 16.

Occurrence and Repository: Bay Head Area (Stn. 42, 45, 51, 53, 65: 39-170 m; living 134-170 m); Central Area (Stn. 88, 104: 38-78 m; living 38 m); ESK Reg. no. F-7734 - 7740; hypotype in fig. 3a, ESK Reg. no. F-7741 from Stn. 104; hypotype in fig. 3b, ESK Reg. no. F-7742 from Stn. 65; hypotype in fig. 3c, ESK Reg. no. F-7743 from Stn.

104.

Geographic Distribution: Off the southeast coast of North Honshū; 32).

Gaudryina nitida HAQUE

Pl. 4, figs. 4a-b

Gaudryina nitida HAQUE, 1956, Pakistan, Geol. Survey, Mem., Pal., v. 1, p. 41, pl. 9, figs. 2a-d.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 70, 71, 73, 75, 78, 80, 81, 83, 89, 90, 92, 99, 100, 104: 23-225 m; living 36-75 m); Bay Mouth Area (Stn. 106, 107, 110, 116, 122, 124, 127, 132, 134, 136, 139, 141: 20- 112 m; living 60-112 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 155-213 m); ESK Reg. no. F-7744 - 7772; hypotype in fig. 4a, ESK Reg. no. F-7743 from Stn. 65; hypotype in fig. 4b, ESK Reg. no. F-7773 from Stn. 70.

Remarks: This species was originally described from the lower Eocene sediments in Pakistan. This is the first record of the present species in Japanese waters.

Gaudryina triangularis CUSHMAN

Gaudryina triangularis CUSHMAN, 1911, U.S. Nat. Mus., Bull., 71, pt. 2, p. 65, figs. 104a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 70: 23 m); ESK Reg. no. F-7774 - 7775.

Geographic Distribution: Off the south coast of Central Honshū; 48) 40-235 m, living 40 m; 51) 23 m with living specimens; 52) 31 m.

Subfamily GLOBOTEXTULARIINAE CUSHMAN, 1927

Genus *Dorothia* PLUMMER, 1931

Dorothia sp.

Occurrence and Repository: Bay Head Area (Stn. 32, 34, 35, 37, 41, 42, 44, 45, 51, 53, 54, 61, 63: 94-182 m; living 124-182 m); Central Area (Stn. 101: 119 m; living): ESK Reg. no. F-7776 - 7789.

Remarks: The number of specimens at hand is insufficient for the specific identification. The present species dominantly occurs in the southern part of the Bay Head Area.

Genus *Eggerella* CUSHMAN, 1933

Eggerella advena (CUSHMAN)

Pl. 4, fig. 5

Verneuilina advena CUSHMAN, 1922, Canada, Biol. Board, Contr., Canadian Biol. (1921), no. 9, p. 9 (141).
Eggerella advena (CUSHMAN). ISHIWADA, 1964, p. 8, pl. 1, fig. 13; DANIELS, 1970, p. 70, taf. 2, fig. 6; Cole, 1981, p. 42, pl. 6, fig. 2; MURRAY, 1973, pl. 5, fig. 7.

Occurrence and Repository: Bay Head Area (Stn. 41, 42, 44, 58: 142-182 m); Central Area (Stn. 66, 76, 100: 75-220 m; living 75 m); ESK Reg. no. F-7790 - 7796; hypotype in fig. 5, ESK Reg. no. F-7791 from Stn. 42.

Geographic Distribution: Off the coast of Northeast Japan, the south coast of Central Honshū and the south coast of Shikoku, and the Seto Inland Sea; 1) 52-158 m; 5); 9) 22-120 m; 11) 56-660 m with living specimens; 12) 19-80 m; 13) 54-640 m, living 54-430 m; 14) 598-818 m, living 598-735 m; 15) 300-695 m, living 510 m; 17) 320-496 m; 23) 56-173 m; 24) 10-148 m, living 18-100 m; 25) 8-335 m; 27) 6-49 m; 28) 14-39 m; 41) 7.8-65 m; 51) 232 m with living specimens; 54) 23 m with living specimens; 55) 13-64 m; 61)

10-74 m; 62) 96 m; 64) 22-60 m, living 22-46 m; 66) 12-33 m; 70) 808 m with living specimens.

Remarks: The present species is apt to be confused with *Eggerella scabra*. The smaller size (max. 0.25 mm), more numerous chambers and less inflated chambers even at later stages are the differences from *E. scabra*.

Eggerella minuta ŌKI, n. sp.

Pl. 4, fig. 6

Test small, pyramidal, the triserial chambers inflated; sutures not distinct, slightly depressed; the wall coarsely arenaceous; surface rough; aperture semicircular, at the base of the inner margin of the chamber; color brownish grey.

Types and Dimensions: Holotype in fig. 6, ESK Reg. no. F-7797 from Stn. 143; paratype, ESK Reg. no. F-7798 from Stn. 143.

Occurrence and Repository: Central Area (Stn. 66, 67, 69, 71, 73, 77, 81, 82, 88, 89, 90, 92, 94, 98, 100, 103: 75-220 m; living 75-220 m); Bay Mouth Area (Stn. 125, 143: 96-140 m; living); ESK Reg. no. F-7799 - 7815.

Remarks: Small tests and large sized grains forming the wall are characteristics of the present specimens and are not known in any other species of genus *Eggerella*.

Eggerella scabra (WILLIAMSON)

Pl. 4, figs. 7a-b

Bulimina scabra WILLIAMSON, 1858, Ray Soc., London, p. 65, pl. 5, figs. 136-137.
Verneuilina chijii KUWANO, 1962, pl. 24, figs. 14-16.
Eggerella scabra (WILLIAMSON). DANIELS, 1970, p. 70, abb. 46, taf. 2, fig. 5; MURRAY, 1970, p. 45, pl. 15, figs. 1-6; MURRAY, 1973, pl. 8, fig. 9.

Occurrence and Repository: Bay Head Area (Stn. 1, 3, 12, 15, 17, 18, 21, 22, 32, 34, 35, 37, 40, 41, 42, 44, 45, 51, 53, 54, 58, 61, 63: 94-228 m; living 102-228 m); Central Area (Stn. 66, 67, 68, 69, 72, 73, 75, 76, 77, 80, 81, 82, 84, 85, 86, 87, 89, 90, 96, 97, 98, 100, 101, 102, 104, 105: 38-225 m; living 38-225 m); Bay Mouth Area (Stn. 134: 112 m; living); ESK Reg. no. F-7816-7866; hypotype in fig. 7a, ESK Reg. no. F-7867 from Stn. 68; hypotype in fig. 7b, ESK Reg. no. F-7868 from Stn. 68.

Geographic Distribution: Off the northeast coast of Honshū and the east coast of Kyūshū; 1) 129-850 m; 2) 84 m; 30); 41) 39-65 m; 42) 142 m; 76) 13 m.

Subfamily VALVULININAE BERTHELIN, 1880

Genus *Clavulina* D'ORBIGNY, 1826

Clavulina cf. *parisiensis* D'ORBIGNY

Pl. 4, figs. 8a-b

Compared with:

Clavulina parisiensis D'ORBIGNY, 1826, Ann. Sci. Nat., ser. 1, tome 7, p. 268.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 83: 36 m); Bay Mouth Area (Stn. 106: 40 m); ESK Reg. no. F-7869 - 7871; hypotype in fig. 8a, ESK Reg. no. F-7872 from Stn. 65; hypotype in fig. 8b, ESK Reg. no. F-7873 from Stn. 65.

Remarks: The sutures of the specimens in the collection are not depressed.

Clavulina sp.

Occurrence and Repository: Bay Mouth Area (Stn. 125, 136: 60-140 m; living 140 m); ESK Reg. no. F-7874 - 7875.

Remarks: The number of specimens in the collection is insufficient for specific identification and the chambers of the adult stage are imperfect.

Genus *Martinottiella* CUSHMAN, 1933

Martinottiella communis (D'ORBIGNY)

Clavulina communis D'ORBIGNY, 1846, Foram. Foss. Bass. Tert. Vienne, p. 196, pl. 12, figs. 1-2.
Martinottiella communis (D'ORBIGNY). MURRAY, 1971, p. 49, pl. 17, figs. 4-6.

Occurrence and Repository: Bay Mouth Area (Stn. 118, 127: 74-101 m; living 74 m); ESK Reg. no. F-7876 - 7877.

Geographic Distribution: Off the Pacific coasts of Honshū and Shikoku; 26) 146-819 m; 33) 154-1111 m; 51) 232 m; 69) 280-900 m; 70) 808 m.

Suborder MILIOLINA DELAGE and Hérouard, 1896

Superfamily MILIOLACEA EHRENBERG, 1839

Family FISCHERINIDAE MILLETT, 1898

Subfamily CYCLOGYRINAE LOEBLICH and TAPPAN, 1961

Genus *Cyclogyra* WOOD, 1842

Cyclogyra planorbis (SCHULTZE)

Pl. 4, fig. 9

Cornuspira planorbis SCHULTZE, 1854, Organisms Polythal., p. 40, pl. 2, fig. 21.
Cyclogyra planorbis (SCHULTZE). MATOBA, 1970, p. 50, pl. 2, figs. 1a-b.

Occurrence and Repository: Central Area (Stn. 70, 99: 23-42 m); Bay Mouth Area (Stn. 116, 136: 60-61 m; living 60 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-7878 - 7883; hypotype in fig. 9, ESK Reg. no. F-7879 from Stn. 99.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū, the south coast of Central Honshū and the west coast of Kyūshū; 24) 18-200 m, living 18-100 m; 29) 0.8-12.5 m, living 1.7-8.7 m; 45); 50); 76) 13-17 m.

Family NUBECULARIIDAE JONES, 1875

Subfamily OPHTHALMIDIINAE WIESNER, 1920

Genus *Wiesnerella* CUSHMAN, 1933

Wiesnerella auriculata (EGGER)

Pl. 4, fig. 10

Planispirina auriculata EGGER, 1893, K. Bayer, Akad. Will., Muenchen, Math. Phys. Cl., Abh., v. 18, pt. 2, p. 371, pl. 13, figs. 19-21.
Wiesnerella auriculata (EGGER). ASANO, 1951, p. 2, text-figs. 6-8; MATSUNAGA, 1963, pl. 30, figs. 7a-c; MATOBA, 1970, p. 63, pl. 2, figs. 2a-b; POAG, 1981, p. 88, pl. 53, fig. 4; pl. 54, figs. 4a-b.

Occurrence and Repository: Bay Mouth Area (Stn. 106, 107, 116: 40-96 m; living 61 m); ESK Reg. no. F-7884 - 7886; hypotype in fig. 10, ESK Reg. no. F-7885 from Stn. 107.

Geographic Distribution: Off the east coast of North Honshū and the south coast of Central Honshū; 28) 34 m; 29) 12.5 m; 56) 9-38 m.

Subfamily SPIROLOCULININAE WIESNER, 1920

Genus *Spiroloculina* D'ORBIGNY, 1826

Spiroloculina depressa D'ORBIGNY

Pl. 4, figs. 11a-b

Spiroloculina depressa D'ORBIGNY, 1826, Ann. Sci. Nat., ser. 1, tome 7, p. 298; BARKER,1960, p. 18, pl. 9, figs. 17a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m); Central Area (Stn. 99: 42 m; living); Bay Mouth Area (Stn. 108, 118, 125, 127, 132, 136, 137, 139, 141, 143: 60-140 m); open sea area (Stn. 144, 145: 105-155 m; living 105 m); ESK Reg. no. F-7887 - 7901; hypotype in fig. 11a, ESK Reg. no. F- 7902 from Stn. 64; hypotype in fig. 11b, ESK Reg. no. F-7903 from Stn. 137.

Geographic Distribution: Off the north coast of North Honshū and the southeast coast of Central Honshū, and the Seto Inland Sea; 18) 5-25 fms; 37)18-70 m; 66) 21 m.

Spiroloculina hadai THALMANN

Spiroloculina costata HADA (not TERQUEM), 1931, Tohoku Imp. Univ., Sci. Rep., 4th ser. (Biol.), v. 6, no. 1, p. 84, text-figs. 37a-b.

Spiroloculina hadai THALMANN, 1933, Jour. Pal., Menasha, Wis., v. 7, no. 3, p. 354.

Occurrence and Repository: Bay Mouth Area (Stn. 124: 20 m); ESK Reg. no. F-7904.

Geographic Distribution: Off the northwest coast of North Honshū, the Pacific coasts of Central Honshū and Shikoku and the north coast of Kyūshū, and the Seto Inland Sea; 18) 3-25 fms; 20) 108 m; 24) 10-58 m; 46) 165-229 m; 57) 1.5 m; 58); 63) 5-15 m; 71) 17-27 m; 73).

Genus *Planispirinoides* PARR, 1950

Planispirinoides? sp.

Occurrence and Repository: Bay Mouth and open sea areas (Stn. 127, 143: 74-96 m; living 74 m): ESK Reg. no. F-7905-7906.

Remarks: Only six specimens are in the collection and most of them are of juvenile stage.

Subfamily NODOBACULARIINAE CUSHMAN, 1927

Genus *Nodobacullariella* CUSHMAN and HANZAWA, 1937

Nodobacullariella sp.

Pl. 4, fig. 12

Occurrence and Repository: Bay Mouth Area (Stn. 118: 101 m): ESK Reg. no. F-7907.

Remarks: Only a single, imperfect specimen is in the collection.

Genus *Nodophthalmidium* MACFADYEN, 1939

Nodophthalmidium tibia (JONES and PARKER)

Pl. 4, fig. 13

Nubecularia tibia JONES and PARKER, 1860, Quart. Jour. Geol. Soc., v. 16, p. 455, pl. 20, figs. 48-51; BRADY, 1884, p. 135, pl. 1, figs. 1-4.

Nodobacularia tibia (JONES and PARKER). CUSHMAN, 1917, p. 39, pl. 8, figs. 1-2; CUSHMAN, 1929, p. 87, pl. 21, fig. 5.

Nodophthalmidium sp. BARKER, 1960, p. 2, pl. 1, figs. 1-4.

Occurrence and Repository: Central Area (Stn. 76, 91, 93: 142-220 m); Bay Mouth and open sea areas (Stn. 141, 144, 145, 146: 60-213 m; living 213 m): ESK Reg. no. F-7908 - 7914; hypotype in fig. 13, ESK Reg. no. F-7914 from Stn. 146.

Remarks: This is the first record of the present species in Japanese waters.

Genus *Vertebralina* D'ORBIGNY, 1826

Vertebralina striata D'ORBIGNY

Vertebralina striata D'ORBIGNY, 1826, Ann. Sci. Nat., ser. 1, tome 7, p. 283; ASANO, 1956, p. 81-82, pl. 9, fig. 19; BARKER, 1960, p. 24, pl. 12, figs.14, 15a-b, 16; MATSUNAGA, 1963, pl. 30, figs. 6a-b.

Occurrence and Repository: Bay Mouth Area (Stn. 127: 74 m): ESK Reg. no. F-7915.

Geographic Distribution: Off the northwest coast of North Honshū, the Pacific coast of Central Honshū and the north coast of Kyūshū, and the Seto Inland Sea; 24) 18-65 m; 45); 46) 229 m; 52) 31 m; 56) 15-33 m; 57) 1.5-1.8 m; 58); 59) 8.6 m; 60) 50-97.5 m; 63) 12 m; 67); 71) 17-27 m; 72); 73).

Family MILIOLIDAE EHRENBERG, 1839

Subfamily QUINQUELOCULININAE CUSHMAN, 1917

Genus *Quinqueloculina* D'ORBIGNY, 1826

Quinqueloculina agglutinata CUSHMAN

Pl. 5, fig. 1

Quinqueloculina agglutinata CUSHMAN, 1917, U.S. Nat. Mus., Bull. 71, pt. 6, p. 43, pl. 9, figs. 2a-c.

Occurrence and Repository: Bay Mouth Area (Stn. 124: 20 m; living): ESK Reg. no. F-7916; hypotype in fig. 1, ESK Reg. no. F- 7917 from Stn. 124.

Geograpic Distribution: Off the Pacific coast of Central Honshū and the Seto Inland Sea; 37) 13-70 m); 50); 56) 33 m; 63) 12 m.

Quinqueloculina cf. *costata* D'ORBIGNY

Pl. 5, figs. 2a-b

Compared with:

Quinqueloculina costata D'ORBIGNY, 1826, Ann. Sci. Nat., v. 7, p. 301, no. 3.

Occurrence and Repository: Central Area (Stn. 99: 42 m); Bay Mouth Area (Stn. 116, 136: 60-61 m); ESK Reg. no. F-7918 - 7920; hypotype in figs. 2a-b, ESK Reg. no. F-7919 from Stn. 116.

Remarks: Only three specimens are in the collection and most of them are of juvenile stage.

Quinqueloculina elongata NATLAND

Quinqueloculina elongata NATLAND, 1938, Scripps Inst. Oceanogr., Bull., Tech. Ser., v. 4, no. 5, p. 141, pl. 4, fig. 5; MATOBA, 1970, p. 59, pl. 2, figs. 8a-b.

Occurrence and Repository: Bay Mouth Area (Stn. 106: 40 m); ESK Reg. no. F-7921.

Geographic Distribution: Off the east coast of Hokkaido, the northwest coast of North Honshū, the Pacific coast from North Honshū to Kyūshū and the north coast of Kyūshū; 5); 24) 10-65 m, living 12-65 m; 29) 0.8-12.5 m, living 0.8 m; 32); 38); 48) 74 m;

50); 52) 31-80 m; 56) 9-25 m; 61) 15-42 m; 63) 5-20 m; 65) 12.5-26 m; 66) 21-25 m; 70) 70 m with living specimens; 71) 17-27 m; 73); 76) 10-62 m.

Quinqueloculina laevigata D'ORBIGNY

Pl. 5, fig. 3

Quinqueloculina laevigata D'ORBIGNY, 1826, Ann. Sci. Nat., p. 301, no. 6; *in* BARKER WEBB and BERTHELOT, 1839, Hist. Nat. Iles Canaries, v. 2, pt. 2, Foraminiferes, p. 143, pl. 3, figs. 31, 33; HUANG, 1961, p. 85, pl. 1, figs. 20-21; PHLEGER, 1964, p. 383, pl. 1, fig. 16; CHIGI and LOPEZ, 1968, p. 110, pl. 8, figs. 12a-b, 13a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Central Area (Stn. 70, 73, 74, 76, 83, 93, 94, 96, 100, 101: 23-220 m; living 28 m); Bay Mouth Area (Stn. 106, 110, 116, 118, 132, 137, 139, 146: 40-110 m; living 40-61 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-7922 - 7941; hypotype in fig. 3, ESK Reg. no. F-7942 from the stn. 116.

Geographic Distribution: Off the southwest coast of Central Honshū and the east coast of Kyūshū; 56) 7-38 m, living 7-9 m; 76) 17 m.

Quinqueloculina lamarckiana D'ORBIGNY

Pl. 5, figs. 4a-b

Quinqueloculina lamarckiana D'ORBIGNY, 1839, *in* DE LA SAGRA, Hist. Fhys. Pol. Nat. Cuba, "Foraminiferes," p. 189, pl. 11, figs. 14-15; CUSHMAN, 1929, p. 26, pl. 2, figs. 6a-c; HADA, 1931, p. 79-80, text-figs. 32a-c; BANDY, 1953, p. 29, pl. 21, figs. 3a-c; ASANO, 1956, p. 60-61, pl. 7, fig. 17; pl. 8, figs. 14, 17; pl. 9, fig. 17; BARKER, 1960, p. 10, pl. 5, figs. 12a-c; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 46, pl. 28, figs. 9-12.

Quinqueloculina cf. *lamarckiana* D'ORBIGNY. MATOBA, 1970, p. 59, pl. 2, figs. 7a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m); Central Area (Stn. 71, 86, 90, 99, 101, 104: 38-215 m); Bay Mouth Area (Stn. 108, 110, 113, 118, 122, 124, 125, 127, 132, 136, 137, 139: 20-140 m; living 102 m); ESK Reg. no. F-7943 - 7962; hypotype in fig. 4a, ESK Reg. no. F-7963 from Stn. 139; hypotype in fig. 4b, ESK Reg. no. F-7964 from Stn. 139.

Geographic Distribution: Off the coasts of Honshū, Shikoku and Kyūshū; 14) 70-505 m; 15) 100 m; 18) 17-25 fms; 19) 165-309 m; 21) 73-457 m; 27) 28-78 m; 35); 37) 13-70 m; 39); 44) 75-150 m; 45); 46) 126-516 m; 47) 54-292 m; 51) 23-232 m, living 23 m; 52) 31-120 m with living specimens; 54) 23 m; 55) 20-40 m; 56) 7- 31 m; 60) 97.5 m; 61) 15-74 m; 62) 96 m; 63) 5-20 m; 64) 46 m; 65) 19.5-26 m; 67) 234-349 m; 70) 70 m with living specimens; 71) 27 m; 72); 74) 132 m; 75) 90-300 m; 76) 10-79 m; 77) 122 m with living specimens.

Quinqueloculina stalkeri LOEBLICH and TAPPAN

Pl. 5, figs. 5a-c

Quinqueloculina stalkeri LOEBLICH and TAPPAN, 1953, Smithson. Misc. Coll., v. 121, no. 7, p. 40, pl. 5, figs. 5-9; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 47, pl. 29, figs. 14-16.

Occurrence and Repository: Bay Head Area (Stn. 34, 64: 66- 149 m; living 66 m); Central Area (Stn. 83, 88, 99, 100, 104: 36- 78 m; living 38 m); Bay Mouth Area (Stn. 106, 107, 108, 113, 124, 136, 139, 143: 20-120 m; living 96-100 m); open sea area (Stn. 144, 145, 146: 105-213 m); ESK Reg. no. F-7965 - 7982; hypotype in fig. 5a, ESK Reg. no. F-7975 from Stn. 113; hypotype in fig. 5b, ESK Reg. no. F-7984 from Stn. 136;

hypotype in fig. 5c, ESK Reg. no. F-7983 from Stn. 124.

Remarks: This is the first record of the present species in Japanese waters.

Quinqueloculina vulgaris D'ORBIGNY

Pl. 5, figs. 6a-c

Quinqueloculina vulgaris D'ORBIGNY, 1826, Ann. Sci. Nat., v. 7, p. 302, no. 33; HADA, 1931, p. 76-77, text-figs. 29a-c; ASANO, 1956, p. 63, pl. 8, figs. 10a-c, 13a-c; HUANG, 1961, p. 85, pl. 1, fig. 1; MATOBA, 1970, p. 59-60, pl. 2, figs. 5a-b; HAGEMAN, 1979, p. 105, pl. 9, figs. 7a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m); Central Area (Stn. 66, 70, 71, 73, 74, 78, 83, 86, 88, 91, 99, 100, 104, 105: 23-207 m; living 40-42 m); Bay Mouth Area (Stn. 106, 107, 110, 116, 118, 124, 125, 127, 136, 137, 139, 141, 143: 20-140 m; living 20-105 m); open sea area (Stn. 144, 146: 105-213 m): ESK Reg. no. F-7985 - 8015; hypotype in fig. 6a, ESK Reg. no. F-8016 from Stn. 127; hypotype in fig. 6b, ESK Reg. no. F-8017 from Stn. 139; hypotype in fig. 6c, ESK Reg. no. F-8018 from Stn. 139.

Geographic Distribution: The seas adjacent to Japan; 1) 78-503 m; 6) 120 m; 14) 70-115 m; 15) 100 m; 18) 15 fms; 19) 165-539 m; 21) 68-187 m; 23) 40 m; 24) 8-65 m, living 8 m; 29) 1.7-12.5 m; 35); 37) 6-70 m; 38); 39); 44) 75-110 m; 46) 64-296 m; 48) 40- 74 m, living 40 m; 50); 51) 23-232 m, living 23-102 m; 52) 31-120 m, living 80-120 m; 56) 7-38 m; 60) 50-97.5 m; 61) 15-74 m; 62) 96 m; 63) 8-20 m; 65) 17.3-33 m; 66) 25 m; 67) 234 m; 71) 25-27 m; 72); 76) 17-79 m; 74) 93-194 m; 77) 35 m with living specimens.

Quinqueloculina sp.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Bay Mouth Area (Stn. 106, 139: 40-105 m); ESK Reg. no. F-8019 - 8021.

Remarks: The specimens in the collection resemble *Quinqueloculina bradyana* CUSHMAN in having angular chambers more or less plicated laterally and with the outer peripheral angle usually being sinuous, but are much smaller than *Q. bradyana* (less the half) and with a different aperture shape. It is probable, however, that the present specimens represent the juvenile stage of *Q. bradyana*.

Genus *Sigmoilopsis* FINLAY, 1947

Sigmoilopsis schlumbergeri (SILVESTRI)

Pl. 5, figs. 7a-b

Sigmoilina schlumbergeri SILVESTRI, 1904, Accad. Pont. Romana Nuovi Lincei, Mem., v. 22, p. 267, 269; TAKAYANAGI, 1955, pl. 1, figs. 13a-b.

Occurrence and Repository: Bay Head Area (Stn. 53: 94 m); Central Area (Stn. 86, 89, 90, 96: 95-215 m); Bay Mouth Area (Stn. 107, 110, 113, 122, 125, 127, 132, 137, 143: 74-140 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-8022 - 8036; hypotype in fig. 7a, ESK Reg. no. F-8037 from Stn. 107; hypotype in fig. 7b, ESK Reg. no. F-8038 from Stn. 113.

Geographic Distribution: Off the northeast coast of North Honshū and the north coast of Kyūshū, and the Seto Inland Sea; 19) 309 m; 32); 55) 40 m; 61) 52 m; 63) 5-15 m; 65) 12.5-26 m; 71) 17-25 m; 72); 73).

Sigmoilopsis sp.

Pl. 5, fig. 8

Occurrence and Repository: Central Area (Stn. 78, 79, 83, 84, 85, 104: 36-220 m); Bay Mouth Area (Stn. 118: 101 m); ESK Reg. no. F-8039 - 8045; hypotype in fig. 8, ESK Reg. no. F-8046 from Stn. 78.

Remarks: The neck-like projection on the aperture side of the last chamber is characteristic of the present specimens. Specific identification is impossible due to the small number of specimens.

Genus *Triloculina* D'ORBIGNY, 1826

Triloculina tricarinata D'ORBIGNY

Pl. 5, figs. 9a-c

Triloculina tricarinata D'ORBIGNY, 1826, Ann. Sci. Nat., ser. 1, v. 7, p. 299, no. 7; BARKER, 1960, p. 6, pl. 3, figs. 17a-b; HADA, 1931, p. 86-87, text-figs. 39a-b; ASANO, 1956, p. 73, pl. 8, fig. 6; MATSUNAGA, 1963, pl. 30, figs. 1a-b; CHIJI and LOPEZ, 1968, p. 113, pl. 7, figs. 11a-b; POAG, 1981, p. 84, pl. 57, fig. 3, pl. 58, 3a-b; NOMURA, 1983, p. 227, pl. 1, figs. 12a-b.

Miliolina tricarinata D'ORBIGNY. FLINT, 1975, p. 298, pl. 44, fig. 4.

Triloculina trigonula (LAMARCK). HAGEMAN, 1979, p. 107, pl. 10, figs. 4a-b.

Occurrence and Repository: Central Area (Stn. 66, 70, 83, 99: 23-130 m); Bay Mouth Area (Stn. 113, 136: 60-100 m); open sea area (Stn. 146: 213 m; living); ESK Reg. no. F-8047 - 8053; hypotype in figs. 9a-b, ESK Reg. no. F-8052 from Stn. 136; hypotype in fig. 9c, ESK Reg. no. F-8051 from Stn. 113.

Geographic Distribution: Off the coast of Honshū, Shikoku and Kyūshū, and the coastal area in Okino-erabu Island; 18) 4-18 fms; 19) 128-325 m; 21) 78-618 m; 23) 50-875 m, living 760 m; 24) 10-58 m; 32); 35); 37) 13-70 m; 38); 39); 40); 44) 75-642 m; 45); 46) 154-296 m; 55) 20-24 m; 56) 2.5-38 m; 57) 1.5-1.8 m; 58); 60) 50-97.5 m; 62) 96 m with living specimens; 63) 5-12 m; 64) 46 m; 71) 17-27 m; 72); 73); 74) 93-219 m; 75) 90-300 m; 76) 13-62 m; 79).

Triloculina trigonula (LAMARCK)

Pl. 5, fig. 10

Miliolites trigonula LAMARCK, 1804, Paris, Mus. Nat. Hist., Ann., v. 5, p. 151; LAMARCK, 1807, *ibid.*, v. 9, pl. 17, figs. 4a-c.

Triloculina trigonula (LAMARCK). CUSHMAN, 1929, p. 56, pl. 12, figs. 10-11, pl. 13, figs. 1-2; HADA, 1931, p. 85-86, text-figs. 38a-b; TAKAYANAGI, 1955, pl. 1, fig. 14; ASANO, 1956, p. 75, pl. 8, fig. 5; BARKER, 1960, p. 6, pl. 3, figs. 15a-b; HUANG, 1961, p. 86, pl. 2, fig. 15; MATSUNAGA, 1963, pl. 30, figs. 2a-b; MATOBA, 1970, p. 62, pl. 3, figs. 3a-b; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 52, pl. 33, figs. 14-16; POAG, 1981, p. 84, pl. 57, fig. 2; pl. 58, figs. 2a-b.

Occurrence and Repository: Bay Mouth Area (Stn. 108, 124: 20-120 m; living 20 m): ESK Reg. no. F-8054 - 8055; hypotype in fig. 10, ESK Reg. no. F-8056 from Stn. 124.

Geographic Distribution: Off the coasts of Honshū, Shikoku and Kyūshū; 18) 10-23 fms; 19) 128-309 m; 21) 78 m; 24) 5-65 m, living 11 m; 27) 28-49 m; 28) 33 m; 29) 4.4 m; 32); 35); 37) 10-70 m; 38); 39); 40); 44) 110-419 m; 45); 46) 165-296 m; 48) 40 m; 49) 3.6 m; 50); 51) 23-155 m, living 43 m; 52) living 31-80 m; 56) 24-38 m; 58); 59) 7-8.6 m; 62) 96 m; 63) 5-15 m; 64) 46 m; 65) 22 m; 67) 234 m; 70) 70 m with living specimens; 71) 17-27 m; 72); 73); 74) 93 m; 75) 300 m; 76) 7-55 m; 77) 35 m with living specimens.

Subfamily MILIOLINELLINAE VELLA, 1957

Genus *Miliolinella* WIESNER, 1931

Miliolinella californica RHUMBLER

Pl. 5, figs. 11a-b

Miliolinella californica RHUMBLER, 1936, Kiel. Meeresf., Kiel, Deutschland, Bd. 1 (1936-1937), Heft 1, p. 215.

Occurrence and Repository: open sea area (Stn. 146: 213 m); hypotype in fig. 11a, ESK Reg. no. F-8057 from Stn. 146; hypotype in fig. 11b, ESK Reg. no. F-8058 from Stn. 146.

Remarks: This is the first record of the present species in Japanese waters.

Miliolinella circularis (BORNEMANN)

Pl. 5, figs. 12a-c

Triloculina circularis BORNEMANN, 1855, Deutsch. Geol. Ges., Zeitschr., v. 7, no. 2, p. 349, pl. 19, figs. 4a-c; CUSHMAN, 1929, p. 58-59, pl. 13, figs. 6-7, pl. 14, figs. 1-2.

Miliolina circularis BORNEMANN. MILLETT, 1898, p. 499, pl. 11, figs. 1, 3; FLINT, 1975, p. 298, pl. 44, fig. 1.

Miliolinella circularis (BORNEMANN). ASANO, 1956, p. 71-72, pl. 8, figs. 4, 8; CHIJI and LOPEZ, 1968, p. 108, pl. 10, figs. 3a-b, 4; MATSUNAGA, 1963, pl. 30, figs. 3a-c; MATOBA, 1970, p. 56, pl. 3, figs. 5a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m; living); Central Area (Stn. 81: 220 m); Bay Mouth Area (Stn. 108, 137, 141: 60-120 m; living 60-120 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-8059 - 8064; hypotype in fig. 12a, ESK Reg. no. F-8065 from Stn. 146; hypotype in fig. 12b, ESK Reg. no. F-8066 from Stn. 137; hypotype in fig. 12c, ESK Reg. no. F-8067 from Stn. 108.

Geographic Distribution: Off the north coast of Hokkaido and the coasts of Honshū, Shikoku and Kyūshū; 1) 165-190 m; 19) 128-539 m; 21) 101-424 m; 23) 50 m; 24) 5-65 m, living 5-19 m; 29) 0.8-12.5 m; 32); 37) 13-70 m; 40); 44) 75-123 m; 45); 46) 192-229 m; 54) 23 m; 55) 33 m; 56) 15-31 m; 57) 1.5-1.8 m; 58); 59) 7-8.6 m; 60) 50-97.5 m; 62) 96 m with living specimens; 63) 5-15 m; 64) 22-46 m; 71) 17-27 m; 72); 73); 74) 110-132 m; 75) 152-353 m; 76) 10-79 m.

Miliolinella sublineata (BRADY)

Pl. 6, figs. 1a-c

Miliolina circularis (BORNEMANN) var. *sublineata* BRADY, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 169, pl. 4, figs. 7a-c.

Milioninella sublineata (BRADY). ASANO, 1956, p. 73, pl. 8, fig. 16; MATOBA, 1970, p. 56, pl. 3, figs. 10a-b.

Occurrence and Repository: Bay Mouth Area (Stn. 124: 20 m); ESK Reg. no. F-8068; hypotype in fig. 1a, ESK Reg. no. F-8069; hypotype in fig. 1b, ESK Reg. no. F-8070; hypotype in fig. 1c, ESK Reg. no. F-8071.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the Pacific coast of Central Honshū, and the Seto Inland Sea; 24) 5-65 m; 29) 3.5 m; 45); 46) 214-229 m; 60) 50 m; 63) 12 m.

Miliolinella oblonga (MONTAGU)

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

Miliolinella oblonga (MONTAGU). ASANO, 1956, p. 72-73, pl. 8, fig. 3; NOMURA, 1983, p. 226, pl. 1, figs. 10a-b.

Occurrence and Repository: Central Area (Stn. 99, 104: 38-42 m); ESK Reg. no. F-8072 - 8073.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū,

the Pacific coast of Central Honshū, Shikoku and Kyūshū and the north coast of Kyūshū, and the Seto Inland Sea; 19) 165-251 m; 24) 8-65 m, living 8-49 m; 29) 0.4-12.5 m, living 0.4-0.5 m; 32); 38); 44) 455 m; 46) 126-296 m; 50); 56) 9-38 m; 62) 96 m; 64) 46 m; 65) 4.1-21 m; 72); 73); 76) 7-79 m.

Genus *Nummoloculina* STEINMANN, 1881

Nummoloculina sp.

Pl. 6, figs. 2a-f

Occurrence and Repository: Bay Mouth Area (Stn. 137, 141: 60-106 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 105-155 m); ESK Reg. no. F-8074 - 8078; hypotype in fig. 2a, ESK Reg. no. F-8079 from Stn. 144; hypotype in fig. 2b, ESK Reg. no. F-8074 from Stn. 137; hypotype in fig. 2c, ESK Reg. no. F-8078 from Stn. 146; hypotype in fig. 2d, ESK Reg. no. F-8080 from Stn. 144; hypotype in fig. 2e, ESK Reg. no. F-8075 from Stn. 137; hypotype in fig. 2f, ESK Reg. no. F-8381 from Stn. 144.

Remarks: The specimens in the collection are characterized by spherical tests and a narrow slit-like aperture with lips.

Family SORITIDAE EHRENBERG, 1839

Subfamily SORITINAE EHRENBERG, 1839

Genus *Marginopora* QUOY and GAIMARD, 1830

Marginopora vertebralis QUOY and GAIMARD

Marginopora vertebralis QUOY and GAIMARD, 1930, Paris, France, F.G. Levrault, tome 60 (Zooph-zyt), p. 377.

Occurrence and Repository: Bay Mouth Area (Stn. 124: 20 m); ESK Reg. no. F-8382.

Geographic Distribution: Coastal areas at South Shikoku and the Nansei Islands; 67); 79); 80); 82).

Suborder ROTALIINA DELAGE and HÉROUARD, 1896

Superfamily NODOSARIACEA EHRENBERG, 1838

Family NODOSARIIDAE EHRENBERG, 1838

Subfamily NODOSARIINAE EHRENBERG, 1838

Genus *Amphicoryna* SCHLUMBERGER, 1881

Amphicoryna scalaris (BATSCH)

Pl. 6, figs. 3a-b

Nautilus (*Orthoceras*) *scalaris* BATSCH, 1791, Conch. Seesandes, no. 4, pl. 2, figs. 4a-b.
Nodosaria scalaris (BATSCH). CUSHMAN, 1921, p. 199, pl. 35, fig. 6.
Lagenonodosaria scalaris (BATSCH). ASANO, 1956, p. 26, pl. 6, figs. 5-7, 10; ISHIWADA, 1964, p. 14, pl. 2, fig. 29.
Nodosaria scalaris (BATSCH). HADA, 1931, p. 100, text-fig. 53.
Amphicoryna scalaris (BATSCH). BARKER, 1960, p. 134, pl. 63, figs. 28a-b, 29-31.

Occurrence and Repository: Central Area (Stn. 71, 73, 75, 79, 84, 88, 90, 93, 100, 102: 75-215 m); Bay Mouth Area (Stn. 108, 110, 113, 116, 122, 125, 132, 137: 61-140 m); ESK Reg. no. F-8083 - 8100; hypotype in fig. 3a, ESK Reg. no. F-8101 from Stn. 110; hypotype in fig. 3b, ESK Reg. no. F-8102 from Stn. 79.

Geographic Distribution: The seas adjacent to Japan; 6) 120 m; 15) 300 m; 18) 15-25 fms; 19) 128-525 m; 21) 187-439 m; 26) 81-146 m; 28) 37 m; 33) 154 m; 44) 110-642 m;

45); 46) 84-527 m; 47) 54-292 m; 48) 40-597 m, living 235 m; 51) 102-422 m, living 102-232 m; 52) 80-585 m, living 80-201 m; 60) 50-97.5 m; 61) 52-74 m; 62) 96 m; 67) 349 m; 70) 70-202 m; 70) 349 m; 74) 90-115 m; 75) 90-115 m; 76) 62 m.

Amphicoryna spicata (CUSHMAN and MCCULLOCH)

Pl. 6, figs. 4a-b

Lagena sulcata (WALKER and JACOB) var. *spicata* CUSHMAN and MCCULLOCH, 1950, Southern California, Univ., Publ., Allan Hancock Pacific Exped., v. 6, no. 6, p. 360.

Lagena striata (D'ORBIGNY) var. *strumosa* REUSS. CUSHMAN, 1913, p. 20, pl. 7, figs. 7-10; CUSHMAN, 1933, p. 32, pl. 8, figs. 2-3.

Lagena sulcata spicata CUSHMAN and MCCULLOCH. ASANO, 1951, p. 34, figs. 147, 148; ASANO, 1956, p. 37, pl. 5, figs. 32, 33; ISHIWADA, 1964, p. 14, pl. 2, fig. 28.

Occurrence and Repository: Central Area (Stn. 66, 74, 81, 84, 86, 98, 99, 101: 28-220 m; living 28-165 m); Bay Mouth Area (Stn. 106, 113, 122, 127, 137, 139: 40-106 m; living 100 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-8103 - 8117; hypotype in fig. 4a, ESK Reg. no. F-8118 from Stn. 113; hypotype in fig. 4b, ESK Reg. no. F-8119 from Stn. 113.

Geographic Distribution: Off the northwest coast of Hokkaido and the Pacific coasts of Honshū and Shikoku, and the Seto Inland Sea; 5); 26) 44-146 m; 27) 8-49 m; 32); 33) 83-154 m; 48) 74-149 m; 51) 43-422 m, living 43-232 m; 52) 80-408 m, living 80 m; 55) 13-64 m; 61) 32-60 m; 65) 19.9 m; 66) 21-27 m; 70) 202-475 m.

Genus *Dentalina* RISSO, 1826

Dentalina cf. *consobrina* D'ORBIGNY

Compared with:

Dentalina consobrina D'ORBIGNY, 1846, Foram. Foss. Vien., p. 46, pl. 2, figs. 1-3.

Dentalina cf. *consobrina* D'ORBIGNY. ASANO, 1956, p. 18, pl. 4, fig. 29

Occurrence and Repository: On the sea mountain at the Central Area (Stn. 86: 165 m); ESK Reg. no. F-8120.

Remarks: Only a single, imperfect specimen is in the collection.

Dentalina emaciata REUSS

Pl. 6, fig. 5

Dentalina emaciata REUSS, 1851, Deutsch. Geol. Ges., Zeitschr., Bd. 3, p. 63, pl. 3, fig. 9.

Dentalina consobrina D'ORBIGNY var. *emaciata* REUSS. HADA, 1931, p. 96-97, text-fig. 49: ASANO, 1956, p. 17, pl. 4, figs. 18-24.

Nodosaria consobrina D'ORBIGNY var. *emaciata* REUSS. FLINT, 1975, p. 310, pl. 56, fig. 1.

Occurrence and Repository: Central Area (Stn. 102: 162 m); Bay Mouth Area (Stn. 137, 139: 105-106 m); ESK Reg. no. F-8121 - 8123; hypotype in fig. 5, ESK Reg. no. F-8122 from Stn. 137.

Geographic Distribution: Off the northwest coast of North Honshū, the north coast of West Honshū, the Pacific coasts of Honshū and Shikoku and the north coast of Kyūshū; 18) 17-25 fms; 19) 309-349 m; 21) 214-439 m; 37) 23-53 m; 44) 139-402 m; 46) 84- 296 m; 48) 74 m with living specimens; 51) 232 m with living specimens; 52) 80-120 m with living specimens; 61) 70 m; 68) 481 m; 72); 74) 187-194 m.

Dentalina cf. *guttifera* D'ORBIGNY

Compared with:

Dentalina guttifera D'ORBIGNY, 1846, Gide et Comp., Paris, France, p. 49, pl. 2, figs. 11-13.

Occurrence and Repository: On the sea mountain at the Central Area (Stn. 86: 165 m; living); Bay Mouth Area (Stn. 118: 101 m); ESK Reg. no. F-8124 - 8125.

Remarks: The specimens in the collection are rather small in number and mostly imperfect.

Dentalina cf. *setanaensis* ASANO

Compared with:

Dentalina setanaensis ASANO, 1938, Tohoku Imp. Univ., Sci. Repts., ser. 2 (Geol.), v. 19 (1937-1938), no. 2, p. 215, pl. 30(7), figs. 9-12, 30-32.

Occurrence and Repository: Central Area (Stn. 84: 88 m); ESK Reg. no. F-8126.

Remarks: Only a single adult specimen with imperfect chambers is in the collection.

Dentalina cf. *subsoluta* (CUSHMAN)

Compared with:

Dentalina subsoluta (CUSHMAN). ASANO, 1956, Tohoku Univ., Sci. Rep. 2nd ser. (Geol.), v. 27, p. 19, pl. 4, fig. 35.

Occurrence and Repository: Central Area (Stn. 86, 88: 78-165 m); ESK Reg. no. F-8127 - 8128.

Remarks: Only a few individuals and the chambers of the adult stage are usually imperfect.

Dentalina vertebralis (BATSCH)

Pl. 6, fig. 6

Nautilus (Orthoceras) vertebralis BATSCH, Conch. des Seesandes, 1791, p. 3, no. 6, pl. 2, figs. 6a-b.
Nodosaria vertebralis (BATSCH). CUSHMAN, 1913, p. 60, pl. 32, fig. 1; CUSHMAN, 1921, p. 86-87, pl. 14, fig. 6.

Occurrence and Repository: Central Area (Stn. 87, 99: 42-182 m); Bay Mouth Area (Stn. 110, 113: 100-110 m); ESK Reg. no. F-8129 - 8132; hypotype in fig. 6, ESK Reg. no. F-8130 from Stn. 99.

Geographic Distribution: Off the southeast coast of Central Honshū and the south coast of Shikoku; 37) 23-53 m; 67) 481 m.

Remarks: The ornamentation characterizing the present species and the spines on the first chamber are clearly recognized.

Genus *Lagena* WALKER and JACOB, 1798

Lagena amphora REUSS

Pl. 6, fig. 7

Lagena amphora REUSS, 1863, K. Akad. Wiss. Wien, Math.-Naturw Cl, bd. 46, abth. 1 (1862), p. 330, pl. 4, fig. 57.
Lagena costata (WILLIAMSON) var. *amphora* REUSS. CUSHMAN, 1913, p. 21, pl. 12, fig. 2.

Occurrence and Repository: Central Area (Stn. 72: 216 m); hypotype in fig. 7, ESK Reg. no. F-8133 from Stn. 72.

Remarks: This species was originally described from an Oligocene formation. In 1913, CUSHMAN reported the Recent specimens from the North Pacific Ocean as a variety of *Lagena costata* (WILLIAMSON). This is the first record of the present species in Japanese waters.

Lagena distoma PARKER and JONES

Pl. 6, fig. 8

Lagena distoma PARKER and JONES MS., 1964, BRADY, Linn. Soc., London, Trans., v. 24, pt. 3, p. 467, pl. 48, fig. 6; BARKER, 1960, p. 119, pl. 58, figs. 11-15; TODD and LOW, 1967, p. A24, pl. 3, fig. 18; MATOBA, 1970, p. 55, pl. 3, fig. 14; FLINT, 1975, p. 306, pl. 53, fig. 5; INGLE, KELLER and KOLPACK, 1980, p. 140, pl. 4, fig. 12.

Occurrence and Repository: Central Area (Stn. 83, 84: 36-88 m; living 88 m); ESK Reg. no. F-8134 - 8135; hypotype in fig. 8, ESK Reg. no. F-8135 from Stn. 84.

Geographic Distribution: Off the coast of North Honshū and the east coast of Kyūshū, and the Seto Inland Sea; 18) 25-33 fms; 29) 2.2-5.2 m; 42) 1203 m; 66) 33 m; 76) 57 m.

Lagena elongata (EHRENBERG)

Pl. 6, fig. 9

Miliola elongata EHRENBERG, 1844, Berichte, Preuss. Akad. Wiss., Berlin, p. 274.
Lagena elongata (EHRENBERG). HADA, 1931, p. 104, text-fig. 59; BARKER, 1960, p. 116, pl. 56, figs. 27-28.

Occurrence and Repository: Central Area (Stn. 92, 95, 96, 97: 170-188 m); ESK Reg. no. F-8136 - 8139; hypotype in fig. 9, ESK Reg. no. F-8138 from Stn. 96.

Geographic Distribution: Off the Pacific coast from Honshū to Kyūshū and the north coast of Central Honshū, and the Seto Inland Sea; 15) 510-840 m; 17) 985 m; 18) 10-25 fms; 42) 633 m; 47) 290 m; 61) 65 m; 64) 32-60 m; 67) 201 m; 76) 79 m.

Lagena hispidula CUSHMAN

Pl. 6, fig. 10

Lagena hispidula CUSHMAN, 1913, U.S. Nat. Mus., Bull. 71, pt. 3, p. 14, pl. 5, figs. 2-3; BARKER, 1960, p. 114, pl. 56, figs. 10-11; COLE, 1981, p. 64, pl. 7, fig. 8.

Occurrence and Repository: Central Area (Stn. 83, 99: 36-42 m; living); ESK Reg. no. F-8140 - 8141; hypotype in fig. 10, ESK Reg. no. F-8140 from Stn. 83.

Geographic Distribution: Off the Pacific coast from the southeastern part of North Honshū to Shikoku, the northwest coast of North Honshū, the north coast of Central Honshū and the north coast of West Honshū; 19) 251-539 m; 21) 70-187 m; 37) 53 m; 44) 139 m; 46) 154-684 m; 48) 149 m; 51) 155-422 m, Living 155 m.

Lagena semilineata WRIGHT

Lagena semilineata WRIGHT, 1886, Belfast Nat. Field Club, Proc., N.S., v. 1, append. 9, p. 320, pl. 26, fig. 7; MATOBA, 1970, p. 56, pl. 3, fig. 17.

Occurrence and Repository: Bay Head Area (Stn. 22: 144 m); Central Area (Stn. 73, 75, 85, 91, 105: 80-220 m); ESK Reg. no. F-8142 - 8147.

Geographic Distribution: Matsushima and Kamaé Bays; 29) 5.2 m; 76) 57 m.

Lagena setigera MILLETT

Pl. 6, fig. 11

Lagena clavata D'ORBIGNY var. *setigera* MILLETT, 1901, Journ. R. Micr. Soc., p. 590, pl. 8, figs. 9a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63: 138 m); hypotype in fig. 11, ESK Reg. no. F-8148 from Stn. 63.

Remarks: This is the first record of the present species in Japanese waters.

Lagena striata (D'ORBIGNY)

Oolina striata D'ORBIGNY, 1839, Voy. Amer. Merid., Foraminiferes, v. 5, pt. 5, p. 21, pl. 5, fig. 12.
Lagena striata (D'ORBIGNY). ASANO, 1956, p. 32-34, pl. 5, figs. 28, 29.

Occurrence and Repository: Central Area (Stn. 82, 86: 150- 165 m); Bay Mouth Area (Stn. 107: 96 m); ESK Reg. no. F-8149 - 8151.

Geographic Distribution: Off the west and south coasts of Hokkaido, the Pacific coast from North Honshū to Kyūshū and the north coast of Kyūshū, and the Seto Inland Sea; 5); 6) 155 m; 12) 59 m; 13) 84-135 m; 14) 598-930 m; 15) Living 300 m; 48) 149-235 m, Living 235 m; 51) 23-232 m with living specimens; 52) 31-80 m, living 31 m; 56) 9-38 m; 61) 52-60 m; 66) 23 m; 67) 130-481 m; 72); 76) 17-79 m; 77) 745 m with living specimens.

Lagena aff. *substriata* WILLIAMSON

Pl. 7, fig. 1

Compared with:

Lagena substriata WILLIAMSON, 1848, Ann. Mag. Nat. Hist., ser. 2, v. 1, p. 15, pl. 2, fig. 12.

Occurrence and Repository: Central Area (Stn. 67, 87, 92, 102: 162-185 m); ESK Reg. no. F-8152 - 8155; hypotype in fig. 1, ESK Reg. no. F-8155 from Stn. 102.

Remarks: CUSHMAN (1913) mentioned that *Lagena substriata* has a long tapering neck, costulate surface extending up onto the neck often to its end and usually spirally arranged on the neck. Specimens from Kagoshima Bay are lacking in costulate spirally arranged on the neck.

Lagena tenuis (BORNEMANN)

Ovulina tenuis BORNEMANN, 1855, Dt. Geol. Ges., v. 7, no. 2, p. 317, pl. 12, fig. 3.
Lagena laevis (MONTAGU) forma *tenuis* BORNEMANN. BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 37, pl. 20, figs. 7-10.

Occurrence and Repository: Bay Head Area (Stn. 17: 146 m): ESK Reg. no. F-8156.

Remarks: This species is discriminated from *Lagena laevis* by its short costae on the aboral extremity.

Lagena sp. 1

Pl. 7, fig. 2

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 65: 39-138 m; living); Central Area (Stn. 72, 80, 89, 92: 95-225 m; living 225 m); Bay Mouth Area (Stn. 136: 60 m); ESK Reg. no. F-8157 - 8163; hypotype in fig. 2, ESK Reg. no. F-8160 from Stn. 92.

Remarks: The specimens in the collection are rather few and mostly imperfect.

Lagena sp. 2

Occurrence and Repository: Central Area (Stn. 74, 76: 28-220 m); ESK Reg. no. F-8164 - 8165.

Remarks: The specimens from Kagoshima Bay are similar to *Lagena substriata* WILLIAMSON having costulate spirally arranged on the neck. Every specimen has a short spine at the base, but *L. substriata* is lacking in the spine.

Genus *Lenticulina* LAMARCK, 1804

Lenticulina calcar (LINNÉ)

Pl. 7, figs. 3a-b

Nautilus calcar LINNÉ, 1758, Syst. Nat., Ed. 10, tomus 1, p. 709, pl. 1, figs. 3g-i, 4l-n.
Cristellaria calcar (LINNÉ). CUSHMAN, 1913, p. 72-73, pl. 32, fig. 4.
Robulus calcar (LINNÉ). KUWANO, 1962, p. 129, pl. 22, figs. 4a-b.
Lenticulina calcar (LINNÉ). BARKER, 1960, p. 146, pl. 70, figs. 9-12; MATOBA, 1967, p. 256, pl. 25, fig. 5.

Occurrence and Repository: Bay Head Area (Stn. 44, 63, 64: 66-144 m); Central Area (Stn. 67, 71, 72, 73, 75, 76, 79, 37, 139, 141, 143: 60-140 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-8166 - 8199; hypotype in figs. 3a-b, ESK Reg. no. F-8200 from Stn. 101.

Geographic Distribution: Off the Pacific coast from the southeastern part of Central Honshū to Kyūshū: 37) 13-53 m; 47) 81-238 m; 48) 74-235 m, living 124-235 m; 51) 43-155 m with living specimens; 52) Living 31-120 m; 61) 34-74 m; 62) 96 m with living specimens; 67) 481 m; 70) 123 m; 71) 17 m; 76) 13-55 m.

Remarks: KUWANO (1962) reported that the living specimens of this species ocurred from the five stations in the Central Area of Kagoshima Bay, ranging from 69 to 193 m in depth.

Lenticulina cultratus (MONTFORT)

Robulus cultratus MONTFORT, 1808, Conch. Syst., v. 1, p. 214, 54 genre.
Cristellaria cultrata (MONTFORT). CUSHMAN, 1913, p. 64-65, pl. 29, figs. 4a-b.

Occurrence and Repository: Central Area (Stn. 75: 93 m); Bay Mouth Area (Stn. 125: 140 m); ESK Reg. no. F-8201 - 8202.

Remarks: This is the first record of the present species in Japanese waters.

Lenticulina lucida (CUSHMAN)

Cristellaria lucida CUSHMAN, 1923, p. 111, pl. 30, fig. 2.
Robulus lucidus (CUSHMAN), MATSUNAGA, 1963, pl. 33, figs. 4a-b; ISHIWADA, 1964, p. 18, pl. 2, fig. 24.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63: 138 m); Central Area (Stn. 67, 70, 100: 23-165 m): Bay Mouth Area (Stn. 107, 118, 122, 136, 139, 143: 60-105 m); open sea area (Stn. 144: 105 m); ESK Reg. no. F-8203 - 8213.

Geographic Distribution: Off the west coast of Hokkaido, the northwest and northeast coasts of North Honshū and the Pacific coasts of Central Honshū and Shikoku, and the Seto Inland Sea; 6) 120-155 m; 14) 70 m with living specimens; 24) 30-94 m; 48) 235-403 m; 51) 72-422 m, living 155-232 m; 52) 80-408 m, living 120-408 m; 61) 71 m; 63) 8 m; 70) 202 m with living specimens.

Lenticulina occidentalis (CUSHMAN)

Cristellaria occidentalis CUSHMAN, 1923, p. 102, pl. 25, fig. 2; pl. 26, figs. 1-2
Robulus occidentalis (CUSHMAN). TODD and LOW, 1967, p. A21, pl. 3, fig. 1.

Occurrence and Repository: Central Area (Stn. 94, 96: 105- 188 m); ESK Reg. no. F-8214 - 8215.

Remarks: This is the first record of the present species in Japanese waters.

Lenticulina peregrina (SCHWAGER)

Cristellaria peregrina SCHWAGER, 1866, Novara Exp., Geol. Theil, v. 2, p. 245, pl. 7, fig. 89.
Lenticulina peregrina (SCHWAGER). ASANO, 1956, p. 7, pl. 3, figs. 9, 17-18; BARKER, 1960, p. 144, pl. 68, figs.

11-16.

Occurrence and Repository: Central Area (Stn. 88: 78 m); ESK Reg. no. F-8216.

Geographic Distribution: Off the Pacific coast from the southeastern part of North Honshū to Shikoku; 19) 325 m; 46) 126- 223 m; 51) 72 m; 76) 79 m.

Lenticulina rotulata (LAMARCK)

Lenticulites rotulata LAMARCK, 1804, Ann. Mus. Nat., v. 5, p. 188, pl. 62, fig. 11.

Occurrence and Repository: Bay Mouth Area (Stn. 113, 125, 136: 60-140 m); ESK Reg. no. F-8217 - 8219.

Remarks: This is the first record of the present species in Japanese waters.

Lenticulina sagamiensis (ASANO)

Robulus sagamiensis ASANO, 1938, Sci. Rep. Tohoku Imp. Univ., 2nd ser., v. 19, no. 2, p. 201, pl. 25, fig. 6; pl. 26, figs. 11-13; pl. 28, fig. 12; pl. 29, fig. 16; ASANO. 1951, p. 7, figs. 32-33; ASANO, 1956, p. 47, pl. 1, figs. 9-11.

Occurrence and Repository: Central Area (Stn. 91: 207 m); Bay Mouth Area (Stn. 143: 96 m); ESK Reg. no. F-8220 - 8221.

Geographic Distribution: Off the Pacific coast from North Honshū to Shikoku, the north coast of Kyūshū and the north coast of West Honshū, and Yamato Bank; 19) 251-539 m; 22) 340 m; 44) 123-214 m; 46) 165-684 m; 70) 808 m with living specimens; 74) 132-146 m.

Lenticulina sp. 1

Pl. 7, fig. 4

Occurrence and Repository: Central Area (Stn. 67, 73, 93: 80-165 m); Bay Mouth and open sea areas (Stn. 139, 144: 105 m); ESK Reg. no. F-8222 - 8226; hypotype in fig. 4, ESK Reg. no. F-8227 from Stn. 144.

Remarks: The specimens at hand are similar to *Lenticulina orbicularis* (D'ORBIGNY) but their sizes are about one fifth of this species. The number of specimens in the present collection is insufficient for specific identification.

Lenticulina sp. 2

Pl. 7, figs. 5a-b

Occurrence and Repository: Central Area (Stn. 87, 89, 91: 95-207 m); open sea area (Stn. 143: 96 m); ESK Reg. no. F-8228 - 8231; hypotype in fig. 5a, ESK Reg. no. F-8229 from Stn. 89; hypotype in fig. 5b, ESK Reg. no. F-8232 from Stn. 91.

Remarks: The coiling of the present specimens loosen in the adult stage and their chambers inflate with growth.

Genus *Marginulina* D'ORBIGNY, 1826

Marginulina crepidula (FICHTEL and MOLL)

Nautilus crepidula FICHTEL and MOLL, 1803, Test. Micr., p. 107, pl. 19, figs. g-i.
Cristellaris crepidula (FICHTEL and MOLL). CUSHMAN, 1923, p. 117, pl. 35, figs. 3-4.

Occurrence and Repository: Bay Mouth Area (Stn. 137: 106 m); ESK Reg. no. F-8233.

Genus *Orthomorphina* STAINFORTH, 1952

Orthomorphina calomorpha (REUSS)

Nodosaria calomorpha REUSS, 1865, Denkschr. Akad. Wiss. Wien, v. 25, p. 129, pl. 1, figs. 15-19; BRADY, 1884, v. 9, p.497, pl. 61, fig. 7; CUSHMAN, 1923, p. 67, pl. 12, fig. 13.

Occurrence and Repository: Southern part of the Central Area (Stn. 105: 97 m; living); ESK Reg. no. F-8234.

Genus *Planularia* DEFRANCE, 1826

Planularia tricarinella (REUSS)

Cristellaria tricarinella REUSS, 1862, Sitz. Akad. Wiss. Wien, v. 46, p. 68, pl. 7, fig. 9; pl. 12, figs. 2-4.
Planularia tricarinella (REUSS). ASANO, 1956, p. 12-13, pl. 4, figs. 1-2; MATSUNAGA, 1963, pl. 32, figs. 3a-b.

Occurrence and Repository: Central Area (Stn. 79: 100 m); ESK Reg. no. F-8235.

Geographic Distribution: Off the south coast of Central Honshū; 51) 102-232 m with living specimens.

Genus *Saracenaria* DEFRANCE, 1824

Saracenaria latifrons (BRADY)

Pl. 7, fig. 6

Cristellaria latifrons BRADY, 1884, Rep. Voy. Challenger, Zool., v. 9, p. 544, pl. 68, fig. 19, pl. 113, fig. 11.
Saracenaria latifrons (BRADY). ASANO, 1956, p. 8, pl. 3, fig. 19; BARKER, 1960, p. 234, pl. 113, figs. 11a-b.

Occurrence and Repository: Central Area (Stn. 90, 96: 188- 215 m); ESK Reg. no. F-8236 - 8237; hypotype in fig. 6, ESK Reg. no. F-8237 from Stn. 96.

Geographic Distribution: Off the Pacific coast from North Honshū to Kyūshū; 19) 325 m; 46) 201-296 m; 70) 202-390 m, living 202 m; 77) 745 m.

Subfamily PLECTOFRONDICULARIINAE CUSHMAN, 1927

Genus *Plectofrondicularia* LIEBUS, 1902

Plectofrondicularia sp.

Occurrence and Repository: open sea area (Stn. 144: 105 m); ESK Reg. no. F-8238.

Remarks: Only a single, imperfect specimen is in the collection.

Family POLYMORPHINIDAE D'ORBIGNY, 1839

Subfamily POLYMORPHININAE D'ORBIGNY, 1839

Genus *Polymorphina* D'ORBIGNY, 1826

Polymorphina equalis D'ORBIGNY

Polymorphina equalis D'ORBIGNY, 1826, Ann. Sci. Nat., v. 7, p. 265, no. 13; CUSHMAN, 1923, p. 149-150, pl. 40, fig. 3.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); ESK Reg. no. F-8239.

Polymorphina oblonga D'ORBIGNY

Polymorphina oblonga D'ORBIGNY, 1846, Gide et Comp., p. 232, pl. 12, figs. 29-31.

Occurrence and Repository: Central Area (Stn. 90: 215 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-8240 - 8241.

Genus *Guttulina* D'ORBIGNY, 1839

Guttulina communis (D'ORBIGNY)

Pl. 7, figs. 7a-b

Polymorphina (Guttuline) communis D'ORBIGNY, 1826, Ann. Sci. Nat., Paris, ser. 1, tome 7, p. 266, pl. 12, figs. 1-4; HADA, 1931, p. 111, text-fig. 68.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m; living 66 m); Central Area (Stn. 85, 102, 104: 38- 220 m; living 162 m); Bay Mouth Area (Stn. 124: 20 m); ESK Reg. no. F-8242 - 8247; hypotype in fig. 7a, ESK Reg. no. F-8245 from Stn. 102; hypotype in fig. 7b, ESK Reg. no. F-8248 from Stn. 64.

Geographic Distribution: Mutsu and Ōmura Bays; 18) 25 fms; 73).

Guttulina pacifica (CUSHMAN and OZAWA)

Guttulina (Sigmoidina) pacifica (CUSHMAN and OZAWA). MATSUNAGA, 1963, pl. 34, figs. 1a-b; 2a-b.

Occurrence and Repository: Central Area (Stn. 88: 78 m); ESK Reg. no. F-8249.

Geographic Distribution: Off the northwest coast of Hokkaido, the northeast coast of North Honshū, the north and southwest coasts of Central Honshū, and the Seto Inland Sea; 5); 14) 115 m; 41) 7.8-64 m; 42) 142-222 m; 52) 80 m with living specimens; 61) 23-70 m; 63) 5 m; 66) 25 m.

Guttulina regina (BRADY, PARKER and JONES)

Pl. 7, fig. 8

Polymorphina regina BRADY, PARKER and JONES, 1870, Linn. Soc. London, Trans., v. 27, p. 241, pl. 41, figs. 32a-b.

Guttulina regina (BRADY, PARKER and JONES). HADA, 1931, p. 112, text-fig. 69.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); hypotype in fig. 8, ESK Reg. no. F-8250.

Geographic Distribution: Mutsu and Ōmura Bays, and the Seto Inland Sea; 18) 10-23 fms; 55) 20 m; 63) 10-12 m; 64) 46 m with living specimens; 65) 21-26 m; 72); 73).

Guttulina sp.

Occurrence and Repository: Bay Head Area (Stn. 34: 149 m); Central Area (Stn. 88, 92, 101: 78-185 m); Bay Mouth Area (Stn. 124: 20 m; living); ESK Reg. no. F-8251 - 8255.

Remarks: The present specimens are similar to *Guttulina pacifica* but differ therefrom in having wider tests and in their outline.

Genus *Paradentalina* UCHIO, 1960

Paradentalina muraii (UCHIO)

Enantiodentalina muraii UCHIO, 1953, Japanese Jour. Geol. Geogr., Trans., v. 23, p. 152, pl. 14, figs. 1a-b, 2.

Occurrence and Repository: Bay Head Area (Stn. 34: 149 m): ESK Reg. no. F-8256.

Remarks: This species was originally described from the Pleistocene Naganuma Formation (UCHIO, 1953).

Genus *Sigmoidella* CUSHMAN and OZAWA, 1928

Sigmoidella elegantissima (PARKER and JONES)

Polymorphina elegantissima PARKER and JONES, 1870, Linn. Soc. London, Trans., v. 27, p. 231, pl. 40, figs. 15a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); ESK Reg. no. F-8257.

Genus *Sigmomorphina* CUSHMAN and OZAWA, 1928

Sigmomorphina sp. 1

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); ESK Reg. no. F-8258.

Remarks: Only a single specimen is in the collection.

Family GLANDULINIDAE REUSS, 1860

Subfamily SEABROOKIINAE REUSS, 1860

Genus *Seabrookia* BRADY, 1890

Seabrookia pellucida BRADY

Pl. 7, figs. 9a-b

Seabrookia pellucida BRADY, 1890, Roy, Micr. Soc., Jour., p. 568-569, tf. 60 (1a-c, 2); MILLETT, 1901, p. 3, pl. 1, fig. 4.

Occurrence and Repository: Central Area (Stn. 66, 71, 73, 75, 79, 82, 84, 86, 87, 94, 98, 100, 101: 75-182 m); Bay Mouth Area (Stn. 107, 113, 139: 96-105 m; living 105 m); ESK Reg. no.F-8259 - 8274; hypotype in fig. 9a, ESK Reg. no. F-8272 from Stn.107; hypotype in fig. 9b, ESK Reg. no. F-8275 from Stn. 139 .

Geographic Distribution: Off the east coast of Kyūshū; 76) 55-57 m.

Subfamily OOLININAE LOEBLICH and TAPPAN, 1961

Genus *Oolina* D'ORBIGNY, 1839

Oolina globosa (MONTAGU)

"*Serpula (Lagena) laevis globosa*" WALKER and BOYS, 1784, Test. Min., p. pl. 1, fig. 8.
Vermiculum globosum MONTAGU, 1803, Test. Brit., p. 523.
Lagena globosa (MONTAGU). CUSHMAN, 1923, p. 20, pl. 4, figs. 1-2.
Oolina globosa (MONTAGU). BARKER, 1960, p. 114, pl. 56, figs. 1-3.

Occurrence and Repository: Central Area (Stn. 75, 79, 95, 100: 75-170 m; living 75 m); ESK Reg. no. F-8276 - 8279.

Geographic Distribution: Ishikari Bay; 5).

Oolina hexagona (WILLIAMSON)

Pl. 7, fig. 10

Entosolenia squamosa (MONTAGU) var. *hexagona* WILLIAMSON, 1958, Ray Soc., p. 13, pl. 1, fig. 32.
Oolina hexagona (WILLIAMSON). TODD and LOW, 1967, p. A29, pl. 3, fig. 28; MATSUNAGA, 1963, pl. 31, fig. 29; MURRAY, 1971, p. 93, pl. 37, figs. 1-3.

Occurrence and Repository: Central Area (Stn. 76, 80, 88, 93: 78-225 m; living 225 m); Bay Mouth Area (Stn. 106, 116, 137, 139, 143: 40-106 m); ESK Reg. no. F-8280 - 8288; hypotype in fig. 10, ESK Reg. no. F-8289 from Stn. 137.

Geographic Distribution: Off the Pacific coast from North Honshū to Shikoku, the north and west coasts of Kyūshū and the north coast from West Honshū to Central Honshū; 19) 128 m; 21) 101-444 m; 28) 14-39 m; 32); 37) 18-53 m; 42) 633 m; 44) 123-402 m; 46) 126-296 m; 66) 16-17 m; 67) 234 m; 72); 73); 74) 93-115 m; 75) 90-148 m.

Oolina melo D'ORBIGNY

Pl. 7, figs. 11a-c

Oolina melo D'ORBIGNY, 1839, Strasbourg, France, Levrault, tome 5, pt. 5, p. 20, pl. 5, fig. 9; MATSUNAGA, 1963, pl. 31, fig. 30; TODD and LOW, 1967, p. A29, pl. 3, fig. 27; MATOBA, 1970, p. 57, pl. 3, fig. 19; MURRAY, 1971, p. 93, pl. 37, figs. 4-6.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m;

living 39-138 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-8290 - 8293; hypotype in fig. 11a, ESK Reg. no. F-8293 from Stn. 145; hypotype in fig. 11b-c, ESK Reg. no. F-8292 from Stn. 65.

Geographic Distribution: The seas adjacent to Japan; 5); 6) 155-220 m; 14) 115 m; 21) 187-448 m; 27) 28-49 m; 28) 30 m; 29) 2.4 m; 44) 150 -419 m; 46) 165-600 m; 48) 124-235 m; 51) 23-155 m, living 72-155 m; 52) 31-408 m, living 31 m; 58); 62) 96 m; 63) 5 m; 64) 46-60 m; 70) 70-808 m; 74) 110-194 m; 76) 17.5-62 m.

Oolina cf. *scalariformis* (WILLIAMSON)

Compared with:

Entosolenia squamosa (MONTAGU) var. *scalariformis* (WILLIAMSON), 1848, Ann. Mag. Nat. Hist., ser. 2, v. 1, p. 20, pl. 2, figs. 21-22.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63: 138 m); ESK Reg. no. F-8294.

Remarks: Only a single specimen is in the collection. This species was reported under the name *Oolina scalariformis* (WILLIAMSON) by FINGER and LIPPS (1981).

Oolina squamosa (MONTAGU)

Pl. 7, fig. 12

Vermiculum squamosum MONTAGU, 1803, Testacea Britannica, p. 526, pl. 14, fig. 2.
Oolina squamosa (MONTAGU). MURRAY, 1971, p. 95, pl. 38, figs. 4-6; HAYWARD and BUZAS, 1979, p. 68, pl. 23, fig. 292.

Occurrence and Repository: Bay Mouth Area (Stn. 113: 100 m); hypotype in fig. 12, ESK Reg. no. F-8295 from Stn. 113.

Remarks: *Oolina squamosa* in Kagoshima Bay is smaller and the width of its rim is broad. This is the first record of the present species in Japanese waters.

Genus *Fissurina* REUSS, 1850

Fissurina agassizi TODD and BRONNIMANN

Pl. 8, fig. 1

Fissurina agassizi TODD and BRONNIMANN, 1957, Cushman Found. Foram. Res., Spec. Publ., no. 3, pl. 9, figs. 14a-b; TODD and LOW, 1967, p. A28, pl. 3, fig. 30.

Occurrence and Repository: Central Area (Stn. 102: 162 m); hypotype in fig. 1, ESK Reg. no. F-8296 from Stn. 102.

Remarks: This is the first record of the present species in Japanese waters.

Fissurina annectens (BURROWS and HOLLAND)

Lagena annectens BURROWS and HOLLAND, 1895, Palaeontogr. Soc., p. 203, pl. 7, figs. 11a-b.
Fissurina annectens (BURROWS and HOLLAND). BARKER, 1960, p. 122, pl. 59, fig. 15.

Occurrence and Repository: Central Area (Stn. 74, 76, 81, 85, 93, 95: 28-220 m; living 220 m); Bay Mouth and open sea areas (Stn. 137, 139, 144: 105-106 m; living 105 m); ESK Reg. no. F-8297 - 8305.

Geographic Distribution: Matsushima and Kamaé Bays; 29) 1.7-5.7 m; 76) 7-62 m.

Fissurina bisulcata (HERON-ALLEN and EARLAND)

Lagena bisulcata HERON-ALLEN and EARLAND, 1932, Discovery Repts., v. 4, p. 380, pl. 9, figs. 29-32.
Fissurina bisulcata (HERON-ALLEN and EARLAND). BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, pl.

15, figs. 1-3.

Occurrence and Repository: Bay Mouth Area (Stn. 134: 112 m); ESK Reg. no. F-8306.

Fissurina cucurbitasema LOEBLICH and TAPPAN

Fissurina cucurbitasema LOEBLICH and TAPPAN, 1953, Smith. Misc. Coll., v. 121, no. 7, p. 76, pl. 14, figs. 10-11; TODD and LOW, 1967, p. A28, pl. 3, fig. 23; MATOBA, 1970, p. 54, pl. 3, figs. 22a-b; ŌKI, 1975, p. 40, pl. 2, fig. 1.

Occurrence and Repository: Bay Head Area (Stn. 34, 44, 63, 65: 39-149 m); Central Area (Stn. 73, 74, 104, 105: 28-97 m); Bay Mouth Area (Stn. 116, 118, 139: 61-105 m); ESK Reg. no. F-8307 - 8317.

Geographic Distribution: Lake Hamanako and Kamaé Bay; 50); 76) 57 m.

Fissurina goreaui BUZAS, SMITH and BEEM

Fissurina goreaui BUZAS, SMITH and BEEM, 1977, Smithsonian Contr. Paleobiol., Washington, D.C., no. 31, p. 71, pl. 1, figs. 17-18.

Occurrence and Repository: Central Area (Stn. 86: 165 m); Bay Mouth Area (Stn. 132: 100 m); ESK Reg. no. F-8318 - 8319.

Fissurina laevigata REUSS

Pl. 8, figs. 2a-b

Fissurina laevigata REUSS, 1850, K. Akad. Wiss. Wien, Math. -Nat. Cl., Bd. 1, p. 366, pl. 46, figs. 1a-b.

Occurrence and Repository: Central Area (Stn. 75, 79, 87, 91, 93, 97, 101, 103, 105: 93-207 m; living 142-207 m); open sea area (Stn. 144: 105 m); ESK Reg. no. F-8320 - 8329; hypotype in fig. 2a, ESK Reg. no. F-8330 from Stn. 144; hypotype in fig. 2b, ESK Reg. no. F-8331 from Stn. 144.

Geographic Distribution: Off the south coast of Hokkaido; 12) 56 m.

Fissurina lucida (WILLIAMSON)

Entosolenia marginata (MONTAGU) var. *lucida* WILLIAMSON, 1848, Ann. Mag. Nat. Hist., ser. 2, v. 1, p. 17, pl. 2, fig. 17.

Fissurina lucida (WILLIAMSON). TODD and LOW, 1967, p. A28, pl. 3, fig. 31.

Occurrence and Repository: Bay Mouth Area (Stn. 125: 140 m); ESK Reg. no. F-8332.

Geographic Distribution: Off the Pacific coasts of Honshū and Shikoku; 14) 505 m; 35); 51) 72-232 m; 56) 38 m; 58); 70) 390 m.

Fissurina marginata SEGUENZA

Fissurina marginata SEGUENZA, 1862, Messina, 1 talia, T. Capra, p. 66, pl. 2, figs. 27-28.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63: 138 m); Central Area (Stn. 75: 93 m); Bay Mouth Area (Stn. 137: 106 m); ESK Reg. no. F-8333 - 8335.

Geographic Distribution: Off the west coast of Hokkaido, the coast of North Honshū, the Pacific coasts of Central Honshū and Shikoku, the north coast of Kyūshū and the north coast from Central to West Honshū; 6) 155-220 m; 20) 269 m; 21) 145-669 m; 22) 620 m; 27) 6-60 m; 28) 14-37 m; 44) 203-419 m; 46) 126-216 m; 48) 403 m; 74) 219-406 m.

Fissurina orbignyana SEGUENZA

Pl. 8, figs. 3a-b

Fissurina orbignyana SEGUENZA, 1862, Dei Terr. Terz. Messina, Pt. 2, Foram. monoth. mioc. Messina, p. 66, pl. 2, figs. 25-26: COLE, 1981, p. 82, pl. 19, figs. 26-27.

Occurrence and Repository: Central Area (Stn. 72, 86: 165- 216 m); Bay Mouth Area (Stn. 113, 137, 141: 60-106 m; living 60 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-8336 -8341; hypotype in fig. 3, ESK Reg. no. F-8338 from Stn. 113.

Geographic Distribution: Off the Pacific coast of North and Central Honshū and the Seto Inland Sea; 27) 49-60 m; 32); 48) 74- 597 m; 51) 23-232 m with living specimens; 52) 80-585 m, living 201 m; 55) 40 m; 64) 60 m.

Fissurina seguenziana (FORNASINI)

Lagena seguenziana FORNASINI, 1886, Soc. Geol. Ital., Boll., v. 5, p. 351, pl. 8, figs. 1-8.
Fissurine seguenziana (FORNASINI)?. BARKER, 1960, p. 122, pl. 59, fig. 1.
Fissurina seguenziana (FORNASINI). COLE, 1981, p. 83, pl. 19, figs. 29-30.

Occurrence and Repository: Bay Mouth Area (Stn. 134, 137, 139: 105-112 m); ESK Reg. no. F-8342 - 8344.

Fissurina semimarginata (REUSS)

Pl. 8, fig. 4

Lagena marginata SEGUENZA var. *semimarginata* REUSS, 1870, S.-B. Akad. Wiss. Wien, Math. Nat. Cl., v. 62, pt. 1, p. 468; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 33, pl. 16, figs. 8-10.

Occurrence and Repository: Southern part of the Central Area (Stn. 104: 38 m); hypotype in fig. 4, ESK Reg. no. F-8345 from Stn. 104.

Geographic Distribution: Off the west coast of Hokkaido; 5); 6) 220 m.

Remarks: The specimen in the collection is slightly different from the specimens reported by BOLTOVSKOY *et al.* (1980) from the southwest Atlantic in ornamentation around the aperture.

Fissurina wiesneri BARKER

Pl. 8, figs. 6a-d

Fissurina wiesneri BARKER, 1960, p. 124, pl. 59, fig. 23; INGLE, KELLER and KOLPACK, 1980, p. 136, pl. 7, fig. 3.
Fissurina orbignyana SEGUENZA. HAYWARD and BUZAS, 1979, p. 57, pl. 16, fig. 208.

Occurrence and Repository: Central Area (Stn. 86, 92: 165- 185 m); Bay Mouth Area (Stn. 107, 110, 113, 127, 132, 137: 74-110 m; living 106 m); open sea area (Stn. 145, 146: 155-213 m); ESK Reg. no. F-8346 - 8355; hypotype in figs. 6a, c, ESK Reg. no. F-8350 from Stn. 113; hypotype in fig. 6b, ESK Reg. no. F-8353 from Stn. 137; hypotype in fig. 6d, ESK Reg. no. F-8355 from Stn. 146.

Remarks: This species was originally described from the early Miocene of Northern New Zealand (HAYWARD and BUZAS, 1979). This is the first record of the present species in Japanese waters.

Fissurina sp.

Pl. 8, fig. 5

Occurrence and Repository: Bay Mouth Area (Stn.141: 60 m; living); hypotype in fig. 5, ESK Reg. no. F-8356 from Stn. 141.

Remarks: The specimens in the collection are characterized by trifacial tests with

triangular apertures.

Genus *Parafissurina* PARR, 1947

Parafissurina sp.

Pl. 8, figs. 7a-b

Occurrence and Repository: Bay Mouth and open sea areas (Stn. 122, 134, 139, 145: 100-155 m; living 100-155 m); ESK Reg. no. F-8357 - 8360; hypotype in fig. 7a, ESK Reg. no. F-8360 from Stn. 145; hypotype in fig. 7b, ESK Reg. no. F-8357 from Stn. 122.

Remarks: The specimens in the collection are characterized by tests with nearly circular front views, broadly elliptical end views, and the development of carina.

Superfamily BULIMINACEA JONES, 1875

Family TURRILINIDAE CUSHMAN, 1927

Subfamily TURRILININAE CUSHMAN, 1927

Genus *Buliminella* CUSHMAN, 1911

Buliminella elegantissima (D'ORBIGNY)

Pl. 8, figs. 8a-c

Bulimina elegantissima D'ORBIGNY, 1839, Voy. Amer. Merid., Foraminiferes, v. 5, pt. 5, p. 51, pl. 7, figs. 13-14.
Buliminella elegantissima (D'ORBIGNY). COLE, 1931, p. 39, pl. 2, fig. 8; CUSHMAN, 1951, p. 39, pl. 11, fig. 20; BANDY, 1953, p. 28, pl. 24, figs. 14a-b; YOSHIDA, 1954, p. 153, pl. 1, fig. 3; PHLEGER, 1954, p. 637, pl. 1, figs. 24, 25; TAKAYANAGI, 1955, p. 43, pl. 2, fig. 1; BARKER, 1960, p. 104, pl. 50, figs. 20-22; AOKI, 1961, pl. 3, fig. 3; KUWANO, 1962, pl. 15, figs. 15-16; MATSUNAGA, 1963, pl. 39, figs. 4a-b; UJIIÉ, 1963, p. 230, pl. 1, fig. 16; ISHIWADA, 1964, p. 7, pl. 4, fig. 50; PHLEGER, 1964, p. 382, pl. 2, fig. 15; LOEBLICH and TAPPAN, 1964, p. C543, fig. 426, 3a-c; MATOBA, 1967, p. 252, pl. 25, fig. 8; TODD and LOW, 1967, p. A26, pl. 3, fig. 36; MATOBA, 1970, p. 50, pl. 3, fig. 24; MURRAY, 1971, p. 105, pl. 42, figs. 1-4; ŌKI, 1975, p. 41-42, pl. 2, fig. 2; HASEGAWA, 1979, p. 144, pl. 3, fig. 5; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 21, pl. 6, figs. 7-10; POAG, 1981, p. 50, pl. 33, fig. 2; pl. 34, figs. 2a-b.

Occurrence and Repository: Bay Head Area (Stn. 22, 32, 34, 44, 45, 63, 65: 39-156 m; living 134-144 m); Central Area (Stn. 66, 67, 69, 70, 72, 73, 74, 75, 76, 77, 78, 79, 80, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 100, 101, 102, 104, 105: 23-225 m; living 23-215 m); Bay Mouth Area (Stn. 106, 107, 108, 116, 118, 127, 132, 134, 139: 40-120 m; living 112 m); open sea area (Stn. 145, 146: 155-213 m); ESK Reg. no. F-8361 - 8413; hypotype in fig. 8a, ESK Reg. no. F-8413 from Stn. 146; hypotype in fig. 8b, ESK Reg. no. F-8414 from Stn. 83; hypotype in fig. 8c, ESK Reg. no. F-8415 from Stn. 83.

Geographic Distribution: Off the coasts of Hokkaido and North Honshū and the coast of Central Honshū, and the Seto Inland Sea; 1) 136-580 m; 3) 9-17.5 m; 5); 7); 8); 9) 22-228 m; 11) 56-100 m, living 56 m; 12) 22-70 m; 13) 84-135 m; 14) 598 m; 15) 300 m; 17) 100-690 m; 24) 10 m with living specimens; 27) 6-78 m; 28) 14-39 m; 29) 0.8-12.5 m, living 0.8-0.9 m; 32); 41) 5.8-56 m; 42) 248 m; 48) 124 m; 50); 51) 23-72 m, living 23 m; 52) 80-120 m; 54) 23 m with living specimens; 56) 7-38 m; 59) 2.9-8.6 m; 60) 97.5 m; 64) 22-60 m, living 32-46 m; 71) 27 m.

Remarks: KUWANO (1962) pointed out the possibility that the specimens occurring in Kagoshima Bay are relics of those inhabiting the bay in the glacial age.

Buliminella milletti CUSHMAN

Pl. 8, fig. 9

Buliminella milletti CUSHMAN, 1933, Contr. Cushman Lab. Foram. Res., v. 9, pt. 4, no. 137, p. 78, pl. 8, figs. 5, 6a-b.

Occurrence and Repository: Central Area (Stn. 98, 102: 145-162 m); Bay Mouth Area (Stn. 132: 100 m); ESK Reg. no. F-8416 - 8418; hypotype in fig. 9, ESK Reg. no. F-8416 from Stn. 98.

Geographic Distribution: Coastal area at Hachijo Island; 40).

Family SPHAEROIDINIDAE CUSHMAN, 1927

Genus *Sphaeroidina* D'ORBIGNY, 1826

Sphaeroidina cf. *bulloides* D'ORBIGNY

Pl. 8, figs. 10a-b

Compared with:

Sphaeroidina bulloides D'ORBIGNY, 1826, Ann. Sci. Nat., Paris, ser. 1, v. 7, p. 267, no. 1.
Sphaeroidina cf. *bulloides* D'ORBIGNY. KUWANO, 1962, pl. 22, figs. 6a-b.

Occurrence and Repository: Central Area (Stn. 66, 67, 73, 96, 98: 80-188 m; living 80 m); Bay Mouth Area (Stn. 107, 122, 139, 143: 96-105 m; living 96 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-8419 - 8428; hypotype in fig. 10a, ESK Reg. no. F-8428 from Stn. 145; hypotype in fig. 10b, ESK Reg. no. F- 8429 from Stn. 143.

Remarks: KUWANO (1962) reported the living specimens of the present species in Kagoshima Bay off Kagoshima City at a depth of 42 m.

Sphaeroidina sp.

Pl. 8, figs. 11a-b

Sphaeroidina sp. A. Kuwano, 1962, pl. 22, figs. 7a-b.

Occurrence and Repository: Central Area (Stn. 87: 182 m); Bay Mouth Area (Stn. 108, 113, 118, 122, 132, 136, 141, 143: 60-120 m; living 120 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-8430 - 8440; hypotype in fig. 11a, ESK Reg. no. F-8438 from Stn. 143; hypotype in fig. 11b, ESK Reg. no. F-8434 from Stn. 122.

Remarks: KUWANO (1962) reported the living specimens of the present species from two stations in Kagoshima Bay. One (92 m in depth) is located in the Bay Mouth Area and another (42 m in depth) off Kagoshima City.

Family BOLIVINITIDAE CUSHMAN, 1927

Genus *Bolivina* D'ORBIGNY, 1839

Bolivina abbreviata HERON-ALLEN and EARLAND

Pl. 8, figs. 12a-b

Bolivina limbata BRADY var. *abbreviata* HERON-ALLEN and EARLAND, 1924, Jour. Linn. Soc. Zool., v. 35, p. 622, pl. 36, figs. 25-27; ASANO, 1958, p. 18, pl. 4, fig. 5.

Occurrence and Repository: Central Area (Stn. 74, 83, 89, 91, 95, 101, 102, 104: 28-207 m; living 28-207 m); Bay Mouth Area (Stn. 106, 118, 134: 40-112 m); ESK Reg. no. F-8441 - 8451; hypotype in fig. 12a, ESK Reg. no. F-8445 from Stn. 95; hypotype in fig. 12b, ESK Reg. no. F-8442 from Stn. 83.

Remarks: This is the first record of the present species in Japanese waters.

Bolivina albatrossi CUSHMAN

Pl. 8, figs. 13a-c

Bolivina albatrossi CUSHMAN, 1922, p. 31, pl. 6, fig. 4.
Brizalina albatrossi (CUSHMAN). POAG, 1981, p. 44, pl. 23, fig. 5; pl. 24, fig. 5a-c.

Occurrence and Repository: Central Area (Stn. 76, 83, 90: 36-220 m); Bay Mouth Area (Stn. 113, 122, 134: 100-112 m; living 100 m); ESK Reg. no. F-8452 - 8457; hypotype in fig. 13a, ESK Reg. no. F-8454 from Stn. 90; hypotype in fig. 13b, ESK Reg. no. F-8457 from Stn. 134; hypotype in fig. 13c, ESK Reg. no. F-8455 from Stn. 113.

Remarks: This is the first record of the present species in Japanese waters.

Bolivina amygdalaeformis BRADY

Bolivina amygdalaeformis BRADY, 1881, Quart. Journ. Micr. Sci., v. 21, p. 59; 1884, Rep. Voy. Challenger, Zoology, v. 9, p. 426, pl. 53, figs. 28-29; CUSHMAN, 1911, p. 42 -43, figs. 69a-b; CUSHMAN, 1921, p. 133, pl. 26, fig. 3.

Occurrence and Repository: Central Area (Stn. 74, 79, 92: 28-185 m); Bay Mouth Area (Stn. 127, 132, 136, 141, 143: 60-100 m; living 100 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-8458 - 8466.

Geographic Distribution: Off the Pacific coasts of Central Honshū and Shikoku, the northwest coast of Kyūshū and the north coast of West Honshū; 44) 75-123 m; 46) 165-199 m; 61) 21-71 m; 74) 93 m; 75) 90 m.

Bolivina durrandii MILLETT

Pl. 8, figs. 14a-c

Bolivina durrandii MILLETT, 1900, Roy. Micr. Soc. London, Jour., p. 544, pl. 4, figs. 7a-b.

Occurrence and Repository: Central Area (Stn. 70, 81, 88, 92, 94, 97, 105: 23-220 m); Bay Mouth Area (Stn. 108, 110, 116, 127, 141: 60-120 m; living 60-61 m); ESK Reg. no. F-8467 - 8478; hypotype in fig. 7a, ESK Reg. no. F-8475 from Stn. 110; hypotype in fig. 7b, ESK Reg. no. F-8474 from Stn. 108; hypotype in fig. 7c, ESK Reg. no. F-8473 from Stn. 105.

Geographic Distribution: Kamaé Bay; 76) 17 m.

Bolivina hadai UCHIO

Pl. 9, fig. 1

Bolivina hadai UCHIO, 1962, p. 388-389, pl. 18, figs. 3a-b, 4a-b.

Occurrence and Repository: Central Area (Stn. 74, 78, 83, 104: 28-40 m; living 28 m); Bay Mouth Area (Stn. 132: 100 m); ESK Reg. no. F-8479 - 8483; hypotype in fig. 1, ESK Reg. no. F-8483 from Stn. 132.

Geographic Distribution: Off the west coast of North Honshū and the Seto Inland Sea; 23) 40-66 m, living 66 m; 24) 5-75 m, living 10-30 m; 25) 38 m with living specimens; 41) 34-55 m; 54) 23 m with living specimens; 62) 96 m with living specimens; 64) 22-60 m, living 46 m.

Remarks: The three stations showing high frequencies (1.9-4.0%) are distributed off the coast between Kagoshima and Kiiré.

Bolivina humilis CUSHMAN and MCCULLOCH

Pl. 9, figs. 2a-f

Bolivina seminuda CUSHMAN var. *humilis* CUSHMAN and MCCULLOCH, 1942, Southern California, Univ., Publ., Allan Hancock Pacific Exped., v. 6, no. 4, p. 211, pl. 26, figs. 1-6.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 70, 73, 85, 88, 90, 92, 93, 96, 97, 98, 99, 100, 103, 104: 23-220 m; living 38-142 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 136, 137, 139, 141, 143: 20-140 m; living 20-96 m); open sea area (Stn. 145, 146: 155-213 m); ESK Reg. no. F-8484 - 8517; hypotype in fig. 2a, ESK Reg. no. F-8518 from Stn. 104; hypotype in fig. 2b, ESK Reg. no. F-8519 from Stn. 104; hypotype in fig. 2c, ESK Reg. no. F-8520 from Stn. 106; hypotype in fig. 2d, ESK Reg. no. F-8521 from Stn. 141; hypotype in fig. 2e, ESK Reg. no. F-8522 from Stn. 139; hypotype in fig. 2f, ESK Reg. no. F-8523 from Stn. 139.

Bolivina karreriana BRADY

Pl. 9, figs. 3a-b

Bolivina karreriana BRADY, 1881, Quart. Jour., Micr. Sci., London, n.s., v. 21, p. 58.
Loxostomum karrerianum carinatum (MILLETT). KUWANO, 1962, pl. 19, fig. 8.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m); Central Area (Stn. 66, 70, 73, 74, 75, 78, 83, 88, 92, 99, 100, 104, 105: 23-185 m; living 28-42 m); Bay Mouth Area (Stn. 106, 110, 116, 118, 127, 134, 136, 141: 40-112 m; living 40-61 m); ESK Reg. no. F-8524 - 8547; hypotype in fig. 3a, ESK Reg. no. F-8548 from Stn. 127; hypotype in fig. 3b, ESK Reg. no. F-8549 from Stn. 99.

Geographic Distribution: Off the northwest coast of North Honshū and the Pacific coast of Central Honshū; 24) 20-75 m; 36) living 208-333 m; 37) 53-70 m; 41) 6.7-65 m; 43) 45-105 m; 46) 126 m; 47) 864-1063 m; 48) 235-597 m, living 235 m; 51) 422-665 m; 52) 201-585 m; 55) 20-42 m; 58).

Bolivina kiiensis ASANO

Pl. 9, figs. 4a-d

Bolivina kiiensis ASANO, 1958, p. 19, pl. 4, figs. 7, 8; ISHIWADA, 1964, p. 40, pl. 4, fig. 61; KUWANO, 1962, p. 132, pl. 14, fig. 12.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Central Area (Stn. 70, 71, 73, 98, 99, 100, 102, 103, 105: 23-175 m; living 60-175 m); Bay Mouth Area (Stn. 110, 122, 127, 136, 137, 139, 141: 60-110 m); ESK Reg. no. F-8550 - 8566; hypotype in figs. 4a-b, ESK Reg. no. F-8567 from Stn. 141; hypotype in fig. 4c, ESK Reg. no. F-8568 from Stn. 103; hypotype in fig. 4d, ESK Reg. no. F-8569 from Stn. 136..

Geographic Distribution: Off the Pacific coasts from Central Honshū to Kyūshū; 46) 126-481 m; 52) 80 m; 60) 97.5 m; 69) 56-98 m; 70) 70-390 m, living 70 m; 77) 122 m; 78) living 23-225 m.

Remarks: This species has been recorded from the coastal water influenced by the Kuroshio current along the Pacific side of the southwest islands of Japan from Shizuoka Prefecture and southwards.

Bolivina ordinaria PHLEGER and PARKER

Pl. 9, figs. 5a-d

Bolivina simplex PHLEGER and PARKER, 1950, Geol. Soc. Amer. Mem. 46, p. 14, pl. 7, figs. 4, 5a-b, 6 (emend. PHLEGER and PARKER, 1952, Cushman Found. Foram. Res., Contr., v. 3, pt. 1, p. 14, *Bolivina ordinaria*).
Bolivina robusta BRADY var. B. KUWANO, 1962, pl. 15, fig. 3.

Occurrence and Repository: Bay Head Area (Stn. 22, 32, 34, 44, 45: 134-156 m); West-Sakurajima Passage (Stn. 63, 64, 65: 39- 138 m; living 39-66 m); Central Area (Stn. 66, 67, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105: 23-225 m; living 60-140 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 134, 136, 137, 139, 141, 143: 20-140 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 105 m); ESK Reg. no. F-8570 - 8636; hypotype in fig. 5a, ESK Reg. no. F-8637 from Stn. 145; hypotype in fig. 5b, ESK Reg. no. F-8638 from Stn. 127; hypotype in fig. 5c, ESK Reg. no. F-8639 from Stn. 127; hypotype in fig. 5d, ESK Reg. no. F-8640 from Stn. 127.

Geographic Distribution: Off the Bōsō Peninsula; 36) living 73-118 m.

Bolivina pacifica CUSHMAN and MCCULLOCH

Pl. 9, figs. 6a-c

Bolivina acerosa CUSHMAN var. *pacifica* CUSHMAN and MCCULLOCH, 1942, Allan Hancock Pacific Exped., v. 6, no. 4, p. 181, pl. 21, figs. 2-3.
Bolivina pacifica CUSHMAN and MCCULLOCH. BANDY, 1953, v. 27, no. 2, p. 28, pl. 24, figs. 8a-b.
Bolivina acerosa pacifica CUSHMAN et MCCULLOCH. KUWANO, 1962, pl. 14, figs. 9-11.

Occurrence and Repository: Central Area (Stn. 71, 73, 79, 82, 84, 87, 88, 92, 93, 94, 95, 97, 98, 99, 100, 102, 103, 105: 42-185 m; living 88-162 m); Bay Mouth and open sea areas (Stn. 106, 108, 110, 113, 118, 122, 127, 132, 134, 136, 137, 139, 141, 143, 144: 40-120 m; living 40-105 m); ESK Reg. no. F-8641 - 8673; hypotype in fig. 6a, ESK Reg. no. F-8674 from Stn. 97; hypotype in fig. 6b, ESK Reg. no. F-8675 from Stn. 137; hypotype in fig. 6c, ESK Reg. no. F-8676 from Stn. 132..

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the Pacific coast from Central Honshū to Kyūshū, and the Seto Inland Sea; 23) 650-875 m with living specimens; 25) 230-760 m with living specimens; 30); 48) 74-403 m with living specimens; 50); 51) 72-232 m with living specimens; 52) 80-585 m, living 80-201 m; 64) 60 m; 70) 70-475 m with living specimens; 76) 7-62 m; 77) 35-122 m with living specimens.

Bolivina retia ŌKI, n. sp.

Pl. 9, figs. 7a-f

Test small, rice shaped, about twice as long as broad, periphery broadly rounded; chambers not distinct, about twice as broad as high; sutures not distinct, obliquely curved, at the periphery forming an angle of about 45° with the horizontal; wall ornamented by reticulate perforation; aperture a small, oval opening at the base of the inner margin of the chamber.

Types and Dimensions: Holotype in fig. 7a, f, ESK Reg. no. F-8677 from Stn.139, length 0.20 mm, breadth 0.10 mm, thickness 0.06 mm; paratype in fig. 7b, ESK Reg. no. F-8678 from Stn. 103, length 0.17 mm, breadth 0.09 mm, thickness 0.05 mm; paratype in fig. 7c, ESK Reg. no. F-8679 from Stn. 139, length 0.22 mm, breadth 0.11 mm, thickness 0.06 mm; paratype in fig. 7d, ESK Reg. no. F-8680 from Stn. 132, length 0.18 mm, breadth 0.09 mm, thickness 0.06 mm; paratype in fig. 7e, ESK Reg. no. F-8681

from Stn. 139, length 0.17 mm, breadth 0.09 mm, thickness 0.05 mm.

Occurrence and Repository: Central Area (Stn. 66, 71, 73, 75, 76, 77, 79, 80, 81, 82, 85, 87, 88, 89, 90, 91, 92, 93, 96, 98, 101, 103: 78-225 m; living 145 m); Bay Mouth Area (Stn. 108, 110, 116, 118, 122, 132, 134, 139: 61-120 m; living 105 m); open sea area (Stn. 144: 105 m); ESK Reg. no. F-8682 - 8712.

Remarks: This new species is distributed in the deepest part of the Bay Mouth Area and on the slope between the outer margin of the submarine terrace and the deep basin bottom in the Central Area (frequency: 1-3%).

Bolivina robusta BRADY

Pl. 10, figs. 1a-e

Bolivina robusta BRADY, 1881, Quart. Jour. Micr. Sci., London, v. 21, p. 27; HADA, 1931, p. 131-132, text-figs. 88a-b; TAKAYANAGI, 1955, p. 43, pl. 2, fig. 5; ASANO, 1958, p. 20-21, pl. 5, figs. 1-3; ISHIWADA, 1964, p. 17, 19, 24, pl. 4, fig. 63; CHIJI and LOPEZ, 1968, p. 105, pl. 10, fig. 15; MATOBA, 1970, p. 49, pl. 3, figs. 26a-b; HASEGAWA, 1979, p. 143, pl. 3, figs. 9a-b, 10a-b.

Bolivina robusta BRADY var. C. KUWANO, 1962, pl. 15, fig. 5.

Occurrence and Repository: Bay Head Area (Stn. 32, 34, 44, 45: 134-156 m); West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m; living 39 m); Central Area (Stn. 66, 67, 69, 70, 71, 73, 74, 75, 76, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 97, 98, 99, 100, 101, 102, 103, 104, 105: 23-225 m; living 28-170 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 134, 136, 137, 139, 141, 143: 20-140 m; living 60-140 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-8713 - 8774; hypotype in fig. 1a, ESK Reg. no. F-8775 from Stn. 64; hypotype in fig. 1b, ESK Reg. no. F-8776 from Stn. 146; hypotype in fig. 1c, ESK Reg. no. F-8777 from Stn. 104; hypotype in fig. 1d, ESK Reg. no. F-8778 from Stn. 146; hypotype in fig. 1e, ESK Reg. no. F-8779 from Stn. 104.

Geographic Distribution: The seas adjacent to Japan; 8); 13) 135 m; 14) 598 m; 17) 100 m; 18) 18 fms; 19) 102-525 m; 21) 68- 618 m; 23) 40-95 m, living 50-80 m; 24) 5-100 m, living 30-94 m; 25) 50 m; 26) 44-135 m; 29) 0.8-4.4 m; 30); 32); 33) 83-1111 m; 34) 64-1180 m; 37) 14-70 m; 42) 83-1203 m; 43) 45-430 m; 44) 75-411 m; 46) 84-600 m; 47) 107-1488 m; 48) 40-597 m with living specimens; 49); 51) 23-665 m with living specimens; 52) 31-585 m, living 31-408 m; 53); 54) 23 m; 55) 33-64 m; 56) 15-38 m; 61) 23- 80 m; 62) 96 m with living specimens; 63) 10 m; 64) 22-60 m, living 46-60 m; 67) 201-481 m; 69) 56-900 m; 70) 70-808 m, living 70-202 m; 73); 74) 93-194 m; 75) 90-549 m; 76) 10-79 m; 77) 35- 745 m, living 35-122 m.

Bolivina spinea CUSHMAN

Pl. 10, figs. 2a-b

Bolivina spinea CUSHMAN, 1936, Cushman Lab. Foram. Res., Spec. Publ., no. 6, p. 58, pl. 8, figs. 11a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63: 138 m); Central Area (Stn. 74, 81, 83: 28-220 m); ESK Reg. no. F- 8780 - 8783; hypotype in fig. 2a, ESK Reg. no. F-8784 from Stn. 63; hypotype in fig. 2b, ESK Reg. no. F-8785 from Stn. 63.

Geographic Distribution: Off the south coast of Hokkaido and the northeast coast of

North Honshū; 11) 902 m with living specimens; 13) 640 m with living specimens; 15) 510-840 m with living specimens; 17) 690-985 m.

Bolivina striatula CUSHMAN

Pl. 10, figs. 3a-b

Bolivina striatula CUSHMAN, 1922, Publ. 311, Carnegie Inst. Wash., p. 27, pl. 3, fig. 10; MATOBA, 1970, p. 49, pl. 3, figs. 28a-b.

Brizalina striatula (CUSHMAN). CHIJI, 1969, fig. 4; SLITER, 1970, p. 170, pl. 7, fig. 6, pl. 8; ŌKI, 1975, p. 42, pl. 2, fig. 3.

Occurrence and Repository: Bay Head Area (Stn. 22, 63, 65: 39-144 m; living 39 m); Central Area (Stn. 67, 69, 70, 71, 73, 74, 75, 77, 78, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105: 23-225 m; living 23-170 m); Bay Mouth Area (Stn. 106, 107, 116, 118, 125, 127, 132, 134, 137, 139, 143: 40-140 m); ESK Reg. no. F-8786 - 8833; hypotype in fig. 3a, ESK Reg. no. F-8834 from Stn. 101; hypotype in fig. 3b, ESK Reg. no. F-8835 from Stn. 91.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the south coast of Central Honshū, and the Seto Inland Sea; 23) 40-56 m, living 56 m; 24) 10-68 m, living 10-30 m; 29) 0.7-12.5 m, living 0.8-8.7 m; 50); 55) 33-64 m; 56) 9-38 m.

Bolivina striatula nishikanbaraensis MATSUNAGA

Bolivina striatula nishikanbaraensis MATSUNAGA, 1963, p. 111, pl. 40, figs. 14a-b.

Occurrence and Repository: Central Area (Stn. 74, 83, 90: 28-215 m; living 28-36 m); Bay Mouth Area (Stn. 107, 127: 74-96 m); ESK Reg. no. F-8836 - 8840.

Remarks: This species was originally described from the Pliocene Wanazu, Tsukayama and Oguni Formations in Niigata Prefecture (MATSUNAGA, 1963).

Bolivina subreticulata PARR

Pl. 10, figs. 4a-c

Bolivina reticlulata BRADY, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 426, pl. 53, figs. 30-31.

Bolivina subreticulata PARR, 1932, Proc. Roy. Soc. Victoria, v. 44, p. 12, pl. 1, figs. 21a-b; CUSHMAN, 1942, p. 31, pl. 9, fig. 2; BARKER, 1960, p. 110, pl. 53, figs. 30a-b, 31.

Occurrence and Repository: Bay Mouth Area (Stn. 108, 118, 122, 143; 96-120 m); open sea area (Stn. 145, 146: 155-213 m); ESK Reg. no. F-8841 - 8846; hypotype in fig. 4a, ESK Reg. no. F-8847 from Stn. 146; hypotype in fig. 4b, ESK Reg. no. F-8841 from Stn. 108; hypotype in fig. 4c, ESK Reg. no. F-8848 from Stn. 143.

Bolivina subspinescens CUSHMAN

Pl. 10, figs. 5a-b

Bolivina spinescens CUSHMAN, 1911, U.S. Nat. Mus., Bull. 71, pt. 2, p. 46-47, figs. 76a-b; MATOBA, 1967, p. 251, pl. 25, fig. 17.

Bolivina subspinescens CUSHMAN, 1922, p. 48, pl. 7, fig. 5; COLE, 1981, p. 88, pl. 10, fig. 4.

Occurrence and Repository: Bay Head Area (Stn. 44, 45, 63, 65; 39-144 m); Central Area (Stn. 71, 73, 74, 75, 77, 79, 83, 84, 88, 91, 93, 94, 95, 96, 99, 104: 28-207 m; living 78-196 m); Bay Mouth and open sea areas (Stn. 110, 116, 118, 125, 127, 132, 134, 136, 137, 139, 141, 144: 60-140 m); ESK Reg. no. F-8849 - 8880; hypotype in fig. 5a, ESK Reg. no. F-8881 from Stn. 139; hypotype in fig. 5b, ESK Reg. no. F-8877 from Stn. 137.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the Pacific coast from Central Honshū to Kyūshū; 23) 56-95 m, living 64 m; 30) 50-150 m; 42) 83-248 m; 48) 74-597 m, living 74-235 m; 51) 72-665 m, living 72-232 m; 52) 80-585 m with living specimens; 70) 123-808 m; 77) 122-745 m.

Bolivina variabilis (WILLIAMSON)

Pl. 10, figs. 6a-f

Textularia variabilis WILLIAMSON, 1858, Ray Soc., p. 75, pl. 6, figs. 162-163.
Bolivina plicatella mera CUSHMAN and PONTON. HAYWARD and BUZAS, 1979, p. 43, pl. 5, figs. 61-62.
Bolivina variabilis (WILLIAMSON). SLITER, 1970, p. 166, pl. 5, figs. 4a-b; pl. 6, figs. 1a-f, 2, 3a-b; pl. 8, figs. 15-16; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 19, pl. 4, figs. 1-4.

Occurrence and Repository: Central Area (Stn. 71, 76, 85, 86, 87, 90, 91, 92, 96, 97, 98, 100, 101, 102, 103, 105: 75-220 m; living 75 m); Bay Mouth and open sea areas (Stn. 108, 110, 116, 118, 134, 136, 139, 143, 145: 60-155 m; living 105-120 m); ESK Reg. no. F-8882 - 8905; hypotype in fig. 6a, ESK Reg. no. F-8906 from Stn. 139; hypotype in fig. 6b, ESK Reg. no. F-8894 from Stn. 101; hypotype in fig. 6c, ESK Reg. no. F-8907 from Stn. 110; hypotype in fig. 6d, ESK Reg. no. F-8903 from Stn. 136 hypotype in fig. 6e, ESK Reg. no. F-8908 from Stn. 139; hypotype in fig. 6f, ESK Reg. no. F-8909 from Stn. 139.

Geographic Distribution: Tanabe Bay; 56) 9-38 m, living 9 m.

Remarks: This species was originally described from the early Miocene sediments in New Zealand.

Bolivina zanzibarica CUSHMAN

Bolivina zanzibarica CUSHMAN, 1936, Cushman Lab. Foram. Res., Spec. Publ., no. 6, p. 58, pl. 8, fig. 12.

Occurrence and Repository: Central Area (Stn. 85: 220 m; living); ESK Reg. no. F-8910.

Bolivina sp. 1

Occurrence and Repository: Central Area (Stn. 98, 99: 42-145 m); Bay Mouth Area (Stn. 107, 125, 127, 136, 143: 60-140 m; living 60 m); ESK Reg. no. F-8911 - 8917.

Remarks: The present species is distinguishable from all other species of the genus *Bolivina* by its elongate outline and coarse foramen.

Bolivina sp. 2

Occurrence and Repository: Bay Mouth Area (Stn. 134, 136: 60-112 m); ESK Reg. no. F-8918 - 8919.

Remarks: The present species is characterized by small tests (length up to 0.2 mm), inflated chambers and fine foramen.

Bolivina sp. 3

Occurrence and Repository: Bay Mouth and open sea areas (Stn. 134, 144: 105-112 m); ESK Reg. no. F-8920 - 8921.

Remarks: The specimens in the collection closely resemble *Bolivina* sp. 1 but are distinguished therefrom by having many costae.

Genus *Rectobolivina* CUSHMAN, 1927

Rectobolivina hancocki (CUSHMAN and MCCULLOCH)

Pl. 10, figs. 7a-b

Bifarina hancocki CUSHMAN and MCCULLOCH, 1942, Southern California, Univ., Publ., Allan Hancock Pacific Ecped., v. 6, no. 4, p. 225, pl. 28, figs. 13-19.

Occurrence and Repository: Central Area (Stn. 81, 104, 105: 38-220 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 116, 122, 124, 127, 132, 136, 137, 139: 20-120 m); ESK Reg. no. F-8922 - 8936; hypotype in fig. 7, ESK Reg. no. F-8925 from Stn. 106.

Remarks: The specimens at Stn. 81 (220 m) are presumed to be derived from the shallow area (shallower than 120 m) by a bottom current.

Rectobolivina raphana (PARKER and JONES)

Pl. 10, figs. 8a-d

Uvigerina (Sagrina) raphanus PARKER and JONES, 1865, Roy. Soc. London, Philos. Trans., v. 155, p. 364, pl. 18, figs. 16a-b, 17.

Siphogenerina raphanus (PARKER and JONES). CUSHMAN, 1913, p. 108, pl. 46, figs. 1-5; HADA, 1931, p. 134-135, text -fig. 91; ASANO, 1950, pt. 2, p. 14, text-figs. 56-57; KUWANO, 1962, pl. 22, figs. 5a-b; MATSUNAGA, 1963, pl. 42, figs. 8a-b; ISHIWADA, 1964, p. 17, pl. 5, fig. 81.

Rectobolivina raphana (PARKER and JONES). MATOBA, 1970, p. 60, pl. 3, fig. 31; HASEGAWA, 1979, p. 154, pl. 4, figs. 1-2.

Occurrence and Repository: Bay Head Area (Stn. 32, 44, 45, 63, 64, 65: 39-156m; living 39 m); Central Area (Stn. 73, 75, 79, 80, 81, 82, 84, 85, 86, 87, 88, 89, 90, 92, 93, 94, 97, 100, 101, 103, 105: 75-225 m; living 78-220 m); Bay Mouth and open sea areas (Stn. 106, 108, 110, 113, 116, 118, 122, 125, 127, 132, 134, 136, 139, 141, 143, 144: 40-140 m; living 61-140 m); ESK Reg. no. F-8937 - 8979; hypotype in fig. 8a, ESK Reg. no. F-8980 from Stn. 88; hypotype in fig. 8b, ESK Reg. no. F-8981 from Stn. 113; hypotype in fig. 8c, ESK Reg. no. F-8977 from Stn. 141; hypotype in fig. 8d, ESK Reg. no. F-8982 from Stn. 127.

Geographic Distribution: The seas adjacent to Japan; 6) 120 m; 14) 70-598 m; 17) 100 m; 18) 17-25 fms; 19) 102-539 m; 23) 48- 760 m, living 56-95 m; 24) 10-148 m, living 40-144 m; 25) 38-150 m, living 50-117 m; 26) 81-135 m; 27) 28-78 m; 28) 25-30 m; 32); 33) 111-1111 m; 34) 64-155 m; 35); 36) living 59-333 m; 37) 18-70 m; 40); 41) 9.6-65 m; 42) 83-1203 m; 43) 45-430 m; 44) 75-348 m; 45); 46) 64-582 m; 47) 130-388 m; 48) 74-235 m with living specimens; 51) 23-232 m, living 43-102 m; 52) 80-120 m, living 80 m; 55) 20-42 m; 58); 60) 50-97.5 m; 61) 23-71 m; 62) 96 m; 64) 46-60 m; 65) 19.5-21 m; 67) 130-527 m; 69) 56-193 m; 70) 70-475 m, living 70 m; 70) 130-527 m; 72); 73); 74) 194 m; 75) 90-300 m; 77) 35-122 m with living specimens.

Remarks: At the deepest part of the Bay Mouth Area, frequency is rather high (1-3%).

Rectobolivina tonohamaensis (TAKAYANAGI)

Pl. 10, fig. 9

Bifarina tonohamaensis TAKAYANAGI, 1953, Tohoku Univ., Inst. Geol. Pal., Short Papers, no. 5, p. 32, pl. 4, figs. 8a-b.

Occurrence and Repository: Central Area (Stn. 70, 74, 78, 80, 83, 94, 103: 23-225 m); Bay Mouth Area (Stn. 106: 40 m); ESK Reg. no. F-8983 - 8990; hypotype in fig. 7a, ESK Reg. no. F-8990 from Stn. 106.

Remarks: This species was originally described from the Pliocene Ananai Formation in Kōchi Prefecture.

Family BULIMINIDAE JONES, 1875

Subfamily BULIMININAE JONES, 1875

Genus *Bulimina* D'ORBIGNY, 1826

Bulimina denudata CUSHMAN and PARKER

Pl. 11, fig. 1

Bulimina pagoda CUSHMAN var. *denudata* CUSHMAN and PARKER, 1938, Contr. Cushman Lab. Foram. Res., Sharon, Mass., U.S.A., v. 14, pt. 3, p. 57, pl. 10, figs. 1a-c; 2a-c.

Bulimina denudata CUSHMAN and PARKER. BANDY, 1953, p. 20, pl. 24, figs. 11a, b; PHLEGER, 1964, p. 382, pl. 4, fig. 4; ŌKI, 1975, p. 44, pl. 2, fig. 7.

Occurrence and Repository: Central Area (Stn. 70, 78, 88, 91, 99: 20-207 m; living 23-42 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-8991 - 8996; hypotype in fig. 1, ESK Reg. no. F-8997 from Stn. 70.

Remarks: This is the first record of the present species in Japanese waters.

Bulimina kochiensis TAKAYANAGI

Pl. 11, figs. 2a-c

Bulimina kochiensis TAKAYANAGI, 1953, Tohoku Univ., Inst. Geol. Pal., Short Papers, no. 5, p. 31, pl. 4, figs. 12a-c.

Bulimina cf. *kochiensis* TAKAYANAGI. KUWANO, 1962, p. 129, pl. 15, figs. 9, 10.

Occurrence and Repository: Bay Head Area (Stn. 34: 149 m); Central Area (Stn. 66, 67, 71, 73, 76, 84, 87, 88, 92, 93, 98, 100, 105: 75-220 m; living 75-220 m); Bay Mouth Area (Stn. 113, 139: 100-105 m; living 105 m); ESK Reg. no. F-8998 - 9013; hypotype in fig. 2a, ESK Reg. no. F-9010 from Stn. 100; hypotype in fig. 2b, ESK Reg. no. F-9012 from Stn. 113; hypotype in fig. 2c, ESK Reg. no. F-9014 from Stn. 105.

Geographic Distribution: Off the Pacific coast from Central Honshū to Kyūshū; 48) 74-597 m, living 124-149 m; 52) 31-120 m, living 31-80 m; 55) 40-64 m; 70) 70-808 m, living 123 m; 77) 122- 745 m, living 122 m.

Remarks: This species was reported from the Kuroshio area off the Pacific coast of southwest Japan, from Shizuoka Prefecture southwards.

Bulimina marginata D' ORBIGNY

Pl. 11, figs. 3a-e

Bulimina marginata D'ORBIGNY, 1826, Ann. Sci. Nat., Paris, ser. 1, v. 7, p. 269, pl. 12, figs. 10-12; CUSHMAN, 1922, p. 91, pl. 21, figs. 4-5; TAKAYANAGI, 1955, pl. 2, fig. 7; ASANO, 1958, p. 4-6, pl. 1, figs. 5, 9-11; KUWANO, 1962, pl. 15, figs. 11-14; ISHIWADA, 1964, p. 39, pl. 4, figs. 52-53; MATOBA, 1967, p. 252, pl. 25, fig. 37; MATOBA, 1970, p. 50, pl. 3, fig. 32; ŌKI, 1975, p. 45-46, pl. 2, figs. 9a-b; pl. 3, fig. 1; INOUE, 1980, pl. 27, fig. 15.

Bulimina aculeata D'ORBIGNY. HADA, 1931, p. 127-128, text -figs. 84a-b.

Occurrence and Repository: Bay Head Area (Stn. 15, 17, 18, 22, 32, 34, 41, 42, 44, 45, 53: 94-182 m; living 94-149 m); West- Sakurajima Passage (Stn. 63, 64, 65: 39-138 m; living 39 m); Central Area (Stn. 66, 67, 68, 69, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105: 28-225 m; living 28-225 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 134, 136, 137, 139, 141, 143: 20- 140 m; living 60-140 m);

open sea area (Stn. 144, 145, 146: 105-213 m); ESK Reg. no. F-9015 - 9087; hypotype in fig. 3a, ESK Reg. no. F-9088 from Stn. 146; hypotype in fig. 3b, ESK Reg. no. F-9086 from Stn. 145; hypotype in fig. 3c, ESK Reg. no. F-9089 from Stn. 143; hypotype in fig. 3d, ESK Reg. no. F-9090 from Stn. 146; hypotype in fig. 3e, ESK Reg. no. F-9091 from Stn. 146.

Geographic Distribution: The seas adjacent to Japan; 5); 6) 120 m; 13) 84 m with living specimens; 14) 115-598 m; 15) 510-695 m; 17) 100-690 m; 18) 17-33 fms; 19) 102-644 m; 21) 68-344 m; 23) 50-875 m, living 67-95 m; 24) 30-144 m, living 30-120 m; 25) 50-760 m; living 117 m; 26) 44-146 m; 27) 45-78 m; 28) 25-33 m; 30); 32); 33) 83-154 m; 34) 155-1180 m; 36) 101-289 with living specimens; 37) 13.5-70 m; 41) 15.9-65 m; 42) 83-1203 m; 43) 45- 570 m; 44) 75-402 m; 45); 46) 82-684 m; 47) 88-1887 m; 48) 40-597 m with living specimens; 50); 51) 43-665 m, living 72-665 m; 52) 31-585 m with living specimens; 55) 20-64 m; 56) 9-38 m; 58); 59) 6.4-7.0 m; 60) 50-97.5 m; 61) 23-70 m; 62) 96 m with living specimens; 64) 60 m; 65) 26 m; 68) 56-680 m; 69) 70-808 m, living 123-202 m; 70) 91-349 m; 74) 93-219 m; 75) 90-300 m; 76) 7-79 m; 77) 35-745 m; 78) living 23-225 m.

Remarks: The present species occurs very commonly throughout the bay. The specimens in the collection represent two types of tests different from each other. Most of the specimens collected from the coastal shallow water have much thinner tests than those from the basin bottom. It is still unknown whether the difference implies merely the fluctuation of this species or a speciation into subspecies or species.

Bulimina cf. *spicata* PHLEGER and PARKER

Compared with:

Bulimina spicata PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, pt. 2, p. 16, pl. 7, figs. 25a-c, 30, 31; BOCK, 1971, p. 17, no. 2, p. 183-184, pl. 1, fig. 3.

Occurrence and Repository: open sea area (Stn. 146: 213 m); ESK Reg. no. F-9092.

Remarks: Only two specimens are in the collection.

Bulimina spinosa (HERON-ALLEN and EARLAND)

Pl. 11, figs. 4a-b

Virgulina schreibersiana CZJZEK var. *spinosa* HERON-ALLEN and EARLAND, 1932, p. 352, pl. 9, figs. 3-4.
Fursenkoina spinosa (HERON-ALLEN and EARLAND). PHLEGER, 1964, p. 383, pl. 3, fig. 13.
Bulimina spinosa (HERON-ALLEN and EARLAND). MATOBA, 1982, p. 1041, pl. 2, fig. 4.

Occurrence and Repository: Bay Head Area (Stn. 17, 22, 32, 34, 44, 45, 63: 134-156 m; living 144-149 m); Central Area (Stn. 66, 67, 69, 72, 73, 75, 76, 77, 79, 80, 81, 82, 84, 85, 86, 87, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 100, 101, 102, 103, 105: 75-225 m; living 95-220 m); Bay Mouth Area (Stn. 108, 132: 100- 120 m); ESK Reg. no. F-9093 - 9132; hypotype in fig. 4a, ESK Reg. no. F-9133 from Stn. 72; hypotype in fig. 4b, ESK Reg. no. F-9134 from Stn. 72.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū; 23) 95 m with living specimens; 24) 30-78 m, living 49-75 m; 25) 50-230 m, living 50-212 m; 30) 95 m with living specimens.

Bulimina sp.

Occurrence and Repository: Central Area (Stn. 70, 73, 74, 78: 23-80 m); ESK Reg. no. F-9135 - 9138.

Remarks: The present specimens are distinguished from all other species of the genus *Bulimina* by their smooth surface, slightly depressed suture and smaller number of coarse perforations.

Genus *Globobulimina* CUSHMAN, 1927

Globobulimina turgida (BAILEY)

Pl. 11, figs. 5a-c

Bulimina turgida BAILEY, 1851, Smithsonian Inst., Contr. Knowledge, v. 2, art. 3, p. 12, pl., figs. 28-31.
Globobulimina turgida (BAILEY). ASANO, 1958, p. 13, pl. 2, figs. 7-9; KUWANO, 1962, p. 133, pl. 18, fig. 2; ISHIWADA, 1964, p. 14, pl. 4, fig. 57; LOEBLICH and TAPPAN, 1964, p. C561, figs. 442, 5-6.

Occurrence and Repository: Central Area (Stn. 68, 72, 76, 77, 80, 81, 82, 85, 86, 87, 90, 91, 93, 96, 97, 98, 101: 119-225 m; living 165-225 m); ESK Reg. no. F-9139 - 9155; hypotype in figs. 5a-b, ESK Reg. no. F-9156 from Stn. 101; hypotype in fig. 5c, ESK Reg. no. F-9157 from Stn. 97.

Geographic Distribution: Off the east coast of North Honshū, the southeast coast of Central Honshū, the south coast of Shikoku, the northwest coast of Kyūshū and the north coast from West Honshū to Central Honshū; 19) 205-309 m; 21) 188-238 m; 26) 146 m; 33) 83-154 m; 36) living 208 m; 44) 411 m; 46) 201 m.

Remarks: The distribution of the present species is restricted to the basin bottom in the Central Area.

Genus *Stainforthia* HOFKER, 1956

Stainforthia complanata (EGGER)

Virgulina schreibersiana CZJZEK var. *complanata* EGGER, 1893, Abh. kon. bay. Akad. Wiss. Munchen, Cl. II, v. 18, p. 292, pl. 8, figs. 91-92; CUSHMAN, 1942, p. 13, pl. 4, figs. 2-5; ISHIWADA, 1950, p. 5, pl., fig. 7; ASANO, 1958, p. 14, pl. 3, fig. 8; UCHIO, 1960, p. 63, pl. 6, fig. 13.
Stainforthia complanata (EGGER). INGLE, KELLER and KOIPACK, 1980, p. 144, pl. 5, figs. 10-11.

Occurrence and Repository: Central Area (Stn. 66, 71, 72, 73, 79, 80, 87, 88, 89, 91, 92, 96, 98, 101, 102: 78-225 m; living 78-216 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-9158 - 9173.

Geographic Distribution: Off the northwest coast of North Honshū and the north and southwest coasts of Central Honshū; 42) 248-1203 m; 46) 126-481 m.

Subfamily PAVONININAE EIMER and FICKERT, 1899

Genus *Chrysalidinella* SCHUBERT, 1908

Chrysalidinella dimorpha (BRADY)

Chrysalidina dimorpha BRADY, 1881, Quart. Jour. Micr. Sci., v. 21, p. 24; MILLETT, 1900, p. 12, pl. 1, figs. 14a-b.
Chrysalidinella dimorpha (BRADY). BARKER, 1960, p. 94, 96, pl. 46, figs. 20, 21a-b; MATSUNAGA, 1963, pl. 41, figs. 14a-b; LOEBLICH and TAPPAN, 1964, p. C563, figs. 444, 7a-b, 8-9; MATOBA, 1970, p. 50, pl. 3, figs. 34a-b.

Occurrence and Repository: Central Area (Stn. 79: 100 m); ESK Reg. no. F-9174.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the coast of Central Honshū, the Seto Inland Sea and coastal area at Hachijo Island; 21) 311 m; 24) 5-40 m; 29) 0.9-4.4 m; 32); 35); 37) 18-70 m; 38); 40); 45); 58); 60)

97.5 m; 63) 12 m; 64) 46 m.

Genus *Reussella* GALLOWAY, 1933

Reussella aculeata CUSHMAN

Pl. 11, figs. 6a-d

Reussella aculeata CUSHMAN, 1945, Cushman Lab. Forams. Res., Contr., Sharon, Mass., v. 21, p. 41, pl. 7, figs. 10-11.

Reussella spinulosa (REUSS), HAGEMAN, 1979, p. 105, pl. 9, fig. 8.

Occurrence and Repository: Bay Head Area (Stn. 17, 44, 65: 39-146 m); Central Area (Stn. 70, 72, 74, 76, 82, 83, 89, 93, 96, 99, 100: 23-220 m; living 42-74 m); Bay Mouth Area (Stn. 107, 110, 127, 136, 137: 60-110 m); ESK Reg. no. F-9175 - 9193; hypotype in fig. 6a, ESK Reg. no. F-9177 from Stn. 65; hypotype in fig. 6b, ESK Reg. no. F-9194 from Stn. 136; hypotype in fig. 6c, ESK Reg. no. F-9195 from Stn. 136; hypotype in fig. 6d, ESK Reg. no. F-9196 from Stn. 136.

Geographic Distribution: Off the northwest and east coast of North Honshū, the north coast of Central Honshū, the Pacific coast from Central Honshū to Kyūshū, the north coast of West Honshū and the northwest coast of Kyūshū, and the Seto Inland Sea; 19) 102-309 m; 21) 130-444 m; 27) 10-28 m; 28) 14-37 m; 32); 41) 5-56 m; 44) 110-150 m; 46) 84-229 m; 47) 639 m; 48) 40-149 m, living 40 m; 51) 23-232 m, living 23-155 m; 52) 31-120 m with living specimens; 55) 13-40 m; 56) 9-33 m; 58); 59) 6.4-8.6 m; 61) 21-59 m; 63) 5-20 m; 70) 70 m with living specimens; 71) 17-27 m; 72); 73); 74) 93 m; 75) 148 m; 77) 35-122 m, living 35 m.

Reussella aequa CUSHMAN and MCCULLOCH

Pl. 11, fig. 7

Reussella aequa CUSHMAN and MCCULLOCH, 1948, Southern California, Univ., Publ., Allan Hancock Pacific Exped., v. 6, no. 5, p. 251, pl. 31, fig. 7.

Reussella spinulosa (REUSS). ŌKI, 1975, p. 47, pl. 3, figs. 5a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 99: 42 m); Bay Mouth Area (Stn.136, 139: 60-105 m); ESK Reg. no. F-9197 - 9200; hypotype in fig. 7, ESK Reg. no. F-9201 from Stn. 136.

Geographic Distribution: Off Sōma City; 32).

Reussella hayasakai ŌKI, n. sp.

Pl. 11, figs. 8a-d

Test small, pyramidal, triangular in transverse section, angles of the test usually acute, the sides flat or slightly concave, initial end acutely pointed, initial end and angles of chambers with sharp spines; chamber slightly inflated; sutures distinct, slightly depressed; wall smooth, with definite bead-like ornamentation near the periphery of the chamber; aperture a narrow slit at the base of the inner margin of the chamber.

Types and Dimensions: Holotype in fig. 8a, ESK Reg. no. F- 9202 from Stn. 116, length 0.17 mm, breadth 0.20 mm; paratype in fig. 8b, ESK Reg. no. F-9203 from Stn. 116, length 0.13 mm, breadth 0.16 mm; paratype in fig. 8c, ESK Reg. no. F-9204 from Stn. 88, length 0.16 mm, breadth 0.19 mm; paratype in fig. 8d, ESK Reg. no. F-9205 from Stn. 101, length 0.15 mm, breadth 0.18 mm.

Occurrence and Repository: Bay Head Area (Stn. 45, 63: 134-138 m); northern part of the Central Area (Stn. 78, 83, 84: 36-88 m); southern part of the Central Area (Stn. 86, 87, 88, 89, 90, 91, 92, 94, 100, 101, 102, 104: 38-215 m); Bay Mouth Area (Stn. 106, 110, 113, 116, 118, 122, 125, 132, 134, 139, 141: 40-140 m; living 112 m); ESK Reg. no. F-9206 - 9232.

Remarks: This new species is characterized by its outline being longer than its breadth and the chambers with spines. It is mainly distributed in the southern half of the Central Area and the Bay Mouth Area.

Reussella simplex (CUSHMAN)

Pl. 11, fig. 9

Trimosina simplex CUSHMAN, 1929, Washington Acad. Sci., Jour., Baltimore, Md., v.19, no.8, p.158, tf.2a-b.

Occurrence and Repository: Central Area (Stn. 99: 42 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-9233 - 9234; hypotype in fig. 9, ESK Reg. no. F-9234 from Stn. 146.

Geographic Distribution: Off the south coast of Central Honshū and Kamaé Bay, Kyūshū; 45); 51) 665 m; 52) 408-585 m; 56) 7-25 m; 57) 1.5-1.8 m; 58); 60) 50-97.5 m; 76) 10-79 m.

Reussella spinulosa (REUSS)

Pl. 11, figs. 10a-b

Verneuilina spinulosa REUSS, 1850, K. Akad. Wiss. Wien, Math. -Nat. Cl., Denkschr., Bd. 1, p. 374, pl. 47, fig. 12.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m); Central Area (Stn. 70, 73, 74, 93, 101: 23-142 m; living 28 m); Bay Mouth Area (Stn. 124, 136, 141: 20-60 m); open sea area (Stn. 145, 146: 155-213 m); ESK Reg. no. F-9235 - 9246; hypotype in fig. 10a, ESK Reg. no. F-9247 from Stn. 74; hypotype in fig. 10b, ESK Reg. no. F-9240 from Stn. 93.

Geographic Distribution: Off the northwest coast of North Honshū, Yamada, Toyama and Tosa Bays and coastal area at Kujūkuri-hama; 24) 10-75 m, living 19-30 m; 28) 39 m; 35); 42) 222-248 m; 67) 91 m.

Reussella sp.

Pl. 12, figs. 1a-b

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 65: 39-138 m); Central Area (Stn. 69, 74, 83, 96, 99, 104: 28-188 m); Bay Mouth Area (Stn. 106, 108, 124, 136: 20-120 m); ESK Reg. no. F-9248 - 9259; hypotype in fig. 1a, ESK Reg. no. F-9251 from Stn. 74; hypotype in fig. 1b, ESK Reg. no. F-9260 from Stn. 83.

Remarks: The specimens in the collection are characterized by inflated chambers and coarse perforations on the walls.

Genus *Trimosina* CUSHMAN, 1927

Trimosina? takayanagii ŌKI, n. sp.

Pl. 12, figs. 2a-g

Test small, generally triangular in both side and end views, slightly longer than

broad, initial end acutely pointed, initial end and angles of chambers often with spines; chambers distinct, inflated, triserial throughout, rapidly increasing in size as added; sutures distinct, depressed; wall coarsely perforate; aperture generally triangular in outline with distinct teeth (fig. 2g).

Types and Dimensions: Holotype in fig. 2a, ESK Reg. no. F- 9261 from Stn. 104, length 0.16 mm, breadth 0.14 mm; paratype in figs. 2b, g, ESK Reg. no. F-9262 from Stn. 104, length 0.13 mm, breadth 0.11 mm; paratype in fig. 2c, ESK Reg. no. F-9263 from Stn. 99, length 0.15 mm, breadth 0.10 mm.

Occurrence and Repository: Northern part of the Central Area (Stn. 73, 74, 78, 81, 83: 28-220 m; living 28-40 m); Southern part of the Central Area (Stn. 86, 87, 88, 93, 97, 98, 99, 101, 104: 38-182 m; living 38-182 m); Bay Mouth Area (Stn. 108, 125: 120-140 m); ESK Reg. no. F-9264 - 9279; hypotype in fig. 2d, ESK Reg. no. F-9276 from Stn. 101; hypotype in fig. 2e, ESK Reg. no. F-9280 from Stn. 104; hypotype in fig. 2f, ESK Reg. no. F-9281 from Stn. 93.

Remarks: The outline of the test of this new species is similar to that of the species of the genus *Trimosina*, but the feature of its aperture is quite different from the latter. Namely, it has a triangular opening on the base of the final chamber with distinct teeth, while the species of *Trimosina* have an elongate slit-like aperture in face of final chamber. The present species is distributed mainly in the shallow water off Kiiré-chō on the Satsuma Peninsula and on the slope between the coastal shallow bottom on the Ōsumi Peninsula side and the basin bottom in the Central Area.

Family UVIGERINIDAE HAECKEL, 1894

Genus *Uvigerina* D'ORBIGNY, 1826

Uvigerina bosoensis AOKI

Pl. 12, figs. 3a-b

Uvigerina bosoensis AOKI, 1965, Saitama Univ., Sci. Rep., ser. B, v. 5, no. 1, p. 55, pl. 7, figs. 13, 14.

Occurrence and Repository: Central Area (Stn. 69, 86: 150- 165 m); Bay Mouth Area (Stn. 108, 122, 125, 139: 100-140 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-9282 - 9288; hypotype in fig. 3a, ESK Reg. no. F-9284 from Stn. 108; hypotype in fig. 3b, ESK Reg. no. F-9289 from Stn. 146.

Uvigerina schencki ASANO

Pl. 12, figs. 4a-b

Uvigerina schencki ASANO, 1950, Hosokawa Print. Co., Tokyo, pt. 2, p. 17, figs. 74-75; KUWANO, 1962, p. 56, pl. 7, fig. 19; ISHIWADA, 1964, p. 18, pl. 5, fig. 79; AOKI, 1965, p. 56, pl. 7, fig. 19.

Occurrence and Repository: Central Area (Stn. 66, 69, 71, 75, 76, 79, 82, 84, 89, 92: 88-220 m; living 93-185 m); Bay Mouth Area (Stn. 107, 108, 110, 125, 132, 139: 96-140 m); ESK Reg. no. F-9290 - 9305; hypotype in fig. 4a, ESK Reg. no. F-9306 from Stn. 139; hypotype in fig. bb, ESK Reg. no. F-9307 from Stn. 139.

Geographic Distribution: Off the Pacific coast from North Honshū to Kyūshū, the north coast from Central to West Honshū, the northwest coast of Kyūshū; 19) 177-539 m; 36) 59-208 m; 46) 168-256 m; 48) 74-235 m with living specimens; 51) 43-232 m, living

43-102 m; 52) 80-201 m with living specimens; 69) 78-193 m; 70) 70-390 m with living specimens; 77) 122 m with living specimens; 78) living 41-100 m.

Remarks: Similar to the following species *Uvigerina vadescens* in distribution. The present species is distributed mainly in the deepest part of the Bay Mouth Area and on the marginal part of the flat bottom surface shallower than 100 meters on the Satsuma Peninsula side of the Central Area. These areas correspond to the boundary between the two different water masses.

Uvigerina vadescens CUSHMAN

Pl. 12, figs. 5a-b

Uvigerina proboscidea SCHWAGER var. *vadescens* CUSHMAN, 1933, Contr. Cushman Lab. Foram. Res., Sharon, Mass., v. 9, pt. 4, no. 137, p. 85, pl. 8, figs. 14, 15.
Uvigerina proboscidea vadescens CUSHMAN. KUWANO, 1962, pl. 24, fig. 9.

Occurrence and Repository: Bay Head Area and West-Sakurajima Passage (Stn. 44, 63, 64, 65: 39-144 m); Central Area (Stn. 66, 67, 69, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105: 28-225 m; living 36-165 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 134, 136, 137, 139, 141, 143: 20-140 m; living 60-112 m) ; open sea area (Stn. 144, 145, 146: 105-213 m; living 213 m); ESK Reg. no. F-9308 - 9368; hypotype in fig. 5a, ESK Reg. no. F-9369 from Stn. 110; hypotype in fig. 5b, ESK Reg. no. F-9370 from Stn. 143.

Geographic Distribution: Off the Pacific coast from Central Honshū to Kyūshū; 48) 74-597 m, living 74-235 m; 51) 43-665 m, living 43-232 m; 52) 31-585 m, living 31-120 m; 69) 78-680 m; 70) 70-808 m, living 70-123 m; 77) 35-745 m, living 35-122 m.

Genus *Hopkinsina* HOWE and WALLACE, 1932

Hopkinsina glabra (MILLETT)

Pl. 12, fig. 6

Uvigerina auberiana D'ORBIGNY var. *glabra* MILLETT, 1903, Roy. Micr. Soc. London, Jour., Part 14, p. 268, pl. 5, figs. 8a-b, 9.
Hopkinsina pacifica CUSHMAN, 1942, p. 51, pl. 15, figs. 1a-b; TAKAYANAGI, 1955, pl. 2, fig. 22; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 36, pl. 18, figs. 18-20.
Hopkinsina glabra (MILLETT). AOKI, 1965, p. 59, pl. 7, fig. 2; ŌKI, 1975, p. 48, pl. 3, fig. 7.
Uvigerinella glabra (MILLETT). MATOBA, 1970, p. 62, pl. 3, figs. 35a-b.

Occurrence and Repository: Bay Head Area (Stn. 34, 64: 66- 149 m); Central Area (Stn. 66, 67, 69, 70, 72, 74, 75, 78, 79, 80, 82, 83, 84, 85, 86, 87, 89, 90, 91, 92, 93, 94, 95, 97, 98, 101, 102, 105: 23-225 m; living 28-150 m); Bay Mouth Area (Stn. 139: 105 m); ESK Reg. no. F-9371 - 9401; hypotype in fig. 6, ESK Reg. no. F-9402 from Stn. 90.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the Seto Inland Sea; 24) 10-75 m, living 10-68 m; 29) 0.7-5.7 m, living 0.9-2.7 m; 30); 54) 23 m with living specimens; 64) 22-60 m, living 32 m.

Hopkinsina kuwanoi ŌKI, n. sp.

Pl. 12, figs. 7a-c

Test elongate, early stage triserial, later biserial, apical end rounded with two or more small spines; chambers comparatively few, inflated; suture much depressed; wall

ornamented by longitudinal raised costae, occasionally branching or anastomosing, and continuing on to the last-formed chamber; aperture broadly oval, subterminal, bordered with a raised lip; color white.

Types and Dimensions: Holotype in fig. 7a, ESK Reg. no. F- 9403 from Stn. 92, length 0.20 mm, breadth 0.10 mm, thickness 0.06 mm; paratype in fig. 7b, ESK Reg. no. F-9404 from Stn. 102, length 0.20 mm, breadth 0.10 mm, thickness 0.06 mm; paratype in fig. 7c, ESK Reg. no. F-9405 from Stn. 139, length 0.28, breadth 0.14, thickness 0.09 mm.

Occurrence and Repository: Central Area (Stn. 79, 86, 87, 91, 92, 99, 101, 102: 42-207 m; living 182 m); Bay Mouth Area (Stn. 118, 132, 134, 137, 139, 143: 96-112 m; living 100 m); open sea area (Stn. 144, 145: 105-155 m); ESK Reg. no. F-9406 - 9421.

Remarks: The specimens in the collection are identical to *Hopkinsina japonica* (MS) reported by KUWANO (1962) from Kagoshima Bay. But no description of this species was given by KUWANO.

Genus *Sagrina* D'ORBIGNY, 1839

Sagrina breviata (SAID)

Bitubulogenerina breviata SAID, 1949, Cushman Lab. Foram. Res., Spec. Publ., Sharon, Mass, no. 26, p. 30, pl. 3, fig. 16.

Occurrence and Repository: Central Area (Stn. 78, 102: 40- 162 m; living); ESK Reg. no. F-9422 - 9423.

Genus *Siphogenerina* SCHLUMBERGER, 1882

Siphogenerina columellaris (BRADY)

Pl. 12, figs. 8a-b

Sagrina columellaris BRADY, 1881, Quart. Jour. Micr. Sci., v. 21, p. 64; 1884, Rep. Voy. Challenger, Zool., v. 9, p. 581, pl. 75, figs. 15-17.
Siphogenerina columellaris (BRADY). ASANO, 1958, p. 30, pl. 7, figs. 14-15.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Bay Mouth Area (Stn. 137, 141: 60-106 m); ESK Reg. no. F-9424 - 9426; hypotype in fig. 8, ESK Reg. no. F-9425 from Stn. 137.

Geographic Distribution: Off the south coast of Shikoku and the northwest coast of Kyūshū, and the Seto Inland Sea; 46) 165-199 m; 55) 63 m; 65) 19.9-26 m; 74) 110 m.

Genus *Siphouvigerina* PARR, 1950

Siphouvigerina fimbriata (SIDEBOTTOM)

Pl. 12, fig. 9

Uvigerina porrecta BRADY var. *fimbriata* SIDEBOTTOM, 1918, Journ. Roy. Micr. Soc., p. 147, pl. 5, fig. 23.
Siphouvigerina fimbriata (SIDEBOTTOM). LOEBLICH and TAPPAN, 1964, p. C571, fig. 449.

Occurrence and Repository: Central Area (Stn. 87, 92: 182- 185 m; living 182 m); Bay Mouth and open sea areas (Stn. 139, 144: 105m; living); ESK Reg. no. F-9427 - 9430; hypotype in fig. 9, ESK Reg. no. F-9429 from Stn. 139.

Genus *Trifarina* CUSHMAN, 1923

Trifarina angulosa (WILLIAMSON)

pl. 12, figs. 10a-b

Uvigerina angulosa WILLIAMSON, 1858, Rec. Foram. Gr. Brit., Ray Soc., p. 67, pl. 5, fig. 140.
Angulogerina angulosa (WILLIAMSON). KUWANO, 1962, pl. 14, figs. 1-2.
Angulogerina angulosa angulosa (WILLIAMSON). BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 16, pl. 1, figs. 13-16.
Trifarina angulosa (WILLIAMSON). LOEBLICH and TAPPAN, 1964, p. C571, figs. 450, 1a-b, 2a-b, 3; MURRAY, 1970, p. 485, pl. 1, fig. 13; FINGER and LIPPS, 1981, p. 134, pl. 2, fig. 9.

Occurrence and Repository: Central Area (Stn. 80, 86, 91, 96, 102, 103, 105: 97-225 m; living 97-165 m); Bay Mouth Area (Stn. 116, 118, 139, 143: 61-105 m; living 61-101 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-9431 - 9443; hypotype in fig. 10, ESK Reg. no. F-9444 from Stn. 146.

Geographic Distribution: Off the west coast of Hokkaido and Suruga Bay; 6) 155-1230 m; 47) 88-1040 m.

Trifarina occidentalis (CUSHMAN)

Pl. 12, figs. 11a-c

Uvigerina angulosa CUSHMAN, 1922, Publ. 311, Carnegie Inst. Washington, p. 34, pl. 5, figs. 3-4.
Uvigerina occidentalis CUSHMAN, 1923, p. 169-170.
Angulogerina angulosa occidentalis (CUSHMAN). BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, pl. 1, figs. 17-18.

Occurrence and Repository: Bay Head Area (Stn. 44, 63: 138-144 m); Central Area (Stn. 67, 78, 84, 90, 93, 99, 100: 40-215 m); Bay Mouth Area (Stn. 106, 116, 118, 122, 127, 136, 141, 143: 40-101 m; living 40-60 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-9445 - 9462; hypotype in fig. 11a, ESK Reg. no. F-9463 from Stn. 136; hypotype in figs. 11b-c, ESK Reg. no. F-9464 from Stn. 146.

Superfamily DISCORBACEA EHRENBERG, 1838

Family DISCORBIDAE EHRENBERG, 1838

Subfamily DISCORBINAE EHRENBERG, 1838

Genus *Discorbis* LAMARCK, 1804

Discorbis candeiana (D'ORBIGNY)

Pl. 12, figs. 12a-d

Rosalina candeiana D'ORBIGNY, *in* DE LA SAGARA, Hist. Fis. Pol. Nat. Cuba, "Foraminiferes," p. 97, pl. 4, figs. 2-4.
Discorbis candeiana (D'ORBIGNY). CUSHMAN, 1931, p. 19, pl. 7, figs. 4a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); southern part of the Central Area (Stn. 104: 38 m); Bay Mouth Area (Stn. 106, 116, 118, 132, 134, 136: 40-112 m); open sea area (Stn. 145: 155 m; living); ESK Reg. no. F-9465 - 9473; hypotype in fig. 12a, ESK Reg. no. F-9474 from Stn. 64; hypotype in fig. 12b, ESK Reg. no. F-9465 from Stn. 104; hypotype in fig. 12c, ESK Reg. no. F-9475 from Stn. 64; hypotype in fig. 12d, ESK Reg. no. F-9473 from Stn. 145.

Discorbis mira CUSHMAN

Pl. 13, figs. 1a-h

Discorbis mira CUSHMAN, 1922, Carnegie Inst. Washington, Publ. no. 311 (Dept. Marine Biol., Papers, v. 17), p. 39, pl. 6, figs. 10-11; CUSHMAN, 1931, p. 25, pl. 5, figs. 5, 6a-c.

Occurrence and Repository: Bay Head Area (Stn. 34, 64, 65: 39-149 m; living 39 m); Central Area (Stn. 66, 69, 70, 71, 73, 74, 75, 76, 78, 79, 80, 83, 85, 86, 87, 89, 91, 93,

94, 95, 97, 98, 99, 100, 101, 103, 104: 23-225 m; living 28-170 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 116, 118, 122, 124, 125, 127, 132, 134, 136, 137, 139, 141, 143: 20-140 m; living 20-100 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 155-213 m); ESK Reg. no. F-9476 - 9525; hypotype in fig. 1a, ESK Reg. no. F-9526 from Stn. 99; hypotype in fig. 1b, ESK Reg. no. F-9527 from Stn. 136; hypotype in fig. 1c-f, ESK Reg. no. F-9528 from Stn.139 ; hypotype in fig. 1d-g, ESK Reg. no. F-9529 from Stn. 136; hypotype in fig. 1e, ESK Reg. no. F-9530 from Stn. 116; hypotype in fig. 1h, ESK Reg. no. F-9531 from Stn. 132.

Geographic Distribution: Tōkyō and Tanabe Bays, and the coastal areas at Hachijo and Yoron Islands; 37) 10-16 m; 40); 56) 9-38 m; 82).

Discorbis nitida (WILLIAMSON)

Rotalina nitida WILLIAMSON, 1858, Ray Soc., London, England, p. 54, pl. 4, figs. 106-108.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Central Area (Stn. 99: 42 m); ESK Reg. no. F-9532 - 9533.

Discorbis williamsoni CHAPMAN and PARR

Discorbis williamsonii CHAPMAN and PARR, 1932, Roy. Soc. Victoria, Proc., Melbourne, Australia, v. 44, p. 226.

Occurrence and Repository: Central Area (Stn. 91, 93, 94, 98, 102: 105-207 m; living 162 m); Bay Mouth Area (Stn. 108, 137, 139: 105-120 m); ESK Reg. no. F-9534 - 9541.

Genus *Buccella* ANDERSEN, 1952

Buccella cf. *calida* (CUSHMAN and COLE)

Compared with:

Eponides frigida (CUSHMAN) var. *calida* CUSHMAN and COLE, 1930, Contr. Cushman Lab. Foram. Res., v.6, p.98, pl.13, figs.3-4; CUSHMAN, 1931, p.47, pl.10, figs.3-4.

Occurrence and Repository: Bay Head Area (Stn. 44: 144 m): ESK Reg. no. F-9542.

Remarks: Only a single, imperfect specimen is in the collection.

Genus *Discorbinella* CUSHMAN and MARTIN, 1935

Discorbinella bertheloti (D'ORBIGNY)

Pl. 13, figs. 2a-c

Rosalina bertheloti D'ORBIGNY, 1939, *in* BARKER-WEBB and BERTHELOT, Hist. Nat. Iles Canaries, v. 2, pt. 2, "Foraminiferes," p. 135, pl. 1, figs. 28-30.

Discorbis bertheloti (D'ORBIGNY). CUSHMAN, 1915, p. 20, pl. 7, figs. 3a-c; CUSHMAN, 1931, p. 16, pl. 3, figs. 2a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Bay Mouth Area (Stn. 106, 107, 108, 113, 118, 125, 127, 132, 137, 139, 141, 143: 40-140 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-9543 - 9556; hypotype in fig. 2a, ESK Reg. no. F-9557 from Stn. 118; hypotype in fig. 2b, ESK Reg. no. F-9558 from Stn. 137; hypotype in fig. 2c, ESK Reg. no. F-9559 from Stn. 145.

Geographic Distribution: Off the northwest coast of North Honshū, the south coast of Central Honshū and the southeast coast of Kyūshū, and Ōmura Bay; 24) 75-78 m; 37) 16-70 m; 47) 91-292 m; 51) 72-232 m, living 72 m; 52) 80 m; 61) 74 m; 73); 77) 122 m.

Remarks: The present species is distributed mainly in the Bay Mouth Area.

Discorbinella convexa (TAKAYANAGI)

Pl. 13, figs. 3a-h

Planulina convexa TAKAYANAGI, 1953, Tohoku Univ., Inst. Geol. Pal., Short Papers, no. 5, p. 34, pl. 4, figs. 14a-c.

Planulina convexa TAKAYAYAGI forma A, B and C. KUWANO, 1962, pl. 20, figs. 6a-c.

Occurrence and Repository: Bay Head Area (Stn. 44, 63, 64: 66-144 m); Central Area (Stn. 67, 71, 73, 74, 75, 76, 78, 79, 81, 84, 86, 87, 88, 92, 93, 94, 98, 99, 100, 101, 105: 28-220 m; living 42-100 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 134, 136, 137, 139, 141, 143: 20- 140 m; living 100-105 m); open sea area (Stn. 144, 145, 146: 105- 213 m; living 105 m); ESK Reg. no. F-9560 - 9603; hypotype in fig. 3a, ESK Reg. no. F-9604 from Stn. 146; hypotype in fig. 3b, ESK Reg. no. F-9605 from Stn. 144; hypotype in fig. 3c, ESK Reg. no. F-9606 from Stn. 146; hypotype in fig. 3d, ESK Reg. no. F-9607 from Stn. 145; hypotype in fig. 3e, ESK Reg. no. F-9608 from Stn. 145; hypotype in fig. 3f, ESK Reg. no. F-9609 from Stn. 146; hypotype in fig. 3g, ESK Reg. no. F-9610 from Stn. 84; hypotype in fig. 3h, ESK Reg. no. F-9611 from Stn. 73.

Geographic Distribution: Off the Pacific coast from Central Honshū to Kyūshū and the Seto Inland Sea; 36) living 80-160 m; 48) 74-235 m, living 74 m; 51) 43-232 m, living 72-232 m; 52) 80- 408 m, living 80 m; 55) 20 m; 70) 70-808 m; 77) 122-745 m.

Remarks: KUWANO (1962) recognized the three types (formas A, B and C) in the present species. Through the examination of many specimens from Kagoshima Bay, I concluded that KUWANO's three formas represent three growth stages of the present species.

Genus *Eoeponidella* WICKENDEN, 1949

Eoeponidella sp. 1

Pl. 13, figs. 4a-e

Occurrence and Repository: Central Area (Stn. 80, 81, 86, 87, 88, 92, 93, 94, 96, 98, 99, 101, 103, 104, 105: 38-225 m; living 78-185 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 116, 118, 122, 127, 132, 136, 137, 139, 141, 143: 40-120 m; living 100-120 m); open sea area (Stn. 144, 145: 105-155 m); ESK Reg. no. F-9612 - 9642; hypotype in fig. 4a, ESK Reg. no. F-9643 from Stn. 139; hypotype in fig. 4b, ESK Reg. no. F-9639 from Stn. 141; hypotype in fig. 4c, ESK Reg. no. F-9644 from Stn. 107; hypotype in fig. 4d, ESK Reg. no. F-9645 from Stn. 139; hypotype in fig. 4e, ESK Reg. no. F-9646 from Stn. 139.

Remarks: Many specimens are in the collection, but the tests are rather small and probably in a juvenile stage.

Eoeponidella sp. 2

Occurrence and Repository: Central Area (Stn. 87: 182 m); Bay Mouth Area (Stn. 113, 139, 143: 96-105 m); ESK Reg. no. F-9647 - 9650.

Remarks: The specimens in the collection are rather few and mostly imperfect.

Eoeponidella sp. 3

Pl. 13, figs. 5a-f

Occurrence and Repository: Central Area (Stn. 76, 82, 86, 87, 88, 89, 92, 94, 96, 97, 98, 102, 103, 104, 105: 38-220 m; living 220 m); Bay Mouth and open sea areas (Stn. 106, 108, 116, 139, 144: 40-120 m); ESK Reg. no. F-9651 - 9670; hypotype in fig. 5a, ESK Reg. no. F-9671 from Stn. 139; hypotype in fig. 5b, ESK Reg. no. F-9668 from Stn. 116; hypotype in fig. 5c, ESK Reg. no. F-9672 from Stn. 139; hypotype in fig. 5d, ESK Reg. no. F-9673 from Stn. 144; hypotype in fig. 5e, ESK Reg. no. F-9674 from Stn. 105; hypotype in fig. 5f, ESK Reg. no. F-9664 from Stn. 104

Remarks: Rather many specimens are in the collection. The umbilicus of every specimen is covered with fine secondary material.

Genus *Epistominella* HUSEZIMA and MARUHASI, 1944

Epistominella kuwanoi ŌKI, n. sp.

Pl. 14, figs. 1a-g

Test small, trochoid throughout, moderately biconvex, periphery acute; chambers about 5 in the last-formed coil; sutures oblique, rather indistinct on the dorsal side, nearly radiate and somewhat depressed on the ventral side; wall smooth, ornamented with many rings in the early stage, perforated coarsely in the adult stage; aperture elongate in parallel with the periphery; color white.

Types and Dimensions: Holotype in fig. 1a, ESK Reg. no. F- 9675 from Stn. 136, maximum diameter 0.18 mm, thickness 0.08 mm; paratype in fig. 1b, ESK Reg. no. F-9676 from Stn. 127, maximum diameter 0.13 mm, thickness 0.06 mm; paratype in fig. 1e, ESK Reg. no. F-9677 from Stn. 127, maximum diameter 0.13 mm, thickness 0.07 mm.

Occurrence and Repository: Central Area (Stn. 73, 99: 42-80 m); Bay Mouth Area (Stn. 107, 118, 127, 136, 139, 141, 143: 60- 101 m); ESK Reg. no. F-9678 - 9686; hypotype in fig. 1c, ESK Reg. no. F-9687 from Stn. 143; hypotype in fig. 1d, ESK Reg. no. F-9688 from Stn. 127; hypotype in fig. 1f, ESK Reg. no. F-9684 from Stn. 139; hypotype in fig. 1g, ESK Reg. no. F-9678 from Stn. 73.

Remarks: The specimens in the collection are identical with *Epistominella hokkaidoensis kagoshimaensis* KUWANO (MS). But no description of this species was given by Kuwano.

Epistominella naraensis (KUWANO)

Pseudoparrella naraensis KUWANO, 1950, Geol. Soc. Japan, Jour, v. 56, no. 657, p. 317, text-figs. 6a-c.
Epistominella naraensis (KUWANO). ASANO, 1951, p. 6, text -figs. 34-36; MATOBA, 1967, p. 254, pl. 26, figs. 11a-c; MATOBA, 1970, p. 53, pl. 4, figs. 5a-c.

Occurrence and Repository: Central Area (Stn. 78, 88, 91, 92, 94, 95: 40-207 m); Bay Mouth Area (Stn. 116: 61 m); ESK Reg. no. F-9689 - 9695.

Geographic Distribution: Off the south coast of Hokkaido and the northwest and east coasts of North Honshū, and Lake Hamanako and the Seto Inland Sea; 9) 82-228 m; 23) 40-875 m, living 56-875 m; 24) 30 m; 25) 38-760 m, living 50-760 m; 27) 8-78 m; 28) 19-39 m; 29) 0.9-8.7 m, Living 8.7 m; 50); 55) 20-40 m; 76) 13-79 m.

Epistominella tubulifera (HERON-ALLEN and EARLAND)

Truncatulina tubulifera HERON-ALLEN and EARLAND, 1915, Trans. Zool. Soc. London, v. 20, no. 12, p. 710, pl.

52, figs. 37-40.

Alabamina tubulifera (HERON-ALLEN and EARLAND). BELFORD, 1966, p. 160-161, pl. 27, figs. 1-6, text-fig. 22-6.

Epistominella tubulifera (HERON-ALLEN and EARLAND). TODD. 1965, p. 31-32, pl. 10, figs. 2a-c.

Occurrence and Repository: open sea area (Stn. 144: 105 m); ESK Reg. no. F-9696.

Genus *Eilohedra* LIPPS, 1965

Eilohedra levicula (RESIG)

Pl. 14, figs. 2a-e

Epistominella levicula RESIG, 1958, Micropaleontology, v. 4, no. 3, p. 304, tf. 16a-c.

Epistominella nipponica KUWANO, 1962, p. 132, pl. 12, figs. 7a-c; MATOBA, 1967, p. 254-255, text-figs. 8a-f; pl. 26, figs. 13a-c.

Eilohedra levicula (RESIG). LIPPS, 1965, p. 124, 138, pl. 3, figs. 5a-c, text-fig. 3.

Occurrence and Repository: Bay Head Area (Stn. 17, 22, 32, 34, 44, 64: 66-156 m; living 149 m); Central Area (Stn. 66, 67, 69, 70, 71, 72, 73, 74, 75, 76, 77, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 100, 101, 102, 103, 105: 23-225 m; living 75-225 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 116, 118, 122, 125, 127, 132, 134, 137, 139, 141, 143: 60-140 m; living 74-140 m); open sea area (Stn. 144, 146: 105-213 m; living); ESK Reg. no. F-9697 - 9755; hypotype in fig. 2a, ESK Reg. no. F-9756 from Stn. 103; hypotype in fig. 2b, e, ESK Reg. no. F-9757 from Stn. 139; hypotype in fig. 2c, ESK Reg. no. F-9758 from Stn. 144; hypotype in fig. 2d, ESK Reg. no. F-9759 from Stn. 102.

Geographic Distribution: Off the northwest and southeast coasts of North Honshū and the Pacific coast from Central Honshū to Kyūshū; 23) 570-875 m; 24) 10-30 m; 25) 200-760 m, living 230- 760 m; 29) 0.9-8.7 m, living 8.7 m; 30); 32); 36) living 101-118 m; 48) 74-597 m, living 149-597 m; 51) 72-232 m with living specimens; 52) 31-585 m, living 80-585 m; 70) 70-808 m, living 70 m; 77) 122-745 m, living 122 m.

Remarks: The present specimens are identical to *Epistominella nipponica* KUWANO reported by kUWANO (1962) from Kagoshima Bay. But KUWANO's species has the aperture bordered by a lip extending along the basal suture of the last chamber between the umbilicus and periphery and it should be identified as *Eilohedra levicula* (RESIG).

Genus *Neoconorbina* HOFKER, 1951

Neoconorbina floridensis (CUSHMAN)

Discorbis bertheloti (D'ORBIGNY) var. *floridensis* CUSHMAN, 1931, U.S. Nat. Mus. Bull. 104, pt. 8, p. 17, pl. 3, figs. 3-5.

Neoconorbina floridensis (CUSHMAN). TODD, 1965, p. 15, pl. 2, figs. 4a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Bay Mouth Area (Stn. 124, 137: 20-106 m; living 20 m); ESK Reg. no. F-9760 - 9762.

Neoconorbina stachi (ASANO)

Pl. 14, figs. 3a-c

Discopulvinulina stachi ASANO, 1951, Illust. Cat. Japan. Tert. Small. Foram., pt. 14, p. 7, text-figs. 46-48; TAKAYANAGI, 1955, p. 44, pl. 2, figs. 9a-b; MATSUNAGA, 1963, pl. 44, figs. 2a-c.

Neoconorbina stachi (ASANO). MATOBA, 1970, p. 57, pl. 4, figs. 6a-c; HASEGAWA, 1979, p. 152, pl. 4, figs. 11a-c.

Occurrence and Repository: Central Area (Stn. 66, 74, 92, 99, 103, 104: 28-185 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 116, 118, 122, 124, 127, 132, 134, 136, 137, 139, 141, 143: 20- 120 m; living 20-101 m); ESK Reg. no. F-9763 - 9784; hypotype in fig.

3a, ESK Reg. no. F-9785 from Stn. 139; hypotype in fig. 3b, ESK Reg. no. F-9786 from Stn. 139; hypotype in fig. 3c, ESK Reg. no. F-9787 from Stn. 136.

Geographic Distribution: Off the northwest and east coasts of North Honshū, the Pacific coast from Central Honshū to Kyūshū; 24) 14-58 m, living 14-49 m; 27) 28-78 m; 28) 27 m; 29) 1.2-12.5 m, living 12.5 m; 32); 45); 50); 51) 23-102 m, living 23-72 m; 52) 31 m; 56) 21 m; 70) 70-123 m with living specimens; 76) 7-40 m; 77) 35 m.

Genus *Patellinella* CUSHMAN, 1928

Patellinella carinata COLLINS

Pl. 14, figs. 4a-b

Patellinella carinata COLLINS, 1958, Brit. Mus. (Nat. Hist.) Great Barrier Reef Exped. 1928-29, Sci. Rep., v. 6, no. 6, Foraminifera, p. 407, pl. 5, fig. 8.

Occurrence and Repository: Bay Mouth Area (St. 136: 60 m); hypotype in fig. 4a, ESK Reg. no. F-9788 from Stn. 136; hypotype in fig. 4b, ESK Reg. no. F-9789 from Stn. 136.

Patellinella inconspicua (BRADY)

Pl. 14, figs. 5a-c

Textularia inconspicua BRADY, 1884, Rept. Challenger Expedition, Zool., pt. 22, v. 9, p. 357, pl. 42, figs. 6a-c.
Patellinella inconspicua (BRADY). BARKER, 1960, p. 86, pl. 42, figs. 6a-c.

Occurrence and Repository: Bay Head Area (Stn. 44, 63, 64: 66-144 m; living 66-138 m); Central Area (Stn. 67, 69, 70, 71, 74, 76, 78, 81, 83, 84, 87, 88, 92, 93, 95, 99, 101, 104: 23-220 m; living 88 m); Bay Mouth and open sea areas (Stn. 113, 116, 122, 127, 132, 134, 136, 139, 141, 143, 144: 60-112 m; living 105-112 m); ESK Reg. no. F-9790 - 9821; hypotype in fig. 5a, ESK Reg. no. F-9822 from Stn. 139; hypotype in fig. 5b, ESK Reg. no. F-9823 from Stn. 134; hypotype in fig. 5c, ESK Reg. no. F-9824 from Stn. 141.

Geographic Distribution: Toyama and Tanabe Bays; 42) 222-248 m; 56) 38 m.

Genus Planulinoides PARR, 1941

Planulinoides biconcava (JONES and PARKER)

Pl. 14, fig. 6

Discorbina biconcava JONES and PARKER *in* CARPENTER, PARKER and JONES, 1862, Ray Soc. Publs., p. 201; PARKER and JONES, 1865, Philos. Trans., v. 155, p.385, p.422, pl. 19, fig. 10b.
Planulinoides biconcava (JONES and PARKER). LOEBLICH and TAPPAN, 1964, p. C584, figs. 458, 4-6.

Occurrence and Repository: Bay Mouth Area (Stn. 127, 134: 74-112 m); ESK Reg. no. F-9825; hypotype in fig. 6, ESK Reg. no. F-9826 from Stn. 134.

Genus *Rosalina* D'ORBIGNY, 1826

Rosalina globularis D'ORBIGNY

Rosalina globularis D'ORBIGNY, 1826, Ann. Sci. Nat., v. 7, p. 271, no. 1, pl. 13, figs. 1-4; TODD, 1965, p. 11-12, pl. 3, figs. 4a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Central Area (Stn. 70, 71, 72, 73, 74, 75, 76, 79, 80, 81, 84, 85, 87, 88, 89, 90, 91, 92, 93, 100, 102, 103, 104: 23-225 m; living 75-220 m); Bay Mouth Area (Stn. 107, 110, 113, 122, 125, 127, 134, 139, 143: 74-140 m; living 74 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-9827 - 9861.

Geographic Distribution: Off the northwest coast of North Honshū and the south coast of Central Honshū; 24) 5-11 m, living 5 m; 37) 13-70 m; 38); 50); 56) 7-38 m; 57) 1.5-1.8; 60) 50-97.5 m.

Rosalina vilardeboana D'ORBIGNY

Pl. 14, figs. 7a-c

Rosalina vilardeboana D'ORBIGNY, 1839, Voy. Amer. Merid., Foraminiferes, v. 5, pt.5, p. 44, pl. 6, figs. 13-15; MATOBA, 1970, p. 61, pl. 4, figs. 10a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m; living); Central Area (Stn. 70, 72, 73, 74, 75, 79, 80, 83, 85, 87, 88, 89, 90, 91, 92, 93, 101, 102, 103, 104: 23-225 m; living 23-225 m); Bay Mouth Area (Stn. 107, 113, 116, 122, 125, 134, 137, 139, 141: 60-140 m; living 61-112 m); open sea area (Stn. 144, 145: 155-213 m); ESK Reg. no. F-9862 - 9870; hypotype in fig. 7a, ESK Reg. no. F-9871 from Stn. 101; hypotype in fig. 7b, ESK Reg. no. F-9872 from Stn. 144; hypotype in fig. 7c, ESK Reg. no. F-9870 from Stn. 145.

Geographic Distribution: Off the west coast of Hokkaido, the northwest and southeast coasts of North Honshū, the north coast of Central Honshū and the Pacific coast from Central Honshū to Kyūshū; 6) 120 m; 11) 56-512 m; 23) 40-50 m, living 40 m; 24) 5-68 m, living 10-30 m; 29) 2.4-12.5 m; 30) 64-155 m; 34) 64-155 m; 37) 18-70 m; 41) 16.8-63 m; 48) 40-235 m, living 74-124 m; 51) 23-155 m with living specimens; 52) 80-408 m; living 80-120 m; 56) 9-38 m; 59) 7-8.6 m; 61) 74 m; 70) 70-202 m; living 70 m; 76) 7-79 m; 77) 35-122 m with living specimens.

Subfamily BAGGININAE CUSHMAN, 1927

Genus *Cancris* DE MONTFORT, 1808

Cancris auricula (FICHTEL and MOLL)

Pl. 14, figs. 8a-c

Nautilus auricula FICHTEL and MOLL, 1798, Testacea micro-scopica, p. 108, pl. 20, figs. a-f.

Cancris auriculus (FICHTEL and MOLL). KUWANO, 1962, pl. 16, figs. 1a-b; MATSUNAGA, 1963, pl. 47, figs. 8a-b; TODD, 1965, p. 22, pl. 5, fig. 5; BELFORD, 1966, p. 96-97, pl. 15, figs. 1-5.

Cancris auricula (FICHTEL and MOLL). HADA, 1931, p. 139, text-figs. 94a-c; MURRAY, 1970, p. 484, pl. 2, fig. 12; MURRAY, 1971, p. 137, pl. 57, figs. 1-7; HAGEMAN, 1979, p. 90, pl. 2, figs. 8a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m; living); Central Area (Stn. 71, 73, 75, 79, 88, 100, 104, 105: 38-100 m; living 75-80 m); Bay Mouth Area (Stn. 106, 116, 139: 40-105 m); ESK Reg. no. F-9873 - 9884; hypotype in fig. 8a, ESK Reg. no. F-9873 from Stn. 116; hypotype in fig. 8b, ESK Reg. no. F-9875 from Stn. 73; hypotype in fig. 8c, ESK Reg. no. F-9885 from Stn. 64.

Geographic Distribution: Off the coast of North Honshū, the Pacific coast from Central Honshū to Kyūshū, and the Seto Inland Sea and coastal area at Hachijo Island; 18) 18-25 fms; 23) 40-95 m, living 50-67 m; 24) 27-75 m with living specimens; 27) 28-60 m; 28) 14-33 m; 30) 120-126 m; 32); 36) living 80-276 m; 37) 13-70 m; 40); 45); 48) 40-149 m with living specimens; 51) 23-155 m with living specimens; 52) 31-120 m with living specimens; 53); 54) 23 m; 55) 40-63 m; 60) 50-97.5 m; 62) 96 m with living specimens; 64) 60 m; 65) 6.5-19.9 m; 67) 234-481 m; 70) 70-202 m, living 70-123 m; 72); 77)

35-122 m with living specimens.

Genus *Valvulineria* CUSHMAN, 1926

Valvulineria aff. *hamanakoensis* (ISHIWADA)

Pl. 14, figs. 9a-f

Compared with:

Anomalina hamanakoensis ISHIWADA, 1958, Geol. Surv. Japan, Rep., no. 180, p. 18, text-figs. 3a-c, pl. 1, figs. 24-27.

Occurrence and Repository: Bay Head Area (Stn. 34, 44, 64: 66-149 m); Central Area (Stn. 66, 67, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 89, 90, 92, 93, 94, 97, 98, 100, 101, 102, 103: 28-225 m; living 75-145 m); Bay Mouth Area (Stn. 108, 110, 113, 116, 118, 122, 125, 127, 132, 134, 136, 137, 139, 141, 143: 60-140 m; living 60-112 m); open sea area (Stn. 144, 146: 105-213 m; living 105 m); ESK Reg. no. F-9886 - 9935; hypotype in fig. 9a, ESK Reg. no. F-9936 from Stn. 139; hypotype in fig. 9b, ESK Reg. no. F-9937 from Stn. 137; hypotype in fig. 9c, ESK Reg. no. F-9938 from Stn. 146; hypotype in fig. 9d, ESK Reg. no. F-9939 from Stn. 143; hypotype in fig. 9e, ESK Reg. no. F-9940 from Stn. 144; hypotype in fig. 9f, ESK Reg. no. F-9941 from Stn. 93.

Remarks: The specimens at hand have less inflated chambers than those of the specimens described under the name of *Valvulineria hamanakoensis* by ISHIWADA (1958) and MATOBA (1962).

Valvulineria sp.

Pl. 15, fig. 1

Occurrence and Repository: Central Area (Stn. 91: 207 m; living); Bay Mouth Area (Stn. 110: 110 m); ESK Reg. no. F-9942; hypotype in fig. 1, ESK Reg. no. F-9943 from Stn. 91.

Remarks: Only two specimens are in the collection. The present species are characterized by many foramens of three perforations.

Family GLABRATELLIDAE LOEBLICH and TAPPAN, 1964

Genus *Glabratella* DORREEN, 1948

Glabratella patelliformis (BRADY)

Pl. 15, figs. 2a-d

Discorbina patelliformis BRADY, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 647, pl. 88, figs. 3a-c; pl. 89, figs. 1a-c.

Occurrence and Repository: Bay Head Area (Stn. 44: 144 m); Central Area (Stn. 80, 91, 103, 104: 38-225 m); Bay Mouth Area (Stn. 106, 108, 127, 132, 136, 137, 139: 40-120 m); open sea area (Stn. 144, 145: 105-155 m); ESK Reg. no. F-9944 - 9957; hypotype in fig. 2a, ESK Reg. no. F-9951, from Stn. 127; hypotype in figs. 2b-c, ESK Reg. no. F-9958, from Stn. 145; hypotype in fig. 2d, ESK Reg. no. F-9949, from Stn. 106.

Geographic Distribution: Off the southwest coast of Central Honshū, the south coast of Shikoku and the east coast of Kyūshū; 52) 31 m; 56) 7-38 m; 70) 70 m; 76) 7-40 m.

Glabratella tabernacularis (BRADY)

Discorbina tabernacularis BRADY, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 648, pl. 89, fig. 7a-c.
Pileolina(?) *tabernacularis* (BRADY). BARKER, 1960, p. 184, pl. 89, fig. 7a-c.

Occurrence and Repository: Bay Mouth Area (Stn. 136: 60 m); ESK Reg. no. F-9959.

Geographic Distribution: Kii Strait and Kamaé Bay; 60) 50 m; 76) 10-57 m.

Remarks: Genus *Pileolina* BERMUDEZ, 1952 is regarded as a synonym of *Glabratella* DORREEN, 1948 by LOEBLICH and TAPPAN (1960).

Glabratella sp. 1

Pl. 15, figs. 3a-f

Occurrence and Repository: Bay Head Area (Stn. 12: 122 m); Central Area (Stn. 94, 100, 104: 38-105 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 116, 127, 132, 137, 139, 141, 143: 40-120 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-9960 - 9976; hypotype in fig. 3a-b, ESK Reg. no. F-9977 from Stn. 146; hypotype in fig. 3c, ESK Reg. no. F-9978 from Stn. 127; hypotype in fig. 3d, ESK Reg. no. F-9979 from Stn. 137; hypotype in fig. 3e, ESK Reg. no. F-9980 from Stn. 106; hypotype in fig. 3f, ESK Reg. no. F-9981 from Stn. 110.

Remarks: The present specimens are characterized by high trochospiral tests with bead-like ornamentation.

Glabratella sp. 2

Pl. 15, figs. 4a-c

Occurrence and Repository: Bay Mouth and open sea areas (Stn. 106, 110, 141, 143, 145: 40-155 m); ESK Reg. no. F-9982 - 9986; hypotype in fig. 4a, ESK Reg. no. F-9984 from Stn. 141; hypotype in fig. 4b, ESK Reg. no. F-9987 from Stn. 106; hypotype in fig. 4c, ESK Reg. no. F-9988 from Stn. 110.

Remarks: The present specimens are characterized by planiconvex tests with radial ornamentation on the ventral side.

Genus *Angulodiscorbis* UCHIO, 1953

Angulodiscorbis quadrangularis UCHIO

Angulodiscorbis quadrangularis UCHIO, 1952, Japanese Jour. Geol. Geogr., v. 22, p. 156, pl. 7, figs. 4a-c.

Occurrence and Repository: Bay Mouth and open sea area (Stn. 127, 146: 74-213 m); ESK Reg. no. F-9989 - 9990.

Geographic Distribution: Off the southwest coast of Central Honshū and the southeast coast of Kyūshū, and the coastal areas at the Kii Peninsula and Hachijo Island; 40); 52) 31-80 m; 56) 12-31 m; 58); 60) 50 m; 76) 10-40 m; 77) 122 m.

Genus *Heronallenia* CHAPMAN and PARR, 1931

Heronallenia wilsoni (HERON-ALLEN and EARLAND)

Discorbina wilsoni HERON-ALLEN and EARLAND, 1922, British Antarctic (Terra Nova) Exped., Zool., v. 6, p. 206, pl. 7, figs. 17-19.
Heronallenia wilsoni (HERON-ALLEN and EARLAND). LOEBLICH and TAPPAN, 1964, p. C589, fig. 464, 4a-c; HERNELIN and SCOTT, 1985, p. 210, pl. 6, fig. 8.

Occurrence and Repository: Bay Mouth Area (Stn. 141: 60 m); ESK Reg. no. F-9991.

Superfamily SPIRILLINACEA REUSS, 1862
Family SPIRILLINIDAE REUSS, 1862
Subfamily SPIRILLININAE REUSS, 1862
Genus *Spirillina* EHRENBERG, 1843
Spirillina vivipara EHRENBERG

Spirillina vivipara EHRENBERG, 1843, K. Adad. Wiss. Berlin, Abhandl. (1841), p. 442, pl. 3, fig. 41.

Occurrence and Repository: Bay Mouth Area (Stn. 116, 137, 143: 61-106 m); ESK Reg. no. F-9992 - 9994.

Subfamily PATELLININAE RHUMBLER, 1906
Genus *Patellina* WILLIAMSON, 1858
Patellina corrugata WILLIAMSON

Patellina corrugata WILLIAMSON,1858, Ray Soc., p. 46, pl. 3, figs. 86-89, 89a; MATOBA, 1970, p. 58, pl. 5, figs. 6a-c; MURRAY, 1971, p. 147, pl. 61, figs. 2-5.

Occurrence and Repository: open sea area (Stn. 144: 105 m); ESK Reg. no. F-9995.

Geographic Distribution: Off the south coast of Hokkaido, the east coast of North Honshū and the southeast and southwest coasts of Central Honshū, and the coastal area at Hachijo Island; 13) 640 m with living specimens; 27) 28 m; 29) 2.5-12.5 m; 37) 23-70 m; 40); 45); 56) 21-31 m; 59) 7 m.

Superfamily ROTALIACEA EHRENBERG, 1839
Family ROTALIIDAE EHRENBERG, 1839
Subfamily ROTALIINAE EHRENBERG, 1839
Genus *Rotalia* LAMARCK, 1804
Rotalia sp.

Occurrence and Repository: Bay Mouth Area (Stn. 124: 20 m); ESK Reg. no. F-9996.

Remarks: Only two, imperfect specimens are in the collection.

Genus *Ammonia* BRÜNNICH, 1772
Ammonia beccarii (LINNÉ) forma A
Pl. 15, figs. 5a-b

Nautilus beccarii LINNÉ, 1758, Syst. Nat., ed. 10, p. 710, pl. 19, figs. 1a-c.
Rotalia beccarii (LINNÉ). BANDY, 1953, p. 29, pl. 22, figs. 8a-c.
Rotalia beccarii (LINNÉ) forma B. TAKAYANAGI, 1955, p. 45, text-figs. 32a-c; 33a-c.
Ammonia beccarii (LINNÉ) forma 1. MATOBA, 1970, p. 47-48, pl. 5, figs. 8a-c, 9a-c.

Occurrence and Repository: Bay Head Area (Stn. 17, 22, 32, 34, 44, 45, 63, 65: 39-156 m; living 39 m); Central Area (Stn. 71, 72, 73, 78, 82, 83, 84, 88, 98, 101, 104, 105: 36-216 m); Bay Mouth Area (Stn. 106, 107, 113, 124, 132: 20-100 m); ESK Reg. no. F-9997 - 10021; hypotype in fig. 5a, ESK Reg. no. F-10022 from Stn. 146; hypotype in fig. 5b, ESK Reg. no. F-9997 from Stn. 17.

Geographic Distribution: Off Soma City and Matsushima Bay; 29) 0.4-8.7 m, living 0.4-2.4 m; 32).

Remarks: The size of less inflated tests of the present species is larger (length up to 0.4 mm) than the following form (*A. beccarii* forma B).

Ammonia beccarii (LINNÉ) forma B

Pl. 15, fig. 6

Nautilus beccarii LINNÉ, 1758, Syst. Nat., ed. 10, p. 710.
Rotalia beccarii (LINNÉ) forma A. TAKAYANAGI, 1955, p. 44-45, text-figs. 30a-c; 31a-c.
Ammonia beccarii (LINNÉ) forma 2. MATOBA, 1970, p. 48, pl. 5, figs. 10a-c, 11a-c, 12a-c.
Ammonia beccarii (LINNÉ). HASEGAWA, 1979, p. 142, pl. 6, figs. 3a-d.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m); Central Area (Stn. 70, 73, 74, 79, 83, 84, 88, 92, 96, 99, 101, 102, 103, 104: 23-188 m; living 28 m); Bay Mouth Area (Stn. 107, 116: 61-96 m); ESK Reg. no. F-10023 - 10040; hypotype in fig. 6, ESK Reg. no. F-10036 from Stn. 102.

Geographic Distribution: Off Sōma City and Matsukawa-ura; 31); 32).

Remarks: Test is smaller than *A. beccarii* forma A (length up to 0.15 mm) and the chambers are inflated.

Ammonia japonica (HADA)

Pl. 15, figs. 7a-c

Rotalia japonica HADA, 1931, Tohoku Imp. Univ., Sci. Repts., 4th ser. (Biol.), v. 6, no. 1, p. 137, p. 138, text-fig. 93; TAKAYANAGI, 1955, pl. 2, figs. 13a-c; MATSUNAGA, 1963, pl. 46, figs. 3a-c.
Ammonia japonica (HADA). MATOBA, 1967, p. 251, pl. 27, figs. 1a-c; MATOBA, 1970, p. 48, pl. 5, figs. 14a-c, pl. 6, figs. 1a-c; HASEGAWA, 1979, p. 142, pl. 6, figs. 4a-c, 5.

Occurrence and Repository: Bay Head Area (Stn. 17, 63, 65: 39-146 m; living 39 m); Central Area (Stn. 69, 74, 78, 83: 28-150 m; living 36 m); ESK Reg. no. F-10041 - 10047; hypotype in fig. 7a, ESK Reg. no. F-10048 from Stn. 65; hypotype in fig. 7b, ESK Reg. no. F-10049 from Stn. 65; hypotype in fig. 7c, ESK Reg. no. F-10050 from Stn. 78.

Geographic Distribution: Off the southeast coast of Hokkaido, the northwest and east coasts of North Honshū, the northwest and southeast coasts of Central Honshū and the northwest coast of Kyūshū, the Seto Inland Sea, Kamaé Bay and the coastal area in the Kanto district; 8); 17) 100 m; 18) 5-33 fms; 23) 40-77 m, living 40-48 m; 24) 5-94 m, living 49 m; 27) 6-78 m; 28) 14-39 m; 29) 0.8-12.5 m with living specimens; 32); 35); 37) 6-52 m; 38); 41) 5.8-65 m; 54) 23 m; 55) 40-64 m; 63) 5 m; 64) 32-60 m; 65) 12.5-33 m; 72); 73); 76) 7-79 m.

Ammonia ketienziensis angulata (KUWANO)

Pl. 15, figs. 8a-c

Rotalia ketienziensis (ISHIZAKI) subsp. *angulata* KUWANO, 1950, Geol. Soc. Japan, Jour., v. 56, no. 657, p. 312; p. 313, tfs. 1, 9.
Streblus ketienziensis angulatus (KUWANO). KUWANO, 1962, pl. 23, figs. 1a-c; ISHIWADA, 1964, p. 17, pl. 6, figs. 92a-c; MATOBA, 1967, p. 251, pl. 27, figs. 2a-c.

Occurrence and Repository: Bay Head Area (Stn. 22, 44, 53, 63, 64, 65: 39-144 m); Central Bay (Stn. 67, 70, 72, 73, 74, 75, 76, 78, 79, 83, 84, 86, 87, 88, 90, 91, 92, 93, 94, 96, 97, 98, 99, 100, 101, 102, 104: 23-220 m; living 40-80 m); Bay Mouth Area (Stn. 106, 108, 110, 113, 127, 134, 139: 40-120 m); ESK Reg. no. F-10051 - 10090 hypotype in fig. 8a, ESK Reg. no. F-10084 from Stn. 106; hypotype in fig. 8b, ESK Reg. no. F-10091 from Stn. 113; hypotype in fig. 8c, ESK Reg. no. F-10092 from Stn. 139.

Geographic Distribution: Off the northwest coast of North Honshū and the Pacific

coast from Sanriku to the Bōsō Peninsula, and the Seto Inland Sea; 23) 40-150 m, living 56-95 m; 24) 8-150 m, living 94-150 m; 26) 81 m; 30); 33) 83-403 m; 36) living 73-118 m; 55) 42 m; 56) 15-38 m.

Genus *Pararotalia* Y. LE CALVEZ, 1949

Pararotalia aff. *globosa* (MILLETT)

Pl. 15, figs. 9a-d

Compared with:

Discorbina imperatoria (D'ORBIGNY) var. *globosa* MILLETT, 1903, Roy. Micr. Soc. London, Jour., p. 694, pl. 7, figs. 6a-c.

Pararotalia? *globosa* (MILLETT), ŌKI, 1975, p. 50-51, pl. 4, figs. 2a-d.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 65: 39-138 m); Central Area (Stn. 66, 70, 71, 74, 75, 77, 78, 83, 88, 89, 93, 98, 102, 103, 104, 105: 23-196 m; living 78 m); Bay Mouth Area (Stn. 106, 107, 110, 118, 122, 124, 132, 139: 20-110 m); ESK Reg. no. F-10093 - 10118; hypotype in fig. 9a, ESK Reg. no. F-10118 from Stn. 139; hypotype in fig. 9b, ESK Reg. no. F- 10119 from Stn. 106; hypotype in fig. 9c, ESK Reg. no. F-10120 from Stn. 104; hypotype in fig. 9d, ESK Reg. no. F-10115 from Stn. 122.

Remarks: The specimens at hand are less inflated than the named species.

Genus *Pseudorotalia* REISS and MERLING, 1958

Pseudorotalia gaimardii (D'ORBIGNY)

Pl. 16, figs. 1a-b

Rotalia (Turbinulina) gaimardii D'ORBIGNY, 1826, Ann. Sci. Nat., Paris, v. 7, p. 275, no. 46.

Pseudorotalia gaimardii (D'ORBIGNY). MATOBA, 1967, p. 257, pl. 27, figs. 4a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m); Central Area (Stn. 67, 71, 77, 79, 82, 86, 88, 96, 99, 100, 102: 42-196 m; living 150 m); Bay Mouth Area (Stn. 132, 134, 136, 137, 141: 60-112 m); ESK Reg. no. F-10121 - 10139; hypotype in fig. 1, ESK Reg. no. F-10133 from Stn. 100.

Geographic Distribution: Off the northwest of North Honshū, the northwest coast of Central Honshū, the Pacific coast from Central Honshū to Kyūshū, and the Seto Inland Sea and Miyako Bay; 23) 48-95 m; 24) 10-78 m, living 10-49 m; 27) 20-60 m; 41) 28-64 m; 48) 40-149 m with living specimens; 51) 23-232 m, living 23-72m; 52) 31-120 m with living specimens; 54) 23 m; 56) 24-38 m; 58); 60) 50-97.5 m; 62) 96 m; 64) 32-60 m, living 46 m; 70) 70- 123 m, living 70 m; 76) 13-62 m; 77) 35-122 m with living specimens.

Family ELPHIDIIDAE GALLOWAY, 1933

Subfamily ELPHIDIINAE GALLOWAY, 1933

Genus *Elphidium* DE MONTFORT, 1808

Elphidium advenum (CUSHMAN)

Pl. 16, figs. 2a-b

Polystomella advena CUSHMAN, 1922, Publ. 311, Carnegie Instit. Washington, p. 56, pl. 9, figs. 11-12.

Elphidium advenum (CUSHMAN). CUSHMAN, 1933, p. 50, pl. 12, figs. 1-3; TAKAYANAGI, 1955, p. 24, pl. 1, fig. 24; ASANO, 1960, p. 195-196, pl. 22, figs. 3a-b; KUWANO, 1962, p. 129, pl. 17, fig. 6; MATSUNAGA, 1963, pl. 36, figs. 4a-b; ISHIWADA, 1964, p. 14-15, pl. 3, fig. 42; ŌKI, 1975, p. 51-52, pl. 4, figs. 3a-b; HAGEMAN, 1979, p. 93, pl. 5, figs. 2a-b, 3.

Occurrence and Repository: Bay Head Area (Stn. 17, 22, 32, 34, 42, 44, 45, 63, 64, 65: 39-170 m; living 39-149 m); Central Area (Stn. 66, 67, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 82, 83, 84, 86, 87, 88, 89, 90, 92, 93, 94, 97, 98, 99, 100, 101, 102, 103, 104: 23-225 m; living 36-150 m); Bay Mouth and open sea areas (Stn. 106, 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 137, 139, 143, 144: 20-140 m); ESK Reg. no. F-10140 - 10198; hypotype in fig. 2a, ESK Reg. no. F-10199 from Stn. 146; hypotype in fig. 2b, ESK Reg. no. F-10200 from Stn. 34.

Geographic Distribution: The seas adjacent to Japan; 1); 3) 9-17.5 m; 5); 6) 120 m; 8); 11) 100 m; 13) 430 m; 14) 70-598 m; 15) 49-100 m; 19) 214-539 m; 21) 90-344 m; 23) 50-95 m; 24) 5-100 m, living 5-10 m; 26) 44-135 m; 27) 7-78 m; 28) 14-39 m; 29) 0.9- 5.2 m; 32); 33) 83-111 m; 34) 64-1180 m; 37) 6-70 m; 38); 39); 41) 28-65 m; 42) 83-248 m; 43) 45-430 m; 44) 75-421 m; 45); 46) 126-600 m; 47) 24-2226 m; 48) 40-597 m, living 235 m; 49) 2.2 m; 50); 51) 23-422 m, living 23-232 m; 52) 31-201 m; 53); 54) 23 m; 55) 20-63 m; 56) 7-38 m, living 7-25 m; 57) 1.5 m; 58); 59) 2.9-6.4 m; 60) 97.5 m; 61) 21-74 m; 62) 96 m; 63) 5-20 m; 65) 6.5-33 m; 66) 20.5-23 m; 67) 130-481 m; 69) 56-680 m; 70) 70-808 m; 71) 17-27 m; 72); 73); 74) 93-219 m; 75) 300 m; 76) 7-79 m; 77) 35- 122 m.

Elphidium articulatum (D'ORBIGNY)

Pl. 16, figs. 3a-b

Polystomella articulata D'ORBIGNY, 1839, Strasbourg, France, Levrault, tome 5, pt. 5, p. 30, pl. 3, figs. 9, 10.

Occurrence and Repository: Bay Head Area (Stn. 34, 44, 65: 39-149 m); Central Area (Stn. 70, 75, 77, 83: 23-196 m); Bay Mouth Area (Stn. 125, 134: 112-140 m); ESK Reg. no. F-10201 - 10209; hypotype in fig. 3a, ESK Reg. no. F-10210 from Stn. 65; hypotype in fig. 3b, ESK Reg. no. F-10211 from Stn. 65.

Geographic Distribution: The Seto Inland Sea; 66) 21-27 m.

Elphidium crispum (LINNÉ)

Pl. 16, figs. 4a-b

Nautilus crispus LINNÉ, 1758, Ed.10. Holmiae, Suecia (Sweden), impensis L. Salvii, tomus 1, p. 709.

Elphidium crispum (LINNÉ). MATOBA, 1967, p. 254, pl. 27, figs. 7a-b; MATOBA, 1970, p. 51, pl. 7, figs. 1a-b; MURRAY, 1971, p. 155, pl. 64, figs. 1-6; HAGEMAN, 1979, p. 94, pl. 5, figs. 6a-b; HASEGAWA, 1979, p. 147, pl. 8, figs. 2a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 103, 104: 38-175 m); Bay Mouth Area (Stn. 108, 124: 20-120 m); open sea area (Stn. 144, 145: 105-155 m); ESK Reg. no. F-10212 - 10218; hypotype in fig. 4a, ESK Reg. no. F-10219 from Stn. 124; hypotype in fig. 4b, ESK Reg. no. F-10220 from Stn. 124.

Geographic Distribution: Off the southwest coast of Hokkaido, the northwest coast of North Honshū, the northwest coast of Central Honshū, the Pacific coast from North Honshū to Kyūshū and the northwest coast of Kyūshū, the Seto Inland Sea and coastal areas of the Kii Peninsula, Okino-Erabu Island and Yoron Island; 5); 6) 120 m; 14) 70-505 m, living 70 m; 15) 49-100 m; 18) 10-25 fms; 19) 102-539 m; 21) 68-311 m; 23) 40-50 m; 24) 5-78 m, living 5-34 m; 27) 7-45 m; 28) 14-39 m; 29) 0.9-12.5 m; 35); 37) 10-70 m; 41) 6.1-28 m; 44) 75 m; 45); 46) 216-229 m; 47) 107-780 m; 48) 40 m; 50); 52) 31-120 m

with living specimens; 53); 54) 23 m; 56) 7-38 m; 57) 1.5-1.8 m; 58); 59) 7 m; 60) 50-97.5 m; 63) 8-15 m; 64) 60 m; 74) 93-115 m; 75) 90-152 m; 76) 7-57 m; 81); 82).

Elphidium depressulum CUSHMAN

Pl. 16, fig. 5

Elphidium advenum (CUSHMAN) var. *depressulum* CUSHMAN, 1933, U.S. Nat. Mus., Bull. 161, pt. 2, p. 51, pl. 12, fig. 4.

Occurrence and Repository: Bay Head Area (Stn. 44, 64, 65: 39-144 m); Central Area (Stn. 67, 70, 74, 78, 81, 82, 83, 84, 85, 86, 87, 95, 97, 102, 103, 104: 23-220 m; living 40 m); Bay Mouth Area (Stn. 106, 107, 134, 136, 137, 143: 40-112 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-10221 - 10246; hypotype in fig. 5, ESK Reg. no. F-10247 from Stn. 65.

Geographic Distribution: Off the east coast of North Honshū; 27) 6-78 m; 28) 19-37 m; 34) 64-155 m.

Elphidium hispidulum CUSHMAN

Elphidium hispidulum CUSHMAN, 1936, Contr. Cushman Lab. Foram. Res., v. 12, pt. 4, p. 83, pl. 14, figs. 13a-b.

Occurrence and Repository: Bay Mouth Area (Stn. 139: 105 m); ESK Reg. no. F-10248.

Geographic Distribution: Off Erimo-misaki and Tanabe Bay; 11) 56-320 m; 56) 7-33 m.

Elphidium jenseni (CUSHMAN)

Pl. 16, figs. 6a-c

Polystomella jenseni CUSHMAN, 1924, Carnegie Inst. Washington, Publ. no. 342 (Dept. Marine Biol., Papers), v. 21, p. 49, pl. 16, figs. 4, 6.

Elphidium jenseni (CUSHMAN). MATSUNAGA, 1963, pl. 36, figs. 11a-b; MATOBA, 1970, p. 52, pl. 7, figs. 3a-b; HASEGAWA, 1979, p. 147, pl. 8, figs. 2a-b.

Occurrence and Repository: Bay Head Area (Stn. 22, 44, 63, 64, 65: 39-144 m; living 39 m); Central Area (Stn. 66, 70, 74, 78, 83, 84, 88, 94, 104: 23-130 m); Bay Mouth Area (Stn. 106, 107, 116, 124: 20-96 m); ESK Reg. no. F-10249 - 10266; hypotype in fig. 6a, ESK Reg. no. F-10265 from Stn. 116; hypotype in fig. 6b, ESK Reg. no. F-10267 from Stn. 106; hypotype in fig. 6c, ESK Reg. no. F-10268 from Stn. 104.

Geographic Distribution: The seas adjacent to Japan; 1) 40 m; 3) 9-17.5 m; 5); 6) 120 m; 8); 14) 505 m; 19) 113-525 m; 21) 130-181 m; 23) 40-56 m; 24) 5-78 m, living 5-50 m; 27) 7-9 m; 28) 25-30 m; 29) 0.8-12.5 m, living 1.5-3.5 m; 32); 35); 37) 10-70 m; 38); 39); 42) 222 m; 44) 150 m; 45); 46) 201-296 m; 48) 40 m; 49) 2.7 m; 50); 51) 23 m with living specimens; 53); 54) 23 m; 55) 13-35 m; 56) 9-31 m; 57) 1.5-1.8 m; 58); 59) 7-8.6 m; 60) 50-97.5 m; 61) 34 m; 63) 5-20 m; 64) 32-60 m; 65) 6.5-33 m; 71) 17-27 m; 72); 73) 6-24 m; 74) 219 m; 75) 148 m; 76) 19-40 m.

Remarks: This species is distributed mainly in the coastal shallow water.

Elphidium oceanicum CUSHMAN

Pl. 16, figs. 7a-b

Elphidium oceanicum CUSHMAN, 1933, U.S. Nat. Mus. Bull. 161, pt. 2, p. 52, pl. 12, figs. 7a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); Central Area (Stn. 67, 71, 74, 83, 101, 102: 28-165 m); Bay Mouth Area (Stn. 108, 139, 143: 96-120 m); ESK Reg. no. F-10269 - 10278; hypotype in fig. 7a, ESK Reg. no. F-10279 from Stn. 108; hypotype in fig. 7b, ESK Reg. no. F-10277 from Stn. 139.

Geographic Distribution: Coastal area at Kujūkuri-hama; 35).

Elphidium poeyanum (D'ORBIGNY)

Pl. 16, fig. 8

Polystomella poeyana D'ORBIGNY, *in* DE LA SAGRA, 1839, Hist. Fis. Pol. Nat. Cuba, "Foraminiferes", p. 55, pl. 6, figs. 25-26.

Occurrence and Repository: Bay Head Area (Stn. 34, 63: 138-149 m); Central Area (Stn. 66, 88, 90, 91, 95, 100: 75-215 m); Bay Mouth Area (Stn. 106: 40 m); ESK Reg. no. F-10280 - 10288; hypotype in fig. 8, ESK Reg. no. F-10289 from Stn. 106.

Elphidium cf. *selseyensis* (HERON-ALLEN and EARLAND)

Pl. 16, figs. 9a-e

Compared with:

Elphidium excavatum (TERQUEM) forma *selseyensis* (HERON-ALLEN and EARLAND). FEYLING-HANSEN, 1972, p. 341-342, pl. 4, figs. 1-7; pl. 5, figs. 1-7.

Occurrence and Repository: Bay Head Area (Stn. 34, 63: 138-149 m); Central Area (Stn. 70, 73, 78, 79, 81, 82, 83, 85, 86, 87, 88, 89, 92, 93, 94, 98, 100, 101, 103, 104, 105: 23-220 m); Bay Mouth Area (Stn. 106, 108, 116, 118, 124, 139, 141, 143: 20-120 m); open sea area (Stn. 145, 146: 155-213 m); ESK Reg. no. F-10290 - 10322; hypotype in fig. 9a, ESK Reg. no. F-10323 from Stn. 116; hypotype in fig. 9b, ESK Reg. no. F-10319 from Stn. 141; hypotype in fig. 9c, ESK Reg. no. F-10324 from Stn. 108; hypotype in fig. 9d, ESK Reg. no. F-10325 from Stn. 139; hypotype in fig. 9e, ESK Reg. no. F-10326 from Stn. 108.

Remarks: The specimens in the collection are quite identical to *Elphidium excavatum* forma *selseyensis* described by FEYLING-HANSSEN (1972), but have rather small tests.

Elphidium subincertum ASANO

Pl. 16, fig. 10

Elphidium subincertum ASANO, 1950, Illust. Cat. Japan. Small. Foram., pt. 1, p. 10, text-figs. 56, 57.
"*Elphidium*" *subincertum* ASANO. MATOBA, 1970, p. 53, pl. 7, figs. 10a-b.

Occurrence and Repository: Central Area (Stn. 70, 83, 87, 100, 102, 104: 23-182 m); Bay Mouth Area (Stn. 106, 107: 40-96 m); ESK Reg. no. F-10327 - 10334; hypotype in fig. 10, ESK Reg. no. F-10331 from Stn. 102.

Geographic Distribution: Around Oki Island, the Seto Inland Sea, Ishikari, Sagami, Tanabe, Ōmura and Kamaé Bays, and the coastal area of the Kii Peninsula; 5); 44) 239-402 m; 45); 50); 58); 59) 2.9-8.6 m; 60) 97.5 m; 63) 8 m; 73) 6-20.5 m; 76) 10-79 m.

Elphidium sp. 1

Pl. 16, figs. 11a-b

Occurrence and Repository: Central Area (Stn. 84, 85, 88, 89, 91, 93, 94, 96, 98, 100, 102, 103, 104: 38-220 m); Bay Mouth Area (Stn. 107, 116, 132, 137, 141: 60-106 m);

open sea area (Stn. 145: 155 m); ESK Reg. no. F-10335 - 10353; hypotype in fig. 11a, ESK Reg. no. F-10354 from Stn. 91; hypotype in fig. 11b, ESK Reg. no. F-10355 from Stn. 89.

Remarks: The present specimens are characterized by a small number of inflated chambers and the sutures filled with coarse material.

Elphidium sp. 2

Pl. 16, figs. 12a-b

Occurrence and Repository: Central Area (Stn. 73: 80 m); hypotype in fig. 12a, ESK Reg. no. F-10356 from Stn. 73; hypotype in fig. 12b, ESK Reg. no. F-10357 from Stn. 73.

Remarks: The present specimens are similar to *Elphidium excavatum* forma *selsey ensis* but differ therefrom in their sinuous sutures.

Genus *Protelphidium* HAYNES, 1956

Protelphidium hadleyana (SMITTER)

Elphidium hadleyana SMITTER, 1955, Palaeontologia Africana, Univ. Witwatersrand, Bernard Prince Inst. Pal. Res., Ann., Johannesburg, v. 3, p. 116; p. 115, fig. 40e-f.

Occurrence and Repository: Bay Head Area (Stn. 45, 65: 39-134 m); Central Area (Stn. 88, 92: 78-185 m); ESK Reg. no. F-10358 - 10361.

Protelphidium schmitti (CUSHMAN and WICKENDEN)

Pl. 17, figs. 1a-b

Elphidium schmitti CUSHMAN and WICKENDEN, 1929, U.S. Nat. Mus., Proc., no. 2780, v. 75, art. 9, p. 7, pl. 3, figs. 9a-c.

Occurrence and Repository: Bay Head Area (Stn. 44, 63, 64, 65: 39-144 m); Central Area (Stn. 66, 67, 70, 73, 74, 78, 83, 88, 89, 90, 92, 93, 94, 95, 96, 99, 100, 101, 102, 104: 23-215 m; living 23-78 m); Bay Mouth Area (Stn. 106, 107, 122, 124, 136, 143: 20-100 m); ESK Reg. no. F-10362 - 10391; hypotype in fig. 1a, ESK Reg. no. F-10392 from Stn. 65; hypotype in fig. 1b, ESK Reg. no. F-10393 from Stn. 65.

Family NUMMULITIDAE DE BLAINVILLE, 1825

Subfamily NUMMULITINAE DE BLAINVILLE, 1825

Genus *Nummulites* LAMARCK, 1801

Nummulites ammonoides (GRONOVIUS)

Pl. 17, figs. 2a-e

Nautilus ammonoides GRONOVIUS, 1781, Zoolphylacium Gronovianum, p. 282, pl. 19, figs. 5-6.
Operculina ammonoides (GRONOVIUS). HUANG, 1961, p. 86, pl. 3, figs. 22-23.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m); Central Area (Stn. 70, 71, 74, 78, 83, 87, 97, 99: 23-182 m; living 28 m); Bay Mouth Area (Stn. 106, 110, 124, 127, 136, 137: 20-110 m); ESK Reg. no. F-10394 - 10409; hypotype in fig. 2a, ESK Reg. no. F-10410 from Stn. 99; hypotype in fig. 2b, ESK Reg. no. F-10411 from Stn. 74; hypotype in fig. 2c, ESK Reg. no. F-10412 from Stn. 99; hypotype in fig. 2d, ESK Reg. no. F-10413 from Stn. 106; hypotype in fig. 2e, ESK Reg. no. F-10409 from Stn. 137.

Geographic Distribution: Kii Strait and Tanabe Bay; 56) 24-38 m, living 33 m; 57)

1.5 m; 60) 50-97.5 m.

Superfamily ORBITOIDACEA SCHWAGER, 1876

Family EPONIDIDAE HOFKER, 1951

Genus *Eponides* DE MONTFORT, 1808

Eponides procera (BRADY)

Pl. 17, fig. 3

Pulvinulina procera BRADY, 1884, Rep. Voy. Challenger, 1881, Quart. Jour., Micr. Sci., Exp., Repts, Zool., v. 4, p. 698, pl. 105, figs. 7a-c.

"*Eponides*?" *procera* (BRADY). BARKER, 1960, p. 216, pl. 105, figs. 7a-c.

Eponides procera (BRADY). HUANG, 1961, p. 87, pl. 3, figs. 6-8.

Occurrence and Repository: open sea area (Stn. 145: 155 m); hypotype in fig. 3, ESK Reg. no. F-10414 from Stn. 145.

Genus *Poroeponides* CUSHMAN, 1944

Poroeponides lateralis (TERQUEM)

Rosalina lateralis TERQUEM, 1878, Mem. Soc. Geol. France, ser.3, v. 1, no. 3, p. 25, pl. 2, figs. 11a-c.

Poroeponides lateralis (TERQUEM). HUANG, 1961, p. 87, pl. 4, figs. 29-30; LOEBLICH and TAPPAN, 1964, p. C683, figs. 546, 5a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64: 66 m); ESK Reg. no. F-10415.

Family AMPHISTEGINIDAE CUSHMAN, 1927

Genus *Amphistegina* D'ORBIGNY, 1826

Amphistegina cf. *gibbosa* D'ORBIGNY

Pl. 17, figs. 4a-c

Compared with:

Amphistegina gibbosa D'ORBIGNY, 1839, A. Bertrand, Paris, France, p. 120, v. 8, figs. 1-3; BRADY, 1884, pl. 111, figs. 2a-c, 4a-c.

Occurrence and Repository: Bay Head Area (Stn. 32, 44, 45, 63, 64, 65: 39-156 m; living 66 m); Central Area (Stn. 66, 67, 70, 71, 73, 74, 78, 83, 87, 88, 89, 92, 93, 97, 98, 99, 100, 102, 103, 105: 23-185 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 118, 122, 124, 127, 132, 134, 136, 141, 143: 20-120 m; living 60-96 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-10416 - 10457; hypotype in fig. 4a, ESK Reg. no. F-10458 from Stn. 99; hypotype in fig. 4b, ESK Reg. no. F-10459 from Stn. 48; hypotype in fig. 4c, ESK Reg. no. F-10460 from Stn. 99.

Remarks: The specimens in the collection are identical to the named species except for their rather thin tests.

Family CIBICIDIDAE CUSHMAN, 1927

Subfamily PLANULININAE BERMÚDEZ, 1952

Genus *Planulina* D'ORBIGNY, 1826

Planulina? sp.

Pl. 17, figs. 5a-c

Occurrence and Repository: Bay Mouth Area (Stn. 108, 139, 141, 143: 60-120 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-10461 - 10466; hypotype in fig. 5a, ESK Reg. no. F-10467 from Stn. 144; hypotype in fig. 5b, ESK Reg. no. F-10468

from Stn. 144; hypotype in fig. 5c, ESK Reg. no. F-10469 from Stn. 139.

Remarks: The number of specimens are insufficient for the specific identification.

Genus *Hyalinea* HOFKER, 1951

Hyalinea balthica (SCHRÖTER)

Pl. 17, figs. 6a-d

Nautilus balthicus SCHRÖTER, 1783, Einleitung in die Conchylienkenntniss nach Linné, v. 1, p. 20, pl. 1, fig. 2.
Anomalina balthica (SCHRÖTER). CUSHMAN, 1931, p. 108, pl. 19, figs. 3a-c; ISHIWADA, 1964, p. 18, pl. 8, fig. 111.
Hyalinea balthica (GMELIN). BELFORD, 1966, p. 124-125, pl. 14, figs. 1-8: text-figs. 13, 1-3.
Hyalinea balthica (SCHRÖTER). LOEBLICH and TAPPAN, 1964, p. C686, figs. 552, 2a-c, 3.

Occurrence and Repository: Bay Head Area (Stn. 34: 149 m; living); Central Area (Stn. 66, 69, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 95, 96, 97, 101, 102, 103, 105: 28-225 m; living 95-220 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 116, 122, 124, 125, 127, 132, 134, 136, 137, 139: 20-140 m; living 61-120 m); open sea area (Stn. 144, 146: 105-213 m; living 105 m); ESK Reg. no. F-10470 - 10517; hypotype in fig. 6a, ESK Reg. no. F-10518 from Stn. 110; hypotype in fig. 6b, ESK Reg. no. F-10519 from Stn. 101; hypotype in fig. 6c, ESK Reg. no. F-10520 from Stn. 139; hypotype in fig. 6d, ESK Reg. no. F-10521 from Stn. 139.

Geographic Distribution: Off the southwest coast of Hokkaido, the east coast of North Honshū and the Pacific coast from Central Honshū to Kyūshū; 6) 120 m; 27) 38 m; 32); 47) 107-864 m; 48) 74-597 m with living specimens; 51) 72-422 m, living 72-155 m; 52) 120-585 m; 61) 65 m; 67) 201-481 m; 69) 78-410 m; 70) 70-808 m, living 70 m; 76) 15-79 m; 77) 745 m.

Remarks: In most of the specimens at hand, the last 3 - 5 chambers are inflated. In general, chambers start to inflate at various stages in each individual, and the earlier the inflation, the smaller the diameter of the test.

Hyalinea inflata UJIIÉ and KUSUKAWA

Pl. 18, figs. 1a-d

Hyalinea inflata UJIIÉ and KUSUKAWA, 1969, Bull. Nat. Sci. Mus. Tokyo, v. 12, no. 3, p. 767-768, pl. 2, figs. 1-3.

Occurrence and Repository: Central Area (Stn. 73, 75, 79, 84, 86, 87, 88, 89, 90, 93, 94, 95, 97, 98, 99, 100, 102, 105: 42-215 m; living 93-170 m); Bay Mouth Area (Stn. 118, 122, 132, 134, 137, 139, 143: 96-112 m; living 100 m); ESK Reg. no. F-10522- 10546; hypotype in fig. 1a, ESK Reg. no. F-10547 from Stn. 90; hypotype in fig. 1b, ESK Reg. no. F-10548 from Stn. 139; hypotype in fig. 1c, ESK Reg. no. F-10549 from Stn. 132; hypotype in fig. 1d, ESK Reg. no. F-10550 from Stn. 132.

Geographic Distribution: Miyako and Yamada Bays; 27) 37-60 m; 28) 33 m.

Remarks: This species originally described by UJIIÉ and KUSUKAWA (1969) from Miyako and Yamada Bays in Iwate Prefecture, is characterized by inflation of the chamber. As already mentioned, the chamber of *Hyalinea balthica* starts to inflate at various stages. This species still has a probability to be synonymous with *balthica*.

Subfamily CIBICIDINAE CUSHMAN, 1927

Genus *Cibicides* DE MONTFORT, 1808

Cibicides inagawaensis MATSUNAGA

Pl. 18, figs. 2a-c

Cibicides inagawaensis MATSUNAGA, 1963, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), v. 35, no. 2, p. 116, pl. 51, figs. 5a-c.

Occurrence and Repository: Bay Head Area (Stn. 22, 32, 45, 64, 65: 39-156 m); Central Area (Stn. 67, 70, 71, 73, 74, 79, 80, 92, 99, 100, 101: 42-185 m; living 75 m); Bay Mouth Area (Stn. 106, 107, 110, 113, 116, 122, 124, 125, 127, 137, 139, 141, 143: 20-140 m; living 20-106 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 105 m); ESK Reg. no. F-10551 - 10582; hypotype in fig. 2a, ESK Reg. no. F-10583 from Stn. 145; hypotype in fig. 2b, ESK Reg. no. F-10584 from Stn. 137; hypotype in fig. 2c, ESK Reg. no. F-10585 from Stn. 144.

Remarks: This species was originally described from the Pliocene Haizume and Shiroiwa Formations, Niigata Prefecture by MATSUNAGA (1963).

Cibicides lobatulus (WALKER and JACOB)

Nautilus lobatulus WALKER and JACOB, 1989, Adams Essays, p. 642, pl. 14, fig. 36.
Cibicides lobatula (WALKER and JACOB). CUSHMAN, 1931, p. 118, pl. 21, figs. 3a-c.
Cibicides lobatulus (WALKER and JACOB). MATOBA, 1970, p. 50, pl. 8, figs. 5a-c, 6a-c.

Occurrence and Repository: Bay Head Area (Stn. 45, 64, 65: 39-134 m); Central Area (Stn. 66, 70, 75, 92, 93, 99, 101: 23-185
m; living 42 m); Bay Mouth Area (Stn. 110, 113, 124, 136, 137, 139, 143: 20-110 m; living 106 m); open sea area (Stn. 144, 146: 105-213 m; living 105 m); ESK Reg. no. F-10586 - 10604.

Geographic Distribution: The seas adjacent to Japan; 5); 6) 220-265 m; 13) 135 m with living specimens; 14) 70-598 m, living 70-115 m; 15) 49-695 m, living 49-100 m; 17) 60-100 m; 18) 4-33 fms; 23) 40-50 m; 24) 5-78 m, living 10-49 m; 27) 9-78 m; 28) 19- 37 m; 29) 0.8-12.5 m; 30); 31); 32); 37) 10-70 m; 38); 39); 40); 42) 468-947 m; 43) 45-570 m; 47) 167-1488 m; 48) 40-74 m; 50); 51) 23-43 m with living specimens; 52) 31-80 m, living 31 m; 53); 54) 23 m; 55) 20-64 m; 56) 7-38 m; 58); 60) 50-97.5 m; 61) 23-74 m; 62) 96 m with living specimens; 63) 5-15 m; 64) 46-60 m; 65) 4.1-33 m; 66) 20.5-27 m; 69) 193-410 m; 70) 234 m; 71) 17-25 m; 72); 73) 6-20.5 m; 76) 10-62 m.

Genus *Caribeanella* BERMÚDEZ, 1952

Caribeanella cf. *polystoma* BERMÚDEZ

Pl. 18, figs. 3a-d

Compared with:

Caribeanella polystoma BERMÚDEZ, 1952, Venezuela, Minase Hidrocarb., Biol., Caracas, v. 2, no. 4, p. 121, pl. 27, figs. 18a-d.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m); Central Area (Stn. 66, 70, 71, 72, 73, 74, 75, 77, 81, 82, 83, 87, 88, 89, 92, 94, 98, 99, 102, 103, 104, 105: 23-220 m; living 42-145 m); Bay Mouth Area (Stn. 106, 108, 110, 116, 122, 125, 127, 132, 134, 136, 137, 139, 141, 143: 40-140 m); open sea area (Stn. 144, 145, 146: 105-213 m); ESK Reg. no. F-10605 - 10644; hypotype in fig. 3a, ESK Reg. no. F-10645 from

Stn. 99; hypotype in fig. 3b, ESK Reg. no. F-10646 from Stn. 66; hypotype in fig. 3c, ESK Reg. no. F-10629 from Stn. 108; hypotype in fig. 3d, ESK Reg. no. F-10635 from Stn. 132.

Remarks: Most of the specimens in the collection are of the juvenile stage and a few adult specimens are imperfect. Therefore, the secondary aperture, an important character of the named species, was not recognized.

Genus *Dyocibicides* CUSHMAN and VALENTINE, 1930

Dyocibicides biserialis CUSHMAN and VALENTINE

Dyocibicides biserialis CUSHMAN and VALENTINE, 1930, Contri. Dept. Geol., Stanford Univ., v. 1, no. 1, p. 31, pl. 10, figs. 1-2; MATSUNAGA, 1963, pl. 52, figs. 4a-b; HAYWARD and BUZAS, 1979, p. 52, pl. 12, fig. 155.

Occurrence and Repository: Bay Mouth Area (Stn. 137: 106 m); ESK Reg. no. F-10647.

Geographic Distribution: Off the south coast of Central Honshū; 45); 48) 74 m; 51) 23 m; 52) 31-120 m, living 31 m; 60) 50-97.5 m.

Family PLANORBULINIDAE SCHWAGER, 1877

Genus *Planorbulina* D'ORBIGNY, 1826

Planorbulina acervalis BRADY

Planorbulina acervalis BRADY, 1884, Rep. Voy. Challenger, Zool., v. 4, p. 657, pl. 92, fig. 4.

Occurrence and Repository: Bay Mouth Area (St. 124: 20 m); ESK Reg. no. F-10648.

Geographic Distribution: Kii Strait, Sagami Bay and the coastal area at the Kii Peninsula; 45); 57) 1.5-1.8 m; 58); 60) 50-97.5 m.

Family CYMBALOPORIDAE CUSHMAN, 1927

Genus *Cymbaloporetta* CUSHMAN, 1928

Cymbaloporetta bradyi (CUSHMAN)

Cymbalopora poey (D'ORBIGNY) var. *bradyi* CUSHMAN, 1915, U.S. Nat. Mus., Bull. 71, pt. 5, p. 25, pl. 10, fig. 2, pl. 14, fig. 2.

Cymbaloporetta bradyi (CUSHMAN). MATOBA, 1970, p. 50, pl. 8, figs. 7a-c.

Occurrence and Repository: Bay Mouth Area (Stn. 122: 100 m); ESK Reg. no. F-10649.

Geographic Distribution: Off the northwest coast of North Honshū, the Pacific coast of Central Honshū, Matsushima Bay and the coastal areas at the Kii Peninsula and Takara Island; 24) 8-14 m; 29) 2.2-4.4 m; 45); 50); 52) 31-80 m with living specimens; 55) 33 m; 56) 15-38 m; 57) 1.5-1.8 m; 58); 60) 50-97.5 m; 79).

Cymbaloporetta hemisphaerica ACCORDI and SELMI

Pl. 18, figs. 4a-f

Cymbaloporetta hemisphaerica ACCORDI and SELMI, 1952, Univ., Ann., Ferrara, n.s., sec. 9 (Sci. Geol., Pal.), v. 1, (1951-1953), no. 3, p. 95, pl. 2, figs. 18, 19.

Occurrence and Repository: Bay Head Area (Stn. 34, 45: 134-149 m); Central Area (Stn. 66, 69, 70, 71, 72, 73, 74, 75, 76, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 98, 99, 100, 101 102, 103, 104, 105: 23-225 m; living 28-225 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 134,

136, 137, 139, 143: 20- 140 m; living 40-120 m); open sea area (Stn. 144: 105 m; living); ESK Reg. no. F-10650 - 10705; hyotype in fig. 4a, ESK Reg. no. F-10706 from Stn. 144; hypotype in fig. 4b, ESK Reg. no. F-10707 from Stn. 139; hypotype in fig. 4c, ESK Reg. no. F-10708 from Stn. 139; hypotype in fig. 4d, ESK Reg. no. F-10709 from Stn. 139; hypotype in fig. 4e, ESK Reg. no. F-10710 from Stn. 137; hypotype in fig. 4f, ESK Reg. no. F-10711 from Stn. 132.

Remarks: This species shows the *Discorbis*-form in the young stage and changes into quite a different form in the adult stage. This is the first record of the present species in Japanese waters.

Superfamily CASSIDULINACEA D'ORBIGNY, 1839

Family CAUCASINIDAE N.K. BYKOVA, 1959

Subfamily FURSENKOININAE LOEBLICH and TAPPAN, 1961

Genus *Fursenkoina* LOEBLICH and TAPPAN, 1961

Fursenkoina schreibersiana (CŽJŽEK)

Pl. 18, fig. 5

Virgulina schreibersiana CŽJŽEK, 1848, Haidinger's Nat. Abh., 2, p. 11, pl. 13, figs. 18-21.
Fursenkoina schreibersiana (CŽJŽEK). HAGEMAN, 1979, p. 98-99, pl. 7, fig. 4.

Occurrence and Repository: Central Area (Stn. 73, 74, 75, 86, 104: 28-165 m; living 165 m); Bay Mouth Area (Stn. 122: 100 m); ESK Reg. no. F-10712 - 10717; hypotype in fig. 5, ESK Reg. no. F-10716 from Stn. 104.

Geographic Distribution: Off the Pacific coast from Central Honshū to Kyūshū; 48) 124-235 m with living specimens; 52) 80 m with living specimens; 56) 31-38 m; 61) 34-80 m; 70) 70-202 m with living specimens; 77) 122 m with living specimens.

Remarks: This species has been reported only in the area of the Kuroshio current.

Genus *Sigmavirgulina* LOEBLICH and TAPPAN, 1957

Sigmavirgulina tortuosa (BRADY)

Pl. 18, figs. 6a-c

Bolivina tortuosa BRADY, 1881, Quart. Jour., Micr. Sci., v. 21, p. 51, (1884) Challenger Exp., Repts., Zool., v. 9, p. 420, pl. 52, figs. 31-32; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 18, pl. 3, figs. 14-17.
Sigmavirgulina tortuosa (BRADY). LOEBLICH and TAPPAN, 1964, p. C733, fig. 601, 1a-c, 2-3; BARKER, 1960, p. 108, pl. 52, figs. 31-32.

Occurrence and Repository: Central Area (Stn. 70, 74, 92: 23-185 m); Bay Mouth Area (Stn. 124, 141: 20-60 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-10718 - 10723; hypotype in fig. 6a-b, ESK Reg. no. F-10723 from Stn. 141; hypotype in fig. 6c, ESK Reg. no. F-10721 from Stn. 124.

Geographic Distribution: Tanabe and Kamaé Bays and the coastal area at the Kii Peninsula; 56) 9-33 m; 58); 59) 8.6 m; 76) 35 m.

Genus *Virgulinella* CUSHMAN, 1932

Virgulinella sp.

Occurrence and Repository: Central Area (Stn. 81, 83, 85, 86, 87, 92, 94, 102: 36-220 m); ESK Reg. no. F-10724 - 10731.

Remarks: The specimens in the collection are rather few and mostly imperfect.

Family CASSIDULINIDAE D'ORBIGNY, 1839

Genus *Globocassidulina* VOLOSHINOVA, 1960

Globocassidulina oriangulata BELFORD

Pl. 18, figs. 7a-d

Globocassidulina oriangulata BELFORD, 1966, Bur. Min. Resour. Aust. Rep., no. 79, p. 148, pl. 25, figs. 1-5, text-fig. 16, nos. 13, 14; NOMURA, 1983, p. 43-45, text-fig. 36, pl. 3, figs. 16-17; pl. 6, fig. 16; pl. 16, figs. 11-12; pl. 17, figs. 1-2.

Occurrence and Repository: West-Sakurajima Passage (Stn. 65: 39 m; living); Central Area (Stn. 70, 71, 73, 74, 75, 76, 79, 80, 81, 84, 85, 86, 87, 88, 90, 91, 92, 97, 98, 101, 102, 103, 105: 23-225 m; living 88-162 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 118, 122, 125, 127, 132, 134, 136, 137, 139, 141, 143: 60-140 m; living 60-140 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 155-213 m); ESK Reg. no. F-10732 - 10773; hypotype in fig. 7a, ESK Reg. no. F-10774 from Stn. 113; hypotype in fig. 7b, ESK Reg. no. F-10775 from Stn. 137; hypotype in fig. 7c, ESK Reg. no. F-10776 from Stn. 143; hypotype in fig. 7d, ESK Reg. no. F-10777 from Stn. 110.

Globocassidulina subglobosa depressa ASANO and NAKAMURA

Cassidulina subglobosa depressa ASANO and NAKAMURA, 1937, Japanese Jour. Geol. Geogr., v. 14, nos. 2-3, p. 148, pl. 13, figs. 8a-c.

Occurrence and Repository: Central Area (Stn. 67, 71, 83, 92, 93, 94, 98: 36-185 m; living 145-185 m); Bay Mouth Area (Stn. 125, 136: 60-140 m; living 60 m); ESK Reg. no. F-10778 - 10786.

Geographic Distribution: Off the southwest coast of Hokkaido, the northeast coast of North Honshū and the Seto Inland Sea; 6) 220-742 m; 34) 64-155 m; 36) living 80-208 m; 65) 19.5 m.

Globocassidulina venustas NOMURA

Pl. 18, figs. 8a-b

Globocassidulina venustas NOMURA, 1983, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), v. 53, no, 1, p. 60-61, text-fig. 29, pl. 1, figs. 7a-c, 8; pl. 14, figs. 4-7.

Occurrence and Repository: Bay Mouth Area (Stn. 113, 118, 127, 132, 134, 136, 139, 143: 60-112 m); open sea area (Stn. 144, 145, 146: 105-213 m); ESK Reg. no. F-10787 - 10797; hypotype in fig. 8a, ESK Reg. no. F-10788 from Stn. 118; hypotype in fig. 8b, ESK Reg. no. F-10798 from Stn. 146.

Geographic Distribution: Tanabe Bay; 59) 6.4-8.6 m.

Genus *Cassidulina* D'ORBIGNY, 1826

Cassidulina nørvangi THALMANN

Pl. 19, figs. 1a-f

Cassidulina islandica NØRVANG var. *nørvangi* THALMANN, 1952, *in* PHLEGER, F.B., Cushman Found. Foram. Res., Contr., v. 3, pt. 2, p. 83, footnote 1; PHLEGER, 1952, pl. 14, fig. 30.

Occurrence and Repository: Bay Head Area (Stn. 22, 34, 63: 138-149 m); Central Area (Stn. 66, 67, 69, 70, 71, 72, 73, 75, 76, 77, 78, 79, 80, 81, 82, 84, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 100, 101, 102, 103, 105: 23 -225 m; living 40-225 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 116, 118, 122, 125, 127, 132, 134, 136, 137,

139, 141, 143: 60-140 m; living 74-120 m); open sea area (Stn. 144, 145: 105-155 m; living 155 m); ESK Reg. no. F-10799 - 10853; hypotype in fig. 1a, ESK Reg. no. F-10854 from Stn. 101; hypotype in fig. 1b, ESK Reg. no. F-10855 from Stn. 145; hypotype in fig. 1c, ESK Reg. no. F-10856 from Stn. 101; hypotype in fig. 1d, ESK Reg. no. F-10857 from Stn. 139; hypotype in fig. 1e, ESK Reg. no. F-10858 from Stn. 101; hypotype in fig. 1f, ESK Reg. no. F-10859 from Stn. 145.

Geographic Distribution: Off the southwest coast of Hokkaido and the northwest coast of North Honshū, and Sendai Bay; 12) 56-80 m; 24) 5-68 m; 30).

Genus *Lernella* SAIDOVA, 1975

Lernella inflata (LEROY)

Pl. 19, figs. 2a-e

Cassidulina inflata LEROY, 1944, Quart. Colo. Sch. Mines, v. 36, no. 1, pt. 1, p. 37, pl. 4, figs. 30-31.
Cassidulinoides inflatus (LEROY). BELFORD, 1966, p. 54, pl. 26, figs. 14-17, nos. 13-14.
Lernella inflata (LEROY). NOMURA, 1983, p. 86-88, pl. 2, figs. 9a-c, pl. 24, figs. 4-5.

Occurrence and Repository: Central Area (Stn. 66, 73, 87, 88, 90, 91, 95, 97): Bay Mouth Area (Stn. 132, 134, 136: 60-112 m); ESK Reg. no. F-10860 - 10870; hypotype in fig. 2a, ESK Reg. no. F-10871 from Stn. 87; hypotype in fig. 2b, ESK Reg. no. F-10872 from Stn. 87; hypotype in fig. 2c, ESK Reg. no. F-10869 from Stn. 134; hypotype in fig. 2d, ESK Reg. no. F-10868 from Stn. 132; hypotype in fig. 2e, ESK Reg. no. F-10873 from Stn. 136.

Lernella ogasawarai NOMURA

Pl. 19, figs. 3a-c

Lernella ogasawarai NOMURA, 1983, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), v. 53, no. 1, p. 88-89, pl. 2, figs. 8a-b, pl. 24, figs. 8-9.
Cassidulinoides japonicus KUWANO, 1962, pl. 16, fig. 5.

Occurrence and Repository: Central Area (Stn. 72, 81, 91, 93, 94, 96, 98, 100, 102: 75-220 m; living 188 m); Bay Mouth Area (Stn. 113, 122, 125, 136, 139: 60-140 m; living 100 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-10874 - 10888; hypotype in fig. 3a, ESK Reg. no. F-10889 from Stn. 145; hypotype in fig. 3b, ESK Reg. no. F-10890 from Stn. 136; hypotype in fig. 3c, ESK Reg. no. F-10885 from Stn. 125.

Geographic Distribution: Off the Bōsō Peninsula; 36) living 141-333 m.

Genus *Paracassidulina* NOMURA, 1983

Paracassidulina minuta (CUSHMAN)

Pl. 19, figs. 4a-c

Cassidulina minuta CUSHMAN, 1933, Cushman Lab. Foram. Res., Contr., v. 9, pt. 4, p. 77-95, pls. 8-10.
Paracassidulina minuta (CUSHMAN). NOMURA, 1983, p. 66-67, pl. 5, figs. 16a-c.

Occurrence and Repository: Bay Head Area (Stn. 54: 125 m); Central Area (Stn. 67, 72, 75, 76, 77, 80, 81, 82, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96, 97, 98, 100, 101, 102, 103, 105: 75-225 m; living 93-225 m); Bay Mouth Area (Stn. 107, 108, 110, 137, 139: 96-120 m; 105-120 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 105 m); ESK Reg. no. F-10891 - 10925; hypotype in fig. 4a, ESK Reg. no. F-10926 from Stn. 101; hypotype in fig. 4b, ESK Reg. no. F-10927 from Stn. 82; hypotype in fig. 4c, ESK

Reg. no. F-10928 from Stn. 102.

Paracassidulina quasicarinata NOMURA

Pl. 19, figs. 5a-f

Paracassidulina quasicarinata NOMURA, 1983, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), v. 53, no. 1, p. 100-101, pl. 2, figs. 19a-c; pl. 25, figs. 9-11.

Cassidulina neocarinata THALMANN. KUWANO, 1962, p. 132, pl. 16, fig. 2.

Occurrence and Repository: Central Area (Stn. 66, 67, 71, 72, 73, 74, 75, 78, 79, 80, 81, 84, 86, 87, 88, 89, 92, 93, 94, 95, 98, 99, 100, 101, 102, 103, 104, 105: 28-225 m; living 93-162 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 122, 125, 127, 132, 134, 136, 137, 139, 141, 143: 40-140 m; living 60-120 m); open sea area (Stn. 144, 145, 146: 105-213 m; living); ESK Reg. no. F-10929 - 10975; hypotype in fig. 5a, ESK Reg. no. F-10976 from Stn. 146; hypotype in fig. 5b, ESK Reg. no. F-10977 from Stn. 146; hypotype in fig. 5c, ESK Reg. no. F-10778 from Stn. 145; hypotype in fig. 5d, ESK Reg. no. F-10979 from Stn. 146; hypotype in fig. 5e, ESK Reg. no. F-10980 from Stn. 146; hypotype in fig. 5f, ESK Reg. no. F-10981 from Stn. 110.

Remarks: In the open sea area and the coastal area off the Ōsumi Peninsula which is under the influence of open-sea water, the frequency of the present species is rather high.

Family NONIONIDAE SCHULTZE, 1854

Subfamily NONIONINAE SCHULTZE, 1854

Genus *Astrononion* CUSHMAN and EDWARDS, 1937

Astrononion hanyudaense MATSUNAGA

Pl. 19, figs. 6a-b

Astrononion hanyudaense MATSUNAGA, 1963, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), p. 107, pl. 35, figs. 8a-b.

Nonion umbilicatulum UCHIO var. KUWANO, 1962, p. 129, pl. 14, figs. 7a-b.

Occurrence and Repository: Bay Head Area (Stn. 17, 22, 32, 34, 42, 44, 45, 63: 134-170 m; living 144 m); Central Area (Stn. 67, 68, 69, 71, 72, 73, 75, 76, 77, 78, 79, 80, 81, 82, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 95, 96, 97, 98, 99, 100, 101, 102, 103: 40-225 m; living 78-225 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 122, 125, 132, 134, 139: 40-140 m; living 100 m); ESK Reg. no. F-10982 - 11033; hypotype in fig. 6a, ESK Reg. no. F-11034 from Stn. 103; hypotype in fig. 6b, ESK Reg. no. F-11035 from Stn. 91.

Astrononion stelligerum (D'ORBIGNY)

Pl. 19, figs. 7a-d

Nonionina stelligera D'ORBIGNY, 1839, *in* BARKER-WEBB and BERTHELOT, Hist. Nat. Canaries, v. 2, pt. 2, Zool., p. 128, pl. 3, figs. 1-2.

Astrononion sidebottomi CUSHMAN and EDWARDS. KUWANO, 1962, pl. 14, figs. 8a-b.

Astrononion stelligerum (D'ORBIGNY). CHIJI and LOPEZ, 1968, p. 104, pl. 15, fig. 11; HAYWARD and BUZAS, 1979, p. 41, pl. 5, fig. 57.

Occurrence and Repository: Bay Head Area (Stn. 32, 41: 156- 182 m); Central Area (Stn. 67, 70, 76, 78, 79, 80, 83, 84, 85, 87, 88, 89, 93, 94, 104: 23-225 m; living 88-225 m); Bay Mouth Area (Stn. 106, 107, 118, 122, 127, 132, 136, 137, 139, 141, 143: 40-106

m; living 60-100 m); open sea area (Stn. 144: 105 m); ESK Reg. no. F-11036 - 11064; hypotype in fig. 7a, ESK Reg. no. F-11046 from Stn. 84; hypotype in fig. 7b, ESK Reg. no. F-11065 from Stn. 141; hypotype in fig. 7c, ESK Reg. no. F-11066 from Stn. 144; hypotype in fig. 7d, ESK Reg. no. F-11067 from Stn. 144.

Geographic Distribution: The Seto Inland Sea, and Tōkyō and Tanabe Bays; 37) 18-53 m; 56) 21-38 m; 66) 23 m.

Genus *Florilus* DE MONTFORT, 1808

Florilus japonicus (ASANO)

Pl. 20, figs. 1a-c

Nonion japonicum ASANO, 1938, Jour. Geol. Soc. Japan, v. 45, no. 538, p. 593, pl. 15, figs. 1a-b, 2a-b; MATSUNAGA, 1963, pl. 37, figs. 3a-b.

Occurrence and Repository: Bay Head Area (Stn. 17, 22, 32, 34, 44, 63, 64, 65: 39-156 m; living 138-156 m); Central Area (Stn. 66, 67, 68, 69, 70, 72, 73, 74, 75, 76, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 95, 96, 97, 98, 99, 100, 101, 103, 104, 105: 23-225 m; living 28-220 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 116, 125, 134, 139, 143: 40-140 m); ESK Reg. no. F-11068 - 11118; hypotype in fig. 1a, ESK Reg. no. F-11119 from Stn. 82; hypotype in fig. 1b, ESK Reg. no. F-11120 from Stn. 82; hypotype in fig. 1c, ESK Reg. no. F-11121 from Stn. 82.

Geographic Distribution: Off the coast of North Honshū, the north coast from Central to West Honshū, the Pacific coast from Central Honshū to Kyūshū and the northwest coast of Kyūshū, and Lake Saroma; 3) 9-17.5 m; 19) 130-539 m; 21) 130-311 m; 23) 40-80 m, living 48-77 m; 24) 18-100 m with living specimens; 25) 50 m with living specimens; 37) 13-53 m; 38); 39); 44) 75-150 m; 46) 84-481 m; 48) 40-235 m, living 40-149 m; 50); 51) 23-155 m with living specimens; 52) 31-80 m with living specimens; 53); 54) 23 m; 55) 33-40 m; 56) 15-25 m, living 15 m; 61) 21-74 m; 62) 96 m; 64) 46-60 m; 65) 17.3-19.9 m; 66) 21 m; 70) 123-390 m; 71) 25-27 m; 73); 74) 93-406 m; 75) 90-300 m; 76) 13-62 m; 77) 35-122 m, living 35 m.

Florilus manpukuziense (OTUKA)

Pl. 20, figs. 2a-b

Nonion manpukuziense OTUKA, 1932, Geol. Soc. Tokyo, Jour., v. 39, no. 469, p. 655; p. 654, tf. 5; ISHIWADA, 1964, p. 1 , pl. 3, fig. 34.

Nonion manpukujiense OTUKA. MATSUNAGA, 1963, pl. 37, figs. 6a-b; ŌKI, 1975, p. 55, pl. 5, fig. 5.

Occurrence and Repository: Bay Head Area (Stn. 15, 22, 42, 44, 53: 94-170 m); West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m); Central Area (Stn. 67, 74, 83, 104: 28-165 m; living 38 m); ESK Reg. no. F-11122 - 11133; hypotype in fig. 2a, ESK Reg. no. F-11134 from Stn. 65; hypotype in fig. 2b, ESK Reg. no. F-11135 from Stn. 65.

Geographic Distribution: Off the northeast coast of North Honshū, the north and southeast coasts of Central Honshū, the south coast of Shikoku, the north coast of West Honshū and the northwest coast of Kyūshū, and the Seto Inland Sea; 19) 205 m; 27) 28-78 m; 28) 25-34 m; 36) living 73-127 m; 37) 6-70 m; 41) 7.8-65 m; 42) 83 m; 44) 101-123 m; 46) 128-152 m; 55) 13-64 m; 60) 50-97.5 m; 69) 56-193 m; 74) 93-132 m; 75) 148 m.

Remarks: This species was originally described from the Pliocene Formation at

Manpukuji, Kawasaki City, Kanagawa Prefecture by OTUKA (1932). In Kagoshima Bay, the present species occurs in near shore waters in the Bay Head and the Central Areas. At Station 65 located at the West-Sakurajima Passage where the tidal current is very strong, the frequency of the present species is high (5%).

Florilus? pauperatus (BALKWILL and WRIGHT)

Pl. 20, figs. 3a-d

Nonionina pauperata BALKWILL and WRIGHT, 1885, Roy. Irish Acad., Trans., v. 28, p. 353, pl. 13, figs. 25-26.
Anomalina? pauperata (BALKWILL and WRIGHT). KUWANO, 1962, pl. 14, figs. 6a-b.
Florilus pauperatus (BALKWILL and WRIGHT). BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 33, pl. 16, figs. 15-18.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m; living 66 m); Central Area (Stn. 75, 80, 87, 88, 92, 99, 100, 101: 42-225 m; living 225 m); Bay Mouth Area (Stn. 107, 110, 113, 125, 127, 132, 134, 136, 139, 141, 143: 60-140 m; living 60-96 m); open sea area (Stn. 145, 146: 155-213 m; living); ESK Reg. no. F-11136 - 11159; hypotype in fig. 3a, ESK Reg. no. F-11160 from Stn. 145; hypotype in fig. 3b, ESK Reg. no. F-11161 from Stn. 143; hypotype in fig. 3c, ESK Reg. no. F-11162 from Stn. 64; hypotype in fig. 3d, ESK Reg. no. F-11163 from Stn. 141.

Geographic Distribution: Off the northwest coast of North Honshū and the Bōsō Peninsula, and Matsushima Bay; 24) 14-75 m; 29) 2.5 m; 36) living 73-378 m.

Remarks: At the shallow water area in the open sea and the West-Sakurajima Passage areas, rather high frequencies (2-5%) were found.

Genus *Pseudononion* ASANO, 1936

Pseudononion grateloupi (D'ORBIGNY)

Pl. 20, figs. 4a-b

Nonionina grateloupi D'ORBIGNY, 1926, Ann. Sci. Nat., Paris, ser. 1, v. 7, p. 294, pl. 6, figs. 6-7.
Nonion grateloupi (D'ORBIGNY). CUSHMAN, 1930, p. 10, pl. 3, figs. 9-11, pl. 4, figs. 1-4; COLE, 1931, p. 32, pl. 7, figs. 7-8; CUSHMAN, 1933, p. 43, pl. 10, figs. 8a-c; ASANO, 1938d, p. 594, pl. 15(4), fig. 14; ASANO, 1950, p. 2, text-figs. 3-4; ASANO, 1960, p. 190, pl. 21, figs. 7a-b; MATSUNAGA, 1963, pl. 37, figs. 5a-b; ISHIWADA, 1964, p. 8, pl. 3, fig. 32; ŌKI, 1975, p. 54-55, pl. 5, fig. 4.
Nonion grateloupi (D'ORBIGNY) forma A. KUWANO, 1962, pl. 19, figs. 10a-c.
Nonion grateloupi (D'ORBIGNY) forma B. KUWANO, 1962, pl. 20, figs. 1a-c.

Occurrence and Repository: Bay Head Area (Stn. 22, 32, 34, 54, 63, 65: 39-156 m); Central Area (Stn. 66, 67, 69, 70, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 86, 87, 88, 89, 92, 93, 94, 96, 97, 100, 102, 103, 104, 105: 23-225 m; living 28-220 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 122, 132, 134, 139, 143: 40-120 m; living 96-105 m); open sea area (Stn. 144, 146: 105-213 m); ESK Reg. no. F-11164 - 11212; hypotype in fig. 4a, ESK Reg. no. F-11213 from Stn. 144; hypotype in fig. 4b, ESK Reg. no. F-11214 from Stn. 78.

Geographic Distribution: Off the coast of Hokkaido, the coast of North Honshū, the north coast of Central Honshū and the northwest coast of Kyūshū, Kii and Tsushima Straits and Kamaé Bay; 1) 40+ m; 9) 276 m; 10) 165-655 m; 11) 660 m with living specimens; 13) 240-430 m, living 430 m; 15) 695 m; 17) 100 m; 19) 102 m; 21) 113 m; 23) 570-875 m, living 650-875 m; 24) 10-78 m, living 49-50 m; 26) 135-283 m; 30); 33) 83-504 m; 34) 64 m; 44) 150-421 m; 45); 46) 130-481 m; 52) 408 m; 56) 9-38 m, living 9-15 m; 59)

7-8.6 m; 61) 54-74 m; 62) 96 m; 64) 32-46 m; 74) 115-406 m; 76) 17.5-79 m.

Remarks: In the coastal water of the Central Area, rather high frequencies of the present species were found.

Pseudononion japonicum ASANO

Pl. 20, fig. 5

Pseudononion japonicum ASANO, 1936, Jour. Geol. Soc. Japan, v. 43(512), p. 347-348, text-figs. a-c; ASANO, 1938b, pl. 7, figs. 1a-c; ASANO, 1938d, p. 597, pl. 15(4), figs. 11a-c; TAKAYANAGI, 1955, pl. 1, figs. 22a-b; ASANO, 1960, p. 193, pl. 21, figs. 2a-c; ISHIWADA, HIGUCHI and KIKUCHI, 1962, fig. 3; KUWANO, 1962, pl. 21, figs. 2a-b; MATSUNAGA, 1963, pl. 38, figs. 7a-c; ISHIWADA, 1964, p. 16, pl. 3, figs. 39a-b; MATOBA, 1967, p. 257, pl. 29, figs. 9a-c; MATOBA, 1970, p. 58, pl. 8, figs. 9a-c; ŌKI, 1975, p. 55-56, pl. 5, figs. 6a-b.

Occurrence and Repository: Bay Head Area (Stn. 34, 63, 64, 65: 39-149 m); Central Area (Stn. 70, 71, 72, 73, 74, 76, 78, 80, 82, 83, 85, 86, 87, 88, 90, 93, 94, 98, 99, 100, 101, 103, 104, 105: 23-225 m; living 38-225 m); Bay Mouth Area (Stn. 106, 107, 108, 116, 118, 122, 124, 132, 134, 137, 139: 20-120 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-11215 - 11254; hypotype in fig. 5, ESK Reg. no. F-11255 from Stn. 65.

Geographic Distribution: The seas adjacent to Japan; 1) 43-150 m; 3) 9 m; 5); 8); 11) 56 m with living specimens; 12) 19-31 m; 13) 135 m with living specimens; 14) 598 m; 19) 165-325 m; 21) 112-188 m; 24) 30 m; 26) 44-135 m; 27) 9-78 m; 28) 19-39 m; 29) 0.7-5.7 m; 30); 32); 34) 64-155 m; 35); 36) living 59-80 m; 38); 39); 41) 5-47 m; 45); 46) 126-516 m; 47) 764-835 m; 49) 2.2 m; 53); 55) 20-42 m; 60) 50-97.5 m; 61) 34-60 m; 64) 60 m; 67) 201 m; 71) 27 m; 73) 8-20.5 m; 74) 194-219 m; 76) 7-24 m; 78) living 23 m.

Genus *Nonionella* CUSHMAN, 1926

Nonionella stella CUSHMAN and MOYER

Nonionella miocenica CUSHMAN, var. *stella* CUSHMAN and MOYER, 1930, Contr. Cushman Lab. Foram. Res., v. 6, p. 56, pl. 7, figs. 17a-c; BANDY, 1953, p. 29, pl. 22, figs. 2a-c.

Nonionella miocenica stella CUSHMAN and MOYER. ASANO, 1950, pt. 1, p. 5, text-figs. 25-26; MATSUNAGA, 1963, p. 88, pl. 38, figs. 2a-c.

Nonionella stella CUSHMAN and MOYER. ISHIWADA, HIGUCHI and KIKUCHI, 1962, p. 71, pl. 1, figs. 2a-b; PHLEGER, 1964, p. 383, pl. 1, figs. 33-34; ISHIWADA, 1964, p. 37, pl. 3, figs. 41a-b; MATOBA, 1967, p. 256, pl. 29, figs. 10a-b; MATOBA, 1970, p. 57, pl. 8, figs. 8a-c; ŌKI, 1975, p. 56-57, pl. 5, fig. 7.

Occurrence and Repository: Bay Head Area (Stn. 34: 149 m); Central Area (Stn. 72, 102: 162-216 m); ESK Reg. no. F-11256-11258.

Geographic Distribution: Off the southwest and south coasts of Hokkaido, the northwest and east coasts of North Honshū, the northwest and southeast coasts of Central Honshū, the Seto Inland Sea, Kii Strait and Kamaé Bay; 5); 9) 36-120 m; 11) 56-320 m, living 56-100 m; 12) 28-70 m; 13) 84-135 m with living specimens; 23) 40-760 m, living 48-173 m; 24) 20-98 m, living 30-94 m; 25) 38-230 m with living specimens; 26) 44-146 m; 29) 0.8-12.5 m, living 2.4 m; 30); 33) 83-154 m; 34) 64-1180 m; 37) 6-70 m; 38); 41) 16.8-65 m; 50); 54) 23 m with living specimens; 59) 7-8.6 m; 62) 96 m; 64) 39 m; 76) 10-15 m.

Nonionella turgida (WILLIAMSON)

Pl. 20, figs. 6a-c

Rotalina turgida WILLIAMSON, 1858, Ray Soc., Paris, p. 50-51, pl. 4, figs. 95-97.

Nonionella turgida (WILLIAMSON). MURRAY, 1970, p. 484, pl. 2, figs. 3-4, 8; MURRAY, 1971, p. 193, pl. 81, figs. 1-5.

Nonionella subextensa KUWANO, 1962, pl. 20, figs. 2, 3a-c.

Occurrence and Repository: Central Area (Stn. 71, 73, 75, 79, 80, 86, 87, 88, 89, 91, 92, 93, 95, 96, 97, 98, 101: 78-225 m; living 78-170 m); Bay Mouth Area (Stn. 118: 101 m); ESK Reg. no. F-11259 - 11276; hypotype in fig. 6a, ESK Reg. no. F-11277 from Stn. 88; hypotype in fig. 6b, ESK Reg. no. F-11278 from Stn. 92; hypotype in fig. 6c, ESK Reg. no. F-11267 from Stn. 89..

Geographic Distribution: Off the Pacific coasts of Central Honshū and Shikoku; 48) 597 m; 51) 232-665 m with living specimens; 70) 808 m.

Genus *Pullenia* PARKER and JONES, 1862

Pullenia quinqueloba (REUSS)

Pl. 20, figs. 7a-c

Nonionina quinqueloba REUSS, 1851, Geol. Ges., Zeit-schr., Berlin, Bd. 3, p. 71, pl. 5, figs. 31a-b.
Pullenia salisburyi STEWART and STEWART var. KUWANO, 1962, pl. 21, figs. 3a-b.
Pullenia quinqueloba (REUSS). PHLEGER, 1964, p. 383, pl. 3, fig. 23.

Occurrence and Repository: Bay Head Area (Stn. 45: 134 m); Central Area (Stn. 67, 73, 75, 79, 80, 81, 84, 86, 88, 90, 97, 100, 102: 75-225 m; living 75-215 m); Bay Mouth Area (Stn. 108, 110, 113, 118, 122, 132, 134, 139, 143: 96-120 m); open sea area (Stn. 145: 155 m); ESK Reg. no. F-11279 - 11302; hypotype in fig. 7a, c, ESK Reg. no. F-11303 from Stn. 143; hypotype in fig. 7b, ESK Reg. no. F-11304 from Stn. 139.

Geographic Distribution: Tōkyō, Sagami, Toyama and Kamaé Bays; 37) 10-70 m; 42) 248 m; 45); 76) 35 m.

Pullenia subcarinata (D'ORBIGNY)

Nonionina subcarinata D'ORBIGNY, 1839, Voy. Amer. Merid., v. 5, pt. 5, p. 28, pl. 5, figs. 23-24

Occurrence and Repository: open sea area (Stn. 144: 105 m); ESK Reg. no. F-11305.

Geographic Distribution: Off the southwest coast of Central Honshū and Shikoku; 51) 665 m; 70) 123-808 m.

Family ALABAMINIDAE HOFKER, 1951

Genus *Oridorsalis* ANDERSEN, 1961

Oridorsalis tener (BRADY)

Pl. 20, figs. 8a-d

Truncatulina tenera BRADY, 1884, Rept. Challenger Exped., Zool., pt. 22, v. 9, p. 665, pl. 95, fig. 11.
Eponides tener (BRADY). BANDY, 1953, p. 29, pl. 23, figs. 3a-c.
Oridorsalis tener (BRADY). CORLISS, 1979, p. 4, pl. 4, figs. 10-15; INGLE, KELLER and KOLPACK, 1980, p. 142, pl. 5, figs. 5-6.

Occurrence and Repository: Central Area (Stn. 67, 72, 76, 77, 79, 80, 81, 84, 85, 86, 88, 91, 93, 95, 96, 97, 98, 100, 102, 103: 75-225 m); Bay Mouth Area (Stn. 107, 110, 113, 118, 122, 134: 96-112 m); ESK Reg. no. F-11306 - 11331; hypotype in fig. 8a, ESK Reg. no. F-11332 from Stn. 86; hypotype in fig. 8b, d, ESK Reg. no. F-11328 from Stn. 113; hypotype in fig. 8c, ESK Reg. no. F-11333 from Stn. 97.

Family OSANGULARIIDAE LOEBLICH and TAPPAN, 1964

Genus *Gyroidinoides* BROTZEN, 1942

Gyroidinoides acuta BOOMGAART

Pl. 21, figs. 1a-c

Gyroidina neosoldanii BROTZEN, var. *acuta* BOOMGAART, 1949, Min. Geol. Inst. Rijks Univ., Utrecht, p. 125, pl. 14, figs. 1a-c; BELFORD, 1966, p. 165, 167, pl. 28, figs. 1-9, text-fig. 21, nos. 6-7.

Occurrence and Repository: Central Area (Stn. 78, 79, 83, 89, 92, 101: 36-185 m); Bay Mouth Area (Stn. 110, 113, 118, 122, 125, 132, 136, 137, 139, 143: 60-140 m); open sea area (Stn. 144, 145, 146: 105-213 m); ESK Reg. no. F-11334 - 11352; hypotype in fig. 1a, ESK Reg. no. F-11353 from Stn. 146; hypotype in fig. 1b, ESK Reg. no. F-11354 from Stn. 144; hypotype in fig. 1c, ESK Reg. no. F-11355 from Stn. 144.

Remarks: Rather high frequencies of the present species were found in the open sea area and the southern part of the Bay Mouth Area.

Gyroidinoides kuwanoi ŌKI, n. sp.

Pl. 21, figs. 2a-c

Test small, unequally biconvex, dorsal side slightly convex, ventral side strongly convex, umbilicate, periphery broadly rounded; chambers 7 or 8 in the lastformed whorl, distinct; wall smooth throughout, thin, translucent; sutures distinct, not depressed on the dorsal side, slightly depressed on the ventral side; aperture, a narrow opening on the ventral edge of the chamber between the umbilicus and periphery.

Types and Dimensions: Holotype in fig. 2a, ESK Reg. no. F-11356 from Stn. 80, maximum diameter 0.12 mm, thickness 0.06 mm ; paratype in fig. 2b, ESK Reg. no. F-11357 from Stn. 81, maximum diameter 0.11, thickness 0.05 mm; paratype in fig. 2c, ESK Reg. no. F-11358 from Stn. 103, maximum diameter 0.13 mm, thickness 0.06 mm.

Occurrence and Repository: Central Area (Stn. 66, 67, 71, 73, 75, 76, 79, 80, 81, 84, 85, 86, 87, 88, 90, 92, 93, 94, 96, 97, 98, 99, 101, 102, 103, 105: 42-225 m; living 80-185 m); Bay Mouth and open sea areas (Stn. 107, 108, 110, 113, 118, 132, 134, 136, 137, 139, 141, 143, 144: 60-120 m; living 105-120 m); ESK Reg. no. F-11359 - 11397.

Remarks: The specimens in the collection are identical to *Gyroidina kagoshimaensis* KUWANO (MS) reported by KUWANO (1962) from Kagoshima Bay. But no description of this species was given by KUWANO. The generic position of this new species is to be *Gyroidinoides*.

Gyroidinoides nipponicus (ISHIZAKI)

Pl. 21, figs. 3a-e

Gyroidina nipponica ISHIZAKI, 1944, Nat. Hist. Soc. Taiwan, Trans., v. 34, no. 244, p. 102, pl. 3, figs. 3a-c; MATSUNAGA, 1963, pl. 44, figs. 3a-c; ISHIWADA, 1964, p. 29, pl. 5, figs. 87a-b; MATOBA, 1967, p. 255, pl. 29, figs. 13a-c.

Occurrence and Repository: Central Area (Stn. 67, 70, 71, 73, 75, 76, 77, 79, 80, 84, 85, 86, 87, 89, 90, 91, 92, 93, 95, 96, 97, 98, 101, 103, 105: 23-225 m; living 170-225 m); Bay Mouth Area (Stn. 107, 108, 110, 113, 118, 122, 125, 132, 134, 137, 139, 143: 96-140 m; living 100-120 m); open sea area (Stn. 144, 146: 105-213 m; living 105 m); ESK Reg. no. F-11398 - 11436; hypotype in fig. 3a, ESK Reg. no. F-11437 from Stn. 103; hypotype in fig. 3b, ESK Reg. no. F-11438 from Stn. 108; hypotype in fig. 3c, ESK Reg. no. F-11438 from Stn. 113; hypotype in fig. 3d, ESK Reg. no. F-11440 from Stn. 118; hypotype in fig. 3e, ESK Reg. no. F-11441 from Stn. 144.

Geographic Distribution: Off the northwest coast of North Honshū and the Pacific coast from Central Honshū to Kyūshū; 23) 570 m; 36) living 129-333 m; 47) 352-1319 m; 48) 74-597 m with living specimens; 51) 43-665 m, living 43-422 m; 52) 31-585 m with living specimens; 70) 123-808 m with living specimens; 76) 10-79 m; 77) 122-745 m with living specimens.

Family ANOMALINIDAE CUSHMAN, 1927

Subfamily ANOMALININAE CUSHMAN, 1927

Genus *Anomalina* D'ORBIGNY, 1826

Anomalina glabrata CUSHMAN

Pl. 21, figs. 4a-c

Anomalina glabrata CUSHMAN, 1924, Carnegie Inst. Washington, Publ., no. 342, p. 39, pl. 12, figs. 5-7; KUWANO, 1962, p. 138, pl. 14, fig. 4.
Anomalinoide cf. *nobilis* BROTZEN. MATSUNAGA, 1963, pl. 50, figs. 2a-c.

Occurrence and Repository: Central Area (Stn. 71, 74, 76, 110: 28-220 m); Bay Mouth Area (Stn. 113, 118, 122, 127, 132, 134, 139, 143: 74-112 m); ESK Reg. no. F-11442 - 11453; hypotype in fig. 4a, ESK Reg. no. F-11454 from Stn. 139; hypotype in fig. 4b-c, ESK Reg. no. F-11450 from Stn. 132.

Geographic Distribution: Off the southwest coast of Hokkaido, the east coast of North Honshū and the Pacific coast of Central Honshū, Kii Strait and Ōmura, Kamaé and Kagoshima Bays; 6) 190-220 m; 28) 37 m; 31); 32); 45); 51) 232 m; 52) 80 m; 58); 60) 97.5 m; 61) 34 m; 73); 76) 19 m; 78) living 83-150 m.

Genus *Cibicidoides* THALMANN, 1939

Cibicidoides pseudoungerianus (CUSHMAN)

Pl. 21, figs. 5a-f

Truncatulina pseudoungeriana CUSHMAN, 1922, U.S. Geol. Surv. Prof. Paper, 129-E, p. 97, pl. 20, fig. 9.
Cibicides pseudoungerianus (CUSHMAN). ISHIWADA, 1964, p. 8, pl. 8, figs. 115a-b.

Occurrence and Repository: West-Sakurajima Passage (Stn. 63, 64, 65: 39-138 m; living 66 m); Central Area (Stn. 66, 70, 71, 73, 74, 78, 84, 86, 92, 93, 99, 102, 104: 23-185 m); Bay Mouth Area (Stn. 106, 107, 108, 110, 113, 116, 118, 122, 124, 125, 127, 132, 134, 136, 137, 139, 141, 143: 20-140 m; living 106-140 m); open sea area (Stn. 144, 145, 146: 105-213 m; living 105-155 m); ESK Reg. no. F-11455 - 11491; hypotype in fig. 5a, ESK Reg. no. F-11492 from Stn. 144; hypotype in fig. 5b, ESK Reg. no. F-11493 from Stn. 137; hypotype in fig. 5c, ESK Reg. no. F-11494 from Stn. 146; hypotype in fig. 5d, ESK Reg. no. F-11495 from Stn. 137; hypotype in fig. 5e, ESK Reg. no. F-11496 from Stn. 145; hypotype in fig. 5f, ESK Reg. no. F-11497 from Stn. 137.

Geographic Distribution: The seas adjacent to Japan; 1) 41-78 m; 6) 120-1300 m; 9) 276 m; 10) 600-655 m; 13) 135-430 m, living 430 m; 14) 70-505 m, living 115 m; 15) 49-510 m; 17) 496 m; 23) 48-95 m, living 80 m; 24) 10-48 m; 29) 3.5-12.5 m; 32); 37) 10-70 m; 40); 42) 142-468 m; 43) 60-570 m; 45); 47) 54-2226 m; 48) 74-235 m; 51) 43-422 m, living 72-155 m; 52) 80-408 m, living 80 m; 54) 23 m; 56) 9-38 m; 62) 96 m with living specimens; 63) 5-15 m; 64) 32-60 m, living 46 m; 65) 4.1-33 m; 67) 91-349 m; 69) 135-410 m; 70) 70-475 m, living 202 m; 70) 91-349 m; 71) 25 m; 73); 76) 20-35 m; 77) 35-122 m.

Cibicidoides? subhaidingerii (PARR)

Pl. 22, figs. 1a-c

Cibicides subhaidingerii PARR, 1950, B.A.N.Z. Antarctic Research Exped. 1929-1931, Repts., Adelaide, ser. B, v. 5, pt. 6, p. 364, pl. 15, fig. 7a-c.
Cibicides haidingerii (D'ORBIGNY). KUWANO, 1962, pl. 16, figs. 8a-c, 9a-b.
Cibicides? subhaidingeri (BRADY). UJIIÉ and KUSUKAWA, 1969, p. 768, pl. 4, figs. 4a-c, 5a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m); Central Area (Stn. 71, 79, 84, 86, 89, 98, 103: 88-175 m; living 88 m); Bay Mouth Area (Stn. 113, 118, 122, 125, 136, 137, 139, 143: 60-140 m; living 100 m); open sea area (Stn. 144, 146: 105-213 m; living 105 m); ESK Reg. no. F-11498 - 11516; hypotype in fig. 1a, ESK Reg. no. F-11517 from Stn. 144; hypotype in fig. 1b, ESK Reg. no. F-11518 from Stn. 144; hypotype in fig. 1c, ESK Reg. no. F-11519 from Stn. 137.

Geographic Distribution: Off the southwest coast of Hokkaido and the north coast of Kyūshū, and Kamaé Bay; 6) 120-1250 m; 72); 76) 20-57 m.

Cibicidoides sp.

Pl. 22, figs. 2a-b

Occurrence and Repository: Bay Mouth Area (Stn. 136, 137, 139: 60-106 m); open sea area (Stn. 146: 213 m); ESK Reg. no. F-11520 - 11523; hypotype in fig. 2a, ESK Reg. no. F-11523 from Stn. 146; hypotype in fig. 2b, ESK Reg. no. F-11521 from Stn. 137.

Remarks: This species is characterized by coarse perforations on the spiral side.

Genus *Hanzawaia* ASANO, 1944

Hanzawaia nipponica ASANO

Pl. 22, figs. 3a-d

Hanzawaia nipponica ASANO, 1944, Geol. Soc. Japan, Jour., v. 51, no. 606, p. 98-99, pl. 4, figs. 1a-b, 2a-b; TAKAYANAGI, 1955, p. 45, 49, pl. 2, figs. 21a-b; KUWANO, 1962, pl. 19, figs. 2a-c; MATSUNAGA, 1963, pl. 52, figs. 5a-c; MATOBA, 1967, p. 255, pl. 29, figs. 14a-c; MATOBA, 1970, p. 55, pl. 8, figs. 10a-c.

Occurrence and Repository: West-Sakurajima Passage (Stn. 64, 65: 39-66 m; living); Central Area (Stn. 99, 100, 103, 104: 38-175 m); Bay Mouth Area (Stn. 107, 116, 125, 136, 141: 60-140 m); ESK Reg. no. F-11524 - 11534; hypotype in fig. 3a, ESK Reg. no. F-11535 from Stn. 141; hypotype in fig. 3b, ESK Reg. no. F-11536 from Stn. 136; hypotype in fig. 3c-d, ESK Reg. no. F-11531 from Stn. 116.

Geographic Distribution: Off the southwest coast of Hokkaido, the coast of North Honshū and the Pacific coast from Central Honshū to Kyūshū, and the Seto Inland Sea; 5); 6) 120 m; 14) 70-505 m; 15) 49-100 m with living specimens; 17) 100 m; 23) 40-80 m, living 40 m; 24) 5-78 m, living 14-30 m; 25) 38 m; 27) 34-78 m; 28) 25-33 m; 29) 0.9-4.4 m; 30); 31); 32); 34) 64-155 m; 36) living 59-160 m; 38); 41) 28-47 m; 45); 48) 40-149 m with living specimens; 49); 51) 23-232 m with living specimens; 52) 31-201 m, living 31-80 m; 55) 20-63 m; 56) 7-38 m; 58); 60) 50-97.5 m; 61) 32-74 m; 62) 96 m with living specimens; 64) 60 m; 65) 17.3 m; 69) 56-78 m; 70) 70-202 m, living 70 m; 76) 10-79 m; 77) 35-122 m, living 35 m.

Genus *Heterolepa* FRANZENAU, 1884

Heterolepa margaritifera (BRADY)

Pl. 22, figs. 4a-c

Truncatulina margaritifera BRADY, 1881, Quart. Jour., Micr. Sci., v. 21, p. 66; 1884, Challenger Exp., Repts, Zool., p. 667, pl. 96, fig. 1a-c; CUSHMAN, 1915, p. 40, Pl. 17, figs. 1a-c; text-figs. 43a-c; CUSHMAN, 1921, p. 319, pl. 65, figs. 1a-c, pl. 74, figs. 1a-c.

Cibicides margaritiferus (BRADY). BARKER, 1960, p. 198, pl. 96, figs. 2a-c; KUWANO, 1962, p. 129, pl. 17, fig. 1; ISHIWADA, 1964, p. 18, pl. 8, figs. 117a-b.

'*Eponides*' *margaritiferus* (BRADY). BELFORD, 1966, p. 126-127, pl. 18, figs. 11-16.

Occurrence and Repository: Central Area (Stn. 73, 75, 79, 84, 88, 101: 78-119 m); Bay Mouth Area (Stn. 108, 110, 113, 125: 100-140 m); ESK Reg. no. F-11537 - 11546; hypotype in fig. 4a, ESK Reg. no. F-11542 from Stn. 101; hypotype in fig. 4b, ESK Reg. no. F-11547 from Stn. 75; hypotype in fig. 4c, ESK Reg. no. F-11548 from Stn. 75.

Geographic Distribution: Kii Strait; 60) 97.5 m.

Genus *Melonis* DE MONTFORT, 1808

Melonis sp.

Pl. 22, figs. 5a-b

Occurrence and Repository: Bay Head Area (Stn. 32, 34, 53: 94-156 m); Central Area (Stn. 73, 98, 103: 80-175 m); Bay Mouth Area (Stn. 107, 122, 134, 136, 141: 60-112 m); ESK Reg. no. F-11549 - 11559; hypotype in fig. 5a, ESK Reg. no. F-11559 from Stn. 141; hypotype in fig. 5b, ESK Reg. no. F-11560 from Stn. 34.

Remarks: The specimens at hand are rather few and the chambers of the adult stage of all the specimens are imperfect.

Superfamily ROBERTINACEA REUSS, 1850

Family CERATOBULIMINIDAE CUSHMAN, 1927

Subfamily CERATOBULIMININAE CUSHMAN, 1927

Genus *Lamarckina* BERTHELIN, 1881

Lamarckina sp.

Pl. 22, fig. 6

Occurrence and Repository: Central Area (Stn. 91, 92, 93: 142-207 m); open sea area (Stn. 144, 145: 105-155 m; living 105 m); ESK Reg. no. F-11561 - 11565; hypotype in fig. 6, ESK Reg. no. F-11566 from Stn. 145.

Remarks: Only six specimens are in the collection, and the tests are rather small and probably of juvenile stage.

Subfamily EPISTOMININAE Wedekind, 1937

Genus *Hoeglundina* BROTZEN, 1948

Hoeglundina elegans (D'ORBIGNY)

Pl. 22, figs. 7a-c

Rotalia (Turbinulina) elegans D'ORBIGNY, 1826, Ann. Sci. Nat., v. 7, p. 276, no. 54.

Epistomina elegans (D'ORBIGNY). CUSHMAN, 1931, p. 65-67, pl. 13, figs.6a-c.

Hoeglundina elegans (D'ORBIGNY). BANDY, 1953, p. 29, pl. 23, figs. 9a-c; MATSUNAGA, 1963, pl. 47, figs. 2a-c; LOEBLICH and TAPPAN, 1964, p. C775, figs. 3a-c, 4-5; TODD, 1965, p. 56, pl. 23, figs. 2a-c; BELFORD, 1966, p. 190-191, pl. 36, figs. 8-13; MATOBA, 1967, p. 255, pl. 29, figs. 17a-c; BOCK, 1971, p. 185, pl. 2, figs. 4-5; FLINT, 1975, p. 331, pl. 75, fig. 1; BOLTOVSKOY, GIUSSANI, WATANABE and WRIGHT, 1980, p. 35-36, pl. 18, figs. 14-17; INGLE, KELLER and KOLPACK, 1980, pl. 2, fig. 11; POAG, 1981, p. 69, pl. 19, fig. 3; pl. 20, figs. 3a-c.

Occurrence and Repository: Central Area (Stn. 66, 67, 69, 71, 72, 73, 75, 76, 79, 80, 81, 82, 85, 86, 87, 89, 90, 91, 92, 93, 95, 96, 97, 98, 101, 102, 105: 80-225 m; living 145 m); Bay Mouth Area (Stn. 113, 125, 132, 134, 139: 100-140 m); open sea area (Stn. 144, 146: 105-213 m; living 105 m); ESK Reg. no. F-11567 - 11600; hypotype in fig. 7a, ESK Reg. no. F-11601 from Stn. 93; hypotype in fig. 7b, ESK Reg. no. F-11602 from Stn. 90; hypotype in fig. 7c, ESK Reg. no. F-11603 from Stn. 76.

Geographic Distribution: Off the southwest coast of Hokkaido, the northwest and northeast coasts of North Honshū and the Pacific coast from Central Honshū to Kyūshū, and coastal areas at Okino-erabu and Yoron Islands; 6) 190-200 m; 23) 95 m with living specimens; 24) 19-94 m, living 94 m; 27) 45 m; 45); 48) 74 m; 51) 72-422 m, living 72-232 m; 52) 31-585 m with living specimens; 60) 97.5 m; 70) 202-808 m; 76) 55-79 m; 77) 745 m; 81); 82).

Remarks: This species occurs at the stations deeper than 80 meters in the open sea, the Bay Mouth and the Central Areas. At the basin bottom in the Central Area, frequencies are rather high (1-3%).

Family ROBERTINIDAE Reuss, 1850

Genus *Geminospira* Makiyama and Nakagawa, 1941

Geminospira simaensis Makiyama and Nakagawa

Geminospira simaensis Makiyama and Nakagawa, 1941, Geol. Soc. Japan, Jour., v. 48, no. 572, p. 241, 243, figs. 3-5.

Occurrence and Repository: Central Area (Stn. 81: 220 m); Bay Mouth Area (Stn. 106, 139, 141: 40-105 m; living 40 m); ESK Reg. no. F-11604 - 11607.

Geographic Distribution: Off the northwest and east coasts of North Honshū; 24) 50-75 m, living 50 m; 27) 34-78 m; 28) 25 m; 32).

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Appendixes I - II

Appendix I

The areas and the authors of the studies on Recent foraminifera in Japan

1) Okhotsku Sea: KUWANO (1953-1954)
2) Northern part of the Sea of Japan: KUWANO (1953)
3) Lake Saroma, Hokkaido: YOSHIDA (1954)
4) Mokoto-numa, Hokkaido: YOSHIDA (1953a)
5) Ishikari Bay, Hokkaido: IKEYA (1970)
6) Around Okushiri Island, Hokkaido: CHIJI and KONDA (1970)
7) Akkeshi Bay, Hokkaido: YOSHIDA (1953b)
8) Akkeshi Bay, Hokkaido: MORISHIMA and CHIJI (1952)
9) Off Kushiro, Hokkaido: ISHIWADA (1964)
10) Off Erimo-misaki, Hokkaido: ISHIWADA (1964)
11) Off Erimo-misaki, Hokkaido: IKEYA (1971)
12) Off Noboribetsu, Hokkaido: UCHIO (1959)
13) Off Muroran, Hokkaido: IKEYA (1971)
14) Off Shiriya-zaki, Aomori Pref.: IKEYA (1971)
15) Off Misawa, Aomori Pref.: IKEYA (1971)
16) Off Hachinohe, Aomori Pref. (Stn.36): ISHIWADA (1964)
17) Off Hachinohe, Aomori Pref.: IKEYA (1971)
18) Mutsu Bay, Aomori Pref.: HADA (1931)
19) Off the northeast coast of Honshū: ASANO (1956a, b, 1958, 1960)
20) Tsugaru Strait: ASANO (1956a, b, 1958, 1960)
21) Off the northwest coast of Honshū: ASANO (1956a, b, 1958, 1960)
22) Yamato Bank, the Sea of Japan: ASANO (1956a, b, 1958, 1960)
23) Off Noshiro, Akita Pref.: MATOBA (1976a)
24) Around the Oga Peninsula, Akita Pref.: MATOBA (1975, 1976c)
25) Off Akita, Akita Pref.: MATOBA and NAKAGAWA (1972)
26) Off Sanriku: ISHIWADA (1964)
27) Miyako Bay, Iwate Pref.: UJIIÉ and KUSUKAWA (1969)
28) Yamada Bay, Iwate Pref.: UJIIÉ and KUSUKAWA (1969)
29) Matsushima Bay, Miyagi Pref.: MATOBA (1970)
30) Sendai Bay: MATOBA (1976b)
31) Matsukawa-ura, Fukushima Pref.: TAKAYANAGI (1955)
32) Off Sōma City, Fukushima Pref.: TAKAYANAGI (1955)
33) Off Sioya-saki, Fukushima Pref.: ISHIWADA (1964)
34) Off Inubō-saki, Chiba Pref.: ISHIWADA (1964)
35) Coastal area at Kujūkuri-hama, Chiba Pref.: HARRINGTON (1960)

36) Off Bōsō Peninsula, Chiba Pref.: KUWANO (1963)
37) Tōkyō Bay: MORISHIMA (1955)
38) Coastal area at Zushi, Miura Peninsula, Kanagawa Pref.: HIGUCHI (1954)
39) Coastal area at Koamishiro, Miura Peninsula, Kanagawa Pref.: HIGUCHI (1954)
40) Coastal area at Hachijo Island, Tōkyō: UCHIO (1952)
41) Off Niigata, Niigata Pref.: UCHIO (1962b)
42) Toyama Bay: ISHIWADA (1950)
43) Toyama Bay: HASEGAWA (1979)
44) Around Oki Island and the north coast of West Honshū: ASANO (1956a, b, 1958, 1960)
45) Nabeta cove, Izu Peninsula, Shizuoka Pref.: AOKI (1967)
46) Off the southwest coast of Japan, from Shizuoka Pref. to Kagoshima Pref.: ASANO (1956a, b, 1958, 1960)
47) Suruga Bay, Shizuoka Pref.: NAGAHAMA (1954)
48) Off Ogasa, Shizuoka Pref.: AOSHIMA (1978)
49) Lake Hamanako, Shizuoka Pref.: ISHIWADA (1958)
50) Lake Hamanako, Shizuoka Pref.: IKEYA (1977)
51) Off Atsumi, Aichi Pref.: AOSHIMA (1978)
52) Off Owase, Mie Pref.: AOSHIMA (1978)
53) Ōsaka Bay: NAKASEKO (1953)
54) Ōsaka Bay: KATO (1982)
55) Izumi-nada, Seto Inland Sea: TAKAYANAGI (1953)
56) Tanabe Bay, Wakayama Pref.: CHIJI and LOPEZ (1968)
57) Tanabe Bay, Wakayama Pref.: UCHIO (1968)
58) Coastal areas at Wakaura, Nishihiro, Seto and Kushimoto, Wakayama Pref.: UCHIO (1962a)
59) Mori Harbor, Wakayama Pref.: UCHIO (1962a)
60) Off Shirahama, Wakayama Pref.: UCHIO (1968)
61) Kii Strait: SAWAI (1958)
62) Kii Strait: KATO (1982)
63) Seto Inland Sea (Seto-naikai): KATO (1979)
64) Seto Inland Sea (Seto-naikai): KATO (1982)
65) Western area off Shodo Island, Seto Inland Sea (Seto-naikai): TAI (1971)
66) Hiuchi-nada, Seto Inland Sea (Seto-naikai): SAWAI (1955)
67) Coastal area at Kouno-ura, Kochi Pref.: ASANO (1937)
68) Tosa Bay, Kochi Pref.: ASANO (1937)
69) Tosa Bay, Kochi Pref.: ISHIWADA (1964)
70) Tosa Bay, Kochi Pref.: AOSHIMA (1978)
71) Hibiki-nada, Yamaguchi Pref.: KATO (1979)
72) Off Tsuyazaki, Fukuoka Pref.: SHUTO (1965)
73) Ōmura Bay, Nagasaki Pref.: SHUTO (1953)

74) Tsushima Strait: ASANO (1956a, b, 1958, 1960)
75) Off the west coast of Kyūshū: ASANO (1956a, b, 1958, 1960)
76) Surrounding sea area of Kamaé Bay, Ōita Pref.: KAMEYAMA (1984)
77) Off Miyazaki, Miyazaki Pref.: AOSHIMA (1978)
78) Kagoshima Bay, Kagoshima Pref.: KUWANO (1962)
79) Coastal area in Takara Island, Kagoshima Pref.: KUWANO (1956)
80) Coastal area in Nakano Island, Kagoshima Pref.: KUWANO (1956)
81) Coastal area in Okino-Erabu Island, Kagoshima Pref.: ETO (1970)
82) Coastal area in Yoron Island, Kagoshima Pref.: ETO (1970)

Appendix II

Distribution of the remarkable species (Figs. 35-68)

The term, "remarkable species", was defined to mean the species of benthonic foraminifera representing groups recognized by cluster analysis of foraminifera, and species whose distribution patterns seemed to be closely related to the environmental factors (Table 12).

Lagenammina kagoshimaensis ŌKI, n. sp. (Fig. 35; Pl. 1, fig. 2): The frequencies are relatively high on the basin bottom in the Central and the Bay Head Areas. The five stations off Kokubu City and around the An-éi Rise in the Bay Head Area (Stn. 12, 18, 35, 37 and 51) had the highest frequencies of this species ranging from 11 to 18%.

Similarly, the living specimens in the living assemblage also had high frequencies on the basin bottom. The three stations (Stn. 65, 89 and 99) located in the rather shallow coastal areas of the southern part of the Central Area and West-Sakurajima Passage had exceptionally high ratios of the number of living specimens to the total number of individuals of this species (33.3 to 100%). It is still unknown, however, whether this type of high frequency is an ecological feature of this species restricted to the winter season or the result of destruction of delicate tests of dead specimens during transportation.

Ammodiscus minimus HÖGLUND (Fig. 36; Pl. 1, fig. 5): This species was found in 12 stations in Kagoshima Bay, but the frequencies are rather low. The samples from the three stations (40, 41 and 42: 170-228 m in depth) located at the 200 m deep bottom in the northeastern part of the Bay Head Area had the highest frequencies of this species ranging from 2 to 8%. As already mentioned, the environment of the 200 meter deep bottom is strongly influenced by the acidic water mass caused by the submarine fumarolic activity in this area (*see* p.15).

Glomospira gordialis (JONES and PARKER)(Fig. 37; Pl. 1, fig. 6): At the three stations (40, 41 and 42) in the above-mentioned 200 meter deep bottom where *Ammodiscus*

minimus occupies 2-8% of the total assemblage, the frequencies of this species ranged from 4 to 7%. At the three stations (32, 44 and 45) located at the boundary between the Bay Head Area and the West-Sakurajima Passage, those range from 1 to 2% lacking *A. minimus*.

Cribrostomoides kosterensis (HÖGLUND)(Fig. 38; Pl. 2, fig. 1): At the deep basin bottom (130-185 m deep) in the northernmost part of the Central Area and the Bay Head Area, the frequencies of this species are rather high (1-8%). Especially high frequencies (6 to 8%) were found at the three stations (21, 41 and 42) in the northeastern part of the Bay Head Area and Station 69 in the northeasternmost corner of the Central Area. At Station 69, living specimens occupy 64% of the total number of individuals of this species.

Textularia bigenerinoides LACROIX (Fig. 39; Pl. 2, fig. 9): This species occurred at the 35 stations deeper than 80 m in the Central and the Bay Head Areas, but it was not found in the stations in the Bay Mouth and the open sea areas. High frequencies were seen in the northernmost part of the Central Area (Stn. 66, 67, 68 and 69) and the northern (Stn. 1, 3, 12, 18, 21, 41 and 42) and southeastern (Stn. 32, 44, 45 and 63) parts of the Bay Head Area. The extremely high frequencies of this species are recognized at the five stations (1, 21, 41, 42 and 68: Group Ia, Ib and VI) where the total agglutinated foraminifera also had high frequencies (95.9-100%). Around the fumaroles at the 200 meter deep basin bottom, the frequency of this species decreased from 25 to 2% toward Station 40, nearest to the fumaroles. Most of the stations in the southeastern part of the Bay Head Area are under the influence of acidic water, while some of the other stations including Stations 1 and 68, characterized by extremely high frequencies, are free from the acidic water. These features suggest that T. *bigenerinoides* prefers embayment conditions and sometimes has high frequencies caused by the paucity of the calcareous foraminifera, which cannot survive due to the presence of acidic water or some other reasons.

Textularia kattegatensis kagoshimaensis ŌKI, n. subsp. (Fig. 40; Pl. 3, fig. 2): This species was mainly found at the stations located in the Central and Bay Head Areas, but it was not found in the stations in the Bay Mouth and the open sea areas. Stations 1, 21, 40, 41 and 42 (Group I) in the northeastern and northwestern parts of the Bay Head Area had high frequencies ranging from 7 to 29%. At the 200 meter deep basin bottom of the Bay Head Area, the frequency of this species increased from 7 to 29% toward Station 40 nearest to the fumaroles, in contrast with the case of *T. bigenerinoides*. The features mentioned above suggest that the acidic water mass provides a condition favourable for *T. kattegatensis kagoshimaensis* to live or does not permit the survival of the other species. Based on this phenomenon, it is assumed that some kind of acidic water occurs also at Station 1 (frequency: 14%), rather remote from the known fumaroles.

Textularia wiesneri EARLAND (Fig. 41; Pl. 3, fig. 4): This species commonly occurs in the Bay Head Area and the northern half of the Central Area. In the Bay Head Area, this species occurred in all the stations (frequencies: 12-20%) at the basin bottom deeper than 102 meters except for four stations. The extremely high frequencies were found at Station 77 located at the foot of the bank in the northeastern part of the Central Area, at Stations 21 and 42 in the 200 meter deep basin bottom, and at Station 61 located at the sequestered area in the southeastern part of the Bay Head Area.

Trochammina osumiensis ŌKI, n. sp. (Fig. 42; Pl. 3, fig. 9): The seven stations (90, 91, 92, 95, 96, 97 and 103: 170-215 m in depth) in the southern part of the Central Area show high frequencies ranging from 4 to 11%. At four stations (91, 95, 96 and 97) among the seven mentioned above and at Station 98, the frequencies of living specimens in the living assemblage were also high (4-10%). On the other hand, only one living specimen was collected without a corresponding dead specimen from each of the four stations (73, 74, 83 and 84) in the shallow coastal area of the northern part of the Central Area (28-88 m in depth). This is thought to result from the destruction of the delicate tests of dead specimens during transportation by the current.

Trochammina pacifica simplex CUSHMAN and MCCULLOCH (Fig. 43; Pl. 3, fig. 10): This species was found at the stations near the shoreline. The stations with relatively high frequencies were within the West-Sakurajima Passage and on the deep basin bottom in the northern part of the Bay Head Area. At the eight stations (1, 3, 12, 18, 21, 40, 41 and 42) in the northern part of the Bay Head Area, no living specimens were collected. On the other hand living specimens made up 20 to 34.8% of the total number of individuals at the two stations (64 and 65) in the West-Sakurajima Passage. This is thought to result from the destruction of delicate dead tests during transportation by bottom current*) in the shallow passage. This is also the case at the stations (73, 88, 104 and 124) with shallow bottoms in the Bay Mouth and Central Areas.

Dorothia sp. (Fig. 44): This species occurred at the 13 stations (Stn. 32, 34, 35, 37, 41, 42, 44, 45, 51, 53, 54, 61 and 63) in the southern half of the Bay Head Area and at Station 101 in the southern part of the Central Area with rather low frequencies.

Eggerella scabra (WILLIASON) (Fig. 45; Pl. 4, fig. 7): This species was found at all the stations in the Central and the Bay Head Areas, except for Station 134 located at the

*) The velocity of the surface water in this area can reach up to 1.7 knots, which is the highest velocity in the bay (Coastal Oceanography Research Commitee, The Oceanographical Society of Japan, 1985). The median diameter values (Mdϕ) at Stations 64 and 65 are -0.1 and 1.9ϕ, reflecting the current velocity in this area.

deepest part of the Bay Mouth Area. At the stations in the northern half of the basin in the Central Area, the frequencies are high (6-23%). In the Bay Head Area, this species occurs at all stations except for the two stations (64 and 65) located at the shallow area of the West-Sakurajima Passage, and is predominant at 15 stations. Therefore, I feel that the foraminiferal fauna in the Bay Head Area is represented by this species. All the stations in the Bay Head Area except for two (Stn. 34 and 63; less than 10%) had frequencies ranging from 15 to 70%. The eight stations (3, 18, 35, 37, 51, 54, 58 and 61) off the Hayato Islands (Oki-kojima, Benten-jima and Heta-kojima), around the An-éi Rise and in the southeastern part of the Bay Head Area, show extremely high frequencies of more than 50%. The same may be said of the living specimens of this species.

Buliminella elegantissima (D'ORBIGNY)(Fig. 46; Pl. 8, fig. 8): This species had with rather low frequencies at most of the stations in the open sea, the Bay Mouth and the Central Areas, and the southwestern part of the Bay Head Area. The distribution of the stations (44, 63, 66, 70, 74, 78, 83, 90, 94 and 100) showing relatively high frequencies (2-6%) are limited to the coastal sea area along the Satsuma Peninsula. This area is under the influence of hyposaline nutritious water.

Bolivina ordinaria PHLEGER and PARKER (Fig. 47; Pl. 9, fig. 5): This species occurs at all the stations except for the ones in the eastern half and the northwestern parts of the Bay Head Area and the two (68 and 85) at the deep basin in the Central Area. The frequencies tend to be low (less than 1%) at the deep basin bottom in the Central Area and at the deepest of the open sea area (Stn. 146) and they are high (2-10%) in the shallow coastal sea area. The two stations (88 and 93) off Furué, Kanoya City in the Ōsumi Peninsula and the ten stations off the coast between Kagoshima and Ibusuki Cities in the Satsuma Peninsula had high frequencies of more than 4%.

Bolivina retia ŌKI, n. sp. (Fig. 48; Pl. 9, fig. 7): In contrast to the fact that many species of *Bolivina* occurred in the shallow coastal area in the bay, *B. retia* was found at the stations deeper than 80 meters in the Bay Mouth and the Central Areas.

Bolivina robusta BRADY (Fig. 49; Pl. 10, fig. 1): This species was found at all the stations in the bay except for the four stations (68, 72, 77 and 96) located at the deep basin in the Central Area and in the eastern half and northwestern part of the Bay Head Area. The frequencies were rather low (less than 1%) at the basin bottom in the Central Area and relatively high (2-11%) at the coastal areas shallower than 100 meters in the Bay Mouth and the Central Areas. At the five stations (99, 104, 127, 136 and 141) off the coast of the Ōsumi Peninsula and the seven stations (63, 65, 74, 78, 83, 116 and 118) off the coast of the Satsuma Peninsula in the Bay Mouth and the Central Areas frequencies of this species are rather high (4 to 11%). The same may be said of the living specimens.

Bolivina striatula CUSHMAN (Fig. 50; Pl. 10, fig. 3): This species was found at most of the stations in the Bay Mouth and the Central Areas, but the frequencies are rather low. The stations having the frequencies of more than 2% were distributed in the shallow coastal area off Kagoshima City and Kiiré-chō (Stn. 70, 74, 78 and 83), and in the southern part of the Central Area (Stn. 94, 95, 97 and 105). These areas are under the influence of hyposaline nutritious water.

Rectobolivina hancocki (CUSHMAN and MCCULLOCH)(Fig. 51; Pl. 10, fig. 7): The occurrence of the species is limited to the stations in the Bay Mouth Area, including the two stations (Stn. 104 and 105) at the southeasternmost part of the Central Area. The specimens collected from Station 81 (220 meter deep) seemed to be from the shallow coastal area.

Bulimina marginata D'ORBIGNY (Fig. 52; Pl. 11, fig. 3): This species representing the benthonic foraminiferal fauna in Kagoshima Bay occurred at all 73 stations except eleven stations influenced by the acidic water mass (Stn. 1, 3, 12, 21, 35, 37, 40, 51, 54, 58 and 61) and two shallow stations in the Central and the Bay Mouth Areas (Stn. 70 and 106). This species predominated at 30 stations among the 73. Frequencies of this species were more than 10% at the 39 stations deeper than 88 meters; 20 to 27% at the four stations (89, 90, 95 and 96) in the southwestern part of the Central Area; 20 to 38% at the nine stations (67, 69, 72, 75, 76, 77, 80, 81 and 82) in the northern part of the Central Area; 20 to 41% at the seven stations (15, 17, 22, 32, 34, 44 and 45) in the southwestern part of the Bay Head Area; and 54% at Station 53 located on the seamount in the eastern part of the same area. The same may be said of the living specimens in the Central and the Bay Head Areas. In the Bay Mouth Area, occurrence of this species was limited to the area east of the line running from NNE to SSW at the central part of the area.

Bulimina spinosa (HERON-ALLEN and EARLAND)(Fig. 53; Pl. 11, fig. 4): This species was found on the slope between the outer edge of the submarine terrace (about 90 meter deep) and the basin bottom in the Central Area, and at the bottom in the southwestern part of the Bay Head Area. Exceptionally, it occurred at the station located in the deepest part of the Bay Mouth Area, but the frequency was less than 1%. At three stations (77, 81 and 94) in the northeastern and southwestern parts of the Central Area and two stations (22 and 34) in the southwestern part of the Bay Head Area, the frequencies were rather high (10 to 30%). The living species occurred mainly at the stations on the marginal slope and its foot in the basin in the Central Area.

Uvigerina vadescens CUSHMAN (Fig. 54; Pl. 12, fig. 5): This species was found at all the stations in the open sea, the Bay Mouth and the Central Areas and the West-Sakurajima

Passage except for the four stations (Stn. 68, 70, 90 and 106). The high frequencies occurred in the deepest parts of the Bay Mouth Area (8-14%) and at five stations (71, 75, 79, 84 and 89) at the edge of the submarine terrace (about 90 m in depth) in the western part of the Central Area (8-21%). These stations were located on either the boundary between the open-sea water flowing into the bay along the Ōsumi Peninsula and the embayment water flowing out along the Satsuma Peninsula or the boundary between the normal saline water flowing into the bay along the Ōsumi Peninsula and the embayment water diluted by fresh water supplied by the rivers.

Discorbis mira CUSHMAN (Fig. 55; Pl. 13, fig. 1): Many stations widely distributed in shallow areas ranging from the open sea area to the West-Sakurajima Passage had frequencies more than 2%. High frequencies (6-12%) were found in four areas; the southeastern part of the Bay Mouth Area where the open-sea water flows northward into the bay (Stn. 127, 136 and 141), the boundary area between the Bay Mouth and the Central Areas (Stn. 99, 103 and 107), off the southern part of Kagoshima City (Stn. 70), and the shallow area in the West-Sakurajima Passage (Stn. 64 and 65).

Eilohedra levicula (RESIG)(Fig. 56; Pl. 14, fig. 2): The species occurred widely in the areas ranging from the open sea to the southwestern part of the Bay Head Area. The stations showing frequencies of more than 4% were concentrated on the slope and the basin bottom deeper than 80 m in the Central Area with an exception of Station 32 at the western part of the Bay Head Area.

Neoconorbina stachi (ASANO)(Fig. 57; Pl. 14, fig. 3): The distribution of the stations yielding this species was restricted to a small area in the Bay Mouth Area and to the southeastern part of the Central Area.

Ammonia beccarii (LINNÉ) forma A (Fig. 58; Pl. 15, fig. 5): This species occurred mainly in the shallow coastal area of the bay, and exceptionally on the basin bottom in the northern part of the Central Area (Stn. 72) and at the southwestern part of the Bay Head Area (Stn. 22, 32, 34, 44 and 63). The dead specimens contained in the bottom sample at Station 72 seem to have been derived from the submarine terrace (less than 100 m in depth) off Tarumizu City, on the Ōsumi Peninsula by the counterclockwise coastal current assumed to exist in the Central Area. The dead specimens at the six stations in the southwestern part of the Bay Head Area are also regarded to have been derived from the shallow coastal area in and near the West-Sakurajima Passage where the bottom current is rather strong. These assumptions are supported by the fact that the specimens are composed exclusively of dead test at the bottom of the Bay Head Area, while living specimens occupy 4% of the total number of individuals of this species at Station 65 located at the shallowest part of the West-Sakurajima Passage.

Elphidium advenum (CUSHMAN)(Fig. 59; Pl. 16, fig. 2): This species occurred in the shallow coastal areas (less than 100 m in depth) of the bay, and the frequencies are relatively high on the Satsuma Peninsula side. Especially Station 64 located at the West-Sakurajima Passage which had a frequency of 18%. The stations which had frequencies of more than 2% were distributed on the bottom of the area extending from the West-Sakurajima Passage to off the Hayato Islands. The living specimens commonly occurred on the shallow bottom of the West-Sakurajima Passage and its northeastern extention (Stn. 34). This suggests that open sea water flowing in through the West-Sakurajima Passage reaches the area around Station 34.

Protelphidium schmitti CUSHMAN and WICKENDEN (Fig. 60; Pl. 17, fig. 1): This species occurred on the shallow coastal sea bottom in the Bay Mouth, the Central and the West-Sakurajima Passage areas. At the five stations (65, 70, 74, 78 and 83) extending from off Kagoshima City to off Kiiré-chō, the frequencies were relatively high ranging from 4 to 9%. This area is strongly influenced by hyposaline and nutritious water from the urban area.

Cymbaloporetta hemisphaerica ACCORDI and SELMI (Fig. 61; Pl. 18, fig. 4): This species occurred at many stations in the Bay Mouth and the Central Areas and at the two stations (34 and 45) in the southwestern part of the Bay Head Area where the influence of the open-sea water coming through the West-Sakurajima Passage is remarkable. High frequencies ranging from 4 to 11% were found in the area off the coast extending from Kagoshima City to Ibusuki City and the boundary area between the Bay Mouth and the Central Areas. These areas correspond quite well with the course of the littoral current flowing southward along the Satsuma Peninsula down to the north of Ibusuki City and reaching the Ōsumi Peninsula across the Bay Head Area.

Globocassidulina oriangulata BELFORD (Fig. 62; Pl. 18, fig. 7): The frequencies seemed to be high in the area influenced by the open-sea water mass; 4 to 11% at the three stations (144, 145 and 46) in the open sea area, and 2 to 7% at the 14 stations in the Bay Mouth Area other than the four off Ibusuki City. This species occurred at more than half of the stations in the Central Area, but the frequencies were relatively low; only 1 to 2% at the six stations (87, 90, 91, 97, 98 and 102) in the southern part and the three stations (71, 75 and 79) at the edge of the submarine terrace (about 90 m in depth) in the western part of this area.

Cassidulina nørvangi THALMANN (Fig. 63; Pl. 19, fig. 1): The stations which had high frequencies, ranging from 4 to 13%, were distributed at depths between 80 and 196 m from the open sea to the Central Area. Extremely high frequencies were found on the marginal slope of the deep basin in the Central Area.

Paracassidulina quasicarinata NOMURA (Fig. 64; Pl. 19, fig. 5): High frequencies of this species were generally found in the open sea area. In the southern and northeastern parts of the Bay Mouth Area, frequencies were also rather high (2-8%). In the Central Area, high frequencies ranging from 1 to 2% were found at the stations on the marginal slope of the deep basin.

Astrononion hanyudaense MATSUNAGA (Fig. 65; Pl. 19, fig. 6): None were found at the open sea stations. At the bottom deeper than 80 m in the Central Area and the southwestern part of the Bay Head Area, the frequencies were rather high (more than 2%). The stations at the basin deeper than 200 m in the Central Area had frequencies ranging from 3 to 9%.

Florilus japonicus (ASANO)(Fig. 66; Pl. 20, fig. 1): This species occurred widely from the Bay Mouth Area to the southwestern part of the Bay Head Area. In the Central Area, the stations showing relatively high frequencies (3-7%) were distributed in the coastal area off Kagoshima City and Kiiré-chō on the Satsuma Peninsula (Stn. 66, 70, 74 and 78: 23-130 m in depth) and in the southern part of the deep basin (Stn. 85, 86, 91, 95 and 96: 165- 220 m in depth). The same was true of the living specimens. It is remarkable that the stations which had frequencies ranging from 3 to 5% were distributed in the narrow strip in the Central Area extending from the shallow area off the southern part of Kagoshima City (Stn. 74: 28 m in depth) to the basin bottom, and that the living specimens occupied 50 to 100% of the total number of individuals at the four stations (Stn. 91, 95, 96 and 103) in the basin area deeper than 150 meters. At the four stations (17, 22, 32 and 34) located in the southwestern part of the Bay Head Area, relatively high frequencies (2-8%) of dead and living specimens were found. This area is influenced by the open-sea water flowing in through the West-Sakurajima Passage.

Pseudononion japonicum ASANO (Fig. 67; Pl. 20, fig. 5): Relatively high frequencies were found in the coastal part of the Central Area. Especially, the four stations (70, 74, 78 and 83) in the coastal shallow area off Kagoshima City and Kiiré-chō influenced by the hyposaline nutritious water mass had high frequencies ranging from 3 to 10%.

Cibicidoides pseudoungeriana (CUSHMAN)(Fig. 68; Pl. 21, fig. 5): This species was found at every station in the open sea and the Bay Mouth Areas. High frequencies (more than 4%) were found in the areas where strong bottom currents were observed, namely, the open sea (Stn. 144, 145 and 146), the Bay Mouth Area (Stn. 106, 107, 122, 125, 134, 136, 137 and 141) and the West-Sakurajima Passage (Stn. 64 and 65). Station 64, characterized by a gravelly sand bottom, had the highest frequency (11%).

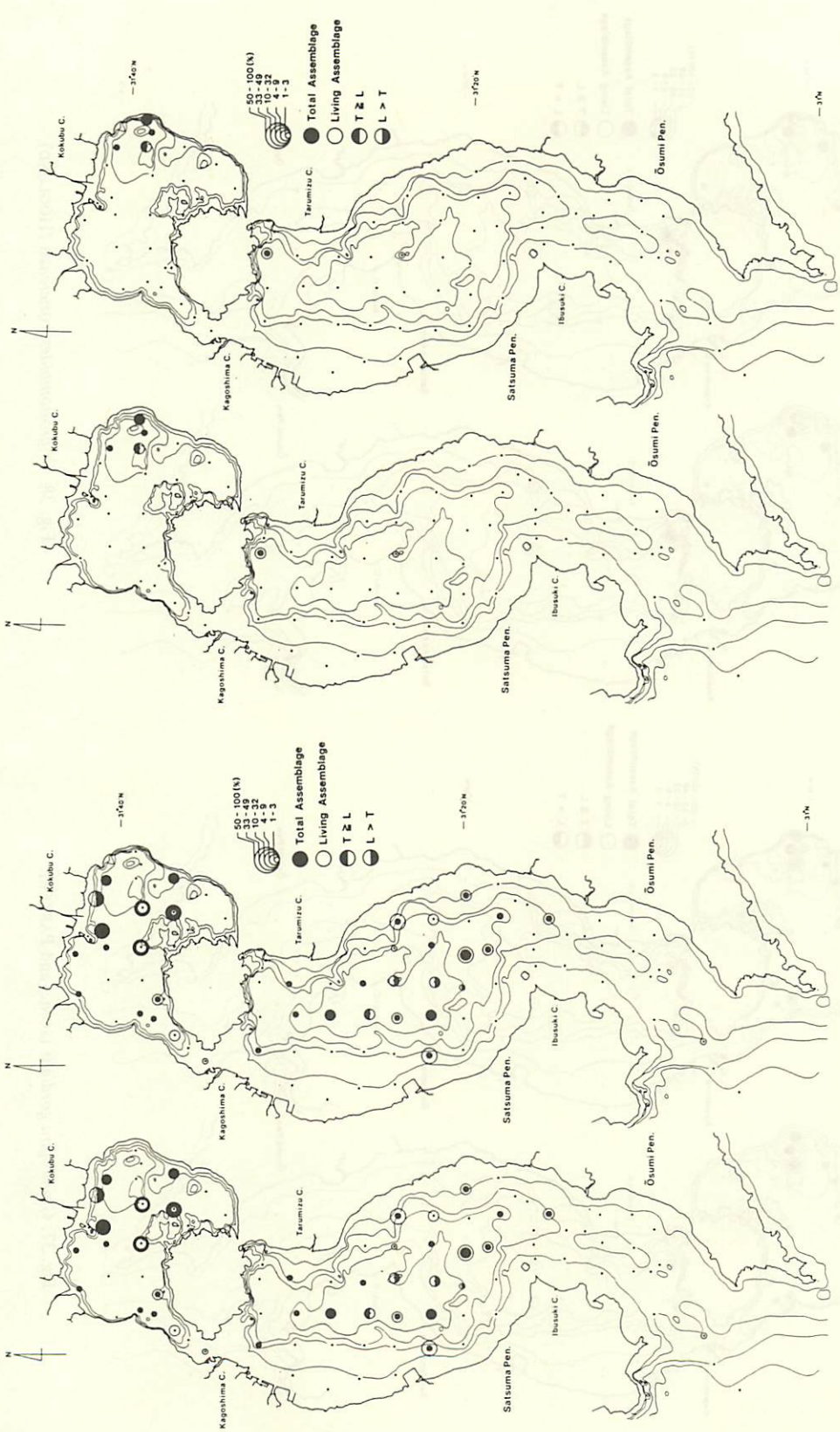


Fig. 35. *Lagenammina kagoshimaensis* ŌKI, n. sp.

Fig. 36. *Ammodiscus minimus* HÖGLUND.

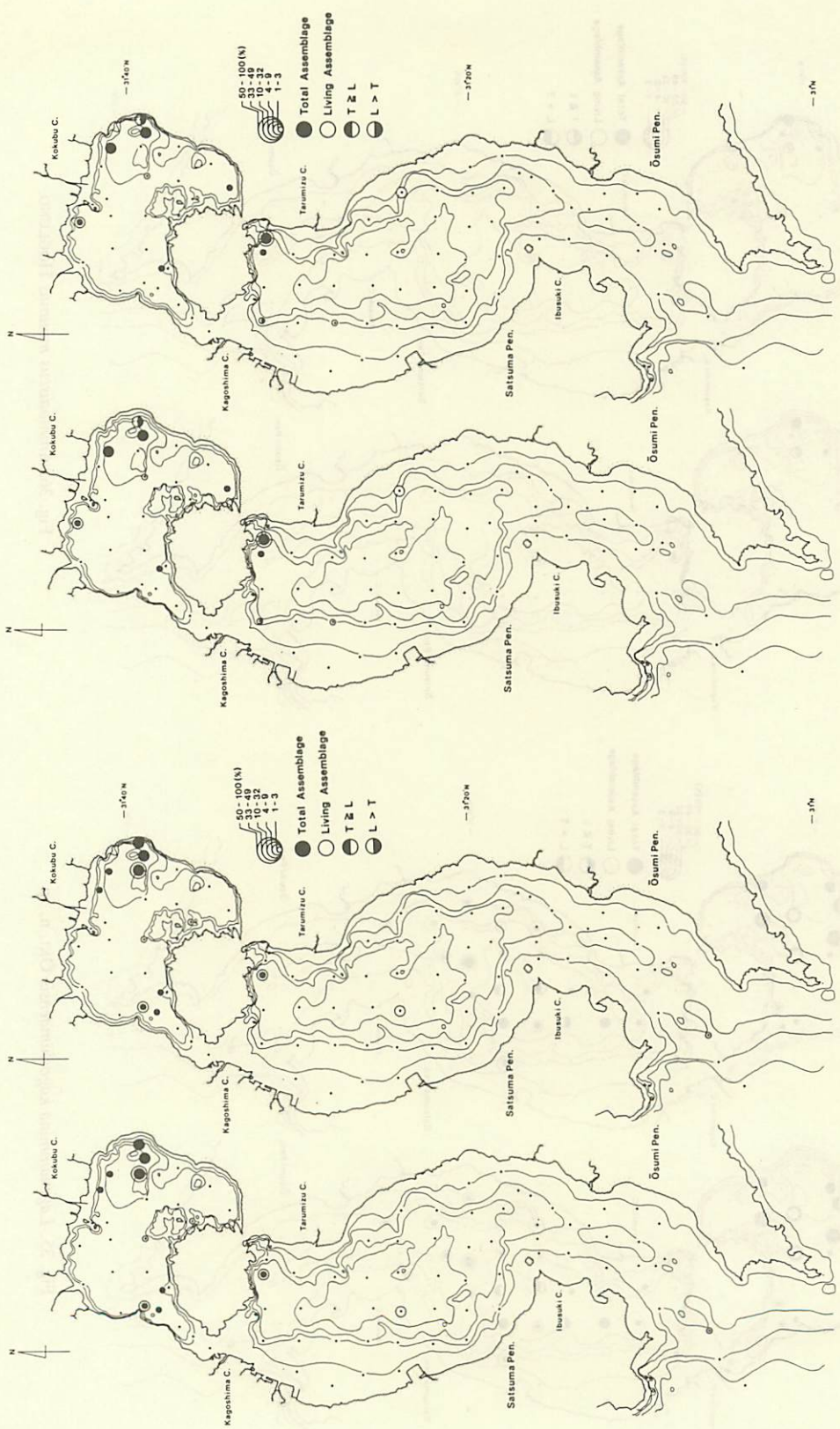


Fig. 37. *Glomospira gordialis* (JONES and PARKER).

Fig. 38. *Cribrostomoides kosterensis* (HÖGLUND).

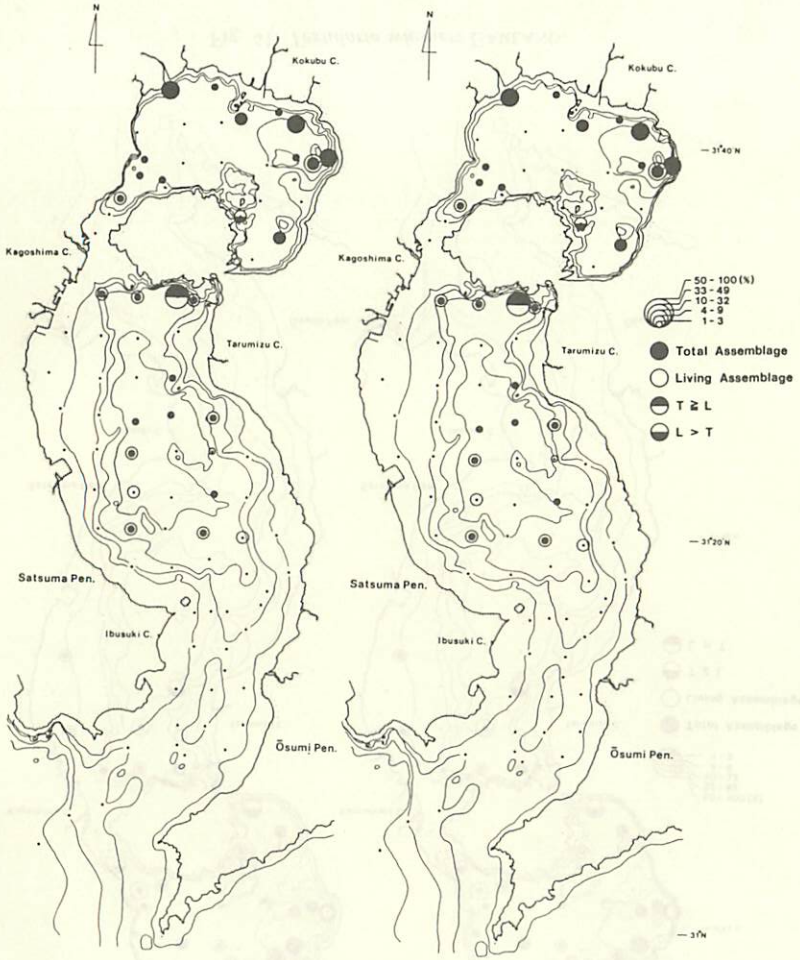


Fig. 39. *Textularia bigenerinoides* LACROIX.

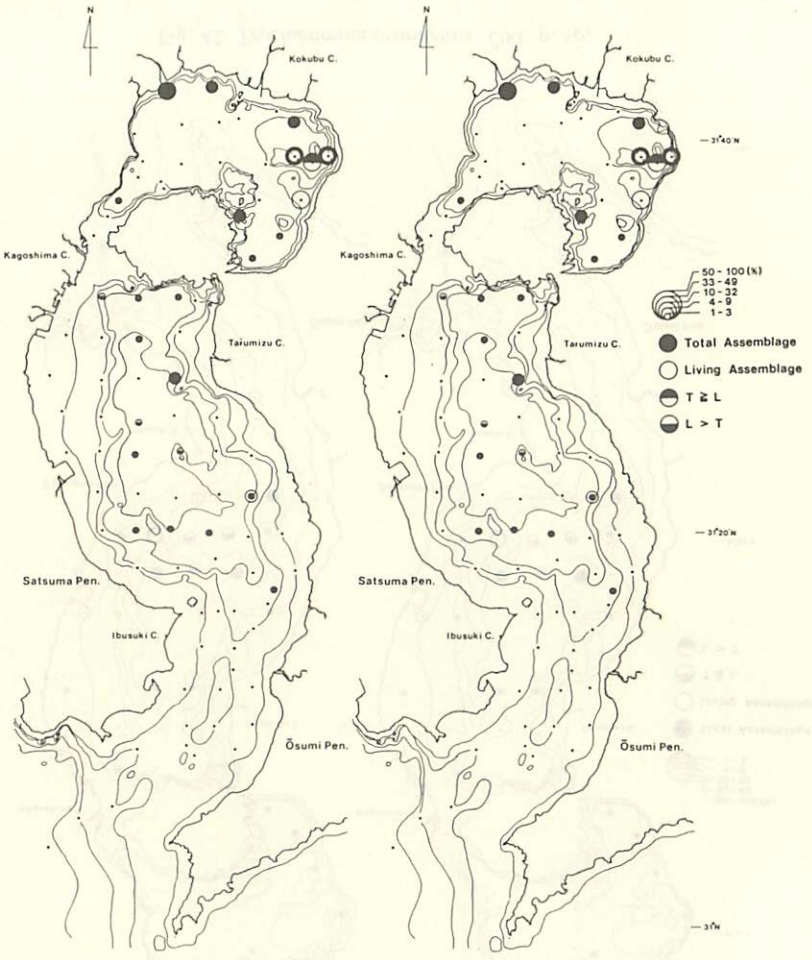


Fig. 40. *Textularia kattegatensis kagoshimaensis* ŌKI, n. subsp.

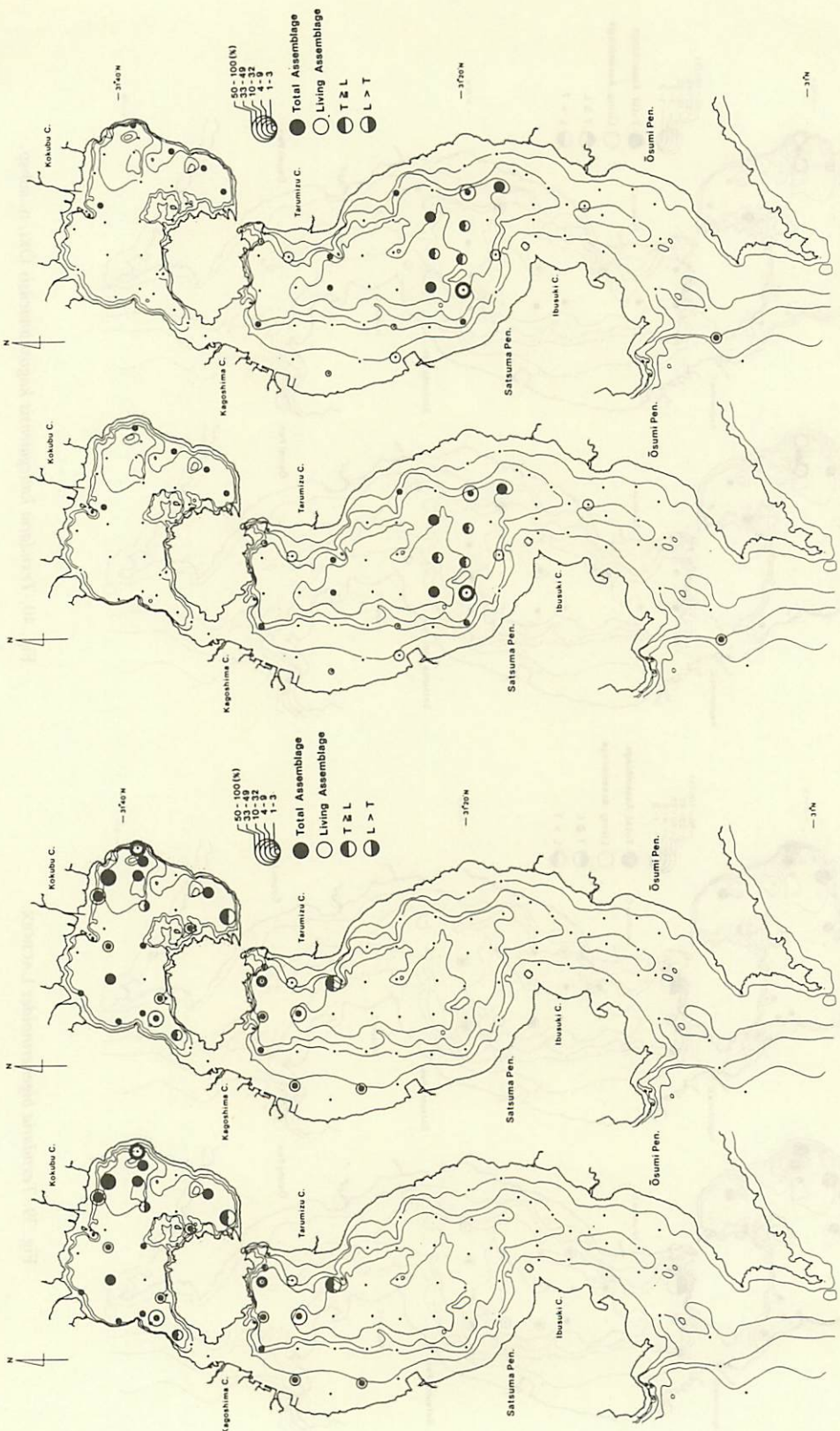


Fig. 41. *Textularia wiesneri* EARLAND.

Fig. 42. *Trochammina osumiensis* ŌKI, n. sp.

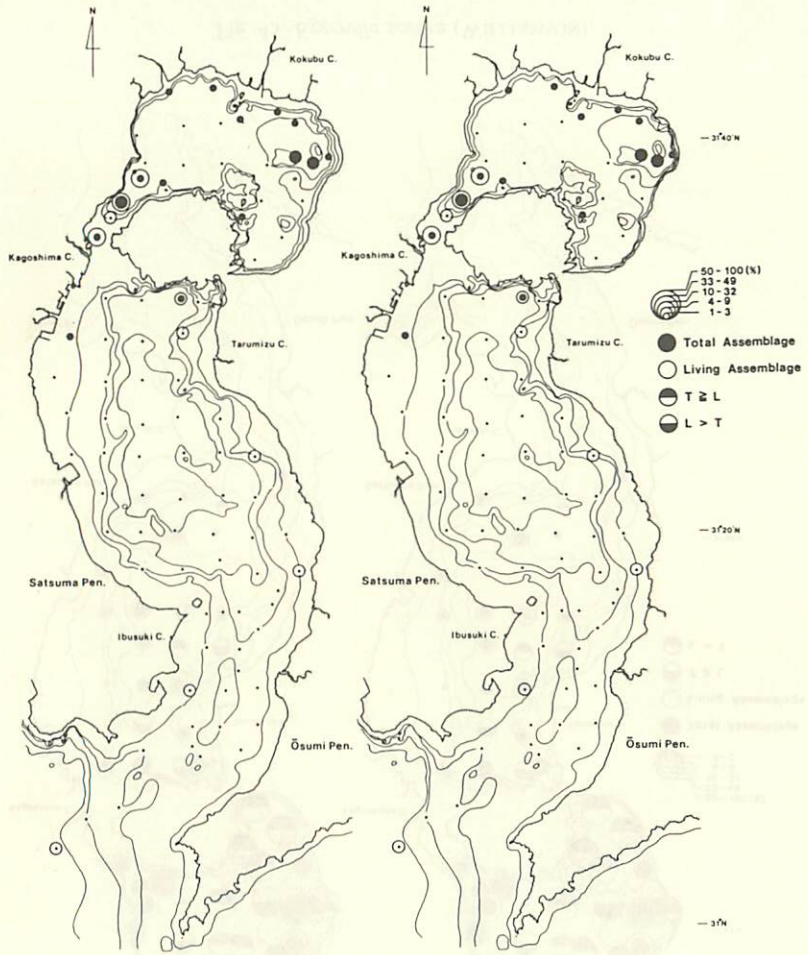


Fig. 43. *Trochammina pacifica simplex* CUSHMAN and MCCULLOCH.

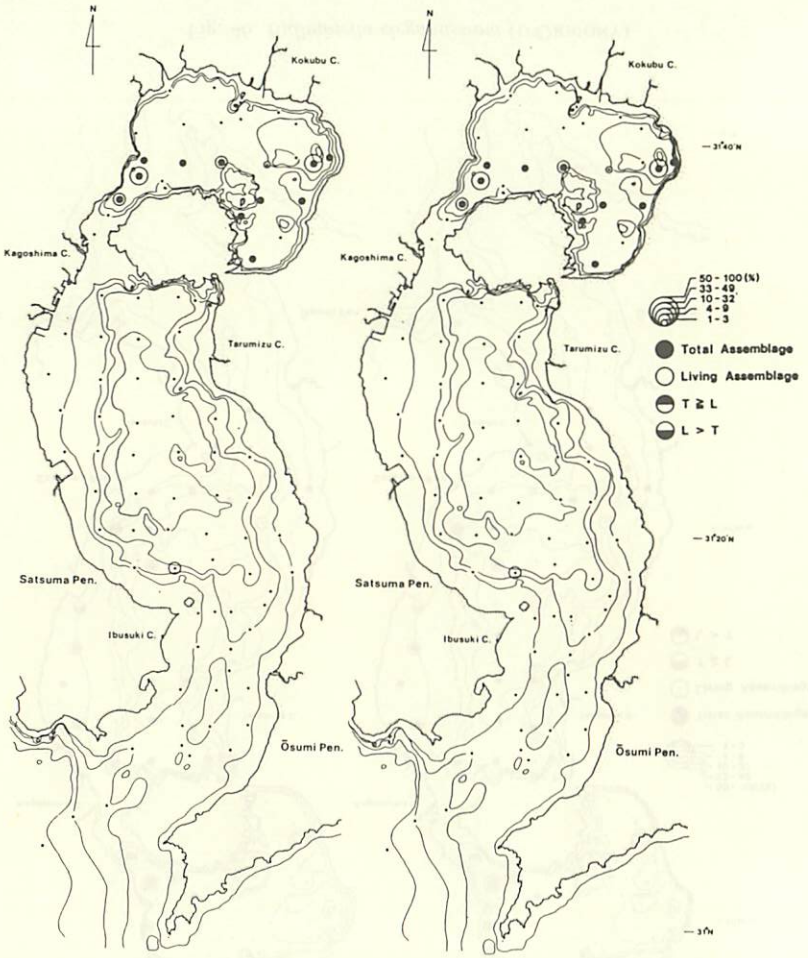


Fig. 44. *Dorothia* sp.

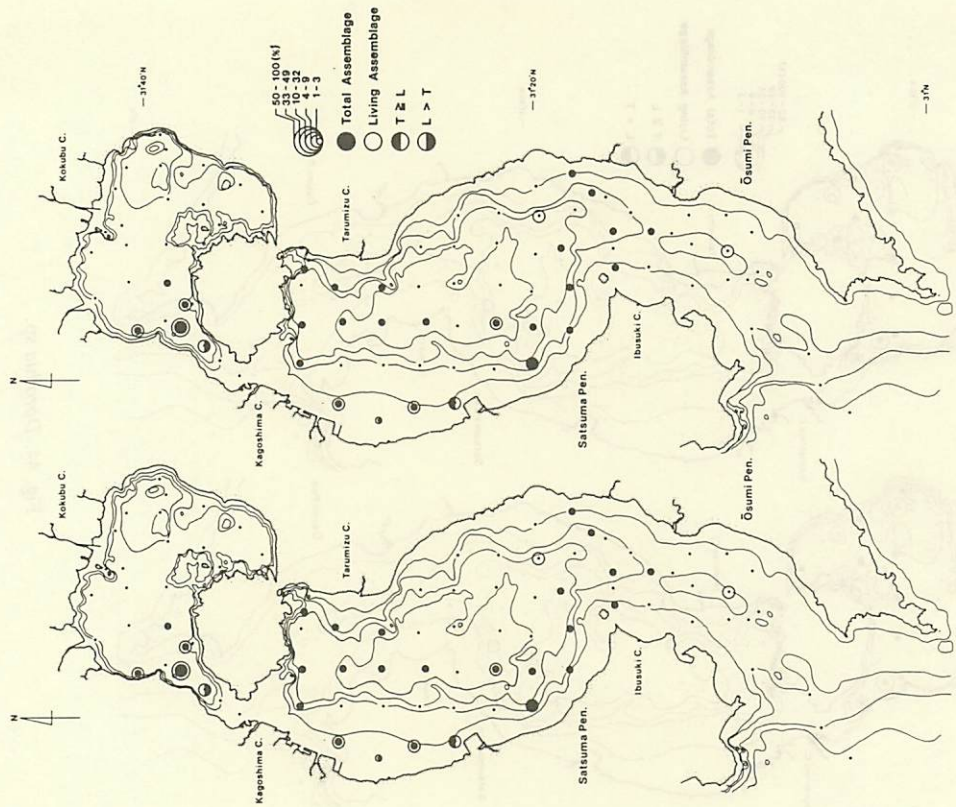


Fig. 46. *Buliminella elegantissima* (D'ORBIGNY).

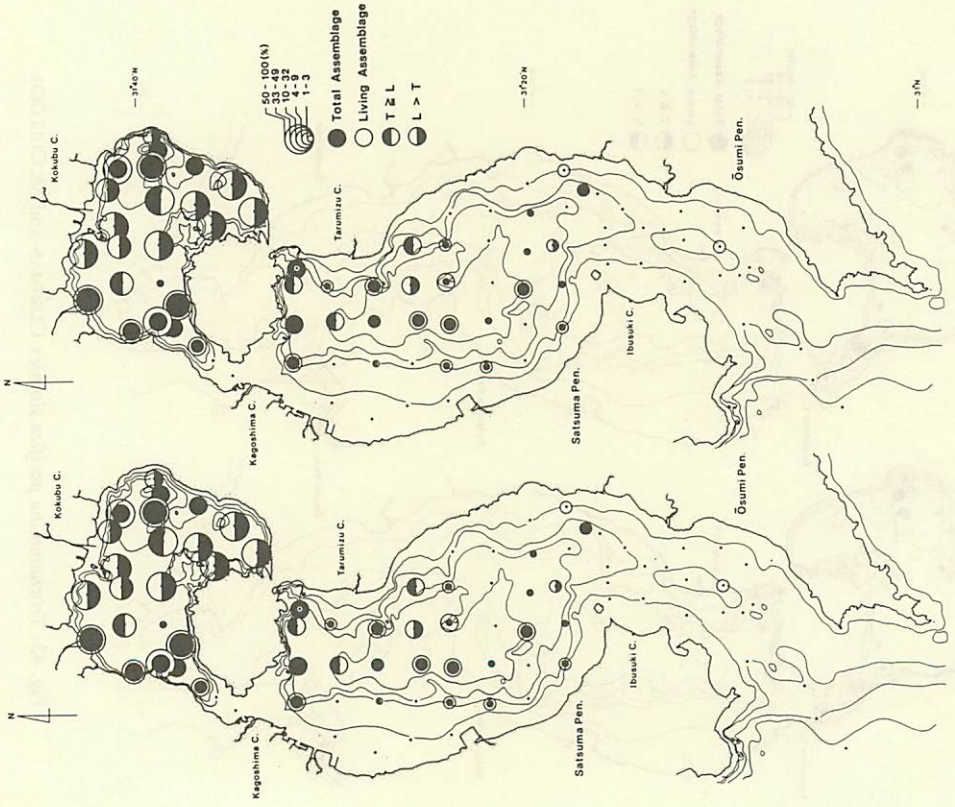


Fig. 45. *Eggerella scabra* (WILLIAMSON).

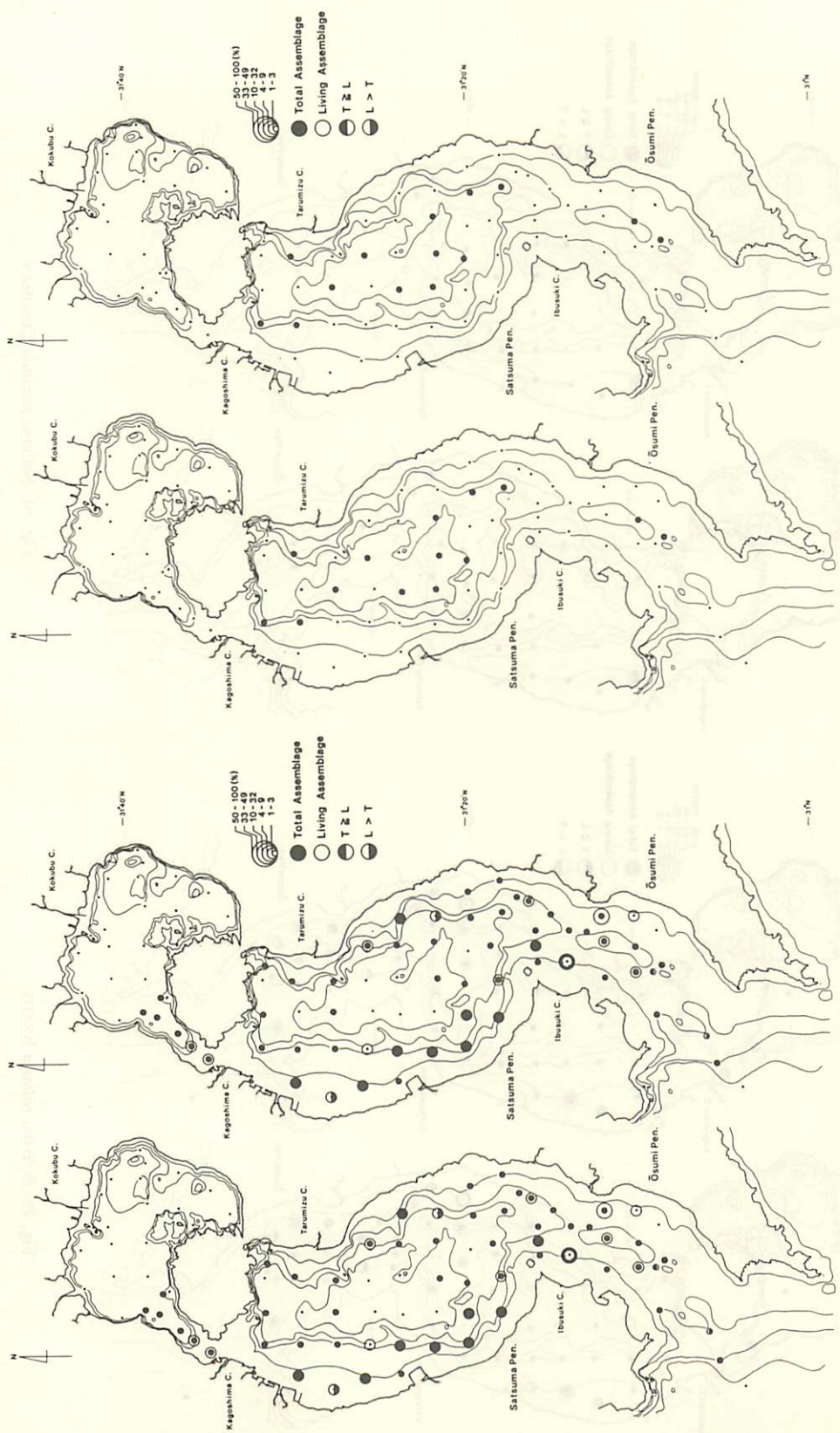


Fig. 47. *Bolivina ordinaria* PHLEGER and PARKER.

Fig. 48. *Bolivina retia* ŌKI, n. sp.

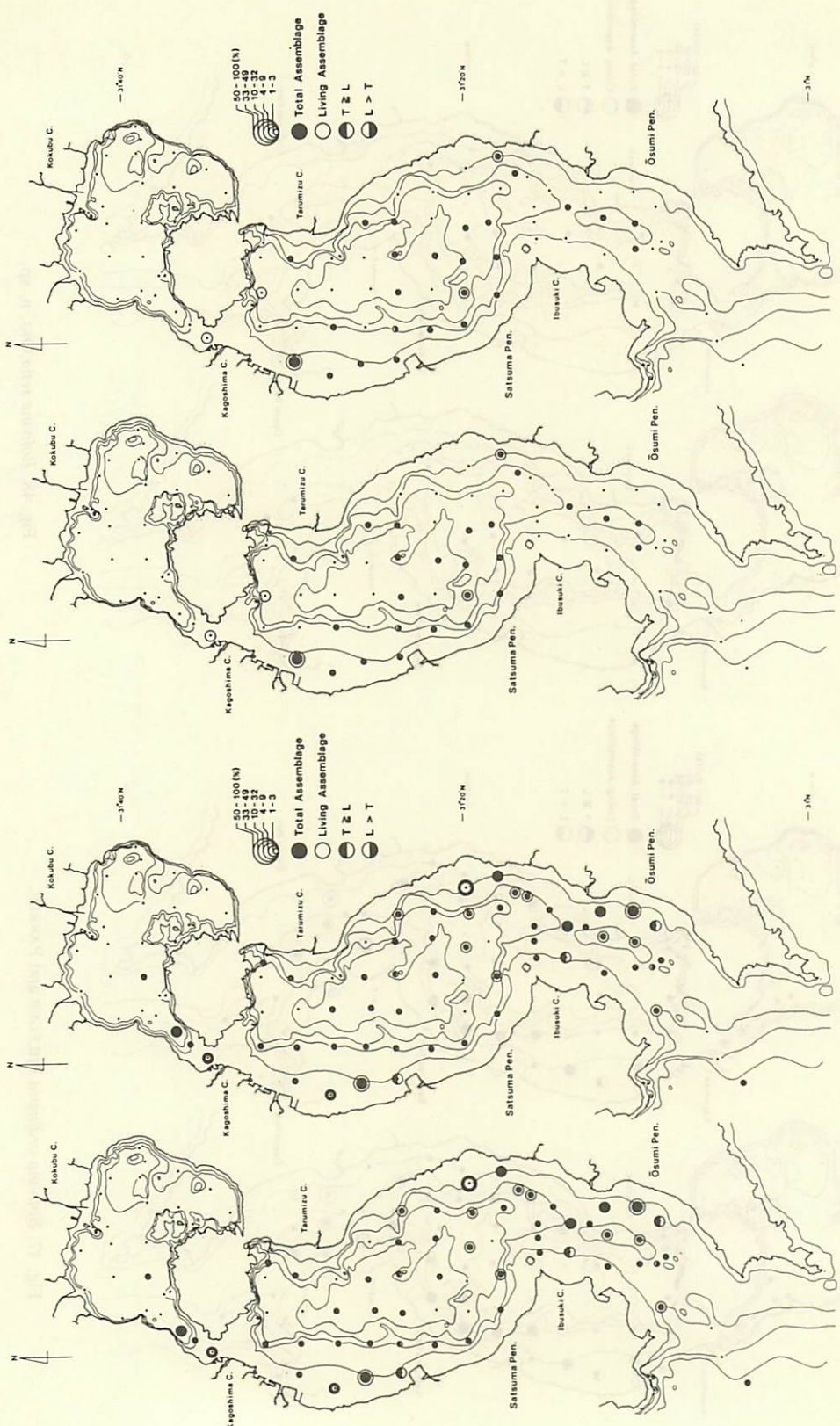


Fig. 49. *Bolivina robusta* BRADY.

Fig. 50. *Bolivina striatula* CUSHMAN.

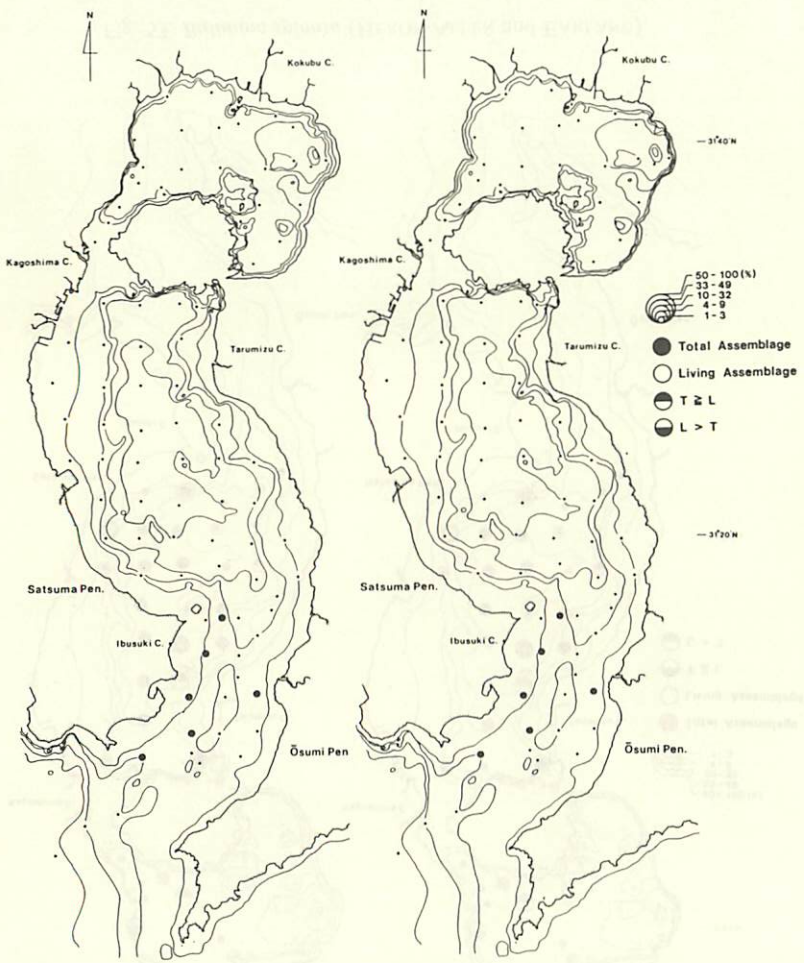


Fig. 51. *Rectobolivina hancocki* (CUSHMAN and MCCULLOCH).

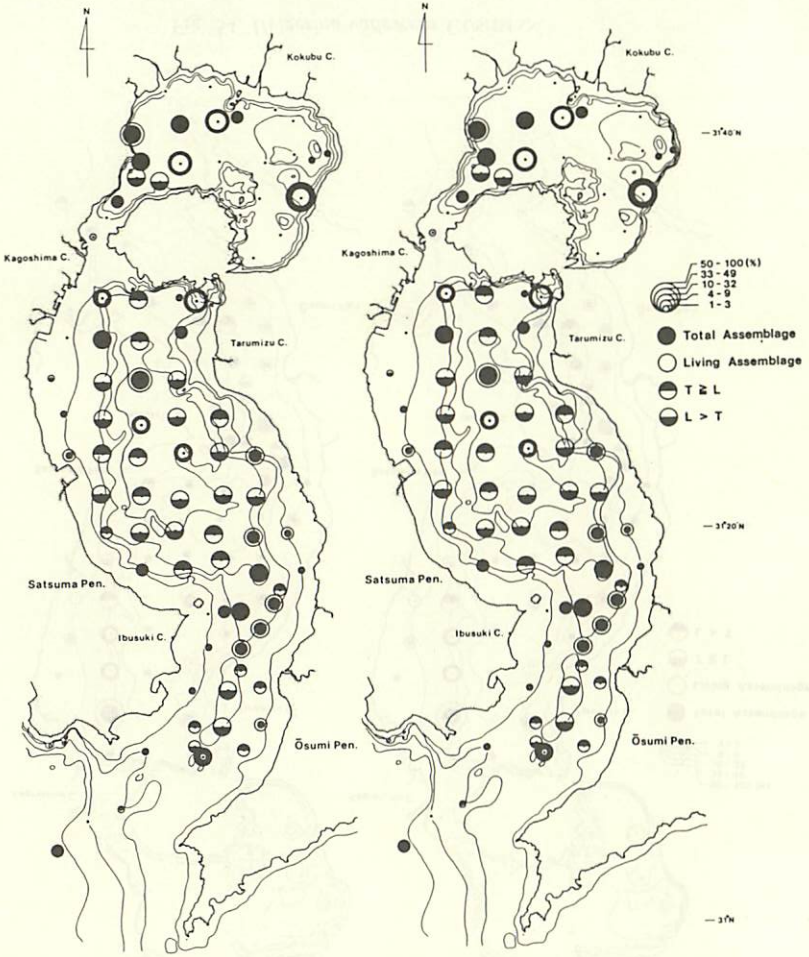


Fig. 52. *Bulimina marginata* D'ORBIGNY.

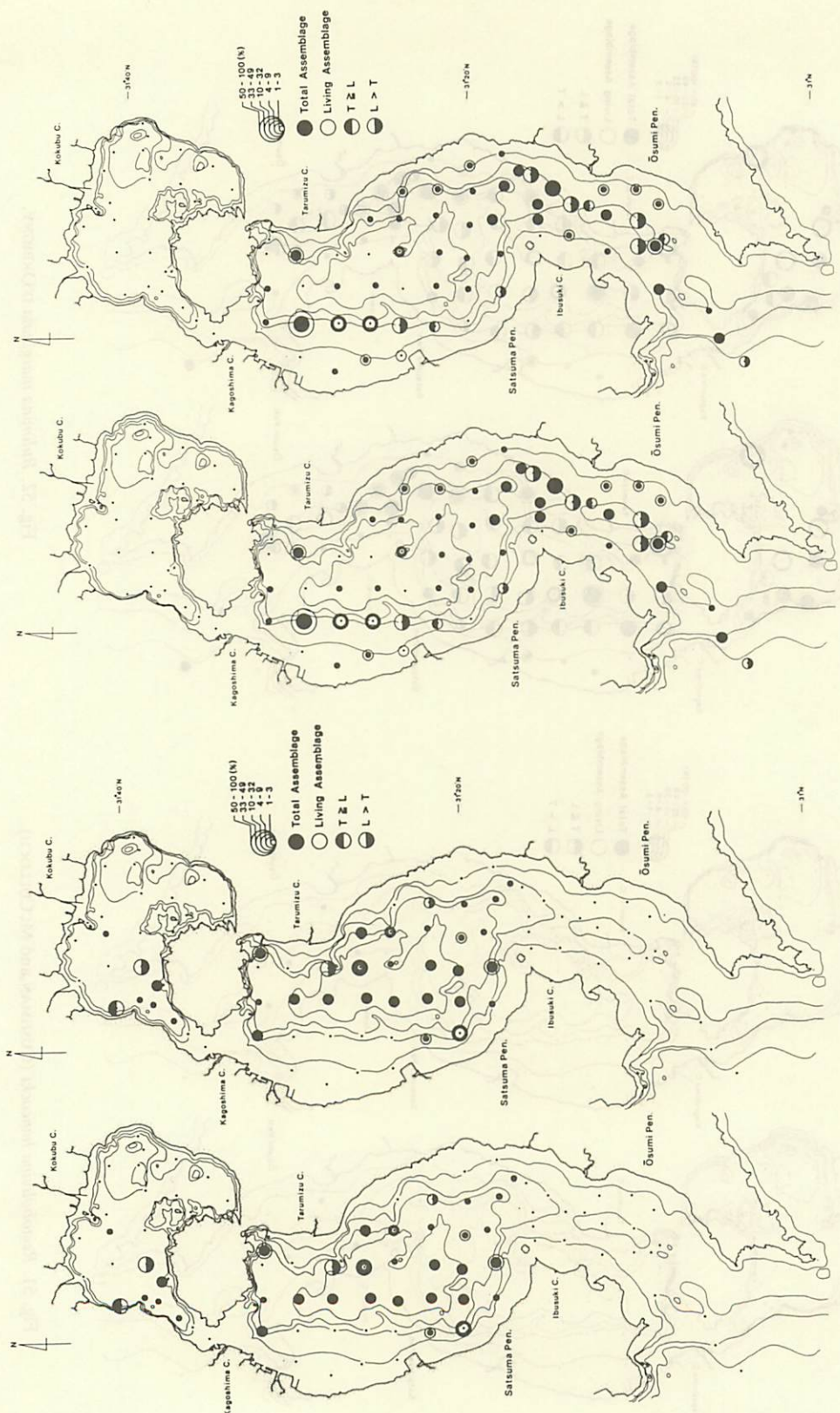


Fig. 53. *Bulimina spinosa* (HERON-ALLEN and EARLAND).

Fig. 54. *Uvigerina vadescens* CUSHMAN.

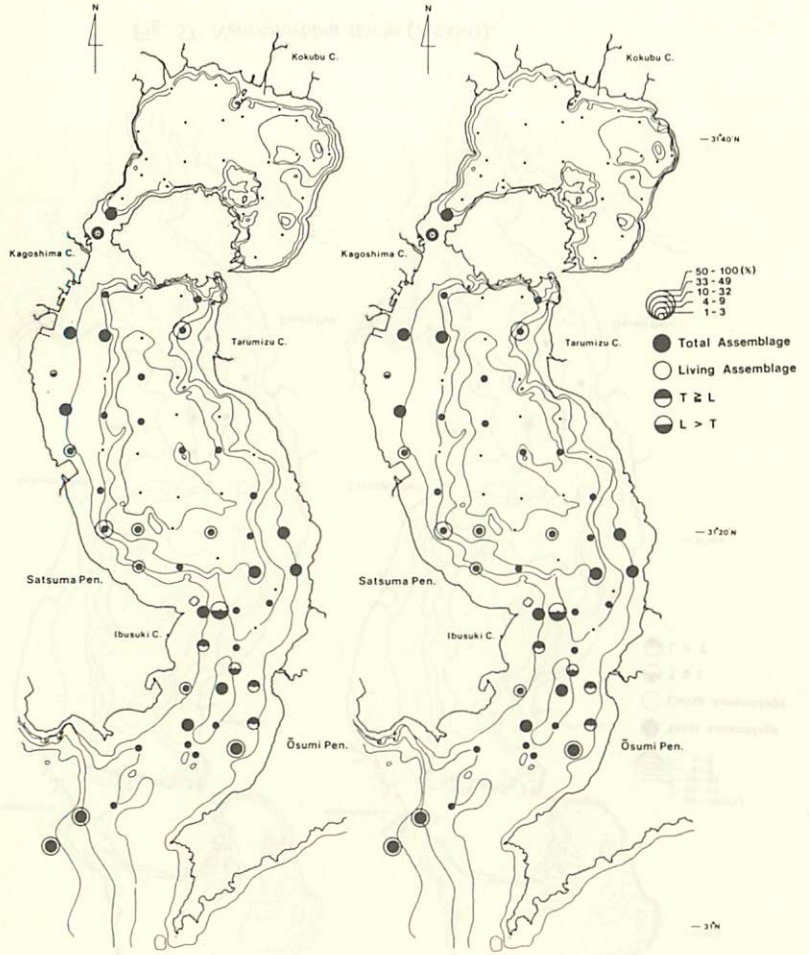


Fig. 55. *Discorbis mira* CUSHMAN.

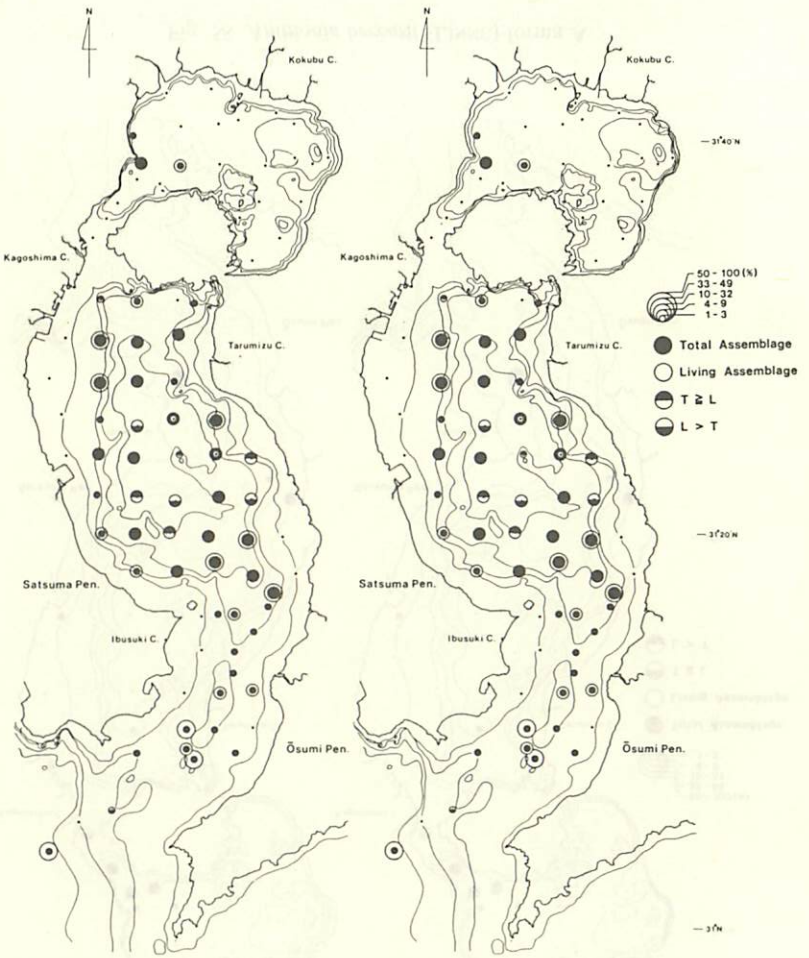


Fig. 56. *Eilohedra levicula* (RESIG).

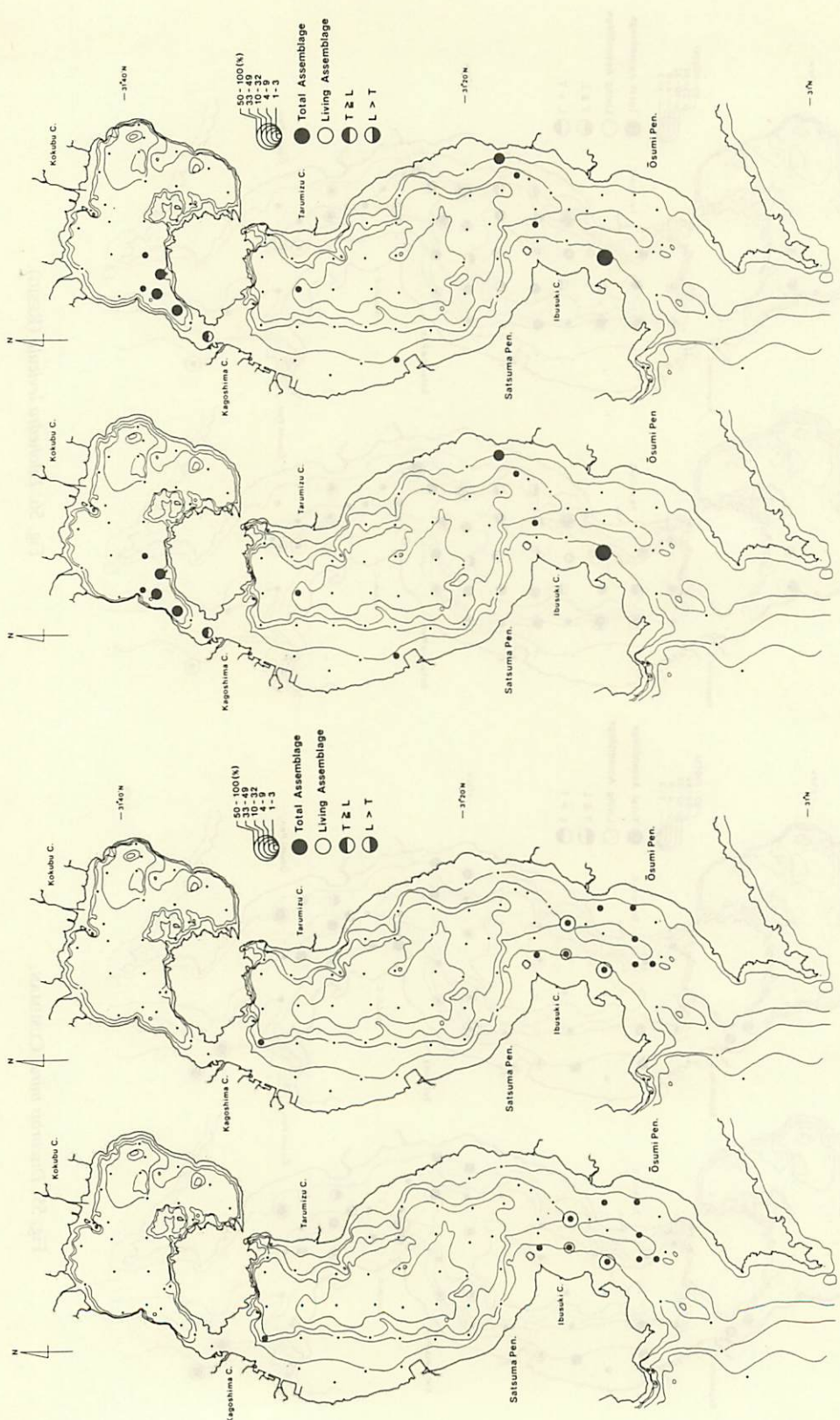


Fig. 57. *Neoconorbina stachi* (ASANO).

Fig. 58. *Ammonia beccarii* (LINNÉ) forma A.

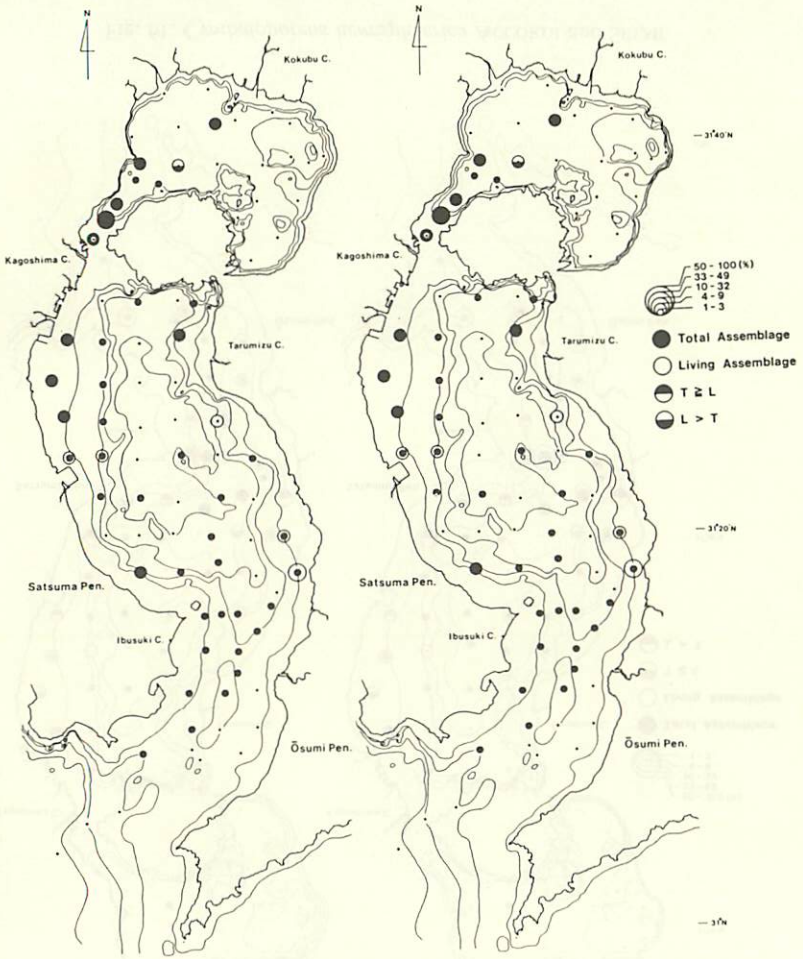


Fig. 59. *Elphidium advenum* (CUSHMAN).

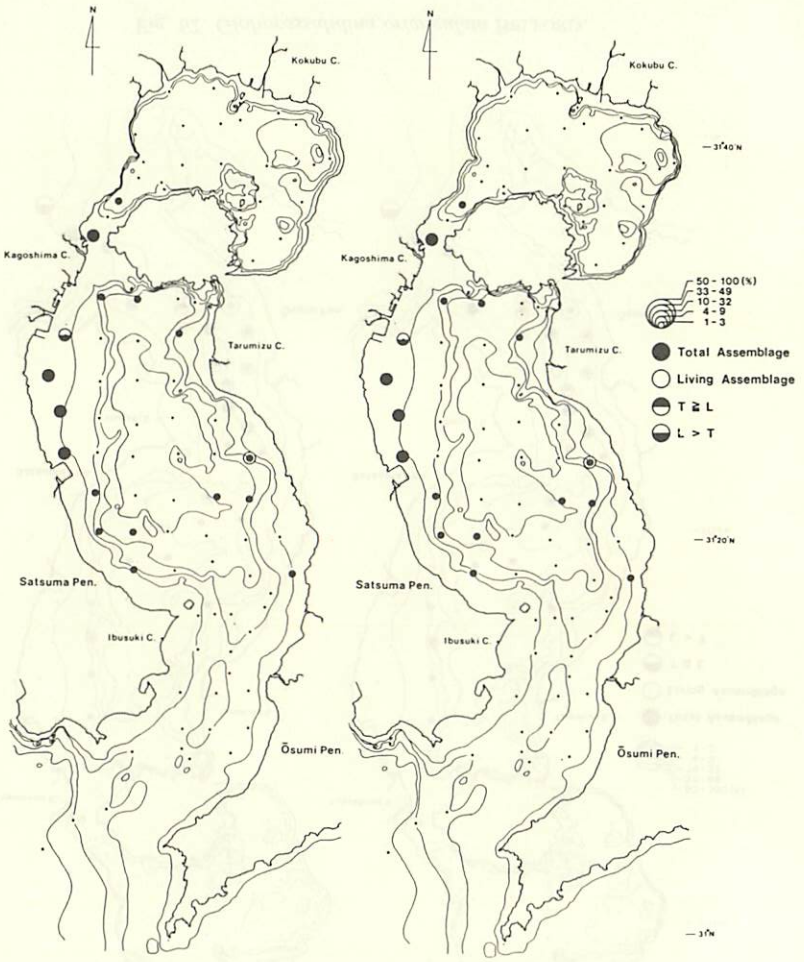


Fig. 60. *Protelphidium schmitti* CUSHMAN and WICKENDEN.

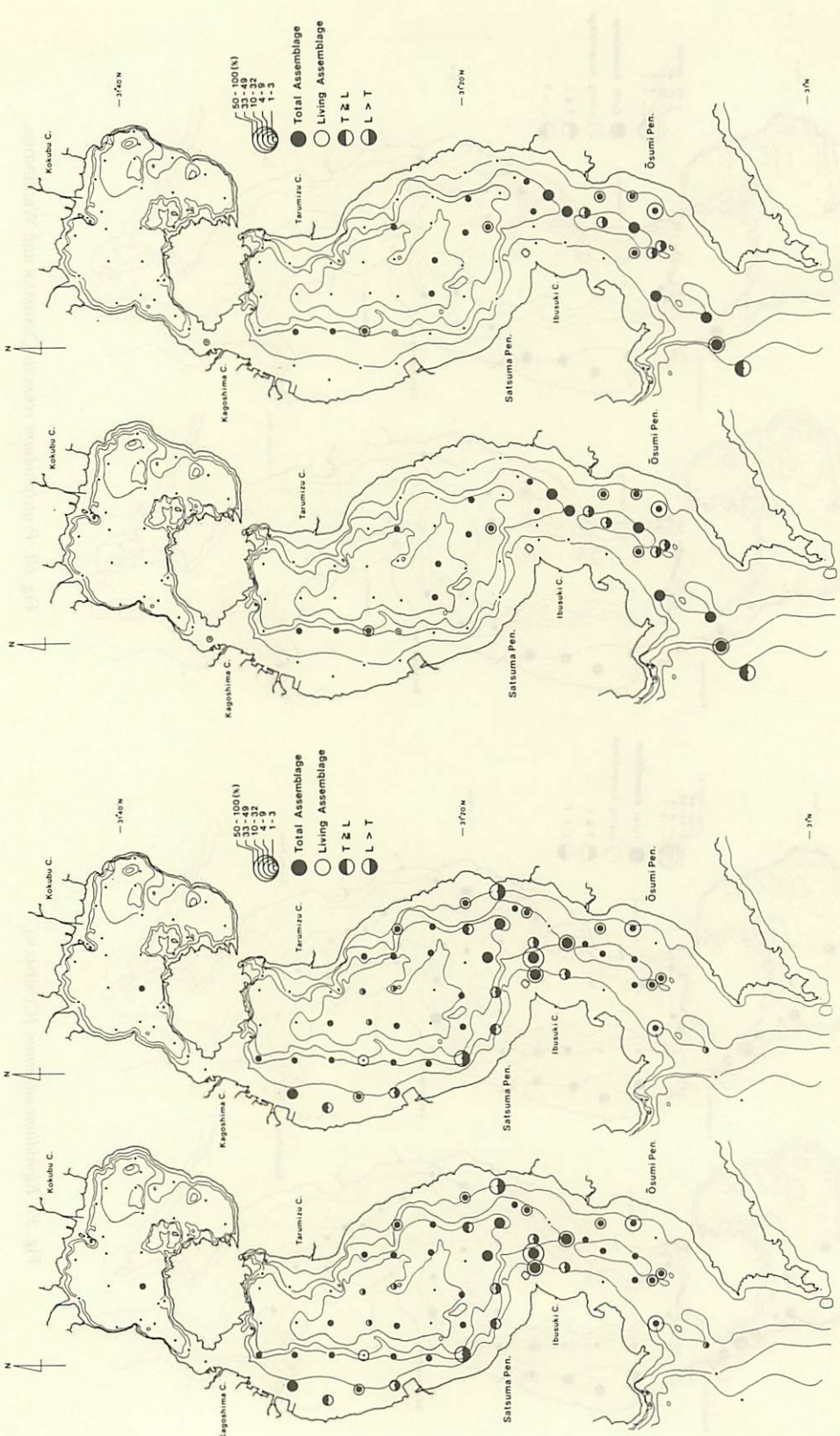


Fig. 61. *Cymbaloporetta hemisphaerica* ACCORDI and SELMI.

Fig. 62. *Globocassidulina oriangulata* BELFORD.

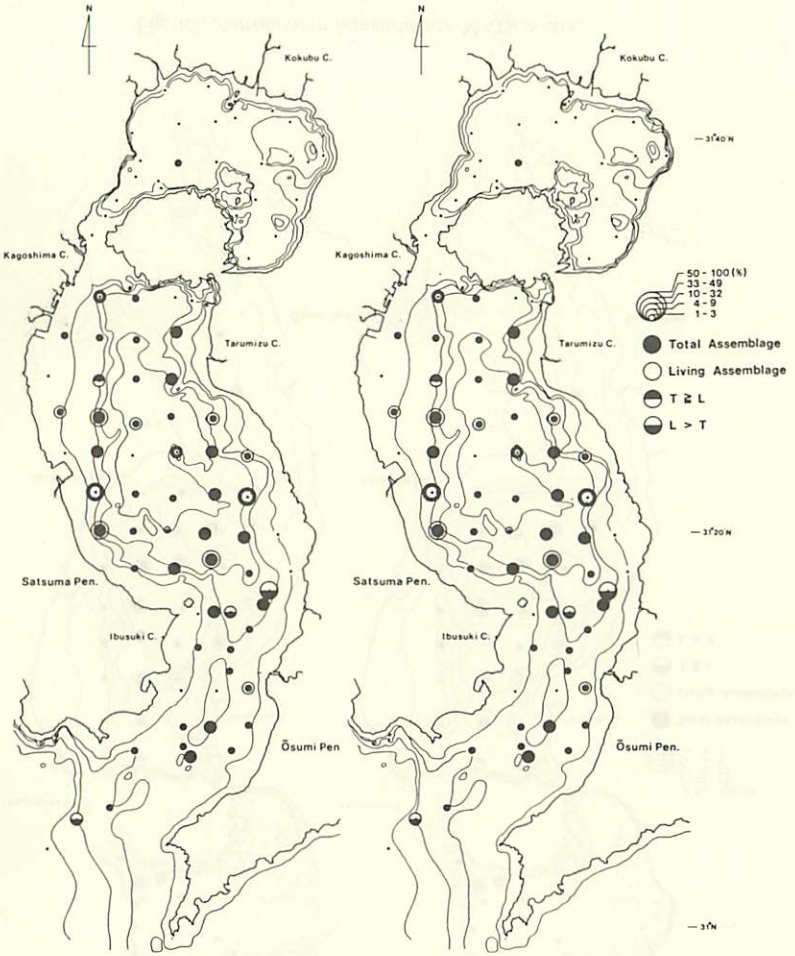


Fig. 63. *Cassidulina nørvangi* THALMANN.

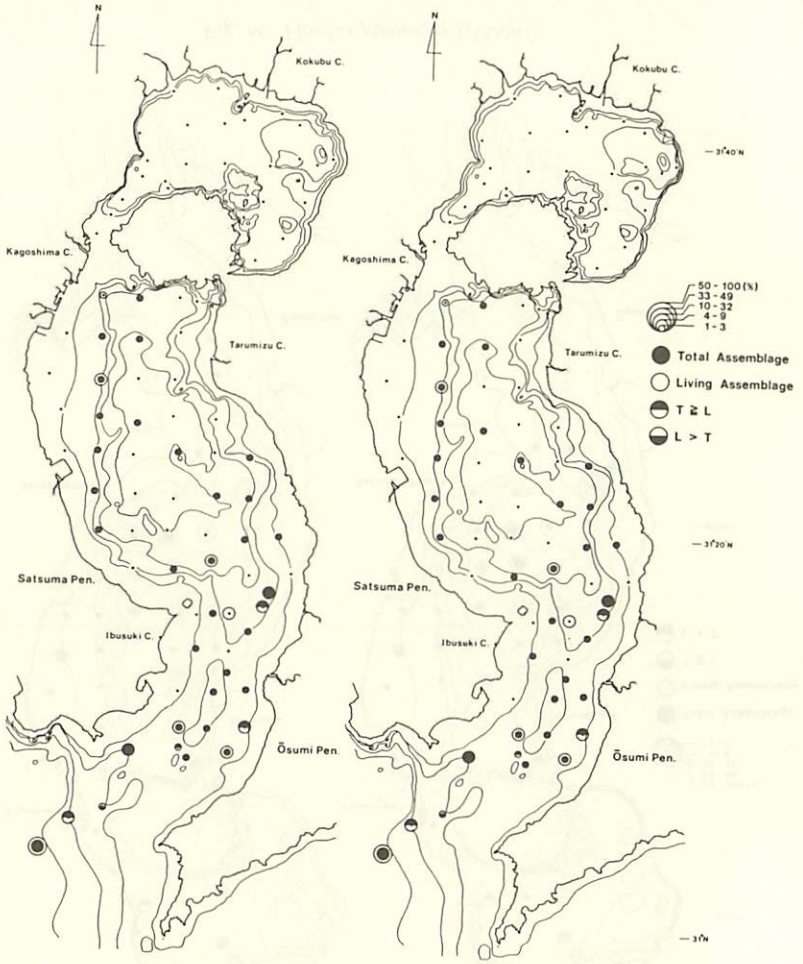


Fig. 64. *Paracassidulina quasicarinata* NOMURA.

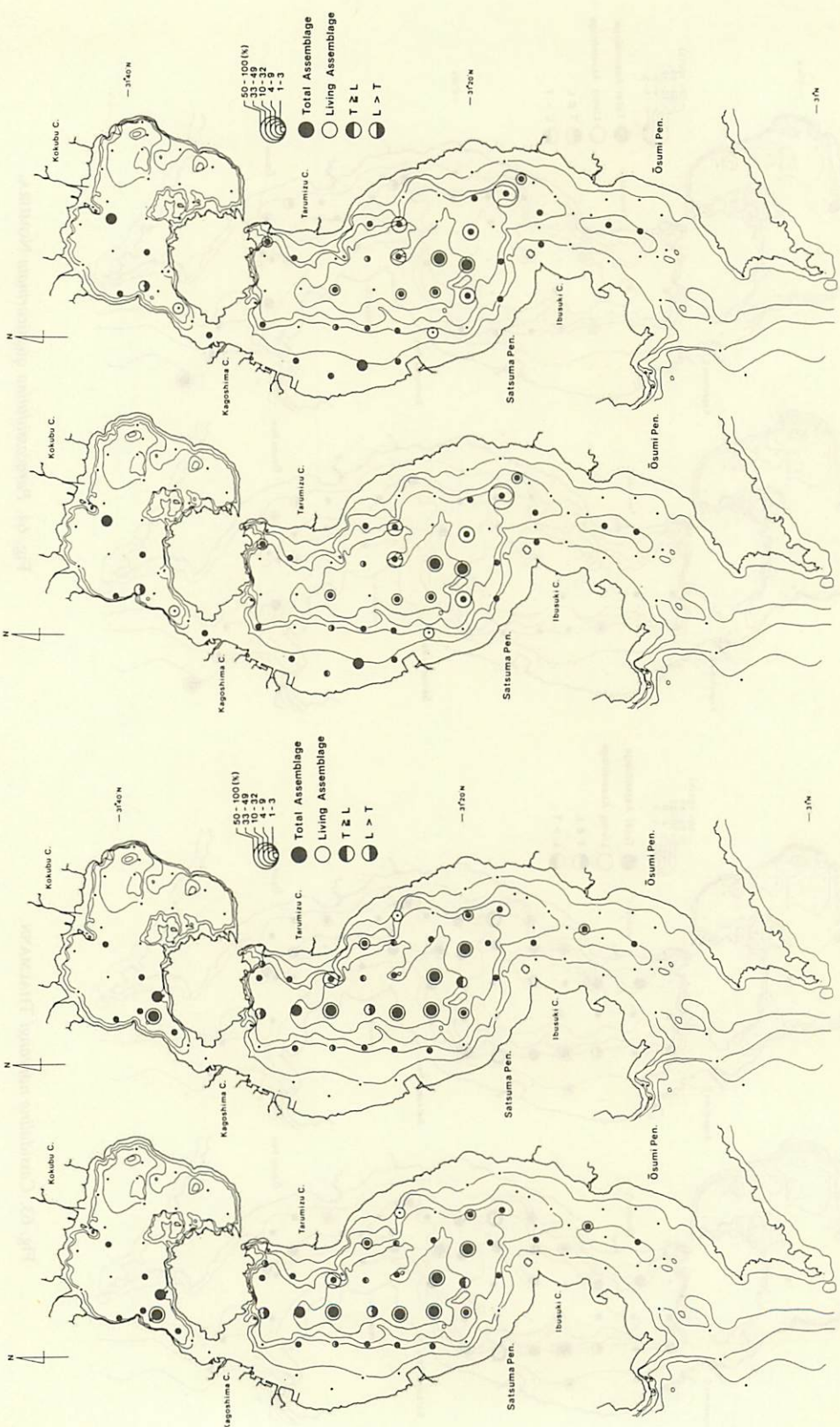


Fig. 65. *Astrononion hanyudaense* Matsunaga.

Fig. 66. *Florilus japonicus* (Asano).

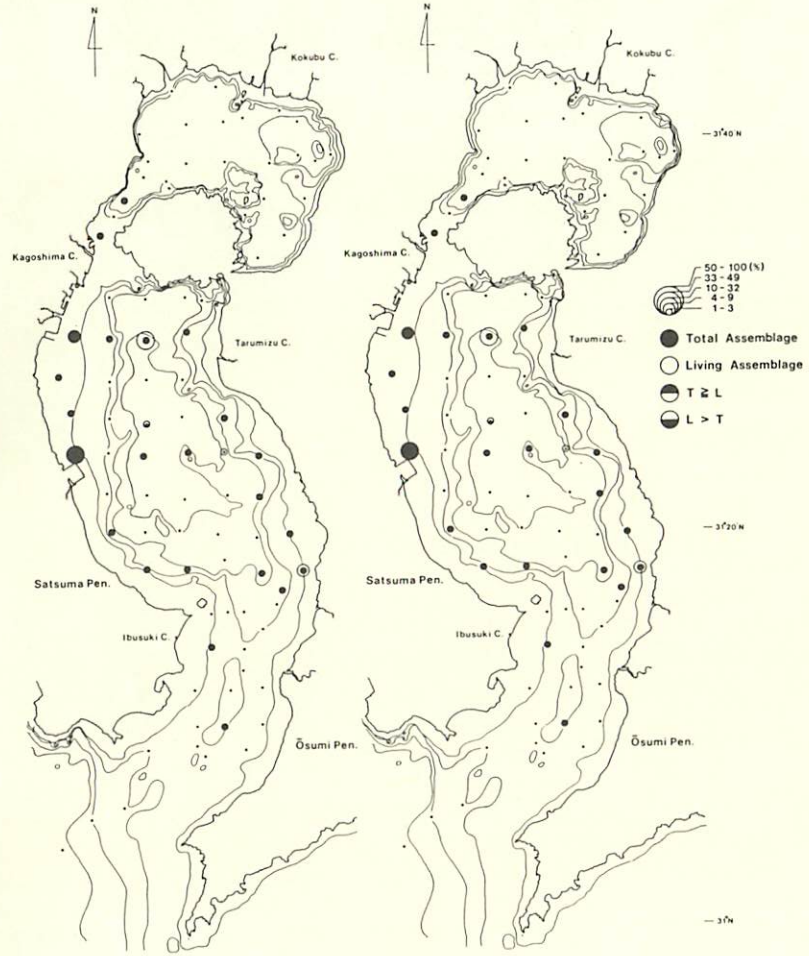


Fig. 67. *Pseudononion japonicum* ASANO.

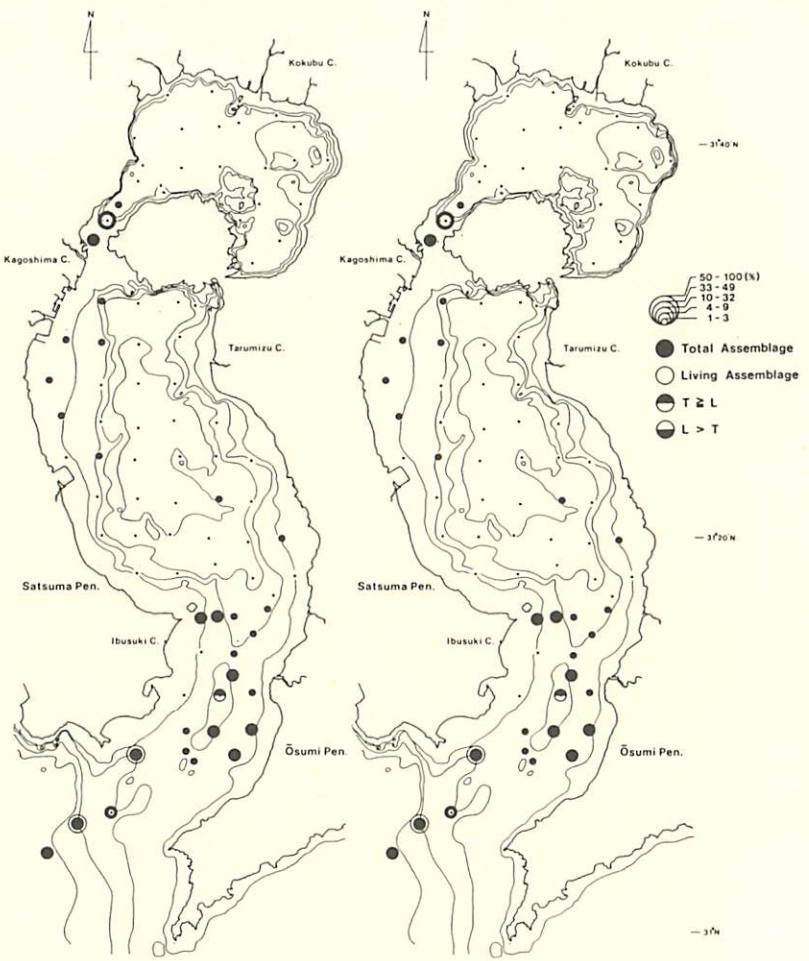


Fig. 68. *Cibicidodes pseudoungeriana* (CUSHMAN).

Plates 1～22

Explanation of Plate 1

Fig. 1. *Saccammina atlantica* (Cushman)(p. 65)
a: ESK Reg. no. F-7029 from Stn. 37
b: ESK Reg. no. F-7027 from Stn. 110

Fig. 2. *Lagenammina kagoshimaensis* Ōki. n. sp.(p.66, 167)
a: Holotype, ESK Reg. no. F-7039 from Stn. 12
b: Paratype, ESK Reg. no. F-7040 from Stn. 12
c: Paratype, ESK Reg. no. F-7041 from Stn. 113

Fig. 3. *Pelosina fusiformis* (Williamson)(p. 67)
ESK Reg. no. F-7097 from Stn. 104

Fig. 4. *Ammodiscus incertus* (d'Orbigny) (p. 68)
ESK Reg. no. F-7105 from Stn. 78

Fig. 5. *Ammodiscus minimus* Höglund (p. 68, 167)
ESK Reg. no. F-7118 from Stn. 42

Fig. 6. *Glomospira gordialis* (Jones and Parker) (p. 68, 167)
a: ESK Reg. no. F-7134 from Stn. 42
b: ESK Reg. no. F-7135 from Stn. 42

Fig. 7. *Reophax gracilis* (Kiaer) (p. 69)
ESK Reg. no. F-7147 from Stn. 68

Fig. 8. *Reophax nana* Rhumbler (p. 70)
ESK Reg. no. F-7180 from Stn. 63
(Optical Photograph)

Fig. 9. *Reophax scorpiurus* Montfort (p. 70)
ESK Reg. no. F-7185 from Stn. 68

Fig. 10. *Reophax scottii* Chaster (p. 70)
ESK Reg. no. F-7195 from Stn. 41
(Optical Photograph)

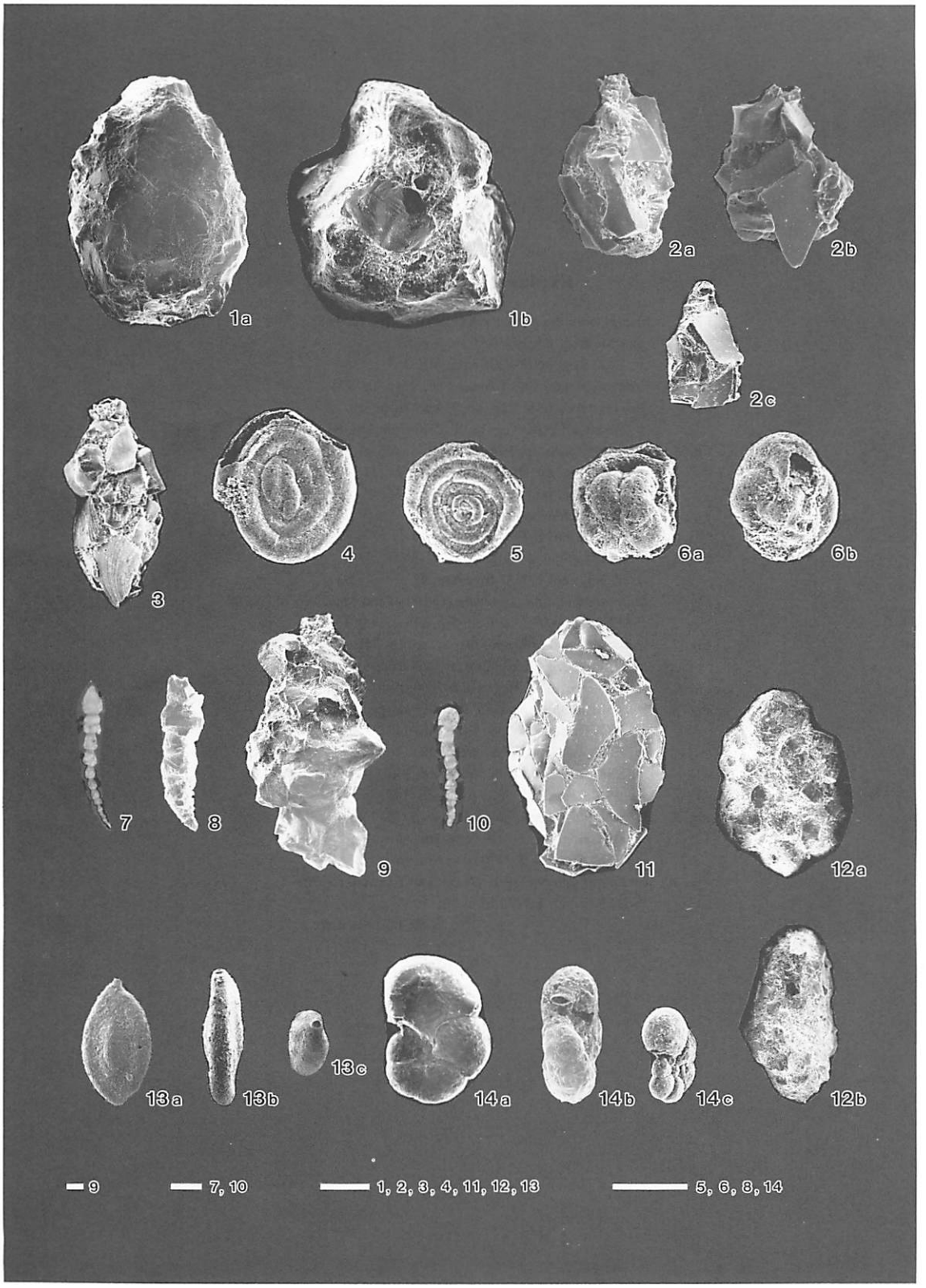
Fig. 11. *Nouria textulariformis* Hada (p. 71)
ESK Reg. no. F-7220 from Stn. 61

Fig. 12. *Nouria*? sp. (p. 71)
a: ESK Reg. no. F-7231 from Stn. 96
b: ESK Reg. no. F-7232 from Stn. 96

Fig. 13. *Spirosigmoilinella* sp. (p. 72)
a: ESK Reg. no. F-7261 from Stn. 143
b: ESK Reg. no. F-7262 from Stn. 139
c: ESK Reg. no. F-7263 from Stn. 139

Fig. 14. *Cribrostomoides jeffreysii* (Williamson) (p. 72)
a: ESK Reg. no. F-7289 from Stn. 139
b: ESK Reg. no. F-7287 from Stn. 124

Scale bar: 0.1 mm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12b
13a
13b
13c
14a
14b
14c
9
7, 10
1, 2, 3, 4, 11, 12, 13
5, 6, 8, 14

Explanation of Plate 2

Fig. 1. *Cribrostomoides kosterensis* (Höglund) (p. 73, 168)
a: ESK Reg. no. F-7307 from Stn. 69
b: ESK Reg. no. F-7308 from Stn. 3

Fig. 2. *Cribrostomoides satsumaensis* Ōki, n. sp. (p. 73)
a: Holotype, ESK Reg. no. F-7309 from Stn. 86
b: Paratype, ESK Reg. no. F-7310 from Stn. 86

Fig. 3. *Cribrostomoides* sp. 1 (p. 73)
a: ESK Reg. no. F-7328 from Stn. 37
b: ESK Reg. no. F-7329 from Stn. 37

Fig. 4. *Cribrostomoides* sp. 2 (p. 73)
ESK Reg. no. F-7334 from Stn. 99

Fig. 5. *Cribrostomoides* sp. 3 (p. 74)
ESK Reg. no. F-7337 from Stn. 42

Fig. 6. *Ammomarginulina catenulata* (Cushman and McCulloch) (p. 74)
ESK Reg. no. F-7353 from Stn. 118

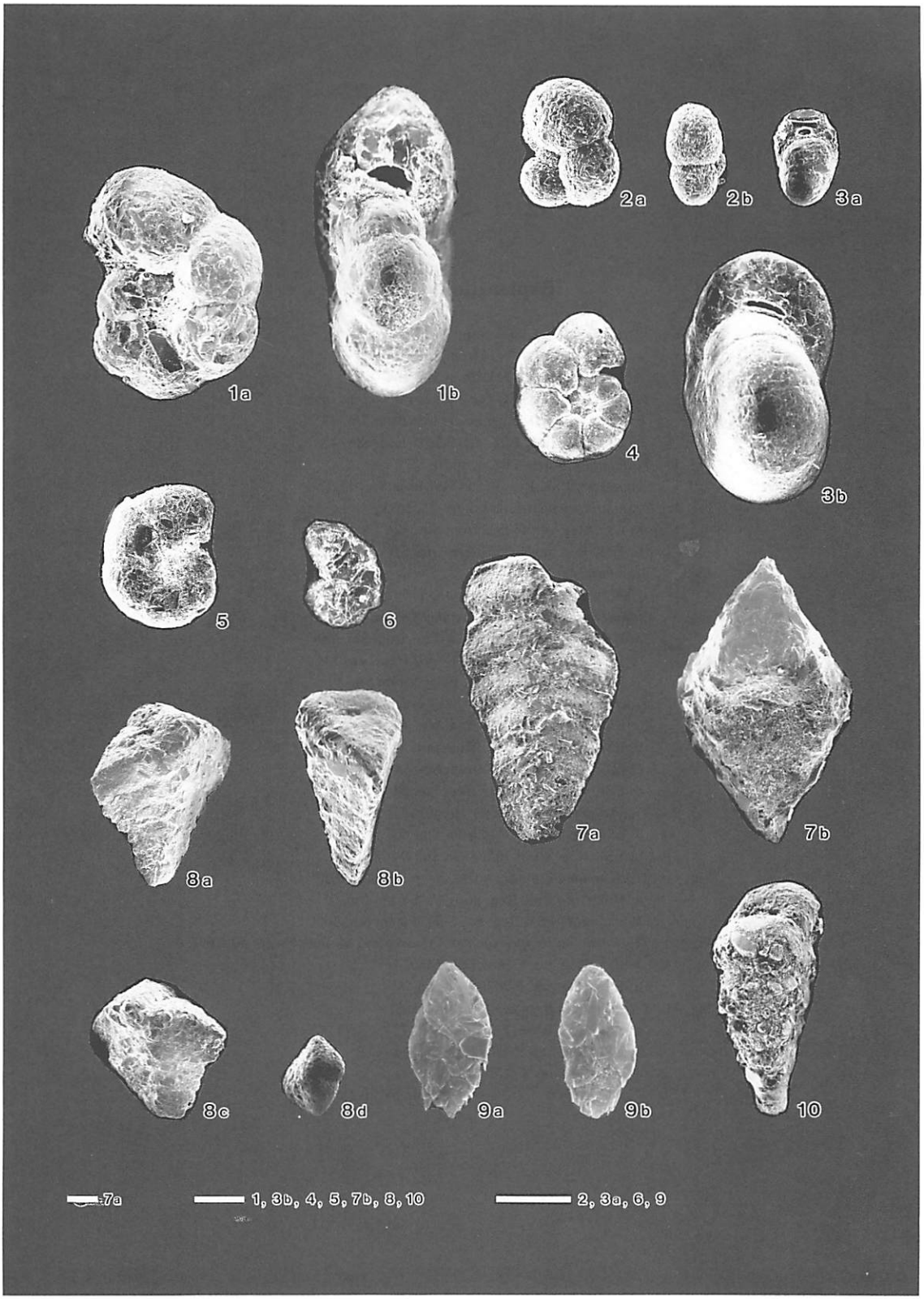
Fig. 7. *Spiroplectammina henmii* Ōki, n. sp. (p. 74)
a: Holotype, ESK Reg. no. F-7359 from Stn. 99
b: Paratype, ESK Reg. no. F-7360 from Stn. 136

Fig. 8. *Spiroplectammina higuchii* Takayanagi (p. 75)
a: ESK Reg. no. F-7380 from Stn. 146
b: ESK Reg. no. F-7381 from Stn. 146
c: ESK Reg. no. F-7382 from Stn. 146
d: ESK Reg. no. F-7383 from Stn. 145

Fig. 9. *Textularia bigenerinoides* Lacroix (p. 75, 168)
a: ESK Reg. no. F-7419 from Stn. 68
b: ESK Reg. no. F-7420 from Stn. 68

Fig. 10. *Textularia foliacea* Heron-Allen and Earland (p. 76)
ESK Reg. no. F-7430 from Stn. 99

Scale bar: 0.1 mm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7b
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8c
8d
9a
9b
10
7a
1, 3b, 4, 5, 7b, 8, 10
2, 3a, 6, 9

Explanation of Plate 3

Fig. 1. *Textularia goesii* Cushman (p. 76)
a: ESK Reg. no. F-7432 from Stn. 144
b: ESK Reg. no. F-7433 from Stn. 144

Fig. 2. *Textularia kattegatensis kagoshimaensis* Ôki, n. subsp. (p. 76, 168)
a: Holotype, ESK Reg. no. F-7434 from Stn. 42
b: Paratype, ESK Reg. no. F-7435 from Stn. 42

Fig. 3. *Textularia kuwanoi* Ôki, n. sp. (p. 77)
Holotype, ESK Reg. no. F-7467 from Stn. 15

Fig. 4. *Textularia wiesneri* Earland (p. 77, 169)
a: ESK Reg. no. F-7522 from Stn. 42
b: ESK Reg. no. F-7523 from Stn. 35

Fig. 5. *Textularia* sp. 3 (p. 78)
ESK Reg. no. F-7556 from Stn. 136

Fig. 6. *Siphotextularia rolshauseni otsukai* Ôki, n. subsp. (p. 78)
a: Holotype, ESK Reg. no. F-7561 from Stn. 146
b: Paratype, ESK Reg. no. F-7562 from Stn. 144
c: Paratype, ESK Reg. no. F-7563 from Stn. 91

Fig. 7. *Trochammina charlottensis* Cushman (p. 79)
a: ESK Reg. no. F-7610 from Stn. 40
b: ESK Reg. no. F-7611 from Stn. 54
c: ESK Reg. no. F-7612 from Stn. 54
d: ESK Reg. no. F-7613 from Stn. 54

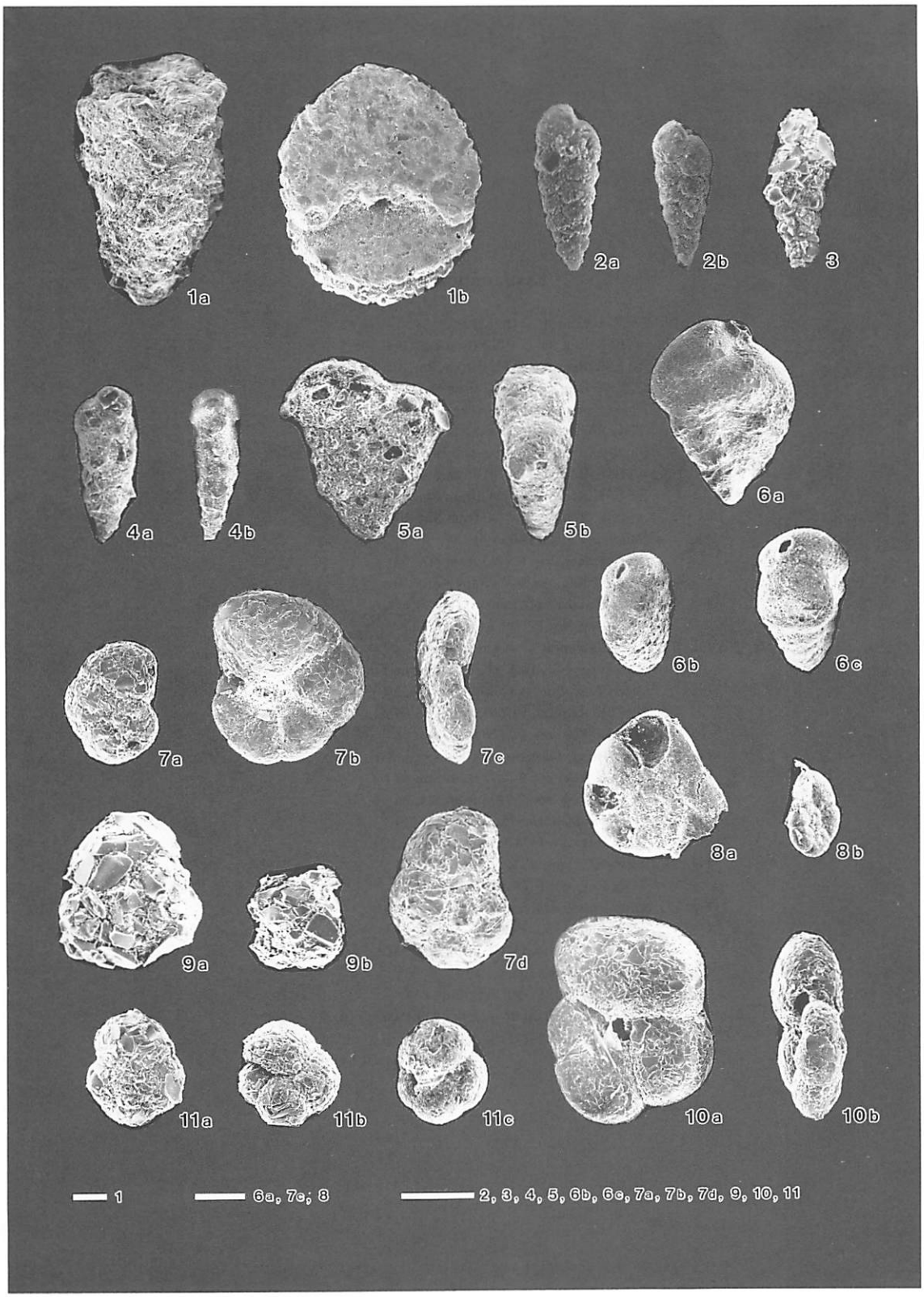
Fig. 8. *Trochammina nitida* Brady (p. 80)
a: ESK Reg. no. F-7618 from Stn. 63
b: ESK Reg. no. F-7621 from Stn. 94

Fig. 9. *Trochammina osumiensis* Ôki, n. sp. (p. 80, 169)
a: Holotype, ESK Reg. no. F-7623 from Stn. 75
b: Paratype, ESK Reg. no. F-7624 from Stn. 100

Fig. 10. *Trochammina pacifica simplex* Cushman and McCulloch (p. 80, 169)
a: ESK Reg. no. F-7685 from Stn. 73
b: ESK Reg. no. F-7671 from Stn. 42

Fig. 11. *Trochammina pygmaea* Höglund (p. 81)
a: ESK Reg. no. F-7707 from Stn. 73
b: ESK Reg. no. F-7708 from Stn. 73
c: ESK Reg. no. F-7709 from Stn. 73

Scale bar: 0.1 mm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2, 3, 4, 5, 6b, 6c, 7a, 7b, 7d, 9, 10, 11

Explanation of Plate 4

Fig. 1. *Trochammina* sp. 2 (p. 82)
a: ESK Reg. no. F-7722 from Stn. 144
b: ESK Reg. no. F-7721 from Stn. 103
c: ESK Reg. no. F-7723 from Stn. 144

Fig. 2. *Tiphotrocha kellettae* (THALMANN) (p. 82)
ESK Reg. no. F-7730 from Stn. 105

Fig. 3. *Gaudryina exilis* CUSHMAN and BRONNIMANN (p. 82)
a: ESK Reg. no. F-7741 from Stn. 104
b: ESK Reg. no. F-7742 from Stn. 65
c: ESK Reg. no. F-7743 from Stn. 104

Fig. 4. *Gaudryina nitida* HAQUE (p. 83)
a: ESK Reg. no. F-7743 from Stn. 65
b: ESK Reg. no. F-7773 from Stn. 70

Fig. 5. *Eggerella advena* (CUSHMAN) (p. 83)
ESK Reg. no. F-7791 from Stn. 42

Fig. 6. *Eggerella minuta* ŌKI, n. sp. (p. 84)
Holotype, ESK Reg. no. F-7797 from Stn. 143

Fig. 7. *Eggerella scabra* (WILLIAMSON) (p. 84, 169)
a: ESK Reg. no. F-7867 from Stn. 68
b: ESK Reg. no. F-7868 from Stn. 68

Fig. 8. *Clavulina* cf. *parisiensis* D'ORBIGNY (p. 84)
a: ESK Reg. no. F-7872 from Stn. 65
b: ESK Reg. no. F-7873 from Stn. 65

Fig. 9. *Cyclogyra planorbis* (SCHULTZE) (p. 85)
ESK Reg. no. F-7879 from Stn. 99

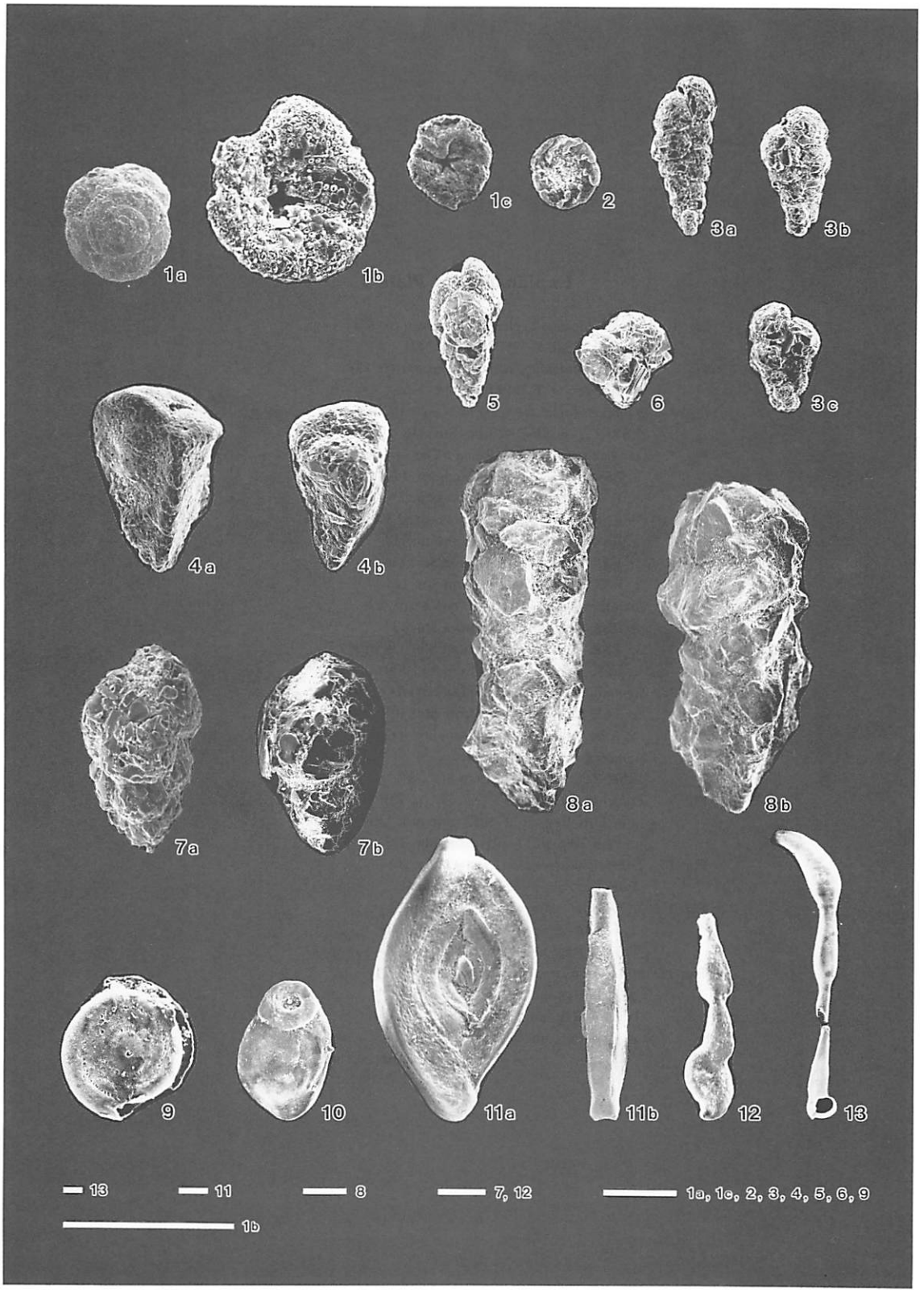
Fig. 10. *Wiesnerella auriculata* (EGGER) (p. 85)
ESK Reg. no. F-7885 from Stn. 107

Fig. 11. *Spiroloculina depressa* D'ORBIGNY (p. 86)
a: ESK Reg. no. F-7902 from Stn. 64
b: ESK Reg. no. F-7903 from Stn. 137

Fig. 12. *Nodobaculariella* sp. (p. 86)
ESK Reg. no. F-7907 from Stn. 118

Fig. 13. *Nodophthalmidium tibia* (JONES and PARKER) (p. 86)
ESK Reg. no. F-7914 from Stn. 146

Scale bar: 0.1 mm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Explanation of Plate 5

Fig. 1. *Quinqueloculina agglutinata* CUSHMAN (p. 87)
ESK Reg. no. F-7917 from Stn. 124

Fig. 2. *Quinqueloculina cf. costata* D'ORBIGNY (p. 87)
ESK Reg. no. F-7919 from Stn. 116

Fig. 3. *Quinqueloculina laevigata* D'ORBIGNY (p. 88)
ESK Reg. no. F-7942 from Stn. 116

Fig. 4. *Quinqueloculina lamarckiana* D'ORBIGNY (p. 88)
a: ESK Reg. no. F-7963 from Stn. 139
b: ESK Reg. no. F-7964 from Stn. 139

Fig. 5. *Quinqueloculina stalkeri* LOEBLICH and TAPPAN (p. 88)
a: ESK Reg. no. F-7975 from Stn. 113
b: ESK Reg. no. F-7984 from Stn. 136
c: ESK Reg. no. F-7983 from Stn. 124

Fig. 6. *Quinqueloculina vulgaris* D'ORBIGNY (p. 89)
a: ESK Reg. no. F-8016 from Stn. 127
b: ESK Reg. no. F-8017 from Stn. 139
c: ESK Reg. no. F-8018 from Stn. 139

Fig. 7. *Sigmoilopsis schlumbergeri* (SILVESTRI) (p. 89)
a: ESK Reg. no. F-8037 from Stn. 107
b: ESK Reg. no. F-8038 from Stn. 113

Fig. 8. *Sigmoilopsis* sp. (p. 89)
ESK Reg. no. F-8046 from Stn. 78

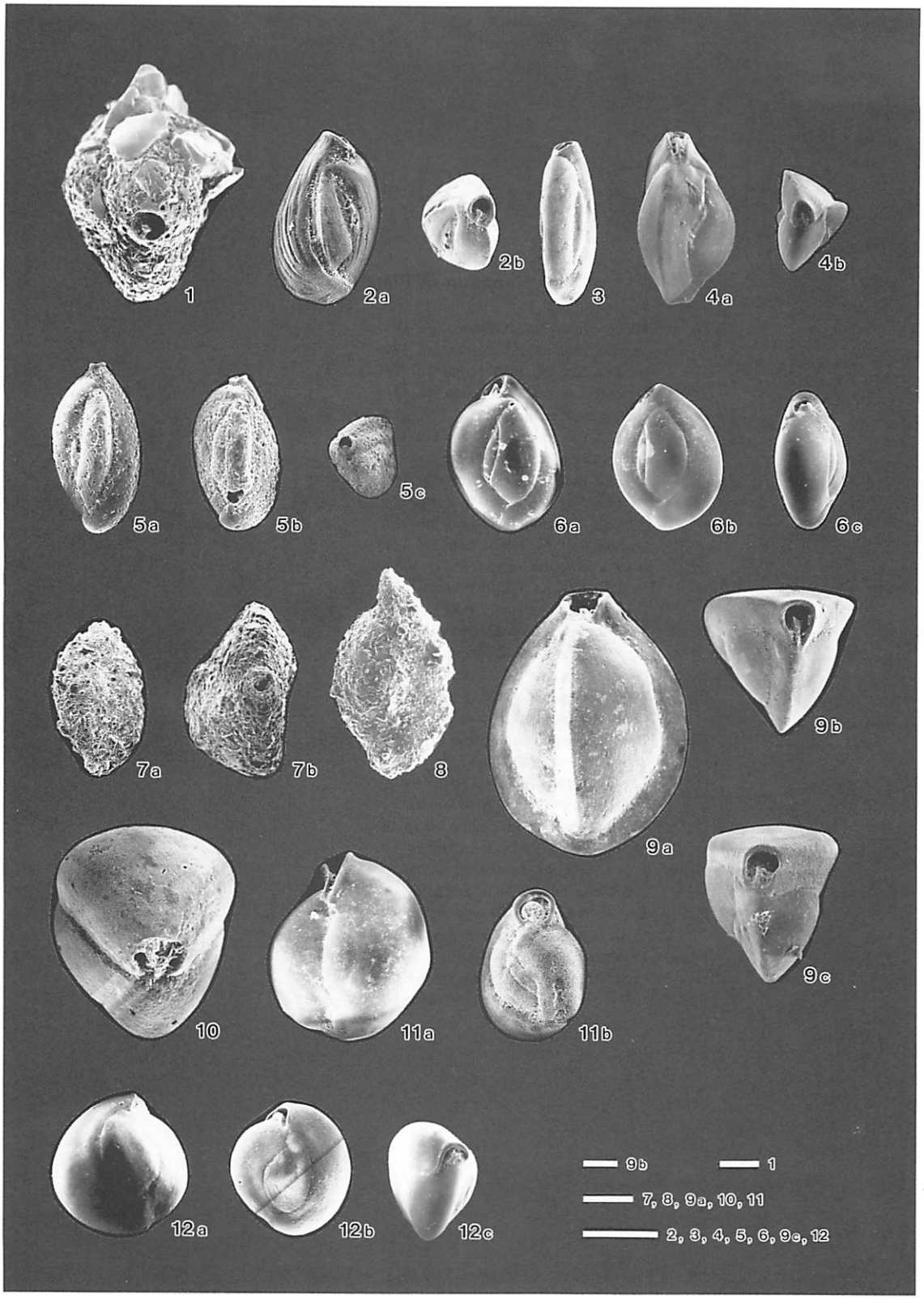
Fig. 9. *Triloculina tricarinata* D'ORBIGNY (p. 90)
a-b: ESK Reg. no. F-8052 from Stn. 136
c: ESK Reg. no. F-8051 from Stn. 113

Fig. 10. *Triloculina trigonula* (LAMARCK) (p. 90)
ESK Reg. no. F-8056 from Stn. 124

Fig. 11. *Miliolinella californica* RHUMBLER (p. 91)
a: ESK Reg. no. F-8057 from Stn. 146
b: ESK Reg. no. F-8058 from Stn. 146

Fig. 12. *Miliolinella circularis* (BORNEMANN) (p. 91)
a: ESK Reg. no. F-8065 from Stn. 146
b: ESK Reg. no. F-8066 from Stn. 137
c: ESK Reg. no. F-8067 from Stn. 108

Scale bar: 0.1 mm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Explanation of Plate 6

Fig. 1. *Miliolinella sublineata* (BRADY) (p. 91)
a: ESK Reg. no. F-8069 from Stn. 124
b: ESK Reg. no. F-8070 from Stn. 124
c: ESK Reg. no. F-8071 from Stn. 124

Fig. 2. *Nummoloculina* sp. (p. 92)
a: ESK Reg. no. F-8079 from Stn. 144
b: ESK Reg. no. F-8074 from Stn. 137
c: ESK Reg. no. F-8078 from Stn. 146
d: ESK Reg. no. F-8080 from Stn. 144
e: ESK Reg. no. F-8075 from Stn. 137
f: ESK Reg. no. F-8081 from Stn. 144

Fig. 3. *Amphicoryna scalaris* (BATSCH) (p. 92)
a: ESK Reg. no. F-8101 from Stn. 110
b: ESK Reg. no. F-8102 from Stn. 79

Fig. 4. *Amphicoryna spicata* (CUSHMAN and MCCULLOCH) (p. 93)
a: ESK Reg. no. F-8118 from Stn. 113
b: ESK Reg. no. F-8119 from Stn. 113

Fig. 5. *Dentalina emaciata* REUSS (p. 93)
ESK Reg. no. F-8122 from Stn. 137

Fig. 6. *Dentalina vertebralis* (BATSCH) (p. 94)
ESK Reg. no. F-8130 from Stn. 99

Fig. 7. *Lagena amphora* REUSS (p. 94)
ESK Reg. no. F-8133 from Stn. 72

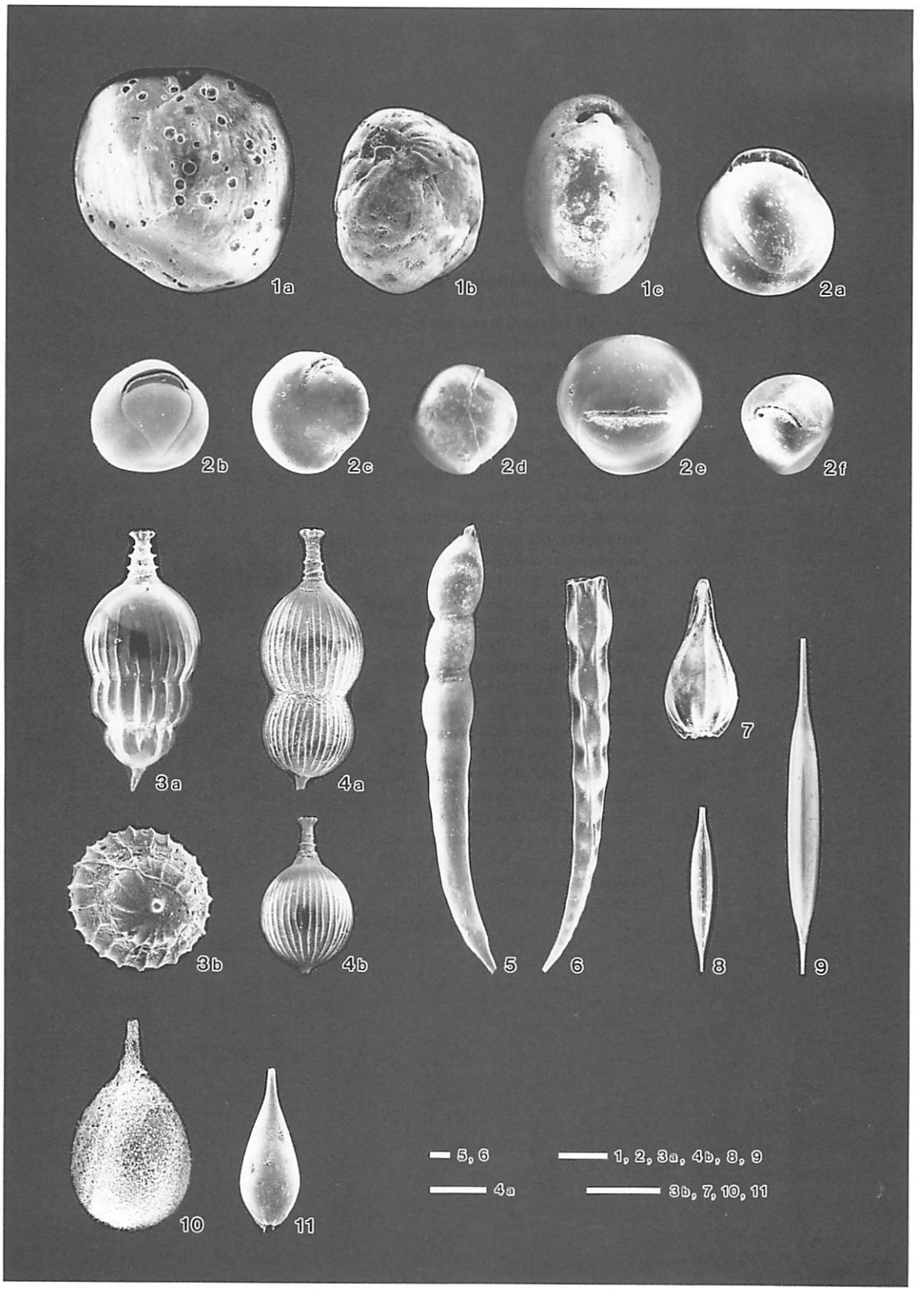
Fig. 8. *Lagena distoma* PARKER and JONES (p. 95)
ESK Reg. no. F-8135 from Stn. 84

Fig. 9. *Lagena elongata* (EHRENBERG) (p. 95)
ESK Reg. no. F-8138 from Stn. 96

Fig. 10. *Lagena hispidula* CUSHMAN (p. 95)
ESK Reg. no. F-8140 from Stn. 83

Fig. 11. *Lagena setigera* MILLETT (p. 95)
ESK Reg. no. F-8148 from Stn. 63

Scale bar: 0.1 mm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3b, 7, 10, 11

Explanation of Plate 7

Fig. 1. *Lagena* aff. *substriata* WILLIAMSON (p. 96)
ESK Reg. no. F-8155 from Stn. 102

Fig. 2. *Lagena* sp. 1 (p. 96)
ESK Reg. no. F-8160 from Stn. 92

Fig. 3. *Lenticulina calcar* (LINNÉ) (p. 97)
a-b: ESK Reg. no. F-8200 from Stn. 101

Fig. 4. *Lenticulina* sp. 1 (p. 98)
ESK Reg. no. F-8227 from Stn. 144

Fig. 5. *Lenticulina* sp. 2 (p. 98)
a: ESK Reg. no. F-8229 from Stn. 89
b: ESK Reg. no. F-8232 from Stn. 91

Fig. 6. *Saracenaria latifrons* (BRADY) (p. 99)
ESK Reg. no. F-8237 from Stn. 96

Fig. 7. *Guttulina communis* (D'ORBIGNY) (p. 99)
a: ESK Reg. no. F-8245 from Stn. 102
b: ESK Reg. no. F-8248 from Stn. 64

Fig. 8. *Guttulina regina* (BRADY, PARKER and JONES) (p. 100)
ESK Reg. no. F-8250 from Stn. 65

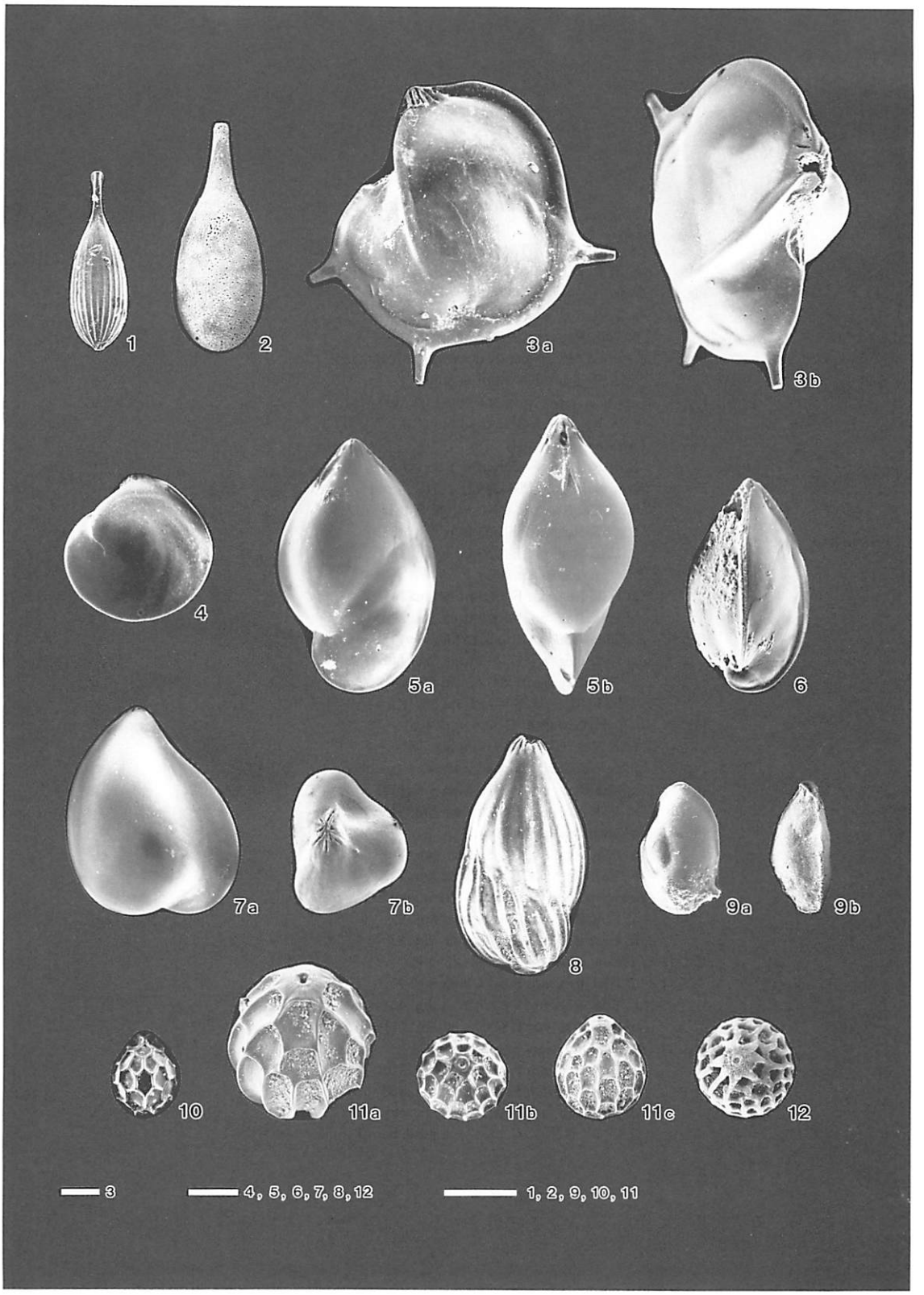
Fig. 9. *Seabrookia pellucida* BRADY (p. 101)
a: ESK Reg. no. F-8272 from Stn. 107
b: ESK Reg. no. F-8275 from Stn. 139

Fig. 10. *Oolina hexagona* (WILLIAMSON) (p. 101)
ESK Reg. no. F-8289 from Stn. 137

Fig. 11. *Oolina melo* D'ORBIGNY (p. 101)
a: ESK Reg. no. F-8293 from Stn. 145
b-c: ESK Reg. no. F-8292 from Stn. 65

Fig. 12. *Oolina squamosa* (MONTAGU) (p. 102)
ESK Reg. no. F-8295 from Stn. 113

Scale bar: 0.1 mm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Explanation of Plate 8

Fig. 1. *Fissurina agassizi* Todd and Bronnimann (p. 102)
ESK Reg. no. F-8296 from Stn. 102

Fig. 2. *Fissurina laevigata* Reuss (p. 103)
a: ESK Reg. no. F-8330 from Stn. 144
b: ESK Reg. no. F-8331 from Stn. 144

Fig. 3. *Fissurina orbignyana* (Seguenza) (p. 103)
ESK Reg. no. F-8338 from Stn. 113

Fig. 4. *Fissurina semimarginata* (Reuss) (p. 104)
ESK Reg. no. F-8345 from Stn. 104

Fig. 5. *Fissurina* sp. (p. 104)
ESK Reg. no. F-8356 from Stn. 141

Fig. 6. *Fissurina wiesneri* Barker (p. 104)
a,c: ESK Reg. no. F-8350 from Stn. 113
b: ESK Reg. no. F-8353 from Stn. 137
d: ESK Reg. no. F-8355 from Stn. 146

Fig. 7. *Parafissurina* sp. (p. 105)
a: ESK Reg. no. F-8360 from Stn. 145
b: ESK Reg. no. F-8357 from Stn. 122

Fig. 8. *Buliminella elegantissima* (d'Orbigny) (p. 105, 170)
a: ESK Reg. no. F-8413 from Stn. 146
b: ESK Reg. no. F-8414 from Stn. 83
c: ESK Reg. no. F-8415 from Stn. 83

Fig. 9. *Buliminella milletti* Cushman (p. 105)
ESK Reg. no. F-8416 from Stn. 98

Fig. 10. *Sphaeroidina* cf. *bulloides* d'Orbigny (p. 106)
a: ESK Reg. no. F-8428 from Stn. 145
b: ESK Reg. no. F-8429 from Stn. 143

Fig. 11. *Sphaeroidina* sp. (p. 106)
a: ESK Reg. no. F-8438 from Stn. 143
b: ESK Reg. no. F-8434 from Stn. 122

Fig. 12. *Bolovina abbreviata* Heron-Allen and Earland (p. 106)
a: ESK Reg. no. F-8445 from Stn. 95
b: ESK Reg. no. F-8442 from Stn. 83

Fig. 13. *Bolivina albatrossi* Cushman (p. 106)
a: ESK Reg. no. F-8454 from Stn. 90
b: ESK Reg. no. F-8457 from Stn. 134
c: ESK Reg. no. F-8455 from Stn. 113

Fig. 14. *Bolivina durrandii* Millett (p. 107)
a: ESK Reg. no. F-8475 from Stn. 110
b: ESK Reg. no. F-8474 from Stn. 108
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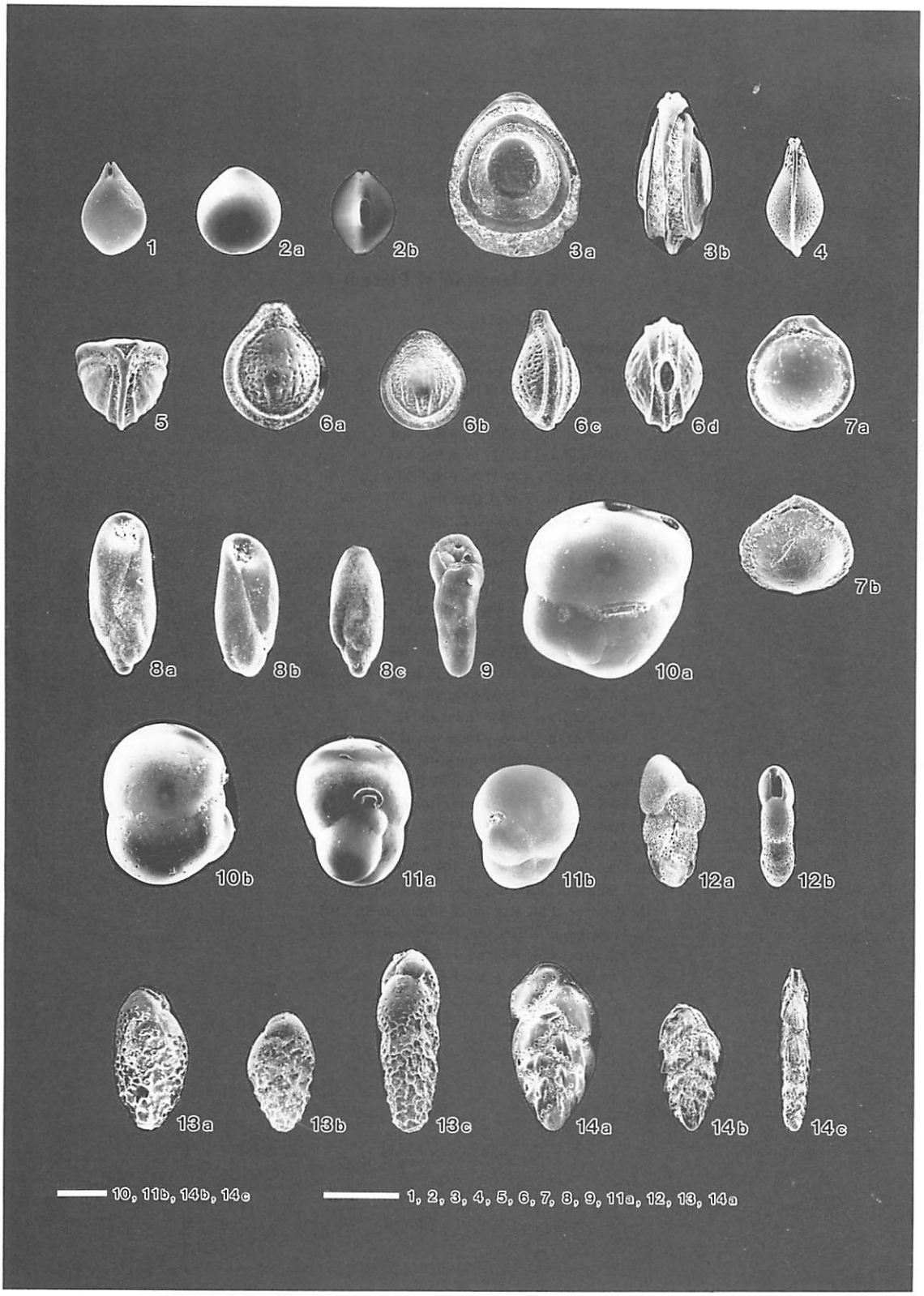
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Explanation of Plate 9

Fig. 1. *Bolivina hadai* Uchio (p. 107)
ESK Reg. no. F-8483 from Stn. 132

Fig. 2. *Bolivina humilis* Cushman and McCulloch (p. 107)
a: ESK Reg. no. F-8518 from Stn. 104
b: ESK Reg. no. F-8519 from Stn. 104
c: ESK Reg. no. F-8520 from Stn. 106
d: ESK Reg. no. F-8521 from Stn. 141
e: ESK Reg. no. F-8522 from Stn. 139
f: ESK Reg. no. F-8523 from Stn. 139

Fig. 3. *Bolivina karreriana* Brady (p. 108)
a: ESK Reg. no. F-8548 from Stn. 127
b: ESK Reg. no. F-8549 from Stn. 99

Fig. 4. *Bolivina kiiensis* Asano (p. 108)
a-b: ESK Reg. no. F-8567 from Stn. 141
c: ESK Reg. no. F-8568 from Stn. 103
d: ESK Reg. no. F-8569 from Stn. 136

Fig. 5. *Bolivina ordinaria* Phleger and Parker (p. 108, 170)
a: ESK Reg. no. F-8637 from Stn. 145
b: ESK Reg. no. F-8638 from Stn. 127
c: ESK Reg. no. F-8639 from Stn. 127
d: ESK Reg. no. F-8640 from Stn. 127

Fig. 6. *Bolivina pacifica* Cushman and McCulloch (p. 109)
a: ESK Reg. no. F-8674 from Stn. 97
b: ESK Reg. no. F-8675 from Stn. 137
c: ESK Reg. no. F-8676 from Stn. 133

Fig. 7. *Bolivina retia* Ōki, n. sp. (p. 109, 170)
a-f: Holotype, ESK Reg. no. F-8677 from Stn. 139
b: Paratype, ESK Reg. no. F-8678 from Stn. 103
c: Paratype, ESK Reg. no. F-8679 from Stn. 139
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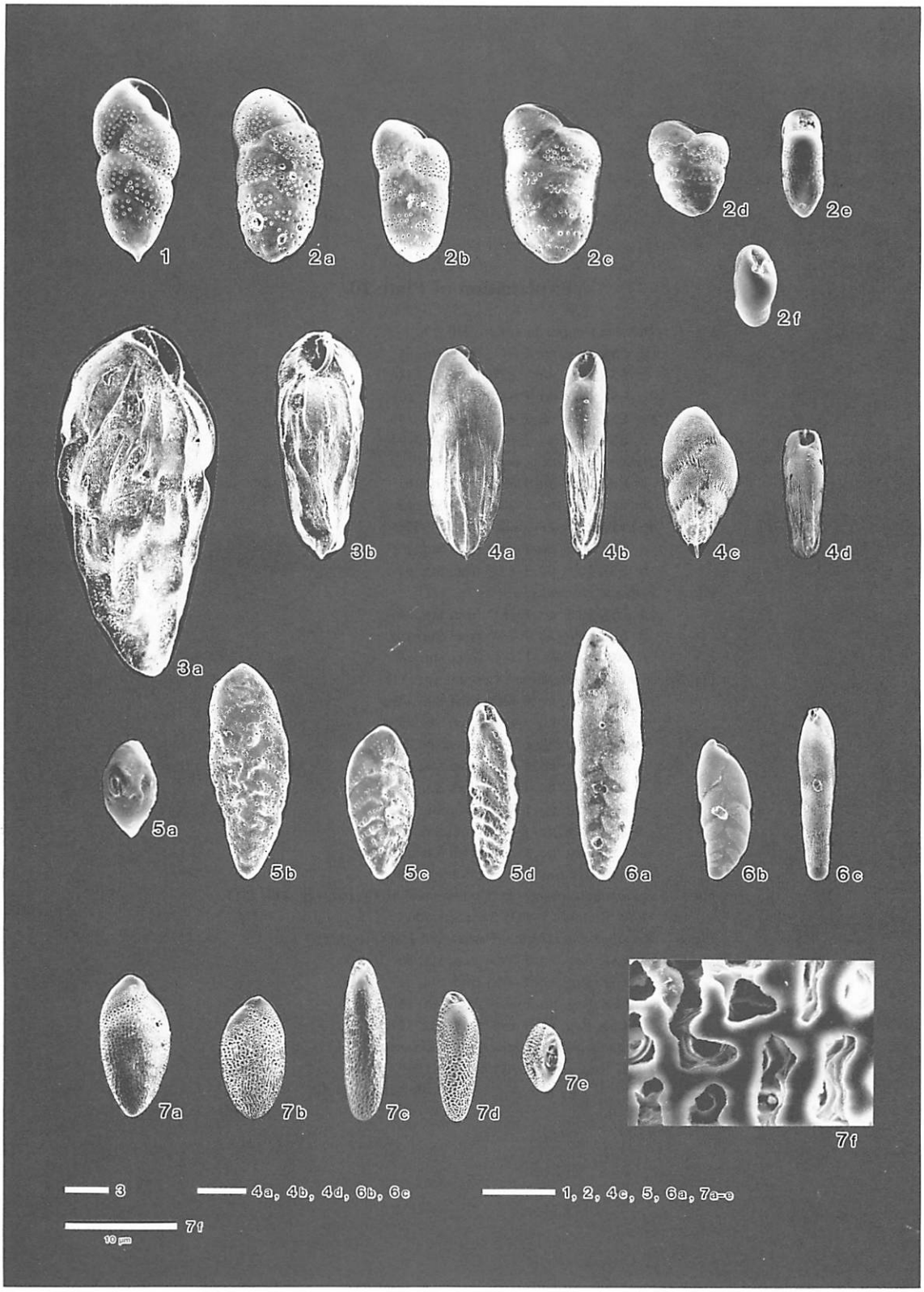
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Explanation of Plate 10

Fig. 1. *Bolivina robusta* BRADY (p. 110, 170)
a: ESK Reg. no. F-8775 from Stn. 64
b: ESK Reg. no. F-8776 from Stn. 146
c: ESK Reg. no. F-8777 from Stn. 104
d: ESK Reg. no. F-8778 from Stn. 146
e: ESK Reg. no. F-8779 from Stn. 104

Fig. 2. *Bolivina spinea* CUSHMAN (p. 110)
a: ESK Reg. no. F-8784 from Stn. 63
b: ESK Reg. no. F-8785 from Stn. 63

Fig. 3. *Bolivina striatula* CUSHMAN (p. 111, 171)
a: ESK Reg. no. F-8834 from Stn. 101
b: ESK Reg. no. F-8835 from Stn. 91

Fig. 4. *Bolivina subreticulata* PARR (p. 111)
a: ESK Reg. no. F-8847 from Stn. 146
b: ESK Reg. no. F-8841 from Stn. 108
c: ESK Reg. no. F-8848 from Stn. 143

Fig. 5. *Bolivina subspinescens* CUSHMAN (p. 111)
a: ESK Reg. no. F-8881 from Stn. 139
b: ESK Reg. no. F-8877 from Stn. 137

Fig. 6. *Bolivina variabilis* (WILLIAMSON) (p. 112)
a: ESK Reg. no. F-8906 from Stn. 139
b: ESK Reg. no. F-8894 from Stn. 101
c: ESK Reg. no. F-8907 from Stn. 110
d: ESK Reg. no. F-8903 from Stn. 136
e: ESK Reg. no. F-8908 from Stn. 139
f: ESK Reg. no. F-8909 from Stn. 139

Fig. 7. *Rectobolivina hancocki* (CUSHMAN and MCCULLOCH) (p. 112, 171)
ESK Reg. no. F-8925 from Stn. 106

Fig. 8. *Rectobolivina raphana* (PARKER and JONES) (p. 113)
a: ESK Reg. no. F-8980 from Stn. 88
b: ESK Reg. no. F-8981 from Stn. 113
c: ESK Reg. no. F-8977 from Stn. 141
d: ESK Reg. no. F-8982 from Stn. 127

Fig. 9. *Rectobolivina tonohamaensis* (TAKAYANAGI) (p. 113)
ESK Reg. no. F-8990 from Stn. 106

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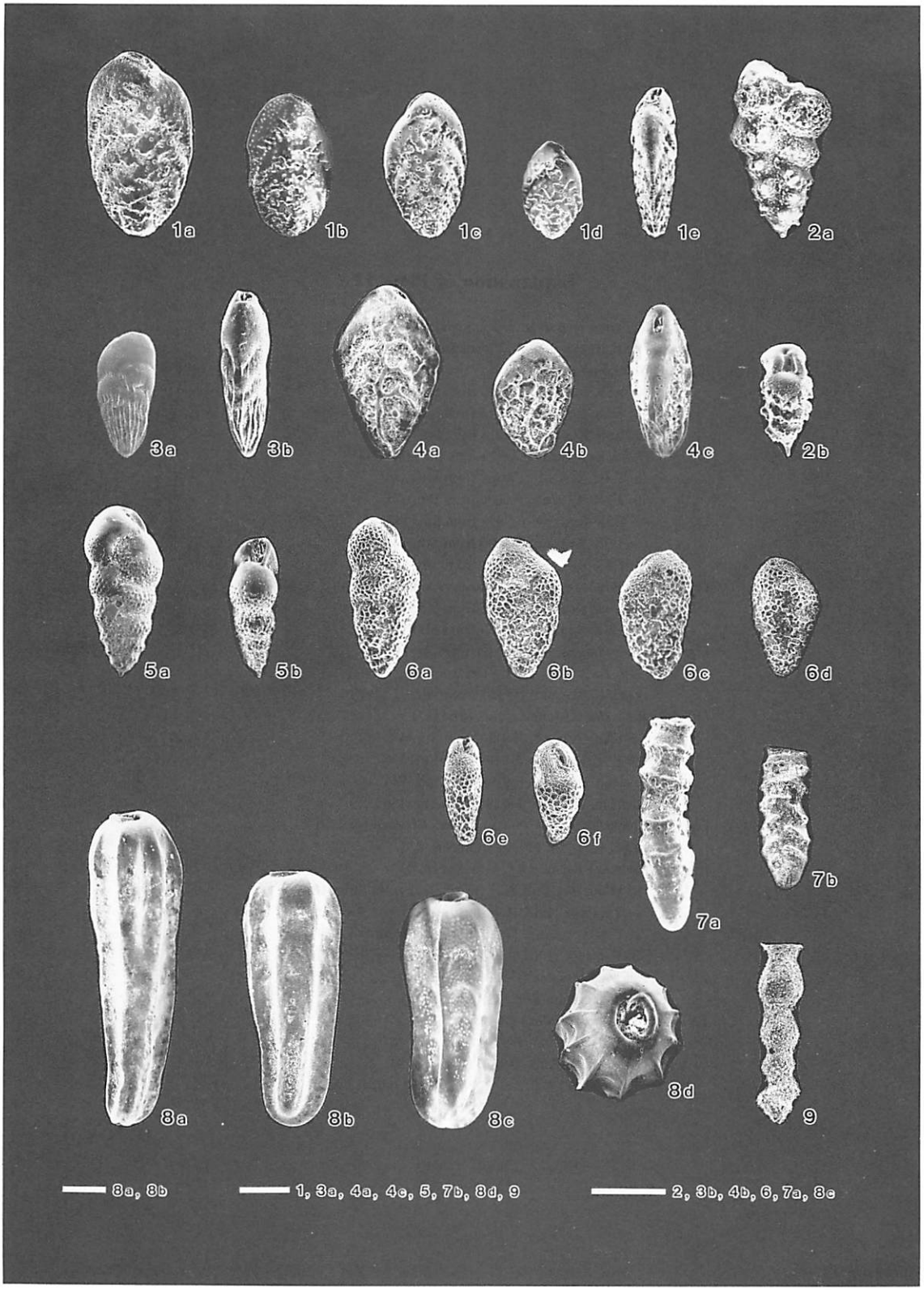
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Explanation of Plate 11

Fig. 1. *Bulimina denudata* CUSHMAN and PARKER (p. 114)
ESK Reg. no. F-8997 from Stn. 70

Fig. 2. *Bulimina kochiensis* TAKAYANAGI (p. 114)
a: ESK Reg. no. F-9010 from Stn. 100
b: ESK Reg. no. F-9012 from Stn. 113
c: ESK Reg. no. F-9014 from Stn. 105

Fig. 3. *Bulimina marginata* D'ORBIGNY (p. 114, 171)
a: ESK Reg. no. F-9088 from Stn. 146
b: ESK Reg. no. F-9086 from Stn. 145
c: ESK Reg. no. F-9089 from Stn. 143
d: ESK Reg. no. F-9090 from Stn. 146
e: ESK Reg. no. F-9091 from Stn. 146

Fig. 4. *Bulimina spinosa* (HERON-ALLEN and EARLAND) (p. 115, 171)
a: ESK Reg. no. F-9133 from Stn. 72
b: ESK Reg. no. F-9134 from Stn. 72

Fig. 5. *Globobulimina turgida* (BAILEY) (p. 116)
a-b: ESK Reg. no. F-9156 from Stn. 101
c: ESK Reg. no. F-9157 from Stn. 97

Fig. 6. *Reussella aculeata* CUSHMAN (p. 117)
a: ESK Reg. no. F-9177 from Stn. 65
b: ESK Reg. no. F-9194 from Stn. 136
c: ESK Reg. no. F-9195 from Stn. 136
d: ESK Reg. no. F-9196 from Stn. 136

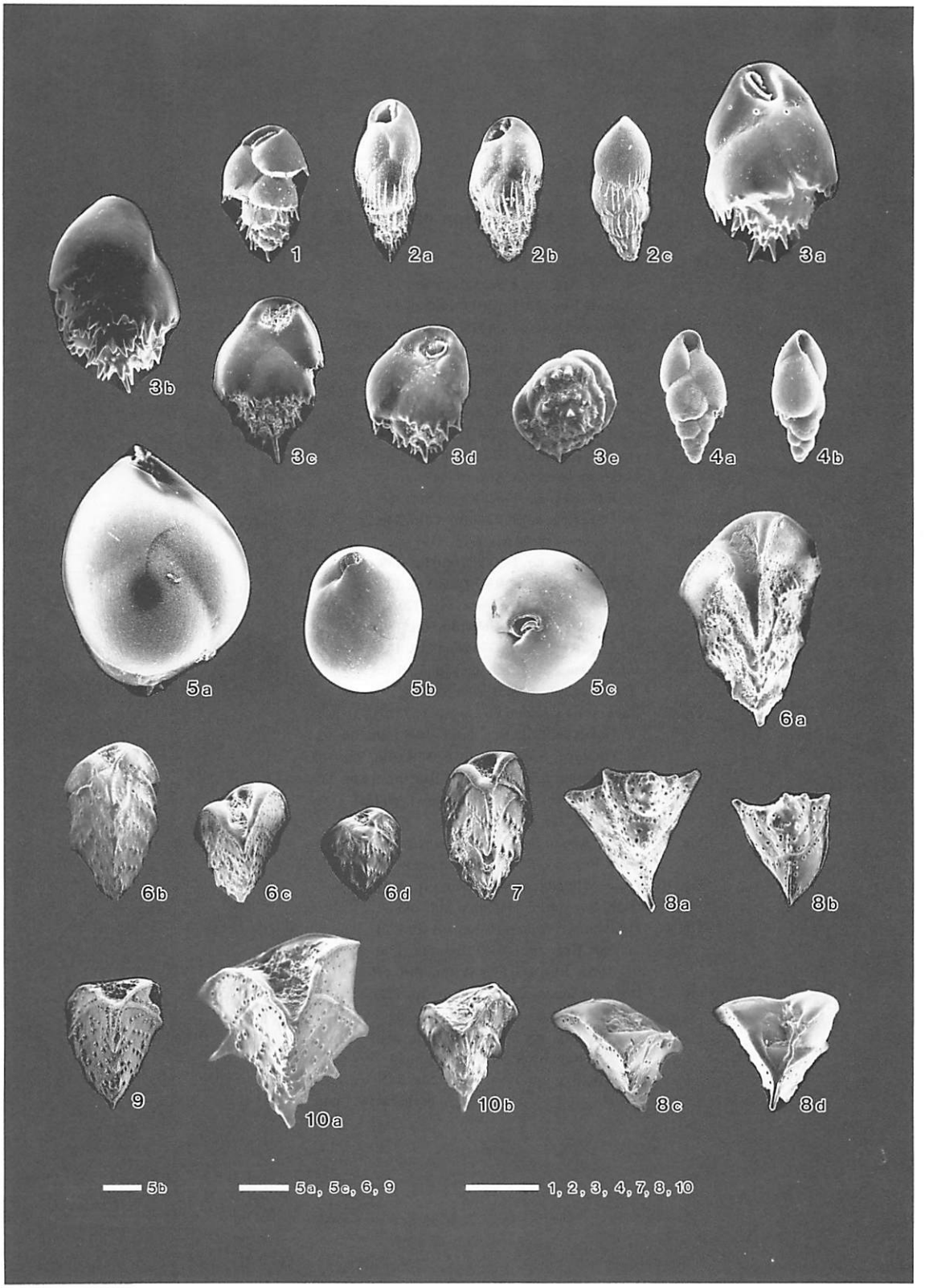
Fig. 7. *Reussella aequa* CUSHMAN and MCCULLOCH (p. 117)
ESK Reg. no. F-9201 from Stn. 136

Fig. 8. *Reussella hayasakai* ŌKI, n. sp. (p. 117)
a: Holotype, ESK Reg. no. F-9202 from Stn. 116
b: Paratype, ESK Reg. no. F-9203 from Stn. 116
c: Paratype, ESK Reg. no. F-9204 from Stn. 88
d: Paratype, ESK Reg. no. F-9205 from Stn. 101

Fig. 9. *Reussella simplex* (CUSHMAN) (p. 118)
ESK Reg. no. F-9234 from Stn. 146

Fig. 10. *Reussella spinulosa* (REUSS) (p. 118)
a: ESK Reg. no. F-9247 from Stn. 74
b: ESK Reg. no. F-9270 from Stn. 93

Scale bar: 0.1 mm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5a, 5c, 6, 9
1, 2, 3, 4, 7, 8, 10

Explanation of Plate 12

Fig. 1. *Reussella* sp. (p. 118)
a: ESK Reg. no. F-9251 from Stn. 74
b: ESK Reg. no. F-9260 from Stn. 83

Fig. 2. *Trimosina? takayanagii* Ōki, n. sp. (p. 118)
a: Holotype, ESK Reg. no. F-9261 from Stn. 104
b,g: Paratype, ESK Reg. no. F-9262 from Stn. 104
c: Paratype, ESK Reg. no. F-9263 from Stn. 99
d: ESK Reg. no. F-9276 from Stn. 101
e: ESK Reg. no. F-9280 from Stn. 104
f: ESK Reg. no. F-9281 from Stn. 93

Fig. 3. *Uvigerina bosoensis* Aoki (p. 119)
a: ESK Reg. no. F-9284 from Stn. 108
b: ESK Reg. no. F-9289 from Stn. 146

Fig. 4. *Uvigerina schencki* Asano (p. 119)
a: ESK Reg. no. F-9306 from Stn. 139
b: ESK Reg. no. F-9307 from Stn. 139

Fig. 5. *Uvigerina vadescens* Cushman (p. 120, 171)
a: ESK Reg. no. F-9369 from Stn. 110
b: ESK Reg. no. F-9370 from Stn. 143

Fig. 6. *Hopkinsina glabra* (Millett) (p. 120)
ESK Reg. no. F-9402 from Stn. 90

Fig. 7. *Hopkinsina kuwanoi* Ōki, n. sp. (p. 120)
a: Holotype, ESK Reg. no. F-9403 from Stn. 92
b: Paratype, ESK Reg. no. F-9404 from Stn. 102
c: Paratype, ESK Reg. no. F-9405 from Stn. 139

Fig. 8. *Siphogenerina columellaris* (Brady) (p. 121)
ESK Reg. no. F-9425 from Stn. 137

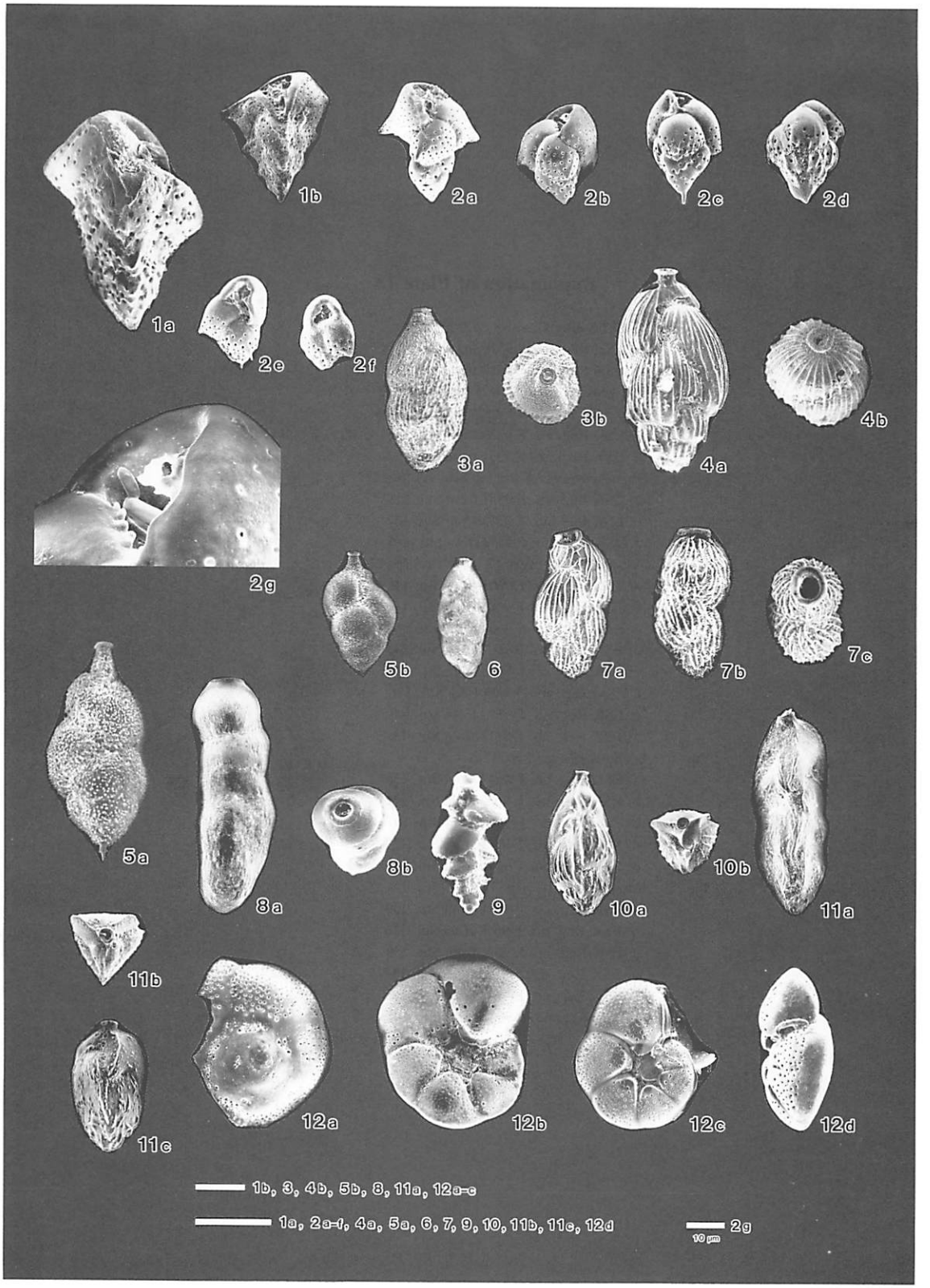
Fig. 9. *Siphouvigerina fimbriata* (Sidebottom) (p. 121)
ESK Reg. no. F-9429 from Stn. 139

Fig. 10. *Trifarina angulosa* (Williamson) (p. 121)
ESK Reg. no. F-9444 from Stn. 146

Fig. 11. *Trifarina occidentalis* (Cushman) (p. 122)
a: ESK Reg. no. F-9463 from Stn. 136
b-c: ESK Reg. no. F-9464 from Stn. 146

Fig. 12. *Discorbis candeiana* (d'Orbigny) (p. 122)
a: ESK Reg. no. F-9474 from Stn. 64
b: ESK Reg. no. F-9465 from Stn. 104
c: ESK Reg. no. F-9475 from Stn. 64
d: ESK Reg. no. F-9473 from Stn. 145

Scale bar: 0.1 mm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10b
11a
11b
11c
12a
12b
12c
12d
1b, 3, 4b, 5b, 8, 11a, 12a–c
1a, 2a–f, 4a, 5a, 6, 7, 9, 10, 11b, 11c, 12d
2g
100 μm

Explanation of Plate 13

Fig. 1. *Discorbis mira* CUSHMAN (p. 122, 172)
a: ESK Reg. no. F-9526 from Stn. 99
b: ESK Reg. no. F-9527 from Stn. 136
c,f: ESK Reg. no. F-9528 from Stn. 139
d,g: ESK Reg. no. F-9529 from Stn. 136
e: ESK Reg. no. F-9530 from Stn. 116
h: ESK Reg. no. F-9531 from Stn. 132

Fig. 2. *Discorbinella bertheloti* (D'ORBIGNY) (p. 123)
a: ESK Reg. no. F-9557 from Stn. 118
b: ESK Reg. no. F-9558 from Stn. 137
c: ESK Reg. no. F-9559 from Stn. 145

Fig. 3. *Discorbinella convexa* (TAKAYANAGI) (p. 124)
a: ESK Reg. no. F-9604 from Stn. 146
b: ESK Reg. no. F-9605 from Stn. 144
c: ESK Reg. no. F-9606 from Stn. 146
d: ESK Reg. no. F-9607 from Stn. 145
e: ESK Reg. no. F-9608 from Stn. 145
f: ESK Reg. no. F-9609 from Stn. 146
g: ESK Reg. no. F-9610 from Stn. 84
h: ESK Reg. no. F-9611 from Stn. 73

Fig. 4. *Eoeponidella* sp. 1 (p. 124)
a: ESK Reg. no. F-9643 from Stn. 139
b: ESK Reg. no. F-9639 from Stn. 141
c: ESK Reg. no. F-9644 from Stn. 107
d: ESK Reg. no. F-9645 from Stn. 139
e: ESK Reg. no. F-9646 from Stn. 139

Fig. 5. *Eoeponidella* sp. 3 (p. 124)
a: ESK Reg. no. F-9671 from Stn. 139
b: ESK Reg. no. F-9668 from Stn. 116
c: ESK Reg. no. F-9672 from Stn. 139
d: ESK Reg. no. F-9673 from Stn. 144
e: ESK Reg. no. F-9674 from Stn. 105
f: ESK Reg. no. F-9664 from Stn. 104

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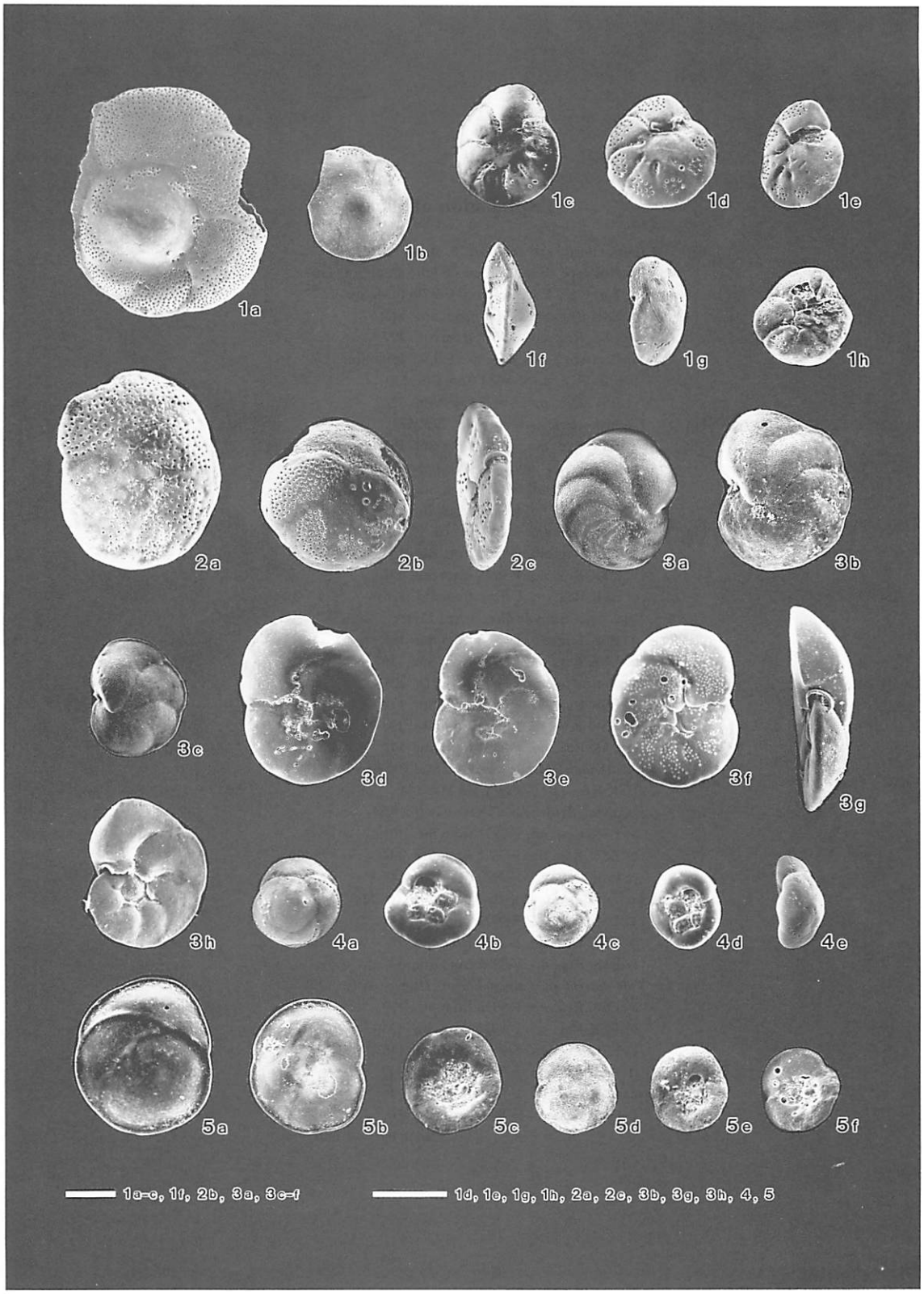
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5f
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1d, 1e, 1g, 1h, 2a, 2c, 3b, 3g, 3h, 4, 5

Explanation of Plate 14

Fig. 1. *Epistominella kuwanoi* Ōki, n. sp. (p. 125)
a: Holotype, ESK Reg. no. F-9675 from Stn. 136
b: Paratype, ESK Reg. no. F-9676 from Stn. 127
c: ESK Reg. no. F-9687 from Stn. 143
d: ESK Reg. no. F-9688 from Stn. 127
e: Paratype, ESK Reg. no. F-9677 from Stn. 127
f: ESK Reg. no. F-9684 from Stn. 139
g: ESK Reg. no. F-9678 from Stn. 73

Fig. 2. *Eilohedra levicula* (Resig) (p. 126, 172)
a: ESK Reg. no. F-9756 from Stn. 103
b,e: ESK Reg. no. F-9757 from Stn. 139
c: ESK Reg. no. F-9758 from Stn. 144
d: ESK Reg. no. F-9759 from Stn. 102

Fig. 3. *Neoconorbina stachi* (Asano) (p. 126, 172)
a: ESK Reg. no. F-9785 from Stn. 139
b: ESK Reg. no. F-9786 from Stn. 139
c: ESK Reg. no. F-9787 from Stn. 136

Fig. 4. *Patellinella carinata* Collins (p. 127)
a: ESK Reg. no. F-9788 from Stn. 136
b: ESK Reg. no. F-9789 from Stn. 136

Fig. 5. *Patellinella inconspicua* (Brady) (p. 127)
a: ESK Reg. no. F-9822 from Stn. 139
b: ESK Reg. no. F-9823 from Stn. 134
c: ESK Reg. no. F-9824 from Stn. 141

Fig. 6. *Planulinoides biconcava* (Jones and Parker) (p. 127)
ESK Reg. no. F-9826 from Stn. 134

Fig. 7. *Rosalina vilardeboana* d'Orbigny (p. 128)
a: ESK Reg. no. F-9871 from Stn. 101
b: ESK Reg. no. F-9872 from Stn. 144
c: ESK Reg. no. F-9870 from Stn. 145

Fig. 8. *Cancris auricula* (Fichtel and Moll) (p. 128)
a: ESK Reg. no. F-9873 from Stn. 116
b: ESK Reg. no. F-9875 from Stn. 73
c: ESK Reg. no. F-9885 from Stn. 64

Fig. 9. *Valvulineria* aff. *hamanakoensis* (Ishiwada) (p. 129)
a: ESK Reg. no. F-9936 from Stn. 139
b: ESK Reg. no. F-9937 from Stn. 137
c: ESK Reg. no. F-9938 from Stn. 146
d: ESK Reg. no. F-9939 from Stn. 143
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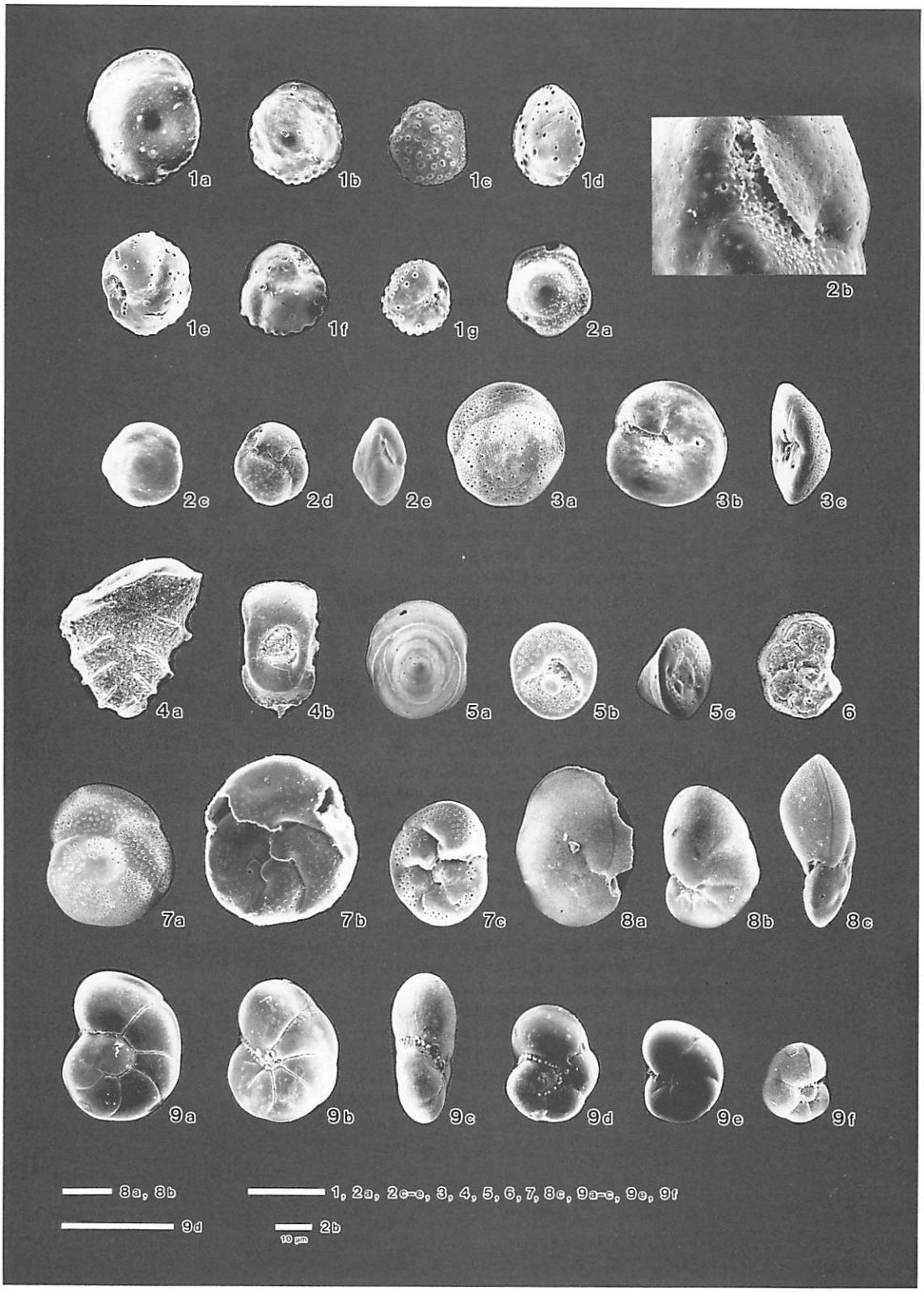
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9c
9d
9e
9f
8a, 8b
1, 2a, 2c–e, 3, 4, 5, 6, 7, 8c, 9a–c, 9e, 9f
9d
2b
10 μm

Explanation of Plate 15

Fig. 1. *Valvulineria* sp. (p. 129)
ESK Reg. no. F-9943 from Stn. 91

Fig. 2. *Glabratella patelliformis* (Brady) (p. 129)
a: ESK Reg. no. F-9947 from Stn. 127
b-c: ESK Reg. no. F-9958 from Stn. 145
d: ESK Reg. no. F-9949 from Stn. 106

Fig. 3. *Glabratella* sp. 1 (p. 130)
a-b: ESK Reg. no. F-9977 from Stn. 146
c: ESK Reg. no. F-9978 from Stn. 127
d: ESK Reg. no. F-9979 from Stn. 137
e: ESK Reg. no. F-9980 from Stn. 106
f: ESK Reg. no. F-9981 from Stn. 110

Fig. 4. *Glabratella* sp. 2 (p. 130)
a: ESK Reg. no. F-9984 from Stn. 141
b: ESK Reg. no. F-9987 from Stn. 106
c: ESK Reg. no. F-9988 from Stn. 110

Fig. 5. *Ammonia beccarii* (Linné) forma A (p. 131, 172)
a: ESK Reg. no. F-10022 from Stn. 146
b: ESK Reg. no. F-9997 from Stn. 17

Fig. 6. *Ammonia beccarii* (Linné) forma B (p. 132)
ESK Reg. no. F-10036 from Stn. 102

Fig. 7. *Ammonia japonica* (Hada) (p. 132)
a: ESK Reg. no. F-10048 from Stn. 65
b: ESK Reg. no. F-10049 from Stn. 65
c: ESK Reg. no. F-10050 from Stn. 78

Fig. 8. *Ammonia ketienziensis angulata* (Kuwano) (p. 132)
a: ESK Reg. no. F-10084 from Stn. 106
b: ESK Reg. no. F-10091 from Stn. 113
c: ESK Reg. no. F-10092 from Stn. 139

Fig. 9. *Pararotalia* aff. *globosa* (Millett) (p. 133)
a: ESK Reg. no. F-10118 from Stn. 139
b: ESK Reg. no. F-10119 from Stn. 106
c: ESK Reg. no. F-10120 from Stn. 104
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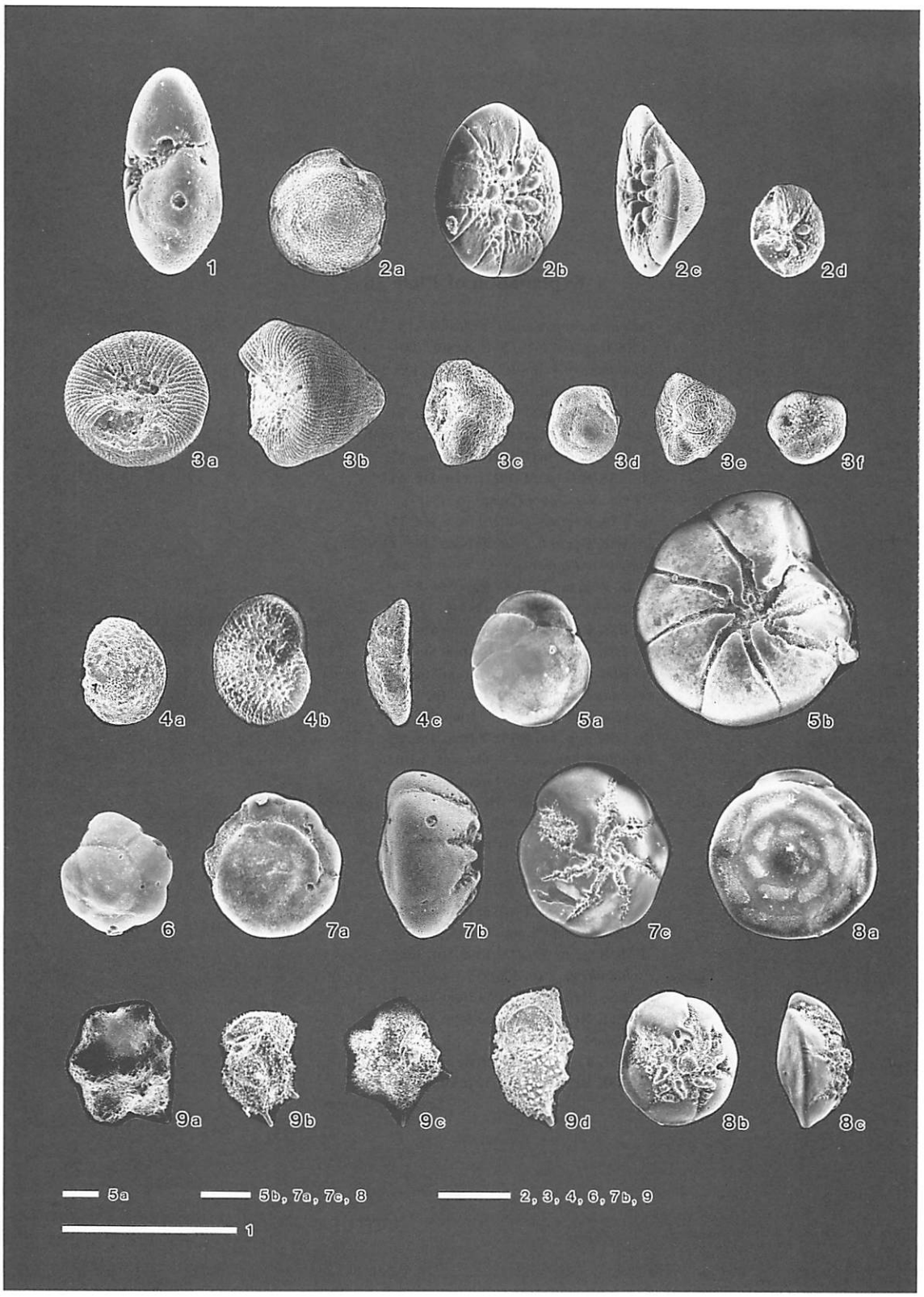
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Explanation of Plate 16

Fig. 1. *Pseudorotalia gaimardii* (D'ORBIGNY) (p. 133)
ESK Reg. no. F-10129 from Stn. 100

Fig. 2. *Elphidium advenum* (CUSHMAN) (p. 133, 173)
a: ESK Reg. no. F-10199 from Stn. 146
b: ESK Reg. no. F-10200 from Stn. 34

Fig. 3. *Elphidium articulatum* (D'ORBIGNY) (p. 134)
a: ESK Reg. no. F-10210 from Stn. 65
b: ESK Reg. no. F-10211 from Stn. 65

Fig. 4. *Elphidium crispum* (LINNÉ) (p. 134)
a: ESK Reg. no. F-10219 from Stn. 124
b: ESK Reg. no. F-10220 from Stn. 124

Fig. 5. *Elphidium depressulum* CUSHMAN (p. 135)
ESK Reg. no. F-10247 from Stn. 65

Fig. 6. *Elphidium jenseni* (CUSHMAN) (p. 135)
a: ESK Reg. no. F-10265 from Stn. 116
b: ESK Reg. no. F-10267 from Stn. 106
c: ESK Reg. no. F-10268 from Stn. 104

Fig. 7. *Elphidium oceanicum* CUSHMAN (p. 135)
a: ESK Reg. no. F-10279 from Stn. 108
b: ESK Reg. no. F-10277 from Stn. 139

Fig. 8. *Elphidium poeyanum* (D'ORBIGNY) (p. 136)
ESK Reg. no. F-10289 from Stn. 106

Fig. 9. *Elphidium selseyensis* (HERON-ALLEN and EARLAND) (p. 136)
a: ESK Reg. no. F-10323 from Stn. 116
b: ESK Reg. no. F-10319 from Stn. 141
c: ESK Reg. no. F-10324 from Stn. 108
d: ESK Reg. no. F-10325 from Stn. 139
e: ESK Reg. no. F-10326 from Stn. 108

Fig. 10. *Elphidium subincertum* ASANO (p. 136)
ESK Reg. no. F-10331 from Stn. 102

Fig. 11. *Elphidium* sp. 1 (p. 136)
a: ESK Reg. no. F-10354 from Stn. 91
b: ESK Reg. no. F-10355 from Stn. 89

Fig. 12. *Elphidium* sp. 2 (p. 137)
a: ESK Reg. no. F-10356 from Stn. 73
b: ESK Reg. no. F-10357 from Stn. 73

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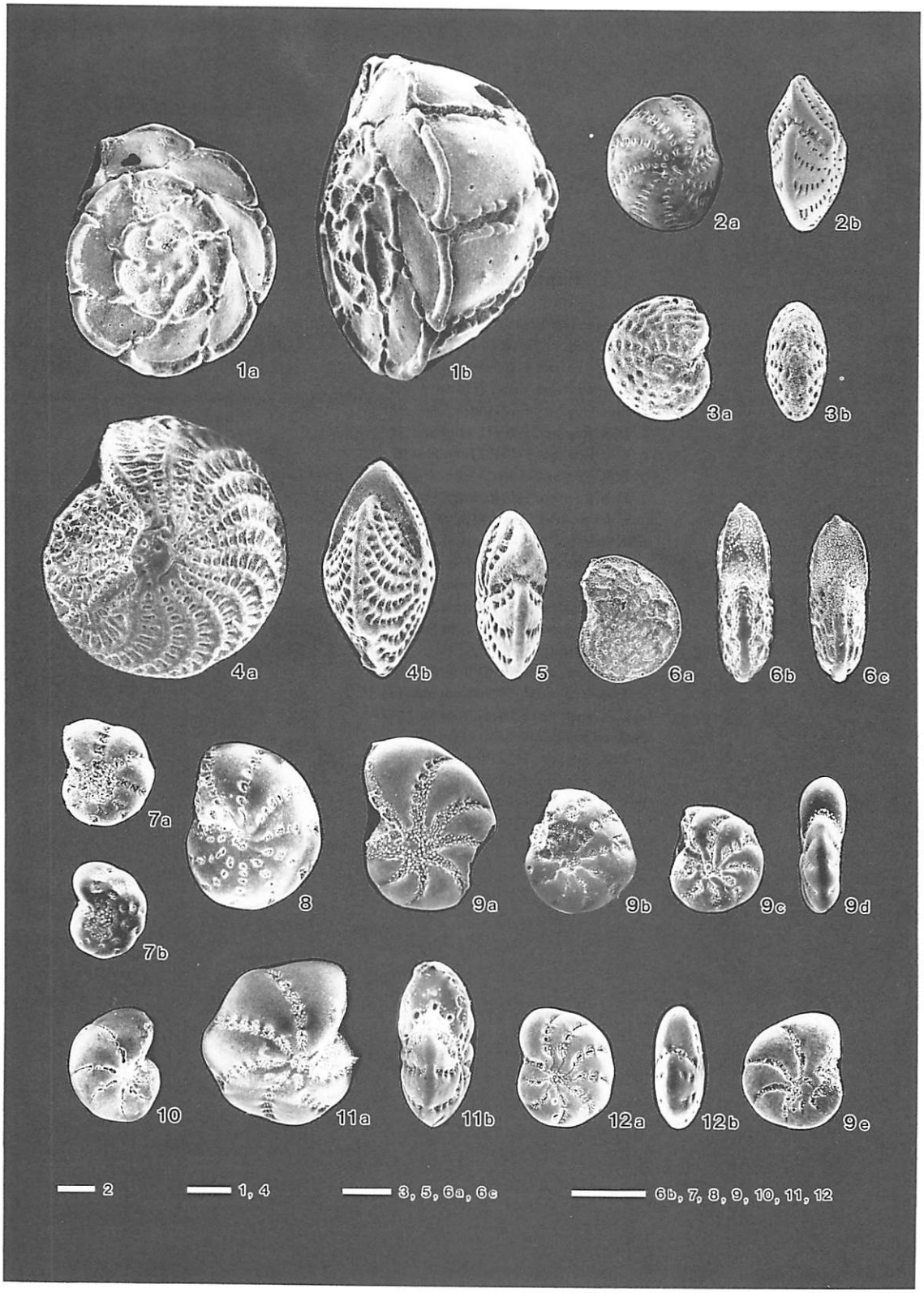
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3, 5, 6a, 6c
6b, 7, 8, 9, 10, 11, 12

Explanation of Plate 17

Fig. 1. *Protelphidium schmitti* (CUSHMAN and WICKENDEN) (p. 137, 173)
a: ESK Reg. no. F-10392 from Stn. 65
b: ESK Reg. no. F-10393 from Stn. 65

Fig. 2. *Nummulites ammonoides* (GRONOVIUS) (p. 137)
a: ESK Reg. no. F-10410 from Stn. 99
b: ESK Reg. no. F-10411 from Stn. 74
c: ESK Reg. no. F-10412 from Stn. 99
d: ESK Reg. no. F-10413 from Stn. 106
e: ESK Reg. no. F-10409 from Stn. 137

Fig. 3. *Eponides procera* (BRADY) (p. 138)
ESK Reg. no. F-10414 from Stn. 145

Fig. 4. *Amphistegina* cf. *gibbosa* D'ORBIGNY (p. 138)
a: ESK Reg. no. F-10458 from Stn. 99
b: ESK Reg. no. F-10459 from Stn. 48
c: ESK Reg. no. F-10460 from Stn. 99

Fig. 5. *Planulina*? sp. (p. 138)
a: ESK Reg. no. F-10467 from Stn. 144
b: ESK Reg. no. F-10468 from Stn. 144
c: ESK Reg. no. F-10469 from Stn. 139

Fig. 6. *Hyalinea balthica* (SCHRÖTER) (p. 139)
a: ESK Reg. no. F-10518 from Stn. 110
b: ESK Reg. no. F-10519 from Stn. 101
c: ESK Reg. no. F-10520 from Stn. 139
d: ESK Reg. no. F-10521 from Stn. 139

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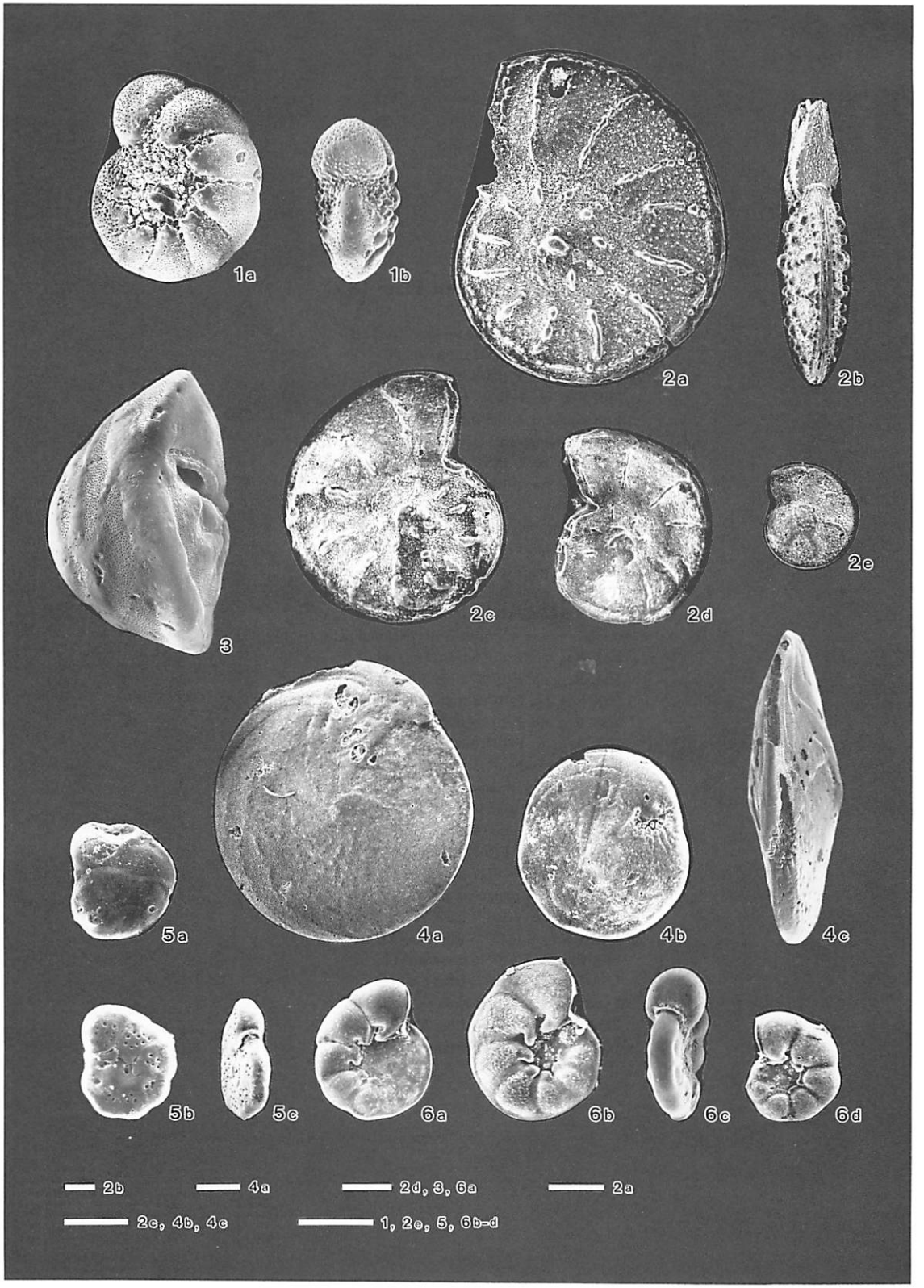
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2d, 3, 6a
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2c, 4b, 4c
1, 2e, 5, 6b–d

Explanation of Plate 18

Fig. 1. *Hyalinea inflata* Ujiié and Kusukawa (p. 139)
a: ESK Reg. no. F-10547 from Stn. 90
b: ESK Reg. no. F-10548 from Stn. 139
c: ESK Reg. no. F-10549 from Stn. 132
d: ESK Reg. no. F-10550 from Stn. 132

Fig. 2. *Cibicides inagawaensis* Matsunaga (p. 140)
a: ESK Reg. no. F-10583 from Stn. 145
b: ESK Reg. no. F-10584 from Stn. 137
c: ESK Reg. no. F-10585 from Stn. 144

Fig. 3. *Caribeanella* cf. *polystoma* Bermúdez (p. 140)
a: ESK Reg. no. F-10645 from Stn. 99
b: ESK Reg. no. F-10646 from Stn. 66
c: ESK Reg. no. F-10629 from Stn. 108
d: ESK Reg. no. F-10635 from Stn. 132

Fig. 4. *Cymbaloporetta hemisphaerica* Accordi and Selmi (p. 141, 173)
a: ESK Reg. no. F-10706 from Stn. 144
b: ESK Reg. no. F-10707 from Stn. 139
c: ESK Reg. no. F-10708 from Stn. 139
d: ESK Reg. no. F-10709 from Stn. 139
e: ESK Reg. no. F-10710 from Stn. 137
f: ESK Reg. no. F-10711 from Stn. 132

Fig. 5. *Fursenkoina schreibersiana* (Czjżek) (p. 142)
ESK Reg. no. F-10716 from Stn. 104

Fig. 6. *Sigmavirgulina tortuosa* (Brady) (p. 142)
a-b: ESK Reg. no. F-10723 from Stn. 141
c: ESK Reg. no. F-10721 from Stn. 124

Fig. 7. *Globocassidulina oriangulata* Belford (p. 143, 173)
a: ESK Reg. no. F-10774 from Stn. 113
b: ESK Reg. no. F-10775 from Stn. 137
c: ESK Reg. no. F-10776 from Stn. 143
d: ESK Reg. no. F-10777 from Stn. 110

Fig. 8. *Globocassidulina venustas* Nomura (p. 143)
a: ESK Reg. no. F-10788 from Stn. 118
b: ESK Reg. no. F-10798 from Stn. 146

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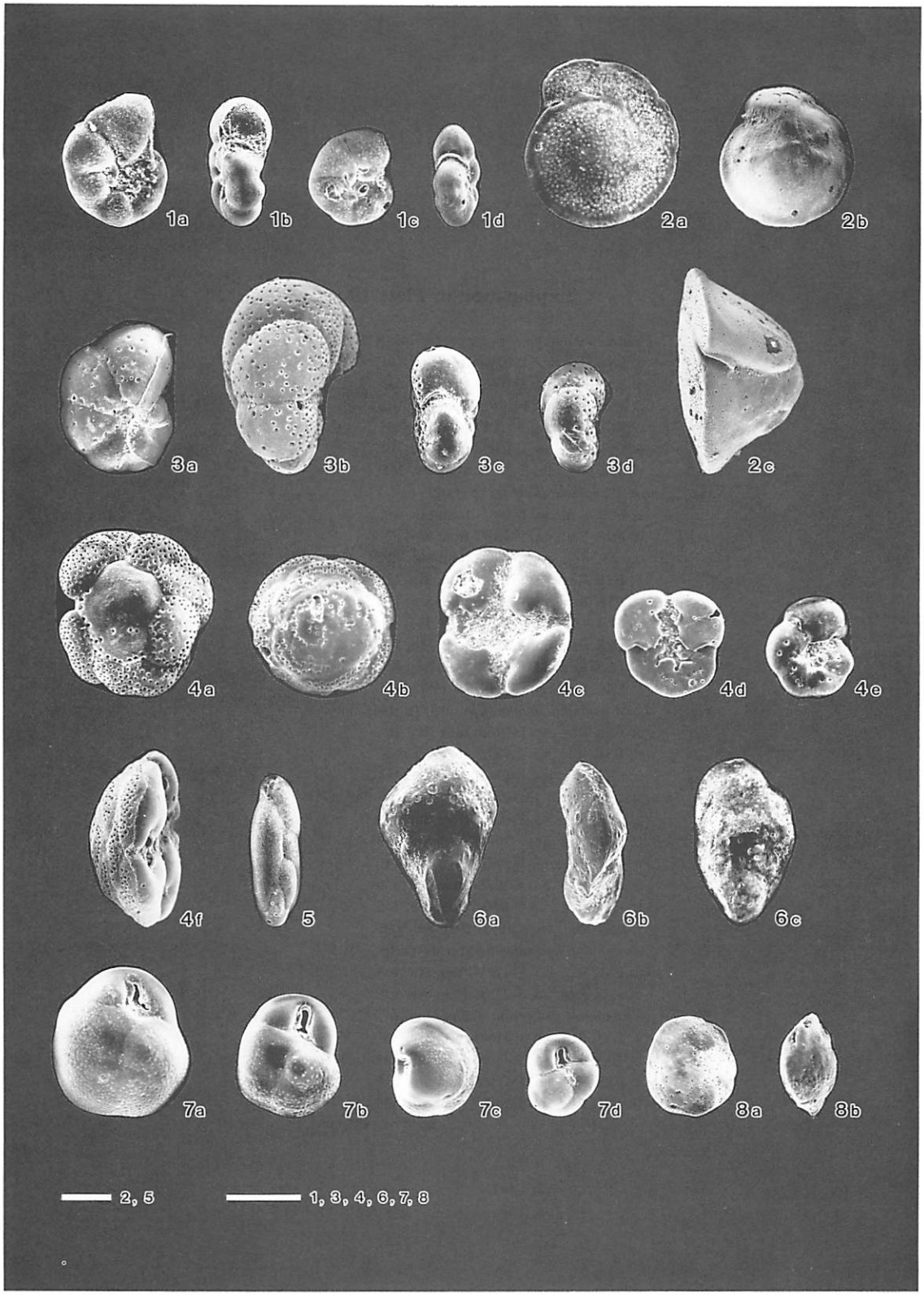
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7c
7d
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1, 3, 4, 6, 7, 8

Explanation of Plate 19

Fig. 1. *Cassidulina nørvangi* Thalmann (p. 143, 173)
- a: ESK Reg. no. F-10854 from Stn. 101
- b: ESK Reg. no. F-10855 from Stn. 145
- c: ESK Reg. no. F-10856 from Stn. 101
- d: ESK Reg. no. F-10857 from Stn. 139
- e: ESK Reg. no. F-10858 from Stn. 101
- f: ESK Reg. no. F-10859 from Stn. 145

Fig. 2. *Lernella inflata* (LeRoy) (p. 144)
- a: ESK Reg. no. F-10871 from Stn. 87
- b: ESK Reg. no. F-10872 from Stn. 87
- c: ESK Reg. no. F-10869 from Stn. 134
- d: ESK Reg. no. F-10868 from Stn. 132
- e: ESK Reg. no. F-10873 from Stn. 136

Fig. 3. *Lernella ogasawarai* Nomura (p. 144)
- a: ESK Reg. no. F-10889 from Stn. 145
- b: ESK Reg. no. F-10890 from Stn. 136
- c: ESK Reg. no. F-10885 from Stn. 125

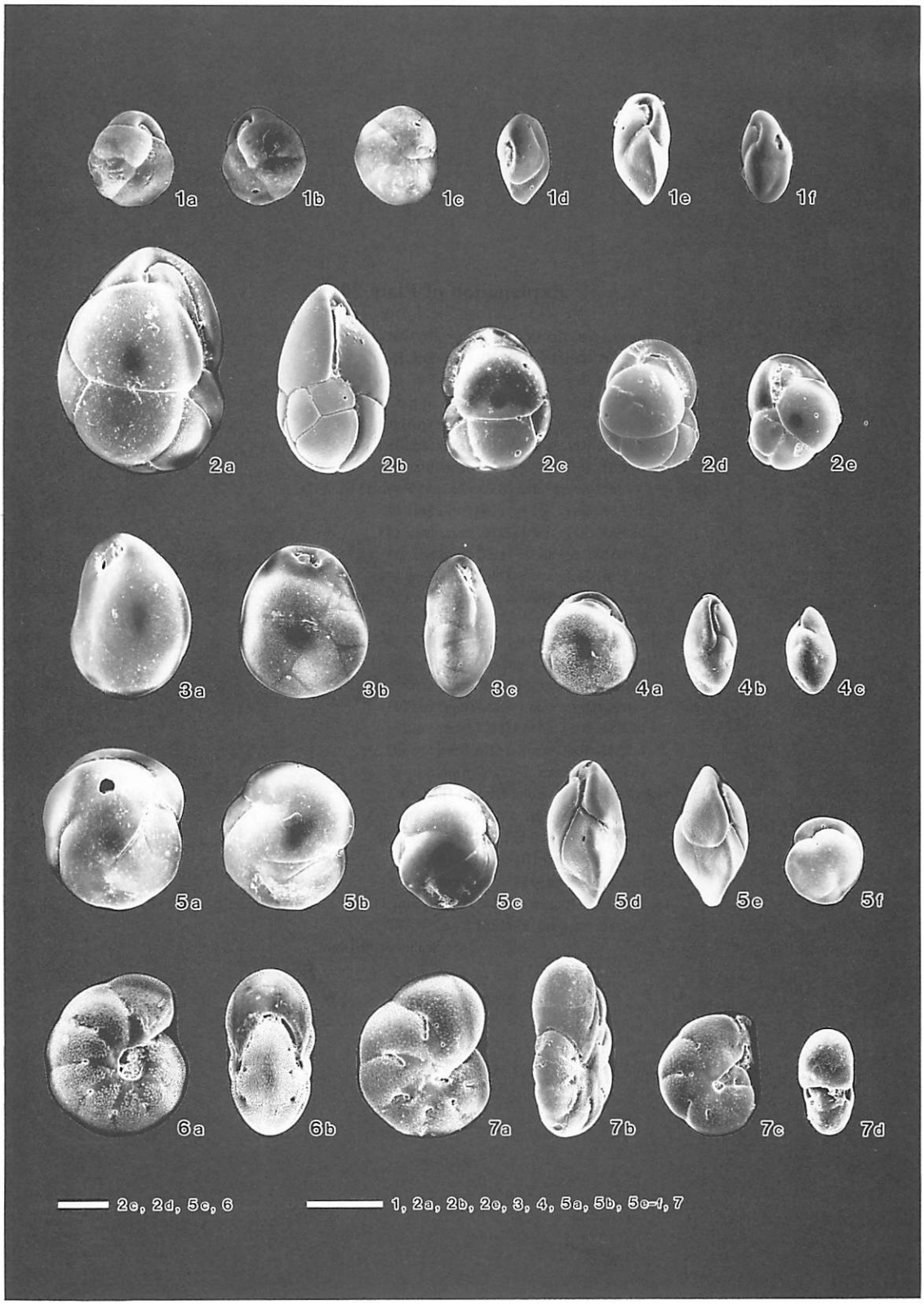
Fig. 4. *Paracassidulina minuta* (Cushman) (p. 144)
- a: ESK Reg. no. F-10926 from Stn. 101
- b: ESK Reg. no. F-10927 from Stn. 82
- c: ESK Reg. no. F-10928 from Stn. 102

Fig. 5. *Paracassidulina quasicarinata* Nomura (p. 145, 174)
- a: ESK Reg. no. F-10976 from Stn. 146
- b: ESK Reg. no. F-10977 from Stn. 146
- c: ESK Reg. no. F-10978 from Stn. 145
- d: ESK Reg. no. F-10979 from Stn. 146
- e: ESK Reg. no. F-10980 from Stn. 146
- f: ESK Reg. no. F-10981 from Stn. 110

Fig. 6. *Astrononion hanyudaense* Matsunaga (p. 145, 174)
- a: ESK Reg. no. F-11034 from Stn. 103
- b: ESK Reg. no. F-11035 from Stn. 91

Fig. 7. *Astrononion stelligerum* (d'Orbigny) (p. 145)
- a: ESK Reg. no. F-11046 from Stn. 84
- b: ESK Reg. no. F-11065 from Stn. 141
- c: ESK Reg. no. F-11066 from Stn. 144
- d: ESK Reg. no. F-11067 from Stn. 144

Scale bar: 0.1 mm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1, 2a, 2b, 2e, 3, 4, 5a, 5b, 5e-f, 7

Explanation of Plate 20

Fig. 1. *Florilus japonicus* (ASANO) (p. 146, 174)
a: ESK Reg. no. F-11119 from Stn. 82
b: ESK Reg. no. F-11120 from Stn. 82
c: ESK Reg. no. F-11121 from Stn. 82

Fig. 2. *Florilus manpukuziense* (OTUKA) (p. 146)
a: ESK Reg. no. F-11134 from Stn. 65
b: ESK Reg. no. F-11135 from Stn. 65

Fig. 3. *Florilus? pauperatus* (BALKWILL and WRIGHT) (p. 147)
a: ESK Reg. no. F-11160 from Stn. 145
b: ESK Reg. no. F-11161 from Stn. 143
c: ESK Reg. no. F-11162 from Stn. 64
d: ESK Reg. no. F-11163 from Stn. 141

Fig. 4. *Pseudononion grateloupi* (D'ORBIGNY) (p. 147)
a: ESK Reg. no. F-11213 from Stn. 144
b: ESK Reg. no. F-11214 from Stn. 78

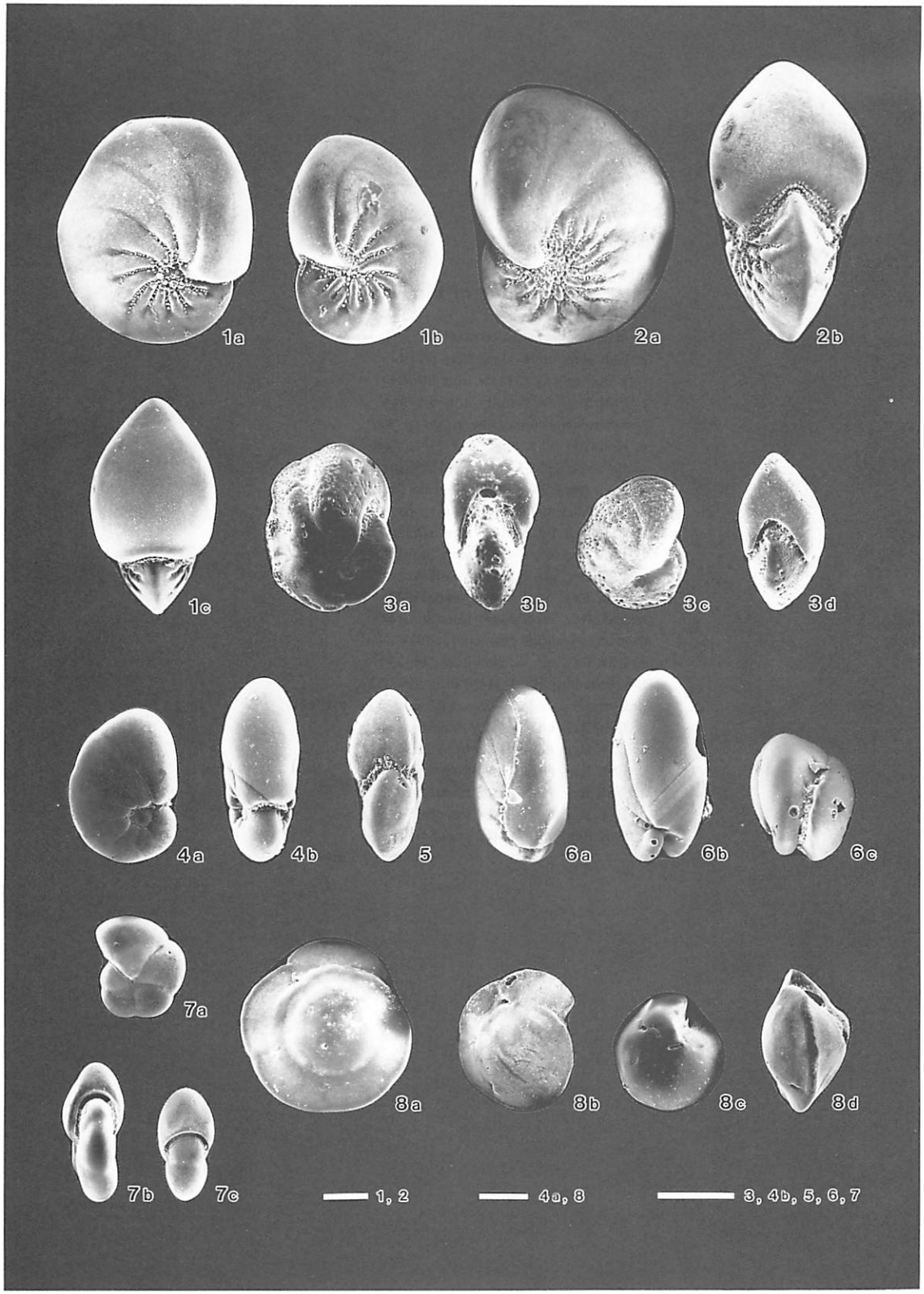
Fig. 5. *Pseudononion japonicum* ASANO (p. 148, 174)
ESK Reg. no. F-11255 from Stn. 65

Fig. 6. *Nonionella turgida* (WILLIAMSON) (p. 148)
a: ESK Reg. no. F-11277 from Stn. 88
b: ESK Reg. no. F-11278 from Stn. 92
c: ESK Reg. no. F-11267 from Stn. 89

Fig. 7. *Pullenia quinqueloba* (REUSS) (p. 149)
a,c: ESK Reg. no. F-11303 from Stn. 143
b: ESK Reg. no. F-11304 from Stn. 139

Fig. 8. *Oridorsalis tener* (BRADY) (p. 149)
a: ESK Reg. no. F-11332 from Stn. 86
b,d: ESK Reg. no. F-11328 from Stn. 113
c: ESK Reg. no. F-11333 from Stn. 97

Scale bar: 0.1 mm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3, 4b, 5, 6, 7

Explanation of Plate 21

Fig. 1. *Gyroidinoides acuta* Boomgaart (p. 149)
a: ESK Reg. no. F-11353 from Stn. 146
b: ESK Reg. no. F-11354 from Stn. 144
c: ESK Reg. no. F-11355 from Stn. 144

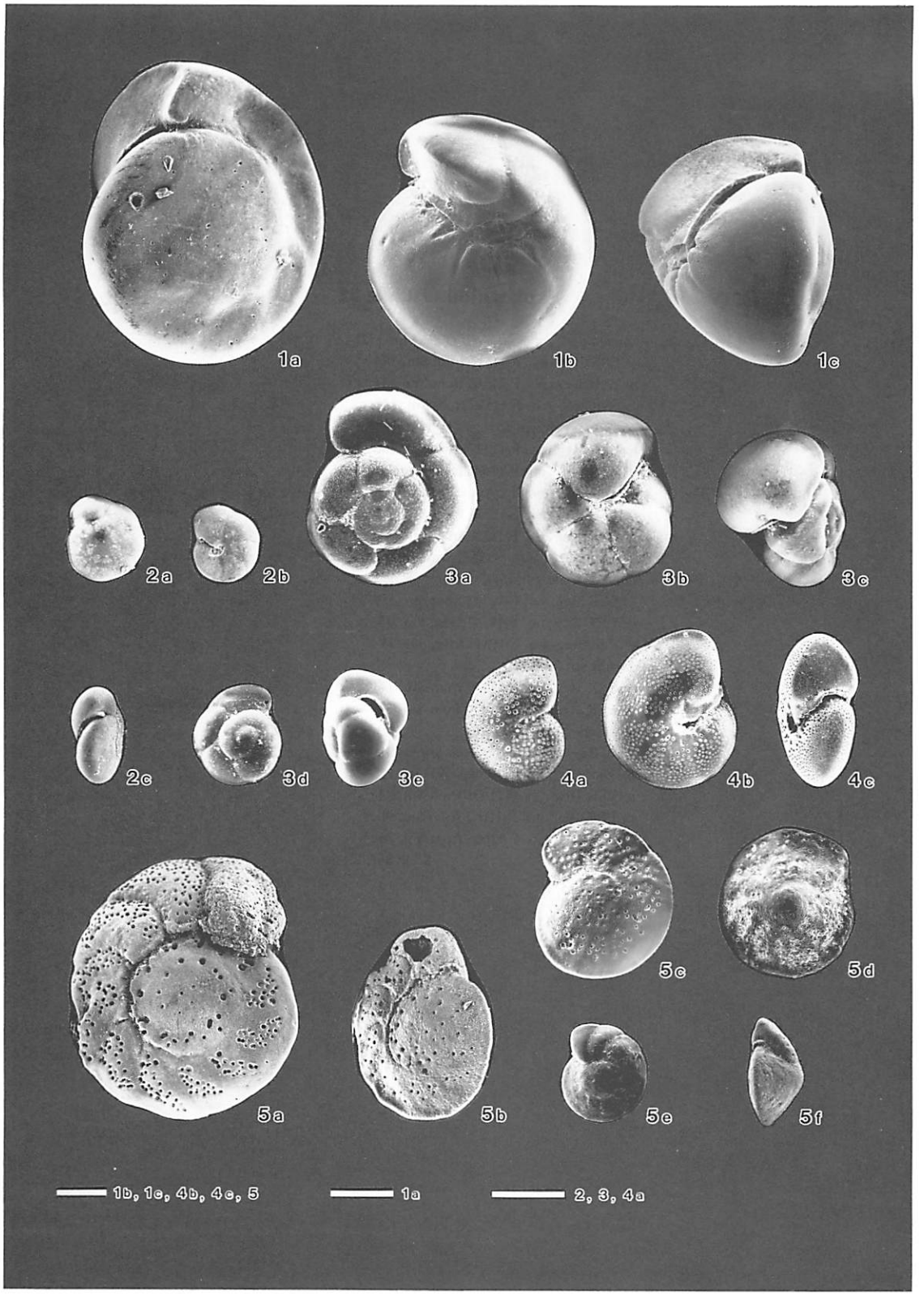
Fig. 2. *Gyroidinoides kuwanoi* Ôki, n. sp. (p. 150)
a: Holotype, ESK Reg. no. F-11356 from Stn. 80
b: Paratype, ESK Reg. no. F-11357 from Stn. 81
c: Paratype, ESK Reg. no. F-11358 from Stn. 103

Fig. 3. *Gyroidinoides nipponicus* (Ishizaki) (p. 150)
a: ESK Reg. no. F-11437 from Stn. 103
b: ESK Reg. no. F-11438 from Stn. 108
c: ESK Reg. no. F-11439 from Stn. 113
d: ESK Reg. no. F-11440 from Stn. 118
e: ESK Reg. no. F-11441 from Stn. 144

Fig. 4. *Anomalina glabrata* Cushman (p. 151)
a: ESK Reg. no. F-11454 from Stn. 139
b-c: ESK Reg. no. F-11450 from Stn. 132

Fig. 5. *Cibicidoides pseudoungerianus* (Cushman) (p. 151, 174)
a: ESK Reg. no. F-11489 from Stn. 144
b: ESK Reg. no. F-11493 from Stn. 137
c: ESK Reg. no. F-11494 from Stn. 146
d: ESK Reg. no. F-11495 from Stn. 137
e: ESK Reg. no. F-11496 from Stn. 145
f: ESK Reg. no. F-11497 from Stn. 137

Scale bar: 0.1 mm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Explanation of Plate 22

Fig. 1. *Cibicidoides? subhaidingerii* (PARR) (p. 152)
a: ESK Reg. no. F-11517 from Stn. 144
b: ESK Reg. no. F-11518 from Stn. 144
c: ESK Reg. no. F-11519 from Stn. 137

Fig. 2. *Cibicidoides* sp. (p. 152)
a: ESK Reg. no. F-11523 from Stn. 146
b: ESK Reg. no. F-11521 from Stn. 137

Fig. 3. *Hanzawaia nipponica* ASANO (p. 152)
a: ESK Reg. no. F-11535 from Stn. 141
b: ESK Reg. no. F-11536 from Stn. 136
c-d: ESK Reg. no. F-11531 from Stn. 116

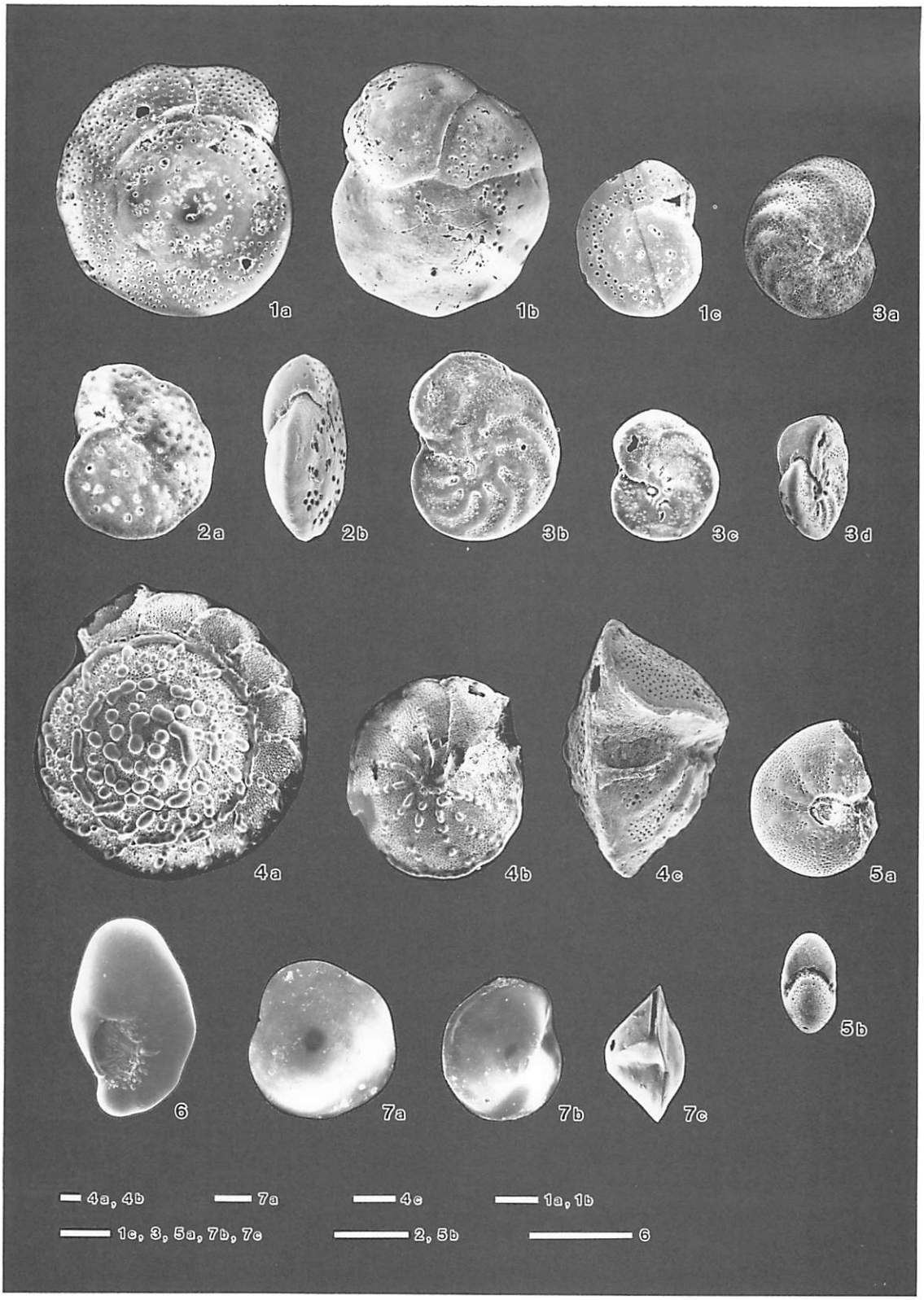
Fig. 4. *Heterolepa margaritifera* (BRADY) (p. 153)
a: ESK Reg. no. F-11542 from Stn. 101
b: ESK Reg. no. F-11547 from Stn. 75
c: ESK Reg. no. F-11548 from Stn. 75

Fig. 5. *Melonis* sp. (p. 153)
a: ESK Reg. no. F-11559 from Stn. 141
b: ESK Reg. no. F-11560 from Stn. 34

Fig. 6. *Lamarckina* sp. (p. 153)
ESK Reg. no. F-11566 from Stn. 145

Fig. 7. *Hoeglundina elegans* (D'ORBIGNY) (p. 153)
a: ESK Reg. no. F-11601 from Stn. 93
b: ESK Reg. no. F-11602 from Stn. 90
c: ESK Reg. no. F-11603 from Stn. 76

Scale bar: 0.1 mm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