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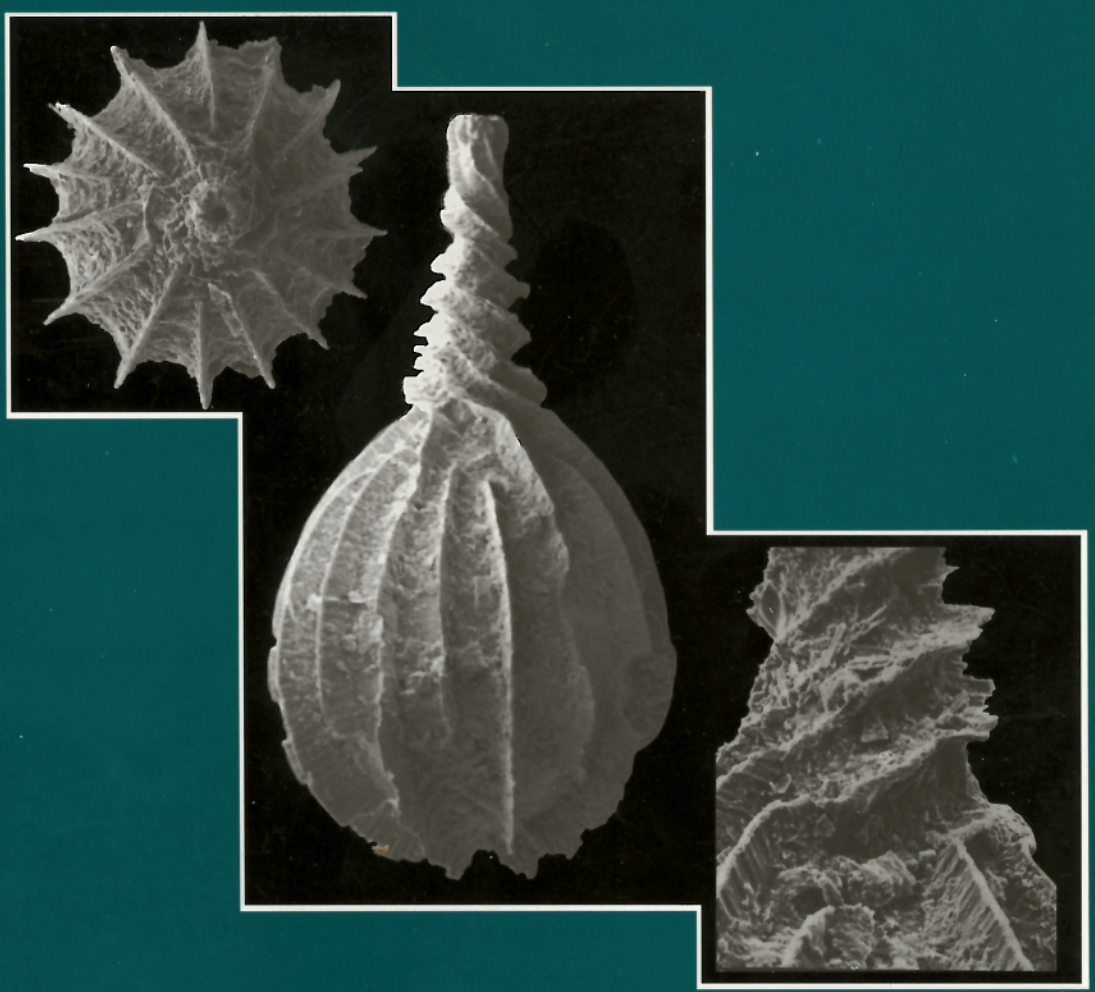
ATLAS OF COMMON BENTHIC FORAMINIFERAL SPECIES FOR QUATERNARY SHELF ENVIRONMENTS OF WESTERN CANADA

R.T. Patterson, S.M. Burbidge, and J.L. Luternauer



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Cover illustration

Various views of the Recent lagenid foraminifer *Lagena fidicularia* Patterson, 1991, from Queen Charlotte Sound, British Columbia. The unusual spiral costae on the neck may aid this infaunal species in moving through the substrate.

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ATLAS OF COMMON BENTHIC FORAMINIFERAL SPECIES FOR QUATERNARY SHELF ENVIRONMENTS OF WESTERN CANADA

Abstract

Taxonomic notes and scanning electron micrographs are provided for 103 species of the more abundant and ecologically diagnostic Quaternary benthic foraminifera commonly found in samples collected from Quaternary shelf environments of western Canada.

Résumé

La présente étude consiste en notes taxonomiques et en photographies réalisées au microscope électronique à balayage se rapportant à 103 espèces de foraminifères benthiques du Quaternaire les plus abondants et les plus diagnostiques sur le plan écologique que l'on trouve communément dans des échantillons prélevés dans les milieux de plate-forme continentale du Quaternaire de l'Ouest du Canada.

SUMMARY

The inside waterways of British Columbia and Washington State occupy a relatively young and narrow coastal trough known as the Georgia-Hecate Depression, which is bounded by Queen Charlotte Ranges, Vancouver Island Ranges, and Olympic Mountains to the west and by the Coast Mountains and Cascade Range to the east. The coastline of British Columbia bounding the depression to the east forms a complex network of inlets, straits, passes, sounds, and narrows. The geology of the Queen Charlotte Sound-Hecate Strait shelf has been studied not only because of the region's hydrocarbon potential, but also for the clues that recently deposited sediments may provide about the Quaternary paleoceanographic history of the west coast of Canada.

Concern over the ramifications of global change – both cooling and warming – has resulted in a dramatic increase in the number of studies throughout the world's oceans dedicated to understanding past climatic oscillations. These paleoclimatic and paleoceanographic studies are necessary to adequately assess the nature of environmental changes that may be occurring today. From a Canadian perspective, an understanding of past oceanographic and climatic change is critical, as most climate models predict that global changes will most profoundly influence higher latitude areas. As the late Quaternary-Holocene paleoceanographic evolution of coastal British Columbia is almost unknown, it is particularly important that such studies be implemented there. Preliminary studies on the distribution of Quaternary foraminifera in the region has been shown to be closely linked to just such local climatic and paleoceanographic changes. Unfortunately, due to a lack of detailed information on the benthic

SOMMAIRE

Les voies maritimes intérieures de la Colombie-Britannique et de l'État de Washington occupent une cuvette côtière étroite et d'origine relativement récente appelée «dépression de Georgia-Hecate». Cette cuvette est limitée à l'ouest par les chaînons des îles de la Reine-Charlotte, les chaînons de l'île de Vancouver et les monts Olympic, et à l'est par la chaîne Côtière et la chaîne des Cascades. La côte de la Colombie-Britannique qui forme la limite la dépression à l'est est constituée d'un réseau complexe de bras, de détroits et de passages. La géologie de la plate-forme continentale dans le détroit de la Reine-Charlotte et le détroit d'Hecate a été étudiée non seulement à cause du potentiel en hydrocarbures de la région, mais aussi en raison des indices que les sédiments déposés depuis peu pourraient fournir en ce qui a trait à l'évolution paléocéanographique du Quaternaire de la côte Ouest du Canada.

Les préoccupations suscitées par les ramifications des changements climatiques (réchauffement et refroidissement) à l'échelle du Globe se sont traduites par une prolifération d'études menées sur tous les océans du monde visant à comprendre les oscillations climatiques du passé. Ces études paléoclimatiques et paléocéanographiques s'imposent pour bien évaluer la nature des changements environnementaux qui pourraient se produire de nos jours. Du point de vue canadien, la connaissance des changements océanographiques et climatiques du passé est d'une importance primordiale, car la plupart des modèles climatiques prévoient que les changements planétaires auront des effets plus marqués sur les régions de haute latitude. Comme l'évolution paléocéanographique de l'Holocène et de l'ensemble du Quaternaire supérieur de la région côtière de la Colombie-Britannique est presque inconnue, il est particulièrement important que de telles études soient réalisées à cet endroit. Les études préliminaires de la répartition des foraminifères du Quaternaire dans la région ont démontré l'existence d'un lien avec les changements climatiques et

foraminiferal faunal makeup found off the British Columbia coast very few other researchers have utilized these rich faunas for Quaternary paleoenvironmental research.

The purpose of this paper is to ease potential systematic difficulties for future researchers working with Quaternary foraminifera by inventorying dominant species of benthic foraminifera found on the British Columbia continental shelf.

Brief taxonomic notes and scanning electron micrographs are provided for 103 of the more abundant and ecologically diagnostic species of the region. Thirty-one plates and a faunal index are included to aid the reader in identifications.

paléocéanographiques locaux. Malheureusement, à cause d'un manque d'information détaillée sur la composition des faunes de foraminifères benthiques au large de la côte de la Colombie-Britannique, très rares sont les autres chercheurs qui ont utilisé ces riches faunes dans leur recherche sur les paléoenvironnements du Quaternaire.

La présente étude vise à atténuer les difficultés systématiques que pourraient rencontrer les futurs chercheurs étudiant les foraminifères du Quaternaire, en répertoriant les espèces dominantes de foraminifères benthiques trouvés sur la plate-forme continentale de la Colombie-Britannique.

Suivent de brèves notes taxonomiques et des photographies réalisées au microscope électronique à balayage se rapportant à 103 espèces les plus abondantes et les plus diagnostiques sur le plan écologique de la région, accompagnées de 31 planches et d'un index faunique conçus pour aider le lecteur à les identifier.

INTRODUCTION

The inside waterways of British Columbia and Washington State occupy a relatively young and narrow coastal trough known as the Georgia-Hecate Depression (Fig. 1). The Georgia-Hecate Depression is bounded by Queen Charlotte Ranges, Vancouver Island Ranges, and Olympic Mountains to the west, and by the Coast Mountains and Cascade Range to the east. The coastline of British Columbia bounding the depression to the east forms a complex network of inlets, straits, passes, sounds, and narrows (Thomson, 1981). The geology of the Queen Charlotte Sound-Hecate Strait shelf has been studied not only because of the region's hydrocarbon potential (Shouldice, 1971, 1973; Patterson, 1989; Dietrich et al., 1990), but also for the clues that recently deposited sediments may provide about the Quaternary paleoceanographic history of the west coast of Canada (Barrie and Bornhold, 1989; Luternauer et al., 1989a, b).

The distribution of Quaternary foraminifera in the region has been shown to be closely linked to local climatic and paleoceanographic changes (Mathewes et al., 1993; Patterson, 1993; Patterson et al., 1995). Unfortunately, very few other researchers have utilized the rich Quaternary benthic foraminiferal faunas found off the British Columbia coast for paleoenvironmental research. The purpose of this paper is to ease potential systematic difficulties for future researchers working with Quaternary foraminifera by inventorying dominant species of benthic foraminifera found on the British Columbia continental shelf. A selection of marsh foraminifera have been illustrated elsewhere (Patterson, 1990a) and is not included here. Brief taxonomic notes and scanning electron micrographs are provided for 103 of the more abundant and ecologically diagnostic species belonging to the dominant genera of the region.

PREVIOUS FORAMINIFERAL RESEARCH

Cushman (1925) described a few Recent species found in shallow waters (14-45 m) in Queen Charlotte Sound (Fig. 1) and Virago Sound (on northern Queen Charlottes Islands). Cushman and Todd (1947a) described Recent fauna from coastal areas of the state of Washington near the British Columbia border. Cockbain (1963) conducted a study of the distribution of foraminifera, found at depths ranging from 112 to 293 m, in the Strait of Georgia (within the Georgia Depression). McCulloch (1977), in a systematic treatment, illustrated a few taxa collected from three stations in Vancouver City harbour. Smith (1970, 1978) interpreted the depositional history of emergent Late Quaternary marine deposits in southern British Columbia. Gallagher (1979) documented the distribution of Recent foraminifera from the continental shelf and slope of Vancouver Island. Conway and Luternauer (1984) listed a few species found at three horizons in a core from Queen Charlotte Sound. Patterson and Cameron (1991) offered a preliminary interpretation of the paleoenvironmental history of the Fraser Delta based on the foraminiferal and ostracod content of a selection of samples from two cores. Using benthic foraminiferal and pollen data from several cores collected in the Queen Charlotte Sound-Hecate Strait area, Mathewes et al. (1993) and Patterson (1993) identified a cooling event correlateable with the Younger Dryas of the North Atlantic region, from several cores collected in the Queen Charlotte Sound-Hecate Strait area.

METHODS AND MATERIALS

Samples were obtained from nine Geological Survey of Canada vibra, piston, or rotary cores collected from Dixon Entrance (END 90A-02, END 90A-04, END 90A-06, and END 90A-07) and southern Hecate Strait-Queen Charlotte

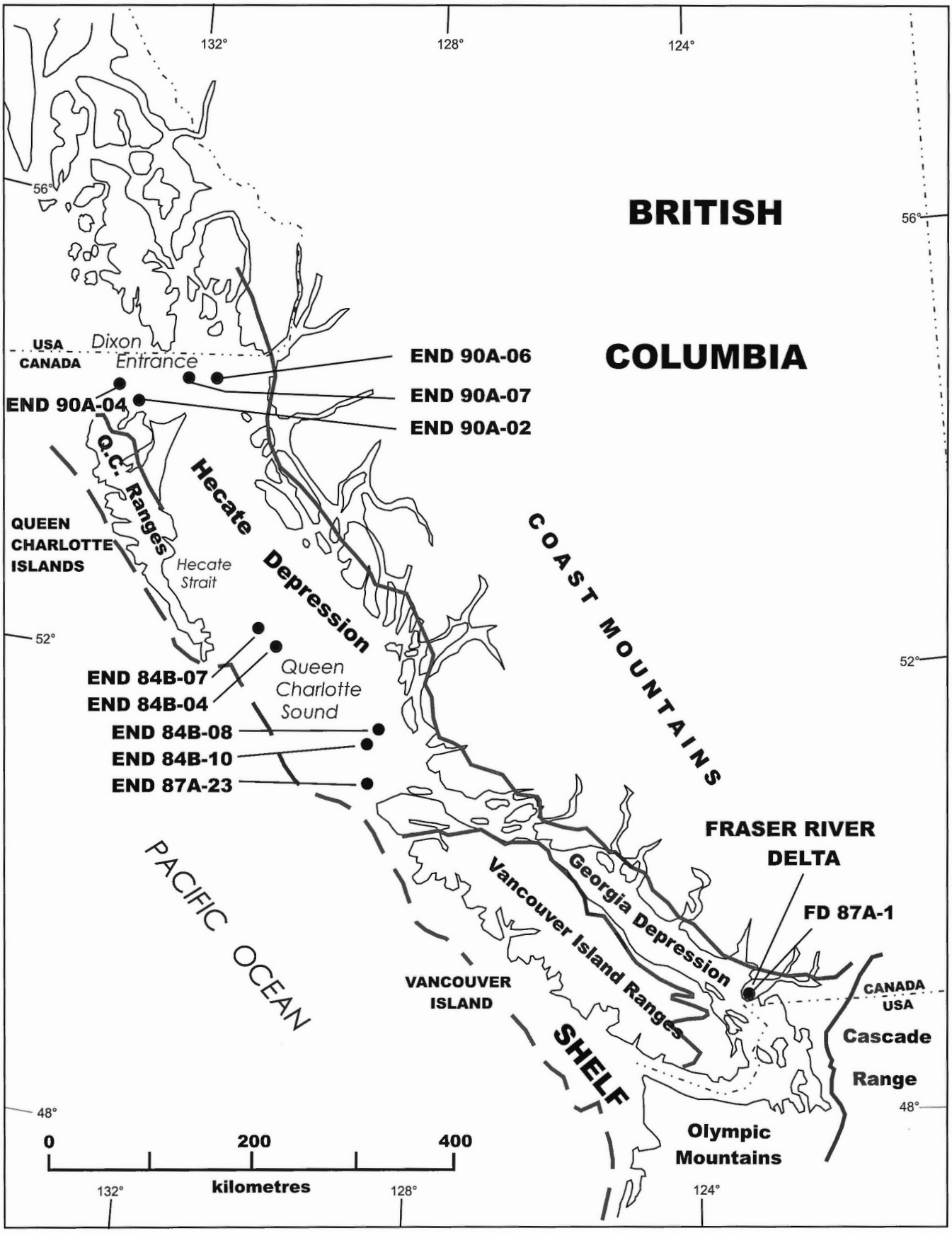

Figure 1. *Geographic regions on the west coast of Canada and sampling sites (•) for this study.*

Sound areas (END 84B-04, END 84B-07, END 84B-08, END 84B-10, and END 87A-23) as well as from the Fraser River Delta (FD 87A-1) (Fig. 1). Exact locations of cores and sampled intervals are as follows:

Queen Charlotte Sound. Core END 87A-23: latitude 50°59.94', longitude 128°26.55': 6-8 cm; 18-20 cm; 33-38 cm; 40-50 cm; 59-61 cm; 65 cm; 75 cm; 90 cm; collected from 95 m water depth.

Hecate Strait. Core END 84B-04: latitude 52°14.72', longitude 130°09.05': 0-1 cm; 32-36 cm; 71-75 cm; 137-141 cm; 215-219 cm; 342-345 cm; 377-381 cm; 443-447 cm; collected from 327 m water depth.

Hecate Strait. Core END 84B-07: latitude 52°16.70', longitude 130°12.27': 0-1 cm; 56-59 cm; 152-156 cm; 260-264 cm; 456-460 cm; 470-474 cm; 516-520 cm; collected from 474 m water depth.

Queen Charlotte Sound. Core END 84B-08: latitude 51°31.07', longitude 128°23.11': 0-1 cm; 41-44 cm; 165-167 cm; 228-232 cm; 329-332 cm; 375-377 cm; 455-457 cm; 480-482 cm; 499-501 cm; 504-506 cm; 517-520 cm; 528-530 cm; 535-539 cm; 552-555 cm; 595-598 cm; 658-661 cm; 1063-1066 cm; collected from 173 m water depth.

Queen Charlotte Sound. Core END 84B-10: latitude 51°28.14', longitude 128°25.14': 0-1 cm; 52-54 cm; 334-337 cm; 555-557 cm; 640-643 cm; 783-785 cm; collected from 184 m water depth.

Dixon Entrance. Core END 90A-02: latitude 54°25.24', longitude 132°50.10': 0-3 cm; 4-6 cm; 25-27 cm; 61-63 cm; 109-111 cm; 270-272 cm; collected from 389 m water depth.

Dixon Entrance. Core END 90A-04: latitude 54°18.89', longitude 132°32.96': 3-5 cm; 142-144 cm; collected from 254 m water depth.

Dixon Entrance. Core END 90A-06: latitude 54°35.02', longitude 131°16.43': 4-6 cm; collected from 130 m water depth.

Dixon Entrance. Core END 90A-07: latitude 54°34.92', longitude 131°43.07': 58-60 cm; 531-533 cm; 590-592 cm; collected from 394 m water depth.

Fraser Delta. Core FD 87A-1: latitude 49°03.25', longitude 123°03.95': 153 m.

All samples were boiled with soda ash to cleanse the foraminiferal tests for examination. Samples were then rinsed using 63 μm screens to retain the foraminifera. Samples containing excessive amounts of sand were dried, and the foraminifera separated from the sand by flotation in sodium polytungstate (s.g. 2.28). All samples were qualitatively examined to determine the species composition. One hundred and three foraminiferal species were identified. Illustrations were made with a Cambridge Stereoscan 90 scanning electron microscope using Polaroid NP 55 film.

ACKNOWLEDGMENTS

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SYSTEMATIC PALEONTOLOGY

Suprageneric classification follows that of Loeblich and Tappan (1987). Illustrated specimens are housed in the micropaleontological collections of the Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario.

Order FORAMINIFERIDA Eichwald, 1830

Suborder TEXTULARIINA Delage and Hérouard, 1896

Superfamily TROCHAMMINACEA Schwager, 1877

Family TROCHAMMINIDAE Schwager, 1877

Subfamily TROCHAMMININAE Schwager, 1877

Genus *Trochammina* Parker and Jones, 1859

Trochammina cf. *T. charlottensis* Cushman

Plate 26, figures 5, 6

Trochammina charlottensis CUSHMAN, 1925, p. 39, Pl. 6, fig. 4a, b.

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

Trochammina nana (Brady)

Plate 1, figures 1-3

Haplophragmium nana BRADY, 1881, p. 50.
Haplophragmium nana Brady. BRADY, 1884, p. 311, Pl. 35, fig. 6-8.

Description. Test free, trochospiral, with spiral side almost flattened and umbilical side more convex, chambers somewhat inflated, particularly on umbilical side to result in

lobulate test periphery; wall agglutinated, opaque, quite smooth; all chambers visible on spiral side, only final 6 to 7 visible on umbilical side; sutures radiate and depressed on both umbilical and spiral sides; aperture low interiomarginal arch extending into umbilicus.

Superfamily VERNEUILINACEA Cushman, 1911

Family VERNEUILINIDAE Cushman, 1911

Subfamily VERNEUILININAE Cushman, 1911

Genus *Gaudryina* d'Orbigny, 1839

Gaudryina arenaria Galloway and Wissler

Plate 1, figures 6, 7

Gaudryina arenaria GALLOWAY and WISSLER, 1927, p. 68, Pl. 11, fig. 5.

Description. Test free, elongate, of equal width for much of 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 somewhat indistinct in triserial section, become depressed in biserial portion; aperture arched at base of final formed chamber.

Superfamily TEXTULARIACEA Ehrenberg, 1838

Family EGGERELLIDAE Cushman, 1937

Subfamily EGGERELLINAE Cushman, 1937

Genus *Eggerella* Cushman, 1935

Eggerella advena (Cushman)

Plate 28, figure 6

Verneuilina advena CUSHMAN, 1922b, p. 141.
Eggerella advena (Cushman). CUSHMAN, 1937, p. 51, Pl. 5, fig. 12-15.
Eggerella advena (Cushman). LOEBLICH and TAPPAN, 1953, p. 36, Pl. 3, fig. 8-10.

Description. Test free, elongate, sharply tapering, early portion with 4 to 5 chambers in a whorl, later portion triserial; 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; wall finely agglutinated with occasional larger grains; aperture small, central, low arch at base of final chamber.

Genus *Karreriella* Cushman, 1933

Karreriella bradyi (Cushman)

Plate 1, figures 4, 5

Gaudryina bradyi CUSHMAN, 1911, p. 67, Fig. 107.

Description. Test free, stout, compressed, tapering sharply from broadest near the aperture to the base; wall agglutinated, finely perforate, opaque, smooth; slightly inflated chambers initially trochospirally coiled, become biserial in final 4 or 5 pairs; sutures depressed; aperture lipped near base of last formed chamber.

Suborder MILIOLINA Delage and Hérouard, 1896

Superfamily MILIOLACEA Ehrenberg, 1839

Family HAUERINIDAE Schwager, 1876

Subfamily SIPHONAPERTINAE Saidova, 1975

Genus *Siphonaperta* Vella, 1957

Siphonaperta agglutinata (Cushman)

Plate 27, figures 5-7

Quinqueloculina agglutinata CUSHMAN, 1917, p. 43, Pl. 9, fig. 2.
Quinqueloculina agglutinata (Cushman). LOEBLICH and TAPPAN, 1953, p. 39, Pl. 5, fig. 1-4.

Description. Test free, oblong, compressed in cross-section, periphery angular; wall calcareous, porcelaineous with agglutinated outer coating, imperforate; chambers elongate and angular, 5 visible in adult; sutures distinct; aperture terminal, circular to oval with small but broad flattened tooth projecting from inner margin.

Siphonaperta stalkeri (Loeblich and Tappan)

Plate 27, figures 1, 2

Quinqueloculina stalkeri LOEBLICH and TAPPAN, 1953, p. 40, Pl. 5, fig. 5-9.

Description. Test free, ovate in outline, rounded in section, periphery rounded; wall calcareous, porcelaineous with agglutinated outer coating, imperforate; chambers quinqueloculine of nearly equal diameter throughout; aperture at end of elongated neck, ovate to rounded and surrounded by distinct lip, small bifid tooth on margin adjacent to preceding chamber.

Subfamily MILIOLINELLINAE Vella, 1957

Genus *Pyrgo* Defrance, 1824

Pyrgo lucernula (Schwager)

Plate 28, figure 3

Biloculina lucernula SCHWAGER, 1866, p. 202, Pl. 4, fig. 14, 17.

Description. Test biloculine, slightly elongated, compressed through midpoint of opposing chambers, periphery sharply angled; chambers one-half coil in length; wall calcareous, imperforate, porcelaineous; aperture circular at end of slightly elongated neck.

Subfamily HAUERININAE Schwager, 1876

Genus *Quinqueloculina* d'Orbigny, 1826

Quinqueloculina akneriana d'Orbigny

Plate 27, figures 3, 4

Quinqueloculina akneriana D'ORBIGNY, 1846, p. 290, Pl. 18, fig. 16-21.

Description. Test free, large and robust in appearance, oblong, subtriangular in cross-section, edges rounded; wall calcareous, opaque, smooth, imperforate; chambers coiled, each one-half coil in length and alternate regularly in 5 planes of coiling; 3 chambers visible on one side and 4 on opposite side; aperture large, semi-circular, no projecting neck, thick bifid tooth projects into the aperture from the margin adjacent to the preceding chamber.

Subfamily SIGMOILINITINAE Luczkowska, 1974

Genus *Spirosigmoilina* Parr, 1942

Spirosigmoilina tenuis (Czjzek)

Plate 2, figures 1, 2

Quinqueloculina tenuis CZJZEK, 1848, p. 149, Pl. 13, fig. 31-34.

Description. Test free, elongate, compressed; wall calcareous, porcelaineous, translucent, smooth; chambers one test length long, early chambers sigmoid with later chambers 180° apart; aperture small and circular with short neck.

Remarks. The fossil specimen illustrated has a considerable amount of very fine debris attached to the test and is slightly corroded. Pristine specimens are very smooth.

Suborder LAGENINA Delage and Hérouard, 1896

Superfamily NODOSARIACEA Ehrenberg, 1838

Family NODOSARIIDAE Ehrenberg, 1838

Subfamily NODOSARIINAE Ehrenberg, 1838

Genus *Botuloides* S.Y. Zheng, 1979

Botuloides pauciloculus S.Y. Zheng

Plate 2, figures 3, 4

Botuloides pauciloculus S.Y. ZHENG, 1979, p. 141, 210.
Botuloides pauciloculus S.Y. Zheng. LOEBLICH and TAPPAN, 1987, p. 395, Pl. 439, fig. 15-18.

Description. Test free, elongate, arcuate, circular in cross-section, made up of only 2 chambers, "sausage-like"; wall calcareous, hyaline, thin, surface smooth; proloculus elongate, about 2.5 times the diameter with a short basal process, followed by slightly shorter second chamber of similar form that partly overlaps distal end of proloculus; aperture small, round.

Genus *Laevidentalina* Loeblich and Tappan, 1986

Laevidentalina? cf. *L. californica* (Cushman and Gray)

Plate 1, figure 9

Dentalina californica CUSHMAN and GRAY, 1946a, p. 66, Pl. 12, fig. 3-5.
Dentalina californica CUSHMAN and GRAY, 1946b, p. 13, Pl. 3, fig. 1-3.
Dentalina californica Cushman and Gray. CUSHMAN and McCULLOCH, 1950, p. 312, 313, Pl. 41, fig. 8-10.

Description. Test free, elongate, arcuate, uniserial, circular in cross-section; wall calcareous, translucent, smooth; 3 to 4 slightly inflated, elongate chambers of varying widths; proloculus somewhat enlarged with basal spine; aperture eccentric toward inner margin.

Remarks. The illustrated specimen was the only one recovered. As the aperture was damaged, it is impossible to determine its nature without breaking the test. However, based on overall appearance this specimen is referable to the species, and is almost identical to the illustrations of Cushman and McCulloch (1950; Pl. 41, fig. 8, 9).

Laevidentalina elegans (d'Orbigny)

Plate 1, figure 8

Dentalina elegans D'ORBIGNY, 1846, p. 45, Pl. 1, fig. 1-5.
Dentalina pauperata D'ORBIGNY, 1846, p. 47, Pl. 1, fig. 57, 58.

Description. Test free, elongate, arcuate, uniserial, circular in cross-section; wall calcareous, translucent, smooth; 6 to 13 slightly inflated chambers; proloculus enlarged in megalospheric specimens; sutures depressed, straight; aperture radial, eccentric, toward inner margin.

Subfamily LINGULININAE Loeblich and Tappan, 1961

Genus *Frondicularia* Defrance, 1826

Frondicularia gigas Church

Plate 2, figures 7, 8

Frondicularia gigas CHURCH, 1929, p. 303, Fig. 1, 2.
Frondicularia gigas Church. CUSHMAN and McCULLOCH, 1950, p. 327, Pl. 43, fig. 1-4.

Description. Test free, very large, elongate and palmate, about twice as long as wide, greatly compressed, 2 to 3 elongate spines project from base in plane of test compression, periphery angled; wall calcareous, hyaline, smooth; chambers low, broad and equitant, up to 20 in mature specimens; sutures very slightly depressed, arched; aperture terminal, radiate, and slightly produced.

Subfamily LENTICULININAE Chapman, Parr, and Collins, 1934

Genus *Lenticulina* Lamarck, 1804

Lenticulina nikobarensis (Schwager)

Plate 2, figures 5, 6

Cristellaria nikobarensis SCHWAGER, 1866, p. 243, Pl. 6, fig. 87.

Description. Test free, large, planispiral, lenticular, biumbonate, slightly elongate; wall calcareous, translucent, smooth, imperforate; chambers 9 to 11 in last whorl, increase rapidly in height and breadth as added; sutures slightly curved and flush, terminate in umbonal region; test periphery characterized by narrow keel; aperture radiates at peripheral angle with elongate slit projecting from aperture halfway down apertural face.

Subfamily MARGINULININAE Wedekind, 1937

Genus *Marginulina* d'Orbigny, 1826

Marginulina pauciloculata (Cushman and Gray)

Plate 3, figure 1

Vaginulina advena Cushman var. *pauciloculata* CUSHMAN and GRAY, 1946b, p. 15, Pl. 3, fig. 15a, b.

Description. Test free, early portion very slightly enrolled but not completely enrolled, later chambers rectilinear; wall calcareous, hyaline, imperforate; discontinuous and sometimes anastomosing costae extend longitudinally; sutures oblique, particularly in early portion; aperture eccentric, radiate, on elongate neck.

Family POLYMORPHINIDAE d'Orbigny, 1839

Genus *Metapolymorphina* McCulloch, 1977

Metapolymorphina charlottensis (Cushman)

Plate 3, figure 8

Polymorphina charlottensis CUSHMAN, 1925, p. 41, Pl. 6, fig. 9.

Description. Test free, large, biserial, elongate, compressed; wall calcareous, thick, hyaline to translucent, smooth, finely perforate; 6 to 8 pairs of biserially arranged lobulate chambers; microspheric specimens elongate with small proloculus, while megalospheric specimens are shorter and broader with proloculus more than twice as large; aperture cribrate but appears more radiate in juvenile specimens.

Genus *Paleopolymorphina* Cushman and Ozawa, 1930

Paleopolymorphina doanei (Galloway and Wissler)

Plate 3, figure 2

Polymorphina doanei GALLOWAY and WISSLER, 1927, p. 54, Pl. 9, fig. 8.

Discussion. Test free, elongate, compressed, periphery somewhat lobulate; wall calcareous, hyaline, smooth; chambers subglobular and slightly elongated, initially biserial and twisted, then become cuneate and finally uniserial; aperture terminal and radiate.

Remarks. The genus *Paleopolymorphina* has previously only been reported from the Cretaceous. However, *Paleopolymorphina doanei* with its biserial chamber arrangement, becoming cuneate and finally uniserial, fits the description of the genus very well. The triserial coiling arrangement of this species reported by Galloway and Wissler (1927) is an illusion resulting from the early twisting of the test.

Family LAGENIDAE Reuss, 1862

Genus *Hyalinonetrion* Patterson and Richardson, 1988

Hyalinonetrion clavatum (d'Orbigny)

Plate 4, figure 1

Oolina clavata D'ORBIGNY, 1846, p. 24, Pl. 1, fig. 2, 3.

Description. Test free, unilocular, elongate, circular in cross-section; wall calcareous, hyaline, smooth, finely perforate; test tapers to both extremities from widest near the midpoint of test; aperture small and circular within phialine lip.

Hyalinonetrion dentaliforme (Bagg)

Plate 2, figure 9

Lagena dentaliformis BAGG, 1912, p. 45, Pl. 13, fig. 1, 2.

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.

Hyalinonetrion sahulense Patterson and Richardson

Plate 4, figure 8

Hyalinonetrion sahulense PATTERSON and RICHARDSON, 1988, p. 243, fig. 5, 6.

Description. Test free, unilocular, fusiform, maintaining constant, maximum diameter for main portion of test where walls are parallel, and tapers gradually, beginning just before apical and apertural extensions; wall calcareous, hyaline, smooth, imperforate; in unbroken specimens aperture small and round with small phialine lip.

Remarks. There is some debris attached to the surface of this fossil. Pristine specimens have a very smooth surface.

Genus *Lagena* Walker and Jacob, 1798

Lagena dorseyae McLean

Plate 3, figures 3-6

Lagena dorseyae McLEAN, 1956, p. 330, Pl. 39, fig. 8a, b.

Description. Test free, unilocular, subglobular, circular in cross-section; wall calcareous, hyaline smooth, imperforate; 30 to 50 discontinuous and anastomosing longitudinal costae extend from base of test to base of neck; neck elongate and narrow, characterized by irregular reticulate pattern of elevated surface sculpture; aperture small and circular, surrounded by heavily reticulated lip.

Lagena fidicularia Patterson

Plate 4, figures 2-4

Lagena sulcata (Walker and Jacob) var. *interrupta* Williamson. BRADY, 1884, p. 463, Pl. 57, fig. 25, 27 (not *Lagena striata* (Walker and Jacob) var. *interrupta* Williamson, 1848).
Lagena laevis (Montagu). BARKER, 1960, p. 118, Pl. 57, fig. 25, 27, not 23, 26 (not *Vermiculum laeve*, Montagu, 1803).
Lagena fidicularia PATTERSON, 1991, p. 355, fig. 5-7

Description. Test free, unilocular, main part of chamber globular; neck narrow and elongate, comprises at least one-third of test length; wall calcareous, hyaline, smooth, imperforate; 15 very deep and narrow costae extend from base, alternate ones terminate near base of neck and near base of test body, others extend from base to terminate at aperture, longer costae abruptly change from longitudinal orientation on test body to spiral arrangement on neck, the spiralling costae complete two-and-one-half whorls on neck; aperture small and round with slight lip.

Lagena flatulenta Loeblich and Tappan

Plate 29, figure 3

Lagena flatulenta LOEBLICH and TAPPAN, 1953, p. 60, Pl. 11, fig. 9, 10.

Description. Test free, unilocular, flask-shaped, circular in cross-section; wall calcareous, hyaline, smooth, finely perforate; aperture terminal with phialine lip at end of narrow and delicate neck, some very short longitudinal costae clustered around neck just below aperture.

Lagena semilineata Wright

Plate 4, figures 5, 6

Lagena semilineata WRIGHT, 1886, p. 320, Pl. 26, fig. 7.
Lagena semilineata Wright. LOEBLICH and TAPPAN, 1953, p. 65, Pl. 11, fig. 14-22.

Description. Test free, unilocular, elongate, amphora-shaped, circular in cross-section, widest near base; wall calcareous, hyaline, finely perforate; upper half of test body smooth, lower portion characterized by 50 to 60 discontinuous and sometimes anastomosing longitudinal costae that terminate at base of elongate caudal process; neck elongate, slightly less than half test length, characterized by a few anastomosing longitudinal costae terminating at aperture; aperture small and circular within phialine lip.

Lagena spicata Cushman and McCulloch

Plate 29, figures 4, 5

Lagena sulcata var. *spicata* CUSHMAN and McCULLOCH, 1950, p. 360, Pl. 48, fig. 3-7.

Description. Test free, unilocular, elongate, amphora-shaped, circular in cross-section, widest near midpoint; wall calcareous, hyaline, finely perforate; tapered neck short, narrow and round; base of test characterized by stout spine; test costae approximately 30, some discontinuous, extend from base to aperture; aperture round with phialine neck.

Lagena striata (d'Orbigny)

Plate 29, figure 6

Oolina striata D'ORBIGNY, 1839, p. 21, Pl. 5, fig. 12.

Description. Test free, unilocular, slightly elongate with bulbous base, circular in cross-section, widest near midpoint; wall calcareous, hyaline, finely perforate; narrow and elongate neck comprises over one-third of test length; numerous longitudinal and anastomosing costae extend from test base to aperture, reduced in number on neck; aperture round and terminal.

Lagena striaticollis (d'Orbigny)

Plate 3, figure 7

Oolina striaticollis D'ORBIGNY, 1839, p. 21, Pl. 5, fig. 14.

Description. Test free, unilocular, subglobular, slightly elongate, circular in cross-section; wall calcareous, hyaline, smooth except for very base of test and neck; a few short and wide longitudinal costae at very base of test, a few slightly spiralling costae on neck; aperture small and circular.

Genus *Procerolagena* Puri, 1954

Procerolagena amphoriniformis (McCulloch)

Plate 4, figures 9, 10

Lagena amphoriniformis McCULLOCH, 1977, p. 27, Pl. 50, fig. 2.

Description. Test free, unilocular, elongate, circular in cross-section, thickest at midpoint, tapers sharply to apertural and aboral ends, test has the appearance of 2 cones joined at the widest ends; wall calcareous, hyaline, transparent; approximately 14 discontinuous, longitudinal costae restricted to tapered ends; aperture small and circular within phialine lip.

Procerolagena complurecosta (Patterson)

Plate 5, figures 1, 2

Lagena complurecosta PATTERSON, 1990b, p. 681, 682, fig. 3.1-3.3.

Description. Test free, unilocular, subglobular with elongate neck, circular in section; wall calcareous, hyaline, finely perforate; 13-16 longitudinal costae, most extend from the base to aperture; aperture circular within phialine lip.

Procerolagena gracilis (Williamson)

Plate 6, figure 1

Lagena gracilis WILLIAMSON, 1848, p. 13, Pl. 1, fig. 5.

Description. Test free, unilocular, elongate, circular in cross-section, widest near midpoint; wall calcareous, hyaline; 16 to 20 discontinuous and occasionally anastomosing longitudinal costae 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 within phialine lip.

Procerolagena meridionalis Wiesner

Plate 4, figure 7

Lagena caudata d'Orbigny. PARKER and JONES, 1865, p. 352, Pl. 16, fig. 7, (non *Oolina caudata* d'Orbigny, 1839).
Lagena gracilis (Williamson). BRADY, 1884, p. 464, Pl. 58, fig. 19 (non fig. 22-24; non *Entosolenia gracilis* Williamson, 1848).
Lagena gracilis Williamson, var. CUSHMAN, 1913, p. 25, Pl. 8, fig. 7.
Lagena gracilis Williamson, var. *meridionalis* WIESNER, 1931, p. 117, Pl. 18, fig. 211.
Lagena meridionalis Wiesner. LOEBLICH and TAPPAN, 1953, p. 62, Pl. 12, fig. 1.

Description. Test free, unilocular, subglobular, broadest near base, neck narrow and elongate; wall calcareous, hyaline, smooth, finely perforate between costae; 18 costae extend up from test base, alternate ones terminate at base of neck, others increase in depth on neck and terminate at aperture; aperture small and round.

Procerolagena simulampulla Patterson

Plate 5, figures 3, 4

Procerolagena simulampulla PATTERSON, 1991, p. 358, fig. 3, 4.

Description. Test free, unilocular, elongate, broadest near midpoint, neck narrow and elongate; wall calcareous, hyaline, smooth, finely perforate between costae; 10 costae extend along test surface, alternate ones terminate at base of neck and near base of test, others extend from base to increase in depth on neck and terminate near aperture; short segment of the neck smooth immediately preceding aperture; aperture small and round surrounded by phialine lip.

Procerolagena wiesneri (Parr)

Plate 5, figures 5, 6

Lagena striata (d'Orbigny) var. *interrupta* WIESNER, 1931, p. 119, Pl. 18, fig. 213.
Lagena striata (Montagu) var. *wiesneri* PARR, 1950, p. 301. New name for *Lagena striata* (Montagu) var. *interrupta* Wiesner [not *L. striata* (Walker and Jacob) var. *interrupta* Williamson, 1848].

Description. Test free, unilocular, subglobular, broadest near midpoint; wall calcareous, hyaline, surface smooth, finely perforate between costae; on average 28 delicate costae extend from base, every sixth terminates at aperture, 3 intervening costae terminate at base of neck, separated by 2 costae of intermediate length which terminate halfway up neck; unlike many similar species there is no tendency for costae to form an elongate aboral process; aperture round within a phialine lip.

Genus *Pygmaeoseistron* Patterson and Richardson, 1988

Pygmaeoseistron hispidum (Reuss)

Plate 5, figures 7, 8

Lagena hispida REUSS, 1863, p. 335, Pl. 6, fig. 77-79.

Description. Test free, unilocular, subglobular yet elongated, circular in cross-section; wall calcareous, hyaline, surface covered with needle-like hispid sculpture most developed on neck; neck narrow and elongate although largely obscured by surface sculpture; aperture small and circular within phialine lip.

Pygmaeoseistron hispidulum (Cushman)

Plate 6, figures 2, 3

Lagena hispidula Cushman, 1913, p. 14, Pl. 5, fig. 2, 3.

Pygmaeoseistron hispidulum (Cushman). PATTERSON and RICHARDSON, 1988, p. 243, 245, fig. 7-10.

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 A. Silvestri, 1923

Subfamily OOLININAE Loeblich and Tappan, 1961

Genus *Entosolenia* Williamson, 1848

Entosolenia lineata Williamson

Plate 29, figures 1, 2

Entosolenia lineata WILLIAMSON, 1848, p. 18, Pl. 2, fig. 18.

Description. Test free, unilocular, globose, circular in cross-section with a very tiny basal spine; wall calcareous, hyaline, covered with numerous closely spaced longitudinal costae extending from test base to aperture; aperture terminal and circular surrounded by slight phialine lip in some specimens and more prominent ends of longitudinal costae in others; entosolenian tube short and straight.

Genus *Exsculptina* Patterson and Richardson, 1988

Exsculptina discrepans (Cushman and Gray)

Plate 6, figures 4, 5

Lagena pliocenica Cushman and Gray var. *discrepans* CUSHMAN and GRAY, 1946b, p. 19, Pl. 3, fig. 35-38.

Description. Test free, unilocular, conical, circular in cross-section, broadest at the base; aboral end of test sharply truncated with planar base, tapers near 45° to base of neck; wall calcareous, hyaline, smooth, except for neck and test base; neck narrow and elongate with 4 to 5 very pronounced longitudinal costae extending from base to aperture, base characterized by radiating network of raised costae interspersed with depressions in test base which, in side view, form crenulated lower test margin.

Genus *Favulina* Patterson and Richardson, 1988

Favulina melo (d'Orbigny)

Plate 6, figures 6-9

Oolina melo D'ORBIGNY, 1839, p. 20, Pl. 5, fig. 9.
Entosolenia squamosa (Montagu) var. *scalariformis* WILLIAMSON, 1848, p. 20, Pl. 1, fig. 21, 22.
Oolina melo d'Orbigny. LOEBLICH and TAPPAN, 1953, p. 71, Pl. 12, fig. 8-15.

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 forming "scale-like" appearance on test surface; aperture small and circular with phialine lip; entosolenian tube short and straight.

Genus *Homalohedra* Patterson and Richardson, 1987

Homalohedra apiopleura (Loeblich and Tappan)

Plate 28, figures 4, 5

Lagena sulcata Walker and Jacob. PARKER and JONES, 1865, p. 351, Pl. 13, fig. 28-31 (not fig. 24, 32, and not *Serpula (Lagena) sulcata* Walker and Jacob, in Kanmacher, 1798).
Lagena acuticosta Reuss. BUCHNER, 1940, p. 429, Pl. 4, fig. 69 (not fig. 68, not *Lagena acuticosta* Reuss, 1862).
Lagena apiopleura LOEBLICH and TAPPAN, 1953, p. 59, Pl. 10, fig. 14-15.

Description. Test free, unilocular (although rare twins occur), ovate to pear-shaped, 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 and circular at end of short smooth neck.

Homalohedra borealis (Loeblich and Tappan)

Plate 7, figures 1, 2

Entosolenia costata WILLIAMSON, 1858, p. 9, Pl. 1, fig. 18.
Oolina costata (Williamson). LOEBLICH and TAPPAN, 1953, p. 68, Pl. 13, fig. 4-6 (not *Oolina costata* Egger, 1857).
Oolina borealis LOEBLICH and TAPPAN, 1954, p. 384.

Description. Test free, unilocular, globular, circular in cross-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)

Plate 28, figures 1, 2

Lagena guntheri EARLAND, 1934, p. 151, Pl. 6, fig. 53, 54.

Description. Test free, unilocular, pyriform, broadest near midpoint, circular in cross-section; wall calcareous, translucent, imperforate; 6 to 8 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.

Homalohedra cf. *H. quasilineata* Patterson

Plate 7, figure 3

Homalohedra quasilineata PATTERSON, 1990b, p. 686, fig. 4.9-4.11.

Description. Test free, subglobular, circular in section; wall calcareous, hyaline, finely perforate; costae numerous and indistinct, longitudinal, may extend from short basal process to aperture, some anastomose, others are discontinuous; test slightly constricted at small, round aperture with thick noncostate rim; entosolenian tube hangs free in chamber lumen and terminates near test base.

Subfamily ELLIPSOLAGENINAE A. Silvestri, 1923

Genus *Fissurina* Reuss, 1850

Fissurina artolabiata Patterson

Plate 8, figures 1, 2

Fissurina artolabiata PATTERSON, 1990b, p. 685, fig. 4.1-4.4.

Description. Test free, unilocular, circular in side view, compressed; wall calcareous, hyaline, smooth, finely perforate; thick lateral carina completely encircles test, bifurcates around aperture; oblong aboral end of entosolenian tube visible within fissurine aperture, becomes attached and terminates in flared opening near test base.

Fissurina copiosa McCulloch

Plate 7, figures 4, 5

Fissurina copiosa McCULLOCH, 1977, p. 97, Pl. 63, fig. 1.

Description. Test free, unilocular, oblong, compressed; wall calcareous, hyaline, smooth, finely perforate; rounded marginal carina extends from basal button to aperture, flanked by a pair of thickened secondary carinae which encircle each test face; entosolenian tube short and straight; aperture small and circular within fissurine slit.

Fissurina eburnea (Buchner)

Plate 8, figures 3, 4

Lagena eburnea BUCHNER, 1940, p. 458, Pl. 9, fig. 146, 147.

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

Fissurina lucida (Williamson)

Plate 7, figures 6, 7

Entosolenia marginata (Montagu) var. *lucida* WILLIAMSON, 1848, p. 17, Pl. 2, fig. 17.

Description. Test free, slightly elongated, compressed in cross-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 marmoraria (Buchner)

Plate 8, figures 5, 6

Lagena marmoraria BUCHNER, 1940, p. 490, Pl. 17, fig. 329-330.

Description. Test free, slightly elongated, compressed in cross-section; wall calcareous, hyaline, smooth, moderately perforate; thick marginal carina completely encircles test; aperture fissurine and terminal within marginal carinae; entosolenian tube short and straight, terminates one third of the way down test.

Fissurina subquadrata Parr

Plate 8, figures 7-9

Fissurina subquadrata PARR, 1945, p. 203, Pl. 9, fig. 5a, b.

Description. Test free, elongate, compressed in cross-section; wall calcareous, hyaline, smooth except for some marginal sculpted area, finely perforate; thick marginal carina with flattened outer margin completely encircles test; incised band almost completely encircles each test face, terminates near top, lower margin is truncated by very narrow band of clear test material; surface of sculpted bands has an irregular mat of granular material giving very roughened surface; aperture fissurine within slightly widened part of marginal carina; entosolenian tube short and straight.

Fissurina vitreola (Buchner)

Plate 9, figures 1-5

Lagena vitreola BUCHNER, 1940, p. 477, Pl. 13, fig. 256-258.
Lagena lucida (Williamson). BUCHNER 1940, p. 477, Pl. 14, fig. 259-261 [not *Entosolenia marginata* (Montagu) var. *lucida* Williamson, 1848].
Fissurina lucida (Williamson). KOHL, 1985, p. 55, Pl. 15, fig. 3, 4 [not *Entosolenia marginata* (Montagu) var. *lucida* Williamson, 1848].
Fissurina lucidiformata McCULLOCH, 1977, p. 115, Pl. 58, fig. 7.
Fissurina clariplana McCULLOCH, 1977, p. 95, Pl. 58, fig. 17.
Fissurina evoluta laticlava McCULLOCH, 1977, p. 105, Pl. 58, fig. 20.
Fissurina neocaelata McCULLOCH, 1977, p. 117, Pl. 58, fig. 6.

Description. Test free, unilocular, oval in side view, compressed; wall calcareous, hyaline, smooth, fine pores do not penetrate outer wall; 2 white 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, 1987

Palliolatella frangens Buchner

Plate 10, figures 3, 4

Entosolenia marginata (Montagu). WILLIAMSON, 1858, p. 9, Pl. 1, fig. 19-21 (not *Vermiculum marginata* Montagu, 1803).
Lagena marginata (Montagu). BAGG, 1912, p. 49, Pl. 14, fig. 18, 21, 22 (not *Vermiculum marginata* Montagu, 1803).
Lagena frangens BUCHNER, 1940, p. 504, Pl. 19, fig. 407-409.
Lagenosolenia habrotes McCULLOCH, 1977, p. 108, Pl. 63, fig. 15.

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 with entosolenian tube attached to one wall and terminating half way down test wall.

Palliolatella immemora Patterson

Plate 10, figures 1, 2

Lagena neglecta BUCHNER, 1940, p. 503, Pl. 19, fig. 405 (not *Lagena neglecta* Buchner, 1940, p. 463, Pl. 11, fig. 173-178).
Palliolatella immemora PATTERSON, 1990b, p. 686, fig. 5.5, 5.6, 5.9, 5.10.

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.

Genus *Tortaguttus* Barrick, Beveridge, Patterson, and Schubert, 1989

Tortaguttus timmsensis (Cushman and Gray)

Plate 9, figures 6, 7

Entosolenia sigmoidella (Cushman) var. *timmsensis* CUSHMAN and GRAY, 1946b, p. 30, Pl. 5, fig. 34-36.
Solenina timmsensis (Cushman and Gray). PATTERSON and RICHARDSON, 1987, p. 220, Pl. 3, fig. 4-9; Pl. 5, fig. 8.
Tortaguttus timmsensis (Cushman and Gray). BARRICK, BEVERIDGE, PATTERSON, and SCHUBERT, 1989, p. 66, Pl. 1, fig. 1-8.

Description. Test free, unilocular, elongate, compressed in cross-section; wall calcareous, hyaline, smooth, finely perforate; 2 double and marginal sigmoidal carinae, connected by numerous struts, extend from aperture to near test base where they are discontinuous; aperture terminal and radiate (several tooth-like structures pointing inward) within phialine lip, at end of elongate neck, with short and straight entosolenian tube.

Subfamily PARAFISSURININAE R.W. Jones, 1988

Genus *Parafissurina* Parr, 1947

Parafissurina semicarinata (Buchner)

Plate 10, figures 5-8

Parafissurina lateralis (Cushman) forma *semicarinata* BUCHNER, 1940, p. 520, Pl. 23, fig. 493-494.

Description. Test free, unilocular, oblong, compressed in cross-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.

Subfamily SIPHOLAGENINAE Patterson and Richardson, 1988

Genus *Nanosylvanella* Patterson, 1990

Nanosylvanella palmulina Patterson

Plate 11, figures 1-4

Nanosylvanella palmulina PATTERSON, 1990c, p. 326-328, fig. 1-4.

Description. Test free, unilocular, teardrop-shaped, circular in section; wall calcareous, translucent, double, with inner and outer wall layers separated by perpendicular 35 µm pillars; pillars 2.3 µm wide at connection to inner layer, narrowing to 2.0 µm at connection to outer layer; inner wall layer solid, outer layer consists of isolated tripartite arranged, horizontal, flattened "palm leaf-like" spokes up to 6.7 µm long, widens from 1.3 µm at base to 6.3 µm at the tips; aperture terminal, small, rounded, on long narrow neck extends from inner wall one-third of test length.

Genus *Pytine* Moncharmont Zei and Sgarrella, 1980

Pytine petaloskelis Patterson and Richardson

Plate 12, figures 1-3

Pytine petaloskelis PATTERSON and RICHARDSON, 1988, p. 257, fig. 37-39, 52.

Description. Test free, unilocular, circular in section, ovate; wall calcareous, translucent; outer wall consists of broad, flattened, calcite strips connected at base of neck; inner wall solid; aperture small, round, terminal, on long narrow neck that extends one-third test length.

Family GLANDULINIDAE Reuss, 1860

Subfamily GLANDULININAE Reuss, 1860

Genus *Laryngosigma* Loeblich and Tappan, 1953

Laryngosigma trilocularis (Bagg)

Plate 12, figures 7, 8

Polymorphina trilocularis BAGG, 1912, p. 75, Pl. 20, fig. 15-18.
Sigmomorphina trilocularis (Bagg). CUSHMAN and GRAY, 1946b, p. 24, Pl. 4, fig. 27.

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

Subfamily SEABROOKIINAE Cushman, 1927

Genus *Seabrookia* Brady, 1880

Seabrookia earlandi Wright

Plate 12, figures 4-6

Millettia earlandi WRIGHT, 1889, p. 448 (nom. nud.).
Seabrookia earlandi WRIGHT, 1891, p. 477, Pl. 20, fig. 6, 7.

Description. Test free, elongate-ovate, compressed in cross-section, convex on upper side and concave on lower; early stage with 3 chambers to a whorl, reduced to 2 chambers per whorl in late stages, last chamber tends to envelop all previous ones; peripheral keel around lateral margins of test; wall calcareous, thin, hyaline, smooth, radial; aperture fissurine and terminal, extends across entire width of narrow end of last formed chamber.

Suborder ROTALIINA Delage and Hérouard, 1896

Superfamily BOLIVINACEA Glaessner, 1937

Family BOLIVINIDAE Glaessner, 1937

Genus *Bolivina* d'Orbigny, 1839

Bolivina decussata Brady

Plate 11, figures 5, 6

Bolivina decussata BRADY, 1881, p. 58.
Bolivina decussata BRADY, 1884, p. 423, Pl. 53, fig. 12, 13.

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 tooth plate attached to one side.

Remarks. The secondary reticulations are not as dramatic on the illustrated specimen as is displayed in some populations (see Patterson et al., 1990, p. 11, fig. 17-1, 2, Pleistocene of California).

Genus *Bolivinellina* Saidova, 1975

Bolivinellina pacifica (Cushman and McCulloch)

Plate 13, figures 1, 2

Bolivina acerosa Cushman var. *pacifica* CUSHMAN and McCULLOCH, 1942, p. 185, Pl. 21, fig. 2, 3.

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 and loop-shaped at base of final formed chamber, with internal tooth plate attached to one side.

Genus *Brizalina* O.G. Costa, 1856

Brizalina fragilis (Phleger and Parker)

Plate 13, figures 6, 7

Bolivina fragilis PHLEGER and PARKER, 1951, p. 13, Pl. 6, fig. 14, 23, 24a, b.

Description. Test free, elongate, about 3 times as long as broad, compressed, slightly tapers, usually with short spine at initial end; wall calcareous, hyaline, smooth in later chambers, coarsely perforate over lower margins of each chamber; 12 to 14 pairs of chambers gradually increase in size as added; sutures distinct, curved, very slightly depressed, at about 45° to longitudinal axis; some longitudinal secondary reticulations concentrated near base of test; very narrow marginal keel runs down each side of test; aperture loop-shaped at base of final formed chamber, with internal tooth plate attached to one side.

Brizalina subaenariensis (Cushman)

Plate 13, figures 8, 9

Bolivina subaenariensis CUSHMAN, 1922a, p. 46, Pl. 7, fig. 6.

Description. Test free, elongate, about 2.5 times as long as wide, very compressed in cross-section; wall calcareous, hyaline, imperforate, smooth except for costae, costae elongate, 2 to 4 run from base (1 or 2 median longitudinal costae extend nearly entire test length whereas bracketing costae terminate near base); 8 to 10 pairs of low, wide chambers extend from test base to aperture; sutures very curved, depressed, at

very high angle to longitudinal axis, almost perpendicular in some cases; aperture an elongate loop at base of final formed chamber, with internal tooth plate attached to one wall.

Superfamily CASSIDULINACEA d'Orbigny, 1839

Family CASSIDULINIDAE d'Orbigny, 1839

Subfamily CASSIDULININAE d'Orbigny, 1839

Genus *Cassidulina* d'Orbigny, 1826

Cassidulina bradshawi Uchio

Plate 14, figures 7, 8

Cassidulina bradshawi UCHIO, 1960, p. 68, Pl. 9, fig. 11, 12.
Cassidulina bradshawi Uchio. PATTERSON, BRUNNER, CAPO, and DAHL, 1990, p. 11, fig. 12-1, 2.

Description. Test free, small, nearly circular in side view, compressed, rounded periphery; wall thin, calcareous, hyaline, smooth, polished, finely perforate; last whorl consisting of about 4 pairs (sometimes 5) of planispirally enrolled chambers, each pair alternating and reaching the preceding chambers at the centre of the test, thus leaving no umbilicus; sutures depressed and distinct; aperture an elongate slit following the curve of the previous chamber, flap extending from the margin of the previous formed chamber almost completely covers apertural opening.

Cassidulina reniforme Nørvang

Plate 14, figures 3, 4

Cassidulina crassa d'Orbigny var. *reniforme* NØRVANG, 1945, p. 41, Fig. 6e-h.
Cassidulina reniforme Nørvang. SEJRUP and GUILBAULT, 1980, fig. 2f-k.

Description. Test free, small, only slightly compressed, periphery broadly rounded; chambers only slightly inflated, about 4 pairs of planispirally enrolled chambers in the final whorl; wall calcareous, hyaline, smooth, polished, moderately to coarsely perforate; aperture a narrow arched slit at the base of the apertural face and parallel to the peripheral margin, almost completely closed by an apertural plate.

Genus *Islandiella* Nørvang, 1959

Islandiella helenae Feyling-Hanssen & Buzas

Plate 31, figures 1-3

Islandiella helenae (FEYLING-HANSSEN and BUZAS, 1976), p. 155, Fig. 1-4.
Cassidulina teretis Tappan. LOEBLICH and TAPPAN, 1953, p. 121, Pl. 24, fig. 3, 4.

Description. Test free, biconvex with a subacutely thickened periphal 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 previous whorls are seen through the thick, clear shell material of the umbilical region, chambers jelly 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.

Remarks. It is important to differentiate this species from the very similar *Islandiella norcrossi* as *Islandiella helenae* is a good indicator of lower salinity, very cold waters in cores from the British Columbia shelf. In *Islandiella norcrossi* the biserially arranged chambers are oriented inward toward the umbilical region whereas in *Islandiella helenae* the chambers are arranged so they are oriented toward the previous chambers. In addition, the aperture of *Islandiella norcrossi* is acute and straddles the peripheral margin of the test whereas in *Islandiella helenae* the aperture is more elongate and asymmetrically oriented along the test margin.

Islandiella norcrossi (Cushman)

Plate 14, figures 1, 2; Plate 31, figures 4-6

Cassidulina norcrossi CUSHMAN, 1933, p. 7, Pl. 2, fig. 7a-c.

Description. Test free, biconvex, strongly compressed, subacute keel surrounds periphery; wall calcareous, translucent, smooth, finely polished; about 5 pairs of planispirally enrolled chambers, every chamber reaches the umbilical boss on both sides with the exception of the final chambers in mature specimens leaving clear umbilical boss; sutures straight to slightly curved, flush; aperture elongate loop in plane of coiling, with projecting internal tooth.

Remarks. See *Islandiella helenae* for a comparison with this taxa.

Subfamily EHRENBERGININAE Cushman, 1927

Genus *Ehrenbergina* Reuss, 1850

Ehrenbergina compressa Cushman

Plate 30, figures 1-3

Ehrenbergina compressa CUSHMAN, 1927, p. 168, Pl. 6, fig. 7.
Ehrenbergina compressa Cushman. TODD and LOW, 1967, p. A38, Pl. 5, fig. 16.

Description. Test free, elongate, compressed in cross-section; early chambers enrolled becoming uncoiled; chambers broad and low, biserial throughout, overlap broadly at midline of periphery, lateral margins spinose; wall calcareous, hyaline, coarsely perforate; sutures limbate and depressed; aperture a curved elongate slit perpendicular to the base of the apertural face and paralleling the peripheral margin, with internal tooth plate.

Superfamily TURRILINACEA Cushman, 1927

Family STAINFORTHIIDAE Reiss, 1963

Genus *Stainforthia* Hofker, 1956

Stainforthia feylingi Knudsen and Seidenkrantz

Plate 14, figures, 5, 6

Virgulina schreibersiana Czjzek. FEYLING-HANSSEN, JØRGENSEN, KNUDSEN, and ANDERSEN, 1971, p. 240, Pl. 7, fig. 6-8 (not *Virgulina schreibersiana* Czjzek, 1848).
Stainforthia feylingi KNUDSEN and SEIDENKRANTZ (1994), Pl. 1, fig. 1-32; Pl. 2, fig. 1-6, 8.

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

Remarks. Many researchers (e.g. Feyling-Hanssen et al., 1971) have referred to the high latitude species illustrated herein as *Virgulina schreibersiana* Czjzek. However, the Czjzek species inhabited the warm epicontinental waters that covered much of central Europe in the Oligocene in contrast to the colder, high latitude waters where the present species is recorded. Based on examination of type material, Knudsen and Seidenkrantz (1994) have concluded that the Czjzek species is a polymorphinid and, in consequence, they have described the Recent form as the new species *Stainforthia feylingi* based on specimens from Scandinavian waters, where it is an important but minor part of the foraminiferal fauna. *Stainforthia feylingi* is much more abundant in Holocene and Recent British Columbia waters where it may make up to 50 per cent of the fauna locally.

Superfamily BULIMINACEA Jones, 1875

Family SIPHOGENERINOIDIDAE Saidova, 1981

Subfamily SIPHOGENERINOIDINAE Saidova, 1981

Genus *Euloxostomum* McCulloch, 1977

Euloxostomum alatum (Seguenza)

Plate 13, figures 3-5

Vulvulina alata SEGUENZA, 1862, p. 115, Pl. 2, fig. 5.
Bolivina pseudobeyrichi CUSHMAN, 1926, p. 35, Fig. 57a, b.
Bolivina alata (Seguenza). TODD and LOW, 1967, p. A26, Pl. 4, fig. 6, 7.

Description. Test free, elongate, compressed; wall calcareous, hyaline, smooth, coarsely perforate; chambers 8 to 9 pairs, broad, low, biserially arranged, increase rapidly in size as added, later higher and cuneate, finally become uniserial; short yet large, flat and blade-like basal spine develops into a marginal carina in some specimens; aperture forms elongate terminal slit, with distinct bordering lip; internal tooth plate extends from foramen to foramen, visible externally, attached to one side of aperture.

Family BULIMINIDAE Jones, 1875

Genus *Bulimina* d'Orbigny, 1826

Bulimina inflata Seguenza

Plate 15, figures 4-7

Bulimina inflata SEGUENZA, 1862, p. 109, Pl. 1, fig. 10.

Description. Test free, slightly elongated subcylinder, circular in cross-section; wall calcareous, hyaline, wall smooth, with lower margin of chambers characterized by numerous downward oriented spines forming crenulated pattern along lower margin; chambers triserially arranged in 5 or 6 whorls, later ones more centred; aperture a loop, extends up apertural face from base of chamber, characterized by a free border having an elevated rim and a fixed border continuous with an internal folded tooth plate that attaches to inside chamber wall below aperture; tooth plate has dentate, flaring, and almost tubular free shank.

Genus *Praeglobobulimina* Hofker, 1951

Praeglobobulimina spinescens (Brady)

Plate 15, figures 2, 3

Bulimina pyrula d'Orbigny *spinescens* BRADY, 1884, p. 400, Pl. 50, fig. 11, 12.

Description. Test free, subglobular, circular in cross-section; wall calcareous, hyaline, smooth, numerous downward-projecting needle-like spines dispersed over surface of lower

third of test, very finely perforate over lower portions of test, imperforate in the apertural region; chambers inflated, 3 to 4 whorls, triserially arranged and strongly overlapping, one-and-one-half times as long as broad, taper at both ends; last whorl comprises seven-eighths of test; aperture an elongate, narrow loop, extends from base of final chamber with a free border having an elevated rim and a fixed border continuous with an internal folded tooth plate that attaches to inside chamber wall below aperture.

Genus *Protoglobobulimina* Hofker, 1951

Protoglobobulimina elongata (d'Orbigny)

Plate 15, figure 1

Bulimina elongata D'ORBIGNY, 1826, p. 206 (nom nud).
Bulimina elongata D'ORBIGNY, 1846, p. 187, Pl. 11, fig. 19, 20.
Bulimina elongata d'Orbigny. PAPP and SCHMID, 1985, p. 73, Pl. 63, fig. 5-9.
Buliminella subfusiformis TODD and LOW, 1967, p. A26, Pl. 3, fig. 37 (not *Buliminella subfusiformis* Cushman, 1925).

Description. Test free, elongate, lobulate, although almost circular in cross-section; wall calcareous, hyaline, smooth, finely perforate; 4 to 5 whorls of inflated high, triserially arranged chambers, increase gradually in size as added, become slightly cuneate in later whorls; aperture loop-shaped with bordering rim; tooth plate straight and trough-like through-out, visible from exterior, protrudes from the basal-central part of aperture.

Protoglobobulimina pupoides (d'Orbigny)

Plate 17, figures 7, 8

Bulimina pupoides D'ORBIGNY, 1846, p. 185, Pl. 11, fig. 11, 12.

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 tooth plate; tooth plate final tip can be seen in aperture.

Family BULIMINELLA Cushman, 1911

Genus *Buliminella* Cushman, 1911

Buliminella elegantissima (d'Orbigny)

Plate 16, figures 6, 7

Bulimina elegantissima D'ORBIGNY, 1839, p. 51, Pl. 7, fig. 13, 14.

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 tooth plate connecting aperture with foramen of previous chamber.

Subfamily UVIGERININAE Haeckel, 1894

Genus *Euuvigerina* Thalmann, 1952

Euuvigerina aculeata (d'Orbigny)

Plate 16, figures 1-3

Uvigerina aculeata D'ORBIGNY, 1846, p. 191, Pl. 11, fig. 27, 28.
Euuvigerina aculeata d'Orbigny. BARKER, 1960, p. 156, Pl. 75, fig. 1-3.

Description. Test free, elongate, 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 atop a tubular neck; tooth plate a narrow twisted ribbon extending from the aperture to fasten against the previous foramen.

Euuvigerina juncea (Cushman and Todd)

Plate 17, figures 1-4

Uvigerina juncea CUSHMAN and TODD, 1941, p. 78, Pl. 20, fig. 4-11.

Description. Test free, elongate, rounded in section, with an approximately equal width for entire length; wall calcareous, translucent, finely perforate; inflated chambers triserially arranged; sutures depressed; numerous longitudinal costae extend along each chamber but do not cross sutures; aperture small and circular within a phialine lip atop a short neck; straight, narrow tooth plate extends from foramen to foramen.

Subfamily ANGULOGERININAE Galloway, 1933

Genus *Angulogerina* Cushman, 1927

Angulogerina angulosa (Williamson)

Plate 18, figures 1, 2

Uvigerina angulosa WILLIAMSON, 1858, p. 67, Pl. 5, fig. 4.
Uvigerina semitrigona GALLOWAY and WISSLER, 1927, p. 77, Pl. 11, fig. 21.

Angulogerina semitrigona (Galloway and Wissler). CUSHMAN and GRAY, 1946b, p. 37, Pl. 6, fig. 16 (not *Uvigerina semitrigona* Galloway and Wissler, 1927).

Description. Test free, elongate, trigonal in cross-section, angles carinate; wall calcareous, hyaline, surface finely perforate and covered by numerous discontinuous longitudinal costae crossing sutures; 4 to 5 whorls of triserially arranged chambers increase gradually in size as added; sutures slightly curved and depressed; aperture terminal, ovate, produced on neck and bordered by narrow lip; internal tooth plate extends from foramen to foramen, characterized by wing-like flange, externally visible as narrow projection in aperture.

Angulogerina fluens Todd

Plate 16, figures 4, 5

Angulogerina fluens TODD in CUSHMAN and TODD, 1947b, p. 67, Pl. 16, fig. 6, 7 (nom nud.).
Angulogerina fluens TODD in CUSHMAN and McCULLOCH, 1948, p. 288.

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 tooth plate extends from foramen to foramen, externally visible as narrow projection in aperture.

Superfamily FURSENKOINACEA Loeblich and Tappan, 1961

Family FURSENKOINIDAE Loeblich and Tappan, 1961

Genus *Suggrunda* Hoffmeister and Berry, 1937

Suggrunda eckisi Natland

Plate 18, figures 3, 4

Suggrunda eckisi NATLAND, 1950, p. 23, Pl. 9, fig. 12.

Description. Test free, elongate, compressed, tapers to base; wall calcareous, hyaline, smooth, finely perforate; chambers 6 to 9 pairs, inflated, biserially arranged, broad and low, with spinose lower margin; sutures nearly straight and depressed, about 75° to longitudinal axis; aperture low asymmetrical to hook-shaped loop at base of final chamber.

Superfamily PLEUROSTOMELLACEA Reuss, 1860

Family PLEUROSTOMELLIDAE Reuss, 1860

Subfamily PLEUROSTOMELLINAE Reuss, 1860

Genus *Pleurostomella* Reuss, 1860

Pleurostomella delicatula Patterson

Plate 17, figures 5, 6

Pleurostomella delicatula PATTERSON, 1991, p. 359, fig. 8, 9.

Description. Test free, elongate, almost circular in cross-section, gradually increases in width with addition of later chambers; 5 to 6 pairs of biserially arranged chambers, later become increasingly more oblique; wall calcareous, finely perforate, surface smooth; aperture terminal with projecting hood on one side and opposite side partially obstructed by flange-like projection.

Superfamily DISCORBACEA Ehrenberg, 1838

Family ROSALINIDAE Reiss, 1963

Genus *Gavelinopsis* Hofker, 1951

Gavelinopsis campanulata (Galloway and Wissler)

Plate 18, figures 5-7

Globorotalia campanulata GALLOWAY and WISSLER, 1927, p. 58, Pl. 9, fig. 14a-c.

Description. Test free, plano-convex; wall calcareous, hyaline, smooth; all chambers visible on convex 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 and interiomarginal extra umbilical arch with secondary sutural openings at margins of previous chambers.

Genus *Rosalina* d'Orbigny, 1826

Rosalina columbiensis (Cushman)

Plate 19, figures 1-3

Discorbis columbiensis CUSHMAN, 1925, p. 43, Pl. 6, fig. 13a-c.
Rosalina columbiensis (Cushman). LANKFORD and PHLEGER, 1973, p. 127, 128, Pl. 5, fig. 10-12.

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 inte-

riomarginal 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 GLABRATELLACEA Loeblich and Tappan, 1964

Family GLABRATELLIDAE Loeblich and Tappan, 1964

Genus *Glabratella* Dorreen, 1948

Glabratella ornatissima (Cushman)

Plate 30, figures 4-6

Discorbis ornatissima CUSHMAN, 1925, p. 42, Pl. 6, fig. 11, 12.

Description. Test free, trochospiral; chambers inflated and globular enlarging rapidly as added, 4 or 5 in final whorl; sutures curved and not depressed, periphery rounded; wall calcareous, coarsely perforate on spiral side, surface smooth except for radial striae and rows of pustules leading to umbilicus; umbilicus often dissolved as result of plastogamic sexual reproduction; aperture low interiomarginal slit.

Superfamily DISCORBINELLACEA Sigal, 1952

Family PSEUDOPARRELLIDAE Voloshinova, 1952

Subfamily PSEUDOPARRELLINAE Voloshinova, 1952

Genus *Epistominella* Husezima and Maruhasi, 1944

Epistominella pacifica (Cushman)

Plate 21, figures 4-6

Pulvinulina pacifica CUSHMAN, 1927, p. 165, Pl. 5, fig. 14, 15.

Description. Test free, trochospiral, with two and a half whorls, unequally biconvex, lateral margin carinate; wall calcareous, hyaline, smooth, finely perforate; test evolute, spiral side low convex with all chambers visible and sutures straight, oblique, and slightly raised; only 6 chambers of final whorl visible on strongly convex and conical umbilical side with sutures slightly curved, radial, and slightly raised; aperture interiomarginal, lipped slit extending parallel to periphery along base of final chamber on umbilical side.

Epistominella vitrea Parker

Plate 20, figures 3-5

Epistominella vitrea PARKER in PARKER, PHLEGER, and PEIRSON, 1953, p. 9, Pl. 4, fig. 34-36, 40, 41.

Description. Test free, trochospiral, biconvex, periphery rounded, and slightly lobulate; wall calcareous, hyaline, smooth, finely perforate; test 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)

Plate 19, figures 4-6

Cibicides fletcheri GALLOWAY and WISSLER, 1927, p. 64, Pl. 10, fig. 8, 9.

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 mckannai (Galloway and Wissler)

Plate 19, figures 7-9

Cibicides mckannai GALLOWAY and WISSLER, 1927, p. 65, Pl. 10, fig. 5, 6.

Description. Test free, plano-convex, trochospiral with flattened spiral side and high convex umbilical side; wall calcareous, translucent, coarsely perforate, so coarsely perforate on umbilical side that wall has 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.

Genus *Montfortella* Loeblich and Tappan, 1963

Montfortella bramlettei Loeblich and Tappan

Plate 20, figures 6-8

Montfortella bramlettei LOEBLICH and TAPPAN, 1963, p. 213, 214, Fig. 7, 8a-c, 9a, b.

Description. Test attached, plano-convex, trochospiral, with flattened evolute spiral side (surface may be extremely distorted depending on topography of attachment substrate); strongly convex, involute umbilical side with sharply angled nonporous keel; wall calcareous, hyaline, smooth, coarsely perforate on umbilical side, imperforate on spiral side; only final 6 to 7 inflated chambers gradually increase in size as added, are visible on umbilical side; all chambers visible on spiral side; sutures flush and strongly curved and thickened on spiral side, depressed and radial on umbilical side; sutural slits deeper near centre on umbilical side completely perforating test as intercameral openings which do not connect with chamber interiors; primary aperture interiomarginal and equatorial arch with thickened projecting lip; apertural openings of adjacent chambers connected beneath marginal flange along spiral suture; secondary apertures interiomarginal on opposite side beneath imperforate umbilical flaps which may remain distinct or fuse centrally.

Subfamily STICHOCIBICIDINAE Saidova, 1981

Genus *Dyocibicides* Cushman and Valentine, 1930

Dyocibicides biserialis Cushman and Valentine

Plate 20, figures 1, 2

Dyocibicides biserialis CUSHMAN and VALENTINE, 1930, p. 31, Pl. 10, fig. 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

Plate 21, figures 1-3

Nonionella turgida (Williamson) var. *digitata* NØRVANG, 1945, p. 29, Fig. 4.

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 (usually 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

Plate 22, figures 1-3

Nonionella miocenica Cushman var. *stella* CUSHMAN and MOYER, 1930, p. 56, Pl. 7, fig. 17.

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. *N. turgida* (Williamson)

Plate 23, figure 8

Rotalina turgida WILLIAMSON, 1858, p. 50, Pl. 9, fig. 95-97.

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

Remarks. The final chamber and apertural flap have been damaged on a single specimen recovered from Hecate Strait. Since the apertural flap is an important feature for identification, more specimens are required to determine the exact affiliation.

Genus *Nonionellina* Voloshinova, 1958

Nonionellina labradorica (Dawson)

Plate 23, figures 1, 2

Nonionina scapha var. *labradorica* DAWSON, 1860, p. 191, Fig. 4.

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)

Plate 23, figures 3-5

Nonion pizarrensis Berry var. *basispinata* CUSHMAN and MOYER, 1930, p. 54, Pl. 7, fig. 18.

Description. Test free, asymmetric planispiral and involute, compressed; wall calcareous, hyaline, smooth, finely perforate; 10 to 16 slightly inflated low chambers rapidly increase in size as added; sutures slightly depressed and curved with some 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

Plate 23, figures 6, 7

Astrononion gallowayi LOEBLICH and TAPPAN, 1953, p. 90, Pl. 17, fig. 4-7.

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 of each of the supplementary apertures.

Subfamily PULLENIINAE Schwager, 1877

Genus *Pullenia* Parker and Jones, 1862

Pullenia salisburyi Stewart and Stewart

Plate 24, figures 4, 5

Pullenia salisburyi STEWART and STEWART, 1930, p. 72, Pl. 8, fig. 2.

Description. Test free, planispiral and involute, compressed; wall calcareous, hyaline, smooth, finely perforate; 6 to 7 slightly inflated chambers, gradually increasing in size as added; sutures slightly depressed and curved; aperture crescentic slit at base of the final formed chamber.

Superfamily CHILOSTOMELLACEA Brady, 1881

Family CHILOSTOMELLIDAE Brady, 1881

Subfamily CHILOSTOMELLINAE Brady, 1881

Genus *Chilostomella* Reuss in Czjzek, 1849

Chilostomella oolina Schwager

Plate 21, figures 7, 8

Chilostomella oolina SCHWAGER, 1878, p. 513, Pl. 1, fig. 16.
Chilostomella oolina Schwager. BARKER, 1960, p. 112, Pl. 55, fig. 12-14, 17, 18.

Description. Test free, ovate, planispiral and involute; wall calcareous, hyaline, smooth; 2 strongly embracing chambers per whorl; aperture narrow interiomarginal slit in side of test.

Family GAVELINELLIDAE Hofker, 1956

Subfamily GYROIDINOIDINAE Saidova, 1981

Genus *Gyroidinoides* Brotzen, 1942

Gyroidinoides altiformis Stewart and Stewart

Plate 22, figures 4-7

Gyroidina soldanii d'Orbigny var. *altiformis* STEWART and STEWART, 1930, p. 67, Pl. 9, fig. 2a-c.

Description. Test free, trochospiral, periphery bluntly angled, test plano-convex; wall calcareous, hyaline, smooth, finely perforate; all chambers visible in 3 whorls on spiral side with sutures straight, slightly oblique, and depressed; umbilical side almost conical with only 9 to 10 chambers of final whorl visible and sutures radial, slightly depressed, and gently curved; aperture low interiomarginal slit extending from near periphery into umbilicus, partially covered with flap; extensions of flaps from previous chambers visible in open and deeply incised umbilicus.

Family TRICHOHYALIDAE Saidova, 1981

Genus *Buccella* Andersen, 1952

Buccella depressa Andersen

Plate 24, figures 1-3

Buccella depressa ANDERSEN, 1952, p. 145, 146, fig. 7a-c, 8.

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)

Plate 25, figures 6-8

Pulvinulina frigida CUSHMAN, 1922b, p. 144.

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 of each chamber.

Superfamily ROTALIACEA Ehrenberg, 1839

Family ELPHIDIIDAE Galloway, 1933

Subfamily ELPHIDIINAE Galloway, 1933

Genus *Cribroelphidium* Cushman and Brönnimann, 1948

Cribroelphidium excavatum (Terquem)

Plate 25, figures 4, 5; Plate 26, figures 1, 2

Polystomella excavata TERQUEM, 1876, p. 25, Pl. 2, fig. 2a-f.
Elphidium incertum (Williamson) var. *clavatum* CUSHMAN, 1930, p. 20, Pl. 7, fig. 10.
Elphidium clavatum Cushman. LOEBLICH and TAPPAN, 1953, p. 98, 101, 102, Pl. 19, fig. 8-10.
Elphidium excavatum (Terquem) forma *clavata* Cushman. MILLER, SCOTT, and MEDIOLI, 1982, p. 124-128, Pl. 1, fig. 5-8; Pl. 2, fig. 3-8; Pl. 3, fig. 3-8; Pl. 4, fig. 1-7; Pl. 5, fig. 4-8; Pl. 6, fig. 1-5.

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.

Cribroelphidium foraminosum (Cushman)

Plate 24, figures 6-8

Elphidium hughesi var. CUSHMAN and GRANT, 1927, p. 75, Pl. 7, fig. 5.
Elphidium hughesi var. *foraminosum* CUSHMAN, 1939, p. 49, Pl. 13, fig. 8a, b.
Elphidium hughesi Cushman and Grant. BERGEN and O'NEIL, 1979, p. 1290, Pl. 1, fig. 1, 2.

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 by short sutural bridges; aperture multiple interiomarginal.

Cribroelphidium hallandense (Brotzen)

Plate 25, figures 1-3

Elphidium hallandense BROTZEN in HESSLAND, 1943, p. 268, Fig. 109 (2a-c).
Elphidium subarcticum CUSHMAN, 1944, p. 27, Pl. 3, fig. 34, 35.

Description. Test free, planispiral and 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.

Genus *Elphidiella* Cushman, 1936

Elphidiella hannai (Cushman and Grant)

Plate 26, figures 3, 4

Elphidium hannai CUSHMAN and GRANT, 1927, p. 77, Pl. 7, fig. 1.
Elphidiella nitida CUSHMAN, 1941, p. 35, Pl. 9, fig. 4.
Elphidiella nitida Cushman. LOEBLICH and TAPPAN, 1953, p. 107, 108, Pl. 19, fig. 11, 12.
Elphidiella nitida Cushman. BERGEN and O'NEIL, 1979, Pl. 1, fig. 3, 4.

Description. Test free, lenticular, planispiral and 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.

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PLATE 1

Illustrated specimens in figures 1-3 and 6, 7 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 4, 5, 8, and 9 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1-3. *Trochammina nana* (Brady) GSC 99294, hypotype, from interval 6-8 cm.

1. Dorsal view showing straight sutures, x127.
2. Umbilical view showing depressed sutures, x179.
3. Edge view showing position of interiomarginal aperture, x188.

Figures 4, 5. *Karreriella bradyi* (Cushman), GSC 99295, hypotype, from interval 152-156 cm.

4. Side view showing coarsely agglutinated surface, x106.
5. Apertural view showing lipped aperture, x100.

Figures 6, 7. *Gaudryina arenaria* Galloway and Wissler, GSC 99296, hypotype, from interval 6-8 cm.

6. Side view showing angular test, x120.
7. Apertural view, x160.

Figure 8. *Laevidentalina elegans* (d'Orbigny), GSC 99297, hypotype, from interval 152-156 cm.

Side view showing characteristic globular proloculus and spine at base, x45.

Figure 9. *Laevidentalina?* cf. *L. californica* (Cushman and Gray), GSC 99298, hypotype, from interval 504-506 cm.

Side view showing damaged aperture, x156.

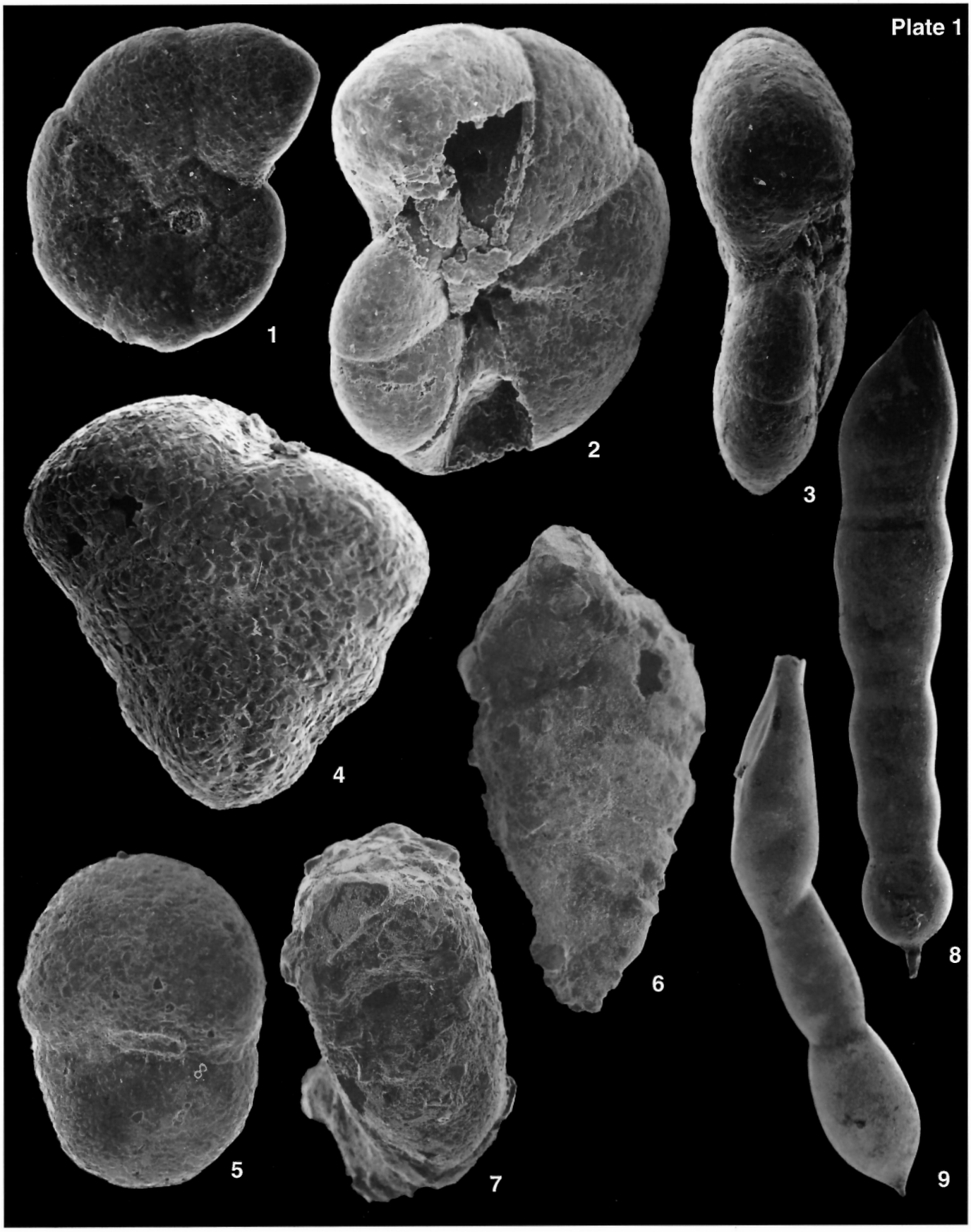
Plate 1
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PLATE 2

Illustrated specimens in figures 1, 2 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound; figures 3, 4 and 5, 6 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 7, 8, and 9 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1, 2. *Spirosigmoilina tenuis* (Czjzek), GSC 99299, hypotype, from interval 504-506 cm.

1. Apertural view showing bifurcated toothplate within lipped apertural opening, x358.
2. Side view showing lipped aperture atop elongated neck, x230.

Figures 3, 4. *Botuloides pauciloculus* S.Y. Zheng, GSC 99300, hypotype, from interval 56-59 cm.

3. Apertural view of showing circular cross-section and aperture, x507.
4. Side view illustrating basal spine, x174.

Figures 5, 6. *Lenticulina nikobarensis* (Schwager), GSC 99301, hypotype, from interval 56-59 cm.

5. Side view of slightly corroded specimen, x187.
6. Apertural view, x266.

Figures 7, 8. *Frondicularia gigas* Church, GSC 99302, hypotype, from interval 18-20 cm.

7. Side view showing characteristic spines at base, x70.
8. Apertural view showing radiate aperture and truncated margins, x108.

Figure 9. *Hyalinonetrion dentaliforme* (Bagg), GSC 99303, hypotype, from interval 18-20 cm.

Side view of smooth elongate specimen, x46.

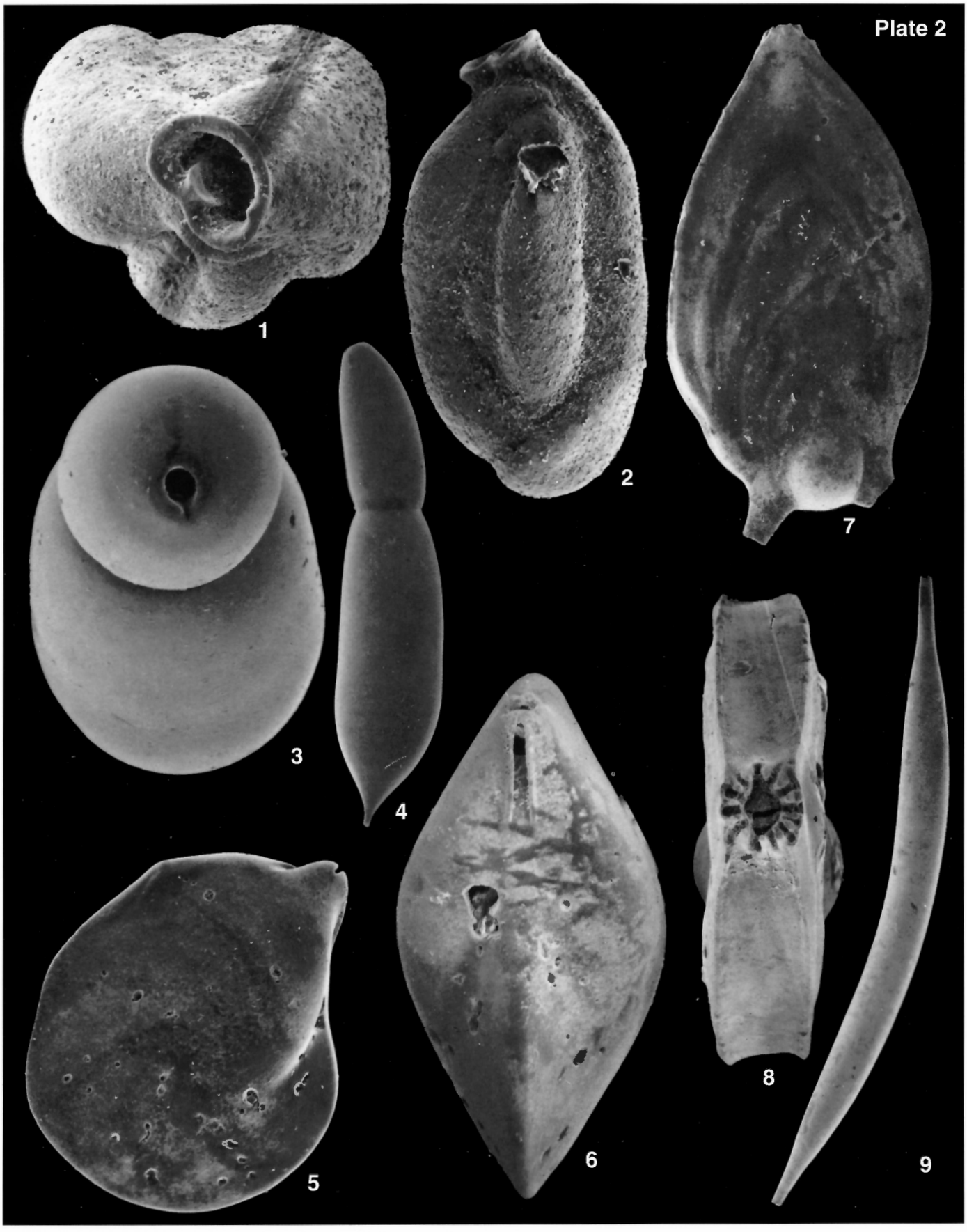
Plate 2
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PLATE 3

Illustrated specimens in figures 1, 2, 5, 6, and 8 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 3 and 4 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound; figure 7 is from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figure 1. *Marginulina pauciloculata* (Cushman and Gray), GSC 99304, hypotype, from interval 6-8 cm.

Side view showing radiate aperture at terminus of narrow, elongate neck, x156.

Figure 2. *Paleopolymorphina doanei* (Galloway and Wissler), GSC 99305, hypotype, from interval 18-20 cm.

Side view showing smooth test surface and slightly damaged radiate aperture, x76.

Figures 3-6. *Lagena dorseyae* McLean; 3, 4, GSC 99306, hypotype, from interval 480-482 cm; 5, 6, GSC 99307, hypotype, from interval 6-8 cm.

3. Apertural view showing circular cross-section, x215.
4. Side view showing unusual smooth portion of test wall, x145.
5. Side view showing characteristic complex reticular pattern on narrow neck, x98.
6. Apertural view showing circular aperture, x250.

Figure 7. *Lagena striaticollis* (d'Orbigny), GSC 99308, hypotype, from interval 56-59 cm.

Side view of specimen with damaged aperture showing poorly developed longitudinal costae restricted to neck and basal region, x196.

Figure 8. *Metapolymorphina charlottensis* (Cushman), GSC 99309, hypotype, from interval 18-20 cm.

Side view showing radiate aperture, x56.

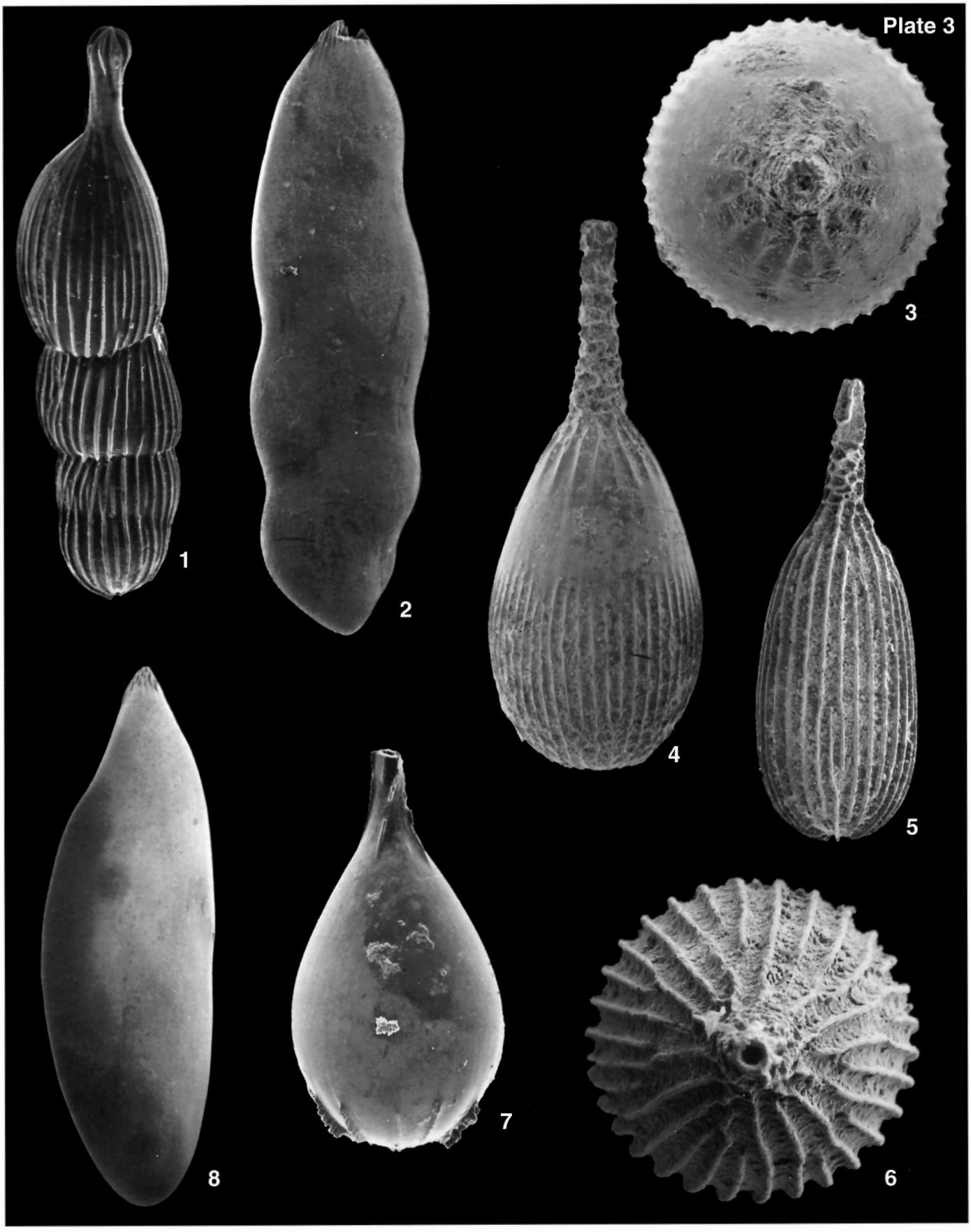
Plate 3
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PLATE 4

Illustrated specimens in figures 1, 5, and 6 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound; figures 2-4, 7, 8, 9, and 10 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figure 1. *Hyalinonetrion clavatum* (d'Orbigny), GSC 99310, hypotype, from interval 535-539 cm.

Side view of smooth surfaced, elongate specimen, x151.

Figures 2-4. *Lagena fidicularia* Patterson, GSC 99311, holotype, from interval 56-59 cm.

2. Side view showing longitudinal surface sculpture on test body becoming spirally arranged on neck, x120.
3. Apertural view showing circular apertural opening, x270.
4. Close up of spiral surface sculpture on neck, x650.

Figures 5, 6. *Lagena semilineata* Wright, GSC 99312, hypotype, from interval 165-167 cm.

5. Side view showing apical spine and phialine lipped aperture atop narrow, elongate neck, x145.
6. Apertural view showing circular cross-section of test and numerous longitudinal costae, x282.

Figure 7. *Procerolagena meridionalis* Wiesner, GSC 99313, hypotype, from interval 56-59 cm.

Side view of hypotype showing some longitudinal costae becoming very wide on neck, x297.

Figure 8. *Hyalinonetrion sahulense* Patterson and Richardson, GSC 99314, hypotype, from interval 152-156 cm.

Side view of elongate specimen, x123.

Figures 9, 10. *Procerolagena amphoriniformis* (McCulloch), GSC 99315, hypotype, from interval 56-59 cm.

9. Side view of elongate specimen showing discontinuous longitudinal costae on test surface, x172.
10. Apertural view showing circular cross-section, x561.

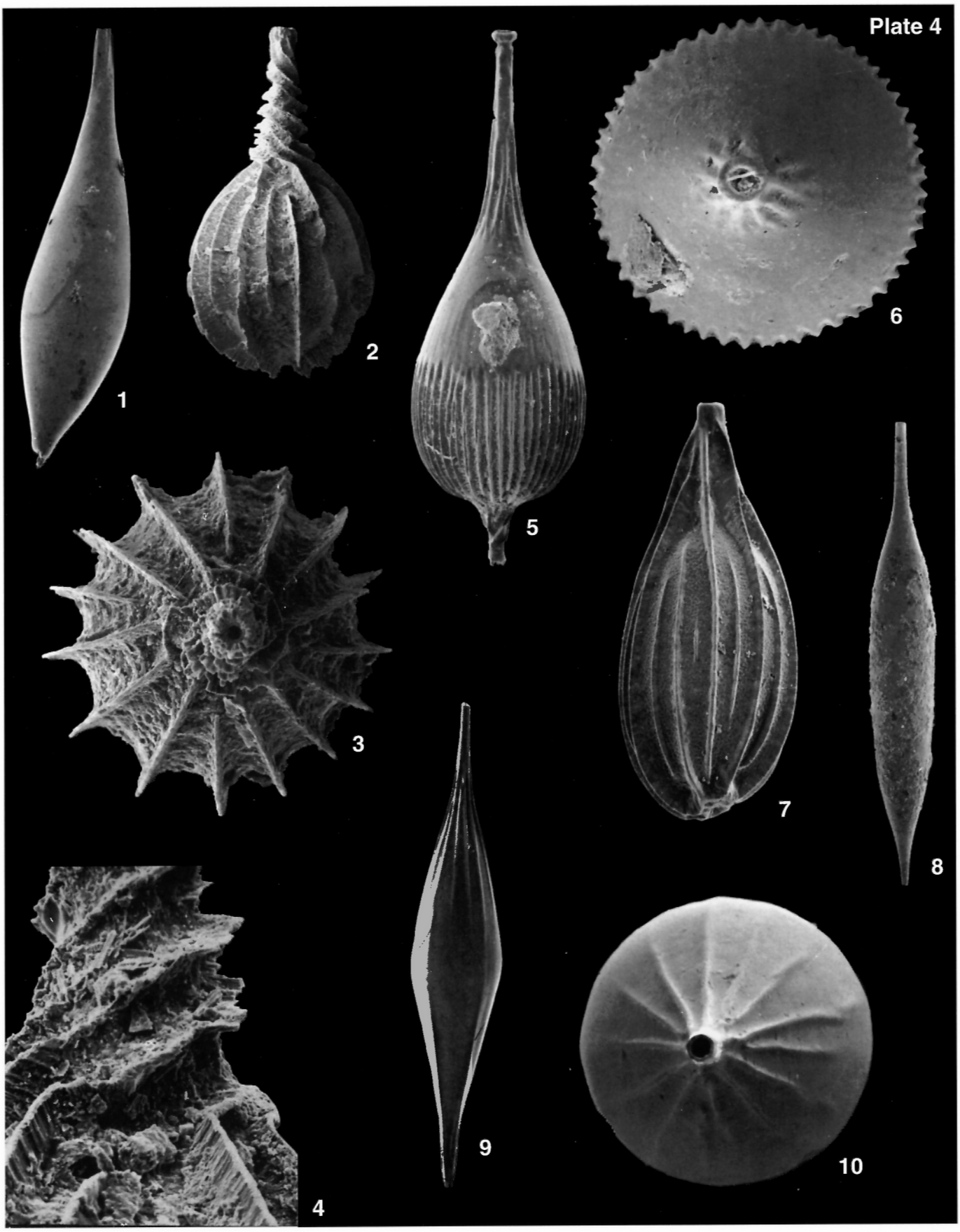
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PLATE 5

Illustrated specimens in figures 1, 2, 7, and 8 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 3 and 4 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 5 and 6 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound.

Figures 1, 2. *Procerolagena complurecosta* (Patterson), GSC 99316, hypotype, from interval 56-59 cm.

1. Apertural view showing circular apertural opening, x381.
2. Side view showing relatively few longitudinal costae becoming more pronounced on test neck, x147.

Figures 3, 4. *Procerolagena simulampulla* Patterson, GSC 99317, holotype, from interval 18-20 cm.

3. Apertural view showing circular aperture within phialine lip, x409.
4. Side view showing pronounced longitudinal costae, some of which extend from the damaged apical spine to just short of the aperture, x170.

Figures 5, 6. *Procerolagena wiesneri* (Parr), GSC 99318, hypotype, from interval 165-167 cm.

5. Apertural view showing positioning of numerous longitudinal costae, x466.
6. Side view showing elongate test topped by phialine lip around aperture, x235.

Figures 7, 8. *Pygmaeoseistron hispidum* (Reuss), GSC 99319, hypotype, from interval 260-264 cm.

7. Side view showing hispid surface sculpture, particularly pronounced on the neck, x208.
8. Apertural view showing circular cross-section and aperture (banding is an artifact of the scanning electron microscope), x328.

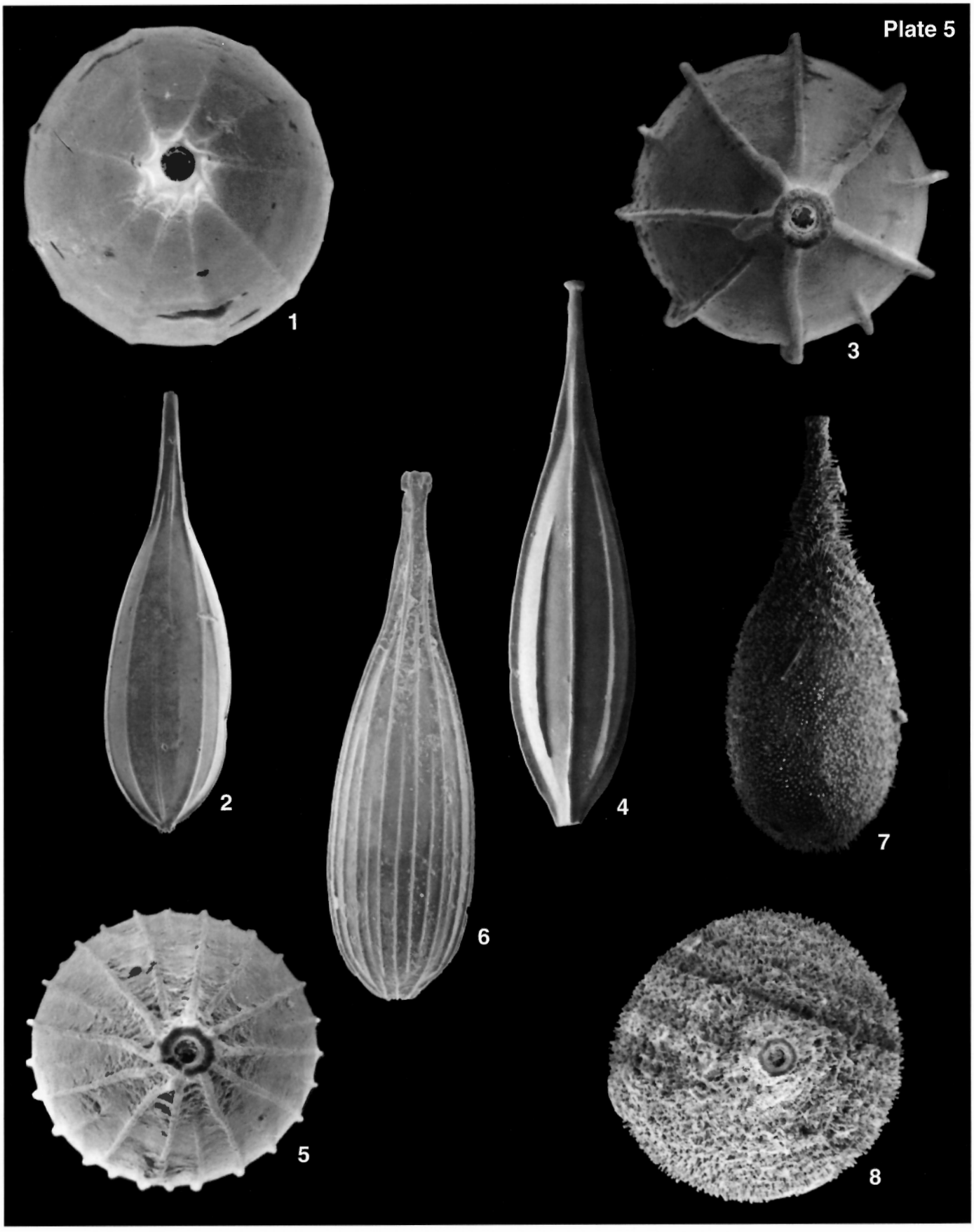
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PLATE 6

Illustrated specimens in figures 1, 2, and 3 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 4 and 5 and 6-9 are from Core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figure 1. *Procerolagena gracilis* (Williamson), GSC 99320, hypotype, from interval 152-156 cm.

Side view, x168.

Figures 2, 3. *Pygmaeoseistron hispidulum* (Cushman), GSC 99321, hypotype, from interval 260-264 cm.

2. Apertural view showing circular cross-section, x430.
3. Side view of elongate, finely hispid specimen, x165.

Figures 4, 5. *Exsculptina discrepans* (Cushman and Gray), GSC 99322, hypotype, from interval 18-20 cm.

4. Apertural view showing circular aperture and cross-section, x169.
5. Side view showing characteristic surface sculpture on neck and truncated base, x127.

Figures 6-9. *Favulina melo* (d'Orbigny); 6, GSC 99323, hypotype; 7,9, GSC 99324, hypotype; 8, GSC 99325, hypotype, from interval 6-8 cm.

6. Side view of 2 specimens attached aperture to basal ring, x147.
7. Apertural view showing circular apertural opening within phialine lip, x302.
8. Side view with a finer array of surface reticulations, x172.
9. Side view showing characteristic curved cross-hatched surface sculpture, x228.

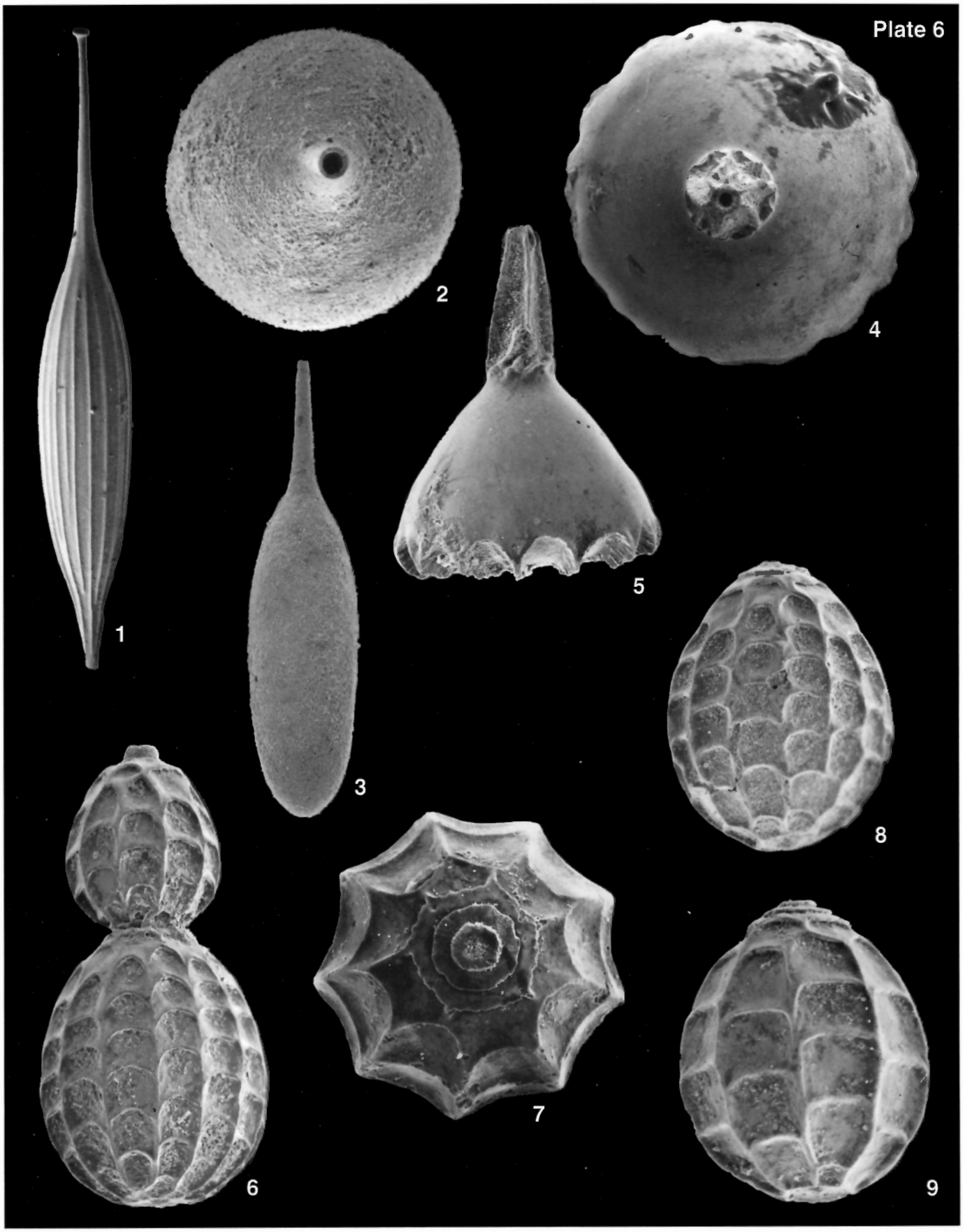
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PLATE 7

Illustrated specimens in figures 1, 2, 4, 5, 6, and 7 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figure 3 is from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1, 2. *Homalohedra borealis* (Loeblich and Tappan), GSC 99326, hypotype, from interval 6-8 cm.

1. Side view of hypotype showing thick longitudinal costae extending from an apical ring to a slightly pronounced aperture, x206.
2. Apertural view showing flat surface of longitudinal costae, x233.

Figure 3. *Homalohedra* cf. *H. quasilineata* Patterson, GSC 99327, hypotype, from interval 56-59 cm.

Side view showing pronounced low profile phialine lip and very indistinct longitudinal costae, x265.

Figures 4, 5. *Fissurina copiosa* McCulloch, GSC 99328, hypotype, from interval 6-8 cm.

4. Apertural view showing slit-like apertural opening, x358.
5. Side view showing dissolution pitted surface and slightly pronounced apertural region, x200.

Figures 6, 7. *Fissurina lucida* (Williamson), GSC 99329, from interval 6-8 cm.

6. Side view showing wide marginal carina and pronounced aperture, x297.
7. Apertural view showing compressed test and slit-like apertural opening, x302.

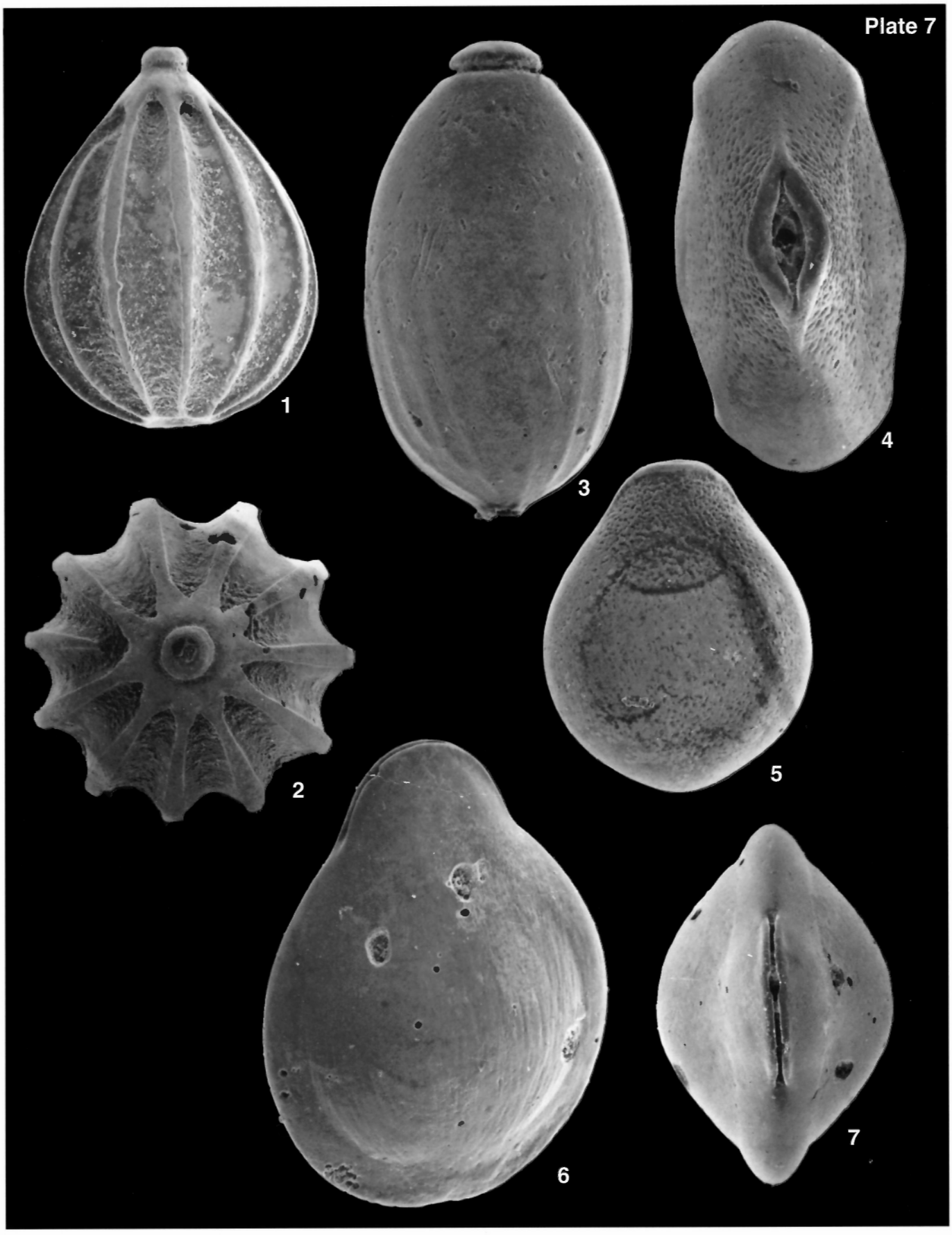
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PLATE 8

Illustrated specimens in figures 1 and 2 and 7-9 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 3 and 4 are from END 84B-04, latitude 52°14.72', longitude 130°09.05', and figures 5 and 6 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1, 2. *Fissurina artolabiata* Patterson, GSC 99330, hypotype, from interval 6-8 cm.

1. Side view of hypotype showing smooth test surface, x182.
2. Apertural view showing slit-like apertural opening and very thick carina, x330.

Figures 3, 4. *Fissurina eburnea* (Buchner), GSC 99331, hypotype, from interval 71-75 cm.

3. Side view showing almost circular profile, x412.
4. Apertural view showing evidence of a slight carina and slit-like apertural opening, x794.

Figures 5, 6. *Fissurina marmoraria* (Buchner), GSC 99332, hypotype, from interval 56-59 cm.

5. Apertural view showing circular terminus of within fissurine apertural opening, x637.
6. Side view showing wide carina, x383.

Figures 7-9. *Fissurina subquadrata* Parr, GSC 99333, hypotype, from interval 6-8 cm.

7. Enlargement of sculpted depression near margin of test, x1240.
8. Side view showing characteristic depressed sculpted bands along each margin, x182.
9. Apertural view showing compressed nature of test and fissurine aperture, x295.

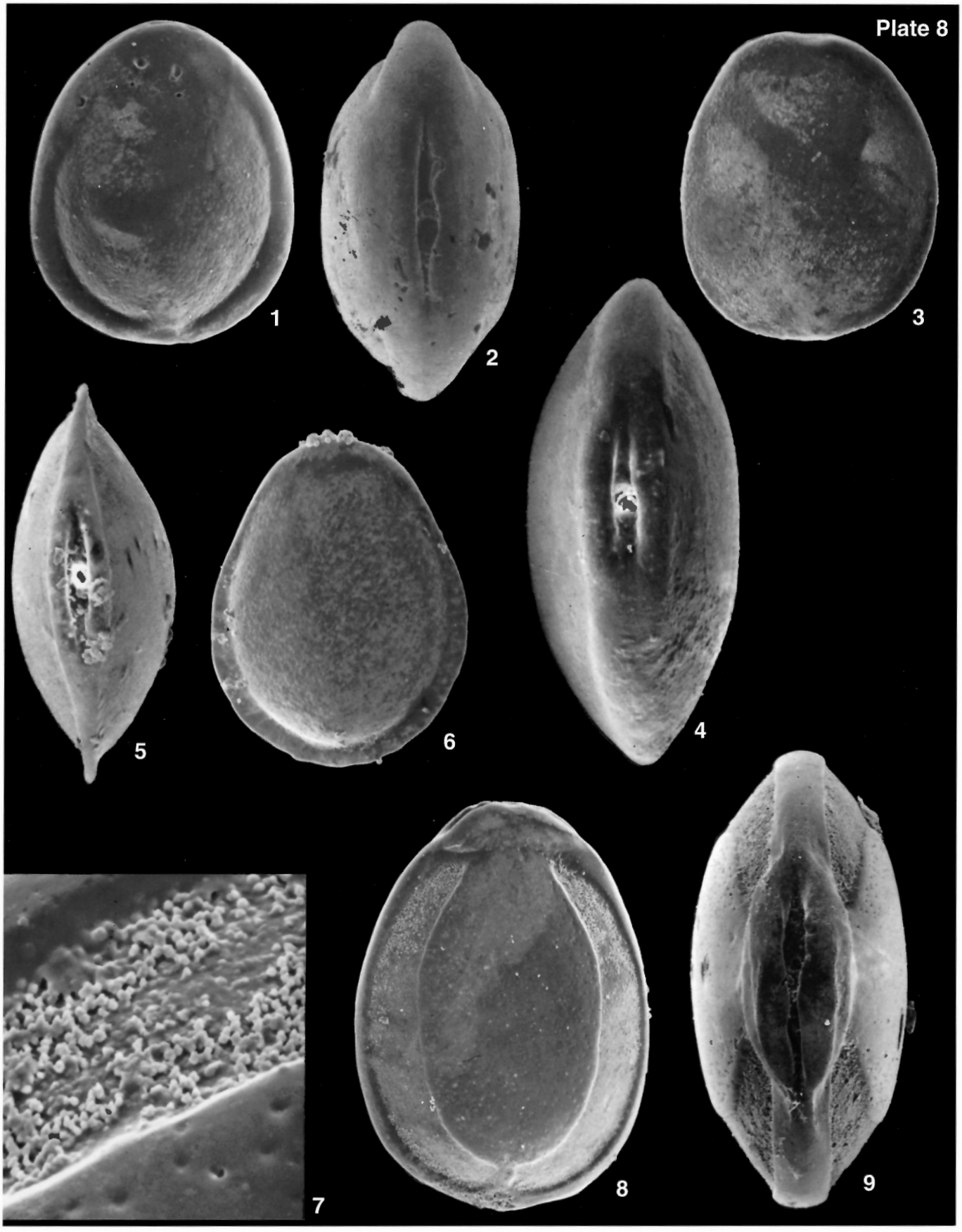
Plate 8
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PLATE 9

Illustrated specimens in figures 1-5 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 6 and 7 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1-5. *Fissurina vitreola* (Buchner); 1, 2, GSC 99334, hypotype; 3, 5, GSC 99335, hypotype; 4, GSC 99336, hypotype, from interval 56-59 cm.

1. Side view of smooth surfaced, elongate specimen, x321.
2. Apertural view showing damaged fissurine apertural opening, x596.
3. Side view showing very pronounced apertural region, x272.
4. Side view of broken specimen showing short straight, entosolenian tube
   x360.
5. Apertural view showing slightly compressed test and very wide fissurine apertural opening, x360.

Figures 6, 7. *Tortaguttus timmsensis* (Cushman and Gray), GSC 99337, hypotype, from interval 6-8 cm.

6. Side view showing complex carinal development, x224.
7. Apertural view showing characteristic sigmoidally twisted test, x300.


Plate 9
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PLATE 10

Illustrated specimens in figures 1, 2 and 3, 4 are from END 84B-04, latitude 52°14.72', longitude 130°09.05', and figures 5 and 6 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 7 and 8 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1, 2. *Palliolatella immemora* Patterson, GSC 99338, hypotype, from interval 71-75 cm.

1. Side view showing pronounced carinal development, x306.
2. Apertural view showing fissurine apertural opening, x474.

Figures 3, 4. *Palliolatella frangens* Buchner, GSC 99339, hypotype, from interval 71-75 cm.

3. Side view of hypotype showing development of secondary carina along the margin of each test face, x269.
4. Apertural view showing compressed test and flattened margins of primary carina, x536.

Figures 5-8. *Parafissurina semicarinata* (Buchner); 5, 6, GSC 99340, hypotype, from interval 56-59 cm; 7, 8, GSC 99341, hypotype, from interval 6-8 cm.

5. Side view showing more pronounced development of carina near base of test, x248.
6. Apertural view showing compressed test and coarsely perforate wall, x466.
7. Side view showing numerous pores, not to be confused with very large holes caused by boring or dissolution, x188.
8. Apertural view, x282.


Plate 10
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PLATE 11

Illustrated specimens in figures 1-4 and 5 and 6 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1-4. *Nanosylvanella palmulina* Patterson, GSC 99342, holotype, from interval 260-264 cm.

1. Side view showing very elongate neck, x132.
2. Enlargement of apertural region showing phialine lip, x987.
3. Apertural view showing circular cross-section, x225.
4. Enlargement of outer test wall showing distinctive tripartite flanges atop pillars, x612.

Figures 5, 6. *Bolivina decussata* Brady, GSC 99343, hypotype, from interval 56-59 cm.

5. Side view of hypotype showing characteristic saw-toothed marginal profile and roughened surface from the acquisition of secondary calcite, x306.
6. Apertural view showing toothplate extending from apertural opening, x516

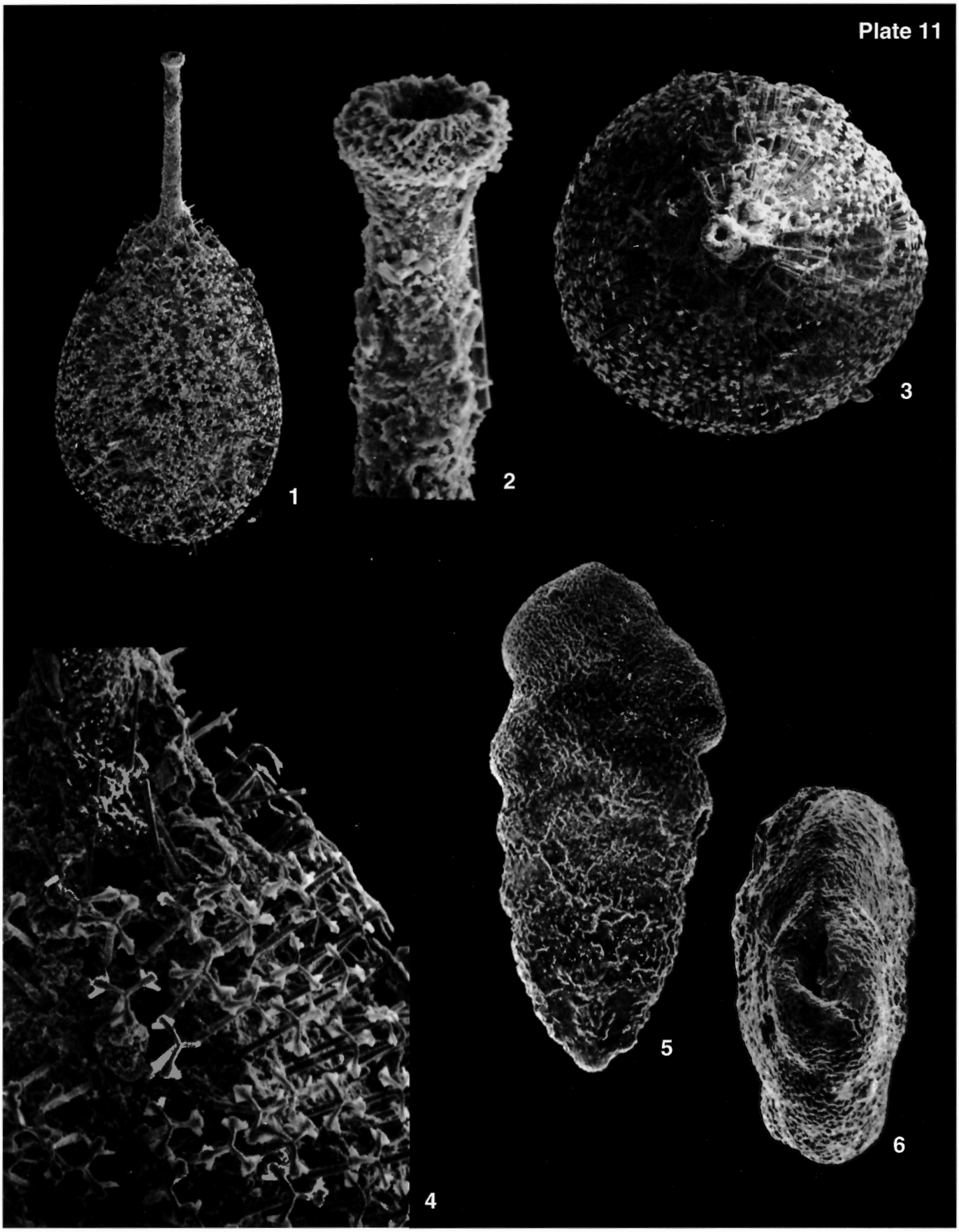
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PLATE 12

Illustrated specimens in figures 1-3 and 4-6 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 7 and 8 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1-3. *Pytine petaloskelis* Patterson and Richardson, GSC 99344, hypotype, from interval 56-59 cm.

1. Enlargement of wall of hypotype showing smooth longitudinal strips of outer wall overlying pillared inner wall, x948.
2. Side view showing elongate neck, x237.
3. Apertural view showing circular cross-section, x503.

Figures 4-6. *Seabrookia earlandi* Wright, GSC 99345, hypotype, from interval 56-59 cm.

4. Apertural view showing compressed nature of test and lipped apertural opening, x700.
5. Side view of front, showing lipped apertural opening, x417.
6. Side view of rear, x414.

Figures 7, 8. *Laryngosigma trilocularis* (Bagg), GSC 99346, hypotype, from interval 6-8 cm.

7. Apertural view of hypotype showing radiate aperture, x185.
8. Side view of elongate test, x105.

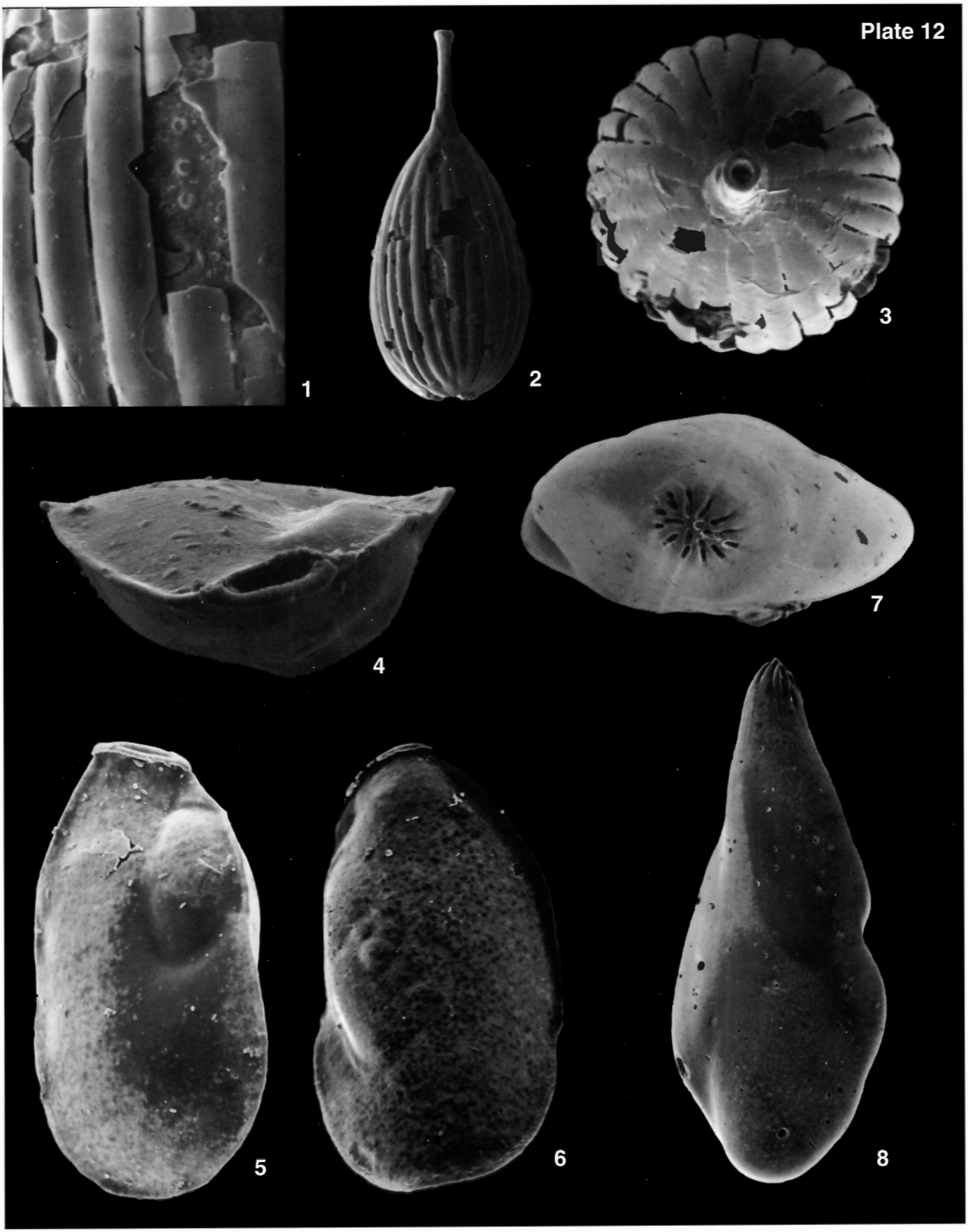
Plate 12
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PLATE 13

Illustrated specimens in figures 1 and 2 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 3-5, 6, 7, 8, and 9 from END 84B-07, latitude 52°16.70', longitude 130°12.27' margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1, 2. *Bolivinellina pacifica* (Cushman and McCulloch), GSC 99347, hypotype, from interval 18-20 cm.

1. Side view showing elongate test, x157.
2. Apertural view showing finely perforate test wall and position of toothplate within apertural opening, x430.

Figures 3-5. *Euloxostomum alatum* (Seguenza); 3, GSC 99348, hypotype, 152-156 cm; 4, 5, GSC 99349, hypotype, from interval 56-59 cm.

3. Side view showing coarsely perforate test and development of elongate blade-like projections at the marginal terminus of each chamber, x101.
4. Apertural view showing extremely compressed test, x283.
5. Side view showing produced neck characteristic of some specimens, x154.

Figures 6, 7. *Brizalina fragilis* (Phleger and Parker), GSC 99350, hypotype, from interval 56-59 cm.

6. Apertural view showing compressed test, x235.
7. Side view showing very coarse perforations more common in the basal portions of each successive chamber, x121.

Figures 8, 9. *Brizalina subaenariensis* (Cushman), GSC 99351, hypotype, from interval 56-59 cm.

8. Apertural view showing compressed test outline, x152.
9. Side view showing elevated sutures and apical spine, x81.


Plate 13
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PLATE 14

Illustrated specimens in figures 1-4 and 7 and 8 are from END 84B-07, latitude 52°16.70', longitude 130°12.27' and figures 5 and 6 are from END 84B-04, latitude 52°14.72', longitude 130°09.05', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1, 2. *Islandiella norcrossi* (Cushman), GSC 99352, hypotype, from interval 56-59 cm.

1. Side view of hypotype, x172.
2. Apertural view, x270.

Figures 3, 4. *Cassidulina reniforme* Nørvang; 3, 4, GSC 99353, hypotype, from interval 516-520 cm.

3. Edge view showing coarsely perforate surface, x233.
4. Side view showing coarse perforations and characteristic flap projecting into apertural opening, x188.

Figures 5, 6. *Stainforthia feylingi* Knudsen and Seidenkrantz, GSC 99354, hypotype, from interval 32-36 cm.

5. Apertural view showing loop-shaped apertural opening, x443.
6. Side view of elongate specimen showing coarsely perforate surface, x294.

Figures 7, 8. *Cassidulina bradshawi* Uchio, GSC 99355, hypotype, from interval 516-520 cm.

7. Side view showing almost circular test and distinctive apertural region, x400.
8. Edge view showing compressed test, x450.

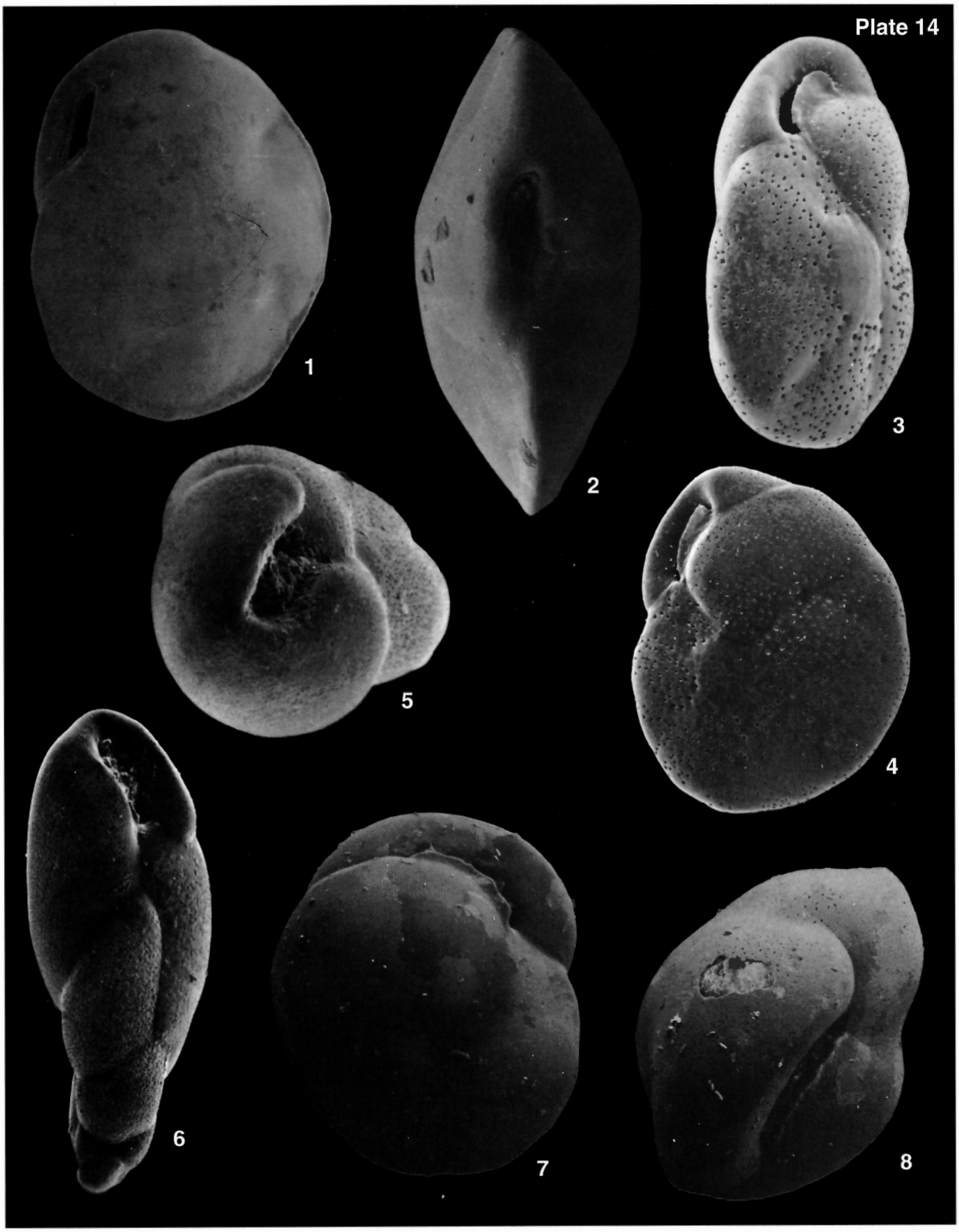
Plate 14
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PLATE 15

Illustrated specimens in all figures of this plate are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figure 1. *Protoglobobulimina elongata* (d'Orbigny), GSC 99356, hypotype, from interval 56-59 cm.

Side view showing toothplate projecting into wide apertural opening, x125.

Figures 2, 3. *Praeglobobulimina spinescens* (Brady), GSC 99357, hypotype, from interval 56-59 cm.

2. Apertural view, x180.
3. Side view showing finely perforate surface and characteristic spines projecting downward over lower one-third of test, x138.

Figures 4-7. *Bulimina inflata* Seguenza; 4, 5, GSC 99358, hypotype, from interval 56-59 cm; 6, 7, GSC 99359, hypotype, from interval 152-156 cm.

4. Apertural view showing positioning of toothplate within apertural opening, x235.
5. Side view showing coarsely perforate test surface and wide flanges over test surface, x217.
6. Apertural view, x197.
7. Side view showing much more pronounced development of spines and particularly the large apical spine exhibited by this specimen, x208.

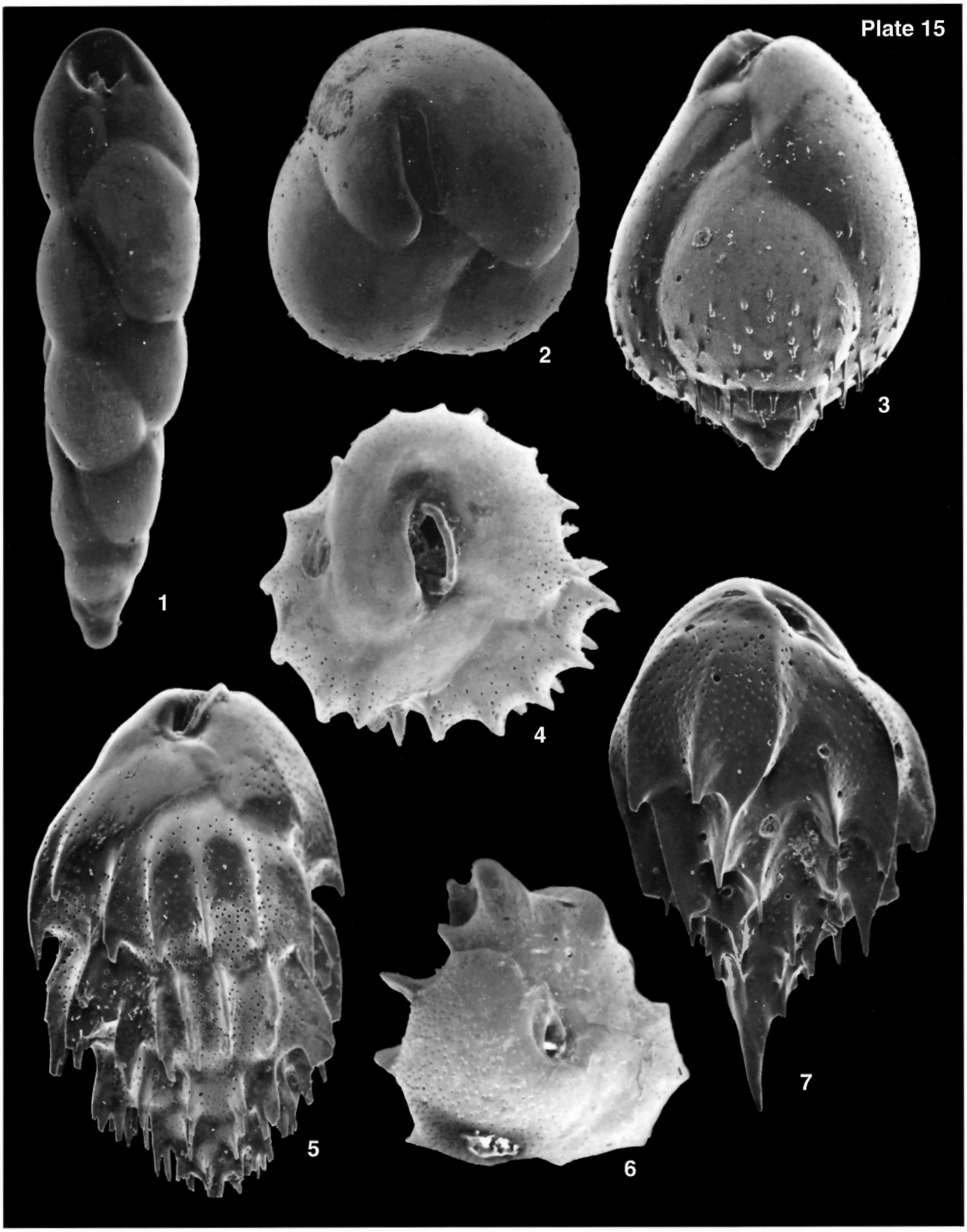
Plate 15
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PLATE 16

Illustrated specimens in figures 1-3 are from END 84B-07, latitude 52°16.70', longitude 130°12.27' and figures 6 and 7 are from END 84B-04, latitude 52°14.72', longitude 130°09.05', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 4 and 5 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1-3. *Euuvigerina aculeata* (d'Orbigny); 1, 2, GSC 99360, hypotype, from interval 56-59 cm; 3, GSC 99361, hypotype, from interval 260-264 cm.

1. Side view of elongate specimen, x123.
2. Apertural view showing numerous spike-like spines over the entire test surface, x300.
3. Side view showing elongate neck and positioning of spines over entire test surface, x138.

Figures 4, 5. *Angulogerina fluens* Todd, GSC 99362, hypotype, from interval 6-8 cm.

4. Apertural view showing lipped aperture and sub-trigonal shape of test, x267.
5. Side view showing discontinuous longitudinal costae over entire test surface, x186.

Figures 6, 7. *Buliminella elegantissima* (d'Orbigny), GSC 99363, hypotype, from interval 32-36 cm.

6. Apertural view showing numerous fine perforations over test surface, x480.
7. Side view of elongate test with broad apertural opening, x277.

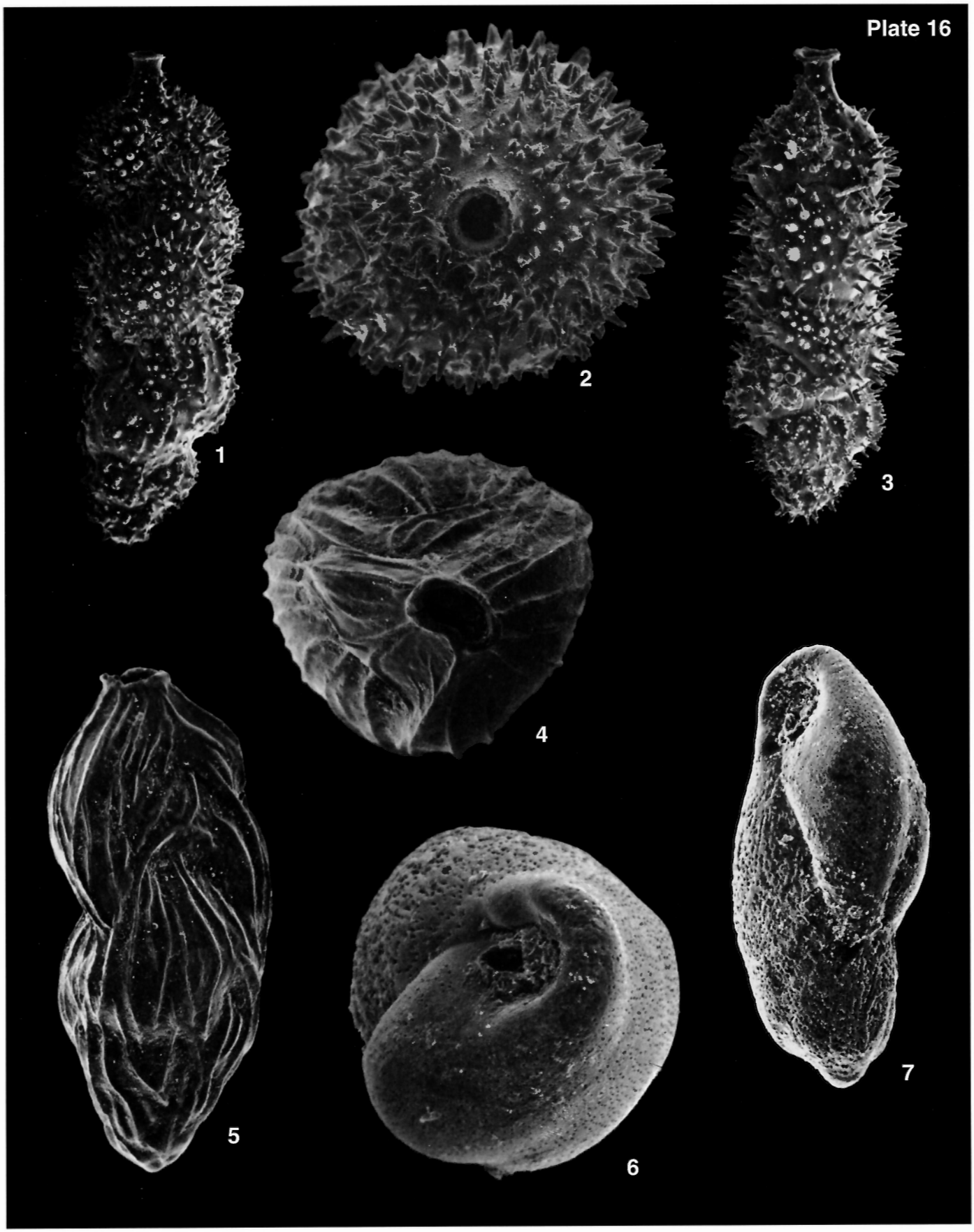
Plate 16
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PLATE 17

Illustrated specimens in figures 1 and 4 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 2 and 3 are from END 84B-04, latitude 52°14.72', longitude 130°09.05' and figures 5, 6, 7, and 8 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1-4. *Euuvigerina juncea* (Cushman and Todd); 1, 4, GSC 99364, hypotype, from interval 6-8 cm; 2, 3, GSC 99365, hypotype, from interval 71-75 cm.

1. Side view with very poorly developed longitudinal costae, x135.
2. Side view of specimen with much more pronounced longitudinal costae, x138.
3. Apertural view showing pronounced toothplate within apertural opening, x350.
4. Apertural view showing generally circular cross-section of test, x300.

Figures 5, 6. *Pleurostomella delicatula* Patterson, GSC 99366, holotype, from interval 152-156 cm.

5. Side view, x255.
6. Apertural view showing fine pores, x1300.

Figures 7, 8. *Protoglobobulimina pupoides* (d'Orbigny), GSC 99367, hypotype, from interval 56-59 cm.

7. Side view, x78.
8. Apertural view showing almost circular cross-section, x120.

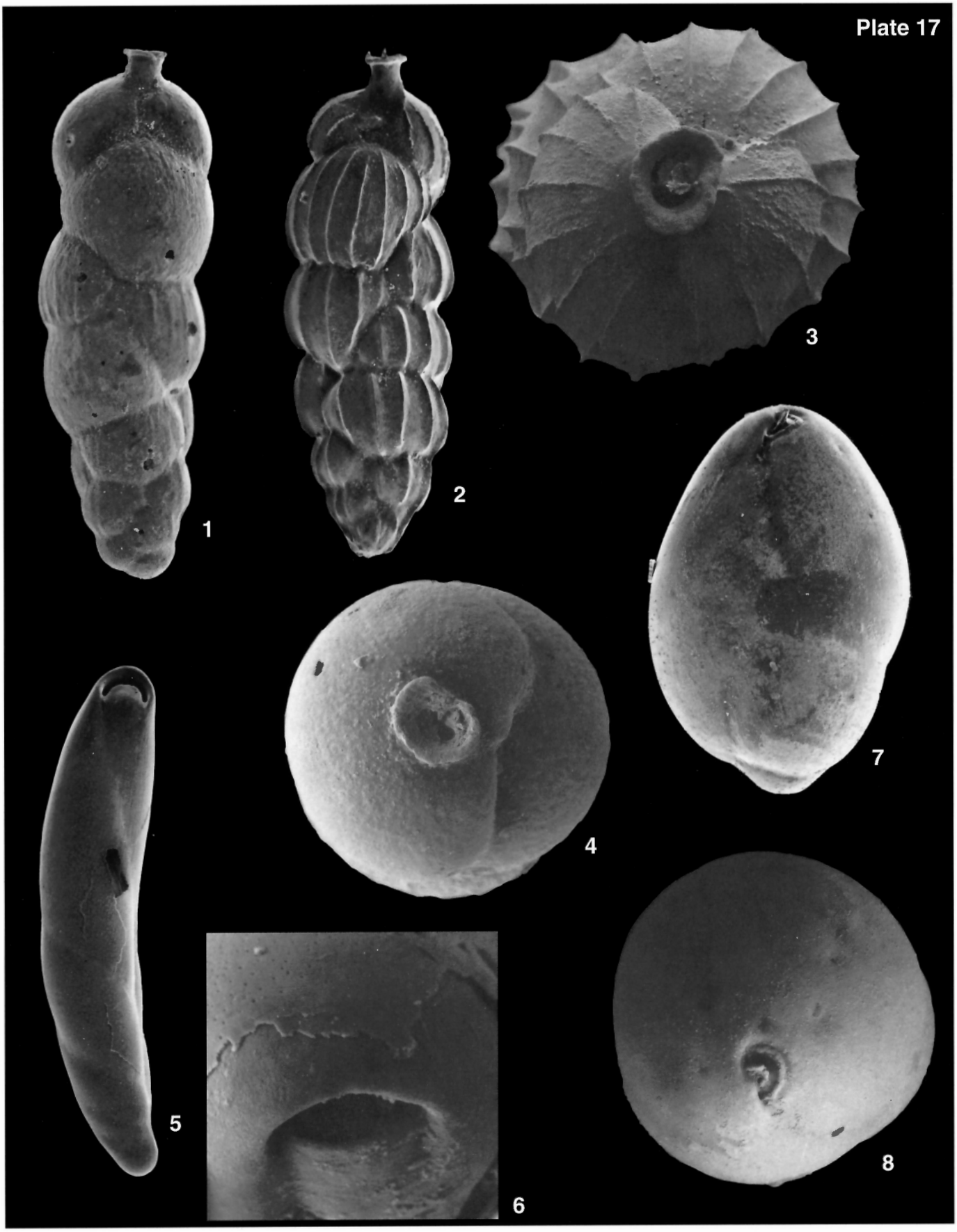
Plate 17
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PLATE 18

Illustrated specimens in figures 1, 2, 3, and 4 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 5-7 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1, 2. *Angulogerina angulosa* (Williamson), GSC 99368, hypotype, from interval 56-59 cm.

1. Apertural view of trigonal specimen, x400.
2. Side view showing very pronounced discontinuous longitudinal costae, x270.

Figures 3, 4. *Suggrunda eckisi* Natland, GSC 99369, hypotype, from interval 56-59 cm.

3. Apertural view showing compressed test and development of toothplate within apertural opening, x167.
4. Side view showing spine-like projections at the margin of each successive chamber, x116.

Figures 5-7. *Gavelinopsis campanulata* (Galloway and Wissler), GSC 99370, hypotype, from interval 6-8 cm.

5. Dorsal view showing numerous fine pores over entire surface, particularly concentrated in the central regions of each visible chamber, x139.
6. Ventral view showing flaps from each successive chamber projecting into the umbilical region, x185.
7. Edge view showing flattened ventral side of test, x215.

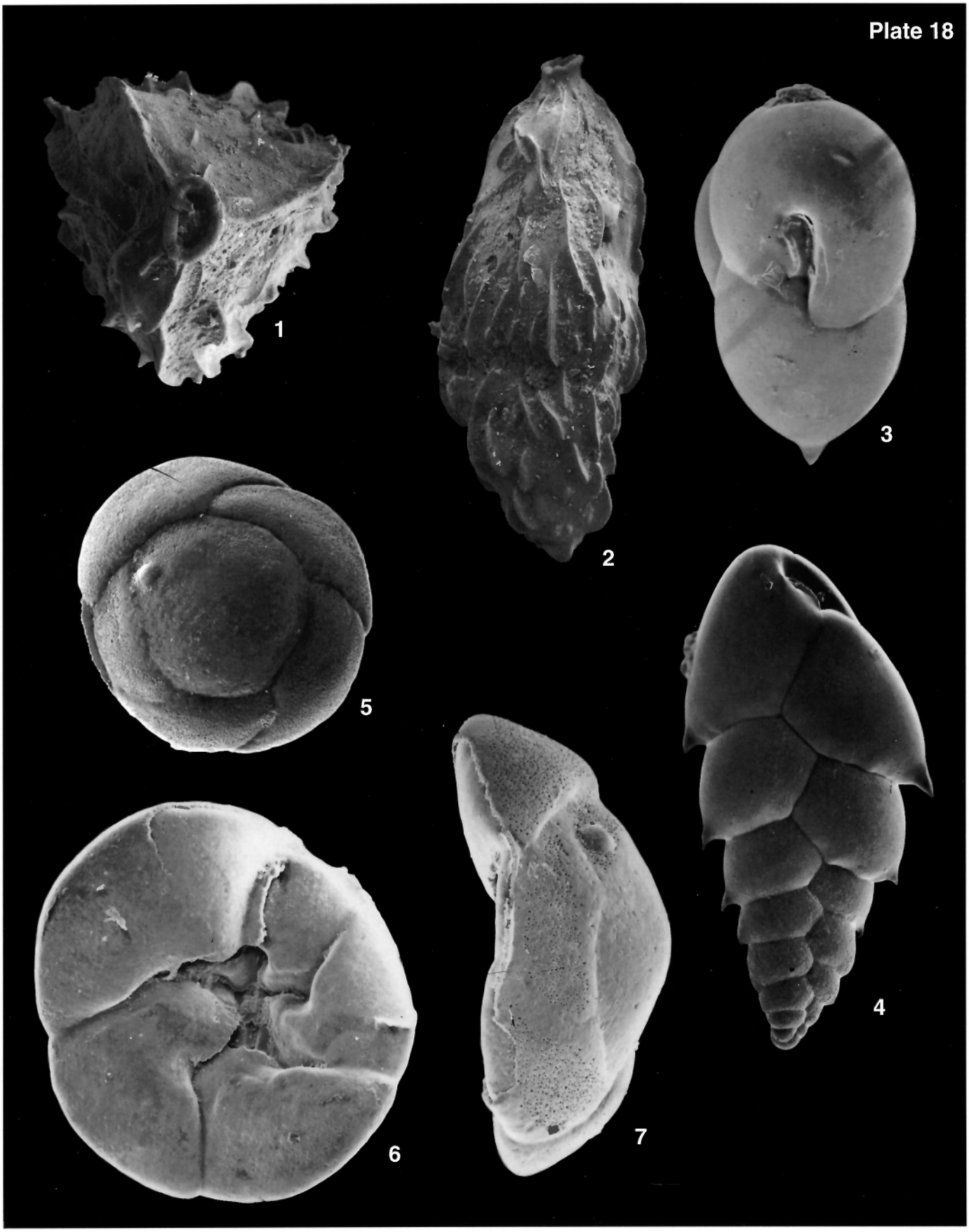
Plate 18
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PLATE 19

Illustrated specimens in figures 1-3 and 4-6 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 7-9 are from core END 87A-23, latitude 50°59.94', Longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1-3. *Rosalina columbiensis* (Cushman), GSC 99371, hypotype, from interval 56-59 cm.

1. Edge view showing lipped marginal aperture, x265.
2. Dorsal view showing deeply incised sutures, x218.
3. Ventral view showing coarsely perforate surface and apertural opening extending back several chambers along the umbilicus, x221.

Figures 4-6. *Lobatula fletcheri* (Galloway and Wissler), GSC 99372, hypotype, from interval 470-474 cm.

4. Coarsely perforate spiral view, x204.
5. Edge view showing flattened spiral side and apertural lip, x256.
6. Dorsal view with only a few perforations, x206.

Figures 7-9. *Lobatula mckannai* (Galloway and Wissler), GSC 99373, hypotype, from interval 33-38 cm.

7. Edge view of hypotype showing large apertural opening, x100.
8. Dorsal view showing roughened surface resulting from the development of a very densely arrayed network of coarse perforations, x80.
9. Spiral view with numerous but slightly finer perforations than on the dorsal side, x77.

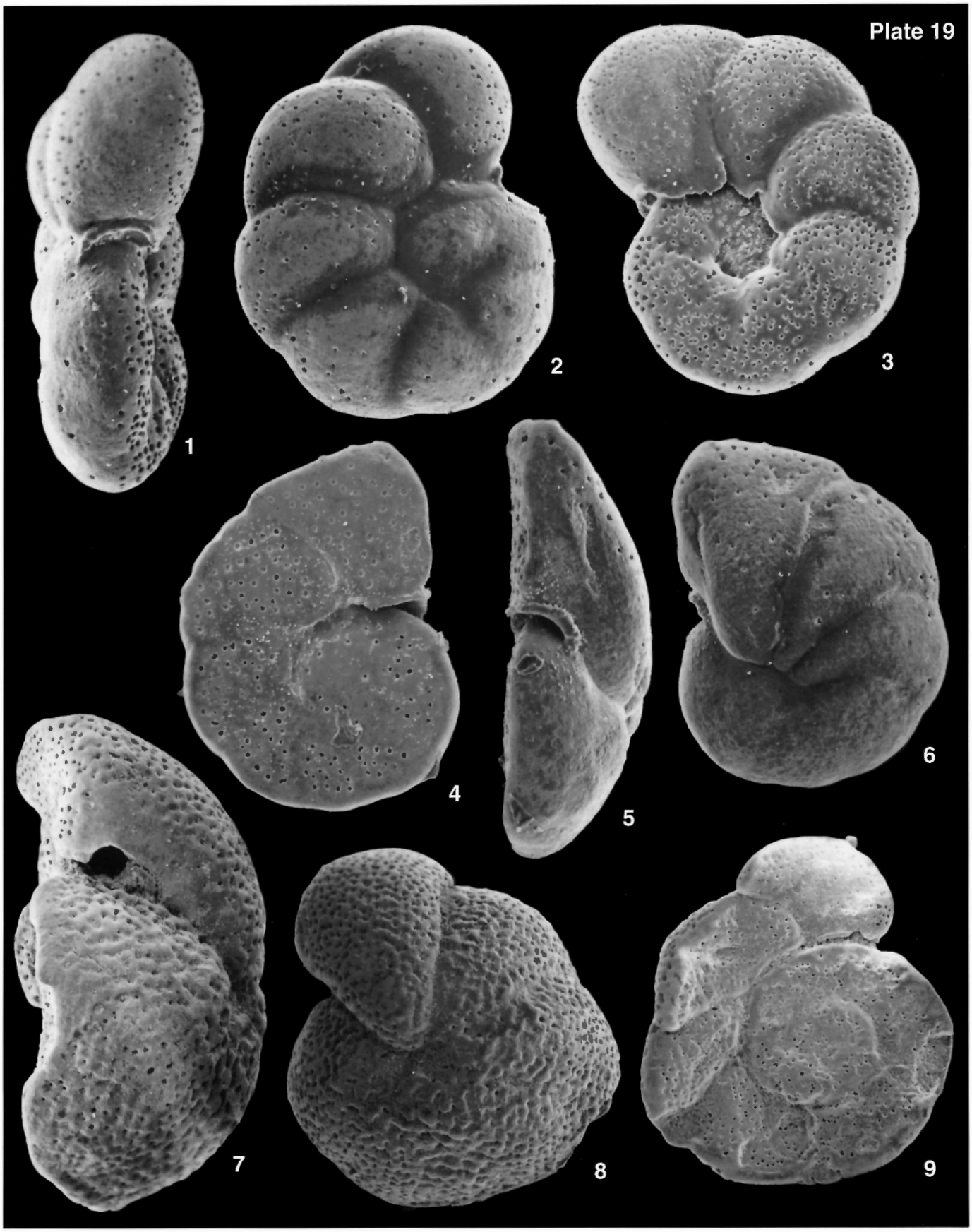
Plate 19
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PLATE 20

Illustrated specimens in figures 1 and 2 and 6-8 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 3-5 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound.

Figures 1, 2. *Dyocibicides biserialis* Cushman and Valentine, GSC 99374, hypotype, irregularly shaped specimen, from interval 18-20 cm.

1. Dorsal view, x57.
2. Ventral view, x68.

Figures 3-5. *Epistominella vitrea* Parker, GSC 99375, hypotype, from interval 41-44 cm.

3. Dorsal view of hypotype, x302.
4. Edge view showing narrow apertural opening, x400.
5. Ventral view showing straight, slightly depressed sutures, x302.

Figures 6-8. *Montfortella bramlettei* Loeblich and Tappan, GSC 99376, hypotype, from interval 6-8 cm.

6. Dorsal view of very coarsely perforate hypotype with characteristic incised areas along each suture, x98.
7. Ventral view of imperforate attachment surface, x140.
8. Edge view showing lipped aperture, x144.

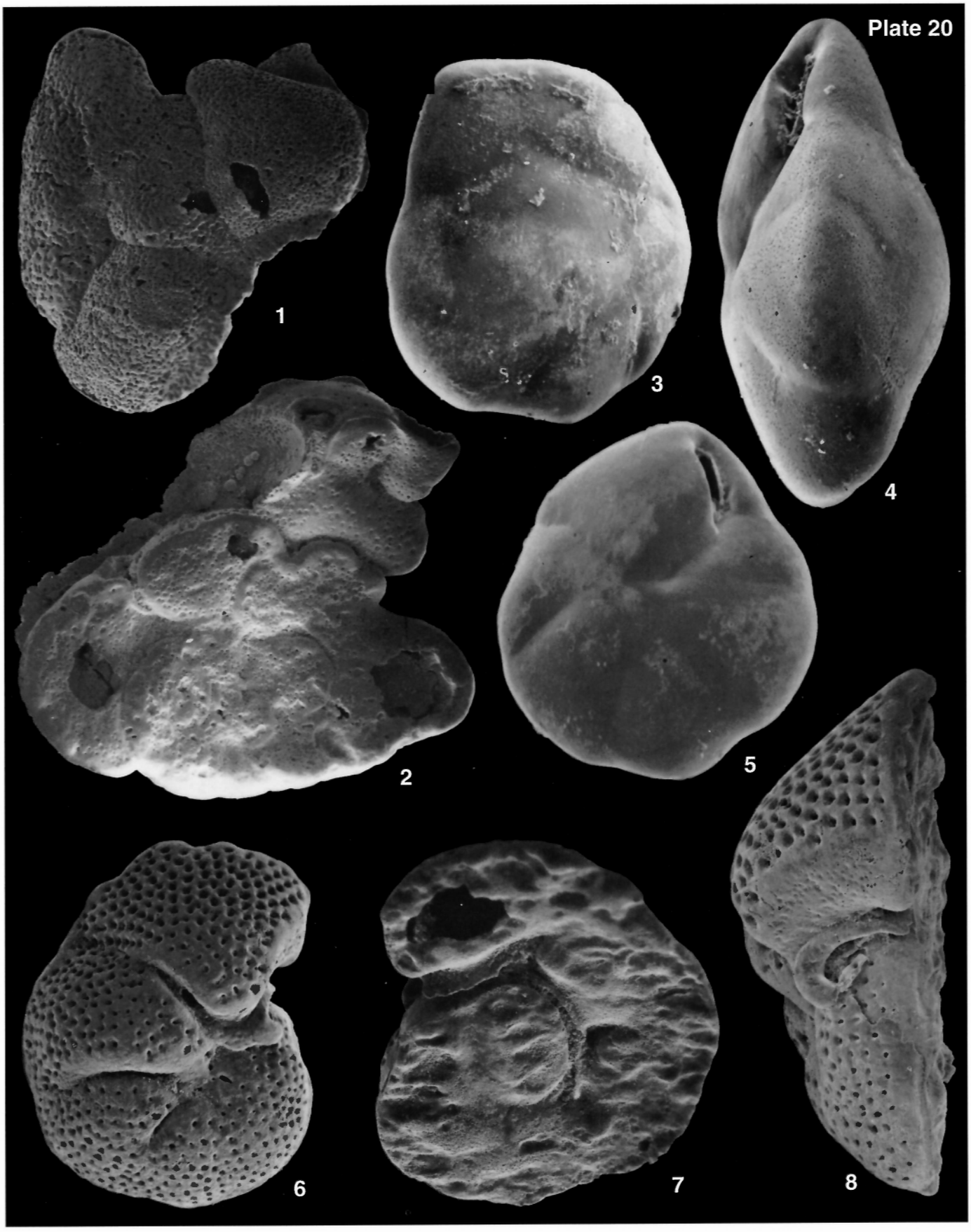
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PLATE 21

Illustrated specimens in figures 1-3 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', and figures 4-6 and 7 and 8 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Goose Island Trough, central Queen Charlotte Sound.

Figures 1-3. *Nonionella digitata* Nørvang, GSC 99377, hypotype, from interval 455-457 cm.

1. Umbilical view showing distinctive finger-like projections covering umbilical region, x179.
2. Spiral view showing deeply incised sutures, x178.
3. Edge view, x171.

Figures 4-6. *Epistominella pacifica* (Cushman), GSC 99378, hypotype, from interval 456-460 cm.

4. Dorsal view of hypotype, x151.
5. Umbilical view showing development of marginal carina, x160.
6. Edge view showing development of apertural lip, x190.

Figures 7, 8. *Chilostomella oolina* Schwager, GSC 99379, hypotype, from interval 56-59 cm.

7. Edge view of egg-shaped hypotype, x165.
8. Apertural view, x233.

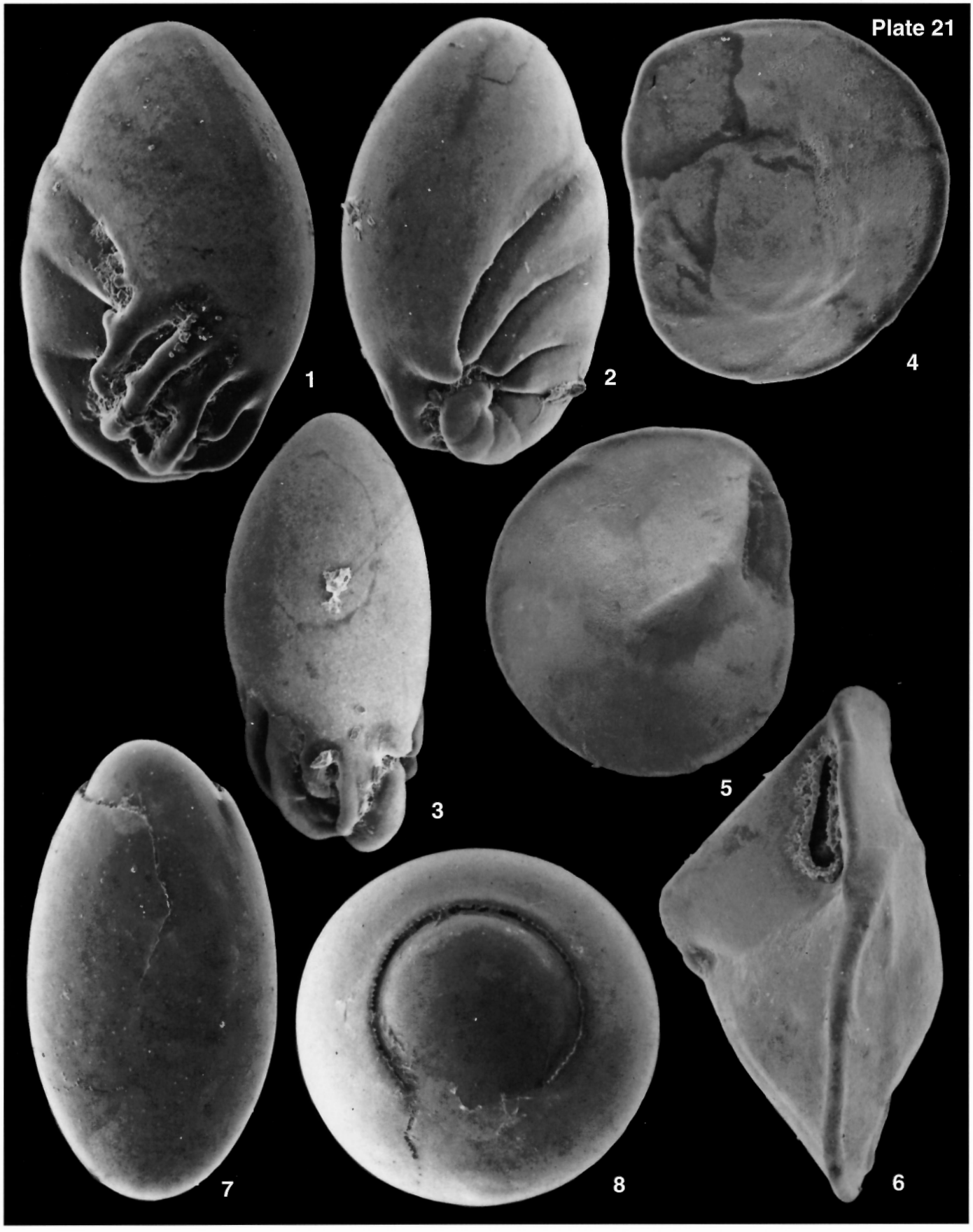
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PLATE 22

Illustrated specimens in figures 1-3 are from END 84B-04, latitude 52°14.72', longitude 130°09.05', and figures 4-7 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', from the margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1-3. *Nonionella stella* Cushman and Moyer, GSC 99380, hypotype, from interval 71-75 cm.

1. Dorsal view showing slightly curved sutures, x200.
2. Ventral view showing flap covering umbilical region, x196.
3. Edge view, x222.

Figures 4-7. *Gyroidinoides altiformis* Stewart and Stewart, GSC 99381, hypotype, from interval 56-59 cm.

4. Ventral view showing distinctive umbilical opening, x75.
5. Dorsal view showing slightly curved sutures, x76.
6. Enlargement of umbilical region showing apertural lips of successive chambers projecting into the opening; x302.
7. Edge view showing narrow aperture extending into umbilical opening, x100.

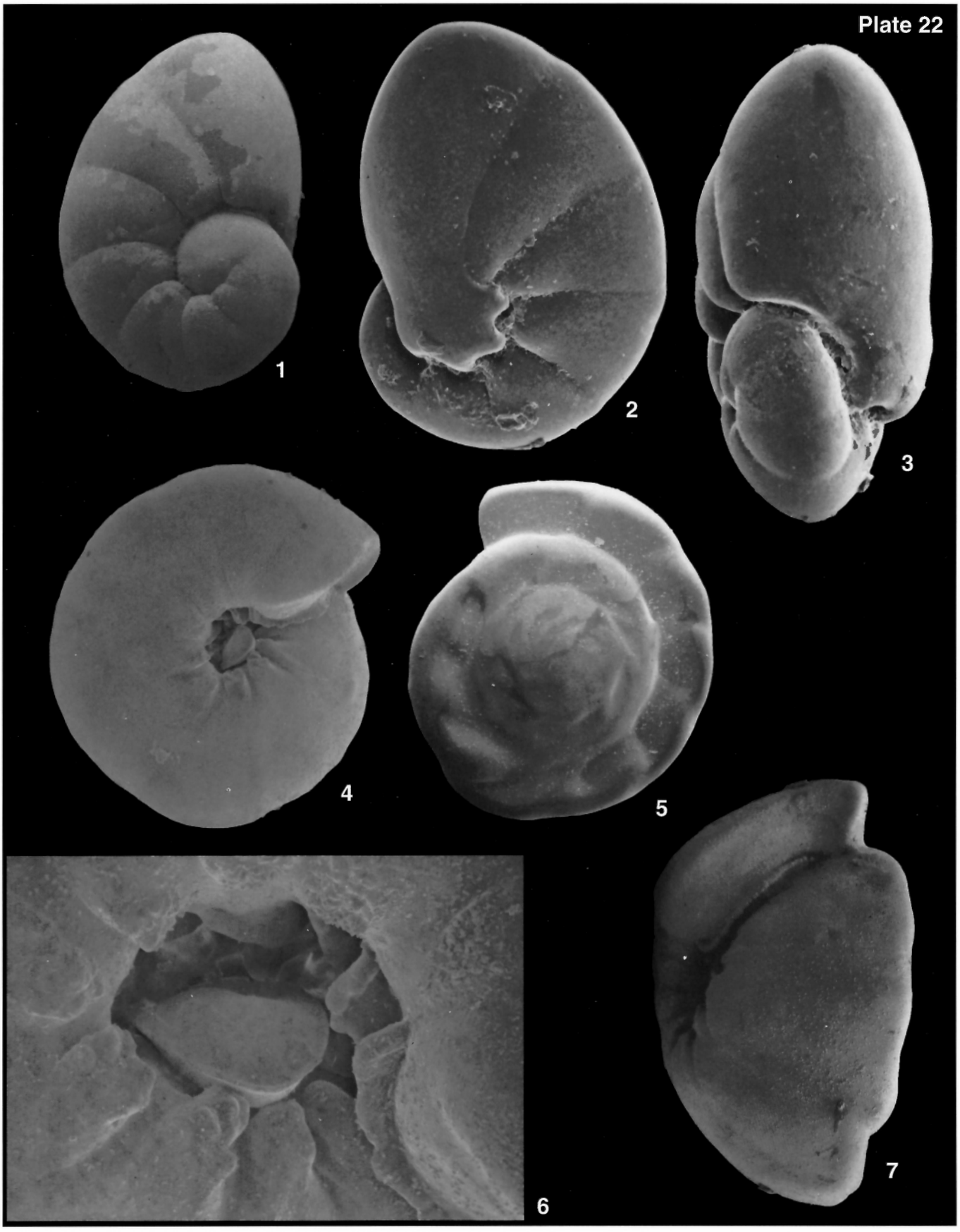
Plate 22
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PLATE 23

Illustrated specimens in figures 1, 2, and 8 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 3-5 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound; figures 6 and 7 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island.

Figures 1, 2. *Nonionellina labradorica* (Dawson), GSC 99382, hypotype, from interval 56-59 cm.

1. Apertural view showing characteristic broad flattened apertural face, x200.
2. Side view, x158.

Figures 3-5. *Pseudononion basispinata* (Cushman and Moyer), GSC 99383, hypotype, from interval 504-506 cm.

3. Umbilical view showing large pustules developed in umbilicus and along deeply incised sutures, x123.
4. Spiral view, x122.
5. Edge view showing slightly eccentric coiling of mature *Pseudononion*, x124.

Figures 6, 7. *Astrononion gallowayi* Loeblich and Tappan, GSC 99384, hypotype, from interval 6-8 cm.

6. Edge view of coarsely perforate specimen, x203.
7. Edge view showing less perforated material infilling sutural and umbilical depressions, x139.

Figure 8. *Nonionella* cf. *N. turgida* (Williamson), GSC 99385, hypotype, from interval 56-59 cm.

Umbilical view showing characteristic elongate chambers, x346.

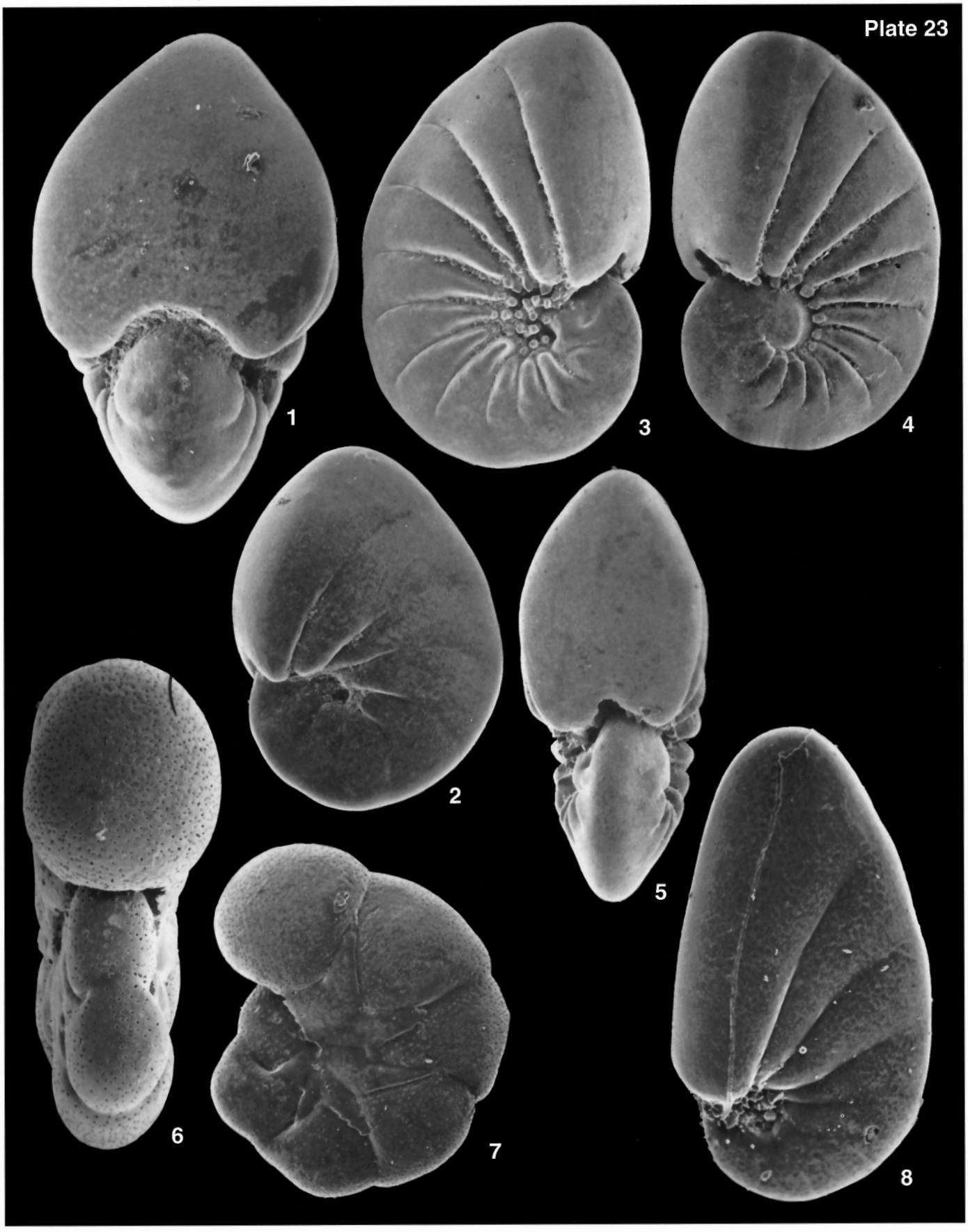
Plate 23
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PLATE 24

Illustrated specimens in figures 1-3 are from core END 87A-23, latitude 50°59.94', longitude 128°26.55', Cook Bank off the northwestern tip of Vancouver Island; figures 4 and 5 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 6-8 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound.

Figures 1-3. *Buccella depressa* Andersen, GSC 99386, hypotype, from interval 6-8 cm.

1. Dorsal view showing characteristic lobulate margin, x241.
2. Umbilical view showing numerous pustules concentrated along sutures, x215.
3. Edge view of compressed test, x258.

Figures 4, 5. *Pullenia salisburyi* Stewart and Stewart, GSC 99387, hypotype, from interval 56-59 cm.

4. Edge view of compressed specimen showing broad apertural opening, x256.
5. Side view of imperforate test showing slightly curved sutures, x246.

Figures 6-8. *Cribroelphidium foraminosum* (Cushman), GSC 99388, hypotype, from interval 228-232 cm.

6. Edge view showing multiple marginal apertural foramina, x116.
7. Side view showing coarsely perforate surface and elongate fossettes along sutures, x86.
8. Enlargement of large umbilical openings showing pustules lining walls, x650.

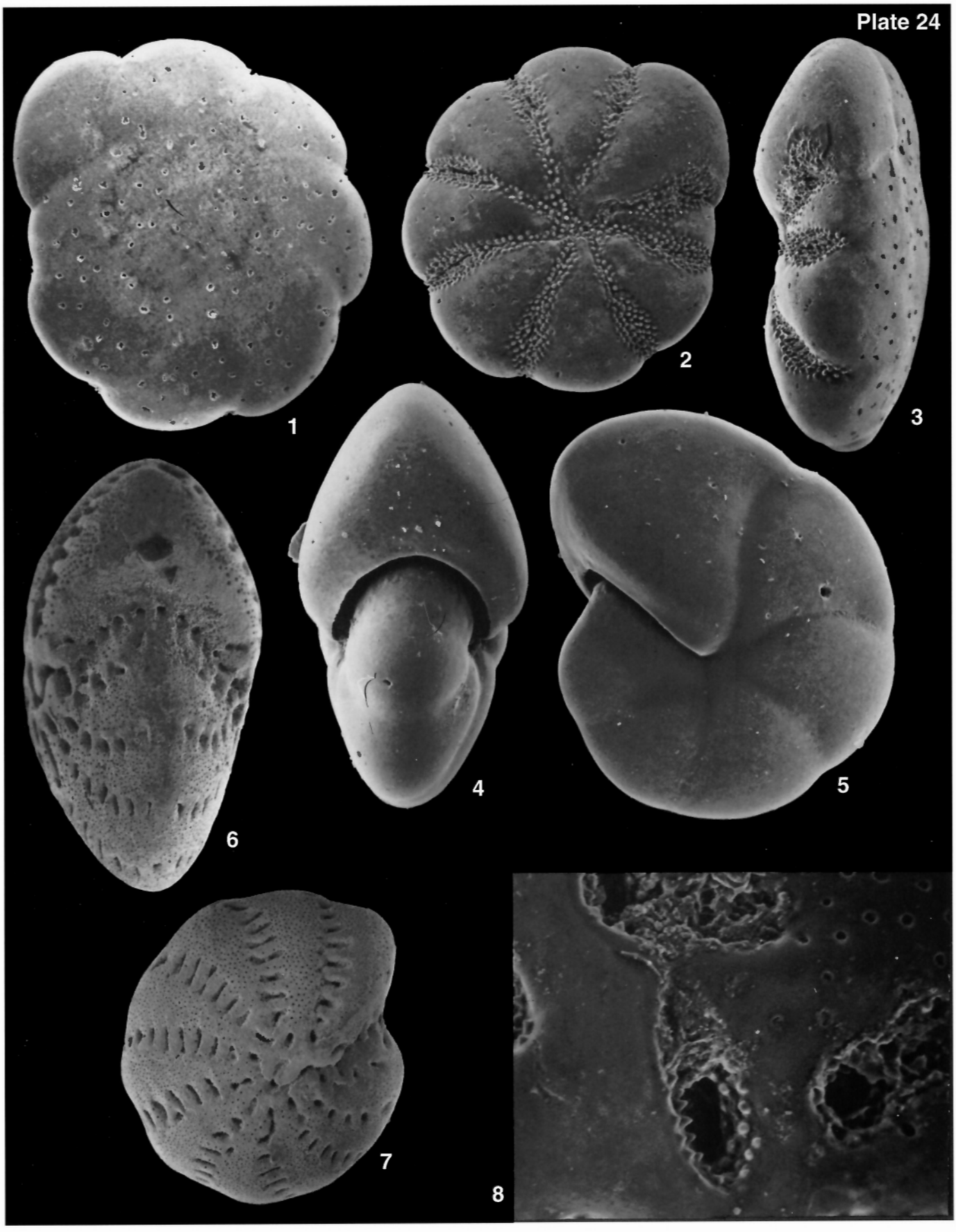
Plate 24
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PLATE 25

Illustrated specimens in all figures of this plate are from END 84B-04, latitude 52°14.72', longitude 130°09.05' margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands.

Figures 1-3. *Cribroelphidium hallandense* (Brotzen); 1, 2, GSC 99389, hypotype, from interval 71-75 cm; 3, GSC 99390, hypotype, from interval 377-381 cm.

1. Side view showing pustules concentrated along sutures, x179.
2. Edge view showing pustules concentrated in apertural region, x300.
3. Side view; dissolution has exposed multiple fossettes opening along sutures, x139.

Figures 4, 5. *Cribroelphidium excavatum* (Terquem), GSC 99391, hypotype, from interval 215-219 cm.

4. Apertural view showing a few pustules developed in the apertural region, x270.
5. Side view showing pustules developed within gently curved, incised sutures and surrounding umbilical plug, x235.

Figures 6-8. *Buccella frigida* (Cushman), GSC 99392, hypotype, from interval 342-345 cm.

6. Edge view of slightly compressed hypotype, x217.
7. Dorsal view showing lobulate but rounded periphery, x160.
8. Ventral view showing numerous pustules concentrated along incised sutures, x132.

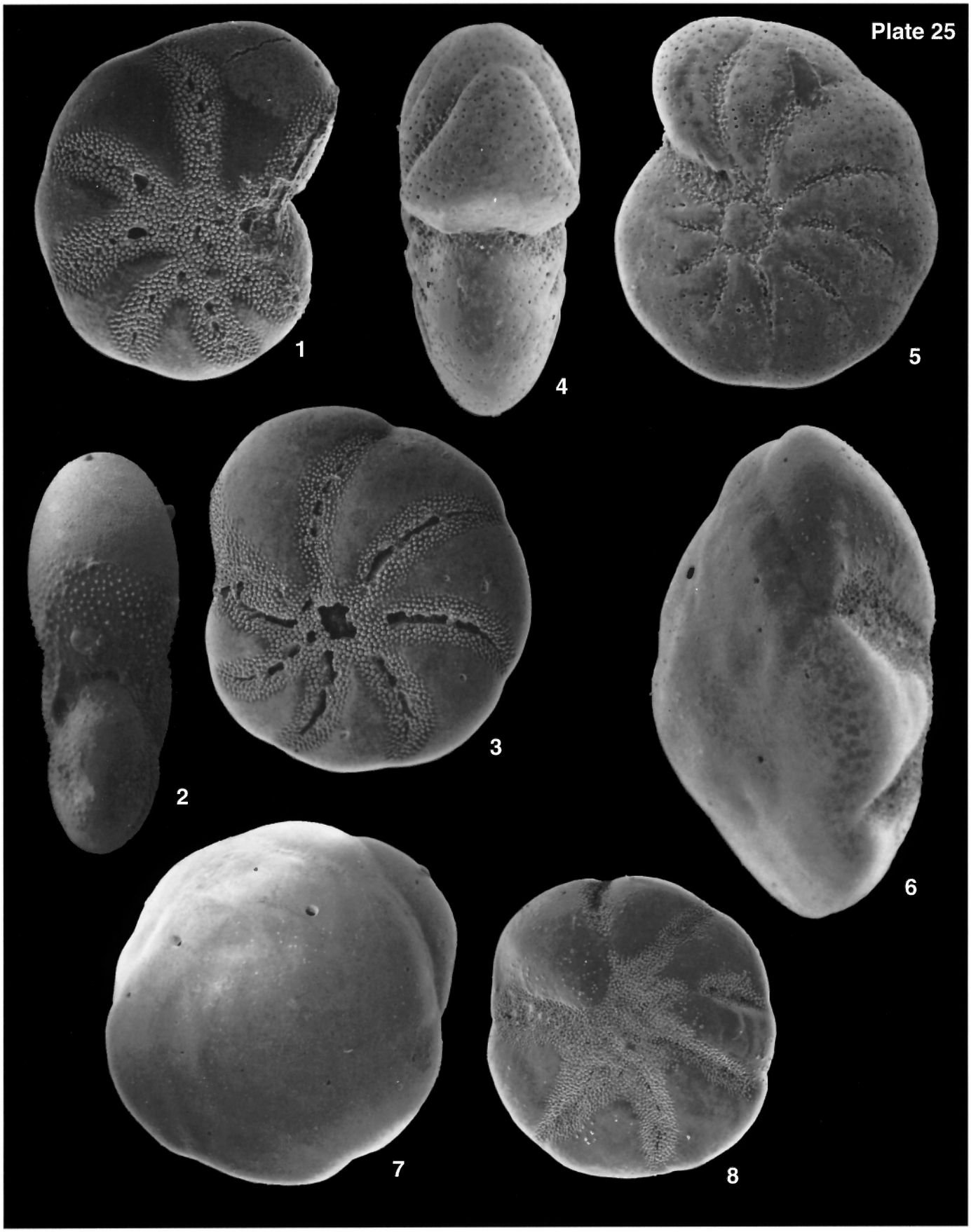
Plate 25
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PLATE 26

Illustrated specimens in figures 1 and 2 are from END 84B-04, latitude 52°14.72', longitude 130°09.05', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 3 and 4 are from END 84B-08, latitude 51°31.07', longitude 128°23.11', margin of Goose Island Trough, central Queen Charlotte Sound; figures 5 and 6 are from END 90A-06, latitude 54°35.02', longitude 131°16.43', Dixon Entrance northeast of Queen Charlotte Islands.

Figures 1, 2. *Cribroelphidium excavatum* (Terquem), GSC 99393, hypotype, from interval 377-381 cm.

1. Edge view of compressed test showing coarsely perforate surface; final chamber of this specimen has been broken, x272.
2. Side view showing deeply incised sutures and characteristic pustule development along sutures, x206.

Figures 3, 4. *Elphidiella hannai* (Cushman and Grant), GSC 99394, hypotype, from interval 517-520 cm.

3. Side view showing characteristic double rows of pores along sutures, x106.
4. Apertural view showing highly developed array of pustules on apertural face, x146.

Figures 5, 6. *Trochammina* cf. *T. charlottensis* Cushman, GSC 107911, hypotype, from interval 4-6 cm.

5. Spiral side view showing incised sutures, x270.
6. Umbilical side view showing deeply incised sutures, note that the last chamber is broken, x350.

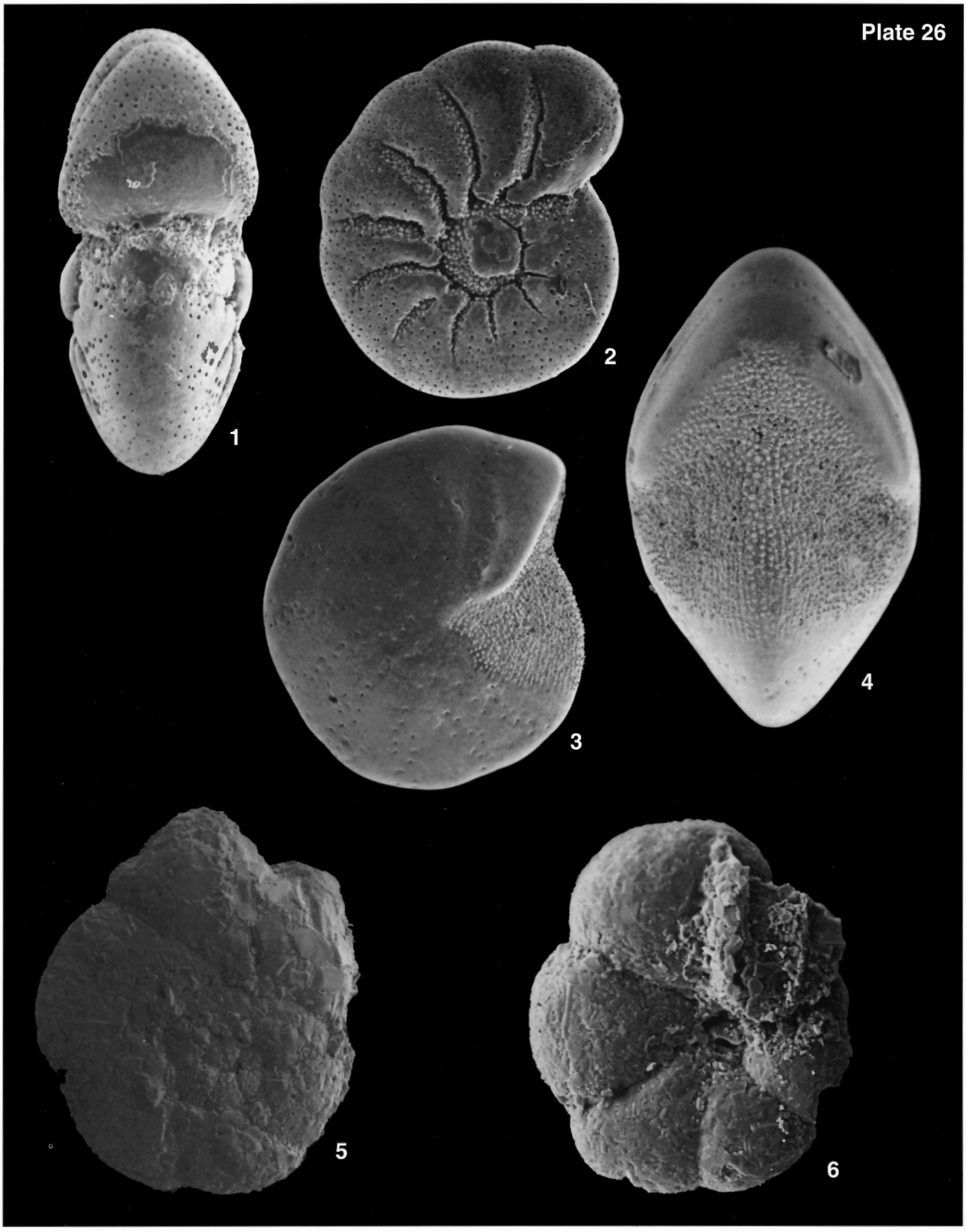
Plate 26
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PLATE 27

Illustrated specimens in figures 1 and 2 are from FD 87A-1, latitude 49°03.25', longitude 123°03.95', Fraser Delta; figures 3 and 4 are from END 84B-07, latitude 52°16.70', longitude 130°12.27', margin of Moresby Trough off southeastern tip of the Queen Charlotte Islands; figures 5-7 are from END 90A-07, latitude 54°34.92', longitude 131°43.07', Dixon Entrance northeast of Queen Charlotte Islands.

Figures 1, 2. *Siphonaperta stalkeri* (Loeblich and Tappan), GSC 107912, hypotype, from interval 153.8 m.

1. Side view showing terminal aperture with tooth, x300.
2. Apertural view showing triangular cross-section, x430.

Figures 3, 4. *Quinqueloculina akneriana* d'Orbigny, GSC 107913, hypotype, from interval 531-533 cm.

3. Side view with 3 chambers visible, apertural end of this specimen is broken, x250.
4. Apertural view showing tooth, x300.

Figures 5-7. *Siphonaperta agglutinata* (Cushman); 5, 6, GSC 107914, hypotype, from interval 531-533 cm; 7, GSC 107915, hypotype, from interval 590-592 cm.

5. Apertural view showing angular periphery, x220.
6. Side view with 4 chambers visible x170.
7. Side view showing 3 chambers, x120.

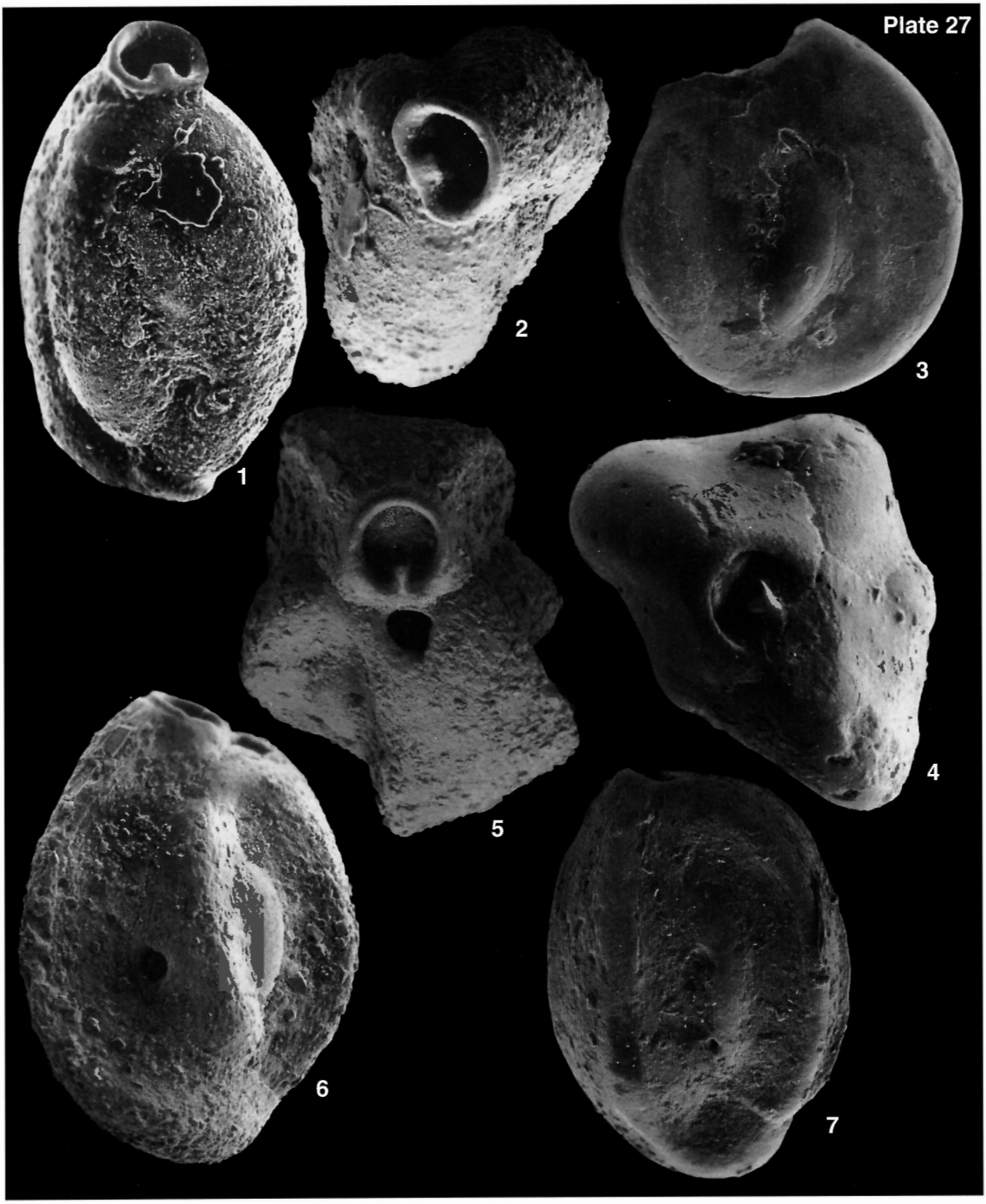
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PLATE 28

Illustrated specimens in figures 1, 2, 4, and 5 are from END 90A-02, latitude 54°25.24', longitude 132°50.10'; figure 3 is from END 90A-07, latitude 54°34.92', longitude 131°43.07' and figure 6 is from END 90A-06, latitude 54°35.02', longitude 131°16.43', Dixon Entrance northeast of Queen Charlotte Islands.

Figures 1, 2. *Homalohedra guntheri* (Earland), GSC 107916, hypotype, 109-111 cm.

1. Side view of hypotype showing longitudinal costae and apertural neck, x190.
2. Apertural view showing hexagonal pits around the aperture, x250.

Figure 3. *Pyrgo lucernula* (Schwager), GSC 107917, hypotype, from interval 58-60 cm.

Side view showing slightly extended apertural neck, x270.

Figures 4, 5. *Homalohedra apiopleura* (Loeblich and Tappan), GSC 107918, hypotype, from interval 0-3 cm.

4. Side view showing longitudinal costae and apertural neck, x180.
5. Apertural view showing apertural collar surrounding round aperture, x270.

Figure 6. *Eggerella advena* (Cushman), GSC 107919, hypotype, from interval 3-5 cm.

Side view showing triangular shape, x500.

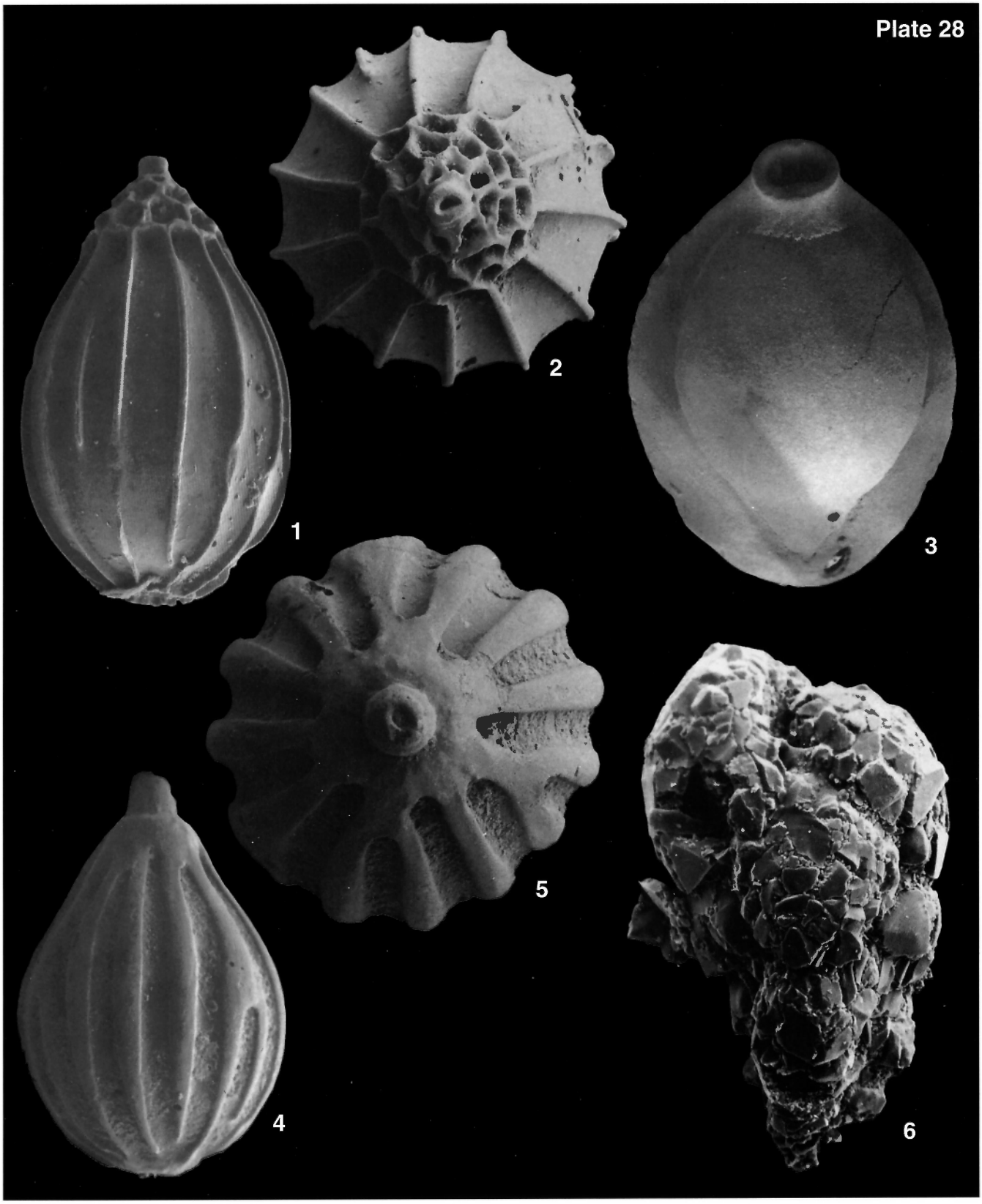
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PLATE 29

Illustrated specimens in figures 1, 2, 3, and 6 are from END 90A-02, latitude 54°25.24', longitude 132°50.10', and figures 4 and 5 are from 90A-04, latitude 54°18.89', longitude 132°32.96', Dixon Entrance northeast of Queen Charlotte Islands.

Figures 1, 2. *Entosolenia lineata* Williamson, GSC 107920, hypotype, from interval 4-6 cm.

1. Side view showing discontinuous longitudinal costae, x300.
2. Apertural view showing circular cross-section, x400.

Figure 3. *Lagena flatulenta* Loeblich and Tappan, GSC 107921, hypotype, from interval 270-272 cm.

Side view of hypotype, x130.

Figures 4, 5. *Lagena spicata* Cushman and McCulloch, GSC 107922, hypotype, from interval 3-5 cm.

4. Side view showing longitudinal costae, x250.
5. Apertural view, x330.

Figure 6. *Lagena striata* (d'Orbigny), GSC 107923, hypotype, from interval 25-27 cm.

Side view x190.

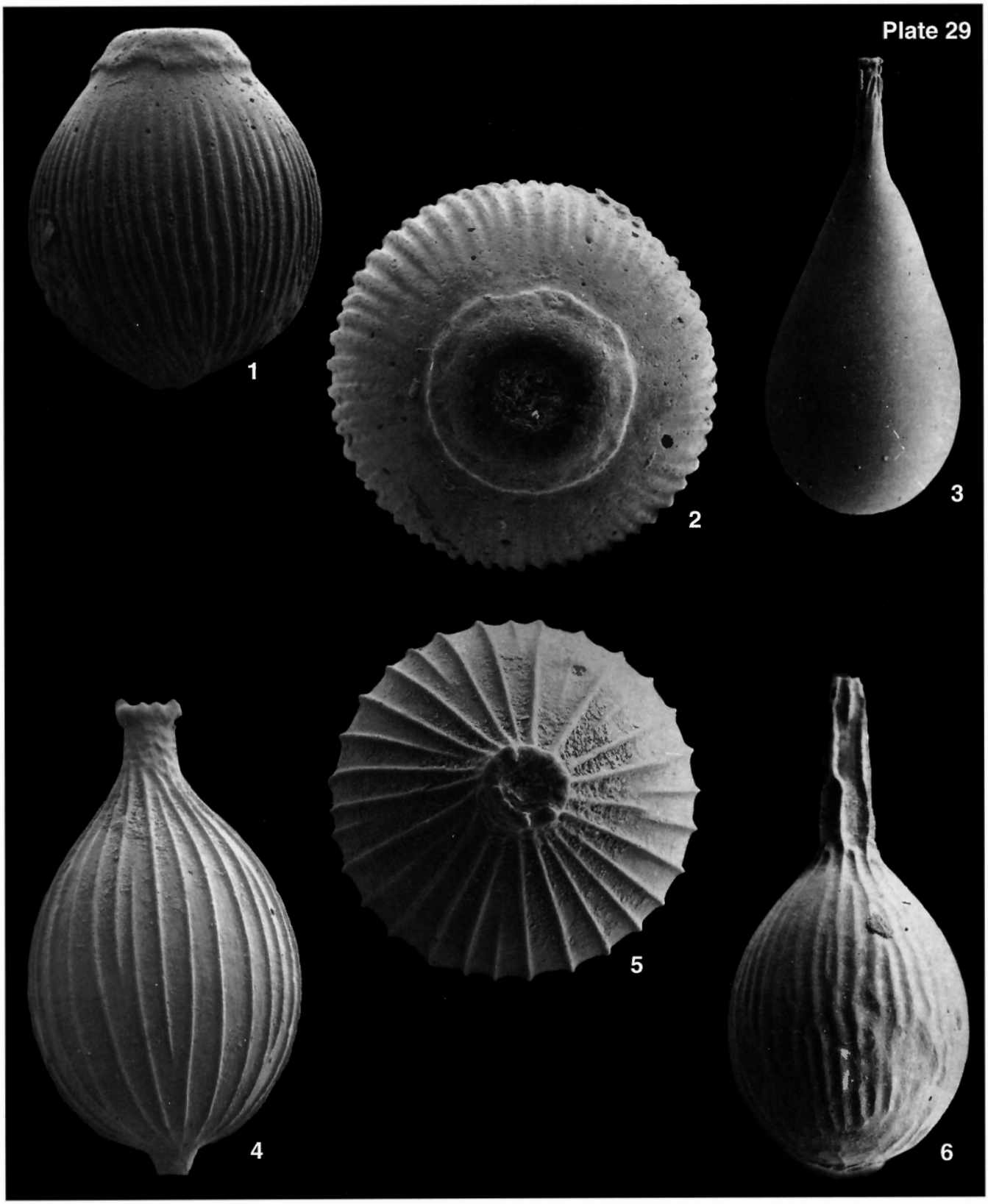
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PLATE 30

Illustrated specimens in figures 1-3 are from END 90A-04, latitude 54°18.89', longitude 132°32.96'; figures 4 and 6 are from END 90A-07, latitude 54°34.92', longitude 131°43.07' and figure 5 is from END 90A-02, latitude 54°25.24', longitude 132°50.10', Dixon Entrance northeast of Queen Charlotte Islands.

Figures 1-3. *Ehrenbergina compressa* Cushman, GSC 107924, hypotype, from interval 142-144 cm.

1. Front view showing apertural lip, x230.
2. Apertural view showing compressed test, x370.
3. Side view showing distinct sutures, the last 2 chambers of this specimen are broken, x250.

Figures 4-6. *Glabratella ornatissima* (Cushman); 4, 6, GSC 107925, hypotype, from interval 590-592 cm; 5, GSC 107926, hypotype, from interval 61-63 cm.

4. Ventral side view of megalospheric specimen, x150.
5. Edge view of 2 specimens joined during plastogamy, x120.
6. Dorsal side view showing pores, x130.


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PLATE 31

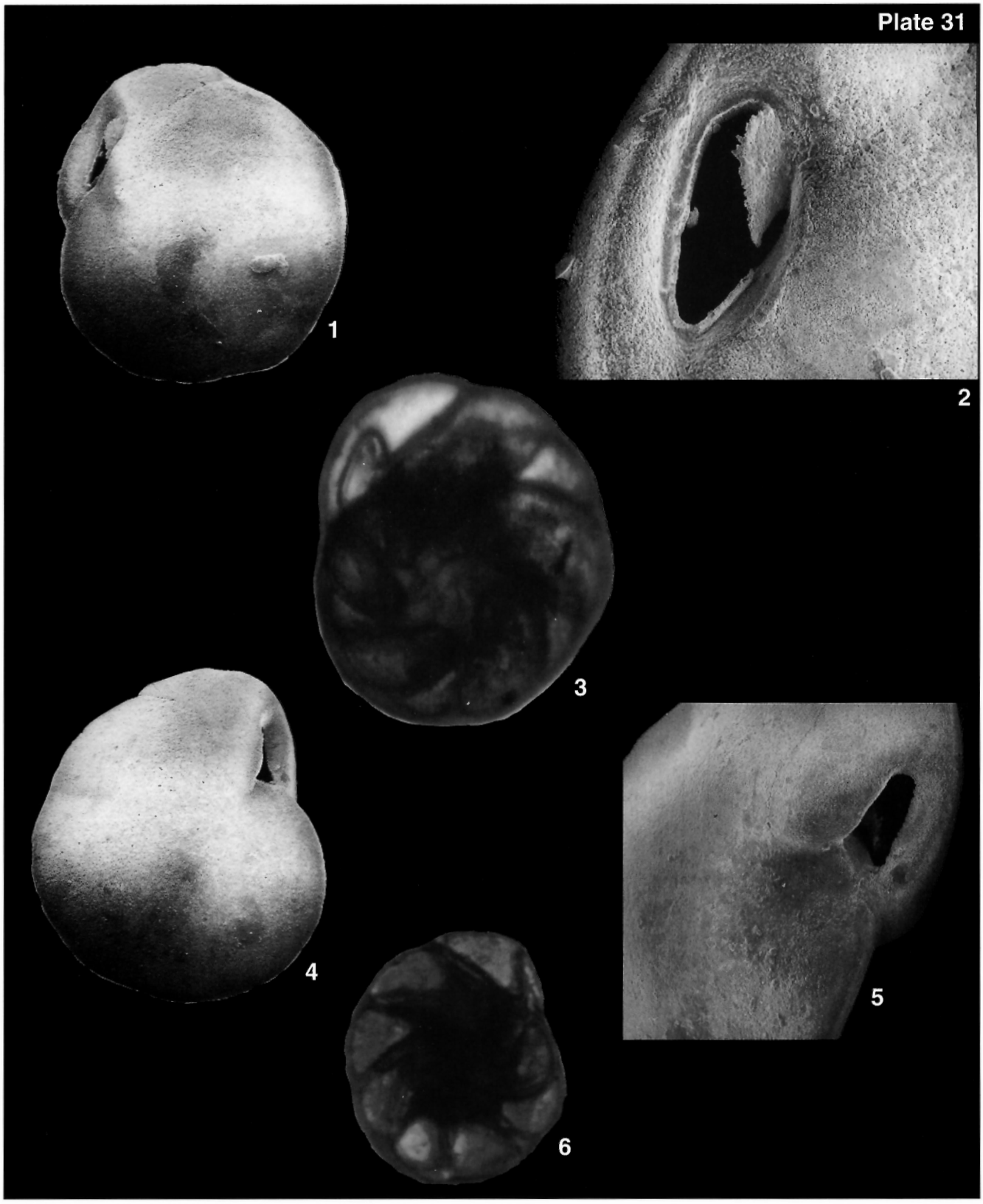
Illustrated specimens in all figures of this plate are from END 84B-10, latitude 51°28.14', longitude 128°25.14', Goose Island Trough, central Queen Charlotte Sound.

Figures 1-3. *Islandiella helenae* Feyling-Hanssen and Buzas, GSC 108830, hypotype, from interval 680-683 cm.

1. Side view showing smooth surface and positioning of broad slitted aperture along periphery, x230.
2. Close-up of apertural region showing protruding tooth plate and fine pores, x750.
3. Transmitted light photograph showing jelly bean-shaped chambers oriented at 45° to umbilicus, x250.

Figures 4-6. *Islandiella norcrossi* (Cushman), GSC 108831, hypotype, from interval 358-361 cm.

4. Side view showing smooth surface and nearly planispiral positioning of aperture, x300.
5. Close-up of apertural region showing internal tooth and fine pores, x500.
6. Transmitted light photograph showing chambers all oriented toward umbilical region, x250.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