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AN ILLUSTRATED GUIDE TO FJORD FORAMINIFERA FROM THE SEYMOUR-BELIZE INLET COMPLEX, NORTHERN BRITISH COLUMBIA, CANADA

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ABSTRACT

Detailed taxonomic descriptions and illustrations of 94 foraminiferal species found in the Seymour-Belize Inlet Complex (SBIC), a fjord network situated on the north coast of British Columbia, are presented as an aid to future researchers. This treatment includes a few planktic foraminiferal taxa that carried into the SBIC from the open ocean. In addition, ten freshwater thecamoebian species that were washed into the inlet from the nearby adjacent shore are also described.

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INTRODUCTION

Coastal mainland British Columbia is a geographically complex and vast area, characterized by a mountainous terrain punctuated by numerous fjords that reach far inland. The Seymour-Belize Inlet Complex (SBIC) is one of these fjord systems, situated on the north-central coast of the province (Figure 1). The SBIC is the target of an ongoing multidisciplinary project that is mandated to assess NE Pacific region climate cycles and trends through the Holocene. Assessing paleoceanographic changes based on variation in foraminiferal faunas over time is an important component of this research. Unfortunately, there is very little baseline foraminiferal distributional data available for this region that can be used to interpret Holocene foraminiferal faunas (e.g., Schafer et al. 1989; Patterson and Cameron 1991; Jonasson and Patterson 1992; Patterson 1993; Guilbault et al. 1997; Guilbault et al. 2003; Vázquez Riveiros et al. 2007), and only one study focuses in fjord fauna (Schafer et al. 1989). Thus the primary purpose of the research presented here is to fully document and characterize the distribution of foraminiferal faunas from the SBIC, which will provide baseline data for use by future researchers to interpret Holocene

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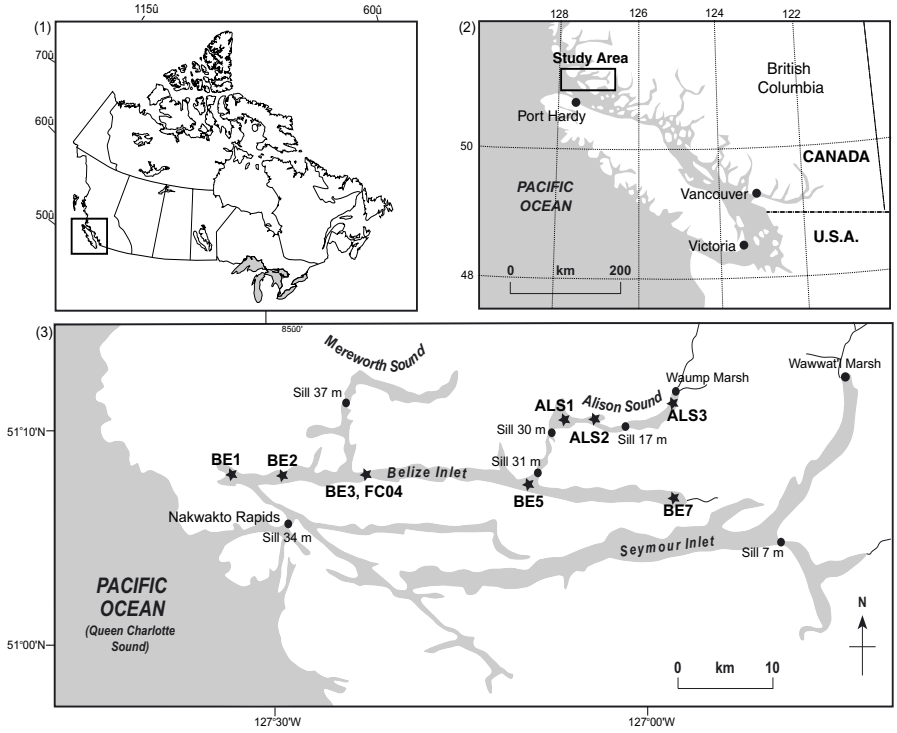

Figure 1. Location of study area and sampling site. **1.** Map of Canada. **2.** Map of Vancouver Island and mainland coastal British Columbia. **3.** Map of the Seymour-Belize Inlet Complex, with sampling sites marked with stars.

and Quaternary deposits from the SBIC and elsewhere along the Pacific Northwest coast.

GEOGRAPHIC SETTING

The SBIC is a network of long and deep steep-sided fjords on the north-central coast of mainland British Columbia (Figure 1), about 40 km northeast of Port Hardy, Vancouver Island. The complex lies between latitudes 50°50.2' N and 51°10.6' N, and longitudes 126°30.2' W and 127°40.5' W, and opens to Queen Charlotte Sound via Slingby and Schooner Channels.

The main arms of the complex are the east-west trending Seymour and Belize inlets, which reach inland ~ 70 and 50 km, respectively. Alison Sound is a smaller inlet that extends 20 km off the northern margin of Belize Inlet, in a northeasterly direction before turning towards the east. Small rivers and creeks provide freshwater to the heads of all inlets in the SBIC, with Belize Creek in Belize Inlet, Waump Creek in Alison Sound and the Seymour River in Seymour Inlet being amongst the most important streams. The freshwater input of these rivers, together with numerous waterfalls along the inlets, peaks during the snow-melt period that starts in May and plays an important role in circulation in the SBIC (Thomson 1981).

Regional Climate

The climate of coastal British Columbia is mild, with winter temperatures typically remaining above the freezing point accompanied by frequent rains, and warm days and cool nights in summer (Hare and Thomas 1979). Mean annual precipitation in the SBIC region is 3120 mm (ranging between 2009 mm and 3943 mm), with an average annual temperature of 9.1°C (ranging between 5.4° to 9.4°C) (Green and Klinka 1994).

Weather systems are seasonally dominated by the counter-clockwise circulating winds that accompany the Aleutian Low (AL) in winter and the clockwise circulating winds that occur with the North Pacific High (NPH) in summer. The mouth of the SBIC is situated at the northern border of the Coastal Upwelling Domain (CUD) (Ware and McFarlane 1989), where from May through September the northwesterly winds of the NPH displace warm water from the surface, promoting the upwelling of cold, nutrient-rich deep water that greatly enhances productivity in the surface layers. However, because the SBIC is at the northern boundary of the domain and opens to Queen Char-

lotte Sound instead of the open ocean, the influence of upwelling within the SBIC is virtually nil as compared to more exposed inlets on the west coast of Vancouver Island (Thomson 1981).

The AL is responsible for the frequency and intensity of storms that promote cold weather and precipitation in winter (Cayan and Peterson 1989; Miller et al. 1994). Conversely, during the spring and summer, when the NPH moves northward and the AL dissipates, less precipitation and clear skies are the dominant features in the area (Hare and Thomas 1979; Thomson 1981).

Oceanographic Setting

Maximum depths within the SBIC are greater than 600 m in Seymour Inlet, ~ 300 m in Belize Sound, and ~ 150 m in Alison Sound. Oxygen concentrations in the bottom waters of the SBIC range from high oxic in the main arms (more than 6 mL/L) to anoxic conditions in Alison Sound (less than 0.1 mL/L; Kaiho 1994).

An important characteristic of these bathymetrically U-shaped basins is the presence of sills in most of them, formed by crushed rock and silt that were deposited as moraines by advancing glaciers (Schafer et al. 1989). The sills reduce the input of oxygen-rich ocean water into the inlets, which together with a low-salinity wedge caused by riverine input at the surface, results in reduced mixing between surface and bottom waters. The outcome is a stratified water column and the development of estuarine circulation. It is typical in the SBIC and in similar partially mixed estuaries to have the salinity of the surface layer increase down-inlet away from freshwater sources, and the salinity of bottom waters to increase slightly towards the head of the inlet (Pickard and Stanton 1980; Thomson 1981). The restricted circulation in these systems enhances the trapping of organic and inorganic material borne by runoff, making these environments effective nutrient traps. Disturbance at the sediment water interface is minimized due to the low oxygen conditions, the high residence time and slow circulation of the bottom water, resulting in undisturbed sediments that create an ideal setting for paleoenvironmental research.

The main sill at the mouth of the SBIC, the Nakwakto Rapids, is only 34 m deep and 300 m wide, forming a major bottleneck during tidal cycles (Department of Energy 1979) (Figure 1). During the ebb tide current flow through Nakwakto Rapids can reach velocities of 8 m/s, making it one of the strongest tidal currents in the world (Thomson 1981). This tidal constriction at the Nakwakto Rapids is so restrictive that it is impossible for sea level with the SBIC to equalize with that of Queen Charlotte Sound during ebb tidal flow, resulting in a tidal range of more than 2 m in Queen Charlotte Sound and a maximum of only 1.3 m in the interior of the SBIC (Fisheries and Oceans 2003).

There are three sills in Alison Sound (Figure 1), which further restrict circulation into this inlet. The outermost one, located at the juncture of Alison Sound with Belize Inlet, is 31 m deep; the second, just inside the mouth of Alison Sound, is 30 m deep, while the last sill, located near the head of the inlet, is only 17 m deep. This restricted circulation reduces the bottom water oxygen concentration to < 1mL/L, the lowest values recorded in the SBIC. Within Belize Inlet oxygen values do not go below 3 mL/L.

PREVIOUS WORK

There has been extensive research on foraminifera as paleoecological proxies along the west coast of North America, although very few studies on the distribution of modern foraminifera have been carried out in coastal mainland British Columbia waters. The first published descriptive study on Recent foraminifera from off the coast of British Columbia was that of Cushman (1925), who described a few Recent species found in shallow waters in Queen Charlotte Sound. Cockbain (1963) described two main faunal divisions in Juan de Fuca and Georgia Straits, and linked those assemblages with the physical oceanography of the area. McCulloch (1977) described and illustrated the fauna found in several samples collected from Vancouver Harbor during her extensive taxonomic research on modern foraminifera of the Eastern Pacific. A key descriptive study of foraminifera found on the British Columbia shelf was produced by Patterson et al. (1998).

Several studies have focused on the continental shelf and on the Strait of Georgia in order to determine the Holocene climate history of the area (Mathewes et al. 1993; Patterson 1993; Guilbault et al. 1997; Guilbault et al. 2003)

The only previous foraminiferal studies carried out in the SBIC were an investigation of the distribution of foraminifera and thecamoebians in two marshes at the heads of Alison Sound and Belize Inlet (Vázquez Riveiros et al. 2007) and a study of the paleoceanographic history of the area during the last 1100 years based on foraminiferal data from Belize Inlet (Vázquez Riveiros 2006). However, there has never been any attempt to systematically describe and illustrate in detail the

foraminiferal fauna that characterizes any of the coastal British Columbia fjords.

METHODS AND MATERIALS

Sampling

Sampling took place during a research cruise to the SBIC by the CCGS *Vector* in April 2002. Eight sediment-water interface samples were collected using a Smith-Mac grab sampler in Belize Inlet (BE1, BE2, BE3, BE5, BE7) and Alison Sound (ALS1, ALS2 and ALS3; Figure 1). In addition, one 145 cm freeze core, FC04, was collected in Belize Inlet at a water depth of 274 m (Figure 1). Subsequent to collection, the grab samples were treated with alcohol as a preservative, stored in plastic vials, and shipped by air to Carleton University, where they were stored prior to processing in a cool room at +4°C.

The freeze core was stored in a freezer aboard the CCGS *Vector* until the vessel returned to port, at which point the core was transported to the Pacific Geoscience Centre (PGC) in Sidney, BC. At the PGC, the outer layer of the freeze core was removed in situ to reduce the risk of contamination. The core was then subdivided longitudinally into ~1 x 2 cm subsections using a band saw, and then subdivided laterally to facilitate handling and x-raying. One complete set of freeze core subsections was transported frozen to Carleton University for subsequent analysis, where they were kept at a constant temperature of –9°C.

Laboratory Analysis

Examination of the grab samples in 2004 revealed no discernable deterioration. Samples from Alison Sound, where dysoxic conditions prevailed, were characterized by a slight sulfurous smell, as well as darker color than those from the more oxygenated Belize Inlet. Ten cm3 aliquots were taken from each grab sample and wet sieved through a 63 mm screen to retain foraminifera and a 500 mm screen to remove coarse organic material. The samples were subsequently split into two fractions using a 125 µm screen, dried under low heat (50°C) in an oven, and weighed. Splitting dry samples into fractions prior to quantitative analysis was done in order to avoid counting errors, as the focus of the microscope does not have to be continually changed (Schröder et al. 1987).

Freeze core FC04 was also taken out of the freezer in 2004 and inspected. As no visible deterioration was detected on the surface, such as desiccation cracks or evidence of mold, it was deemed suitable for analysis. The sediments comprising the freeze core FC04 were very fine grained and soupy, and would have been impossible to recover using conventional coring methods. The core was subdivided using a ceramic knife into 121, 1 cm thick samples for foraminiferal analysis. Ceramic knives are particularly useful for subdividing freeze cores, as the blade is extremely thin and sharp and permits the production of extremely thin slices when required. A few subsamples were selected for dating of the core with ^{14}C and ^{210}Pb, which revealed that it was comprised of sediments deposited between ~ 900 AD and 2002 AD. The rest of the freeze core samples were sieved and processed using the same procedure described above for the grab samples.

Since almost two years had passed between the collection of the samples and the laboratory analysis, it was concluded that the staining of the microfossils with Rose Bengal, used to distinguish between live and dead populations, would not provide reliable results. It was assumed that all the cytoplasmic material would already be dead by the time of analysis.

These sediment-water interface grab and freeze core samples were quantitatively analyzed for foraminifera under an Olympus SZH10 stereo microscope. All foraminiferal specimens were picked and stored on gridded micropaleontological slides, and identified following the classification of Loeblich and Tappan (1987). Scanning electron photomicrographs were obtained using a JEOL 6400 Scanning Electron Microscope at the Carleton University Research Facility for Electron Microscopy (CURFEM), and the digital images were later converted into figures.

SYSTEMATIC PALEONTOLOGY

Suprageneric classification follows that of Loeblich and Tappan (1987). Illustrated specimens are housed in the Department of Earth Sciences, Carleton University, Ottawa, Ontario.

Order FORAMINIFERIDA Eichwald, 1830
Suborder TEXTULARIINA Delage and Hérouard, 1896
Superfamily ASTRORHIZACEA Brady, 1881
Family SACCAMMINIDAE Brady, 1884
Subfamily SACCAMMININAE Brady, 1884
Genus *Saccammina* Carpenter, 1869
Saccammina atlantica (Cushman 1944)

1944 *Proteonina atlantica* Cushman, p. 5, pl. 1, fig. 4.

1980 *Saccammina atlantica* (Cushman 1944). Rodrigues, p. 69, pl. 3-1, fig. 11.

1995 *Saccammina* cf. *atlantica* (Cushman 1944). Blais, p. 92, pl. 2.3, fig. 4.

Description. Test free, single elongate, oval, or pyriform chamber; wall agglutinated, fairly coarse; aperture very small, at tapered end of chamber; no distinct neck, but gradually contracted toward apertural end; circular in section.

Saccammina sphaerica Sars, 1872

1872 Saccammina sphaerica Sars, p. 250, Figure in Carpenter, 1875, p. 532, fig. 272; Höglund, 1947, p. 50, pl. 3, fig. 7; Schröder, 1986, p. 37, pl. 10, fig. 4; Jonasson, 1994, p. 47, pl. 2, fig. 5.

Description. Test free, single globular chamber, spherical or pyriform; wall agglutinated, fine, smooth; aperture rounded, may be nearly flush or on short neck; inner organic wall layer modified in living specimens to an oral apparatus or entosolenian tube around opening.

Superfamily AMMODISCACEA Reuss, 1862
Family AMMODISCIDAE Reuss, 1862
Subfamily AMMOVOLUMMININAE Chernykh, 1967Genus *Ammodiscus* Reuss, 1862
Ammodiscus gullmarensis Höglund, 1948
Figure 2.1

1947 *Ammodiscus planus* Höglund, p. 123, pl. 8, figs. 2, 3, 8; pl. 28, figs. 17, 18.

1948 *Ammodiscus gullmarensis* Höglund, p. 45.

Description. Test free, small, flattened but tending to irregular coiling in last whorls; wall agglutinated with fairly large amount of cement; 7 to 9 whorls; sutures distinct, proloculum central and subspherical.

Superfamily RZEHAKINACEA Cushman, 1933a
Family RZEHAKINIDAE Cushman, 1933a
Genus *Miliammina* Heron-Allen and Earland, 1930
Miliammina fusca (Brady 1870)

1870 *Quinqueloculina fusca* Brady, in Brady and Robertson, p. 286, pl. 11, fig. 2.

1972 *Miliammina fusca* (Brady, 1870) Murray, p. 21, pl. 3, figs. 1-6; Patterson, 1990a, p. 240, pl. 1, fig. 4.

Description. Test elongate ovate; narrow chambers one-half coil in length, quinqueloculine arrangement; wall thick, very finely agglutinated; aperture at end of chamber, large and conspicuous, equal in size to transverse section of chamber.

Superfamily LITUOLACEA de Blainville, 1827
Family HAPLOPHRAGMOIDIDAE Maync, 1952
Genus *Cribrostomoides* Cushman, 1910
Cribrostomoides crassimargo (Norman 1892)
Figure 2.2

1892 *Haplophragmium crassimargo* Norman, p. 17, pl. 7-8.

1947 *Labrospira crassimargo* (Norman 1892). Höglund, p. 141, pl. 11, fig. 1.

1953 *Alveolophragmium crassimargo* (Norman 1892). Loeblich and Tappan, p. 29, pl. 3, figs. 1-3.

1967 *Cribrostomoides crassimargo* (Norman 1892). Todd and Low, p. 15, pl. 1, fig. 24.

Description. Test free, planispiral, partially involute; wall agglutinated, thick, coarse, with large sand grains, sometimes of orange color; 2 to 4 whorls, 8 to 10 chambers in last whorl; sutures straight, slightly depressed; umbilicus depressed; periphery rounded, lobulate; aperture interio-areal, forming an oblong, curved slit, upper and lower lip well developed.

Cribrostomoides jeffreysii (Williamson 1858)
Figures 2.4a-2.4c

1858 *Nonionina jeffreysii* Williamson, p. 34, pl. 3, figs. 72,73.

1953 *Alveolophragmium jeffreysii* Williamson, 1858. Loeblich and Tappam, p. 31, pl. 3, figs. 4-7.

1972 *Cribrostomoides jeffreysii* (Williamson 1858). Murray, p. 23, pl. 4, figs. 1-5.

Description. Test free, planispiral, almost involute, compressed laterally; wall finely agglutinated, yellow to brown; 6 to 8 chambers in last whorl, with their lateral surface triangular in shape; periphery rounded, slightly lobulate; sutures depressed and radial; aperture a lipped slit near base of apertural face.

Cribrostomoides cf. *subglobosum* (Cushman 1910)
Figures 2.5a, 2.5b

1910 *Haplophragmoides subglobosum* Cushman, p. 105, figs. 162-164.

1947 *Labrospira subglobosa* (Cushman, 1910). Höglund, p. 144, pl. 11, fig. 2.

1986 *Cribrostomoides subglobosus* (Cushman, 1910). Schröder, p. 48, pl. 17, figs. 15, 16; Jonasson, 1994, p. 53, pl. 5, fig. 8.

1981 *Cribrostomoides subglobosum* (Cushman 1910). Poag, p. 57, pl. 11, fig. 2.

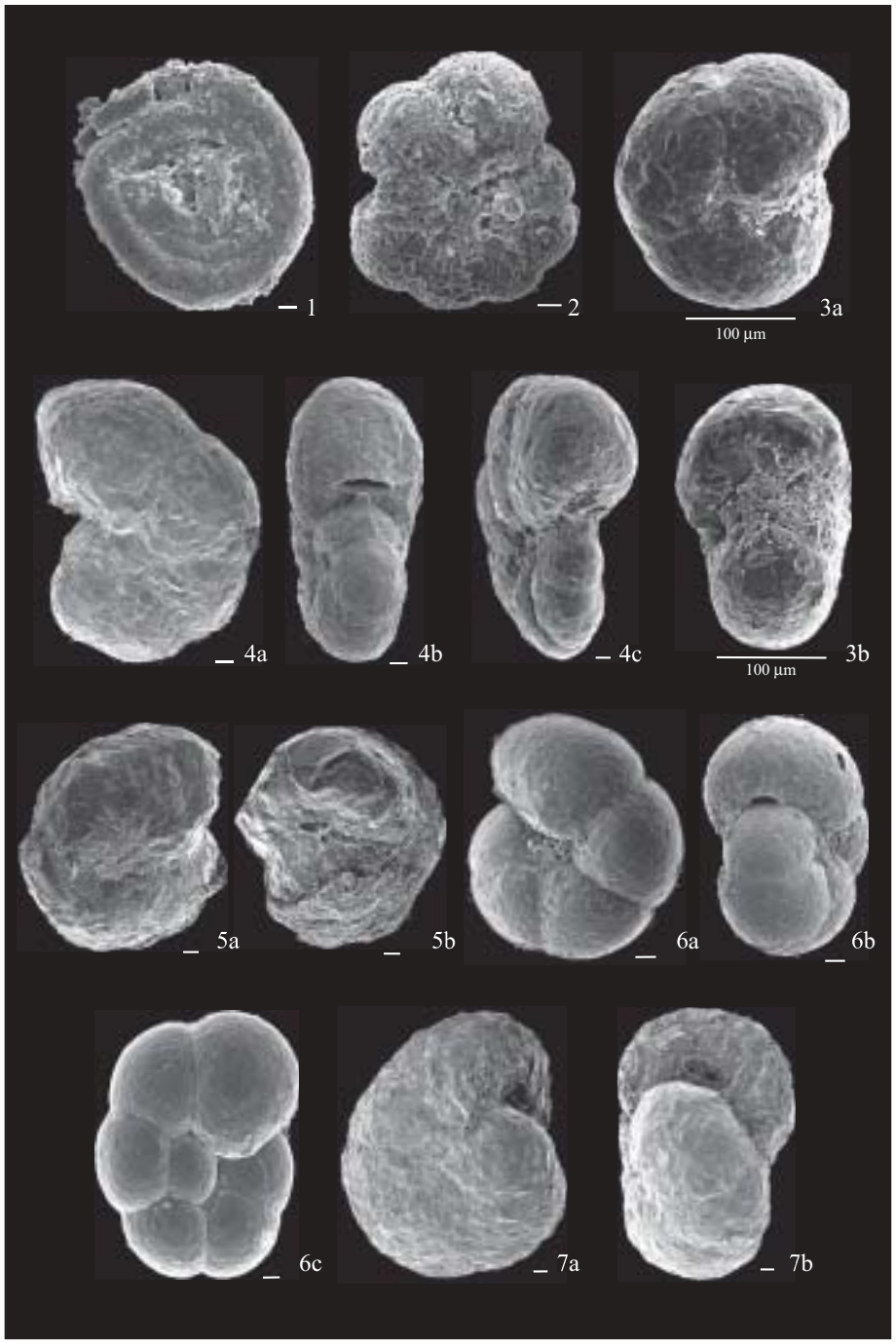

Figure 2. 1. *Ammodiscus gullmarensis* Höglund, from sample FC04-86, side view. **2.** *Cribrostomoides crassimargo* (Norman), from sample FC04-90, side view showing lobulate periphery and coarse agglutination. **3.** *Cribrostomoides* sp. A, from sample FC04-77; 3a, side view, showing rounded periphery and inflated last chamber; 3b, apertural view, showing inflated last chamber. **4.** *Cribrostomoides jeffreysii* (Williamson), from sample BE5; 4a, side view, showing ovate periphery; 4b, apertural view, showing depressed test and typical aperture; 4c, apertural view from another specimen from sample BE7, showing leaf-like aperture. **5.** *Cribrostomoides* cf. *subglobosum* (Cushman), from sample ALS2; 5a, side view showing rounded periphery; 5b, apertural view showing globular test and characteristic aperture. **6.** *Haplophragmoides bradyi* (Brady), from sample BE3; 6a, side view showing very smooth test; 6b, apertural view showing characteristic interiomarginal aperture; 6c, side view of a more evolute specimen from sample BE5. **7.** *Recurvoides turbinatus* (Brady), from sample ALS1; 7a, side view; 7b, apertural view showing asymmetry of test and angled aperture. All scales are 10 µm unless otherwise indicated.

Description. Test free, planispiral, involute, depressed at the umbilicus; wall agglutinated, somewhat roughened but variable; chambers broad and low, usually 4 to 8 in last whorl, making test as whole subglobular; aperture interio-areal, forming oblong, very narrow curved slit immediately above inner margin of apertural face, with well developed lips.

Remarks. Although *C. subglobosum* is reported to be of a bigger size than the specimens present on the SBIC (J.P. Guilbault, oral communication, 2006), the general shape of these specimens agrees well with the description of *C. subglobosum*. However, the apertural face in most specimens was covered by debris, making it impossible to recognize the shape of the aperture. They are therefore named as *C.* cf. *subglobosum*, until a better designation is found.

Cribrostomoides wiesneri (Parr 1950)
Figures 3.1a-3.1c

1950 *Labrospira wiesneri* Parr, p. 272, pl. 4, figs. 25, 26.

1986 *Cribrostomoides wiesneri* (Parr 1950). Schröder, p. 48, pl. 17, figs. 10, 12; Poag, 1981, p. 57, pl. 9, fig. 1.

Description. Test free, planispiral, not completely involute; wall agglutinated, fine, with excess of yellow to reddish brown cement, smooth; umbilical region depressed, with chambers of earlier whorls visible; about 3 whorls; periphery slightly lobulate; 7 to 9 chambers in last whorl; sutures distinct, slightly depressed; aperture a short narrow slit slightly above base of apertural face.

Cribrostomoides sp. A
Figures 2.3a, 2.3b

Description. Test free, planispiral, involute, depressed at the umbilicus; wall agglutinated, somewhat roughened but variable; chambers broad and low, usually 5 to 7 in last whorl; last chamber much inflated and wider, protruding strongly on both sides on apertural view, rest of the chambers more compressed; periphery rounded; aperture interio-areal, forming a curved slit immediately above of inner margin of apertural face.

Remarks. This species resembles *C. subglobosum*, but the width of the last chamber, very prominent in all specimens, sets it apart.

Genus *Haplophragmoides* Cushman, 1910
Haplophragmoides bradyi (Brady 1887)
Figures 2.6a-2.6c

1887 *Trochammina robertsoni* Brady, p. 893, pl, 20, fig. 4.

1891 *Trochammina bradyi* Robertson, p. 388.

1947 *Haplophragmoides bradyi* (Brady 1887). Höglund, p. 134, pl. 10, fig. 1; Murray, 1972, p. 24, pl, 5, figs. 1,2; Schröder, 1986, p. 46, pl. 17, fig. 8.

Description. Test free, planispiral, partly evolute, discoidal or compressed, nearly symmetrical bilaterally; wall agglutinated, very fine, brown, very smooth; 5 chambers in outer whorl, somewhat inflated; sutures distinct, depressed; aperture interiomarginal, lipped.

Superfamily HAPLOPHRAGMIACEA Eimer and Fickert, 1899
Family AMMOSPHAEROIDINIDAE Cushman, 1927
Subfamily RECURVOIDINAE Alekseychik-Mitskevich, 1973
Genus *Recurvoides* Earland, 1934
Recurvoides turbinatus (Brady 1881)
Figures 2.7a, 2.7b

1881 *Lituola (Haplophragmium) turbinatum* Brady, p. 50, pl. 35, fig. 9.

1953 *Recurvoides turbinatus* (Brady 1881). Loeblich and Tappan, p. 27, pl. 2, fig. 11; Rodrigues, 1980, p. 66, pl. 3-3, fig. 8; Jonasson, 1994, p. 58, pl. 7, fig. 2.

Description. Test free, streptospiral, involute on one side and evolute on the other; wall agglutinated, somewhat roughened but variable; chambers not inflated but somewhat irregular in shape; periphery rounded; aperture an elongated areal slit set at an angle on periphery.

Superfamily TROCHAMMINACEA Schwager, 1877
Family TROCHAMMINIDAE Schwager, 1877
Subfamily TROCHAMMININAE Schwager, 1877
Genus *Ammoglobigerina* Eimer and Fichert, 1899
Ammoglobigerina globigeriniformis (Parker and Jones 1865)
Figures 4.7a, 4.7b

1865 *Lituola nautiloidea* var. *globigeriniformis* Parker and Jones, p. 40.7, pl. 15, figs. 46, 47.

1986 *Trochammina* cf. *globigeriniformis* (Parker and Jones 1865). Schröder, p. 52, pl. 19, figs. 5-8.

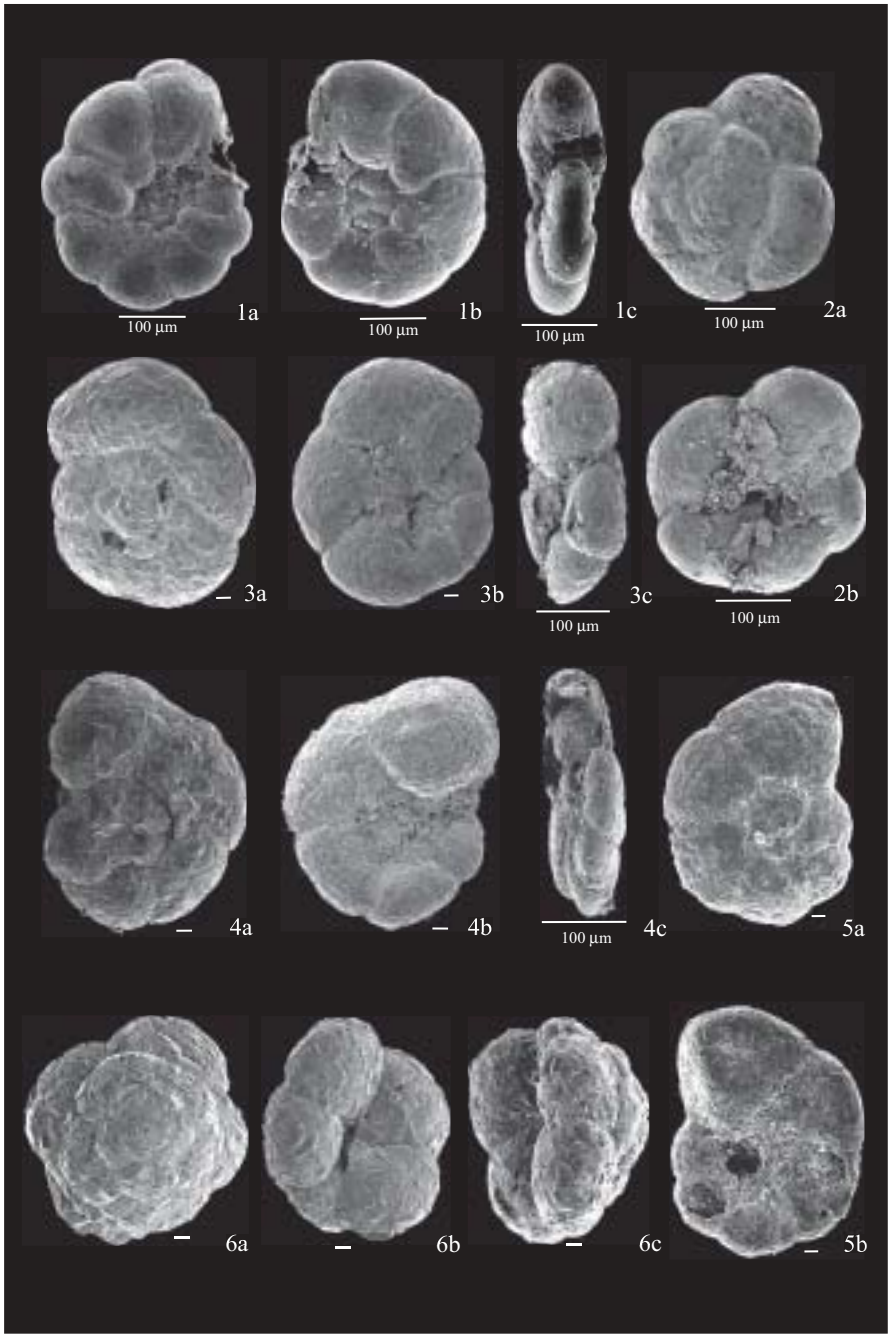

Figure 3. 1. *Cribrostomoides wiesneri* (Parr); 1a, side view of specimen from sample FC04-99; 1b, side view of another specimen from sample FC04-99; 1c, apertural view of a third specimen from sample FC04-99. **2.** *Trochammina inflata* (Montagu), from sample BE3; 2a, dorsal view; 2b, umbilical view. **3.** *Portatrochammina bipolaris* Brönnimann and Whitaker, from sample BE7; 3a, dorsal view; 3b, umbilical view, showing characteristic umbilical flap; 3c, side view from another specimen from sample BE7. **4.** *Lepidoparatrochammina charlottensis* (Cushman), from sample BE5; 4a, dorsal view; 4b, umbilical view, showing characteristic very inflated last chamber; 4c, side view, from another specimen from sample ALS3, with first chamber broken. **5.** *Zavodovskina nana* (Brady), from sample FC04-77; 5a, dorsal view; 5b, umbilical view, showing very deep umbilicus. **6.** *Deuterammina discorbis* (Earland), from sample BE5; 6a, dorsal view; 6b, umbilical view; 6c, side view showing very high spiral. All scales are 10 µm unless otherwise indicated.

Description. Test free, trochospiral, varying from depressed to slightly conical; wall medium to coarsely agglutinated with finer grained matrix; 2 or 3 whorls; chambers rapidly increasing in size; periphery rounded; aperture simple at inner margin on umbilical side of last chamber opening into narrow umbilicus.

Genus *Deuterammina* Brönnimann 1976
Deuterammina discorbis (Earland, 1934)
Figures 3.6a-3.6c, 4.4

1934 *Trochammina discorbis* Earland, p. 104, pl. 3, figs. 28-31; Blais, 1995, p. 93, pl. 2-3, figs. 7, 8.

1988 *Deuterammina discorbis* (EARLAND) Brönnimann and Whittaker, p. 101, fig. 36A-I.

Description. Test free, minute, trochospiral; wall agglutinated, very fine with much cement; surface smooth but not very highly polished; 3 or 4 whorls visible on spiral side, 4 or 5 chambers from final whorl visible on dorsal side; dorsal side highly convex, umbilical side nearly flat but with deeply sunk umbilicus; sutures recurved on dorsal side, straight on ventral; periphery subacute; aperture small slit on inner edge of final chamber on ventral side.

Deuterammina grisea (Earland 1934)

1934 *Trochammina grisea* Earland, p. 100, pl. 3, figs. 35-37.

1988 *Deuterammina (Deuterammina) grisea* (Earland) Brönnimann and Whittaker, p. 107-110, fig. 39D-I.

Description. Test free, large, trochospiral; wall agglutinated, fine, smooth, unpolished; 3 whorls with 6 chambers each on dorsal side, only 6 last chambers visible on umbilical side, very slightly inflated; dorsal side flattened, umbilical side deeply depressed at umbilicus; sutures on dorsal side straight and distinct, slightly depressed, sutures more depressed on umbilical side; periphery round, slightly lobulate at last few chambers; aperture a narrow slit on inner apertural face of last chamber.

Deuterammina rotaliformis (Heron-Allen and Earland, 1911)
Figures 4.6a, 4.6b

1911 *Trochammina rotaliformis* Heron-Allen and Earland, p. 309; Loeblich and Tappan, 1953, p. 51, pl. 8, figs. 6-9; Murray, 1972, p. 39, pl. 12, figs. 1-5; Blais, 1995, p. 93, pl. 2-3, figs. 1-3.

Description. Test free, trochospiral; wall agglutinated, imperforate; 20 elongated chambers arranged in 3 whorls on dorsal side, 5 chambers broadly triangular on umbilical side; strongly convex on dorsal side, shallow-concave on umbilical side; periphery rounded, slightly lobulate; sutures not well defined, more depressed on umbilical side; umbilical depression star-shaped, open and deep with 5 arms; primary aperture interiomarginal extraumbilical, secondary posterior aperture umbilical-sutural.

Genus *Lepidodeuterammina* Brönnimann and Whittaker 1983
Lepidodeuterammina ochracea (Williamson 1858)
Figures 4.3a-4.3c

1858 *Rotalina ochracea* Williamson, p. 55, pl. 5, fig. 113.

1987 *Lepidodeuterammina ochracea* (Williamson 1858). Loeblich and Tappan, pl. 135, figs. 10-14.

1972 *Trochammina ochracea* (Williamson 1858). Murray, p. 37, pl. 11, figs. 1-5; Alves Martins and Ruivo Dragão Gomes, 2004, p. 29, fig. 2.12.

Description. Test free, trochospiral, depressed; wall agglutinated; two-and-one-half whorls in dorsal side, with 8 or 9 chambers each, filled with dark organic matter on umbilical side; slightly convex on dorsal side, correspondingly concave on ventral side; periphery round, very slightly lobulate at last chambers; sutures sometimes raised, arcuate, flexuous and very prominent; aperture a peripheral interiomarginal arch, secondary umbilical apertures at umbilical inflated portions of chambers.

Genus *Lepidoparatrochammina* Brönnimann and Whittaker 1986
Lepidoparatrochammina charlottensis (Cushman, 1925)
Figures 3.4a-3.4c

1925 *Trochammina charlottensis* Cushman, p. 39, pl. 6, fig. 4a, b.

1995 *Trochammina charlottensis* Cushman, 1925. Blais, p. 92, pl. 2-3, fig. 1; Patterson, Burbidge and Luternauer, 1998, p. 4, pl. 26, figs. 5, 6.

Description. Test free, compressed, very flat trochospiral; wall coarsely agglutinated, opaque; sutures radiate and depressed, especially on the umbilical side; all chambers visible on spiral side, last 6 chambers visible on the umbilical side; aperture a low interiomarginal arch opening into the open umbilicus.

Remarks. This species is easily distinguishable by the very big, inflated last chamber.

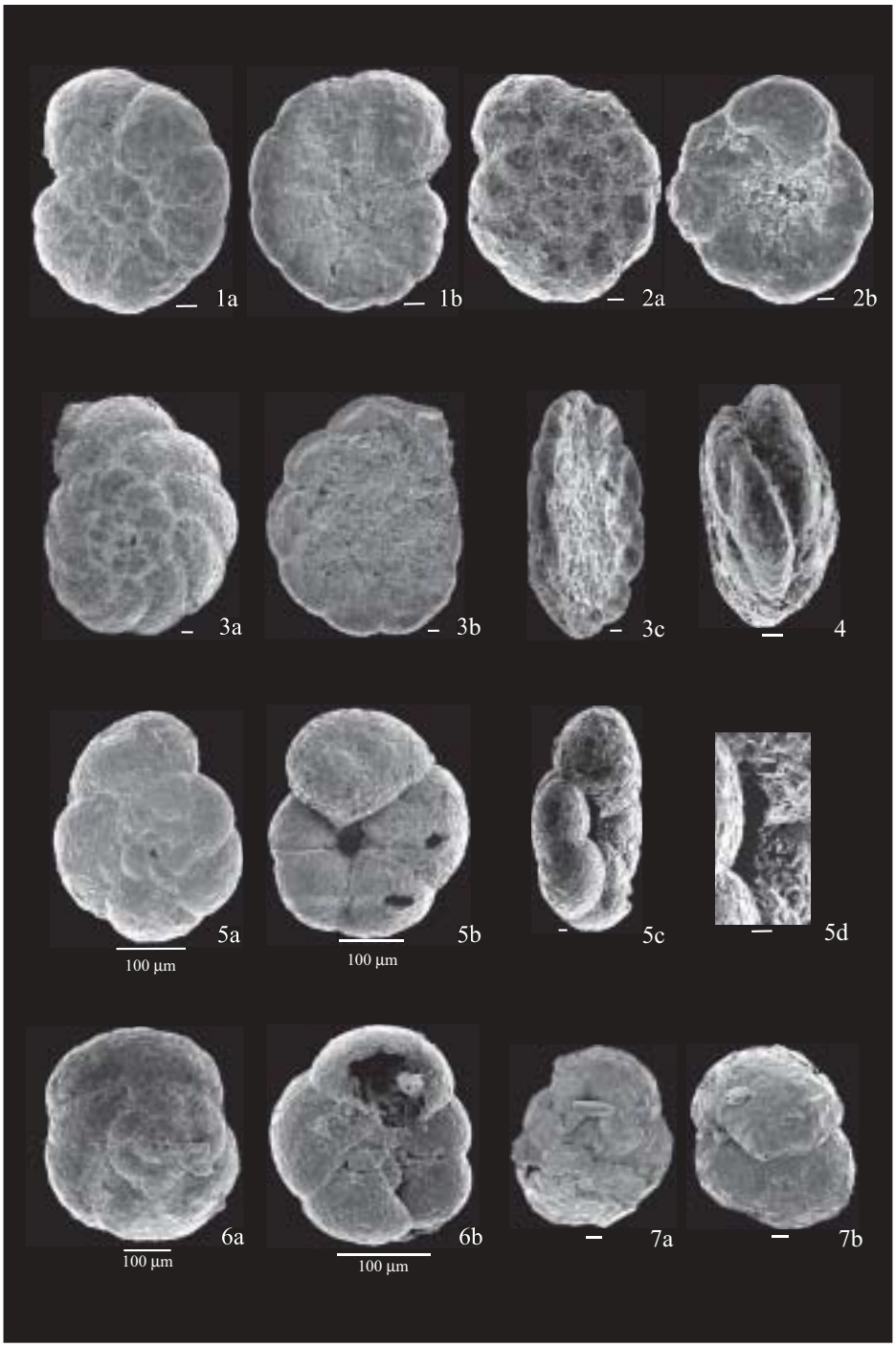

Figure 4. 1. *Polystomammina nitida* (Brady), from sample BE7; 1a, dorsal view, showing very straight sutures; 1b, umbilical view. **2.** *Trochammina squamata* Jones and Parker, from sample FC04-96; 2a, dorsal view; 2b, umbilical view. **3.** *Lepidodeuterammina ochracea* (Williamson), from sample ALS1; 3a, dorsal view; 3b, umbilical view, with umbilical region filled with organic matter; 3c, side view, showing depressed concave test. **4.** Two forms of *D. discorbis* attached to each other, from sample FC04-79. **5.** *Trochammina pacifica* Cushman, from sample BE5; 5a, dorsal view; 5b, umbilical view, showing inflated chambers; 5c, side view, showing aperture reaching the umbilicus; 5d, detail of aperture showing lip. **6.** *Deuterammina rotaliformis* (Heron-Allen and Earland), both specimens from sample BE1; 6a, dorsal view; 6b, umbilical view, with debris partially obscuring star-shaped umbilicus. **7.** *Ammoglobigerina globigeriniformis* (Parker and Jones) from sample BE5; 7a, dorsal view of specimen with last chamber broken; 7b, umbilical view of another specimen. All scales are 10 µm unless otherwise indicated.

Genus *Portatrochammina* Echols, 1971
Portatrochammina bipolaris Brönnimann and Whittaker, 1980
Figures 3.3a-3.3c

1980 *Portatrochammina bipolaris* Brönnimann and Whittaker, pp. 181, 183, figs. 15, 16, 18, 19, 20-31.

Description. Test free, trochospiral; wall agglutinated, imperforate; about 14 chambers, 6 to 8 chambers in the final whorl, increasing rapidly in size; shallow umbilicus covered by flap from each successive chamber; elongate-ovate in outline, final portion somewhat lobulate; compressed, almost flat spirally, concave umbilically; periphery rounded to sub-acute; final chamber characteristically flat on spiral side and strongly convex on umbilical side; radial sutures straight to sinuous on umbilical side and slightly curved on spiral side; color dark brow grading into light brown; aperture begins as low interiomarginal opening near periphery, extends as slit around umbilical flap.

Genus *Polystomammina* Seiglie, 1965
Polystomammina nitida (Brady 1881)
Figures 4.1a, 4.1b

1881 *Trochammina nitida* Brady, p. 52, Figure in Brady, 1884, pl. 41, figs. 5, 6; Snyder, Hale and Kontrovitz, 1990, p. 277, pl. 7, fig. 3.

Description. Test free, low trochospiral, compressed; wall agglutinated, thin and fragile; 2 or 3 whorls on dorsal side, final whorl with 9 chambers, increasing rapidly in size as added; dorsal side flat, umbilical side convex, somewhat excavated at umbilicus; periphery rounded, slightly depressed at sutures; aperture a curved or angled slit, beginning at base of apertural face in equatorial position and curving openly upward onto umbilical side of chamber.

Genus *Trochammina* Parker and Jones, 1859
Trochammina inflata (Montagu 1808)
Figures 3.2a, 3.2b

1808 *Nautilus inflatus* Montagu, p. 81, pl. 18, fig. 3.

1972 *Trochammina inflata* (Montagu, 1808). Murray, p. 35, pl. 10, figs. 3-6; Patterson, 1990a, p. 241, pl. 1, figs. 8-10.

Description. Test free, trochospiral; wall very finely agglutinated, very smoothly finished; 2 or 3 whorls, with 4 to 5 chambers in last whorl; chambers extremely inflated; periphery rounded; sutures distinct but only slightly depressed, nearly radial; aperture a narrow slit on ventral side, at base of last-formed chamber.

Trochammina pacifica Cushman, 1925
Figures 4.5a-4.5d

1925 *Trochammina pacifica* Cushman, p. 39, pl. 6, fig. 3; Patterson, 1990a, p. 240, pl. 1, figs. 5-7; Snyder, Hale and Kontrovitz, 1990, p. 273, pl. 5, fig. 1; Blais, 1995, p. 93, pl. 2.2, figs. 7-8.

Description. Test free, trochospiral; wall coarsely agglutinated, smoothly finished; 2 or 3 whorls, with 4 to 5 chambers in last whorl; chambers extremely inflated; periphery rounded; sutures distinct but only slightly depressed, nearly radial; aperture a narrow slit on ventral side, at base of last-formed chamber.

Trochammina squamata Jones and Parker, 1860
Figures 4.2a, 4.2b

1860 *Trochammina squamata* Jones and Parker, fig. in Hedley, Hurdle and Burdett, 1964, p. 422, fig. 1, p. 424, figs. 1-3.

1947 *Trochammina astrifica* Rhumbler, 1938. Höglund, p. 206, pl. 15, fig. 2.

1990 *Trochammina squamata* Jones and Parker, 1860. Snyder, Hale and Kontrovitz, p. 279, pl. 8, fig. 1.

Description. Test free, small, low trochoidal, excavated on umbilical side; wall finely agglutinated, with occasional larger grains, smoothly finished; periphery angular in outline, slightly lobulate; chambers not inflated, lunate shaped; 2 whorls visible on spiral side; sutures distinct, apparently flush with surface of test, visible on spiral side as dark brown curved backwards lines; aperture a narrow slit at inner margin of umbilical side of last chamber.

Genus *Zavodovskina* Brönnimann and Whittaker 1988
Zavodovskina nana (Brady 1881)
Figures 3.5a, 3.5b

1881 *Haplophragmium nana* Brady, p. 50; Brady, 1884, p. 311, pl. 35, figs. 6-8;

1953 *Trochammina nana* (Brady 1881). Loeblich and Tappan, p. 50, pl. 8, fig. 5; Patterson, Burbidge and Luternauer, 1998, p. 4, pl. 1, figs. 1-3.

Description. Test free, trochospiral, with spiral side almost flattened and umbilical side more convex; wall agglutinated, opaque, of medium-size grains, with some larger clear quartz grains, quite

smooth; lobulate periphery; two-and-one-half whorls, all chambers visible on spiral side, only final 6 or 7 visible on umbilical side; chambers somewhat inflated; sutures distinct, nearly straight and radiate ventrally, curving backwards to periphery on dorsal side; aperture low interiomarginal arch extending into very open umbilicus.

Superfamily HORMOSINACEA Haeckel, 1894
Family HORMOSINIDAE Haeckel, 1894
Subfamily REOPHACINAE Cushman, 1910
Genus *Reophax* de Montfort, 1808
Leptohalysis catella (Höglund 1947)
Figure 5.3

1947 *Reophax catella* Höglund, p. 97, figs. 77,78; Alve, 1990, p. 693, pl. 1, figs. 16, 18.

1995 *Leptohalysis catella* (Höglund 1947). Blais, p. 91, pl. 2-1, fig. 6.

Description. Test free, elongate, slender, tapering, circular in section; wall agglutinated, thin; numerous (up to 20) chambers, increasing in size, arranged in straight line or slightly curved; chambers short and broad, height equaling or slightly exceeding the breadth, chamber sides convex, slightly converging upward, contact surface between chambers broad; aperture a simple rounded opening at top of chamber.

Leptohalysis gracilis (Kiaer 1900)

1900 *Nodulina gracilis* Kiaer, p. 24, figs. 1, 2.

1990 *Reophax gracilis* (Kiaer, 1900). Alve, p. 693, pl. 1, fig. 17.

Description. Test free, elongate, composed of about 19 loosely sutured segments, at the outset short and wide, becoming elongated and pointed towards aperture, with almost horizontally sectioned basal parts; wall agglutinated, smooth.

Remarks. *R. gracilis* differs from *R. catella* and *R. scottii* in basal part of its chambers, which look almost horizontally sectioned.

Leptohalysis scottii (Chaster 1892)

1892 *Reophax scottii* Chaster, p. 57, pl.1, fig. 1; Murray, 1972, p. 17, pl. 1, figs. 6-8; Alve, 1990, p. 693, pl. 1, fig. 19.

Description. Test free, elongate, narrow; wall agglutinated, very delicate, transparent, flexible when moist; 10-20 chambers arranged in a line, gradually increasing in size; chambers somewhat pyriform, abruptly truncated below; aperture small.

Superfamily SPIROPLECTAMMINACEA Cushman, 1927
Family SPIROPLECTAMMINIDAE Cushman, 1927
Subfamily SPIROPLECTAMMININAE Cushman, 1927
Genus *Spiroplectammina* Cushman, 1927
Spiroplectammina biformis (Parker and Jones 1865)
Figures 5.6a-5.6c

1865 *Textularia agglutinans* d'Orbigny var. *biformis* Parker and Jones, p. 370, pl. 15, figs. 23, 24.

1947 *Spiroplectammina biformis* (Parker and Jones 1865). Höglund, p. 163, pl. 12, fig. 1; Loeblich and Tappan, 1953, p. 34, pl. 4, figs. 1-6; Schröder, 1986, p. 51, pl. 21, fig. 14.

Description. Test free, elongate, narrow, ovoid in section, margins broadly rounded, sides nearly parallel; wall agglutinated, solid; large early planispiral coil of few chambers followed by biserially arranged chambers, coil commonly of greater breadth than first few parts of biserial chambers; chambers very slightly inflated; sutures somewhat indistinct, only slightly depressed; aperture a low arch at inner margin of final chamber.

Superfamily VERNEULINACEA Cushman, 1911
Family VERNEULINIDAE Cushman, 1911
Subfamily VERNEULININAE Cushman, 1911
Genus *Gaudryina* d'Orbigny, 1839
Gaudryina arenaria Galloway and Wissler, 1927
Figure 5.1

1927 *Gaudryina arenaria* Galloway and Wissler, p. 68, pl. 11, fig. 5; Patterson, Burbidge and Luternauer, 1998, p. 5, pl. 1, figs. 6, 7.

Description. Test free, elongate, of equal with for much of the test length, tapers to base; wall agglutinated, finely perforate, opaque, surface roughened; chambers initially triserial and triangular in cross-section, then become biserial and slightly inflated; sutures indistinct in triserial section, become depressed in biserial portion; aperture arched at base of final chamber.

Superfamily TEXTULARIACEA Ehrenberg, 1838
Family EGGERELLIDAE Cushman, 1937
Subfamily EGGERELLINAE Cushman, 1937
Genus *Eggerella* Cushman, 1933b
Eggerella advena (Cushman 1922)
Figures 5.4a-5.4d

1922 *Verneuilina advena* Cushman, p.141.

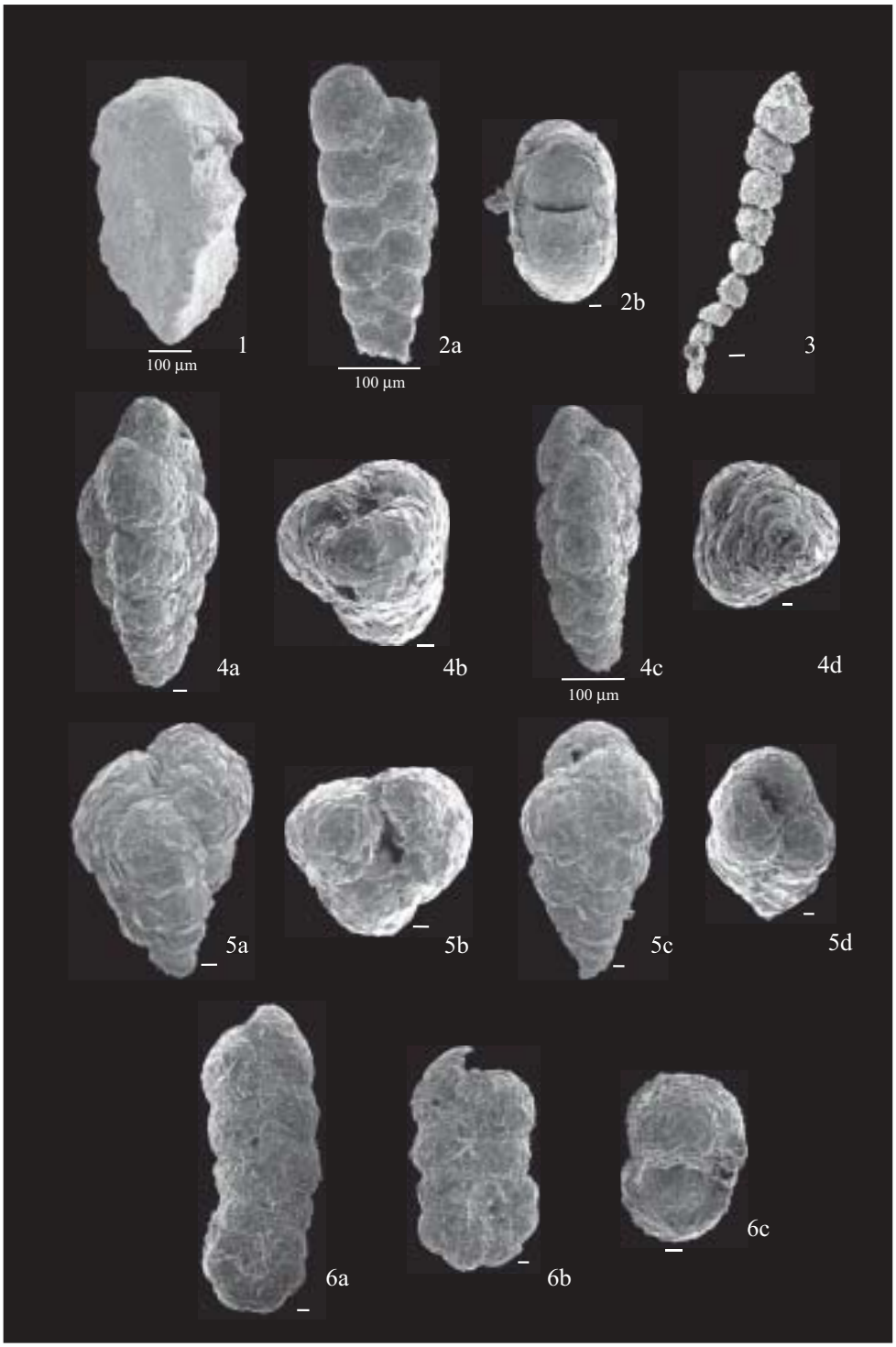

Figure 5. 1. *Gaudryina arenaria* Galloway and Wissler, from sample BE1, side view of eroded specimen. **2.** *Textularia earlandi* Parker, from sample BE7; 2a, side view of broken specimen, with first chambers missing; 2b, apertural view, showing interiomarginal arch. **3.** *Leptohalysis catella* (Höglund), from sample FC04-121, side view. **4***. Eggerella advena* (Cushman), from sample ALS3; 4a, side view; 4b, apertural view; 4c, side view of second specimen, from sample ALS3; 4d, apertural view of specimen 4c. **5.** *Eggerella* sp., from sample ALS2; 5a, side view; 5b, apertural view; 5c, side view of a second specimen from sample ALS3; 5d, apertural view of specimen 5d. **6.** *Spiroplectammina biformis* (Parker and Jones), from sample ALS1; 6a, side view of long specimen; 6b, side view of shorter specimen from sample BE1; 6c, apertural view of specimen 6b. All scales are 10 µm unless otherwise indicated.

1953 *Eggerella advena* (Cushman 1922). Loeblich and Tappan, p. 36, pl. 3, figs. 8-10; Patterson, Burbidge and Luternauer, 1998, p. 5, pl. 28, fig. 6.

Description. Test free, elongate, sharply tapering, early portion with 4 to 5 chambers in a whorl, later portion triserial; wall finely agglutinated with occasional larger grains; chambers numerous, low and broad in early portion, increase in relative height as added, those of final whorl approximately equal in height and breadth; sutures distinct and depressed; aperture small, central, low arch at base of final chamber.

Eggerella sp.
Figures 5.5a-5.5d

1963 *Eggerella advena* (Cushman, 1922). Resig, p. 125, fig. 2.

Description. Test free, elongate, sharply tapering, early portion with 4 to 5 chambers in a whorl, later portion triserial, triangular in cross-section; wall finely agglutinated with occasional larger grains; normally 4 to 5 whorls; chambers numerous, low and broad in early portion, increasing slowly in relative height as added, normally three chambers in final whorl, very inflated and extending outwards of the axis of the test, giving the test a triangular outline in apertural view and an almost flat apertural face; sides straight, except for sutures, increasing at 25° from the axis; sutures distinct and depressed; aperture small, central, low arch at base of final chamber, sometimes with a narrow lip.

Remarks. This species is typically found with *E. advena* (Cushman), although the tapering of the final chambers and the more elongated test easily differentiates the latter.

Family TEXTULARIIDAE Ehrenberg, 1838
Subfamily TEXTULARIINAE Ehrenberg, 1838
Genus *Textularia* Defrance, 1824
Textularia earlandi Parker, 1952
Figures 5.2a, 5.2b

1952 *Textularia earlandi* Parker, new name for *Textularia tenuissima* Earland, 1933, p. 95, pl. 3, figs. 21-40; Murray, 1972, p. 33, pl. 9, figs. 1-5; Blais, 1995, p. 92, pl. 2-2, fig. 1.

Description. Test minute, very elongate, biserial, straight or slightly curved, oval in section, tapering very gradually to the oral, thickest portion; wall agglutinated, thin, smooth, with little sign of cement; periphery straight in first half of test, then slightly lobulate, rounded throughout; chambers very numerous, distinct, regularly increasing in size and thickness, finally becoming slightly inflated; sutures distinct, depressed; aperture an interiomarginal arch, distinct.

Suborder MILIOLINA Delage and Hérouard, 1896
Superfamily NODOSARIACEA Ehrenberg, 1838
Family NODOSARIIDAE Ehrenberg, 1838
Subfamily NODOSARIINAE Ehrenberg, 1838
Genus *Dentalina* Risso, 1826
Dentalina ittai Loeblich and Tappan, 1953
Figures 6.1a, 6.1b

1953 *Dentalina ittai* Loeblich and Tappan, p. 56, pl. 10, fig. 10-12; Rodrigues, 1980, p. 150, pl. 3-7, fig. 6.

Description. Test free, narrow, elongate, arcuate; 2 to 6 elliptical chambers, nearly equal in diameter, slightly overlapping; sutures distinct, constricted, straight; wall calcareous, finely perforate, translucent, so that neck and aperture of earlier chambers may be seen through wall of following chamber, surface smooth and unornamented; aperture radiate, terminal and central in position, very slightly produced.

Suborder LAGENINA Delage and Hérouard, 1896
Superfamily NODOSARIACEA Ehrenberg, 1838
Family LAGENIDAE Reuss, 1862
Genus *Hyalinonetrion* Patterson and Richardson, 1988
Hyalinonetrion dentaliforme (Bagg 1912)
Figure 6.10

1912 *Lagena dentaliformis* Bagg, p. 45, pl. 13, figs. 1, 2.

1998 *Hyalinonetrion dentaliforme* (Bagg, 1912). Patterson, Burbidge and Luternauer, p. 8, pl. 2, fig. 9.

Description. Test free, large, elongate, circular in cross-section, tapers at ends; wall calcareous, hyaline, smooth, finely perforate, although pores do not penetrate outer wall; aperture small and circular with phialine lip.

Genus *Lagena* Walker and Jacob, 1798
Lagena laevis (Montagu 1803)
Figures 6.3a, 6.3b

1803 *Vermiculum leave* Montagu, p. 524.

1953 *Lagena laevis* (Montagu 1803). Loeblich and Tappan, p. 61, pl. 11, figs. 5-8; Murray, 1972, p. 83, pl. 32, figs. 6, 7.

Description. Test free, unilocular, flask-shaped, somewhat elongate, widest slightly below midportion of test, base rounded; wall calcareous, hyaline,

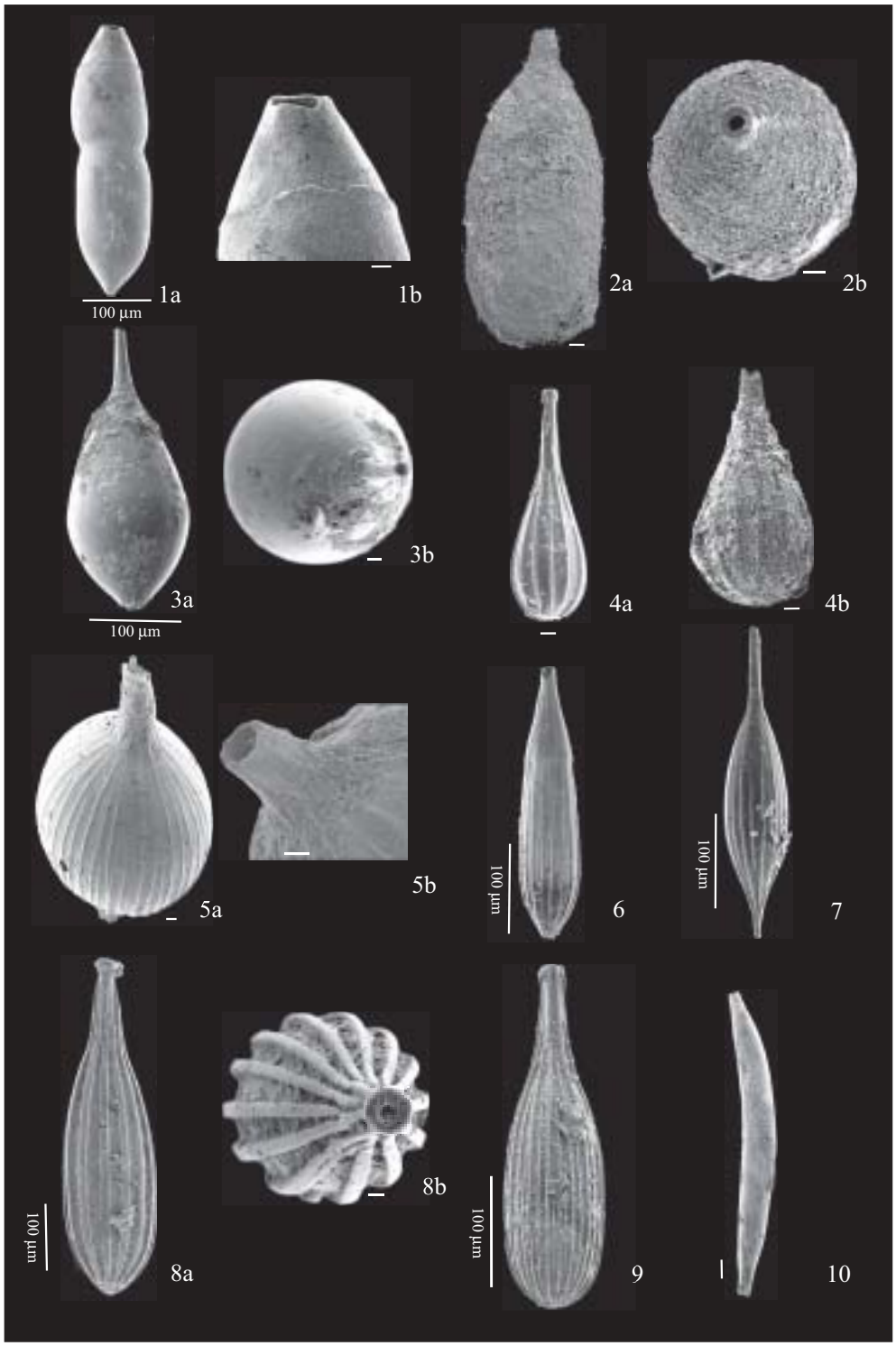

Figure 6. 1. *Dentalina ittai* Loeblich and Tappan, from sample BE1; 1a, side view; 1b, detail of apertural end. **2.** *Pygmaeoseistron hispidulum* (Cushman), from sample BE3; 2a, side view of very corroded specimen; 2b, apertural view. **3.** *Lagena laevis* (Montagu), from sample BE2; 3a, side view; 3b, apertural view. **4.** *Lagena meridionalis* Wiesner, from sample FC04-68; 4a, side view of well preserved specimen; 4b, side view of very corroded specimen. **5.** *Lagena semilineata* Wright, from sample BE1; 5a, side view; 5b, bottom view, showing hollow basal spine. **6.** *Procerolagena mollis* (Cushman), from sample FC04-66, side view. **7.** *Procerolagena gracilis* (Williamson), from sample FC04-75, side view; **8.** *Procerolagena* cf. *amphora* (Reuss), from sample BE1; 8a, side view; 8b, apertural view. **9.** *Procerolagena wiesneri* (Parr), from sample BE1, side view. **10.** *Hyalinonetrion dentaliforme* (Bagg), from sample BE1; side view. All scales are 10 µm unless otherwise indicated.

finely perforate, surface smooth except occasionally very slightly and finely hispid at base, but without distinct spines; upper portion of test tapering gradually to very elongate and slender neck; rounded aperture at top of neck.

Lagena meridionalis Wiesner, 1931
Figures 6.4a, 6.4b

1931 *Lagena gracilis* var. *meridionalis* Wiesner, p. 117, pl. 18, fig. 211

1967 *Lagena meridionalis* Wiesner, 1931. Todd and Low, p. 24, pl. 3, fig. 21.

Description. Test free, unilocular, minute, flask-shaped, wider near rounded base, tapering into long, slender neck; wall calcareous, hyaline, finely perforate, surface ornamented with longitudinal costae, of which every second one is shorter, stopping at the base of the neck, the long costae extend onto neck; aperture simple, terminal, rounded.

Lagena parri Loeblich and Tappan, 1953

1946 *Lagena laevis* (Montagu) var. *baggi* Cushman and Gray, p. 18, pl. 3, figs. 26, 27.

1953 *Lagena parri* Loeblich and Tappan, p. 64, pl. 11, figs. 11-13.

Description. Test free, unilocular, flask-shaped to ovate, widest in lower half of test, with single distinct basal spine; long, very slender neck; wall calcareous, hyaline, finely perforate, smooth; aperture terminal at top of delicate neck.

Lagena semilineata Wright, 1886
Figures 6.5a, 6.5b

1886 *Lagena semilineata* Wright, p. 320, pl. 26, fig. 7; Loeblich and Tappan, 1953, p. 65, pl. 11, figs. 14-22.

Description. Test free, unilocular, flask-shaped, widest near apiculate base, somewhat tapered at upper portion and grading into very long, slender, delicate neck; wall calcareous, hyaline, finely perforate, upper one-half to two-thirds of test is smooth, lower portion ornamented with fine costae, which double in number by intercalation a short distance from the base, in occasional specimens intercalary costae do not develop; delicate basal spine of about one-half the diameter of neck, sometimes broken; neck long, slender, length about two-thirds of chamber; aperture terminal at end of neck, surrounded by slight lip.

Genus *Procerolagena* Puri, 1953
Procerolagena cf. *amphora* (Reuss 1862)
Figures 6.9a, 6.9b

1862 *Lagena amphora* Reuss, p. 330, pl. 4, fig. 57; Todd and Low, 1967, p. 23.

Description. Test free, unilocular, big, amphora-shaped, elongate, tapering into long, slender neck; wall calcareous, hyaline, finely perforate, surface ornamented with thick, longitudinal, plate-like costae that extend onto neck; aperture simple, terminal, rounded, with phialine lip.

Procerolagena gracilis (Williamson, 1848)
Figure 6.7

1848 *Lagena gracilis* Williamson, p. 13, pl. 1, fig. 5

1998 *Procerolagena gracilis* (Williamson, 1848). Patterson, Burbidge and Luternauer, p. 9, pl. 6, fig. 1.

Description. Test free, unilocular, elongate, circular in cross-section, widest near midpoint; wall calcareous, hyaline; 16 to 20 discontinuous and occasionally anastomosing longitudinal costae that extend from base to neck, in some specimens costae unite to form an elongate process in aboral region; neck narrow and elongate, comprises less than one-half of test length; aperture small and circular with phialine lip.

Procerolagena mollis (Cushman 1944)
Figure 6.6

1944 *Lagena gracillima* (Seguenza) var. *mollis* Cushman, p. 21, pl. 3, fig. 3.

1953 *Lagena mollis* (Cushman 1944). Loeblich and Tappan, p. 63, pl. 11, figs. 25-27.

Description. Test free, unilocular, elongate-fusiform, with basal spine and extremely long and slender neck at opposite end, sides nearly parallel over central portion of test; wall calcareous, hyaline, finely perforate, ornamented with numerous very fine longitudinal ribs which die out at beginning of neck; aperture terminal, surrounded by flared lip, at end of long, slender and smooth neck.

Procerolagena wiesneri (Parr 1950)
Figure 6.9

1950 *Lagena striata* (Montagu) var. *wiesneri* Parr, p. 301.

1998 *Procerolagena wiesneri* (Parr, 1950). Patterson, Burbidge and Luternauer, p. 10, pl. 5, figs. 5, 6.

Description. Test free, unilocular, subglobular, broadest near midpoint; wall calcareous, hyaline, surface smooth, finely perforated between costae; on average 28 delicate costae extending from base, every sixth terminates at aperture, three intervening costae terminate at base of neck, separated by two costae of intermediate length which terminate halfway up to neck; no tendency for costae to form an elongate aboral process; aperture round with a phialine lip.

Genus *Pygmaeoseistron* Patterson and Richardson, 1988

Pygmaeoseistron hispidulum (Cushman 1913)

Figures 6.2a, 6.2b

1913 *Lagena hispidula* Cushman, p. 14, pl. 5, figs. 2, 3.

1988 *Pygmaeoseistron hispidulum* (Cushman, 1913). Patterson and Richardson, p. 243, 245, figs. 7-10; Patterson, Burbidge and Luternauer, 1998, p. 10, pl. 6, figs. 2, 3.

Description. Test free, unilocular, elongate, circular in section; wall calcareous, translucent, surface coarse, imperforate; aperture small, circular, with phialine lip, terminal on narrow neck.

Family ELLIPSOLAGENIDAE Silvestri, 1923

Subfamily OOLININAE Loeblich and Tappan, 1961

Genus *Favulina* Patterson and Richardson, 1988

Favulina epibathra Patterson and Richardson, 1988

Figures 7.1a-7.1c

1988 *Favulina epibathra* Patterson and Richardson, p. 250, figs. 30, 31.

Description. Test free, unilocular, subspherical; wall calcareous, hyaline; surface ornamented with 8 to 10 high, stout longitudinal costae, and discontinuous transverse costae, about one-half the height of longidudinal costae, so pattern on test is rectangular; longitudinal costae bifurcate near apex of text to form a single row of hexagonal reticulations; aperture small, round, with phialine lip, may have entosolenian tube.

Favulina melo (d'Orbigny 1839)

Figures 7.2a, 7.2b

1839 *Oolina melo* d'Orbigny, p. 20, pl. 5, fig. 9; Loeblich and Tappan, 1953, p. 71, pl. 12, figs. 8-15; Murray, 1972, p. 93, pl. 37, figs. 4-6.

1998 *Favulina melo* (d'Orbigny 1839). Patterson, Burbidge and Luternauer, p. 11, pl. 6, figs. 6-9.

Description. Test free, unilocular, globular, circular in section; wall calcareous, hyaline, fine perforations do not penetrate outer wall; 9 to 14 longitudinal costae extend from base to aperture; numerous downward curved cross struts unite longitudinal costae giving squamiform appearance to test surface; aperture small and circular, phialine lip; entosolenian tube short and straight.

Genus *Homalohedra* Patterson and Richardson, 1988

Homalohedra apiopleura (Loeblich and Tappan 1953)

Figures 7.3a-7.3c

1953 *Lagena apiopleura* Loeblich and Tappan, p. 59, pl. 10, figs. 14, 15.

1998 *Homalohedra apiopleura* (Loeblich and Tappan, 1953). Patterson, Burbidge and Luternauer, p. 11, pl. 28, figs. 4, 5.

Description. Test free, unilocular, rare twins occur, ovate to pyriform, circular in section, base rounded; wall calcareous, hyaline, finely perforate, translucent; 14 longitudinal costae merge to 7 on upper part of test; collar terminates at base of apertural neck, surface smooth or may have costae with slight bifurcations; aperture small, circular, at end of short smooth neck.

Homalohedra borealis (Loeblich and Tappan 1954)

Figures 7.4a-7.4c

1953 *Oolina costata* (Williamson 1858). Loeblich and Tappan, p. 68, pl. 13, figs. 4-6, new name for *Entosolenia costata* Williamson, 1858, p. 9, pl. 1, fig. 18.

1954 *Homalohedra borealis* (Loeblich and Tappan). Patterson, Burbidge and Luternauer, 1998, p. 11, pl. 7, figs. 1, 2.

Description. Test free, unilocular, globular, circular in section; wall calcareous, hyaline, finely perforate but pores do not penetrate outer surface; 11 to 17 narrow longitudinal ribs extend from circular basal ring and grade into smooth area surrounding aperture; aperture terminal and circular with slightly produced rim; entosolenian tube short and straight.

Homalohedra guntheri (Earland 1934)

Figures 7.5a, 7.5b, 7.6a-7.6c

1934 *Lagena guntheri* Earland, p. 151, pl. 6, figs. 53, 54.

1998 *Homalohedra guntheri* (Earland 1934). Patterson, Burbidge and Luternauer, p. 11, pl. 28, figs. 1, 2.

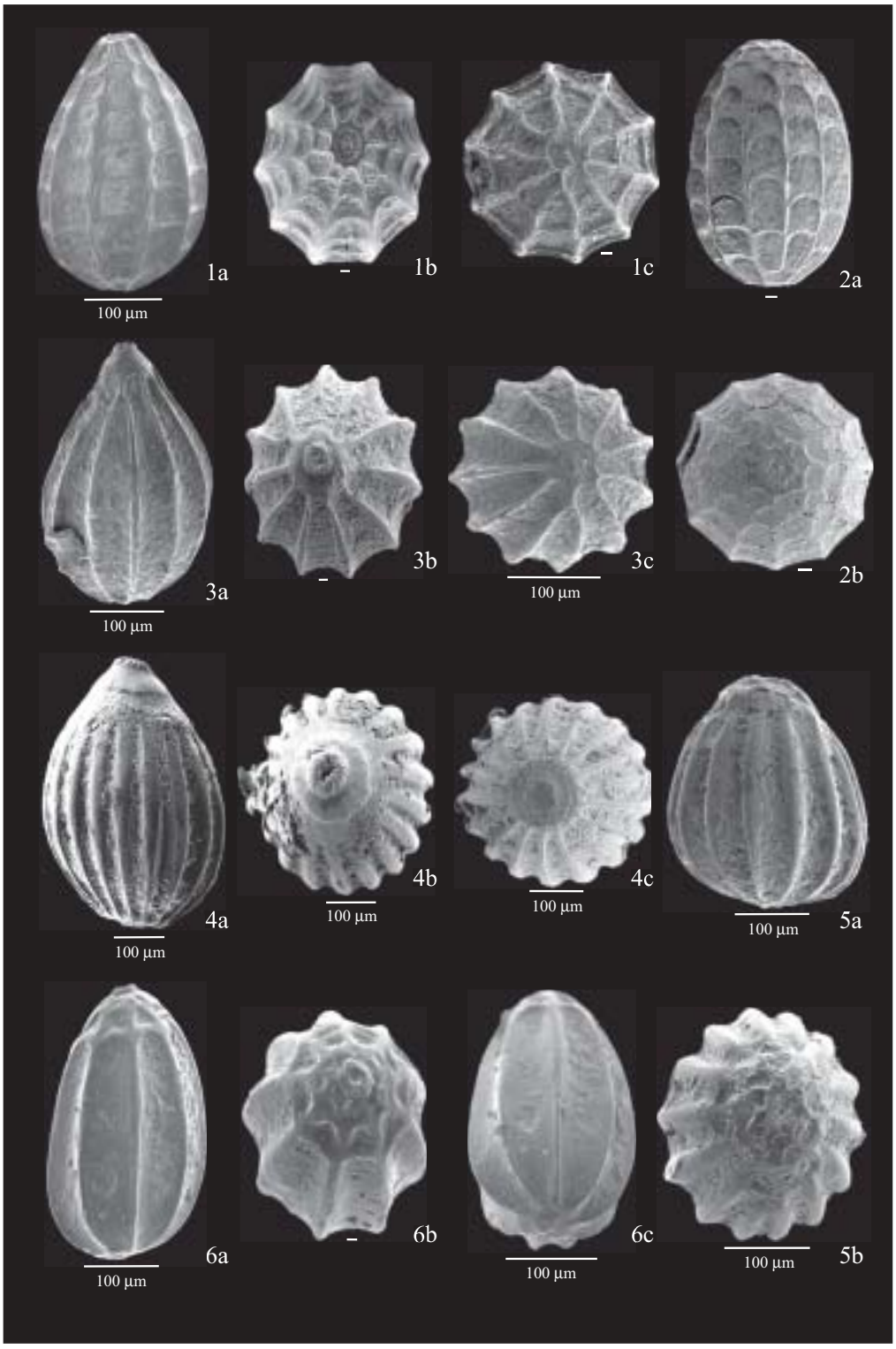

Figure 7. 1. *Favulina epibathra* Patterson and Richardson, from sample BE1; 1a, side view; 1b, apertural view; 1c, bottom view. **2.** *Favulina melo* (d'Orbigny), from sample BE2; 2a, side view; 2b, apertural view. **3.** *Homalohedra apiopleura* (Loeblich and Tappan), from sample BE1; 3a, side view; 3b, apertural view; 3c, bottom view. **4.** *Homalohedra borealis* (Loeblich and Tappan), from sample BE1; 4a, side view; 4b, apertural view; 4c, bottom view. **5-6.** *Homalohedra guntheri* (Earland), from sample BE1; 5a, side view of specimen showing few longitudinal costae; 5b, apertural view of specimen 5a; 6a, side view of specimen from sample FC04-38 showing more longitudinal costae; 6b, apertural view of specimen 6a; 6c, bottom view of specimen 6a. All scales are 10 µm unless otherwise indicated.

Description. Test free, unilocular, pyriform, broadest near midpoint, circular in section; wall calcareous, translucent, imperforate; 6 to 9 longitudinal costae extend from basal ring, then bifurcate and rejoin forming hexagonal pits encircling upper part of test; aperture terminal, small, and round; entosolenian tube short and straight.

Remarks. There is a variation in the number of costae present in this species, going from 9 to 14.

Subfamily ELLIPSOLAGENINAE Silvestri, 1923
Genus *Fissurina* Reuss, 1850
Fissurina cucurbitasema Loeblich and Tappan, 1953
Figures 8.3a-8.3c

1953 *Fissurina cucurbitasema* Loeblich and Tappan, p. 76, pl. 14, figs. 10, 11.

Description. Test free, unilocular, ovate, depressed in cross-section, with almond-like outline, occasionally very slightly produced at the base; wall calcareous, translucent, finely perforate, with thin marginal keel, surface smooth; aperture terminal, ovate, with slight lip, entosolenian tube extending about one-half the length of the test.

Fissurina eburnea (Buchner 1940)
Figures 8.1a, 8.1b, 8.8

1940 *Lagena eburnea* Buchner, p. 458, pl. 9, figs. 146, 147.

1998 *Fissurina eburnea* (Buchner 1940). Patterson, Burbidge and Luternauer, p. 12, pl. 8, figs. 3, 4.

Description. Test free, unilocular, compressed, circular in side view; marginal carina completely encircling test; wall calcareous, hyaline, smooth, finely perforate; aperture circular at centre of fissurine opening; entosolenian tube short and straight.

Fissurina lucida (Williamson 1848)
Figures 8.2a, 8.2b

1953 *Fissurina lucida* (Williamson, 1848). Loeblich and Tappan, , p. 76, pl. 14, fig. 4; Murray, 1972, p. 97, pl. 39, figs. 1-3; Patterson, Burbidge and Luternauer, 1998, p. 12, pl. 8, figs. 5, 6.

Description. Test free, unilocular, slightly elongated, compressed in section; wall calcareous, hyaline, smooth; broad horseshoe-shaped white band follows the margin except in the upper part of test; test entirely encircled by broad and thick marginal carina; aperture slightly produced, fissurine and very elongate, within marginal carina; entosolenian tube short and straight.

Fissurina quadrata (Williamson 1858)
Figure 8.6

1858 *Entosolenia marginata* (Montagu) var. *quadrata* Williamson, p. 11, pl. 1, figs. 27, 28.

1994 *Fissurina quadrata* (Williamson 1858). Loeblich and Tappan, p. 90, pl. 155, figs. 1-6

Description. Test free, unilocular, compressed in section, with the shape of a parallelogram; wall calcareous, hyaline, smooth; test encircled by thin marginal carina; aperture slightly produced, fissurine and very elongate, within marginal carina; entosolenian tube short and straight.

Fissurina vitreola (Buchner 1940)

1940 *Lagena vitreola* Buchner, p. 477, pl. 13, figs. 256-258.

1998 *Fissurina vitreola* (Buchner 1940). Patterson, Burbidge and Luternauer, p. 12, pl. 9, figs. 1-5.

Description. Test free, unilocular, oval in side view, compressed; wall calcareous, hyaline, smooth, fine pores do not penetrate outer wall; 2 wide longitudinal bands near margins, may be connected at base forming horseshoe-shaped structure; aperture an elongate fissurine slit on slight extension of test; entosolenian tube short and straight.

Genus *Palliolatella* Patterson and Richardson, 1988
Palliolatella frangens (Buchner 1940)
Figure 8.4

1940 *Lagena frangens* Buchner, p. 504, pl. 19, figs. 407-409.

1998 *Palliolatella frangens* (Buchner 1940). Patterson, Burbidge and Luternauer, p. 12, pl. 10, figs. 3, 4.

Description. Test free, unilocular, oblong, compressed in cross-section; wall calcareous, hyaline, smooth, finely perforate; wide marginal carina completely encircles test forming a very slight recurved lip around the aperture; 2 high, thin longitudinal costae nearly encircle each test face; aperture a fissurine slit, entosolenian tube attached to one wall and terminating halfway down test wall.

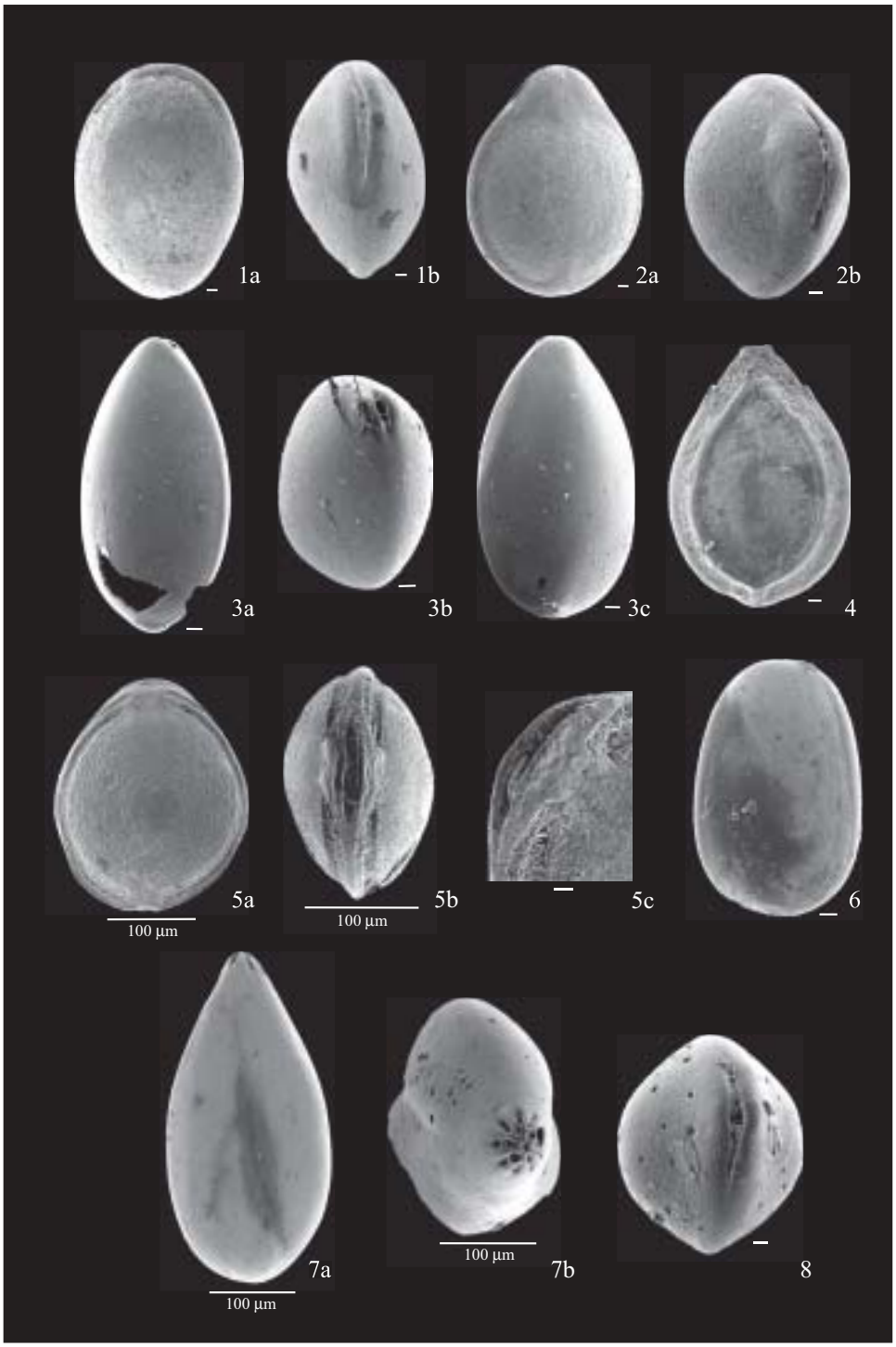

Figure 8. 1. *Fissurina eburnea* (Buchner), from sample BE1; 1a, side view; 1b, lateral view showing aperture. **2.** *Fissurina lucida* (Williamson), from sample FC04-59; 2a, side view; 2b, apertural view. **3.** *Fissurina cucurbitasema* Loeblich and Tappan; 3a, side view of specimen from sample FC04-65, showing thin marginal keel; 3b, apertural view of specimen from sample FC04-67; 3c, side view of specimen from sample FC04-76, showing seed-like shape. **4.** *Palliolatella frangens* (Buchner), side view of specimen from sample BE1. **5.** *Palliolatella immemora* Patterson, from sample BE1; 5a, side view; 5b, apertural view; 5c, detail of the aperture. **6.** *Fissurina quadrata* (Williamson), from sample BE1, side view. **7.** *Laryngosigma trilocularis* (Bagg), pictures of two specimens from sample BE1; 7a, side view; 7b, apertural view showing radiate aperture. **8.** *Fissurina eburnea* (Buchner), from sample BE1, apertural view of specimen with more globular test. All scales are 10 µm unless otherwise indicated.

Palliolatella immemora Patterson, 1990b
Figures 8.5a-8.5c

1940 *Lagena neglecta* Buchner, p. 503, pl. 19, fig. 405 (not *Lagena neglecta* Buchner, 1940, p. 463, pl. 11, figs. 173-178).

1990b *Palliolatella immemora* Patterson, p. 686, fig. 5; Patterson, Burbidge and Luternauer, 1998, p. 13, pl. 10, figs. 1, 2.

Description. Test free, unilocular, compressed, oblong in side view; wall calcareous, hyaline, smooth, finely perforate; thin marginal carina completely encircles test, becomes much wider on short neck; outer margin of carina also thickens on neck, forms recurved area around aperture; aperture small and circular within narrow fissurine slit; entosolenian tube attached to one wall and terminates near test base.

Subfamily PARAFISSURININAE Jones, 1984
Genus *Parafissurina* Parr, 1947
Parafissurina semicarinata (Buchner, 1940)

1940 *Parafissurina lateralis* (Cushman) forma *semicarinata* Buchner, p. 520, pl. 23, figs. 493-494.

1998 *Parafissurina semicarinata* (Buchner, 1940). Patterson, Burbidge and Luternauer, p. 13, pl. 10, figs. 5-8.

Description. Test free, unilocular, oblong, compressed in section; wall calcareous, hyaline, smooth, finely perforate; narrow lateral carina encircles test; aperture arched; subterminal slit at one side of test with overhanging hood-like extension of opposite wall; entosolenian tube attached to overhanging wall and terminates halfway down test.

Family GLANDULINIDAE Reuss, 1860
Subfamily GLANDULININAE Reuss, 1860
Genus *Laryngosigma* Loeblich and Tappan, 1953
Laryngosigma trilocularis (Bagg 1912)
Figures 8.7a, 8.7b

1912 *Polymorphina trilocularis* Bagg, p. 75, pl. 20, figs. 15-18.

1998 *Laryngosigma trilocularis* (Bagg, 1912). Patterson, Burbidge and Luternauer, p. 13, pl. 12, figs. 7, 8.

Description. Test free, elongate, compressed; wall calcareous, hyaline, smooth, finely perforate; chambers 3 to 4 pairs, high, narrow, biserial, added slightly less than 180° apart, form a sigmoid series; aperture terminal and radiate; entosolenian tube short and straight.

Suborder ROTALIINA Delage and Hérouard, 1896
Superfamily BOLIVINACEA Glaessner, 1937
Family BOLIVINIDAE Glaessner, 1937
Genus *Bolivina* d'Orbigny, 1839
Bolivina decussata Brady, 1881
Figures 9.1a, 9.1b

1881 *Bulimina (Bolivina) decussata* Brady, p. 58, fig. in Brady, 1884, p. 423, pl. 53, figs. 12, 13.

1998 *Bolivina decussata* Brady, 1881. Patterson, Burbidge and Luternauer, p. 14, pl. 11, figs. 5, 6.

Description. Test free, elongate, very compressed, of nearly equal thickness throughout; wall calcareous, translucent, finely perforate although perforations commonly obscured by coarse reticulations formed by secondary calcification; chambers 8 to 10 pairs, rapidly expand from subacute initial end; sutures distinct, slightly curved at about 45° to longitudinal axis; aperture loop-shaped at top of final formed chamber, with internal toothplate attached to one side.

Bolivina minuta Natland, 1938
Figures 9.2a, 9.2b

1938 *Bolivina minuta* Natland, p. 146, pl. 5, fig. 10.

Description. Test free, very compressed, sides nearly parallel, periphery angled, flattened, forming a slightly concave side; wall calcareous, thin, finely perforated; 8 to 10 pairs of chambers biserially arranged, rapidly increasing in size; sutures distinct, curved, quite oblique; aperture a loop-shaped opening in top of last chamber.

Genus *Bolivinellina* Saidova, 1975
Bolivinellina pacifica (Cushman and McCulloch 1942)
Figures 9.4a, 9.4b

1942 *Bolivina acerosa* Cushman var. *pacifica* Cushman and McCulloch, p. 185, pl. 21, figs. 2, 3.

1998 *Bolivinellina pacifica* (Cushman and McCulloch, 1942). Patterson, Burbidge and Luternauer, p. 14, pl. 13, figs. 1,2.

Description. Test free, elongate, compressed, broadest near aperture and tapers to base; wall calcareous, hyaline, smooth, finely perforate; chambers 10 to 13 pairs, biserially arranged, slightly inflated and wider than high, gradually increase in size as added; sutures slightly curved and depressed, about 60° to longitudinal axis; aperture lipped, loop-shaped at base of final

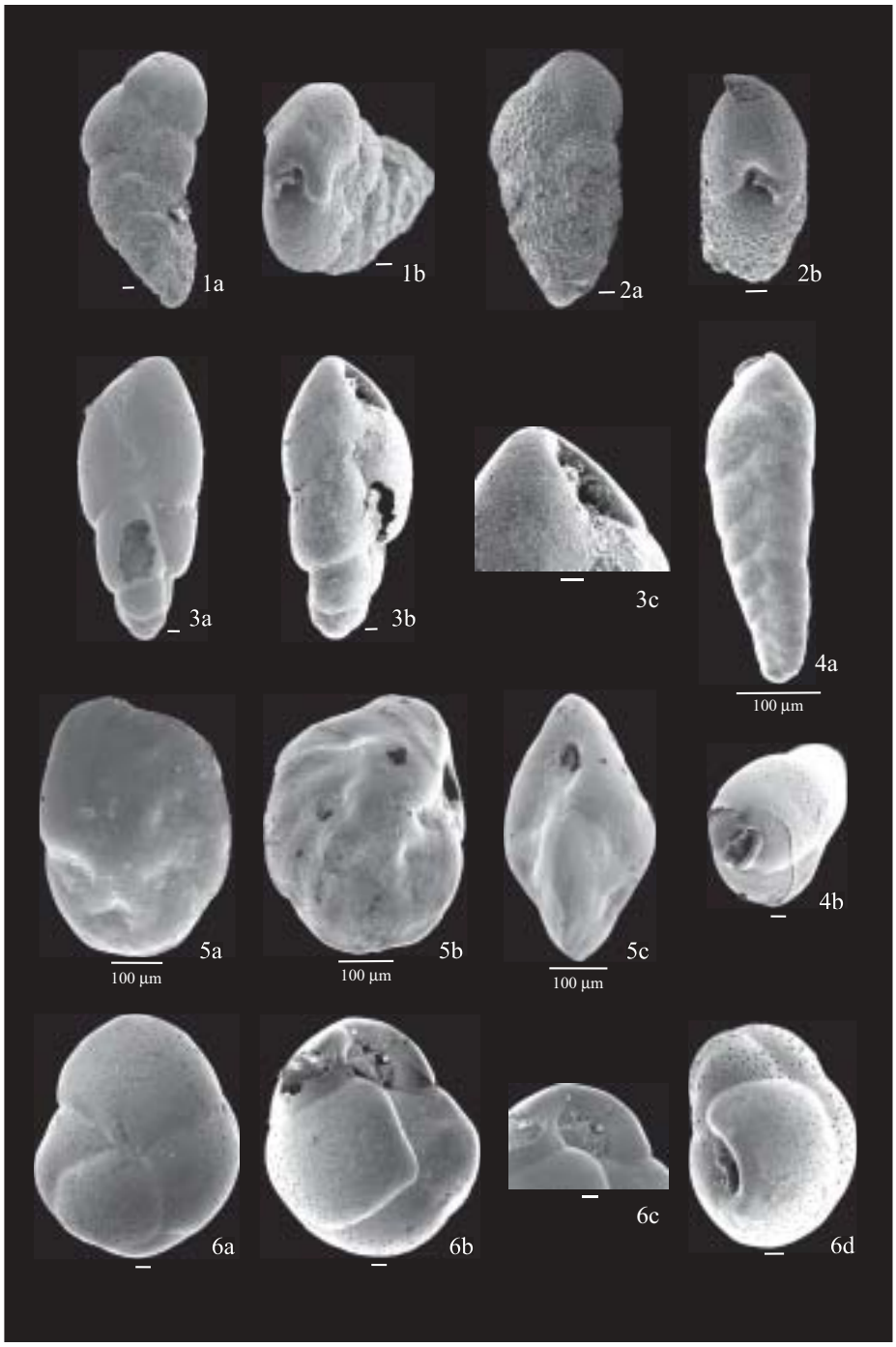

Figure 9. 1. *Bolivina decussata* Brady, from sample BE1; 1a, side view showing roughened surface; 1b, apertural view. **2.** *Bolivina minuta* Natland, from sample BE1; 2a, side view showing nearly parallel sides; 2b, apertural view. **3.** *Stainforthia feylingi* Knudsen and Seidenkrantz, from sample BE1; 3a, side view showing smooth, finely perforated test; 3b, side view showing fusiform test; 3c, detail of aperture showing toothplate. **4.** *Bolivinellina pacifica* (Cushman and McCulloch), from sample BE1; 4a, side view showing elongated test and biserial arrangement; 4b, apertural view, showing lip and internal toothplate. **5.** *Islandiella helenae* Feyling-Hanssen and Buzas, from sample BE1; 5a, side view showing smooth test; 5b, view of the other side, showing position of aperture along periphery; 5c, apertural view showing biconvex test. **6.** *Cassidulina crassa* d'Orbigny, from sample FC04-14; 6a, side view showing rectangular last chamber; 6b, view of the other side, showing slightly inflated chambers; 6c, detail of aperture; 6d, view of another specimen from sample BE3, showing rounded outline and depressed sutures, different from the more compressed test and flushed sutures of *C. reniforme.* All scales are 10 µm unless otherwise indicated.

formed chamber, with internal toothplate attached to one side.

Superfamily CASSIDULINACEA d'Orbigny, 1939
Family CASSIDULINIDAE d'Orbigny, 1939
Subfamily CASSIDULININAE d'Orbigny, 1939
Genus *Cassidulina* d'Orbigny, 1826
Cassidulina crassa d'Orbigny, 1839
Figures 9.6a-9.6d

1839 *Cassidulina crassa* d'Orbigny, p. 56, pl. 7, figs. 18-20.

2004 *Cassidulina crassa* d'Orbigny, 1839. Alves Martins and Ruivo Dragão Gomes, p. 118, fig. 2.67.

Description. Test free, circular to oval, biconvex; periphery slightly rounded; chambers slightly inflated, last chamber rectangular to trapezoidal; sutures slightly depressed; wall calcareous, delicate, translucent, shiny, finely perforated; aperture a simple slit in the middle of a central, triangular depression of the basal suture of the last chamber, partially closed by an apertural plate.

Remarks. *C. crassa* differs from *C. reniforme* Nørvang in the more globular test, slightly inflated chambers and depressed sutures.

Genus *Islandiella* Nørvang, 1959
Islandiella helenae Feyling-Hanssen and Buzas, 1976
Figures 9.5a-9.5c

1976 *Islandiella helenae* Feyling-Hanssen and Buzas, p. 155, figs. 1-4; Patterson, Burbidge and Luternauer, 1998, p. 15, pl. 31, figs. 1-3.

Description. Test free, biconvex with a sub acutely thickened peripheral margin, lenticular; wall calcareous, perforate, translucent to hyaline, very distinctly radial when viewed in polarized light; about 5 pairs of chambers in the final whorl, biserially arranged, evolutely coiled so that the previous whorls are seen through the thick, clear shell material of the umbilical region, chambers bean-shaped, oriented at 45° to umbilicus giving them the appearance of leaning into side of previous chamber; sutures distinct, thickened, flush with the surface, outlining the chambers; aperture a broad short slit paralleling the periphery and with a free apertural tongue projecting out of it.

Superfamily TURRILINACEA Cushman, 1927
Family STAINFORTHIIDAE Reiss, 1963
Genus *Stainforthia* Hofker, 1956
Stainforthia feylingi Knudsen and Seidenkrantz, 1994
Figures 9.3a-9.3c

1994 *Stainforthia feylingi* Knudsen and Seidenkrantz, ol. 1, figs. 1-32; pl. 2, figs. 1-6, 8; Patterson, Burbidge and Luternauer, 1998, p. 16, pl. 14, figs. 5, 6.

Description. Test free, elongate, streamlined, fusiform, compressed and ovate in cross-section, broadest often near the middle; wall calcareous, hyaline, smooth, finely perforate; chambers slightly inflated, approximately 7 to 11 pairs, triserially arranged in early stages, later biserial and often slightly twisted; sutures depressed and slightly curved at 45° to 50° to longitudinal axis; aperture depressed and loop-shaped at base of final chamber, with narrow incurved lip at one side and broad toothplate at opposite side bending under lip and partially closing opening; toothplate with serrated free folded portion, lower portion attached to preceding chamber wall.

Superfamily BULIMINACEA Jones, 1875
Family BULIMINIDAE Jones, 1875
Genus *Protoglobobulimina* Hofker, 1951
Protoglobobulimina pupoides (d'Orbigny 1846)
Figures 10.1a-10.1c

1846 *Bulimina pupoides* d'Orbigny, p. 185, pl. 11, figs. 11, 12.

1998 *Protoglobobulimina pupoides* (d'Orbigny 1846). Patterson, Burbidge and Luternauer, p. 17, pl. 17, figs. 7, 8.

Description. Test free, elongate, broadest near base, almost circular in cross-section; wall calcareous, hyaline, smooth, finely perforate; chambers inflated, much higher than wide and strongly overlapping, triserially arranged, in 2 or 3 whorls; sutures depressed; aperture elongate, extends up from base of final chamber; successive chambers connected by an internal toothplate; toothplate final tip can be seen in aperture.

Family BULIMINELLA Cushman, 1911
Genus *Buliminella* Cushman, 1911
Buliminella elegantissima (d'Orbigny 1839)
Figures 10.2a-10.2d

1839 *Bulimina elegantissima* d'Orbigny, p. 51, pl. 7, figs. 13, 14.

1972 *Buliminella elegantissima* (d'Orbigny 1839). Murray, p. 105, pl. 42, figs. 1-4; Patterson, Burbidge and Luternauer, 1998, p. 17, pl. 16, figs. 6, 7.

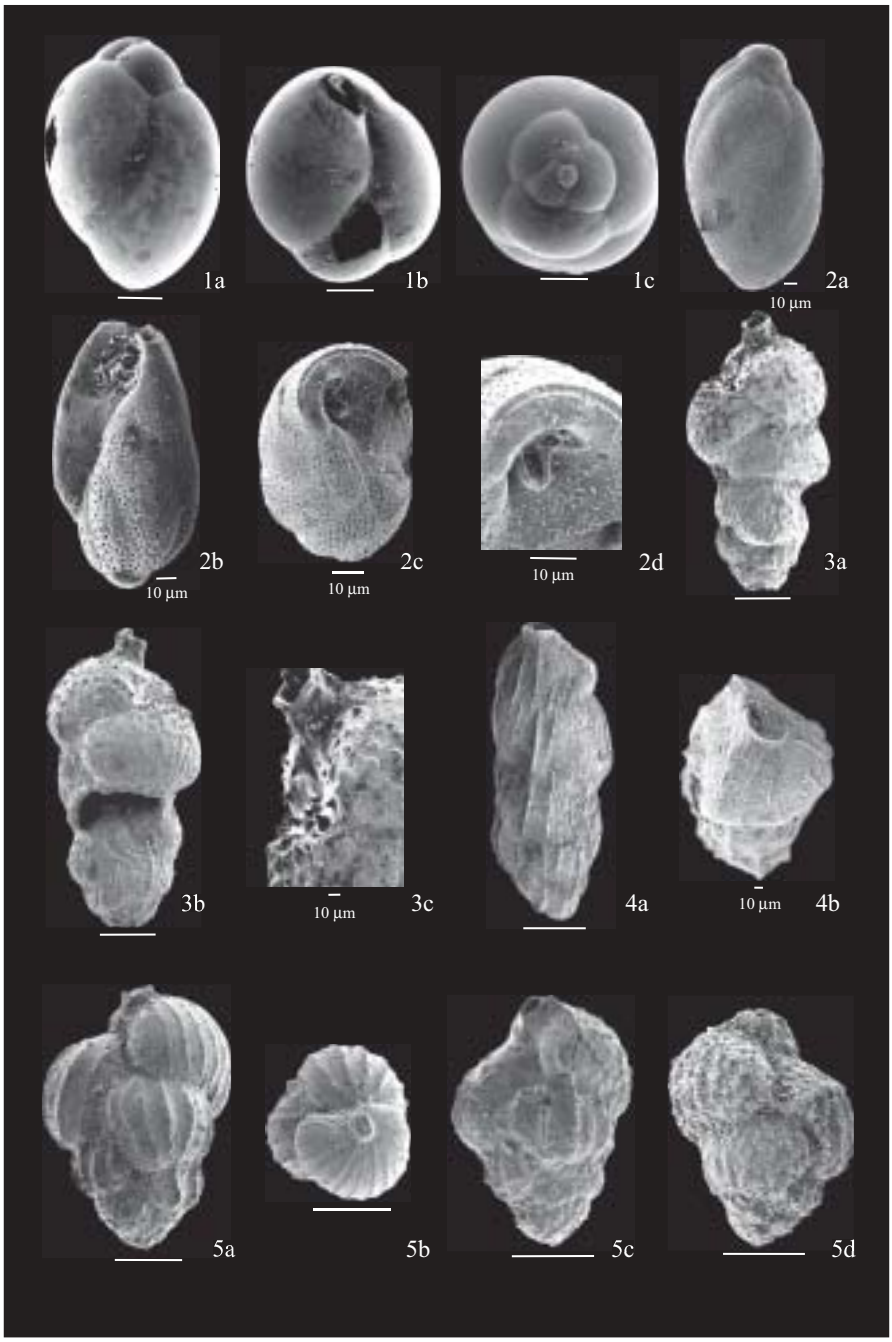

Figure 10. 1. *Protoglobobulimina pupoides* (d'Orbigny), three specimens from sample FC04-76; 1a, side view showing strongly overlapping chambers; 1b, apertural view showing internal toothplate; 1c, basal view showing circular cross-section and triserial arrangement. **2.** *Buliminella elegantissima* (d'Orbigny); 2a, side view of specimen from sample BE1, showing close spiral; 2b, side view of specimen from sample FC04-64, showing aperture obscured by debris; 2c, apertural view of specimen from sample FC04-63, showing internal toothplate; 2d, detail of aperture of specimen 2c. **3.** *Euuvigerina aculeata* (d'Orbigny), from sample FC04-52; 3a, side view showing elongated shape; 3b, side view showing etched surface, spines uniting to form ribs at the base of test can be discerned; 3c, detail of tubular neck, showing remnants of cone-shaped spines at the base. **4.** *Angulogerina fluens* Todd, from sample BE1; 4a, side view showing elongate test and longitudinal costae crossing the sutures; 4b, apertural view showing trigonal cross-section. **5.** *Euuvigerina peregrina* (Cushman); 5a, side view of specimen from sample FC04-53 showing clear longitudinal costae; 5b, apertural view of specimen 5a showing rounded aperture on top of tubular neck; 5c, side view of specimen from sample FC04-55, showing etched surface; 5d, side view of specimen from sample FC04-52 showing less developed costae and well developed pustules between them. All scales are 100 µm unless otherwise indicated.

Description. Test free, elongate, with a high and close spiral formed by numerous high narrow chambers in 3 to 4 whorls; wall calcareous, hyaline, smooth, finely perforate; aperture loop-shaped with internal toothplate connecting aperture with foramen of previous chamber.

Subfamily UVIGERININAE Haeckel, 1894
Genus *Euuvigerina* Thalmann, 1952
Euuvigerina aculeata (d'Orbigny 1846)
Figures 10.3a-10.3c

1846 *Uvigerina aculeata* d'Orbigny, p. 191, pl. 11, figs. 27, 28.

1998 *Euuvigerina aculeata* (d'Orbigny 1846). Patterson, Burbidge and Luternauer, p. 17, pl. 16, figs. 1-3.

Description. Test free, elongated, rounded in section; wall calcareous, hyaline, surface finely perforate and covered with numerous cone-shaped spines occasionally uniting to form discontinuous rib-like elements; 4 to 5 whorls of inflated, triserially arranged chambers become cuneate in later whorls; aperture small and circular within a phialine lip at top of tubular neck; toothplate a narrow twisted ribbon extending from the aperture to fasten against the previous foramen.

Euuvigerina peregrina (Cushman 1923)
Figures 10.5a-10.5d

1923 *Uvigerina peregrina* Cushman, p. 166, pl. 42, figs. 7-10; Murray, 1972, p. 121, pl. 50, figs. 1-7.

2004 *Euuvigerina peregrina* (Cushman 1923). Alves Martins and Ruivo Dragão Gomes, p. 162, figs. 2.93, 2.94.

Description. Test free, elongate, triserial to biserial in last chambers; chambers numerous, distinct, inflated; sutures depressed; wall calcareous, perforate, surface with numerous longitudinal costae, generally discontinous, disrupted by sutures; space between costae presents little pustules; aperture terminal, rounded, on tubular neck, bordered with phialine lip, narrow ribbon like and twisted toothplate extends within from aperture to fasten against previous foramen.

Genus *Neouvigerina* Thalmann, 1952
Neouvigerina cf. *proboscidea* (Schwager 1866)

1866 *Uvigerina proboscidea* Schwager, p. 250, pl. 7, fig. 96.

2005 *Neouvigerina proboscidea* (Schwager 1866). Narayan, Barnes and Johns, p. 137, pl. 5., figs. 20, 21.

Description. Test small to medium, stout, 1.5 times as long as wide; 3 to 4 whorls; chambers in early portion triserially arranged, small, closely packed, later portion biserial, much inflated, globular; periphery lobulate; sutures distinct, depressed; wall calcareous, finely perforate, ornamented with numerous fine papillae, appearing slightly spinose or granular; aperture terminal, rounded, at end of elongate, papillose neck with phialine lip.

Remarks. The ornamentation in these specimens is very damaged, making it difficult to ascribe them with certainty to this species. However, the overall shape and fainted papillae seem to belong to *N. proboscidea*.

Subfamily ANGULOGERININAE Galloway, 1933
Genus *Angulogerina* Cushman, 1927
Angulogerina fluens Todd, 1948
Figures 10.4a, 10.4b

1948 *Angulogerina fluens* Todd, in Cushman and McCulloch, 1948, p. 288, pl. 36, fig. 1; Loeblich and Tappan, 1953, p. 112, pl. 20, figs. 10-12; Patterson, Burbidge and Luternauer, 1998, p. 18, pl. 16, figs. 4, 5.

Description. Test free, elongate, trigonal in cross-section, angles subrounded and carinate; wall calcareous, hyaline, smooth except numerous discontinuous longitudinal costae cross suture lines and extend from base to aperture; chambers arranged in 4 to 5 whorls, initially triserial, become cuneate; sutures depressed and curved; aperture terminal, reniform, produced on very short neck and bordered by pronounced lip; internal toothplate extends from foramen to foramen, externally visible as narrow projection in aperture.

Superfamily DISCORBACEA Ehrenberg, 1838
Family ROSALINIDAE Reiss, 1963
Genus *Gavelinopsis* Hofker, 1951
Gavelinopsis campanulata (Galloway and Wissler 1927)
Figures 11.1a-11.1c

1927 *Globorotalia campanulata* Galloway and Wissler, p. 58, pl. 9, fig. 14.

1998 *Gavelinopsis campanulata* (Galloway and Wissler 1927). Patterson, Burbidge and Luternauer, p. 18, pl. 18, figs. 5-7.

Description. Test free, plano-convex; wall calcareous, hyaline, smooth; all chambers visible on con-

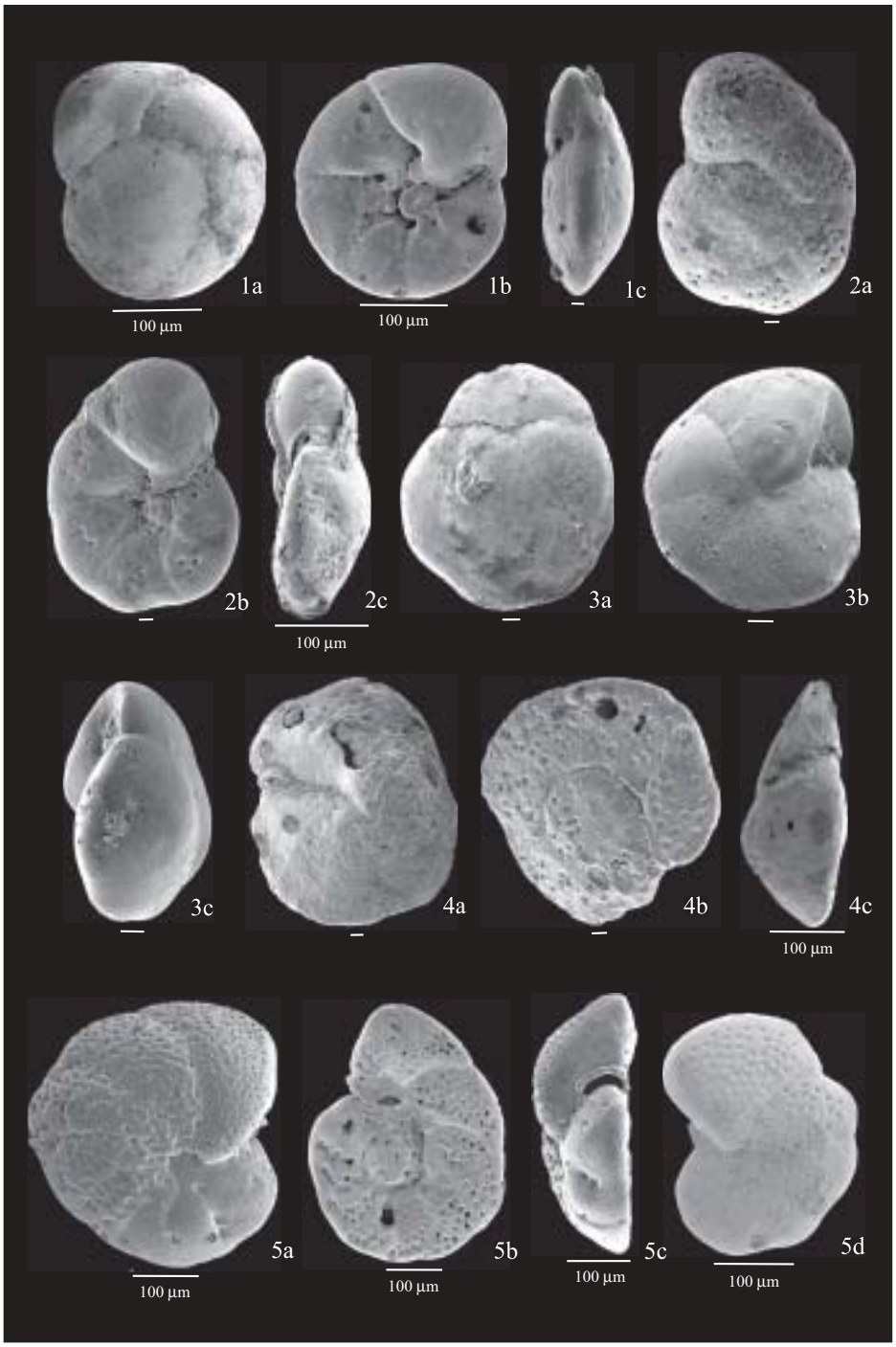

Figure 11. 1. *Gavelinopsis campanulata* (Galloway and Wissler), from sample BE1; 1a, dorsal view; 1b, ventral view showing umbilical plug; 1c, side view showing more convex dorsal side. **2.** *Rosalina columbiensis* (Cushman), from sample BE1; 2a, dorsal side showing coarse pores; 2b, ventral view showing aperture extending back along umbilicus; 2c, side view showing lipped marginal aperture. **3.** *Epistominella vitrea* Parker, from sample BE2; 3a, dorsal side showing smooth test; 3b, ventral view showing radial sutures; 3c, side view. **4.** *Lobatula fletcheri* (Galloway and Wissler), from sample BE1; 4a, dorsal view showing lipped aperture; 4b, ventral view showing coarse perforation; 4c, side view showing well developed umbilical view on spiral side. **5.** *Lobatula lobatula* (Walker and Jacob), from sample BE1; 5a, dorsal view showing very coarse perforation; 5b, ventral view showing aperture extending on the last few chambers; 5c, side view showing lipped aperture; 5d, dorsal view of another specimen with a more ovate outline. All scales are 10 µm unless otherwise indicated.

vex spiral side, only final 6 to 7 of final whorl visible on ventral side; sutures smooth and radiating on spiral side, depressed and slightly curved on ventral side, radiating from open umbilicus with central umbilical plug, often invisible, partially filling gap; aperture an interiomarginal extra umbilical arch with secondary sutural openings at margins of previous chambers.

Genus *Rosalina* d'Orbigny, 1926
Rosalina columbiensis (Cushman 1925)
Figures 11.2a-11.2c

1925 *Discorbis columbiensis* Cushman, p. 43, pl. 6, fig. 13.

1998 *Rosalina columbiensis* (Cushman 1925). Patterson, Burbidge and Luternauer, p. 18, pl. 19, figs. 1-3.

Description. Test free or attached, plano-convex, trochospiral; wall calcareous, hyaline, smooth, finely perforate; chambers irregular in shape and gradually increase in size as added, all visible on spiral side, and only 6 to 7 visible on final whorl around open umbilicus on partially evolute umbilical side; sutures depressed and slightly curved; aperture an interiomarginal arch at base of final chamber, near periphery on umbilical side extending into umbilicus; planktic-stage specimens have large subglobular float chamber completely covering umbilical side.

Superfamily DISCORBINELLACEA Sigal, 1952
Family PSEUDOPARRELLIDAE Voloshinova, 1952
Subfamily PSEUDOPARRELLINAE Voloshinova, 1952
Genus *Epistominella* Husezima and Maruhasi, 1944
Epistominella vitrea Parker, 1952
Figures 11.3a-11.3c

1953 *Epistominella vitrea* Parker, in Parker, Phleger and Peirson, 1953, p. 9, pl. 4, figs. 34-36, 40, 41; Murray, 1972, p. 131 pl. 54, figs. 1-6; Patterson, Burbidge and Luternauer, 1998, p. 19, pl. 20, figs. 3-5.

Description. Test free, trochospiral, biconvex, periphery rounded, and slightly lobulate; wall calcareous, hyaline, smooth, finely perforate; spiral side with all 3 whorls and chambers visible and sutures straight, depressed, and oblique; only final 6 chambers visible on umbilical side with sutures radial and depressed; aperture narrow lipped slit oriented slightly oblique to peripheral margin.

Superfamily PLANORBULINACEA Schwager, 1877
Family CIBICIDIDAE Cushman, 1927
Subfamily CIBICIDINAE Cushman, 1927
Genus *Lobatula* Fleming, 1828
Lobatula fletcheri (Galloway and Wissler 1927)
Figures 11.4a-11.4c

1927 *Cibicides fletcheri* Galloway and Wissler, , p. 64, pl. 10, figs. 8, 9.

1998 *Lobatula fletcheri* (Galloway and Wissler 1927). Patterson, Burbidge and Luternauer, p. 19, pl. 19, figs. 4-6.

Description. Test free, plano-convex, trochospiral with spiral side flattened and umbilical side rounded and convex; wall calcareous, translucent, smooth, coarsely perforate on spiral side; 8 to 9 slightly inflated chambers visible on concave umbilical side; all chambers visible on spiral side with a well developed umbilical boss; sutures slightly curved and depressed; aperture low interiomarginal lipped, may extend along spiral suture on spiral side.

Lobatula lobatula (Walker and Jacob 1798)
Figures 11.5a-11.5d

1798 *Nautilus lobatulus* Walker and Jacob, p. 20, pl. 3, fig. 71.

1972 *Cibicides lobatulus* (Walker and Jacob, 1798). Murray, p. 175, pl. 73, figs. 1-7.

1987 *Lobatula lobatula* (Walker and Jacob, 1798). Loeblich and Tappan, p. 168, pl. 637, figs. 10-13; Villanueva Guimerans and Cervera Currado, 1999, p. 186, fig. 2.3; Alves Martins and Ruivo Dragão Gomes, 2004, p. 211, fig. 2.126.

Description. Test trochospiral, ovate; wall calcareous, coarsely perforate or lacking pores on umbilical side, on spiral side with pores of intermediate size and uniformly distributed; spiral side flat or irregular, umbilical side convex; chambers inflated, 7 or 8 in final whorl, gradually increasing in size as added; periphery acute, carinate; sutures on spiral side slightly raised and imperforate, depressed and slightly backwards on umbilical side; aperture interiomarginal, extraumbilical-equatorial, bordered by protruding rim continuing into spiral supplementary aperture, open in last 1 to 3 chambers.

Lobatula mckannai (Galloway and Wissler 1927)
Figures 12.1a-12.1c

1927 *Cibicides mckannai* Galloway and Wissler, p. 65, pl. 10, figs. 5, 6.

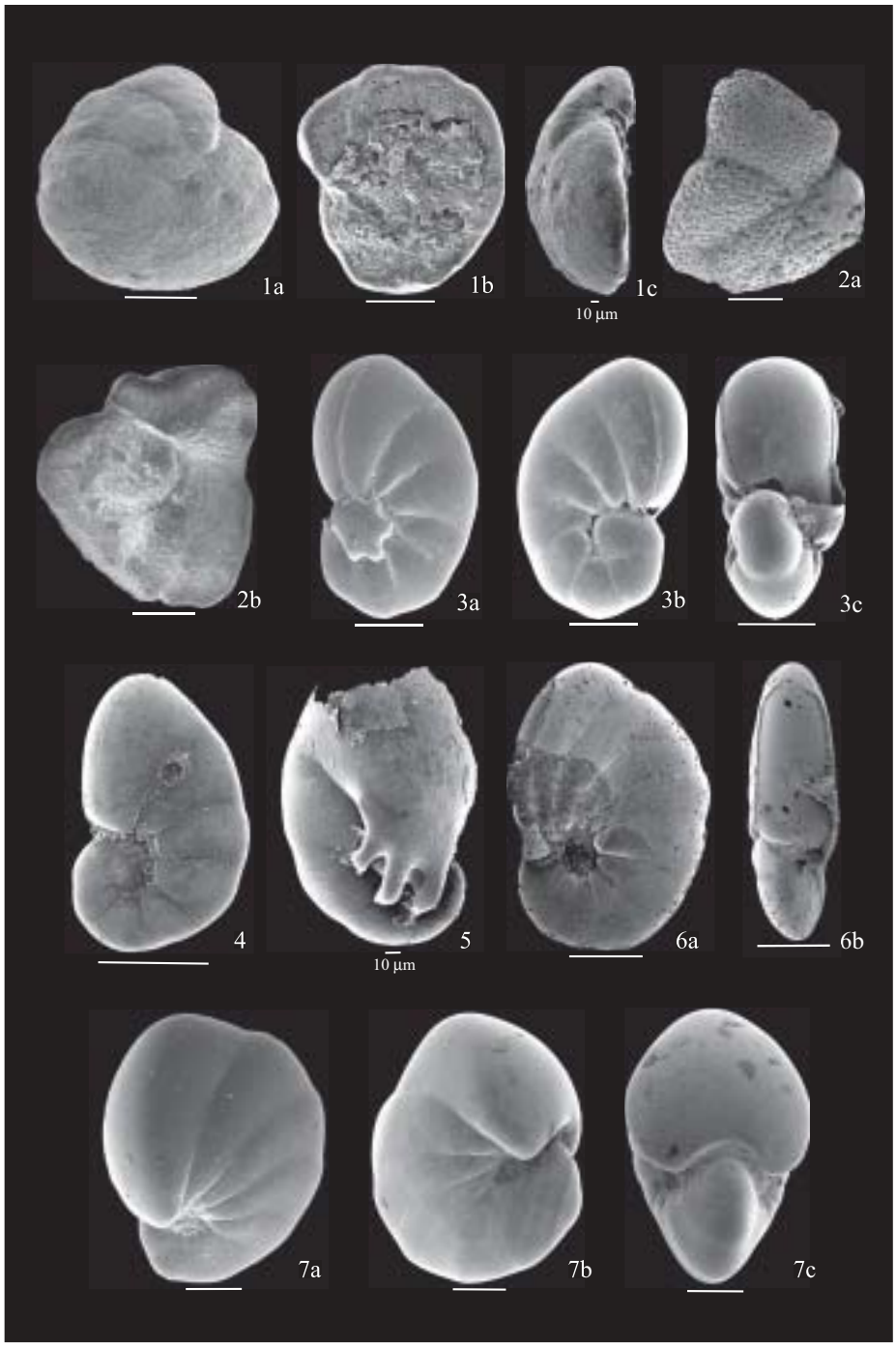

Figure 12. 1. *Lobatula mckannai* (Galloway and Wissler), from sample BE1; 1a, dorsal view; 1b, ventral view covered with debris; 1c, side view showing aperture. **2.** *Dyocibicides biserialis* Cushman and Valentine, from sample BE1; 2a, dorsal view showing irregular outline; 2b, ventral view showing coarse perforation. **3.** *Nonionella stella* Cushman and Moyer, from sample BE1; 3a, side view showing umbilical flap extending from broken last chamber and covering the umbilicus; 3b, view of other side; 3c, apertural view showing basal arcuate aperture. **4.** *Nonionella* cf. *turgida* (Williamson) from sample BE1, side view. **5.** *Nonionella digitata* Nørvang from sample FC04-76, side view with broken last chamber, showing finger-like projections over umbilicus. **6.** *Pseudononion basispinata* (Cushman and Moyer) from sample BE2; 6a, side view showing hispid material in open umbilicus; 6b, apertural view showing compressed test. **7.** *Nonionellina labradorica* (Dawson) from sample BE1; 7a, side view; 7b, view of the other side showing pustules covering umbilicus; 7c, apertural view showing broad flat apertural face. All scales are 100 µm unless otherwise indicated.

1998 *Lobatula mckannai* (Galloway and Wissler 1927). Patterson, Burbidge and Luternauer, p. 19, pl. 19, figs. 7-9; Patterson and Kumar, 2002, p. 121, pl. 1, fig. 5.

Description. Test free, plano-convex, trochospiral with flattened spiral side and high convex umbilical side; wall calcareous, translucent, coarsely perforate, especially on umbilical side which has a roughened appearance; only final 9 slightly inflated chambers of umbilical side visible; all chambers visible on spiral side; sutures slightly depressed and radiate; aperture low interiomarginal lipped slit which may extend back several chambers on spiral side.

Subfamily STICHOCIBICIDINAE Saidova, 1981
Genus *Dyocibicides* Cushman and Valentine, 1930
Dyocibicides biserialis Cushman and Valentine, 1930
Figures 12.2a, 12.2b

1930 *Dyocibicides biserialis* Cushman and Valentine, p. 31, pl. 10, figs. 1, 2; Patterson, Burbidge and Luternauer, 1998, p. 20, pl. 20, figs. 1, 2.

Description. Test attached, elongate, trochospiral, with attachment area on spiral side; wall calcareous, translucent, smooth, coarsely perforate; all chambers visible on flattened spiral side; only 7 to 8 slightly inflated chambers visible in final whorl of umbilical side, gradually increasing in size as added; later chambers uncoiled and irregularly biserial, increasing greatly in size as added; sutures depressed and curved; aperture terminal and lipped.

Superfamily NONIONACEA Schultze, 1854
Family NONIONIDAE Schultze, 1854
Subfamily NONIONINAE Schultze, 1854
Genus *Nonionella* Cushman, 1926
Nonionella digitata Nørvang, 1945
Figure 12.5

1945 *Nonionella turgida* (Williamson) var. *digitata* Nørvang, p. 29, fig. 4.

1998 *Nonionella digitata* Nørvang, 1945. Patterson, Burbidge and Luternauer, p. 20, pl. 21, figs. 1-3.

Description. Test free, compressed, general outline elongate, elliptical, in low trochospiral coil, periphery rounded; wall calcareous, hyaline, smooth, finely perforate without pustules; spiral side partially evolute around umbonal boss with all chambers visible (about 10), rapidly increasing in size; sutures strongly depressed and slightly curved; umbilical side involute with only 5 to 6 chambers of final whorl visible, flap-like extensions of final chambers subdivided in finger-like projections that cross umbilical regions, obscuring it; aperture small interiomarginal and nearly equatorial arch, extending onto umbilical side.

Nonionella stella Cushman and Moyer, 1930
Figures 12.3a-12.3c

1930 *Nonionella miocenica* Cushman var. *stella* Cushman and Moyer, p. 56, pl. 7, fig. 17.

1998 *Nonionella stella* Cushman and Moyer, 1930. Patterson, Burbidge and Luternauer, p. 20, pl. 22, figs. 1-3.

Description. Test free, trochospiral, slightly compressed; wall calcareous, translucent, smooth, finely perforate; 7 to 10 inflated low chambers rapidly increase in size as added; large umbilical flap extends from last chamber and covers umbilical region; all chambers visible on spiral side; aperture low arch extending somewhat onto umbilical side, at base of large flat apertural face.

Nonionella cf. *turgida* (Williamson 1858)
Figure 12.4

1858 *Rotalina turgida* Williamson, p. 50, pl. 9, figs. 95-97.

1972 *Nonionella turgida* (Williamson, 1858). Murray, p. 193, pl. 81, figs. 1-5.

1998 *Nonionella* cf. *N. turgida* (Williamson 1858). Patterson, Burbidge and Luternauer, p. 20, pl. 23, fig. 8.

Description. Test free, compressed, slightly elongated in low trochospiral coil, periphery rounded; all chambers visible on spiral side, partially evolute around umbonate boss; only 9 final chambers visible on umbilical side, extension of final chambers into umbilicus, partially obscuring it; sutures depressed and slightly curved on both sides; wall calcareous, hyaline, smooth, finely perforate; aperture low, interiomarginal, a nearly equatorial arch, extending slightly onto umbilical side.

Remarks. The few specimens recovered were broken in the last chamber; therefore, the species is named *N.* cf. *turgida*.

Genus *Nonionellina* Voloshinova, 1958
Nonionellina labradorica (Dawson 1860)
Figures 12.7a-12.7c

1860 *Nonionica scapha* var. *labradorica* Dawson, p. 191, fig. 4.

1953 *Nonion labradoricum* (Dawson, 1860). Loeblich and Tappan, p. 86, pl. 17, figs. 1, 2.

1998 *Nonionellina labradorica* (Dawson 1860). Patterson, Burbidge and Luternauer, p. 20, pl. 23, figs. 1, 2.

Description. Test free, trochospiral in early stage, later nearly planispiral and involute, periphery rounded and slightly lobulate; wall calcareous, hyaline, smooth other than fine pustules clustered in sutural depression and filling umbilicus, finely perforate; 14 chambers visible on both umbilical and spiral sides; sutures strongly depressed and curved; aperture low arched slit at base of final chamber.

Genus *Pseudononion* Asano, 1936
Pseudononion basispinata (Cushman and Moyer 1930)
Figures 12.6a, 12.6b

1930 *Nonion pizarrensis* Berry var. *basispinata* Cushman and Moyer, p. 54, pl. 7, fig. 18.

1998 *Pseudononion basispinata* (Cushman and Moyer 1930). Patterson, Burbidge and Luternauer, p. 21, pl. 23, figs. 3-5.

Description. Test free, asymmetric planispiral and involute, compressed; wall calcareous, hyaline, smooth, finely perforate; 10 to 16 slightly inflated low chambers rapidly increasing in size as added; sutures slightly depressed and curved, hispid material found in open umbilicus and along lower parts of sutures on one side, or with an umbilical knob on the other side; aperture narrow, interiomarginal with equatorial opening.

Subfamily ASTRONONIONINAE Saidova, 1981
Genus *Astrononion* Cushman, 1937
Astrononion gallowayi Loeblich and Tappan, 1953
Figures 13.1a-13.1c

1953 *Astrononion gallowayi* Loeblich and Tappan, p. 90, pl. 17, figs. 4-7; Patterson, Burbidge and Luternauer, 1998, p. 21, pl. 23, figs. 6, 7.

Description. Test free, planispiral and involute, compressed, periphery rounded and lobulate; wall calcareous, hyaline, with medium sized perforations; 7 to 8 strongly inflated chambers of final whorl visible, increase gradually in size as added; wedge-shaped supplementary chambers surround umbilicus on each side, taper outward to suture about two-thirds the distance to periphery; sutures slightly curved and depressed; aperture low arch at base of final chamber extending on each side toward umbilicus with supplementary opening at outer posterior margin or each of the supplementary chambers.

Family TRICHOHYALIDAE Saidova, 1981
Genus *Buccella* Andersen, 1952
Buccella depressa Andersen, 1952
Figures 13.2a, 13.2b

1952 *Buccella depressa* Andersen, p. 145, 146, figs. 7, 8; Patterson, Burbidge and Luternauer, 1998, p. 22, pl. 24, figs. 1-3.

Description. Test free, trochospiral, roughly biconvex, periphery rounded, lobulate; wall calcareous, hyaline, smooth except concentrations of fine pustules in umbilicus and in narrow bands along sutures, coarsely perforate; two-and-one-half whorls and all chambers visible on slightly convex spiral side; spiral side sutures slightly curved, oblique, and very slightly depressed; only highly inflated final 7 to 9 chambers of final whorl visible on umbilical side and gradually increase in size as added; umbilical side sutures slightly curved and radial; aperture interiomarginal with slit-like supplementary apertures found along posterior margins of chambers on umbilical side.

Buccella frigida (Cushman 1922)
Figures 13.3a-13.3c

1922 *Pulvinulina frigida* CUSHMAN, p. 144; Loeblich and Tappan, 1953, p. 115, pl. 22, figs. 2, 3; Murray, 1972, p. 129, pl. 53, figs. 1-5; Reinhardt, Easton, and Patterson, 1996, p. 41, fig. 3; Patterson, Burbidge and Luternauer, 1998, p. 22, pl. 25 figs. 6-8.

Description. Test free, trochospiral, plano-convex; wall calcareous, hyaline, smooth, finely perforate; all chambers visible on convex, spiral side; only 6 to 7 slightly inflated chambers gradually increase in size as added and visible on flattened umbilical side; sutures oblique on spiral side, slightly curved and radial and depressed on umbilical side; pustulose material most concentrated on the umbilicus partially obscures sutures; aperture interiomarginal with supplementary sutural apertures at posterior margin or each chamber.

Buccella hannai (Phleger and Parker 1951), emend. Andersen, 1952
Figures 13.4a-13.4c

1951 *Eponides hannai* Phleger and Parker, p. 21, pl. 10, figs. 11-14.

Buccella hannai (Phleger and Parker 1951). Andersen, 1952, p. 147, fig. 3.

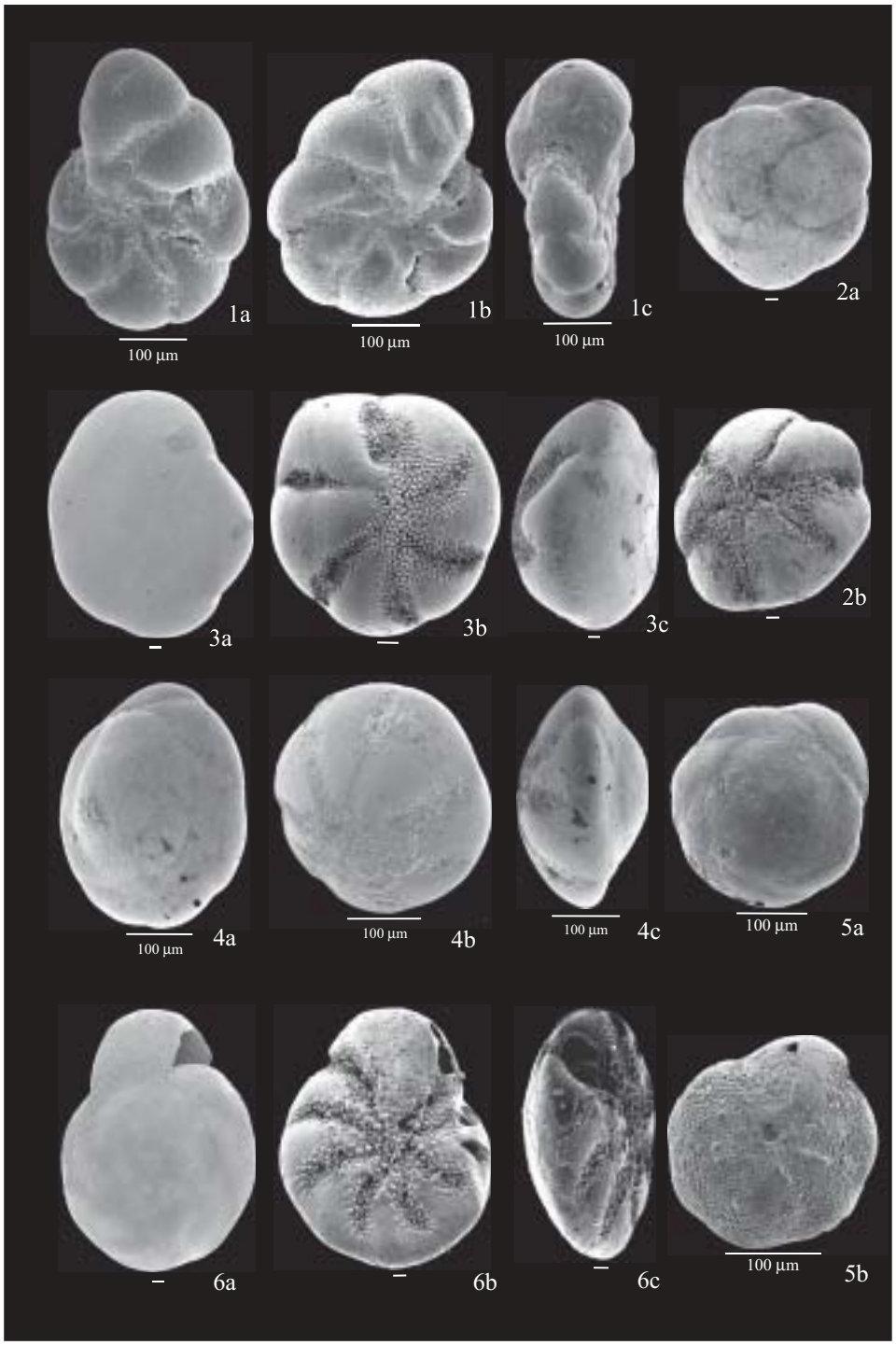

Figure 13. 1. *Astrononion gallowayi* Loeblich and Tappan, from sample BE1; 1a, side view showing wedge-shaped supplementary chambers surrounding umbilicus; 1b, view of the other side showing supplementary apertures at the posterior margin of the supplementary chambers; 1c, apertural view. **2.** *Buccella depressa* Andersen from sample FC04-39; 2a, dorsal view showing lobulate periphery; 2b, ventral view. **3.** *Buccella frigida* (Cushman) from sample BE1; 3a, dorsal view showing smooth test; 3b, ventral view showing pustules along sutures; 3c, side view showing plano-convex test. **4.** *Buccella hannai* (Phleger and Parker) from sample BE1; 4a, dorsal view; 4b, ventral view showing radial sutures; 4c, side view showing biconvex test and limbate periphery. **5.** *Buccella inusitata* Andersen from sample BE1; 5a, dorsal view; 5b, ventral view showing thick pustulose coating. **6.** *Buccella tenerrima* (Bandy) from sample BE1; 6a, dorsal view showing overgrown last chamber; 6b, ventral view showing 8 chambers; 6c, side view. All scales are 10 µm unless otherwise indicated.

Description. Test free, trochospiral, biconvex, ranging from specimens with equal convexity on both sides to extremely convex on dorsal side and flat on ventral side; wall calcareous, hyaline, smooth, finely perforate; 7 to 9 chambers, slightly inflated; three to three-and-one-half whorls; sutures curved, limbate on spiral side, depressed and radial on umbilical side; periphery distinctly lobulate, typically acute and limbate; pustulose material most concentrated on the umbilicus partially obscures sutures; aperture interiomarginal with supplementary sutural apertures at posterior margin or each chamber.

Buccella inusitata Andersen, 1952
Figures 13.5a, 13.5b

1952 *Buccella inusitata* Andersen, p. 148, figs. 10a-c, 11a-c; Loeblich and Tappan, 1953, p. 116, pl. 22, fig. 1.

Description. Test free, trochospiral, dorsal and ventral sides equally biconvex in the microspheric form, ventral side nearly flat and dorsal side extremely convex in the megalospheric form; wall calcareous, hyaline, smooth, finely perforated; all chambers visible on convex, spiral side; only 7 to 9 slightly inflated chambers visible on flattened umbilical side; sutures slightly limbate, strongly oblique to the peripheral margin on dorsal side, depresses and radial on ventral side; umbilicus, sutures, and basal margin of last chamber with thick coating of pustules; periphery acute and limbate, last 2 or 3 chambers usually lobate; sutural apertures at posterior margin or each chamber.

Buccella tenerrima (Bandy 1950)
Figures 13.6a-13.6c

1950 *Rotalia tenerrima* Bandy, p. 278, pl. 42, fig. 3.

1996 *Buccella tenerrima* (Bandy 1950). Reinhardt, Easton and Patterson, p. 41, fig. 3.

Description. Test free, trochospiral, biconvex; wall calcareous, hyaline, smooth, finely perforated; periphery slightly lobulate, carinate; umbilicus pustulose; three-and-one-half whorls, 8 to 10 chambers in last whorl; dorsal sutures somewhat oblique and slightly curved, ventral sutures depressed, nearly radial; pustulose material covering umbilicus and sutures; aperture a series of pores at base of last septal face.

Superfamily ROTALIACEA Ehrenberg, 1839
Family ELPHIDIIDAE Galloway, 1933
Subfamily ELPHIDIINAE Galloway, 1933

Genus *Cribroelphidium* Cushman and Brönnimann, 1948
Cribroelphidium excavatum (Terquem 1876)
Figures 14.1-14.5

1876 *Polystomella excavata* Terquem, p. 25, pl. 2, fig. 2.

1972 *Elphidium excavatum* (Terquem, 1876). Murray, p. 159, pl. 66, figs. 1-7.

1998 *Cribroelphidium excavatum* (Terquem 1876). Patterson, Burbidge and Luternauer, p. 22, pl. 25, figs. 4, 5; pl. 26, figs. 1, 2.

Description. Test free, planispiral, involute, biumbonate, periphery rounded; wall calcareous, thin, smooth except concentrations of pustules found along sutures, in umbilicus, and around aperture; fine circular pores less concentrated along septa and on apertural face; no pores in central extensions of chamber walls; usually 9 to 11 gradually enlarging chambers in last whorl; sutures depressed, backward-curved, usually closed before reaching the umbilical region, with single row of large sutural pores, and few 2 to 7 short sutural bridges which may not be visible in smaller specimens; aperture multiple interiomarginal.

Remarks. Five different morphotypes of *C. excavatum* are differentiated, following the work of Miller et al. (1982). They are grouped on five formae: *C. excavatum* forma *excavata* (Terquem 1876), *C. excavatum* forma *selseyensis* (Heron-Allen and Earland 1911), *C. excavatum* forma *clavata* (Cushman 1930), *C. excavatum* forma *lidoensis* (Cushman 1936), and *C. excavatum* forma *magna* (Miller et al. 1982). For more information on the taxonomy and ecology of these formae, the reader is referred to Miller et al. 1982.

Cribroelphidium foraminosum (Cushman, 1927)
Figures 15.1a-15.1c

1939 *Elphidium hughesi* var. *foraminosum* Cushman, p. 49, pl. 13, fig. 8.

1996 *Cribroelphidium foraminosum* (Cushman, 1927). Reinhardt, Easton and Patterson, p. 41, fig. 3; Patterson, Burbidge and Luternauer, 1998, p. 22, pl. 24, figs. 6-8.

Description. Test free, planispiral, involute, biumbonate, periphery rounded; wall calcareous, hyaline, smooth, coarsely perforate except on imperforate apertural face; 10 to 11 chambers of last whorl visible and gradually increase in size as added; sutures depressed, backward-curved, with single row of large oblong sutural pores separated

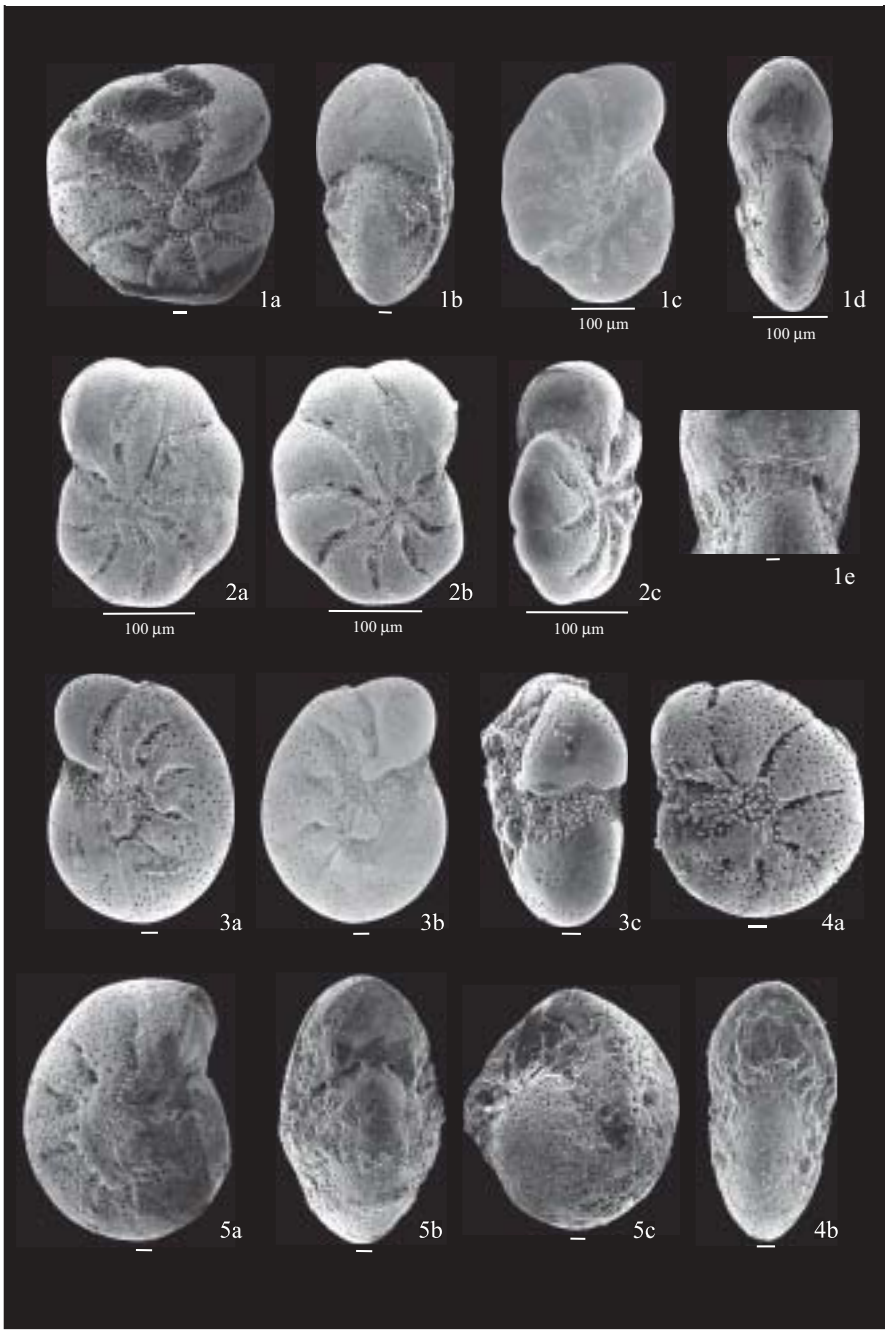

Figure 14. 1. *Cribroelphidium excavatum* forma excavata (Terquem); 1a, side view of specimen from sample BE5, showing straight sutures extending unconstricted to the umbilicus; 1b, apertural view of specimen 1a; 1c, side view of specimen from sample BE1; 1d, apertural view of specimen 1c; 1d, detail of aperture of specimen 1c, showing pustulose material arranged on triangular patterns on the apertural face. **2.** *Cribroelphidium excavatum forma lidoensis* (Cushman), from sample BE1; 2a, side view showing sutures curved backwards, broadening towards the umbilicus, filled with papillae; 2b, other side; 2c, apertural view. **3.** *Cribroelphidium excavatum forma clavata* (Cushman), from sample BE1; 3a, side view showing umbilical boss and backwards-curved sutures; 3b, view of the other side; 3c, apertural view. **4.** *Cribroelphidium excavatum forma selseyensis* (Heron-Allen and Earland), from sample BE1; 4a, side view showing granular material filling the umbilicus; 4b, apertural view. **5.** *Cribroelphidium excavatum forma magna* (Miller), from sample FC04-62; 5a, side view showing large umbilicus filled with one knobby boss, and sutures constricted before reaching the umbilicus; 5b, apertural view showing strongly convex walls and raised umbilicus; 5c, view of another specimen from sample FC04-62, with very strongly convex walls that give it an almost circular cross-section. All scales are 10 µm unless otherwise indicated.

by short sutural bridges; aperture multiple interiomarginal.

Cribroelphidium hallandense (Brotzen 1943)
Figures 15.3a-15.3c

1943 *Elphidium hallandense* BROTZEN, p. 268, fig. 109.

1998 *Cribroelphidium hallandense* (Brotzen, 1943). Patterson, Burbidge and Luternauer, p. 22, pl. 25, figs. 1-3.

Description. Test free, planispiral, involute, sides flat, periphery broadly rounded, slightly lobulate margin; wall calcareous, hyaline, smooth except bands of granular material found in umbilicus along sutures and near aperture; 7 to 9 slightly inflated and gradually enlarging chambers in final whorl; sutures slightly depressed and curved; aperture a low interiomarginal equatorial arch often obscured by granular material covering apertural face.

Cribroelphidium magellanicum (Heron-Allen and Earland 1932)
Figures 15.4a-15.4c

1932 *Elphidium (Polystomella) magellanicum* Heron-Allen and Earland, p. 440, pl. 16, figs. 26-28.

1972 *Elphidium magellanicum* (Heron-Allen and Earland 1932). Murray, p. 163, pl. 68, figs. 1-7; Murray, 2002, p. 21, figs. 7.9, 7.10.

Description. Test free, planispiral, involute, biumbonate, compressed; 5 to 6 chambers in the last whorl; sutures backward curved and strongly depressed, chambers slightly inflated; periphery rounded, markedly lobulate; sutures filled with very finely granular matter, contrasting with glassy chambers; fossettes concealed under granules; aperture a series of interiomarginal pores.

Cribroelphidium microgranulosum (Galloway and Wissler 1927)
Figures 15.2a-15.2c

1927 *Themeon decipiens* Galloway and Wissler, p. 83, pl. 12, figs. 15, 16.

1990 *Cribroelphidium microgranulosum* (Galloway and Wissler 1927). Patterson, Brunner, Capo, and Dahl, p. 11, fig. 13; Reinhardt, Easton, and Patterson, 1996, p. 41, fig. 3.

Description. Test free, planispiral, involute, biumbonate, compressed; 5 to 6 chambers in the last whorl; periphery very slightly lobulate; sutures slightly curved, slightly depressed and each provided with 8 to 10 small, indistinct, round pores; wall calcareous, granular, completely covered with pustulose material; aperture a very narrow curved slit.

Genus *Elphidiella* Cushman, 1936
Elphidiella hannai (Cushman and Grant 1927)
Figures 15.5a-15.5c

1927 *Elphidium hannai* Cushman and Grant, p. 77, pl. 7, fig. 1

1996 *Elphidiella hannai* (Cushman and Grant 1927). Reinhardt, Easton, and Patterson, p. 41, fig. 3; Patterson, Burbidge and Luternauer, 1998, p. 22, pl. 26, figs. 3, 4.

Description. Test free, lenticular, planispiral, involute, bilaterally symmetrical, periphery rounded; wall calcareous, hyaline, smooth except concentration of granular material near aperture; 13 to 15 chambers of the last whorl visible and increase gradually in size as added; sutures distinct, thickened but not raised, slightly curved, bordered by double row of fine sutural pores that extend to smooth umbilical region; aperture a row of pores at base of apertural face of final formed chamber.

Suborder GLOBIGERININA Delage and Hérouard, 1896
Superfamily GLOBOROTALIACEA Cushman, 1927
Family CANDEINIDAE Cushman, 1927
Subfamily GLOBIGERINITINAE Bermúdez, 1961
Genus *Globigerinita* Brönnimann, 1951
Globigerinita uvula (Ehrenberg 1861)
Figures 16.1a, 16.1b

1861 *Pylodexia uvula* Ehrenberg, pp. 276, 277, 308.

1981 *Globigerinita uvula* (Ehrenberg 1861). Saito, Thompson and Breger, p. 81, pl. 24.2, fig. 3.

Description. Test free, very small, high trochospiral; 3 or 4 whorls with 15 to 20 chambers, 3 or 4 chambers in last whorl; chambers spherical, increasing slowly in size as added, much embracing; sutures distinct; wall calcareous, fragile, translucent, very smooth, finely perforate, non-spinose, slightly pustulate near aperture; aperture interiomarginal, umbilical, a small, low arch.

Superfamily GLOBIGERINACEA Carpenter, Parker and Jones, 1862
Family GLOBIGERINIDAE Carpenter, Parker and Jones, 1862
Subfamily GLOBIGERININAE Carpenter, Parker

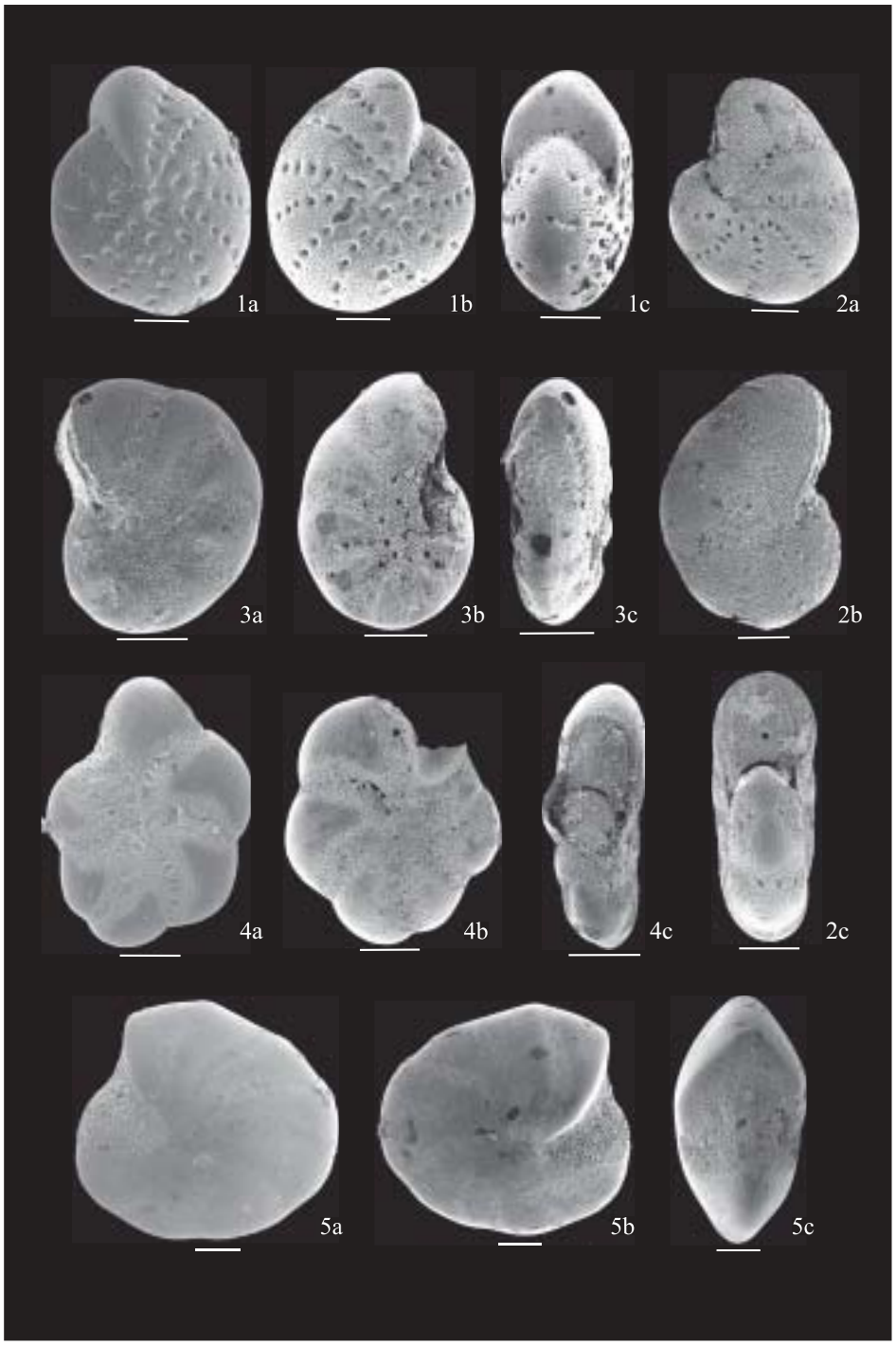

Figure 15. 1. *Cribroelphidium foraminosum* (Cushman), from sample BE1; 1a, side view showing coarse perforation, sutural pores and sutural bridges; 1b, view of the other side; 1c, apertural view showing imperforate apertural face and multiple aperture. **2.** *Cribroelphidium microgranulosum* (Galloway and Wissler), from sample BE1; 2a, side view showing round pores along sutures; 2b, view of other side showing wall completely covered with pustulose material; 2c, apertural view showing narrow curved aperture. **3.** *Cribroelphidium hallandense* (Brotzen) from sample BE1; 3a, side view showing bands of pustulose material covering umbilicus and along sutures; 3b, view of the other side; 3c, apertural view. **4.** *Cribroelphidium magellanicum* (Heron-Allen and Earland) from sample BE1; 4a, side view showing very lobulate periphery; 4b, view of the other side with last chamber broken; 4c, apertural view. **5.** *Elphidiella hannai* (Cushman and Grant) from sample BE1; 5a, side view showing rounded periphery; 5b, view of the other side showing thickened flushed sutures with double row of fine pores; 5c, apertural view showing concentration of granular material. All scales are 100 μm.

and Jones, 1862
Genus *Globigerina* d'Orbigny, 1826
Globigerina bulloides d'Orbigny, 1826
Figures 16.2a, 16.2b

1826 *Globigerina bulloides* d'Orbigny, p. 277; Murray, 1972, p. 211, pl. 87, figs. 1-5; Saito, Thompson and Breger, 1981, p. 40, pl. 7.1, fig. 1.

Description. Test free, size variable, low to medium trochospiral, strongly lobulate; 2 to two-and-one-half whorls with 8 to 10 chambers, 3 to 5 globular chambers in the last whorl; chambers spherical to slightly ovoid, well separated, size increasing slowly; sutures deep; wall calcareous, uniformly and densely perforated, spines simple and with circular cross-sections; aperture umbilical, interiomarginal, a high, symmetrical arch occasionally with thin rim-like lip.

Globigerina quinqueloba Natland, 1938
Figures 16.3a, 16.3b

1938 *Globigerina quinqueloba* Natland, p. 149, pl. 6, fig. 7; Murray, 1972, p. 217, pl. 90, figs. 1-5; Saito, Thompson and Breger, 1981, p. 48, pl. 10, fig. 1.

Description. Test free, small, low trochospiral; two-and-one-half whorls with 15 chambers, 5 chambers in final whorl; chambers subglobular, slightly flattened radially, final chamber of mature specimens typically partially or completely covers umbilicus like a bulla; sutures distinct, slightly incised; wall calcareous, thick, finely perforated, hispid, spinose; aperture umbilical-extraumbilical, interiomarginal, frequently obscured by final chamber with its rim-like basal lip.

Genus *Globigerinoides* Cushman, 1927
Globigerinoides cyclostomus (Galloway and Wissler 1927)
Figures 16.4a, 16.4b

1927 *Globigerina cyclostoma* Galloway and Wissler, p. 42, pl. 7, figs. 8, 9.

Globigerinoides cyclostomus (Galloway and Wissler 1927). Saito, Thompson and Breger, 1981, p. 60, pl. 15, fig. 2.

Description. Test free, small, low to medium trochospiral; 3 whorls with 11 chambers, 3 chambers on final whorl; chambers subspherical to ovoid, increasing moderately in size but closely packed giving the test a rectangular outline; wall calcareous, coarsely perforated, spinose; spines simple rounded cross sections, in simple raised bases; primary aperture umbilical, small oval opening, secondary aperture(s) on spiral side at intersection of spiral and intercameral sutures.

Subphylum SARCODINA Schmarda, 1871
Class RHIZOPODEA von Siebold, 1864
Subclass LOBOSA Carpenter, 1861
Order ARCELLINIDA Kent, 1880
Superfamily ARCELLACEA Ehrenberg, 1830
Family CENTROPYXIDIDAE Deflandre, 1953
Genus *Centropyxis* Stein, 1859
Centropyxis aculeata (Ehrenberg 1832)
Strain '*aculeata'* Reinhardt, Dalby, Kumar, and Patterson, 1998

1832 *Arcella aculeata* Ehrenberg, p. 91.

1983 *Centropyxis aculeata* (Ehrenberg, 1832). Medioli and Scott, p. 39, figs. 11.7-11.16, pl. 7, figs. 10-12, 18, 19.

1998 *Centropyxis aculeata* (Ehrenberg, 1832) strain *aculeata* Reinhardt, Dalby, Kumar and Patterson, pl. 1, fig. 1.

Description. Test depressed; in dorsal view, usually large and more or less circular; anterior slope large, with small (15° to 45°) anterior angle; posterior slope ill-defined, practically absent, fusing into fundus; fundus quite posterior; 1 to 8 spines in postero-lateral margin; wall basically organic, agglutinated, with siliceous particles completely covering the membrane; aperture subcentral, usually slightly anterior, invaginated.

Centropyxis constricta (Ehrenberg 1843)
Strain '*constricta'* Reinhardt, Dalby, Kumar, and Patterson, 1998
Figure 16.9

1843 *Arcella constricta* Ehrenberg, p. 410, pl. 4, fig. 35, pl. 5, fig. 1.

1983 *Centropyxis constricta* (Ehrenberg, 1843). Medioli and Scott, p. 41, figs. 12.7, 12.14, 12.16, 12.17, pl. 7, figs. 1-4, 6-9.

1998 *Centropyxis constricta* (Ehrenberg, 1843) strain *constricta* Reinhardt, Dalby, Kumar, and Patterson, pl. 1, fig. 4.

Description. Test much less depressed than in C. *aculeata*, usually elliptical on dorsal view, with profile usually raised posteriorly; large (40° to 65°) anterior angle; posterior angle well-defined; fundus raised in uppermost position; ventral side often small; three or fewer spines on fundus; wall agglutinated, completely covered with mineral particles of various nature; aperture antero-marginal, with variable degree of invagination.

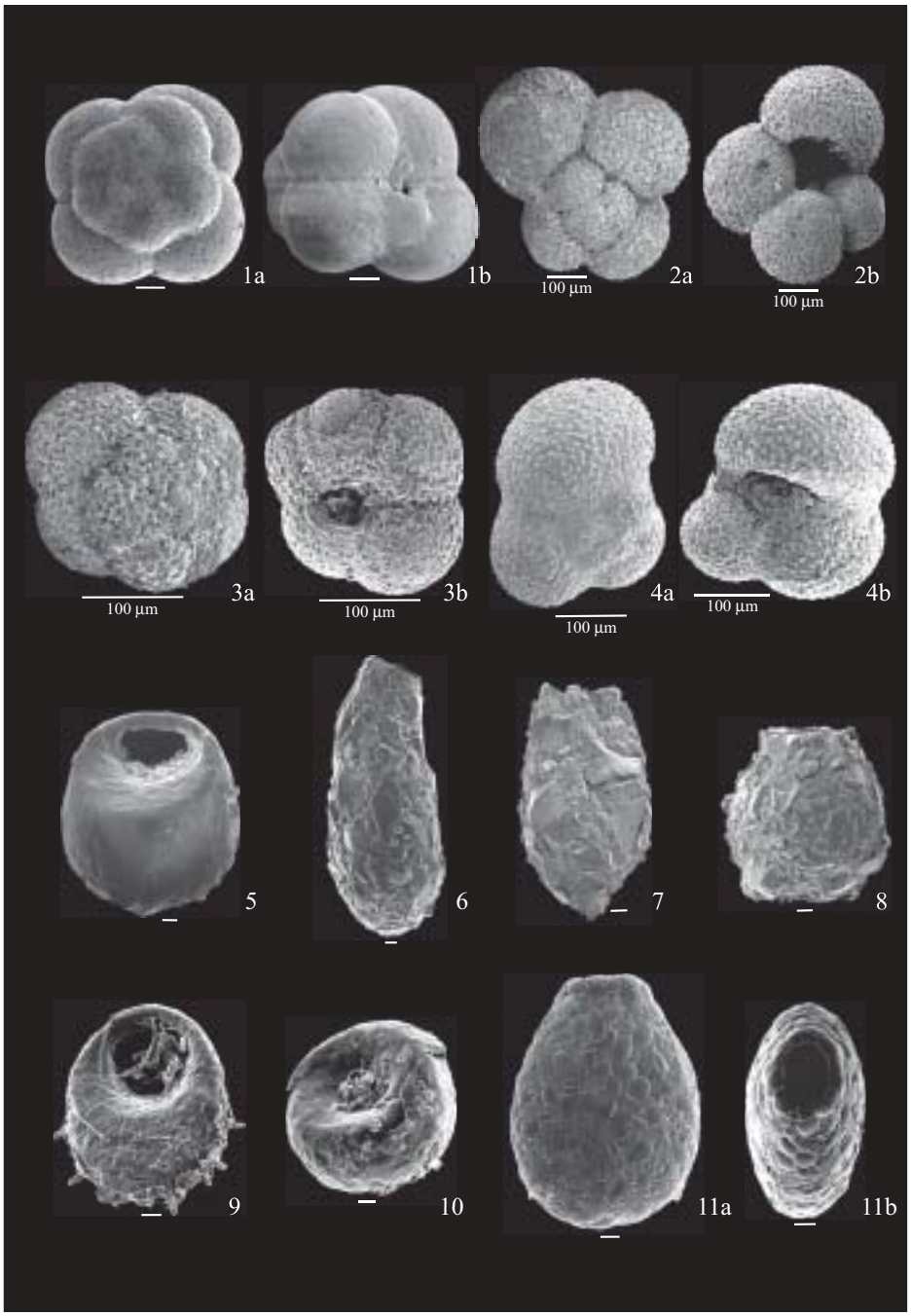

Figure 16. 1. *Globigerinita uvula* (Ehrenberg), from sample FC04-64; 1a, dorsal view showing very smooth test; 1b, ventral view showing low-arched aperture. **2.** *Globigerina bulloides* d'Orbigny from sample FC04-77; 2a, dorsal view showing globular chambers; 2b, ventral view showing high-arched aperture. **3.** *Globigerina quinqueloba* Natland from sample FC04-77; 3a, dorsal view showing low trochospiral arrangement; 3b, ventral view showing lipped aperture. **4.** *Globigerinoides cyclostomus* (Galloway and Wissler) from sample BE1; 4a, dorsal view showing ovoid chambers; 4b, ventral view showing rectangular test outline. **5.** *Centropyxis constricta aerophila* Reinhardt et al., from sample BE3, side view of specimen covered with organic material. **6.** *Difflugia oblonga* Ehrenberg, from sample FC04-85, side view showing pyriform test. **7.** *Difflugia protaeiformis* Lamarck, from sample FC04-85, side view showing spine in fundus. **8.** *Difflugia urceolata* Carter, from sample FC04-85, side view showing cauldron-like test. **9.** *Centropyxis constricta* constricta Reinhardt et al., from sample FC04-110, showing spines in fundus. **10.** *Cyclopyxis kahli* (Deflandre), from sample FC04-80, side view showing hemispherical test. **11.** *Heleopera sphagni* (Leidy), from sample FC04-92; 11a, side view showing test entirely composed of idiosomes; 11b, apertural view showing compressed test and elliptical aperture. All scales are 10 µm unless otherwise indicated.

Centropyxis constricta (Ehrenberg, 1843)
Strain *'aerophila'* Reinhardt, Dalby, Kumar, and Patterson, 1998
Figure 16.5

1929 *Centropyxis aerophila* Deflandre.

1980 *Centropyxis aerophila* Deflandre, 1929. Ogden and Hedley, p. 48-49.

1983 *Centropyxis constricta* (Ehrenberg, 1843). Medioli and Scott, p. 41, figs. 12.6, 12.8-12.12, 12.15, 12.18-12.26, pl. 7, fig. 5.

1998 *Cucurbitella* [sic.] *constricta* Reinhardt, Dalby, Kumar, and Patterson, pl. 1, fig. 6.

1998 *Centropyxis constricta* (Ehrenberg, 1843) strain *aerophila* Kuman and Dalby, fig. 5.1.

Description. Test much less depressed than in C. *aculeata,* usually elliptical on dorsal view, with profile usually raised posteriorly; large (40° to 65°) anterior angle; posterior angle well-defined; fundus raised in uppermost position; ventral side often small; spines absent; wall agglutinated, completely covered with mineral particles of various nature; aperture antero-marginal, with variable degree of invagination.

Genus *Cyclopyxis* Deflandre, 1929
Cyclopyxis kahli (Deflandre 1929)
Figure 16.10

1929 *Centropyxis kahli* Deflandre, p. 330.

1980 *Cyclopyxis kahli* (Deflandre, 1929). Ogden and Hedley, p. 70-71, pl. 24, figs. a-e; Roe and Patterson, 2006, p. 29, pl. 1, fig. 7, p. 33, pl. 3, figs. 1-6.

Description. Test plano-convex, radially symmetrical, hemispherical; wall agglutinated; aperture circular, large, centered.

Family HYALOSPHENIIDAE Schulze, 1877
Genus *Heleopera* Leidy, 1879
Heleopera sphagni (Leidy 1874)
Figures 16.11a, 16.11b

1874 *Difflugia sphagni* Leidy, p. 157

1879 *Heleopera picta* Leidy.

1983 *Heleopera sphagni* (Leidy, 1879). Medioli and Scott, p. 37-38, fig. 9, pl. 6, figs. 15-18.

Description. Test strongly compressed, ovoid; oral pole narrower in broadside view; test composed of siliceous idiosomes, substituted more or less extensively by xenosomes; aperture at narrow end of test, an elongated, narrow ellipse with acute commissures.

Genus *Nebela* (Leidy, 1874)
Nebela collaris (Ehrenberg 1848)

1848 *Nebela collaris* Ehrenberg; Ogden and Hedley 1980, p. 94-95; Kumar and Dalby, 1998, fig. 9.2.

Description. Test strongly compressed, ovoid; oral pole narrower in broadside view; test composed of siliceous plates; collar showing at narrow end of test; aperture elongate, narrow, at end of collar.

Family DIFFLUGIDAE Stein, 1859
Genus *Difflugia* Leclerc in Lamarck, 1816
Difflugia oblonga Ehrenberg, 1832
Figure 16.6

1832 *Difflugia oblonga* Ehrenberg, p. 90; Ogden and Hedley, 1980, p. 148, pl. 63, figs. a-c; Haman, 1982, p. 397, pl. 3, figs. 19-25; Scott and Medioli, 1983, p. 818, fig. 6, pl. 2, figs. 1-17.

Description. Test variable in shape and size, pyriform, rounded in cross-section; fundus rounded to subacute; neck subcylindrical, elongated, gradually narrowed toward oral end; test agglutinated, comprised of detrital particles, sometimes mixed with diatom frustules; aperture terminal, circular to slightly oval.

Difflugia protaeiformis Lamarck, 1816
Figure 16.7

1816 *Difflugia protaeiformis* Lamarck, p. 95; Kumar and Dalby, 1998, figs. 14.1, 15.1, 15.2.

Description. Test pyriform, rounded in cross-section; fundus tapering, acuminate with one or more spines; oral end sometimes narrower; test agglutinated, fine to coarse grains; aperture terminal, circular.

Difflugia urceolata Carter, 1864
Figure 16.8

1864 *Difflugia urceolata* Carter, p. 27, pl. 1, fig. 7; Medioli and Scott, 1983, p. 31, figs. 1-23, pl. 4, figs. 1-4; Kumar and Dalby, 1998, figs. 22.1, 22.2.

Description. Test spheroid to acutely ovate, amphora-like to cauldron-like; fundus rounded to acuminate; neck short, terminating in evaginated, sometimes recurved or straight collar of variable shape and size; wall agglutinated, composed of detrital grains of variable coarseness; aperture wide, circular, terminal.

Genus *Lagenodifflugia* Medioli and Scott, 1983
Lagenodifflugia vas (Leidy 1874)

1874 *Difflugia vas* Leidy, p. 155.

1983 *Lagenodifflugia vas* (Leidy, 1874). Medioli and Scott, p. 33, pl. 2, figs. 18-23, 27, 28; Reinhardt, Dalby, Kumar, and Patterson 1998, pl. 1, fig. 8.

Description. Main part of test usually ovoid, with neck arising from its narrower extremity; wide fundus; neck usually slightly higher than wide, coniform, truncated at aperture and constriction; constriction between body and neck not always conspicuous, normally visible in wet specimens; wall agglutinated; aperture rounded, terminal.

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REFERENCES

Alekseychik-Mitskevich, L.S. 1973. Klassifikatsii foraminifer semeystva Haplophragmiidae (Towards the classification of the foraminiferal family Haplophragmiidae). *Trudy vsesoyuznogo neftyanogo nauchnoissledovatel'skogo geologorazvedochnogo instituta (VNIGRI),* 343:12-44.

Alve, E. 1990. Variations in estuarine foraminiferal biofacies with diminishing oxygen conditions in Drammensfjord, SE Norway, p. 661-694. In Hemleben, C., Kaminski, M.A., Kuhnt, W., and Scott, D.B. (eds.), *Paleoecology, biostratigraphy, paleoceanography and taxonomy of agglutinated foraminifera.* NATO ASI Series C: Mathematical and Physical Sciences. Kluwer Academic Publishers, The Netherlands.

Alves Martins, M.V., and Ruivo Dragão Gomes, V.d.C. 2004. *Foraminíferos da margem continental NW ibérica: sistemática, ecologia e distribuição*. Agenda Comum - Comunicação lda.

Andersen, H.V. 1952. *Buccella*, a new genus of the rotalid foraminifera. *Journal of the Washington Academy of Sciences,* 42(5):143-151.

Asano, K. 1936. *Pseudononion*, a new genus of foraminifera found in Muracks-mura, Kamakura-gori, Kanagawa Prefecture. *Journal of the Geological Society of Japan,* 43:347-348.

Bagg, R.M., Jr. 1912. Pliocene and Pleistocene foraminifera from Southern California. *U.S. Geological Survey Bulletin,* 513:153.

Bandy, O.L. 1950. Some later Cenozoic foraminifera from Cape Blanco, Oregon. *Journal of Paleontology,* 24(3):269-281.

Bermúdez, P.J. 1961. Contribución al estudio de las Globigerinidea de la region Caribe-Antillana (Paleoceno-Reciente). *Boletín de Geologia, Venezuela, Publicación Especial,* 3:1119-1393.

Blais, A. 1995. *Foraminiferal biofacies and Holocene sediments from Saanich Inlet, British Columbia: implications for environmental and neotectonic research.* Unpublished Ph.D. Thesis, Carleton University, Ottawa, ON, Canada.

Brady, H.B. 1870. Analysis and descriptions of the foraminifera. *Annuals and Magazine of Natural History, ser. 4,* 6:273-309.

Brady, H.B. 1881. Notes on some of the relicularian Rhizopoda of the "Challenger" Expedition; part III. *Quarterly Journal of Microscopy Science, new ser.,* 21:31-71.

Brady, H.B. 1884. Report on the foraminifera dredged by H.M.S. Challenger, during the years 1873-1876, *Report on the scientific results of the voyage of the H.M.S. Challenger during the years 1873-1876, Zoology*

Brady, H.B. 1887. A synopsis of the British recent foraminifera. *Journal of the Royal Microscopic Society of London* 1887:872-927.

Brönnimann, P. 1951. *Globigerinita naparimaensis* n. gen., n. sp. from the Miocene of Trinidad, B.W.I. *Contributions from the Cushman Foundation for Foraminiferal Research,* 2:16-18.

Brönnimann, P. 1976. Two new genera of Recent *Trochamminidae* (Foraminifera). *Archives del Sciences, Genève,* 29:215-218.

Brönnimann, P., and Whittaker, J.E. 1980. A redescription of *Trochammina nana* (Brady) (Protozoa: Foraminiferida), with observations on several other recent Trochamminidae in the Collections of the British Museum (Natural History). *British Museum of Natural History Bulletin, Zoology Series,* 38(4):181-183.

Brönnimann, P., and Whittaker, J.E. 1983. *Zaninettia* n. gen., a spicular-walled remaneicid (Foraminiferida, Trochamminacea) from the Indian and South Atlantic Oceans with remarks on the origin of the spicules. *Revue de Paléobiologie, Genève,* 2:13-33.

Brönnimann, P., and Whittaker, J.E. 1986. On the morphology of *Paratrochammina (Lepidoparatrochammina) haynesi* (Atkinson) from south Cardigan Bay, Wales, and validation of *Paratrochammina (Lepidoparatrochammina)* Brönnimann and Whittaker. *Revue de Paléobiologie, Genève,* 5:117-125.

Brönnimann, P., and Whittaker, J.E. 1988. The Trochamminacea of the Discovery Reports. *British Museum of Natural History*:1-152.

Brotzen, F. 1943. Appendix, p. 267-269. In Hessland, I. (ed.), *Marine Schalenablagerungen Nord-Bohusläns*. Bulletin of the Geological Institute of the University of Uppsala, vol. 36.

Buchner, P. 1940. Die Lagenen des Golfes von Neapel und der marinen Ablagerungen auf Ischia (Beitrage zur Naturgeschichte der Insel Ischia 1). *Nova Acta Leopoldino, new series,* 9(62):364-560.

Carpenter, W.B. 1861. On the systematic arrangement of the Rhizopoda. *Natural History Review,* 1(4):456-472.

Carpenter, W.B. 1869. On the rhizopodal fauna of the deep sea. *Proceedings of the Royal Society of London,* 18:59-62.

Carpenter, W.B. 1875. *The microscope and its revelations*. J. & A. Churchill, London.

Carpenter, W.B., Parker, W.K., and Jones, T.R. 1862. *Introduction to the study of the Foraminifera*. Ray Society, London.

Carter, H.J. 1864. On freshwater Rhizopoda of England and India. *Annuals and Magazine of Natural History, ser. 3,* 13:18-39.

Cayan, D.R., and Peterson, D.H. 1989. The influence of North Pacific atmospheric circulation on streamflow in the west, p. 375-398. In Peterson, D.H. (ed.), *Aspects of climate variability in the Pacific and the Western Americas.* Geophysical Monograph. American Geophysical Union, Washington D.C., USA.

Chaster, G.W. 1892. Report upon the foraminifera of the Southport Society of Natural Science District. *First Report Southport Society of Natural Science (1890-1891),* appendix:54-72.

Chernykh, V.V. 1967. Novye Pozdnesiluriyskie foraminifery Urala (New Late Silurian Foraminifera of the Urals). *Paleontologischeskiy Zhurnal,* 2:37-43.

Cockbain, A.E. 1963. Distribution of foraminifera in Juan de Fuca and Georgia Straits, British Columbia, Canada. *Contributions from the Cushman Foundation for Foraminiferal Research,* 14:37-57.

Cushman, J.A. 1910. A monograph of the foraminifera of the North Pacific Ocean. Pt. I - Astrorhizidae and Lituolidae. *U.S. National Museum Bulletin,* 71(1):1-134.

Cushman, J.A. 1911. A monograph of the foraminifera of the North Pacific Ocean. Pt. II - Textulariidae. *U.S. National Museum Bulletin,* 71(2):1-108.

Cushman, J.A. 1913. A monograph of the foraminifera of the North Pacific Ocean. Pt. III - Lagenidae. *U.S. National Museum Bulletin,* 71(3):1-125.

Cushman, J.A. 1922. Results of the Hudson Bay expedition, 1920; I - The foraminifera. *Contributions of Canadian Biology, 1921, Biological Board of Canada,* 9:135-147.

Cushman, J.A. 1923. The foraminifera of the Atlantic Ocean; Part 4 - Lagenidae. *U.S. National Museum Bulletin,* 104(4):1-228.

Cushman, J.A. 1925. Recent foraminifera from British Columbia. *Contributions from the Cushman Foundation for Foraminiferal Research,* 1:38-47.

Cushman, J.A. 1926. Foraminifera of the typical Monterey of California. *Contributions from the Cushman Foundation for Foraminiferal Research,* 2(3):53-69.

Cushman, J.A. 1927. An outline of a re-classification of the foraminifera. *Contributions from the Cushman Foundation for Foraminiferal Research,* 2:94-95.

Cushman, J.A. 1930. The foraminifera of the Atlantic Ocean, pt. 7: Nonionidae, Camerinidae, Peneroplidae, and Alveolinellidae. *U.S. National Museum Bulletin,* 104(7):1-79.

Cushman, J.A. 1933a. Foraminifera, their classification and economic use. *Cushman Foundation Special Publication,* 4:1-349.

Cushman, J.A. 1933b. Foraminifera, their classification and economic use. *Special Publication Cushman Laboratory for Foraminiferal Research,* 4:1-349.

Cushman, J.A. 1936. Some new species of *Elphidium* and related genera. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 12(4):78-89.

Cushman, J.A. 1937. A monograph of the foraminiferal family Valvulinidae. *Special Publication Cushman Laboratory for Foraminiferal Research,* 7:1-157.

Cushman, J.A. 1939. A monograph of the foraminiferal family Nonionidae. *Professional Papers U.S. Geological Survey* 191:1-100.

Cushman, J.A. 1944. Foraminifera from the shallow water of the New England coast. *Special Publication Cushman Laboratory for Foraminiferal Research,* 12:1-37.

Cushman, J.A., and Brönnimann, P. 1948. Some new genera and species of foraminifera from brackish water of Trinidad. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 24:15-21.

Cushman, J.A., and Grant, H.S. 1927. Late Tertiary and Quaternary *Elphidium* of the West Coast of North America. *San Diego Society of Natural History, Transactions,* 5(6):69-82.

Cushman, J.A., and Gray, H.B. 1946. A foraminiferal fauna from the Pliocene of Timms Point, California. *Special Publication Cushman Laboratory for Foraminiferal Research,* 19:1-46.

Cushman, J.A., and McCulloch, I. 1942. Some Virgulininae in the collections of the Allan Hancock Foundation. *Allan Hancock Pacific Expeditions,* 6:179-230.

Cushman, J.A., and Moyer, D.A. 1930. Some recent foraminifera from off San Pedro, California. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 6:49-62.

Cushman, J.A., and Valentine, W.W. 1930. Shallow-water foraminifera from the Channel Islands of southern California. *Contributions from the Department of Geology of Stanford University,* 1:5-51.

Dawson, J.W. 1860. Notice of Tertiary fossils from Labrador, Maine, etc., and remarks on the climate of Canada in the newer Pliocene or Pleistocene period. *Canadian Natural Geology,* 5:188-200.

de Blainville, H.M.D. 1927. *Manuel de malacologie et de conchyologie*. F.G. Levrault, Paris.

Deflandre, G. 1929. Le genre *Centropyxis* Stein. *Archiv fur Protistenkunde,* 67:322-375.

Deflandre, G. 1953. Ordres des Testaceolobosa (De Saedeleer 1934), Testaceofilosa (De Saedeleer 1934), Thalamia (Haeckel 1862) ou Thecamoebiens (Auct.) (Rhizopoda Testacea), p. 97-148. In Grasse, P.-P. (ed.), *Traite de Zoologie*. Masson, Paris.

Defrance, M.J.L. 1824. In Blainville, H.M.D.d. (ed.), *Dictionnaire des sciences naturelles, 32, mollus-morf*. F.G. Levrault, Paris.

Delage, Y., and Hérouard, E. 1896. *Traité de Zoologia Concrète,* 1: La cellule at le protozoaires. Schleicher Frères, Paris.

de Monfort, P.D. 1808. *Conchyliologie systématique et classification méthodique des coquilles,* 1. F. Schoell, Paris.

Department of Energy, M.a.R. 1979. Cape Caution, British Columbia (92 M/4). Department of Energy, Mines and Resources, Ottawa.

d'Orbigny, A. 1826. Tableau méthodique de la classe des Céphalopodes. *Annales des Sciences Naturelles,* 7:245-314.

d'Orbigny, A. 1839. *Voyage dans l'Amérique Méridionale; Foraminifères,* 5. Levrault, Strasbourg, France.

d'Orbigny, A. 1846. *Foraminiféres fossiles du bassin tertiare de Vienne (Autriche)*. Gide et Comp., Paris.

Earland, A. 1933. Foraminifera; Part II - South Georgia. *"Discovery" Reports,* 7:27-138.

Earland, A. 1934. Foraminifera; Part III - The Falklands sector of the Antartic (excluding South Georgia). *"Discovery" Reports,* 10-1-208.

Echols, R.J. 1971. Distribution of foraminifera in sediments of the Scotia Sea area, Antarctic waters, p. 93-168. In Reid, J.L. (ed.), *Antarctic Oceanography I.* Antarctic Research Series. American Geophysical Union, Washington D.C., USA.

Ehrenberg, G.C. 1830. *Organisation systematik und geographisches Verhaltnis der Infusionsthierchen.* Druckerei del Koniglichen Akademie del Wissenschaften, Berlin.

Ehrenberg, G.C. 1832. Beitrage zur Kenntnis del Organisation der Infusorien und ihrer geographischen Verbreitung, besonders in Sibirien. *Koningliche Akademie der Wissenschaften zu Berlin Abhandlungen*:1-88.

Ehrenberg, G.C. 1838. Über dem blossen Auge unsichtbare Kalkthierchen und Kieselthierchen als Hauptbestandtheile der Kreidegebirge. *Bericht uber die zur Bekanntmachung geeigneten Verhanlungen del Königlichen Preussischen Akademie der Wissenschaften zu Berlin,* 1838:192-200.

Ehrenberg, G.C. 1839. Über die Bildung der Kreidefelsen und des Kreidemergels durch unsichtbare Organismen. *Physikalische Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin,* 1838 (1840: separate 1839):59-147.

Ehrenberg, G.C. 1843. Verbreitung und Einfluss des mikroskopischen Lebens in Sud-und Nord-Amerika: Konigliche Akademie der Wissenschaften zu Berlin Abhandlungen, 1841. *Physikalische Abhandlungen*:291-446.

Ehrenberg, G.C. 1848. Fortgesetzte Beobachtungen uber jetzt herrschende atmospharische mikroskopische Verhaltnisse. *Bericht uber die zur Bekanntmachung geeigneten Verhanlungen del Koniglichen Preussischen Akademie der Wissenschaften zu Berlin,* 13:370-381.

Ehrenberg, G.C. 1861. Elemente des tiejen Meeresgrundes in Mexikanischen Golfstrome bei Florida; Über die Tiefgrund-Verhältnisse des Oceans am Eingange der Davisstrasse und bei Island. *Monatsbericht der Koniglichen Preussischen Akademie der Wissenscraften zu Berlin,* 1858:295-311, 324-337.

Eichwald, C.E.v. 1830. *Zoologia specialis,* 2. D.E. Eichwaldus, Vilnae.

Eimer, G.H.T., and Fickert, C. 1899. Die Artibildung und Verwandtschaft bei den Foraminiferen. Entwurf einer natürlichen Eintheilung derselben. *Zeitschrift fur wissenschaftliche Zoologie,* 65:599-708.

Feyling-Hanssen, W., and Buzas, M.A. 1976. Emendation of *Cassidulina* and *Islandiella helenae* new species. *Journal of Foraminiferal Research,* 6(2):154-158.

Fisheries and Oceans, C. 2003. Tides, currents and water levels, pp. www.tides.gc.ca.

Fleming, J. 1828. *A history of British animals, exhibiting the descriptive characters and systematic arrangement of the genera and species of quadrupeds, birds, fishes, mollusca and radiata of the United Kingdom*. Bell & Bradfute, Edinburgh.

Galloway, J.J. 1933. *A manual of foraminifera*. Principia Press, Bloomington.

Galloway, J.J., and Wissler, S.G. 1927. Pleistocene foraminifera from the Lomita Quarry, Palos Verdes Hills, California. *Journal of Paleontology,* 1:35-87.

Glaessner, M.F. 1937. Die Entfaltung der Foraminiferenfamilie Buliminidae. *Problemy Paleontologii, Paleontologicheskaya Laboatoriya Moskovskogo Gosudarstvennogo Universiteta,* 2-3:411-422.

Green, R.N., and Klinka, K. 1994. *A field guide to site identification and interpretation for the Vancouver Forest Region,* Land Management Handbook No. 28. British Columbia Ministry of Forests.

Guilbault, J.P., Patterson, R.T., Thomson, R.E., Barrie, J.V., and Conway, K. 1997. Late Quaternary paleoceanographic changes in Dixon Entrance, Northwest British Columbia, Canada: evidence from the foraminiferal faunal succession. *Journal of Foraminiferal Research,* 27(3):151-174.

Guilbault, J.P., Radi, T., Barrie, J.V., Conway, K., and Lapointe, M. 2003. Paleoenvironments of the Strait of Georgia, British Columbia during the last deglaciation: Microfaunal and microfloral evidence. *Quaternary Science Reviews,* 22(8-9):839-857.

Haeckel, E. 1894. *Systematische Phylogenie. Entwurf eines Natürlichen Systems der Organismen auf Grund ihrer Stammesgeschichte. Systematische Phylogenie der Protisten und Pflanzen,* 1. Georg Reimer, Berlin.

Haman, D. 1982. Modern Thecamoebinids (Arcellinida) from the Balize Delta, Louisiana. *Transactions, Gulf Coast Association of Geological Societies,* 32:353-376.

Hare, F.K., and Thomas, M.K. 1979. *Climate Canada*. John Wiley & Sons, Toronto.

Hedley, R.H., Hurdle, C.M., and Burdett, I.D.J. 1964. *Trochammina squamata* Jones and Parker (foraminifera) with observations on some closely related species. *New Zealand Journal of Science,* 7(3):419-425.

Heron-Allen, E., and Earland, A. 1911. On the recent and fossils foraminifera of the shore-sands of Selsey Bill, Sussex, IV. *Journal of the Royal Microscopy Society*:436-448.

Heron-Allen, E., and Earland, A. 1930. Some new foraminifera for the South Atlantic; III. *Miliammina*, a new siliceous genus. *Journal of the Royal Microscopical Society of London,* ser. 3, 50:38-45.

Heron-Allen, E., and Earland, A. 1932. Foraminifera; Part I - The ice-free area of the Falkland Islands and adjacent seas, p. 440, *"Discovery" Reports, issued by the "Discovery" Committee, Colonial Office, London*. University Press, Cambridge, UK.

Hofker, J. 1951. *The foraminifera of the Siboga expedition. Part III. Siboga-Expeditie, Monographie IVa*. E.J. Brill, Leiden.

Hofker, J. 1956. Tertiary foraminifera of coastal Ecuador: Part II, Additional notes on the Eocene species. *Journal of Paleontology,* 30:891-958.

Höglund, H. 1947. Foraminifera in the Gullmar Fjord and the Skagerak. *Zoologiske Bidrag från Uppsala,* 26:1-328.

Höglund, H. 1948. New names for four homonym species described in "Foraminifera in the Gullmar Fjord and the Skagerak." *Contributions from the Cushman Foundation for Foraminiferal Research,* 24:45.

Husezima, R., and Maruhasi, M. 1944. A new genus and thirteen new species of foraminifera from the core-sample of Kasiwazaki oil field, Niigata-ken. *Journal Sigenkagaku Kenkyusyo,* 1(3):391-400.

Jonasson, K.E. 1994. *Benthic foraminiferal distribution at Middle Valley, Juan de Fuca Ridge: a northeast Pacific hydrothermal venting site*, Carleton University, Ottawa, ON, Canada.

Jonasson, K.E., and Patterson, R.T. 1992. Preservation potential of marsh foraminifera from the Fraser Rivel Delta, British Columbia. *Micropaleontology,* 38:289-301.

Jones 1875. In Griffith, J.W., and Henfrey, A. (eds.), *The Micrographic Dictionary*. van Voorst, London.

Jones, R.W. 1984. A revised classification of the unilocular Nodosariida and Buliminida (Foraminifera). *Revista Española de Micropaleontología,* 16:91-160.

Jones, T.R., and Parker, W.K. 1860. On the Rhizopodal fauna of the Mediterranean, compared with that of the Italian and some other Tertiary deposits. *Quarterly Journal of the Geological Society of London,* 16:304.

Kaiho, K. 1994. Benthic foraminiferal dissolved-oxygen index and dissolved-oxygen levels in the modern ocean. *Geology,* 22:719-722.

Kent, W.S. 1880. A manual of the Infusoria: including a description of all known Flagellate, Ciliate, and Tentaculiferous Protozoa, British and foreign, and an account of the organisation and affinities of the Sponges. *Bogue,* 1:1-472.

Kiaer, H. 1900. Synopsis of the Norwegian marine Thalamophora. *Norwegian Fisheries Marine Investigation,* 1(7):1-58.

Knudsen, K.L., and Seidenkrantz, M.-S. 1994. *Stainforthia feylingi* new species from artic to subartic environments, previously recorded as *Stainforthia schreibersiana* (Czjzek). *Cushman Foundation for Foraminiferal Research Special Publication,* 32:5-13.

Kumar, A., and Dalby, A.P. 1998. Identification key for Holocene lacustrine Arcellacean (Thecamoebian) taxa. *Palaeontologia Electronica,* 1(1):34 http://www.palaeo-electronica.org/1998_1/dalby/issue1.htm.

Lamarck, J.B. 1816. *Histoire naturelle des animaux sans vertebres,* 2. Verdiere, Paris.

Leidy, J. 1874. Notice of some Rhizopods. *Academy of Natural Sciences of Philadelphia Proceedings,* ser. 3, 1874:13-15.

Leidy, J. 1879. Fresh-water Rhizopods of North America. *United States Geological Survey of the Territories Report,* 12:1-324.

Loeblich, A.R., and Tappan, H. 1953. Studies of Arctic foraminifera. *Smithsonian Miscellaneous Collections,* 121(7):1-150.

Loeblich, A.R., and Tappan, H. 1954. New names for two foraminiferal homonyms. *Journal of the Washington Academy of Sciences,* 44:384.

Loeblich, A.R., and Tappan, H. 1961. Remarks on the systematics of the Sarcodina (Protozoa), renamed homonyms and new and validated genera. *Proceedings of the Biological Society of Washington,* 74:213-234.

Loeblich, A.R., and Tappan, H. 1987. *Foraminiferal Genera and Their Classification.* Van Norstrand Reinhold Company, New York.

Loeblich, A.R., and Tappan, H. 1994. Foraminifera of the Sahul Shelf and Timor Sea. *Cushman Foundation for Foraminiferal Research Special Publication,* 31.

Mathewes, R.W., Heusser, L.E., and Patterson, R.T. 1993. Evidence for a Younger Dryas-like cooling event on the British Columbia coast. *Geology,* 21:101-104.

Maync, W. 1952. Critical taxonomy study and nomenclatural revision of the Lituolidae based upon the prototype of the family, *Lituola nautiloidea* Lamarck, 1804. *Contributions to the Cushman Foundation for Foraminiferal Research,* 3:35-56.

McCulloch, I. 1977. *Qualitative observations on Recent foraminiferal tests with emphasis on the eastern Pacific*. University of Southern California, Los Angeles, California.

Medioli, F.S., and Scott, D.B. 1983. Holocene Arcellacea (Thecamoebians) from eastern Canada. *Cushman Foundation Special Publication,* 21:63.

Miller, A.A.L., Scott, D.B., and Medioli, F.S. 1982. *Elphidium excavatum* (Terquem): ecophenotypic versus subespecific variation. *Journal of Foraminiferal Research,* 12(2):116-144.

Miller, A.J., Cayan, D.R., Barnett, T.P., Graham, N.E., and Oberhuber, J.M. 1994. The 1976-77 climate shift of the Pacific Ocean. *Oceanography,* 7(1):21-26.

Montagu, G. 1803. *Testacea Britannica, or natural history of British shells, marine, land and fresh-water, including the most minute.* J.S. Hollis, Romsey, England.

Montagu, G. 1808. *Testacea Britannica*. S. Woolmer, Exeter, England.

Murray, J.W. 1972. *An atlas of British recent Foraminiferids*. Heinemann Educational Books Ltd., London.

Murray, J.W. 2002. An illustrated guide to the benthic foraminifera of the Hebridean Shelf, west of Scotland, with notes on their mode of life. *Palaeontologia Electronica,* 5(2):31 p.

Narayan, Y.R., Barnes, C.R., and Johns, M.J. 2005. Taxonomy and biostratigraphy of Cenozoic foraminifers from Shell Canada wells, Tofino Basin, offshore Vancouver Island, British Columbia. *Micropaleontology,* 51(2):101-167.

Natland, M.L. 1938a. New species of foraminifera from off the west coast of North America and from the later Tertiary of the Los Angeles Basin. *Scripps Institute of Oceanography Bulletin, Technical Series,* 4(5):146.

Natland, M.L. 1938b. New species of foraminifera from off the west coast of North America and from the later Tertiary of the Los Angeles Basin. *Scripps Institute of Oceanography Bulletin, Technical Series,* 4(5):137-164.

Norman, A.M. 1892. *Museum Normanianum*, Durham, England.

Nørvang, A. 1945. Foraminifera. *Zoology of Iceland,* 2(2):1-79.

Nørvang, A. 1959. *Islandiella* n.g. and *Cassidulina* d'Orbigny. *Videnskabelige Meddeleser fra Dansk Naturhistorisk Forening i Kjøbenhavn,* 120:25-41.

Ogden, C.G., and Hedley, R.H. 1980. *An atlas of freshwater Testate Amoebae*. London and Oxford University Press, Oxford.

Parker, F.L. 1952. Foraminiferal distribution in the Long Island Sound - Buzzards Bay area. *Bulletin of the Museum of Comparative Zoology, Harvard College,* 106(10):428-473.

Parker, F.L., Phleger, F.B., and Peirson, J.F. 1953. Ecology of foraminifera from San Antonio Bay and environs, southwest Texas. *Cushman Foundation for Foraminiferal Research Special Publication,* 2:75 p.

Parker, W.K., and Jones, T.R. 1859. On the nomenclature of the foraminifera. II. On the species enumerated by Walker and Montagu. *Annals and Magazine of Natural History, series 3,* 4:333-351.

Parker, W.K., and Jones, T.R. 1865. On some foraminifera from the North Atlantic and Arctic Oceans, including Davis Straits and Baffin's Bay. *Royal Society of London Philosophical Transactions,* 155:325-441.

Parr, W.J. 1947. The Lagenid foraminifera and their relationships. *Proceedings of the Royal Society of Victoria,* 58:116-130.

Parr, W.J. 1950. Foraminifera. *B.A.N.Z. Antarctic Research Expedition 1929-1931, Q2series B (Zoology, Botany),* 5(6):232-392.

Patterson, R.T. 1990a. Intertidal benthic foraminiferal biofacies on the Fraser River Delta, British Columbia: modern distribution and paleoecological importance. *Micropaleontology,* 36(3):229-244.

Patterson, R.T. 1990b. New and renamed species of benthic foraminifera from the Pleistocene Santa Barbara formation of California. *Journal of Paleontology,* 64(5):681-691.

Patterson, R.T. 1993. Late Quaternary benthic foraminiferal biofacies and paleoceanography of Queen Charlotte Sound and southern Hecate Strait, British Columbia. *Journal of Foraminiferal Research,* 23(1):1-18.

Patterson, R.T., Brunner, C.A., Capo, R., and Dahl, J. 1990. A paleoenvironmental study of Early to Middle Pleistocene foraminifera of the Santa Barbara Formation at Santa Barbara, California. *Journal of Paleontology,* 64(1):1-25.

Patterson, R.T., Burbidge, S.M., and Luternauer, J.L. 1998. *Atlas of common benthic foraminiferal species for Quaternary shelf environments of western Canada. Geological Survey of Canada Bulletin,* 503.

Patterson, R.T., and Cameron, B.E.B. 1991. Paleoenvironmental significance of the foraminiferal biofacies succession in the Late Quaternary sediments of the Fraser River Delta, British Columbia. *Journal of Foraminiferal Research,* 21:228-243.

Patterson, R.T., and Kumar, A. 2002. Post-glacial paleoceanographic history of Saanich Inlet, British Columbia, based on foraminiferal proxy data. *Journal of Foraminiferal Research,* 32(2):110-125.

Patterson, R.T., and Richardson, R.H. 1988. Eight new genera of unilocular Foraminifera. *Transactions American Microscopical Society,* 107(3):240-258.

Phleger, F.B., and Parker, F.L. 1951. Ecology of Foraminifera, northwest Gulf of Mexico. *Geological Society of America Memoirs,* 46:1-64.

Pickard, G.L., and Stanton, B.R. 1980. Pacific fjords - a review of their water characteristics, p. 1-51. In Freeland, H.J., Farmer, D.M., and Levings, C.D. (eds.), *Fjord Oceanography (Proceedings of the NATO conference on fjord oceanography, Victoria, BC, 1979)*. Plenum Press, New York, USA.

Poag, C.W. 1981. *Ecologic atlas of benthic foraminifera of the Gulf of Mexico.* Marine Science International, Woods Hole, Massachusetts.

Puri, H.S. 1953. *Contribution to the study of the Miocene of the Florida panhandle. Florida Geological Survey Bulletin,* 36.

Reinhardt, E.D., Dalby, A.P., Kumar, A., and Patterson, R.T. 1998. Utility of arcellacean morphotype variants as pollution indicators in mine tailing contaminated lakes near Cobalt, Ontario, Canada. *Micropaleontology,* 44:1-18.

Reinhardt, E.D., Easton, N.A., and Patterson, R.T. 1996. Foraminiferal evidence of Late Holocene sea-level change and Amerindian site distribution at Montague Harbour, British Columbia. *Géographie physique et Quaternaire,* 50(1):35-46.

Resig, J.M. 1963. Size relationships of Eggerella advena to sediment and depth of substratum. *Essays in Marine Geology in honor of K.O. Emery:* 121-126.

Reiss, Z. 1963. Reclassification of perforate foraminifera. *Bulletin of the Geological Survey of Israel,* 35:1-111.

Reuss, A.E. 1850. Neues Foraminiferen aus den Schichten des österreichischen Tertiärbeckens. *Denkschriften der Kaiserlichen Akademie del Wissenschaften, Mathematisch-Naturwissenschafliche Classe,* 1:365-390.

Reuss, A.E. 1860. Die Foraminiferen der Westphälischen Kreideformation. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Classe,* 40:147-238.

Reuss, A.E. 1862. Entwuf einer systematischen Zusammenstellung der Foraminiferen. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Classe,* 44(1):355-396.

Rhumbler, L. 1938. Foraminiferen aus dem Meeressand von Helgoland, gesammelt von A. Remane (Kiel). *Kieler Meeresforschungen,* 2(2):157-222.

Risso, A. 1826. *Histoire naturelle des principales productions de l'Europe Méridionale et particulièrment de celles des environs de Nice et des Alpes Maritimes,* 4. F.G.Levrault, Paris.

Robertson, D. 1891. *Trochammina bradyi, n.n. Annual Magazine of Natural History,* 7:388.

Rodrigues, C.G. 1980. *Holocene microfauna and paleoceanography of the Gulf of St. Lawrence.* Ph.D. Thesis, Carleton University, Ottawa, Canada.

Roe, H.M., and Patterson, R.T. 2006. Distribution of thecamoebians (testate amoebae) in small lakes and ponds, Barbados, West Indies. *Journal of Foraminiferal Research,* 36(2):116-134.

Saidova, K.M. 1975. *Bentosnye Foraminifery Tikhogo Okeana (Benthonic foraminifera of the Pacific Ocean)*. Institut Okeanologii P.P. Shirshova, Akademiya Nauk SSSR, Moscow.

Saidova, K.M. 1981. *O sovremennom sostoyanii sistemy nadvidovykh Kaynozoyskikh bentosnikh foraminifer (On an up-to-date system of supraspecific taxonomy of Cenozoic benthonic foraminifera)*. Institut Okeanologii P.P.Shirshova, Akademiya Nauk, SSSR, Moscow.

Saito, T., Thompson, P.R., and Breger, D. 1981. *Recent and Pleistocene planktonic foraminifera*. University of Tokyo Press, Tokyo.

Sars, G.O. 1872. Undersøgelser over Hardangerfjordens Fauna. *Fordhandlinger i Videnskasselskabet i Kristiania,* 1871:246-255.

Schafer, C.T., Cole, F.E., and Syvitski, J.P.M. 1989. Bio- and lithofacies of modern sediments in Knight and Bute Inlets, British Columbia. *Palaios,* 4:107-126.

Schmarda, L.K. 1871. *Zoologie: Band I*. Braumüller, Wien.

Schröder, C. 1986. Deep-water arenaceous Foraminifera in the northwest Atlantic Ocean. *Canadian Technical Report of Hydrography and Ocean Sciences,* 71:191 p.

Schröder, C., Scott, D.B., and Medioli, F.S. 1987. Can smaller benthic foraminifera be ignored in paleoenvironmental analyses? *Journal of Foraminiferal Research,* 17:101-109.

Schulze, F.E. 1877. Rhizopodenstudien VI. *Archiv fur Mikroskopische Anatomie,* 13:9-30.

Schultze, M.S. 1854. *Über den Organismus der Polythalamien (Foraminiferen), nebst Bermekungen über die Rhizopoden im Allgemeinen.* Wilhelm Engelmann, Leipzig.

Schwager, C. 1866. Fossile foraminiferan von Kar-Nicobar: reise der osterreichischen fregatte novarra. *Geologica Theil,* 2:187-268.

Schwager, C. 1877. Quadro del proposto sistema di classificazione dei foraminiferi con guscio. *Bolletino R. Comitato Geologico d'Italia,* 8:18-27.

Scott, D.B., and Medioli, F.S. 1983. Agglutinated rizhopods in Lake Erie: modern distribution and stratigraphic implications. *Journal of Paleontology,* 57(4):809-820.

Seiglie, G.A. 1965. Un género nuevo y dos especies nuevas de foraminíferos de Los Testigos, Venezuela. *Caribbean Journal of Sciences,* 4:497-512.

Sigal, J. 1952. Aperçu stratigraphique sur la micropaléontologie du Crétacé. *XIX Congrés Géologique International, Monographies Régionales, série I, Algérie,* 26:1-47.

Silvestri, A. 1923. Lo stipite della Elissoforme e le sue affinità. *Memorie della Pontificia Accademia della Scienze, Nuovi Lincei, ser. 2,* 6:231-270.

Snyder, S.W., Hale, W.R., and Kontrovitz, M. 1990. Assessment of postmortem transportation of modern benthic foraminifera of the Washington continental shelf. *Micropaleontology,* 36(3):259-282.

Stein, S.F.N.v. 1859. Uber die ihm aus eigener Untersuchung bekannt gewordenen Suswasser-Rhizopoden. *Konigliche Bohmishce Gesellschaft der Wissenchaften Abhandlungen,* 10(5):41-43.

Terquem, O. 1876. Essai sur le classement des animaux qui vivent sur la plage et dans les environs de Dunkerque, pt. 1. *Mémoires de la Société Dunkerquoise pour l'Encouragement des Sciences, des Lettres et des Arts (1874-1876),* 19:405-457.

Thalman, H.E. 1952. Bibliography and index to new genera, species and varieties of foraminifera for the year 1951. *Journal of Paleontology,* 26:953-992.

Thomson, R.E. 1981. Oceanography of the British Columbia coast. *Canadian Special Publication of Fisheries and Aquatic Sciences,* 56:291 p.

Todd, R. 1948. Subfamily Uvigerininae, p. 288. In Cushman, J.A., and McCulloch, I. (eds.), *The species of Bulimina and related genera in the collections of the Allan Hancock Foundation*. University of Southern California Publication, Allan Hancock Pacific Expedition, Los Angeles, California, USA.

Todd, R., and Low, D. 1967. Recent foraminifera from the Gulf of Alaska and southeastern Alaska. *Geological Survey Professional Paper,* 573-A:55 p.

Vázquez Riveiros, N. 2006. *Paleoceanographic history of the Seymour-Belize Inlet Complex, British Columbia, Canada, through the last 1100 years, based on foraminiferal data.* M.Sc. Thesis, Carleton University, Ottawa.

Vázquez Riveiros, N., Babalola, A.O., Boudreau, R.E.A., Patterson, R.T., Roe, H.M., and Doherty, C. 2007. Modern distribution of salt marsh foraminifera and thecamoebians in the Seymour-Belize Inlet Complex, British Columbia, Canada. *Marine Geology,* 242(1-3):39-63.

Villanueva Guimerans, P., and Cervera Currado, J.L. 1999. Distribution of Planorbulinacea (benthic foraminifera) assemblages in surface sediments on the northern margin of the Gulf of Cadiz. *Boletin del Instituto Espanol de Oceanografia,* 15(1-4):181-190.

Voloshinova, N.A. 1952. p. 1-151. In Voloshinova, N.A., and Dain, L.G. (eds.), *Iskopaemye Foraminifery SSRS. Nonionidy, Kassidulinidy i Khilostomellidy (Fossil foraminifera of the USSR. Nonionidae, Cassidulinidae and Chilostomellidae.* Vsesoyuznogo Neftyanogo Nauchnoissledovatel'skogo Geologorazvedochnogo Instituta (VNIGRI).

Voloshinova, N.A. 1958. O novy sistematike Nonionid (On new systematics of the Nonionidae). *Trudy vsesoyuznogo neftyanogo nauchnoissledovatel'skogo geologorazvedochnogo instituta (VNIGRI),* 115:117-191.

von Siebold, C.T.E. 1864. Wirbellose Thiere: part 1, p. 679. In von Siebold, C.T.E., and von Stannius, H. (eds.), *Lehrbuch del Vergleichenden Anatomie*

Walker, D.A., and Jacob, E. 1798. In Kanmacher, F. (ed.), *Adam's essays on the microscope; the second edition with considerable additions and improvements*. Dillon & Keating, London.

Ware, D.M., and McFarlane, G.A. 1989. Fisheries production domains in the Northeast Pacific Ocean, p. 359-379. In Beamish, R.J., and McFarlane, G.A. (eds.), *Effects of ocean variability on recruitment and an evaluation of parameters used in stock assessment models*. Canadian Special Publication of Fisheries and Aquatic Sciences.

Wiesner, H. 1931. Die Foraminiferen der deutschen Südpolar-Expedition 1901-1903. *Deustche Südpolar-Expedition vol. 20 Zoologie,* 12:53-165.

Williamson, W.C. 1848. On the Recent British species of the genus *Lagena*. *Annals and Magazine of Natural History, series 2,* 1:1-20.

Williamson, W.C. 1858. On the recent foraminifera of Great Britain. *Ray Society, London*:107 p.

Wright, J. 1886. Foraminifera of the Belfast Naturalists' Field Club's cruise off Belfast Lough in the steam-tug "Protector," June 1885; also, foraminifera found by Dr. Malcomson, at Rockport, Belfast Lough. *Belfast Naturalists' Field Club Proceedings, new series,* 1:317-325.