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Upper Cretaceous (Campanian and Maestrichtian) foraminifera from the upper Lambert and Northumberland formations, Gulf Islands, British Columbia, Canada

ABSTRACT

Campanian and Maestrichtian foraminifera herein described from the study area include: *Gaudryina laevigata* Franke, *Lagenammina* sp., *Ammodiscus cretaceus* (Reuss), *Spiroplectammina semicomplanata* (Carsey), *S. (Textularia) laevis* (Roemer), *Praebulimina carseyae* (Plummer), *P. petroleana* Cushman and Hedberg, *Marginulinopsis austinana* (Cushman), *Dentalina catenula* Reuss, *Stilostomella pseudoscripta* (Cushman), *Bolivina incrassata* Reuss, *Osangularia cordieriana* (d'Orbigny), *Gyroidinoides quadratus* (Cushman and Church), *G. goudkoffi* (Trujillo), *Globorotalites spineus* (Cushman), *Gavelinella henbesti* (Plummer), *G. velascoensis* (Cushman), *G. nacatochensis* (Cushman), *Cibicides beaumontianus* (d'Orbigny), *Rugoglobigerina rugosa* (Plummer), *Globotruncana arca* (Cushman), *G. linneiana* (d'Orbigny), *G. calcarata* (Cushman) and *G. contusa* (Cushman). Upper Campanian foraminifera include: *Rzehakina epigona* (Rzehak), *Silicosigmoilina californica* Cushman and Church, *Glomospirella cf. gaultina* (Berthelin), *Spiroplectammina gryzbowskii* (Frizzell), *Dorothia pupa* (Reuss), *Gravellina* sp., *Marssonella trochus* (d'Orbigny), *Fissurina orbignyana* Seguenza, *Pseudonodosaria mutabilis* Trujillo, *Lagena acuticosta* Reuss, *Lenticulina* spp., *Pullenia jarvisi* Cushman, *Globorotalites hiltermanii* (Kaeffer), *G. michelinianus* (d'Orbigny), *G. nitidus* (Reuss), *Hoeglundina* sp., *Anomalinoides clementiana* (d'Orbigny), *Globotruncana hilli* Pessagno, *G. rosetta* (Carsey), *Planoglobulina ornatissima* (Cushman and Church). The occurrence of the Tethyan planktonic form *Globotruncana calcarata* may mark the most northerly recorded occurrence of this species in the northeastern Pacific area. The Gulf Islands Cretaceous microfaunas probably represent a mixture of Tethyan, intermediate, and Boreal assemblages.

INTRODUCTION

Some of the more important and better preserved foraminifera forming the data base for the biostratigraphic and paleoecologic interpretations of McGugan (1979) are herein described and illustrated. The stratigraphic nomenclature followed is essentially that of Usher (1952) and McGugan (1962, 1964, 1979, 1981). For locations sampled, see text-figures 1–4.

McGugan (1962, 1964) first described Upper Cretaceous foraminifera from the Nanaimo group of the Vancouver Island area. Langhus (1968) made a detailed study of the distribution and paleoecology of foraminifera from the Trent River Formation on Lower Tsable River south of Comox, British Columbia and recognized the occurrence of Santonian and Campanian microfaunas. Scott (1974) studied the foraminifera from the lower part of the Cretaceous succession outcropping in the Comox and Nanaimo basins on southeastern Vancouver Island. Sliter (1973) discussed and illustrated some foraminifera from several localities in the Nanaimo Group, but did not indulge in formal taxonomic descriptions. Oliver (1979) studied in detail the foraminifera from the lower part of the Upper Cretaceous succession on Trent River, Vancouver Island. McGugan (1981) recorded Campanian foraminifera from wildcat exploratory well Charter et al. Saturna No. 1.

The numerous and diverse foraminiferal populations on which the present study is based result from greatly increased sampling density when compared with that used by McGugan (1962, 1964), the maximum stratigraphic thickness of interval samples being 5 ft (1.5 m).

SYSTEMATIC PALEONTOLOGY

The classification followed here is that of Loeblich and Tappan (1964, 1974) with minor modifications. Occurrences refer to figured specimens. Material is deposited in University of Calgary collections.

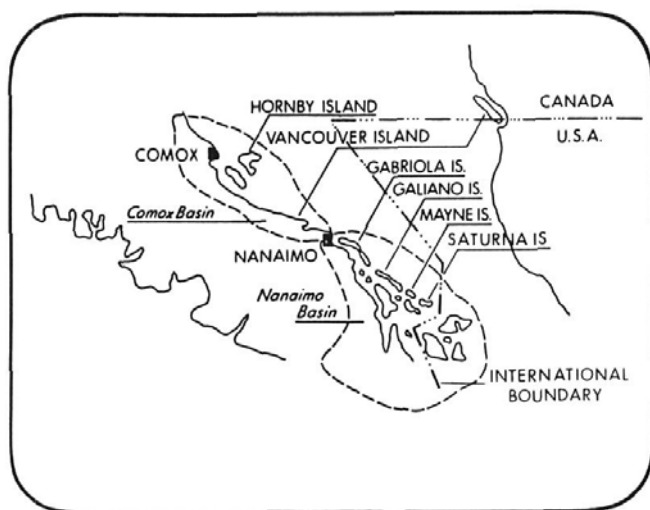
Family SACCAMMINIDAE Brady, 1884
Subfamily SACCAMMININAE Brady, 1884
Genus LAGENAMMINA Rhumbler, 1911

Lagenammina sp.

Plate 4, figure 6; plate 6, figures 8–9

Description: Test a single, flask-shaped chamber, wall finely agglutinated, aperture terminal, on neck. Length 0.4 mm; maximum width 0.2 mm.

Occurrence: Upper Northumberland Formation (Maestrichtian), Des-



TEXT-FIGURE 1
Location map of eastern Vancouver Island and the Gulf Islands.

canso Bay Roadcut, Gabriola Island, Sample 32, 1977. Lower Northumberland Formation (Campanian), Village Bay, Mayne Island, Sample 16, 1977 (pl. 4, fig. 6 only).

Family AMMODISCIDAE Reuss, 1862
Subfamily AMMODISCINAE Reuss, 1862
Genus AMMODISCUS Reuss, 1862

Ammodiscus cretaceus (Reuss)
Plate 4, figure 7

Operculina cretacea REUSS, 1845, p. 35, pl. 13, figs. 64–65.
Ammodiscus cretaceus (Reuss).—CUSHMAN, 1946, p. 17, pl. 1, fig. 35.—FRIZZELL, 1954, p. 58, pl. 1, fig. 15.—TAPPAN, 1962, p. 130, pl. 30, figs. 1–2.—GRAHAM and CHURCH, 1963, p. 17, pl. 1, fig. 17.—SLITER, 1968, p. 42, pl. 1, fig. 8.
Involutina cretacea (Reuss).—TAKAYANAGI, 1960, p. 67, pl. 1, figs. 10–12.

Description: Test flattened, discoidal, with proloculus followed by coiled planispiral, tubular chamber, without septae. Spiral suture distinct, depressed. Wall finely agglutinated. Aperture at open end of chamber. Diameter 0.7 mm; thickness 0.1 mm.

Occurrence: Upper Northumberland Formation, Descanso Bay Roadcut, Gabriola Island, Sample 2, 1972. Near base of section. Recorded range, Albian-Campanian.

Genus GLOMOSPIRELLA Plummer, 1945

Glomospirella* cf. *gaultina (Berthelin)
Plate 7, figures 5–6

Ammodiscus gaultinus BERTHELIN, 1880, p. 19, pl. 1, fig. 3.—TAPPAN, 1940, p. 95, pl. 14, fig. 6; 1943, p. 481, pl. 77, fig. 6.—FRIZZELL, 1954, p. 58, pl. 1, fig. 17.
Involutina gaultina (Berthelin).—TAKAYANAGI, 1960, p. 67, pl. 1, figs. 13–14.
Glomospirella gaultina (Berthelin).—TAPPAN, 1962, p. 130, pl. 29, figs. 17–20.—CRESPIN, 1963, p. 27, pl. 2, fig. 10.—SLITER, 1973, pl. 1, fig. 2.

Description: Test compressed, undivided tubular

chamber initially streptospirally coiled as in *Glomospira*, later planispiral as in *Ammodiscus*, three or four volutions. Wall finely agglutinated. Aperture open end of chamber. Diameter up to 0.5 mm; thickness 0.05 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 13, 1977.

The type species is from the Albian of France.

Family RZEHAKINIDAE Cushman, 1933
Genus RZEHAKINA Cushman, 1927

Rzehakina epigona (Rzehak)
Plate 7, figures 3A–4

Silicina epigona RZEHAK, 1895, p. 214, pl. 6, fig. 1.
Rzehakina epigona (Rzehak).—LOEBLICH and TAPPAN, 1964, p. C220, fig. 133, 1–3.—SLITER, 1968, p. 43, pl. 1, fig. 18.

Description: Test ovate, compressed, chambers planispiral, two per whorl, involute to somewhat evolute. Sutures indistinct, flush. Wall finely agglutinated. Aperture a rounded opening, terminal. Length 0.4 mm; width up to 0.3 mm; thickness 0.2 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 9, 1977. Recorded range, Upper Cretaceous-Paleocene.

Genus SILICOSIGMOILINA Cushman and Church, 1929

Silicosigmoilina californica Cushman and Church
Plate 7, figures 1–2B

Silicosigmoilina californica CUSHMAN and CHURCH, 1929, p. 502, pl. 36, figs. 10–12.—GRAHAM and CHURCH, 1963, p. 23, pl. 1, fig. 20.—MARTIN, 1964, p. 57, pl. 4, fig. 4.—SLITER, 1968, p. 43, pl. 1, figs. 13–15.

Description: Test oval, compressed. Early chambers planispirally coiled, later sigmoidal. Sutures indistinct, wall smooth, finely agglutinated. Aperture terminal, oval, with tooth. Length up to 0.6 mm; width up to 0.5 mm; thickness 0.2 mm.

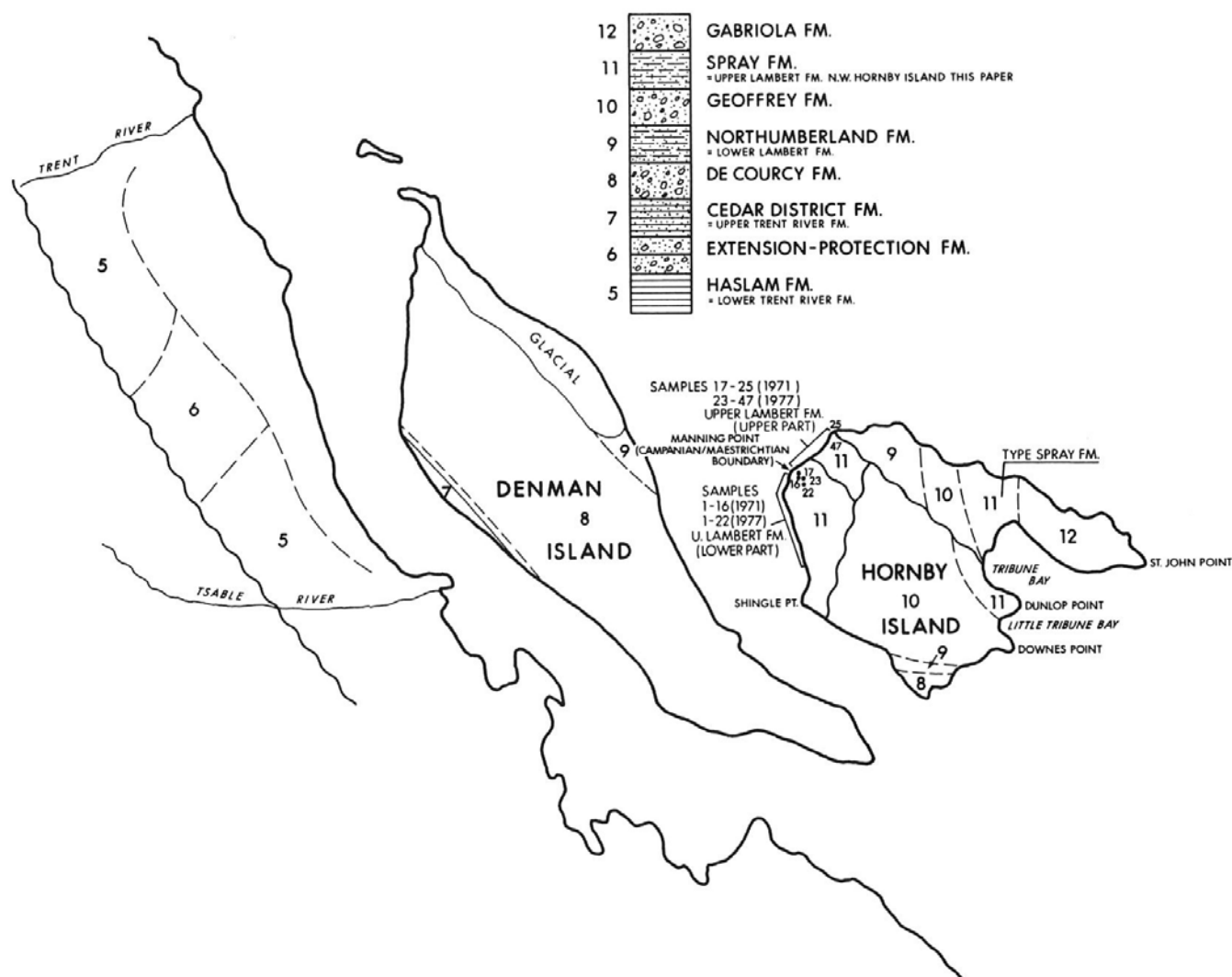
Discussion: This species is evidently tolerant of high stress environments, as it is frequently present as the dominant species or as the only species represented. In diversity plots it might indicate hyposaline conditions as in the Miliolina.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977.

Family TEXTULARIIDAE Ehrenberg, 1838
Subfamily SPIROPECTAMMININAE Cushman, 1927
Genus SPIROPECTAMMINA Cushman, 1927

Spiropectamina grzybowskii Frizzell
Plate 8, figure 4

Spiropectoides clotho (Grzybowski).—CUSHMAN and JARVIS, 1928, p. 101, pl. 14, figs. 13–14.
Spiropectoides(?) clotho (Grzybowski).—CUSHMAN, 1934, p. 42, pl. 6, figs. 20–23.



TEXT-FIGURE 2

Location map and sample localities on Hornby Island, Comox Basin. Geology after Muller and Jeletzky (1970).

Spiroplectammina grzybowskii FRIZZELL, 1943, p. 339, figs. 12a-b, 13.—BELFORD, 1960, pp. 7-8, pl. 1, figs. 4-6.—MCGUGAN, 1964, p. 939, pl. 150, fig. 1 (not 2).

Description: Test elongate, somewhat compressed, early four chambers planispiral, later about 18 biserial chambers low and broad. Sutures distinct, depressed, wall agglutinated, aperture a low arch at base of chamber. Length 0.5 mm; width 0.15 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977. The species ranges through the Campanian of the study area, and has been recorded from the Upper Cretaceous of Peru, Mexico and California.

***Spiroplectammina semicomplanata* (Carsey)**

Plate 4, figures 2-4; plate 7, figures 7-12; plate 8, figures 1-3

Textularia semicomplanata CARSEY, 1926, pl. 3, fig. 4.

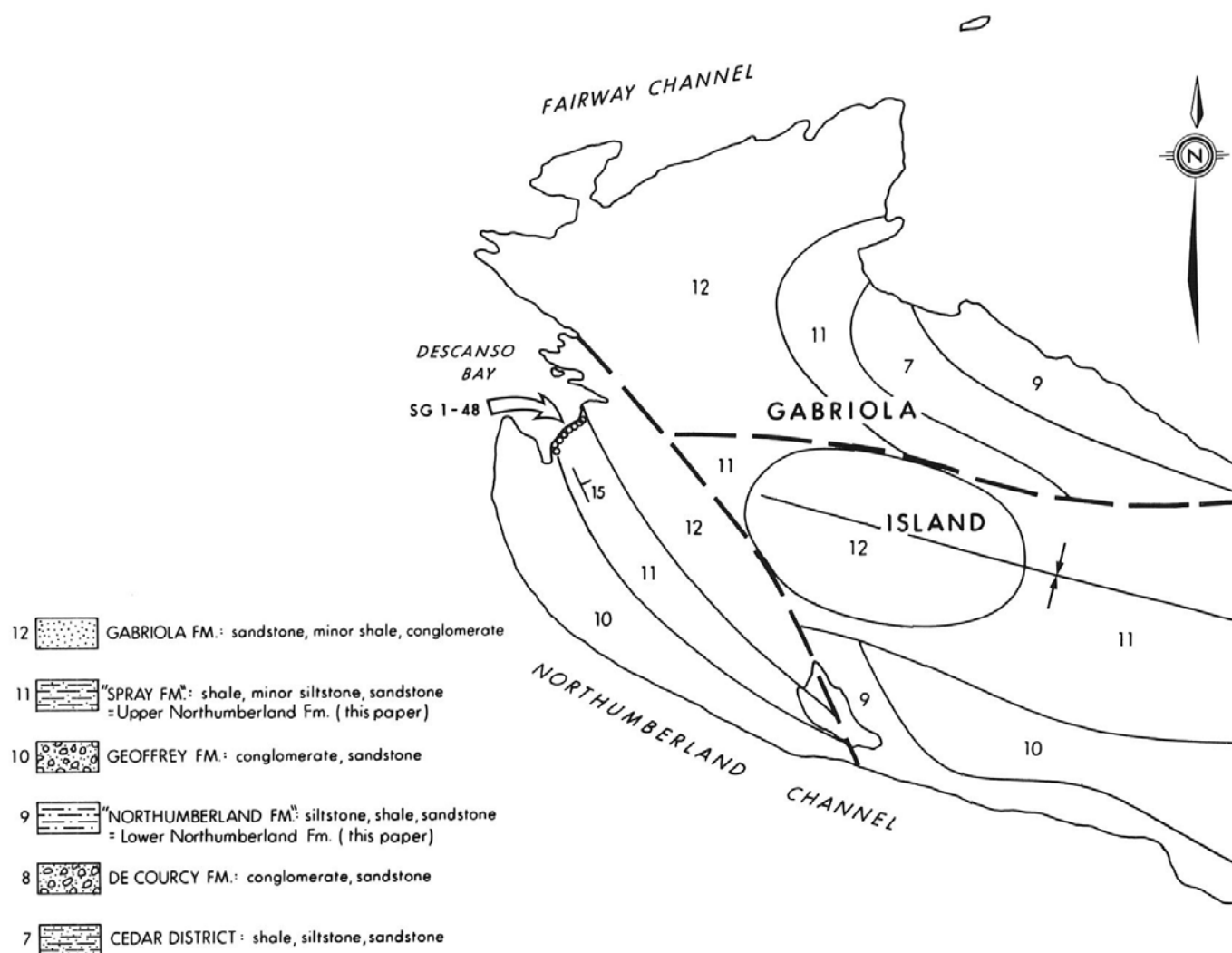
Spiroplectammina semicomplanata (Carsey).—GRAHAM and CHURCH, 1963, p. 23, pl. 1, figs. 10-11 (synonymy).

Spiroplectammina chicoana Lalicker.—SLITER, 1968, p. 46, pl. 2, fig. 8.

Description: Test variably elongate tapering to sub-parallel, compressed, periphery acute. Chambers low, broad, initially planispiral (about 5) later biserial (10-17). Sutures almost straight to slightly curved, flush with surface, wall moderately coarsely agglutinated to finely agglutinated. Aperture a low arch at base of chamber. Length 0.3 mm-0.7 mm; thickness 0.15 mm.

Discussion: Considerable variation in form is evident in the large populations available for study. Megalospheric individuals may be equivalent to species referred to the genus *Textularia* by some authors.

Occurrence: Upper Northumberland Formation (Maestrichtian), Descanso Bay Roadcut, Gabriola Island, Sample 32, 1977. Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample



TEXT-FIGURE 3

Location map and sample localities on Gabriola Island, Nanaimo Basin. Geology after Muller and Jeletzky (1970).

8, 1977. Recorded range, Upper Cretaceous to ?Paleocene (Taylor, Navarro and Midway groups).

***Spiroplectammina laevis* (Roemer)**

Plate 4, figure 5

Textularia laevis ROEMER, 1841, p. 97, pl. 15, fig. 17.

Spiroplectammina laevis (Roemer).—CUSHMAN, 1932, p. 87, pl. 11, fig. 2.—HOFKER, 1957, p. 61, fig. 58.—SLITER, 1968, p. 46, pl. 2, fig. 9.

Spiroplectammina laevis (Roemer) var. *cretosa* CUSHMAN, 1946, p. 27, pl. 6, figs. 1–3.

Description: Test tapering, subtriangular, compressed, periphery subacute. Chambers low, broad, initially planispiral (4), later biserial (22). Wall finely agglutinated, aperture a low arch at base of chamber. Length 0.3 mm; thickness 0.15 mm.

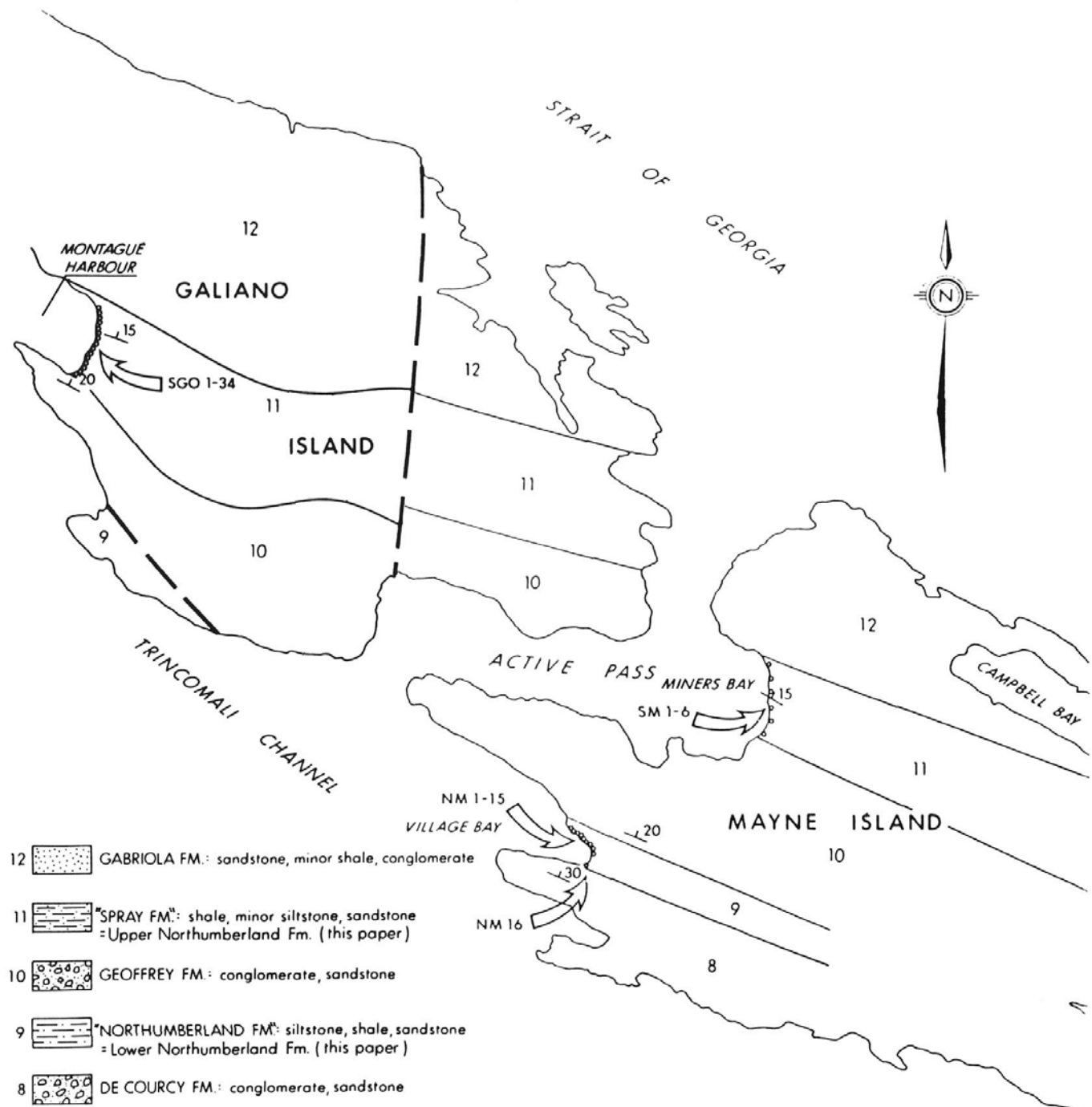
Occurrence: Upper Northumberland Formation (Maestrichtian), Descanso Bay Roadcut, Gabriola Is-

land, Sample 42, 1977 (near top). The original type specimens are from the Upper Cretaceous of Germany, and identical forms occur in the upper Taylor Group of Texas and the Rosario Formation of southern California.

?*Spiroplectammina* sp. A

Plate 8, figures 5–6

Description: Test elongate, biserial, agglutinated. The initial portion of both specimens is broken off, and generic affinities are therefore uncertain. However, it seems probable that the coiled initial chambers of *Spiroplectammina* have been broken off, as often is the case, with narrow elongate forms. Length up to 0.9 mm; width 0.1 mm. It is included here because of its unusually high length/width ratio, and because it may have a restricted stratigraphic range. More specimens



TEXT-FIGURE 4

Location map and sample localities on Galiano and Mayne islands, Nanaimo Basin. Geology after Muller and Jeletzky (1970).

would be necessary to erect a formal new species.
Mayne Island, Samples 8, 16, 1977.

Family ATAXOPHRAGMIDAE Schwager, 1877
Subfamily VERNEUILININAE Cushman, 1911
Genus GAUDRYINA d'Orbigny, 1839

Gaudryina laevigata Franke
Plate 1, figure 1; plate 4, figure 1

Gaudryina laevigata FRANKE, 1914, p. 431, pl. 27, figs. 1-2.—

CUSHMAN, 1946, p. 33, pl. 8, fig. 4.—FRIZZELL, 1954, p. 71, pl. 5, fig. 26.—BELFORD, 1960, p. 12, pl. 2, figs. 15-16.—TAKAYANAGI, 1960, p. 79, pl. 3, fig. 1.—GRAHAM and CHURCH, 1963, p. 20, pl. 1, fig. 12.—MARTIN, 1964, p. 52, pl. 3, fig. 2.—MCGUGAN, 1964, p. 940, pl. 150, figs. 6-8.—SLITER, 1968, p. 48, pl. 3, fig. 8.

Gaudryina pyramidata Cushman.—TRUJILLO, 1960, p. 308, pl. 44, fig. 9.

Description: Test large, robust, initial portion triserial, triangular, becoming biserial, inflated to subrectangular

in adult. Chambers indistinct in young, becoming conspicuous, overlapping with depressed sutures. Wall finely to coarsely agglutinated, aperture a low arch at inner margin of chamber face. Adults up to 1 mm in length; $\frac{1}{2}$ mm in width.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian). North shore Hornby Island, Sample 46, 1977. Upper Northumberland Formation (Maestrichtian), Descanso Bay Roadcut, Gabriola Island, Sample 2, 1972. This species ranges through the Cretaceous succession in the study area and in California in the Santonian to Maestrichtian.

Subfamily GLOBOTEXTULARIINAE Cushman, 1927
Genus MARSSONELLA Cushman, 1933

Marssonella trochus (d'Orbigny)
Plate 9, figures 1–2

Textularia trochus D'ORBIGNY, 1840, p. 45, pl. 4, figs. 225–226.
Marssonella trochus (d'Orbigny).—HOFKER, 1957, pp. 81–83, figs. 82–83.—GRAHAM and CHURCH, 1963, p. 21, pl. 1, figs. 6a–b (synonymy).

Description: Test conical, initially trochospiral, four or five chambers per whorl, later biserial. Chambers low, broad, sutures flush. Wall finely agglutinated, smooth. Aperture a low slit at inner margin of aperture face. Length 0.4 mm; width 0.3 mm. *Marssonella trochus* differs from *M. oxycona* (Reuss) in its curved outline in contrast to the straight sides of *M. oxycona*. However, some authors (Hofker, 1957) include a wide range of shapes within the species. Larger populations are necessary to evaluate the variation in *Marssonella* species.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977 (base of section). Original types are from the Upper Cretaceous of France. Range in California, Coniacian–Maestrichtian.

Genus DOROTHIA Plummer, 1931

Dorothia pupa (Reuss)
Plate 8, figures 7–8

Textularia pupa REUSS, 1860, p. 232, pl. 13, figs. 4a–b (not 5a–b).
Gaudryina crassa KARRER, 1870, p. 166, pl. 1, fig. 4.
Gaudryina pupoides FRANKE (not d'Orbigny), 1925, pl. 1, figs. 26a–b; 1928, p. 143, pl. 13, figs. 7a–b.
Textularia conulus Reuss var. *pupa* FRANKE, 1925, p. 11, pl. 1, figs. 12a–b; 1928, p. 132, pl. 12, figs. 5a–b.
Dorothia pupa (Reuss).—CUSHMAN, 1937a, p. 78, pl. 8, figs. 22, 24.—GRAHAM and CHURCH, 1963, p. 18, pl. 1, fig. 7.—MCGUGAN, 1964, p. 941, pl. 150, figs. 15–16.—SLITER, 1968, p. 50, pl. 4, fig. 1.

Description: Test stout, early portion with several chambers per whorl, reducing rapidly to two. Chambers inflated, sutures depressed. Wall finely agglutinated, aperture a low opening at inner margin of apertural face. Length 0.6 mm; width 0.4 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 7, 1977. This species is common in the Senonian of northwest Europe and was reported from the lower part of the upper Lambert Formation (upper Campanian) of Hornby Island by McGugan (1964). Original type specimens are from the Senonian of Germany, and the species occurs in the Campanian of California, England, Egypt and Australia.

Genus GRAVELLINA Bronnimann, 1953

Gravellina sp.
Plate 8, figures 9–13

Description: Test elongate, variable in shape, small, agglutinated, multi-serial, chambers difficult to observe, sutures flush. Aperture not observed. Length 0.3–0.6 mm; width 0.2–0.3 mm.

Discussion: This form is widespread in the Upper Cretaceous of the study area. A superficially similar form also widespread geographically and stratigraphically is apparently mainly biserial and probably referable to the genus *Gaudryina*.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977.

Superfamily NODOSARIACEA Ehrenberg, 1838
Family NODOSARIIDAE Ehrenberg, 1838
Subfamily NODOSARIINAE Ehrenberg, 1838
Genus DENTALINA Risso, 1826

Dentalina cf. *catenula* Reuss
Plate 1, figure 6

?*Dentalina catenula* REUSS, 1860, p. 185, pl. 3, fig. 6.—CUSHMAN, 1946, p. 59, pl. 20, figs. 5–10.

Description: Test elongate, slightly compressed, early portion coiled, later uncoiled, gently curved, chambers distinct, not inflated, sutures flush, slightly curved, wall smooth. Aperture radiate at outer peripheral angle. Length to 0.73 mm; width 0.2 mm.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 42, 1977. This species ranges through the Campanian and Maestrichtian of the study area. Original types are from the Austin Chalk and Brownstown Marl (Campanian).

Genus PSEUDONODOSARIA Boomgaard, 1949

Pseudonodosaria mutabilis (Reuss)
Plate 10, figures 6–7

Glandulina mutabilis REUSS, 1863, p. 58, pl. 5, figs. 7–11.
Rectoglandulina mutabilis (Reuss).—TRUJILLO, 1960, p. 326, pl. 47, fig. 2.

Description: Test elongate, moderately inflated, uni-serial, rectilinear. Chambers overlapping, sutures dis-

tinct, flush, wall calcareous perforate, smooth. Aperture terminal, radiate. Length 2.0 mm; width 0.13 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 13, 1977. Reuss reported this species from the Aptian and Albian in northern Germany, and Trujillo's specimens are from the Santonian of California.

Genus *LAGENA* Walker and Jacob in Kanmacher, 1798

***Lagena acuticosta* Reuss**

Plate 10, figure 8

Lagena acuticosta REUSS, 1862, p. 305, pl. 1, fig. 4.—CUSHMAN, 1946, p. 94, pl. 39, figs. 14–15.—SLITER, 1968, p. 63, pl. 6, figs. 22–23.

Description: Test subglobular, ornamented with 12 longitudinal costae dying out proximally. Aperture terminal on short neck. Length 0.2 mm; width 0.15 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 13, 1977. Original type specimens are from the Cretaceous of Holland, and the range in Gulf Coast sections is Austin to Navarro (Campanian to Maestrichtian).

Genus *LENTICULINA* Lamarck, 1804

***Lenticulina* sp.**

Plate 10, figures 9–10

Insufficient numbers of individuals were present to enable reliable evaluation of specific variation.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, figure 9, Sample 16, figure 10, Sample 8, 1977.

Genus *MARGINULINOPSIS* Silvestri, 1904

***Marginulinopsis austinana* (Cushman)**

Plate 1, figures 4–5

Marginulina austinana CUSHMAN, 1937b, p. 92, figs. 1–4; 1946, p. 59, pl. 20, figs. 5–10.

Description: Test elongate, compressed, early portion coiled, later uncoiled, dorsal side gently curved. Wall smooth, aperture radiate, at outer peripheral angle. Length up to 1.2 mm; width 0.4 mm.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 42, 1977. The types are from the middle part of the Gober tongue of the Austin Chalk (Campanian), Texas. It occurs at numerous localities in the upper Austin.

Family *GLANDULINIDAE* Reuss, 1860

Subfamily *OOLININAE* Loeblich and Tappan, 1961

Genus *FISSURINA* Reuss, 1850

***Fissurina orbignyana* Seguenza**

Plate 10, figure 5

Fissurina orbignyana SEGUENZA, 1862, p. 66, pl. 2, figs. 25–26.—

POZARYSKA, 1957, p. 61, pl. 6, figs. 1–3.—MARTIN, 1964, p. 63, pl. 5, fig. 9.—SLITER, 1968, p. 82, pl. 11, fig. 3.

Lagena orbignyana (Seguenza).—CUSHMAN, 1931, p. 39, pl. 6, fig. 2.

Description: Test one subglobular chamber with distinct sharp lateral keel. Wall calcareous, perforate, smooth. Aperture terminal, ovate. Length 0.3 mm; thickness 0.15 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977. This species occurs in the Rosario Formation of southern California (Campanian/Maestrichtian).

Superfamily *BULIMINACEA* Jones, 1875

Family *TURRILINIDAE* Cushman, 1927

Subfamily *TURRILININAE* Cushman, 1927

Genus *PRAEBULIMINA* Hofker, 1953

***Praebulimina carseyae* (Plummer)**

Plate 1, figure 3

Buliminella carseyae PLUMMER, 1931, p. 179, pl. 8, fig. 9.—CUSHMAN, 1946, p. 119, pl. 50, figs. 17–20.—CUSHMAN and PARKER, 1947, p. 58, pl. 15, fig. 8.—MARTIN, 1964, p. 88, pl. 11, fig. 11.

Buliminella hofkeri BROTZEN, 1936, p. 129, fig. 45, pl. 8, fig. 3.—TAPPAN, 1962, p. 186, pl. 48, figs. 11–15.

Bulimina cf. *aspera* Cushman and Parker.—MCGUGAN, 1964, p. 943, pl. 150, fig. 24.

Praebulimina carseyae (Plummer).—SLITER, 1968, p. 83, pl. 11, fig. 16.

Description: Test small, ovate, four chambers in last whorl, inflated, sutures depressed, wall calcareous, smooth, perforate; aperture loop-shaped in face of chamber. Length 0.5 mm; width 0.25 mm.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 47, 1977. This species ranges through the upper Campanian and Maestrichtian of the study area, and is often physically squashed or flattened. The species occurs in the Austin, Taylor, and lower Navarro groups in the Gulf Coast, the Senonian of Alaska, and the Santonian of central California.

***Praebulimina petroleana* (Cushman and Hedberg)**

Plate 2, figure 8; plate 4, figures 11–12

Bulimina petroleana CUSHMAN and HEDBERG, 1941, p. 95, pl. 22, fig. 31.—CUSHMAN and GOUDKOFF, 1944, p. 59, pl. 10, fig. 2.—CUSHMAN, 1946, p. 125, pl. 66, fig. 13.—MCGUGAN, 1964, p. 943, pl. 150, fig. 25.

Bulimina akkeshiensis YOSHIDA, 1963, p. 227, figs. 8–10.

Description: Test small, tapering rapidly, with five whorls. Chambers distinct, inflated, especially last three. Sutures distinct, compressed, curved. Wall of initial portion with short spines pointing toward initial chamber. Later smooth, calcareous, perforate. Aperture loop-shaped, at base of chamber with simple internal toothplate. Length 0.3 mm; maximum width 0.2 mm.

Discussion: This species may be related to *Praebulimina spinata* (Cushman and Campbell) (1935, p. 72, pl. 11, fig. 1), which was also described by Sliter (1968, p. 85, pl. 12, figs. 3–4).

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 18, 1971. Upper Northumberland Formation, Gabriola Island, Sample 31, 1977.

Family BOLIVINITIDAE Cushman, 1927

Genus BOLIVINA d'Orbigny, 1839

Bolivina incrassata Reuss

Plate 2, figures 9–11; plate 5, figures 1–2, 5

Bolivina incrassata REUSS, 1851, p. 29, pl. 5, fig. 13.—CUSHMAN and CAMPBELL, 1935, pl. 11, fig. 10.—FRIZZELL, 1954, p. 117, pl. 17, fig. 25.—HOFKER, 1957, p. 228, figs. 282–286, 291.—MCGUGAN, 1957, pp. 340, 341, pl. 23, figs. 1–4; 1964, p. 942, pl. 150, figs. 22–23.—GRAHAM and CHURCH, 1963, p. 52, pl. 5, fig. 26.—MARTIN, 1964, p. 90, pl. 11, fig. 14.—SLITER, 1968, p. 88, pl. 12, fig. 13.

Description: Test elongate, biserial, compressed, periphery subrounded. Chambers low, broad, arcuate, sutures limbate, flush to slightly depressed. Wall calcareous, perforate, smooth. Aperture loop-shaped, subterminal with internal toothplate. Megalospheric form sturdy (pl. 2, figs. 9–10). Microspheric form more slender (pl. 2, fig. 11). Length 0.6 mm; width up to 0.2 mm.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 17, 1971. Upper Northumberland Formation (Maestrichtian), Descanso Bay Roadcut, Gabriola Island, Sample 48, 1977 (near top of section). Upper Northumberland Formation (Maestrichtian), Montague Harbour, Galiano Island, Sample 27, 1977. In the present collection, the

species is restricted to the upper part (Maestrichtian) of the upper Lambert Formation in the Comox Basin and to the upper Northumberland Formation of the Nanaimo Basin. However, Oliver (1979) reported *B. incrassata* from Campanian shales on eastern Vancouver Island, and *B. incrassata* is known to occur in both upper Campanian and Maestrichtian strata elsewhere.

Family EOUVIGERINIDAE Cushman, 1927

Genus STILOSTOMELLA Guppy, 1927

Stilostomella pseudoscripta (Cushman)

Plate 1, figures 7–9; plate 4, figure 8

Nodosaria spinifera CUSHMAN and CAMPBELL, 1935, p. 71, pl. 10, figs. 9–10.—TRUJILLO, 1960, p. 328, pl. 47, fig. 7.

Ellipsonodosaria pseudoscripta CUSHMAN, 1937b, p. 103, pl. 15, fig. 14.

Nodogenerina spinosa HOFKER, 1956, p. 69, pl. 6, fig. 26.

Stilostomella spinosa (Hofker).—HOFKER, 1957, p. 142, fig. 164.

Siphonodosaria pseudoscripta (Cushman).—GRAHAM and CHURCH, 1963, p. 56, pl. 6, fig. 13.

Stilostomella pseudoscripta (Cushman).—NORTH and CALDWELL, 1964, p. 22, pl. 4, figs. 2–3.—SLITER, 1968, p. 90, pl. 13, figs. 6–7.

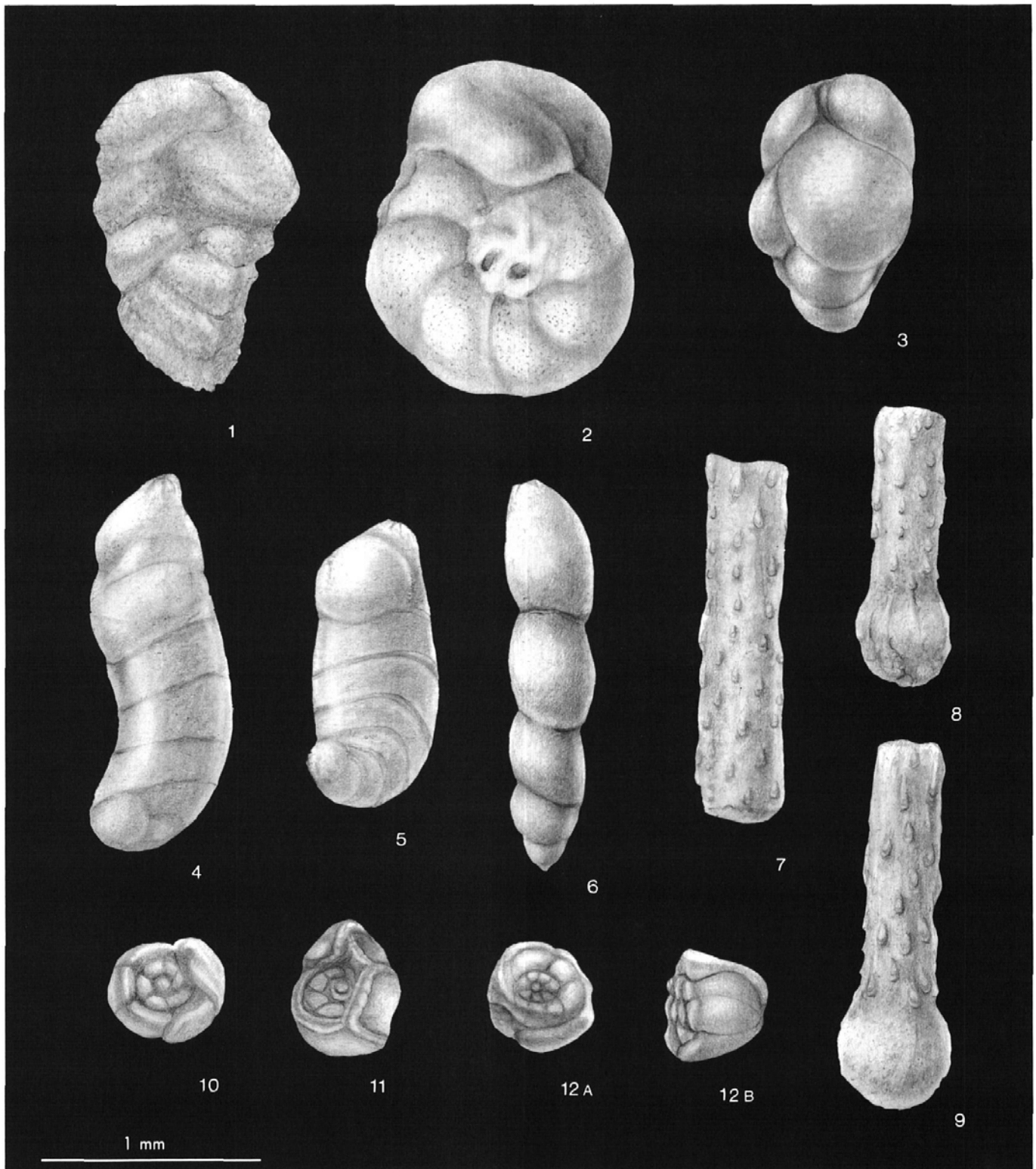
Description: Test elongate, uniserial, wall calcareous perforate, surface irregularly spinose at base of chambers. Specimens usually broken, somewhat variable in shape and degree of inflation of chambers. Aperture not observed.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 47, 1977. Upper Northumberland Formation (Maestrichtian), Descanso Bay Roadcut, Gabriola Island, Sample 31, 1977. The recorded range of this species is from Santonian to Maestrichtian, but in the study area may be restricted to Maestrichtian strata.

PLATE 1

Upper Lambert Formation, north shore Hornby Island. Campanian-Maestrichtian boundary at Manning Point. Samples 1–16 (1971), 1–22 (1977) are upper Campanian. Samples 17 upward (1971), 23 upward (1977) are Maestrichtian (see text-fig. 2). S = Sample. Scale line = 1 mm for all figures.

- | | |
|---|---|
| 1 <i>Gaudryina laevigata</i> Franke
Lateral view. N.H. 77. S. 46. | 6 <i>Dentalina</i> cf. <i>catenula</i> Reuss
Lateral view. N.H. 77. S. 42. |
| 2 <i>Cibicides beaumontianus</i> (d'Orbigny)
Spiral side. N.H. 71. S. 5. | 7–9 <i>Stilostomella pseudoscripta</i> (Cushman)
Lateral view. N.H. 77. S. 47. |
| 3 <i>Praebulimina carseyae</i> (Plummer)
Lateral view. N.H. 77. S. 47. | 10 <i>Gyroidinoides quadratus</i> (Cushman and Church)
Spiral side. N.H. 71. S. 11. |
| 4–5 <i>Marginulinopsis austinana</i> (Cushman)
Lateral view. N.H. 77. S. 42. | 11–12B <i>Gyroidinoides quadratus</i> (Cushman and Church)
Oblique and lateral views. N.H. 71. S. 8. |



Family HETEROHELICIDAE Cushman, 1927
Subfamily HETEROHELICINAE Cushman, 1927
Genus PLANOGLOBULINA Cushman, 1927

Planoglobulina ornatissima (Cushman and Church)

Plate 12, figures 8–9

Ventilabrella ornatissima CUSHMAN and CHURCH, 1929, p. 512, pl. 39, figs. 12–15.

Gublerina ornatissima (Cushman and Church).—GRAHAM and CHURCH, 1963, p. 61, pl. 7, fig. 10.—MARTIN, 1964, p. 86, pl. 11, fig. 3.—TAKAYANAGI, 1965, p. 200, pl. 20, figs. 6–8.—SLITER, 1968, p. 97, pl. 14, fig. 10; 1973, pl. 2, fig. 1.

Ventilabrella cf. austinana Cushman.—MCGUGAN, 1964, p. 942, pl. 150, fig. 21.

Planoglobulina ornatissima (Cushman and Church).—SLITER, 1968, p. 97, pl. 14, fig. 10.

Description: Test flattened, initial seven to nine chambers biserial as in *Heterohelix*, later flabelliform, with numerous chambers. Chambers subglobular, periphery rounded, sutures depressed, less so in adult. Wall calcareous, perforate, with longitudinal costate ornament on chambers, becoming smooth in latest chambers. Apertural details not preserved. Length 0.5 mm; width 0.3 mm; thickness 0.1 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Samples 13, 16, 1977. This species occurs in the Upper Cretaceous of the Gulf Coast, Eagle Ford shale to Taylor marl, Campanian-Maestrichtian.

Family GLOBOTRUNCANIDAE Brotzen, 1942
Genus RUGOGLOBIGERINA Bronnimann, 1952

Rugoglobigerina rugosa (Plummer)

Plate 3, figures 3A–C; plate 4, figures 9–10B

Globigerina rugosa PLUMMER, 1927, p. 38, pl. 2, fig. 10.—FRIZZELL, 1954, p. 127, pl. 20, figs. 1–6.

Rugoglobigerina rugosa (Plummer).—BOLLI et al., 1957, p. 42, pl.

11, figs. 1–5.—OLSSON, 1964, p. 173, pl. 7, figs. 2–5.—SLITER, 1968, p. 108, pl. 19, fig. 2; 1973, pl. 4, figs. 10–12.

Rugoglobigerina rugosa (Plummer).—CORMINBOEUF, 1961, p. 119, pl. 2, fig. 5.—HERM, 1962, p. 60, pl. 3, fig. 2.—BRONNIMANN and RIGASSI, 1963, pl. 8, fig. 1.

Globotruncana (*Rugoglobigerina*) *rugosa* (Plummer).—VAN HINTE, 1963, p. 92, pl. 11, figs. 1–3.

Description: Test trochospiral, biconvex, periphery rounded, about six chambers per whorl, globular, sutures slightly curved, depressed. Wall calcareous, perforate, with radiating rugose ornament. Umbilical structure not preserved. Diameter 0.3 mm; height 0.15 mm.

Occurrence: Upper Lambert Formation, lower part (upper Campanian), north shore Hornby Island, Sample 5, 1971. Upper Northumberland Formation (Maestrichtian), Descanso Bay Roadcut, Gabriola Island, Sample 31, 1977.

Rugoglobigerina rugosa and *R. pilula* (Santonian) are apparently related species which are sometimes difficult to separate. Also, *R. rugosa* was reported from Campanian strata by Oliver (1979). Recorded range in California and Gulf Coast Campanian-Maestrichtian.

Genus GLOBOTRUNCANA Cushman, 1927

Globotruncana arca (Cushman)

Plate 3, figures 4A–C; plate 5, figure 3; plate 11, figures 4A–6B, 8A–B

Pulvinulina arca CUSHMAN, 1926, p. 23, pl. 3, fig. 1.

Globotruncana arca (Cushman).—BANDY, 1951, p. 509, pl. 75, fig. 1.—BRONNIMANN and BROWN, 1956, p. 539, pl. 23, figs. 10–12.—BOLLI et al., 1957, p. 44, pl. 11, figs. 6–11.—MCGUGAN, 1957, pl. 34, fig. 15.—KLAUS, 1960, p. 824, pl. 7, fig. 5.—HERM, 1962, p. 67, pl. 7, fig. 3.—MARTIN, 1964, p. 79, pl. 9, fig. 4.—OLSSON, 1964, p. 162, pl. 4, figs. 1–3.—TAKAYANAGI, 1965, p. 209, pl. 23, figs. 1–2.—PESSAGNO, 1967, p. 321, pl. 79, figs. 5–

PLATE 2

Upper Lambert Formation, north shore Hornby Island, Campanian-Maestrichtian Boundary at Manning Point. S = Sample. Scale line = 1 mm for all figures.

1A–B *Gavelinella velascoensis* (Cushman)
1A, spiral side; 1B, apertural view. N.H. 71. S. 22. Manning Point.

2, 5 *Gavelinella* sp.
Spiral side. N.H. 71. S. 6.

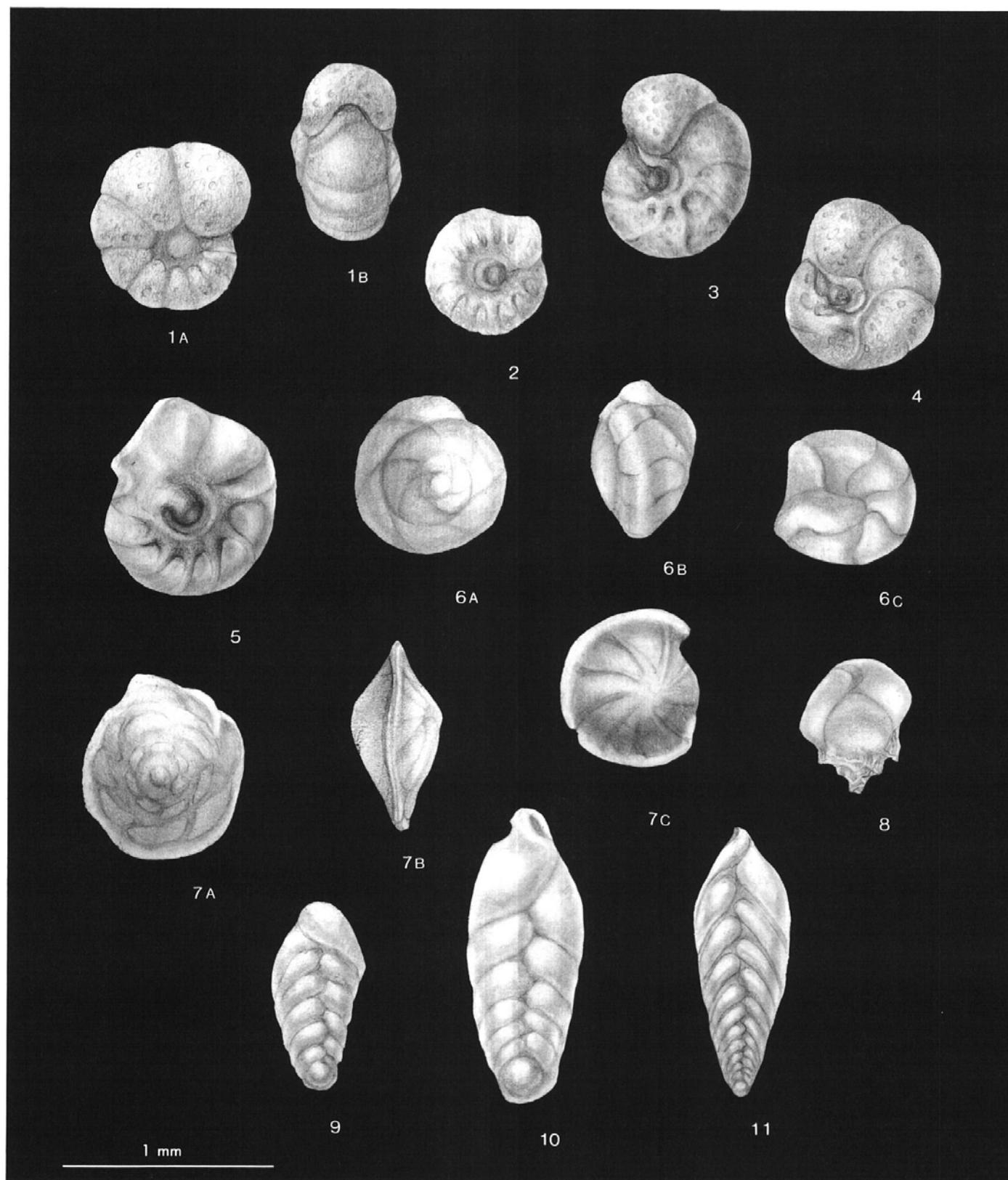
3–4 *Gavelinella nacatochensis* (Cushman)
Spiral side. N.H. 71. 3, S. 6; 4, S. 8.

6A–C *Gyroidinoides goudkoffi* (Trujillo)
6A, spiral side; 6B, lateral view; 6C, umbilical side. N.H. 71. S. 6.

7A–C *Osangularia cordieriana* (d'Orbigny)
7A, spiral side; 7B, lateral view; 7C, umbilical side. N.H. 77. S. 44.

8 *Praebulimina petroleana* (Cushman and Hedberg)
Lateral/apertural view. N.H. 71. S. 18.

9–11 *Bolivina incrassata* Reuss
Lateral views. 9, 10, megalospheric; 11, microcephalic. N.H. 71. S. 17.



8; pl. 90, figs. 6–8 (synonymy).—SLITER, 1968, p. 101, pl. 15, figs. 9–10; 1973, pl. 2, figs. 8–10.

Description: Test trochospiral, spiroconvex, periphery truncate with two distinct keels, six or seven chambers in last whorl, sutures on spiral side curved, raised, beaded. On umbilical side slightly curved, raised. Umbilical structures not preserved. Wall calcareous, perforate. Diameter 0.3 mm; height 0.2 mm.

Occurrence: Upper Lambert Formation (upper part), Maestrichtian, north shore Hornby Island, Sample 47, 1977 (top of section). Upper Northumberland Formation (Maestrichtian), Descanso Bay Roadcut, Gabriola Island, Sample 48, 1977 (top of section). Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Samples 13, 16, 1977 collection. Recorded range, Campanian–Maestrichtian in Alaska, North and South America, Europe, Russia, North Africa and Australia.

Globotruncana calcarata Cushman
Plate 3, figure 5; plate 6, figure 7

Globotruncana calcarata Cushman.—FRIZZELL, 1954, p. 128, pl. 20, fig. 23.—PESSAGNO, 1967, pp. 326–328, pl. 64, figs. 18–20; pl. 72, figs. 5–6 (synonymy).

Description: Test trochospiral, plano-convex, compressed, seven chambers in last whorl, single keeled, periphery with one spine per chamber. Spiral side flat. Sutures straight, elevated on spiral side, depressed on umbilical side. Umbilical structure not preserved. Diameter 0.4 mm; height 0.2 mm.

Occurrence: Upper Lambert Formation, lower part (uppermost Campanian), north shore Hornby Island, Sample 22, 1971. Upper Northumberland Formation, Miners Bay, Mayne Island, Sample 4, 1977. *Globotruncana calcarata* is a short-ranging species restricted to uppermost Campanian strata. This occurrence is the most northerly record in the northeastern Pacific area.

Globotruncana contusa (Cushman)
Plate 6, figures 4A–6C

Globotruncana arca (Cushman) Cushman var. *contusa* (Cushman).—CUSHMAN, 1926, p. 26.

Globotruncana contusa (Cushman).—PESSAGNO, 1967, pp. 330–333, pl. 75, figs. 18–20; pl. 77, figs. 1–9; pl. 78, figs. 6–11 (synonymy).

Description: Test high trochospiral, spiroconvex, six chambers in last whorl, sutures curved, raised, beaded. Two keels on early whorls, merging into one. Wall calcareous perforate.

Occurrence: Upper Northumberland Formation (Maestrichtian), Miners Bay, Mayne Island, Samples 4, 5, 1977. *Globotruncana contusa* is a global Maestrichtian index foraminifer. This occurrence may be the most northerly record in the northeastern Pacific area.

Globotruncana hilli Pessagno
Plate 11, figures 2A–B

Globotruncana hilli PESSAGNO, 1967, p. 343, pl. 64, figs. 9–14.—SLITER, 1973, pl. 3, figs. 4–6.

Description: Test small, trochospiral, six chambers in last whorl, first four lacking a double keel, last two with double keel. Chambers petaloid, curved slightly. Elevated sutures not conspicuously beaded. Umbilical and apertural features not preserved.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 13, 1977. Original types are from the Taylor Formation of the Gulf Coast.

Globotruncana sp.
Plate 3, figures 2A–B

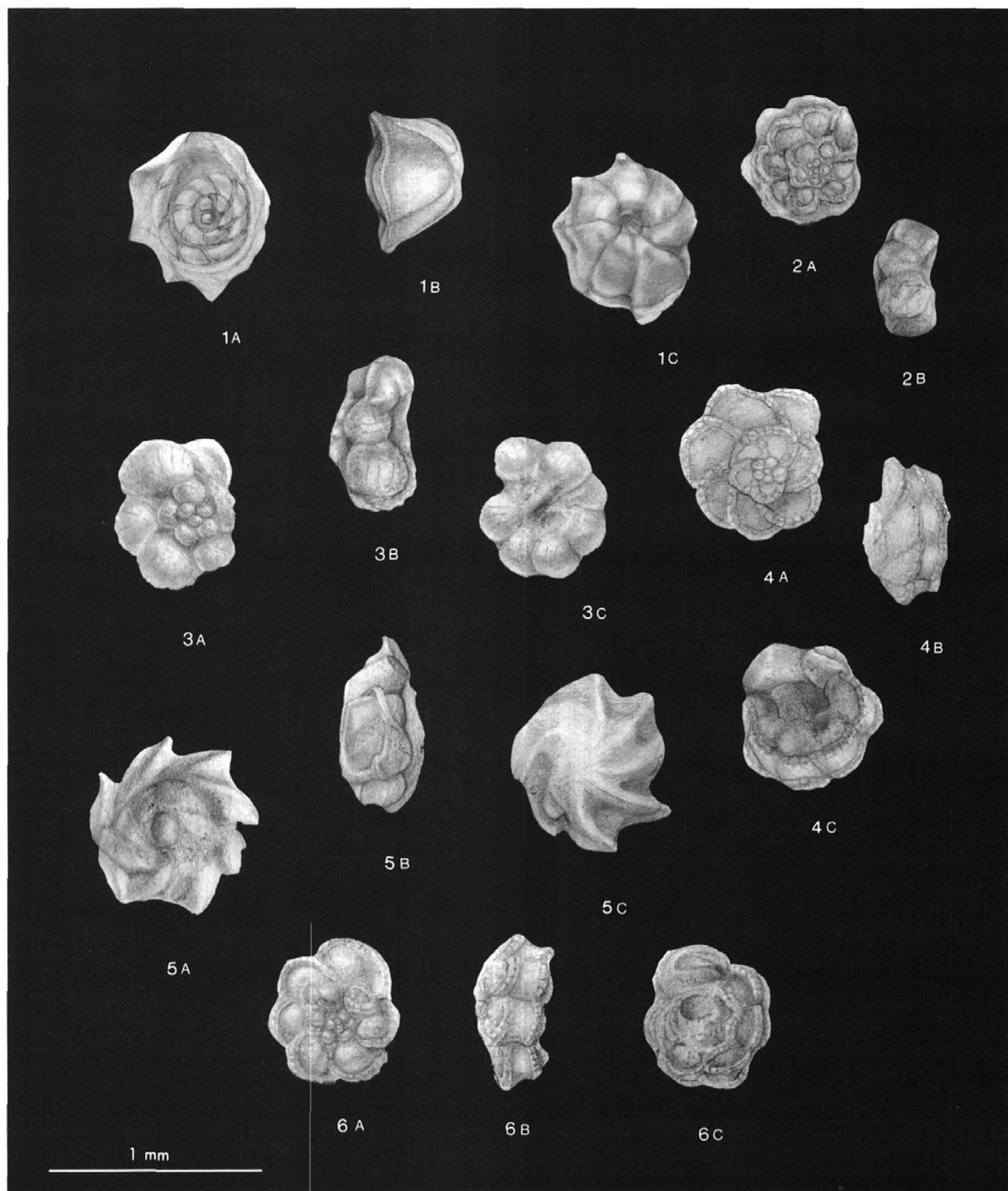
This form has affinities to *G. hilli* Pessagno. Preservation and lack of material preclude more precise diagnosis.

PLATE 3

Upper Lambert Formation, north shore Hornby Island. S = Sample. Scale line = 1 mm for all figures.

- 1A–C *Globorotalites spineus* (Cushman)
1A, spiral side; 1B, lateral view; 1C, umbilical side. N.H. 71. S. 34.
- 2A–B *Globotruncana* sp.
2A, spiral side; 2B, lateral view. N.H. 77. S. 41.
- 3A–C *Rugoglobigerina rugosa* (Plummer)
3A, spiral side; 3B, lateral view; 3C, umbilical side. N.H. 71. S. 5.

- 4A–C *Globotruncana arca* (Cushman)
4A, spiral side; 4B, lateral view; 4C, umbilical side. N.H. 77. S. 47.
- 5A–C *Globotruncana calcarata* Cushman
5A, spiral side; 5B, lateral view; 5C, umbilical side. N.H. 71. S. 22.
- 6A–C *Globotruncana* cf. *linneana* (d'Orbigny)
6A, spiral side; 6B, lateral view; 6C, umbilical side. N.H. 77. S. 41.



Occurrence: Upper Lambert Formation, north shore Hornby Island, N.H. 77. S. 41.

***Globotruncana ventricosa* White**

Plate 11, figures 3A–B

Globotruncana caniculata var. *ventricosa* WHITE, 1928, p. 284, pl. 38, fig. 5.

Globotruncana ventricosa White.—SACAL and DEBOURLE, 1957, p. 62, pl. 27, figs. 3, 5.—VAN HINTE, 1963, p. 86, pl. 7, fig. 3.—TAKAYANAGI, 1965, p. 226, pl. 29, fig. 1.—SLITER, 1968, p. 107, pl. 18, figs. 7–8; 1973, pl. 4, figs. 1–3.

Description: Test trochospiral, biconvex, umbilical side more convex, periphery truncate, two distinct keels. Six chambers in final whorl, sutures on spiral side curved, elevated, beaded, depressed on umbilical side. Wall calcareous, perforate. Umbilical and apertural details not preserved. Diameter 0.4 mm; thickness 0.25 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 13, 1977. Type *G. ventricosa* is from the Upper Cretaceous of Mexico, recorded range upper Coniacian–lower Maestrichtian.

***Globotruncana* sp.**

Plate 11, figure 10

Description: This poorly preserved form is similar to *G. ventricosa* but may be deformed pathogenically or by sediment pressure.

Occurrence: Northumberland Formation, Village Bay, Mayne Island, M.V.B. 77. S. 8.

***Globotruncana linneiana* (d'Orbigny)**

Plate 11, figures 7A–B, 9A–B; plate 12, figures 2A–4B, 6A–7C

Rosalina linneiana D'ORBIGNY, 1839, p. 101, pl. 5, figs. 10–12.

Globotruncana lapparenti lapparenti BROTZEN, 1936, p. 175.—HERM, 1962, p. 82, pl. 6, fig. 2.—TOLLMANN, 1960, p. 192, pl. 20, fig. 10.

Globotruncana caniculata (Reuss).—BANDY, 1951, p. 509, pl. 75, fig. 2.

Globotruncana linneiana (d'Orbigny).—BRONNIMANN and BROWN, 1956, p. 540, pl. 20, figs. 13–17; pl. 21, figs. 16–18.—BRONNIMANN and RIGASSI, 1963, pl. 17, fig. 5.—VAN HINTE, 1963, p. 75, pl. 5, figs. 1–2.—OLSSON, 1964, p. 166, pl. 2, figs. 6–8.—MARTIN, 1964, p. 81, pl. 10, fig. 3.—TAKAYANAGI, 1965, p. 217, pl. 26, fig. 1.—PESSAGNO, 1967, p. 346, pl. 72, figs. 1–2, 3–4, 7–9.—SLITER, 1968, p. 104, pl. 17, figs. 3–4.—SCOTT, 1974, p. 162, pl. 4, figs. 17–19.

Description: Test low trochospiral, spiral and umbilical sides nearly flat, periphery angular truncate with two keels. Side view subrectangular. Six or seven chambers in last whorl, sutures elevated, curved, limbate, beaded on spiral side, slightly curved to radial, depressed on umbilical side. Wall calcareous perforate. Umbilicus deep. Details of apertures not preserved. Diameter 0.25–0.5 mm; thickness 0.2 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Samples 1, 8, 16, 1977. Recorded range, upper Turonian to Maestrichtian.

***Globotruncana* cf. *linneiana* (d'Orbigny)**

Plate 3, figures 6A–C

This single, poorly preserved specimen occurs in the upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 41, 1977.

***Globotruncana rosetta* (Carsey)**

Plate 12, figures 1A–B, 5A–B

Globotruncana rosetta (Carsey).—PESSAGNO, 1967, p. 352, pl. 70, figs. 9–12; pl. 73, figs. 5–8 (synonymy).

PLATE 4

Upper Northumberland Formation, Descanso Bay Roadcut, Northwest Gabriola Island (Campanian/Maestrichtian). S = Sample. Scale line = 1 mm for all figures.

- | | |
|---|---|
| <p>1 <i>Gaudryina laevigata</i> Franke
Lateral view. S.G. 77. S. 32.</p> <p>2–4 <i>Spiroplectammina semicomplanata</i> (Carsey)
Lateral views. S.G. 77. S. 32.</p> <p>5 <i>Spiroplectammina laevis</i> (Roemer)
Lateral view. S.G. 77. S. 42.</p> <p>6 <i>Lagenammina</i> sp.
Lateral view. S.G. 77. S. 32.</p> | <p>7 <i>Ammodiscus cretaceus</i> (Reuss)
Side view. S.G. 72. S. 2.</p> <p>8 <i>Stilostomella pseudoscripta</i> (Cushman)
Lateral view. S.G. 77. S. 31.</p> <p>9–10B <i>Rugoglobigerina rugosa</i> (Plummer)
9, spiral side; 10A, spiral view; 10B, lateral view. S.G. 77. S. 31.</p> <p>11–12 <i>Praebulimina petroleana</i> Cushman and Hedberg
Lateral views. S.G. 77. S. 31.</p> |
|---|---|



Description: Test low trochospiral, spiral side slightly convex, umbilical side irregularly flat. Periphery lobulate, angular, with two irregular keels tending to merge to form single keel in last whorl. Six chambers in last whorl, spiral sutures raised, beaded, slightly curved, less beaded umbilically. Umbilicus deep, wide, details of apertures not preserved. Diameter 0.4 mm; thickness 0.15 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 1, 1977. Original types are from the Taylor Marl. Recorded range is Campanian to Maestrichtian but restricted to the Campanian in southern California.

Family NONIONIDAE Schultze, 1854
Genus PULLENIA Parker and Jones, 1862

Pullenia jarvisi Cushman
Plate 10, figure 17; plate 11, figure 1

Pullenia jarvisi CUSHMAN, 1936, p. 77, pl. 13, fig. 6.—MARTIN, 1964, p. 76, pl. 8, fig. 8.—MCGUGAN, 1957, p. 342, pl. 33, figs. 6–7.

Pullenia sp. cf. *P. jarvisi* Cushman.—GRAHAM and CHURCH, 1963, p. 69, pl. 18, fig. 15.

Description: Test planispiral, involute, compressed, biumbilicate, periphery rounded. Five chambers in final whorl, inflated. Sutures distinct, depressed, curved. Wall calcareous, finely perforate, smooth. Aperture a low interomarginal arch at base of apertural face. Diameter 0.3 mm; thickness 0.15 mm.

Occurrence: Lower Northumberland Formation (Campanian), Village Bay, Mayne Island, Samples 4, 13, 1977.

Family OSANGULARIIDAE Loeblich and Tappan, 1964
Genus OSANGULARIA Brotzen, 1940

Osangularia cordieriana (d'Orbigny)
Plate 2, figures 7A–C

Rotalia cordieriana D'ORBIGNY, 1840, p. 33, pl. 3, figs. 9–11.

Osangularia cordieriana (d'Orbigny).—HOFKER, 1957, p. 389, fig. 433.

Osangularia sp. GRAHAM and CHURCH, 1963, p. 67, pl. 6, figs. 25a–c.

Osangularia sp. cf. *O. cordieriana* (d'Orbigny).—GRAHAM and CHURCH, 1963, p. 59, pl. 7, fig. 4.—MCGUGAN, 1964, p. 946, pl. 152, fig. 2.

Osangularia cordieriana (d'Orbigny).—MARTIN, 1964, p. 102, pl. 15, fig. 2.—SLITER, 1968, p. 118, pl. 21, fig. 9.

Description: Test trochospiral, biconvex, periphery carinate. Seven chambers in final whorl. Sutures flush, curved. Wall calcareous, finely perforate, smooth. Aperture at base of final chamber. Diameter 0.4 mm; thickness 0.2 mm.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 44, 1977. D'Orbigny's types are from the Upper Cretaceous of the Paris Basin. The recorded range is Santonian-lower Maestrichtian.

Genus GLOBOROTALITES Brotzen, 1942

Globorotalites spineus (Cushman)
Plate 3, figures 1A–C; plate 9, figures 13A–B

Truncatulina spinea CUSHMAN, 1926, p. 22, pl. 2, fig. 10.

Eponides? spinea (Cushman).—CUSHMAN, 1946, p. 142, pl. 57, fig. 16.—GRAHAM and CHURCH, 1963, p. 57, pl. 6, fig. 19.

Eponides spinea (Cushman).—MARTIN, 1964, p. 98, pl. 13, fig. 8.

Globorotalites spinea (Cushman).—MCGUGAN, 1964, p. 949, pl. 152, fig. 13.

PLATE 5

1–4 Upper Northumberland Formation, Descanso Bay Roadcut, Northwest Gabriola Island (? Campanian/Maestrichtian). 5–7C Upper Northumberland Formation, Montague Harbour, Galiano Island (? Campanian/Maestrichtian). 8–11 Upper Northumberland Formation, Miners Bay, Mayne Island (? Campanian/Maestrichtian). S = Sample. Scale line = 1 mm for all figures.

1–2 *Bolivina incrassata* Reuss
Lateral views. S.G. 77. S. 48.

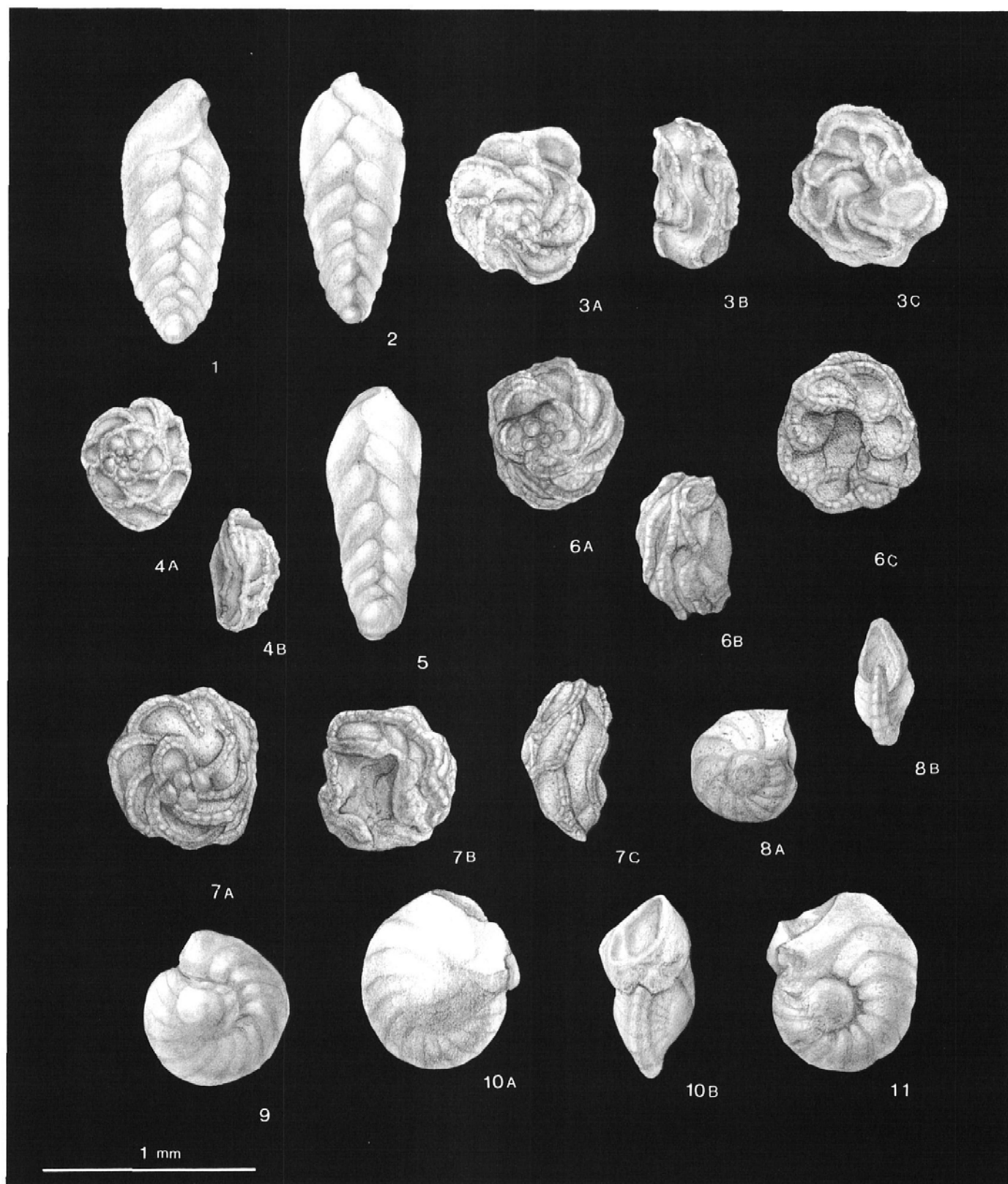
3A–C *Globotruncana arca* (Cushman)
3A, spiral side; 3B, lateral view; 3C, umbilical side. S.G. 77. S. 48.

4A–B *Globotruncana* cf. *arca* (Cushman)
4A, spiral side; 4B, lateral view; S.G. 77. S. 48.

5 *Bolivina incrassata* Reuss
Lateral view. M.H. 77. S. 27.

6A–7C *Globotruncana* sp.
6A, spiral side; 6B, lateral view; 7A, spiral side; 7B, umbilical side; 7C, lateral view. M.H. 77. S. 19.

8A–11 *Gavelinella henbesti* (Plummer)
8A, spiral side; 8B, lateral view; 9, spiral side; 10A, spiral side; 10B, lateral view; 11, spiral side. M.B. 77. S. 5.



Globorotalites spineus (Cushman).—SLITER, 1968, pp. 119–120, pl. 22, fig. 4.

Description: Test small trochospiral, dorsal side flat or slightly concave, ventral side conical to slightly rounded, periphery sharp, with one short spine per suture. Seven to nine chambers in final whorl. Sutures on dorsal side distinct, flush, curved, oblique. Radial, limbate, slightly depressed on ventral side. Wall calcareous, perforate, smooth. Aperture an elongate slit at base of apertural face extending close to periphery. Diameter 0.3 mm; height 0.2 mm.

Discussion: *Globorotalites spineus* and *G. michelinianus* (d'Orbigny) are apparently related and taxonomically gradational.

Occurrence: Upper Lambert Formation, upper part (Maestrichtian), north shore Hornby Island, Sample 34, 1971. Mayne Island, Village Bay, upper Northumberland Formation, Sample 16, 1977. In the study area this species is common in Maestrichtian strata but also occurs in the Campanian where *G. michelinianus* is more abundant. Types are from the Upper Cretaceous of Mexico.

Globorotalites cf. *spineus* (Cushman)
Plate 10, figure 2

This form has inconspicuous, poorly developed spines, and is intermediate in form between *G. spineus* and *G. michelinianus*.

Occurrence: Northumberland Formation, Village Bay, Mayne Island, M.V.B. 77. S. 16.

Globorotalites michelinianus (d'Orbigny)
Plate 9, figures 14A–B; plate 10, figures 1A–B

Rotalia micheliniana D'ORBIGNY, 1840, pl. 3, figs. 1–3.
Globorotalia micheliniana (d'Orbigny).—CUSHMAN, 1946, p. 152, pl. 63, figs. 2–3.
Gyroidina micheliniana (d'Orbigny).—SCHIJFSMA, 1946, p. 87, pl. 5, fig. 2.

Globorotalites michelinianus (d'Orbigny).—MARTIN, 1964, p. 99, pl. 14, fig. 4.—SLITER, 1968, p. 119, pl. 22, fig. 1.

Globorotalites conicus (Carsey).—MCGUGAN, 1957, p. 343, pl. 34, fig. 13; 1964, p. 949, pl. 152, fig. 12.

Description: Test trochospiral, spiral side flat to slightly concave, umbilical side convex, periphery acute, carinate. Seven chambers in last whorl. Sutures oblique, flush on spiral side, curved. Limbate, depressed on umbilical side. Wall calcareous, perforate, smooth. Aperture an interomarginal slit at base of final chamber. Diameter 0.2 mm; thickness 0.15 mm.

Discussion: See remarks under *G. spineus*.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Samples 8, 16, 1977. Original type specimens are from the Campanian of France. Recorded range, Cenomanian–Campanian.

Globorotalites sp.
Plate 10, figures 3A–B

This form is related to *G. michelinianus*, but the test is deeper and more rounded ventrally. Insufficient material is available to erect a new species or subspecies.

Occurrence: Northumberland Formation, Village Bay, Mayne Island, M.V.B. 77. S. 8.

Globorotalites hiltermanii KAEVER
Plate 9, figures 3A–6B

Globorotalites hiltermanii KAEVER, 1961, p. 418, pl. 20, figs. 1a–c (not synonymy).

Description: Test biconvex, umbilical more so than spiral side, tightly coiled with six to seven chambers in last whorl, sutures flush curved (more so on umbilical side). Peripheral keel developed. Wall calcareous perforate, aperture a low slit at base of chamber from just below the keel halfway to umbilicus. Diameter 0.2 mm; height 0.15 mm.

PLATE 6

1–7 Upper Northumberland Formation, Miners Bay, Mayne Island (? Campanian/Maestrichtian). 8–9 Lower Northumberland Formation, Village Bay, Mayne Island (upper Campanian). S = Sample. Scale line = 1 mm for all figures.

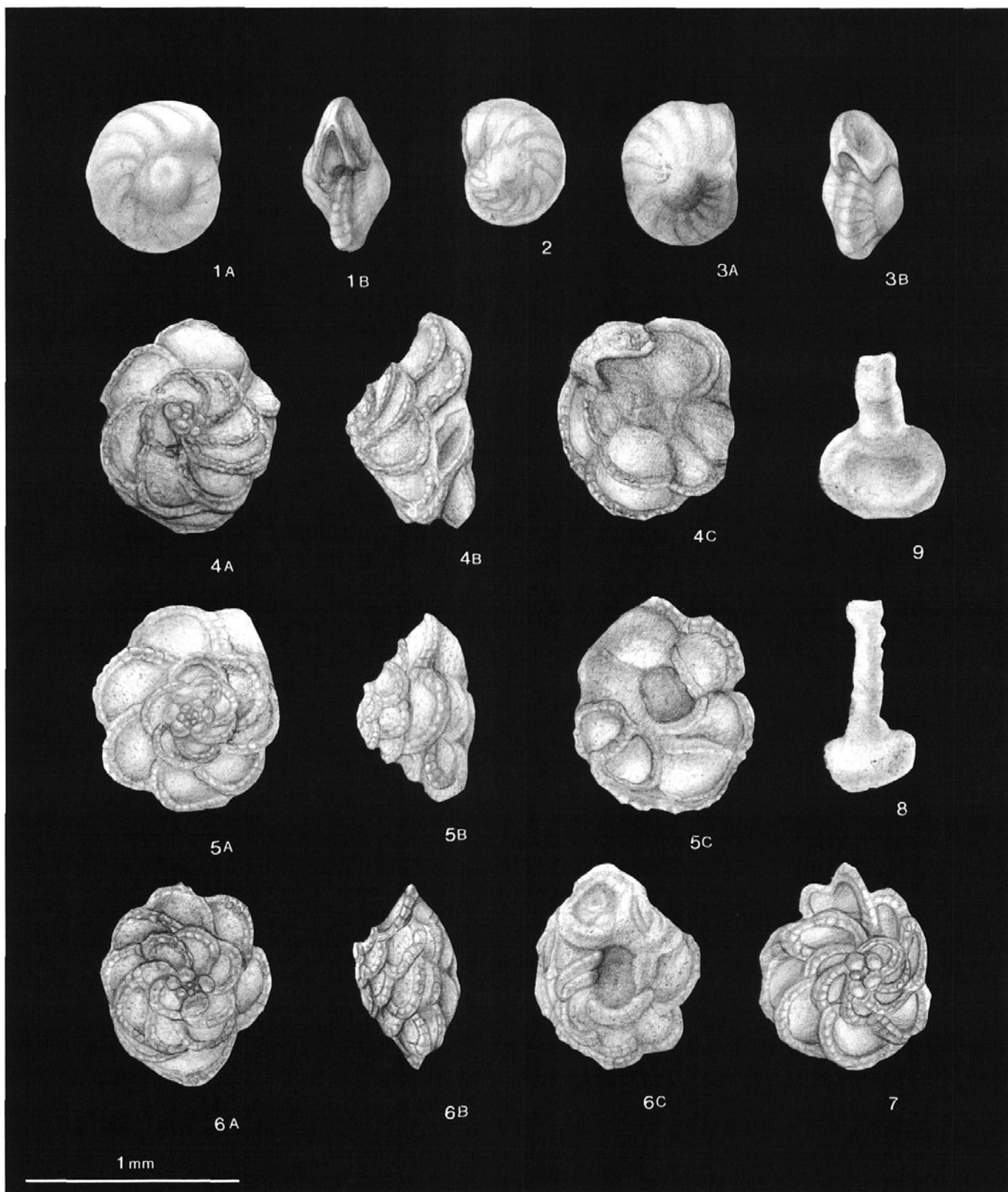
1A–3B *Gavelinella henbesti* (Plummer)
1A, spiral side; 1B, lateral view; 2, spiral side.
M.B. 77. S. 5. 3A, spiral side; 3B, lateral view.
M.B. 77. S. 4.

4A–6C *Globotruncana contusa* (Cushman)
4A, spiral side; 4B, lateral view; 4C, umbilical side. M.B. 77. S. 5. 5A, 6A, spiral side; 5B,

6B, lateral view; 5C, 6C, umbilical side. M.B. 77. S. 4.

7 *Globotruncana calcarata* Cushman
Spiral side. M.B. 77. S. 4. (Umbilical side damaged, not shown.)

8–9 *Lagenammia* sp.
Lateral views. M.V.B. 77. S. 16.



Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977. The holotype of this species is from the uppermost Campanian of Limburg, Holland and the species is common in the upper Campanian but rare in the Maestrichtian.

Genus GYROIDINOIDES Brotzen, 1942

Gyroidinoides goudkoffi (Trujillo)

Plate 2, figures 6A–C; plate 9, figures 8–10

Eponides goudkoffi TRUJILLO, 1960, p. 333, pl. 48, fig. 6.

Gyroidina sp. GRAHAM and CHURCH, 1963, p. 59, pl. 6, fig. 23.

Gyroidina goudkoffi (Trujillo).—MARTIN, 1964, p. 96, pl. 13, fig. 3.

Eponides sp. cf. *beisseli* Schijfsma.—MCGUGAN, 1964, p. 944, pl. 151, fig. 4.

Eponides sp. cf. *simplex* (White).—MCGUGAN, 1964, p. 945, pl. 151, fig. 7.

Gyroidinoides goudkoffi (Trujillo).—SLITER, 1968, p. 120, pl. 22, fig. 6; 1973, pl. 5, figs. 7–9.

Description: Test trochospiral, spiral side gently convex, umbilical side strongly convex. Periphery fairly acute, seven chambers in final whorl, sutures limbate, flush on spiral side, depressed on umbilical side. Wall smooth, calcareous, perforate. Aperture a low arch at base of chamber extending from umbilicus to periphery. Diameter 0.3 mm; thickness 0.2 mm.

Occurrence: Upper Lambert Formation, lower part (upper Campanian), north shore Hornby Island, Sample 6, 1971. Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Samples 8, 16, 1977. Original types are from the Santonian of northern California. Recorded range, Santonian to upper Campanian.

Gyroidinoides nitidus (Reuss)

Plate 9, figures 7A–C

Rotalina nitida REUSS, 1845, p. 35, pl. 8, fig. 52; pl. 12, figs. 8, 20.

Gyroidina nitida (Reuss).—BROTZEN, 1936, p. 157, fig. 58, pl. 11, fig. 3.—CUSHMAN, 1946, p. 140, pl. 58, fig. 5.—SCHIJFSMA, 1946, p. 85, pl. 5, fig. 1.

Gyroidinoides nitida (Reuss).—LOEBLICH and TAPPAN, 1964, p. C753, fig. 615, 6.

Gyroidinoides nitidus (Reuss).—SLITER, 1968, p. 121, pl. 22, fig. 7.

Description: Test trochospiral, subglobular, umbilical side more convex than spiral side. Periphery rounded. Six or seven chambers in final whorl, sutures curved, slightly depressed. Wall calcareous, perforate. Aperture a low interomarginal slit at base of apertural face, extending from umbilicus to near periphery. Diameter 0.2 mm; thickness 0.15 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977. Original types are from the Turonian of Sweden. Recorded range Turonian-Campanian, ?Maestrichtian.

Gyroidinoides quadratus (Cushman and Church)

Plate 1, figures 10–12B; plate 9, figures 11A–12B

Gyroidina quadrata CUSHMAN and CHURCH, 1929, p. 516, pl. 41, figs. 7–9.—GRAHAM and CHURCH, 1963, p. 58, fig. 2.—MARTIN, 1964, p. 97, pl. 13, fig. 5.—MCGUGAN, 1964, p. 944, pl. 151, fig. 5.

Gyroidinoides quadratus (Cushman and Church).—SLITER, 1968, p. 121, pl. 22, fig. 8; 1973, pl. 5, figs. 10–12.

Description: Test trochospiral, spiral side flat to concave. Umbilical side strongly convex, U-shaped. Periphery rounded, sharp shoulder on spiral side. Five to seven chambers in final whorl, long and shallow, slightly inflated at shoulder. Sutures radial, flush to depressed. Wall calcareous, perforate, smooth. Aperture a low interomarginal slit at base of apertural face, with slight lip, extending from umbilicus to near periphery. Diameter 0.2 mm; height 0.15 mm.

Occurrence: Upper Lambert Formation. Lower part (upper Campanian), north shore Hornby Island, Samples 8, 11, 1971. Lower Northumberland Formation (upper Campanian). Village Bay, Mayne Island, Samples 8, 16, 1977. Original types are from the Upper Cretaceous of central California. Recorded range is upper Santonian to Maestrichtian. Sliter (1973, fig. 2),

PLATE 7

Lower Northumberland Formation, Village Bay, Mayne Island (upper Campanian). S = Sample. Scale line = 1 mm for all figures.

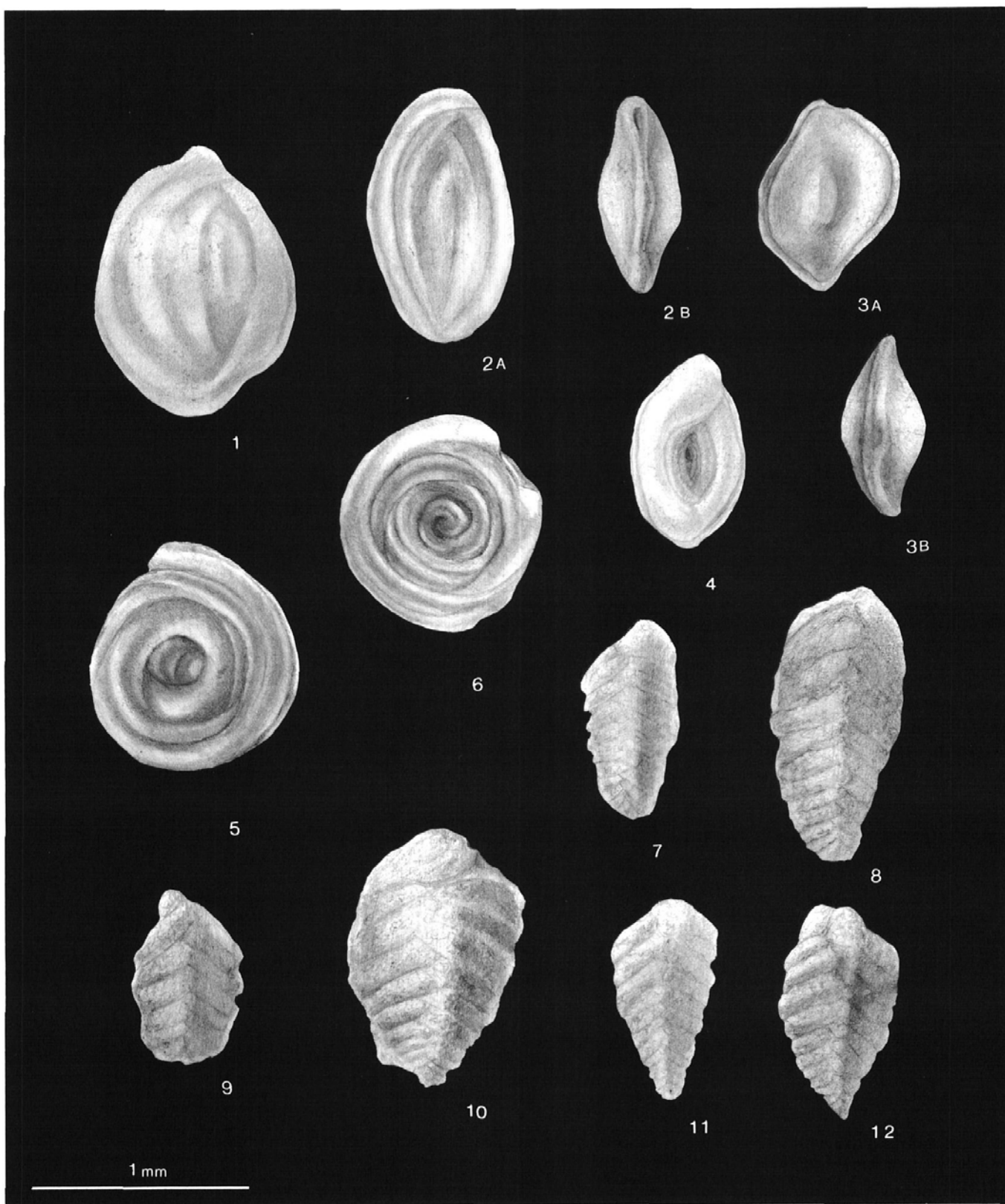
1–2B *Silicosigmoilina californica* Cushman and Church
1, lateral view; 2A, lateral view; 2B, apertural view. M.V.B. 77. S. 16.

3A–4 *Rzehakina epigona* (Rzehak)

3A, lateral view; 3B, apertural view; 4, lateral view. M.V.B. 77. S. 9.

5–6 *Glomospirella* cf. *gaultina* (Berthelin)
Side views. M.V.B. 77. S. 13.

7–12 *Spiroplectammia semicomplanata* (Carsey)
Side views. M.V.B. 77. S. 8.



showed range in study area from mid-Campanian to Maestrichtian.

Family ANOMALINIDAE Cushman, 1927
Subfamily ANOMALININAE Cushman, 1927
Genus ANOMALINOIDES Brotzen, 1942

Anomalinoides clementiana (d'Orbigny)

Plate 10, figures 11A–B

Rosalina clementiana D'ORBIGNY, 1840, p. 37, pl. 3, figs. 23–25.
Anomalina clementiana (d'Orbigny).—FRANKE, 1925, p. 85, pl. 7, fig. 12.—CUSHMAN, 1931, p. 61, pl. 13, fig. 1.—JENNINGS, 1936, p. 138, pl. 5, fig. 2.—CUSHMAN, 1940, p. 29, pl. 5, figs. 7–8.—CUSHMAN and GOUDKOFF, 1944, p. 63, pl. 10, fig. 12.—CUSHMAN, 1946, p. 155, pl. 63, figs. 12–13.—FRIZZELL, 1954, p. 130, pl. 21, fig. 2.

Gavelinella clementiana (d'Orbigny).—HOFKER, 1957, p. 294, fig. 350.

Description: Test trochoid, compressed evolute, periphery rounded. Nine chambers in last whorl. Sutures on dorsal side curved, limbate; on ventral side nearly radial. Wall calcareous, perforate, smooth; aperture peripheral, extending onto dorsal side. Diameter 0.2 mm; thickness 0.1 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 16, 1977. Original types are from the Upper Cretaceous of France. Recorded range, Gulf Coast and California, Campanian–Maestrichtian.

Genus GAVELINELLA Brotzen, 1942

Gavelinella henbesti (Plummer)

Plate 5, figures 8A–11; plate 6, figures 1A–3B; plate 10, figures 12–13

Anomalina henbesti PLUMMER, 1931, p. 290, pl. 5, figs. 7–10.—CUSHMAN and GOUDKOFF, 1944, p. 63, pl. 10, fig. 11.—CUSHMAN, 1946, p. 155, pl. 64, fig. 2.—BANDY, 1951, p. 506, pl. 74, fig. 5.—FRIZZELL, 1954, p. 131, pl. 21, fig. 3.

Gavelinella henbesti (Plummer).—SLITER, 1968, pp. 123–124, pl. 23, fig. 2.

Cibicides voltziana (d'Orbigny).—MCGUGAN, 1964, p. 946, pl. 152, fig. 1.

Description: Test biconvex, trochospiral, evolute, compressed, spiral side with umbo. Ten chambers in final whorl, sutures depressed, almost radial on spiral side, limbate, curved on umbilical side. Wall calcareous, perforate. Aperture a low interomarginal arch from periphery to umbilicus. Diameter 0.3 mm; thickness 0.2 mm.

Occurrence: Upper Northumberland Formation (?Campanian, Maestrichtian), Miners Bay, Mayne Island, Sample 5, 1977. Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Samples 7, 15, 1977. Reported range, Campanian.

Gavelinella nacatochensis (Cushman)

Plate 2, figures 3–4

Planulina nacatochensis CUSHMAN, 1938, p. 50, pl. 8, fig. 9.—MCGUGAN, 1964, p. 946, pl. 152, fig. 3.

Planulina mascula BANDY, 1951, p. 506, pl. 74, fig. 8.—MARTIN, 1964, p. 107, pl. 16, fig. 7.

Planulina sp. cf. *P. mascula* Bandy.—GRAHAM and CHURCH, 1963, p. 66, pl. 8, fig. 3.

Gavelinella nacatochensis (Cushman).—SLITER, 1968, p. 124, pl. 33, fig. 415.

Description: Test low trochospiral, nearly planispiral, spiral side partially evolute, umbilical side involute, axial periphery rounded. Six chambers in final whorl, slightly inflated. Sutures gently curved, flush, later depressed. Wall calcareous, perforate. Aperture an interomarginal arch from periphery to umbilicus, with slight lip. Diameter 0.3 mm; thickness 0.15 mm.

Occurrence: Upper Lambert Formation, lower part (Campanian), north shore Hornby Island, Samples 6, 8, 1971. The stratigraphic range of the species is Campanian to Maestrichtian.

Gavelinella stephensoni (Cushman)

Plate 10, figures 15–16

Cibicides stephensoni CUSHMAN, 1938, p. 70, pl. 12, fig. 5.—CUSHMAN and GOUDKOFF, 1944, p. 63, pl. 10, fig. 15.

Anomalina sp. GRAHAM and CHURCH, 1963, p. 65, pl. 8, fig. 1.

PLATE 8

Lower Northumberland Formation, Village Bay, Mayne Island (upper Campanian). S = Sample. Scale line = 1 mm for all figures.

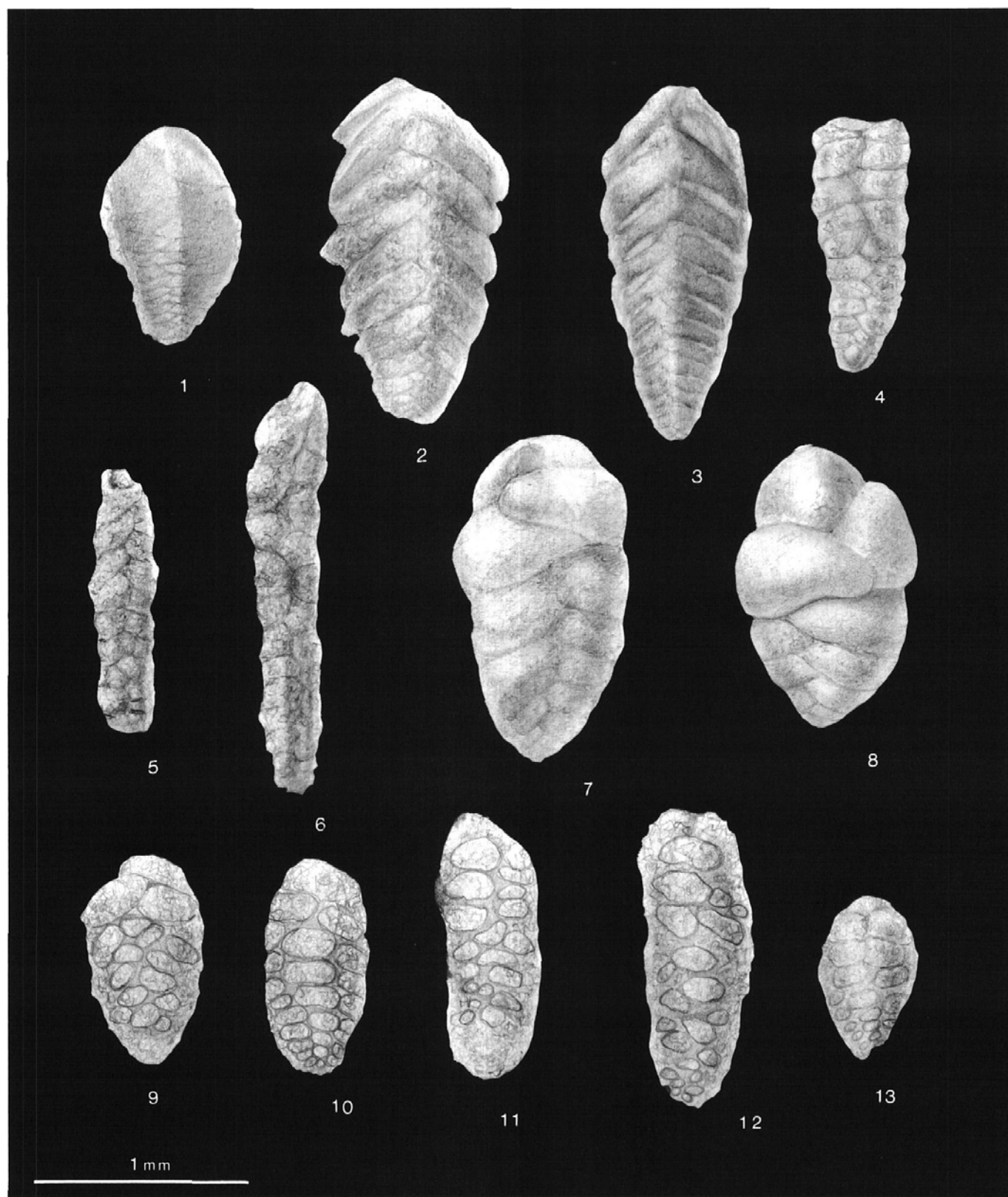
1–3 *Spiroplectammina semicomplanata* (Carsey)
Side views. M.V.B. 77. S. 8.

4 *Spiroplectammina grybowski* Frizzell
Side view. M.V.B. 77. S. 8.

5–6 ?*Spiroplectammina* sp. A
Lateral views. M.V.B. 77. S. 16, 8.

7–8 *Dorothia pupa* (Reuss)
Lateral views. M.V.B. 77. S. 7.

9–13 *Gravellina* sp.
Lateral views. M.V.B. 77. S. 16.



Cibicides validus MARTIN, 1964, pl. 16, fig. 5.

Gavelinella stephensoni (Cushman).—SLITER, 1968, p. 125, pl. 23, fig. 3.

Description: Test trochospiral, biconvex, compressed, involute, spiral side with small central boss. Umbilical side with umbilical boss, periphery subacute. Fifteen narrow chambers in final whorl. Early sutures flush, later depressed. Wall calcareous perforate, smooth. Aperture an interomarginal slit from periphery to umbilicus. Diameter 0.5 mm; thickness 0.15 mm.

Occurrence: Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 15, 1977. Sliter (1973, fig. 2) showed range as Santonian to early Maestrichtian.

Gavelinella velascoensis (Cushman)

Plate 2, figures 1A–B; plate 10, figure 14

Anomalina velascoensis CUSHMAN, 1925, p. 21, pl. 3, fig. 3; 1940, p. 32, pl. 5, fig. 10; 1946, p. 156, pl. 64, fig. 7.

Anomalinoides pinguis (Jennings).—FRIZZELL, 1954, p. 131, pl. 21, fig. 8.—GRAHAM and CHURCH, 1963, p. 65, pl. 8, fig. 2.

Gavelinella velascoensis (Cushman).—SLITER, 1968, p. 125, pl. 23, fig. 9; 1973, pl. 6, figs. 3–5.

Description: Test almost biconvex to plano-convex, involute spiral side with rounded imperforate boss, umbonal side slightly flattened with spiral umbonal boss, periphery rounded. Eight or nine chambers in final whorl, slightly inflated, sutures depressed on spiral side. Wall calcareous, strongly punctate. Aperture a low arch extending from umbilicus to periphery. Diameter 0.3 mm; thickness 0.2 mm.

Occurrence: Upper Lambert Formation, top of lower part (upper Campanian), Manning Point, north shore Hornby Island, Sample 22, 1971. Lower Northumberland Formation (upper Campanian), Village Bay, Mayne Island, Sample 15, 1977. Original types are from the Paleocene of Mexico, recorded range, upper Campanian to Paleocene. In the study area, Sliter (1973, fig. 2) showed the range as upper Campanian to lower Maestrichtian.

***Gavelinella* sp.**

Plate 2, figures 2, 5

These forms appear to be related to *G. nacatochensis* (Cushman).

Occurrence: Upper Lambert Formation, north shore Hornby Island. N.H. 71. S. 6.

Family CIBICIDIDAE Cushman, 1927

Subfamily CIBICIDINAE Cushman, 1927

Genus CIBICIDES De Montfort, 1808

Cibicides beaumontianus (d'Orbigny)

Plate 1, figure 2

Truncatulina beaumontiana D'ORBIGNY, 1840, p. 35, pl. 3, figs. 17–19.

Cibicides beaumontianus (d'Orbigny).—FRIZZELL, 1954, p. 132, pl. 21, fig. 19.—CUSHMAN, 1946, p. 160, pl. 65, fig. 12.—MCGUGAN, 1957, p. 344, pl. 32, fig. 24.

Falsocibicides beaumontianus (d'Orbigny).—SLITER, 1968, p. 109, pl. 19, fig. 5.

Description: Test attached on dorsal side, large, plano-convex to irregularly concavo-convex, shape of dorsal

PLATE 9

Lower Northumberland Formation, Village Bay, Mayne Island (upper Campanian). S = Sample. Scale line = 1 mm for all figures.

1–2 *Marssonella trochus* (d'Orbigny)
Lateral views. M.V.B. 77. S. 16.

3A–6B *Globorotalites hiltermanii* Kaever
3A, 4A, 5A, spiral side; 3B, 4B, 5B, lateral view; 3C, 4C, umbilical side. M.V.B. 77. S. 16. 6A, spiral side; 6B, lateral view. M.V.B. 77. S. 8.

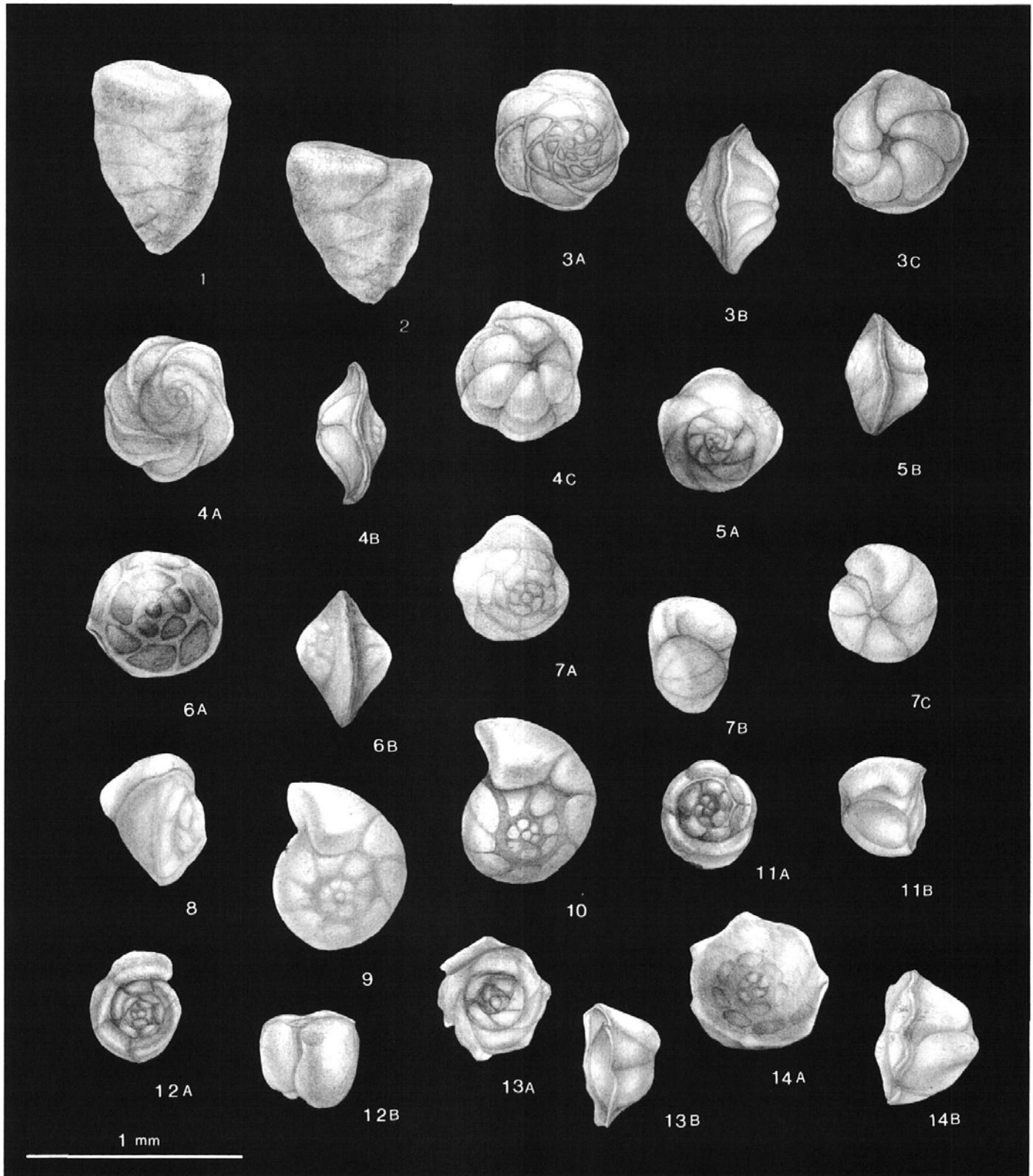
7A–C *Gyroidinoides nitidus* (Reuss)
7A, spiral side; 7B, lateral/apertural view; 7C, umbilical view. M.V.B. 77. S. 16.

8–10 *Gyroidinoides goudkoffi* (Trujillo)
8, lateral/apertural view. M.V.B. 77. S. 17.
9, 10, spiral/oblique view. M.V.B. 77. S. 8.

11A–12B *Gyroidinoides quadratus* (Cushman and Church)
11A, spiral side; 11B, lateral/apertural view. M.V.B. 77. S. 8. 12A, spiral side; 12B, lateral view. M.V.B. 77. S. 16.

13A–B *Globorotalites spineus* (Cushman)
13A, spiral side; 13B, lateral/oblique view. M.V.B. 77. S. 16.

14A–B *Globorotalites michelinianus* (d'Orbigny)
14A, spiral side; 14B, lateral view. M.V.B. 77. S. 8.



surface variable. Seven chambers in last whorl, becoming increasingly inflated, sutures depressed. Wall calcareous, smooth, coarsely perforate. Aperture an interomarginal arch extending on to spiral side. Adults up to 0.66 mm in diameter. The author prefers to refer the species to the genus *Cibicides*, rather than *Falsocibicides*, which is Oligocene to Miocene in age and displays supplementary umbilical apertures not found in our specimens.

Occurrence: The figured specimen is from the upper Lambert Formation, lower part (upper Campanian), north shore Hornby Island, Sample 5, 1971. Original types are from the Upper Cretaceous, Craie Blanche of France and the species occurs in the Taylor Group of the Gulf Coast and the Rosario Formation in southern California. Recorded range, Campanian to ?Maestrichtian.

Superfamily ROBERTINACEA Reuss, 1850
Family CERATOBULIMIDAE Cushman, 1927
Subfamily EPISTOMININAE Wedekind, 1937
Genus HOEGLUNDINA Brotzen, 1948

Hoeglundina cf. *supracretacea* (ten Dam)
Plate 10, figures 4A–B

Description: The single specimen available appears similar to *H. supracretacea* (ten Dam). Additional, bet-

ter preserved specimens are required for positive diagnosis.

Occurrence: Northumberland Formation, Village Bay, Mayne Island, M.V.B. 77. S. 8.

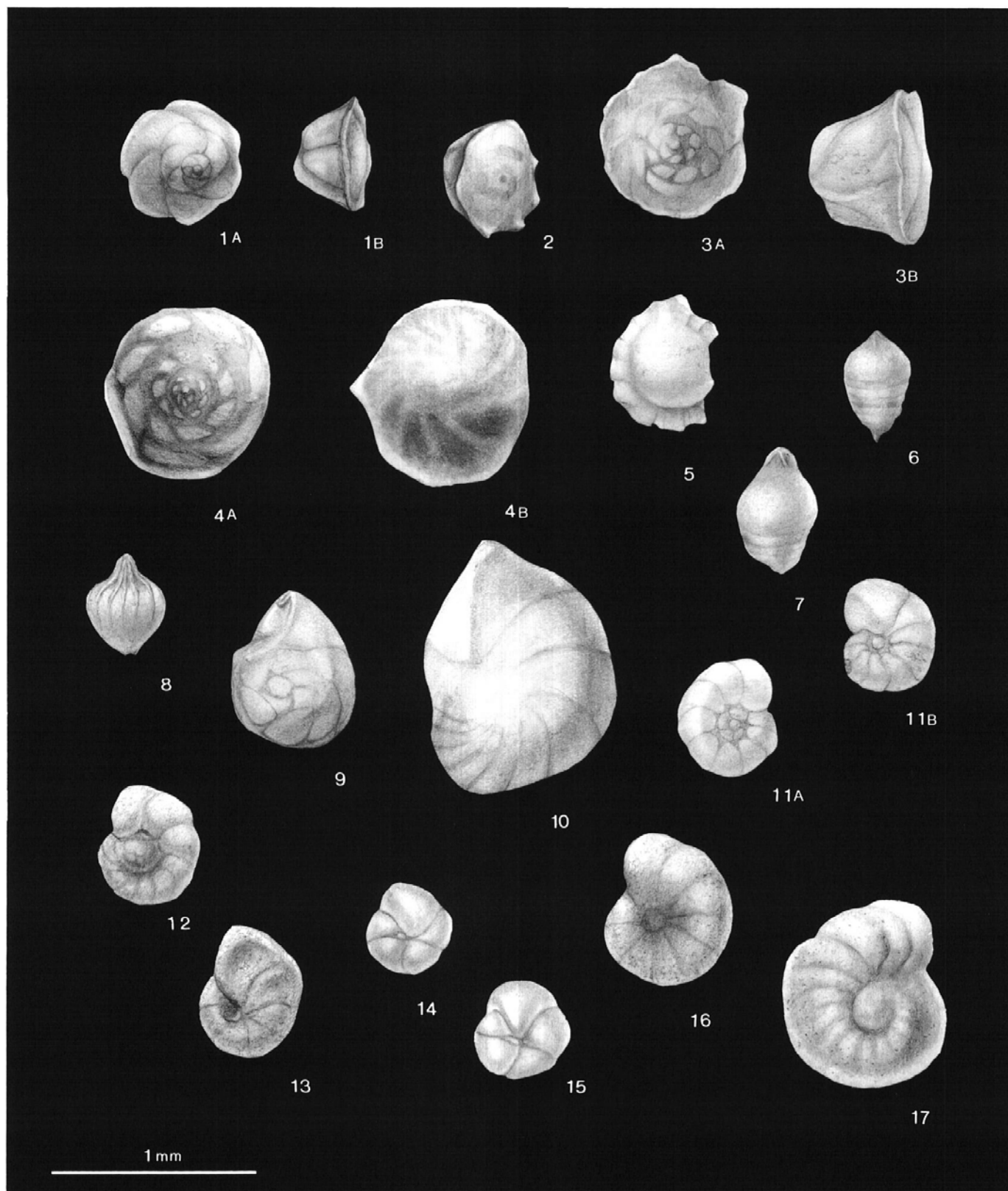
DISTRIBUTION OF PLANKTONIC FORAMINIFERA

The biostratigraphic and paleobiogeographic distribution of planktonic foraminifera in the northeastern Pacific province has been considered by Sliter (1968, 1973) and by Douglas (1969, 1972). Douglas (1972) pointed out obvious differences in Upper Cretaceous microfaunal occurrences and diversities in the Atlantic coast, the Gulf Coast, the cratonic seaway of the western interior and the Pacific Coast, and demonstrated that Pacific foraminifera north of about 40°N latitude are less diverse and largely different from their more southern Tethyan counterparts. Sliter (1968, p. 27) stated that "... *Globotruncana contusa* (Cushman) ss. ..." is unknown from the northeastern Pacific, a record corrected by McGugan (1979). Sliter (1973, text-fig. 4) recognized four Late Cretaceous Pacific faunal provinces with Vancouver Island in the most northerly part of his "intermediate Province," and (1973, text-fig. 5) inferred various coastal currents to explain foraminiferal distributions. Pessagno (1967, p. 333) con-

PLATE 10

Lower Northumberland Formation, Village Bay, Mayne Island (upper Campanian). S = Sample. Scale line = 1 mm for all figures.

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| <p>1A–B <i>Globorotalites michelinianus</i> (d'Orbigny)
1A, spiral side; 1B, lateral/oblique view.
M.V.B. 77. S. 8.</p> <p>2 <i>Globorotalites</i> cf. <i>spineus</i> (Cushman)
Spiral oblique view. M.V.B. 77. S. 16.</p> <p>3A–B <i>Globorotalites</i> sp.
3A, spiral side; 3B, lateral view. M.V.B. 77.
S. 8.</p> <p>4A–B <i>Hoeglundina</i> cf. <i>supracretacea</i> (ten Dam)
4A, spiral side; 4B, umbilical view. M.V.B.
77. S. 8.</p> <p>5 <i>Fissurina orbignyana</i> Seguenza
Lateral view. M.V.B. 77. S. 16.</p> <p>6–7 <i>Pseudonodosaria mutabilis</i> Trujillo
Lateral views. M.V.B. 77. S. 13.</p> <p>8 <i>Lagena acuticosta</i> Reuss
Side view. M.V.B. 77. S. 13.</p> | <p>9–10 <i>Lenticulina</i> sp.
9, side view. M.V.B. 77. S. 16. 10, side view.
M.V.B. 77. S. 8.</p> <p>11A–B <i>Anomalinoides clementiana</i> (d'Orbigny)
11A, spiral side; 11B, umbilical view. M.V.B.
77. S. 16.</p> <p>12 <i>Gavelinella henbesti</i> (Plummer)
Spiral side. M.V.B. 77. S. 7.</p> <p>13 <i>Gavelinella</i> cf. <i>henbesti</i> (Plummer)
Spiral side. M.V.B. 77. S. 15.</p> <p>14 <i>Gavelinella velascoensis</i> (Cushman)
Spiral side. M.V.B. 77. S. 15.</p> <p>15–16 <i>Gavelinella stephensoni</i> (Cushman)
15, umbilical view; 16, spiral side. M.V.B. 77.
S. 15.</p> <p>17 <i>Pullenia jarvisi</i> Cushman
Spiral side. M.V.B. 77. S. 13.</p> |
|---|--|



sidered *Globotruncana contusa* to be distributed in both Tethyan and Boreal provinces, whereas *Globotruncana calcarata* Cushman, reported from the Vancouver Island area by McGugan (1979), appears from its occurrence records (Pessagno, 1967, p. 328) to be a Tethyan form. No doubt some transitional mixing of Tethyan and Boreal elements took place on the Pacific coast. Biostratigraphic distributions of *Globotruncana* species in the Vancouver Island area are shown by McGugan (1979, fig. 4).

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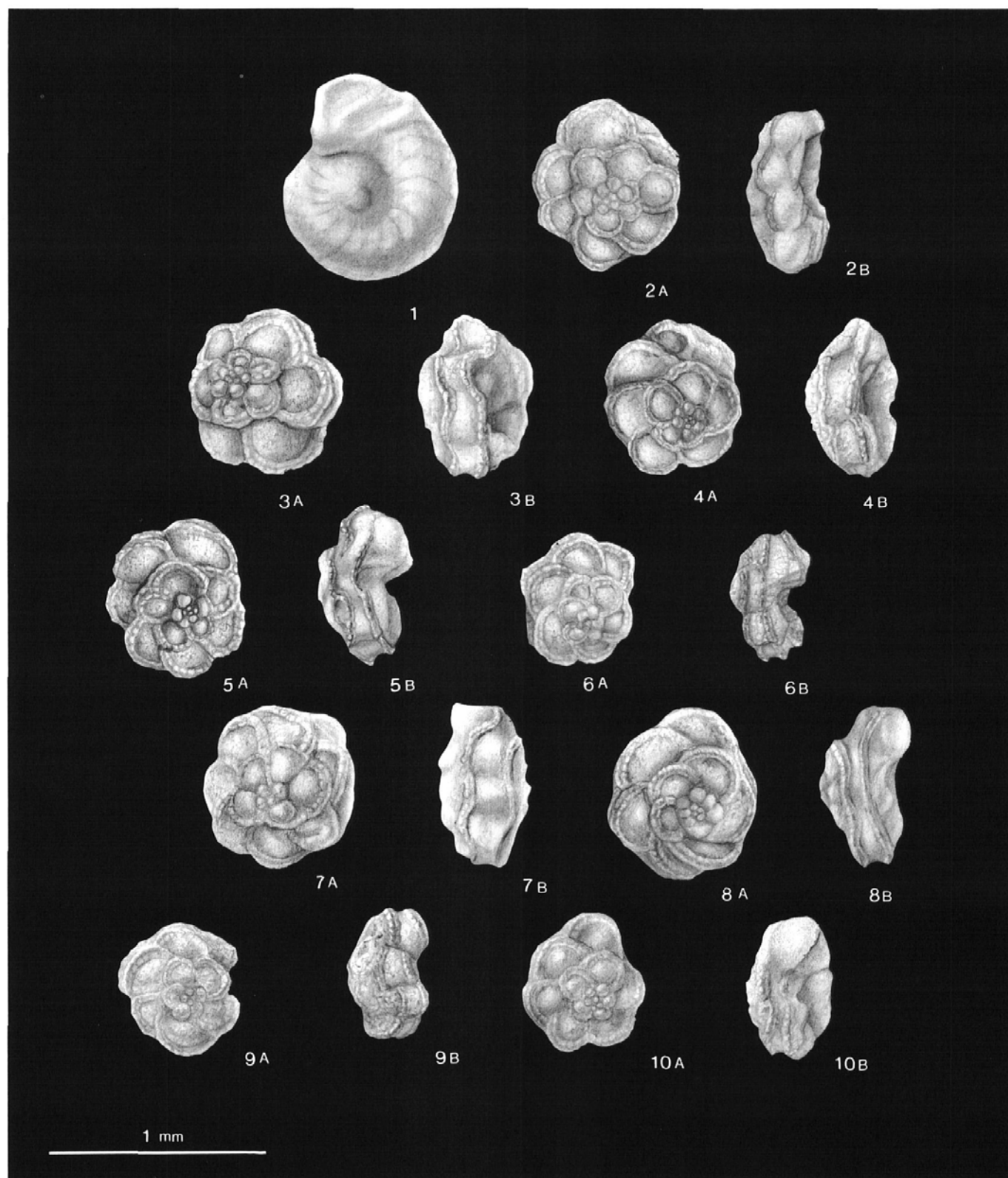
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PLATE 11

Lower Northumberland Formation, Village Bay, Mayne Island (upper Campanian). S = Sample. Scale line = 1 mm for all figures.

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|--------|--|-------|---|
| 1 | <i>Pullenia jarvisi</i> Cushman | 8A–B | 4A, 5A, 6A, 8A, spiral side; 4B, 5B, 6B, 8B, lateral view. M.V.B. 77. 4A–B, 5A–B, S. 13; 6A–B, S. 16; 8A–B, S. 4. |
| 2A–B | <i>Globotruncana hilli</i> Pessagno | 7A–B, | <i>Globotruncana linneiana</i> (d'Orbigny) |
| | 2A, spiral side; 2B, lateral view. M.V.B. 77. S. 13. | 9A–B | 7A, spiral side; 7B, lateral view. M.V.B. 77. S. 1. 9A, spiral side; 9B, lateral view. M.V.B. 77. S. 16. |
| 3A–B | <i>Globotruncana ventricosa</i> White | 10A–B | <i>Globotruncana</i> sp. |
| | 3A, spiral side; 3B, lateral view. M.V.B. 77. S. 13. | | 10A, spiral side; 10B, lateral view. M.V.B. 77. S. 8. |
| 4A–6B, | <i>Globotruncana arca</i> (Cushman) | | |

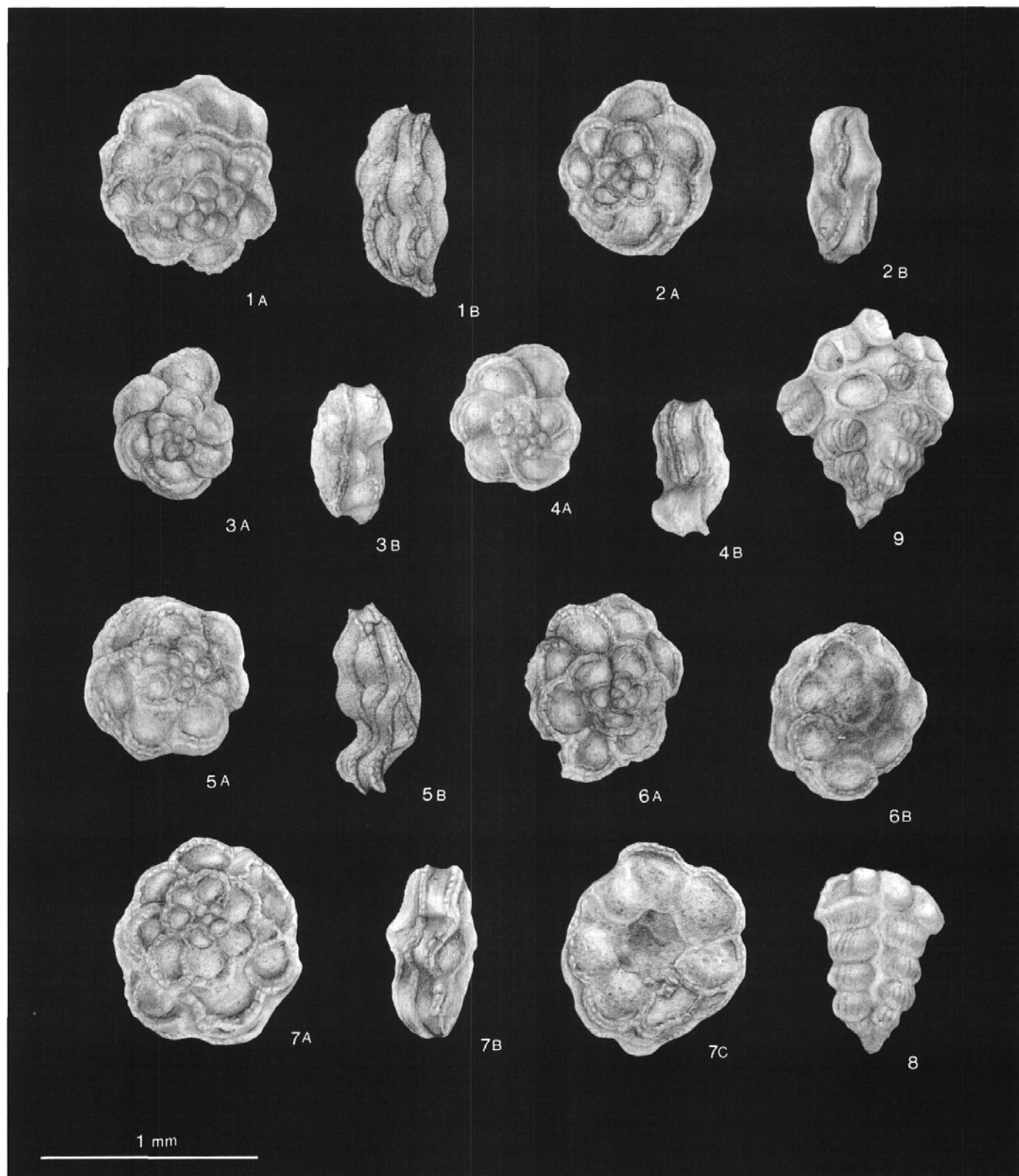


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PLATE 12

Lower Northumberland Formation, Village Bay, Mayne Island (upper Campanian). S = Sample. Scale line = 1 mm for all figures.

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| 1A–B, <i>Globotruncana rosetta</i> (Carsey) | spiral side; 6B, umbilical view; 7A, spiral |
| 5A–B 1A, 5A, spiral side; 1B, 5B, lateral view. | side; 7B, lateral view; 7C, umbilical view. |
| M.V.B. 77. S. 1. | M.V.B. 77. S. 8. |
| 2A–4B, <i>Globotruncana linneiana</i> (d'Orbigny) | 8–9 <i>Planoglobulina ornatissima</i> (Cushman and |
| 6A–7C 2A, spiral side; 2B, lateral view. M.V.B. 77. | Church) |
| S. 1. 3A, spiral side; 3B, lateral view; 6A, | Side views. M.V.B. 77. 8, S. 16; 9, S. 13. |



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