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RECYCLED CRETACEOUS BELEMNITES IN LOWER MIOCENE GLACIO-MARINE SEDIMENTS (CAPE MELVILLE FORMATION) OF KING GEORGE ISLAND, WEST ANTARCTICA

(Plates 9—11)

BIRKENMAJER, K., GAŹDZICKI, A., PUGACZEWSKA, H. and WRONA, R.: Recycled Cretaceous belemnites in Lower Miocene glacio-marine sediments (Cape Melville Formation) of King George Island, West Antarctica. Palaeontologia Polonica, 49, 49—62, 1987.

Fossiliferous glacio-marine strata of the Cape Melville Formation (Lower Miocene) yielded recycled Cretaceous fossils — coccoliths and belemnites in addition to Tertiary biota. The belemnites here described belong to the family Dimitobelidae WHITEHOUSE, 1924, and are represented by three taxa: *Dimitobelus* aff. *macgregori* (GLAESSNER, 1945), *D.* cf. *superstes* (HECTOR, 1886) and *Peratobelus* sp. These Cretaceous fossils were brought to King George Island by drifting icebergs during the Lower Miocene Melville Glaciation and redeposited together with other dropstones in outer shelf deposits of the Cape Melville Formation. The provenance of these recycled Cretaceous fossils is unknown: they could have been brought by drifting icebergs either from the area of Alexander Island where Cretaceous strata with analogous belemnites are known, or from another site (or sites) of the Antarctic Peninsula sector. Relative abundance of recycled belemnites and Cretaceous calcareous nannoplankton suggests rather a source situated at a distance less than that between King George Island and Alexander Island (some 1200 km), either under ice-sheet or within the shelf area of the Bransfield Strait.

Key words: Cretaceous, belemnites, Dimitobelidae, Lower Miocene, glacio-marine strata, South Shetland Islands, Antarctica.

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REDEPONOWANE KREDOWE BELEMNITY W LODOWCOWO-MORSKICH OSADACH FORMACJI CAPE MELVILLE (DOLNY MIOCEN) WYSPY KRÓLA JERZEGO, ANTARKTYKA ZACHODNIA

Streszczenie. — W lodowcowo-morskich osadach formacji Cape Melville (dolny miocen) występują oprócz skamieniałości trzeciorzędowych, także redeponowane formy kredowe — kokkolity i belemnity. Belemnity opisane w niniejszej pracy należą do rodziny Dimitobelidae WHITEHOUSE, 1924 i są reprezentowane przez trzy taksony: *Dimitobelus* aff. *macgregori* (GLAESSNER, 1945), *D.* cf. *superstes* (HECTOR, 1886) and *Peratobelus* sp. Skamieniałości kredowe zostały przyniesione przez dryfujące góry lodowe w czasie dolnomioceńskiego zlodowacenia Melville i wraz z głazami eratycznymi zdeponowane w osadach lodowcowo-morskich typu zewnętrznego szelfu. Pochodzenie redeponowanych skamieniałości kredowych nie jest jasne: mogły one pochodzić z rejonu Wyspy Aleksandra (ok. 1200 km na południe od Wyspy Króla Jerzego), gdzie znane są osady kredowe z podobnymi belemnitami, lub z innego obszaru na Półwyspie Antarktycznym. Względna obfitość redeponowanych skamieniałości kredowych (belemnitów i nannoplanktonu wapiennego) sugeruje raczej stanowisko lub stanowiska położone bliżej obecnego miejsca występowania, np. w obrębie szelfu Cieśniny Bransfielda lub pod czapą lodową Półwyspu Antarktycznego.

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GEOLOGICAL PART

by

K. BIRKENMAJER, A. GAŹDZICKI and R. WRONA

INTRODUCTION

The belemnites here described have been collected by the authors from the Cape Melville — Melville Peninsula area (fig. 1), the easternmost termination of King George Island, South Shetland Islands (West Antarctica), during the Vth Polish Antarctic Expedition (1980—81) led by K. BIRKENMAJER. They come predominantly from the main fossil locality at Melville Peninsula called Crab Mound and Crab Creek (fig. 2). The collection amounts to more than 80 fragmented, usually poorly preserved belemnite rostra. The described material is housed in the Institute of Palaeobiology of the Polish Academy of Sciences in Warsaw (abbreviated ZPAL). The photographs of belemnite fragments and cross-sections have been made by Mrs GRAŻYNA PODBIELSKA of that Institute. The SEM photomicrographs were taken at the Institut für Paläontologie, Universität Erlangen-Nürnberg, while one of the authors (A. G.) was on a fellowship granted by the Alexander von Humboldt-Stiftung (Bonn).

GEOLOGICAL SETTING

The geological structure of the Cape Melville — Melville Peninsula area has been described in detail by Birkenmajer (1982*b*, 1984; 1987, this volume), and needs not be repeated here. Figures 2 and 3 show a geological map and main lithostratigraphic columns of Lower Miocene glacio-marine sediments distinguished as the Cape Melville Formation, which unconformably overlies shallow-marine deposits of the Destruction Bay Formation. The base of both formations is represented by basaltic lavas of the Sherratt Bay Formation. The whole succession, belonging to the Moby Dick Group, is crossed by two sets of andesitic and basaltic dykes, the older ones K-Ar dated at around 20 Ma (BIRKENMAJER *et al.* 1985). Taking this Lower Miocene data into account as a minimum age of glacio-marine sediments of the Cape Melville Formation, and the fact that the underlying sediments of the Destruction Bay Formation yielded Lower Miocene brachiopods (BIERNAT *et al.* 1985), the age of the Cape Melville Formation would correspond to Lower Miocene.

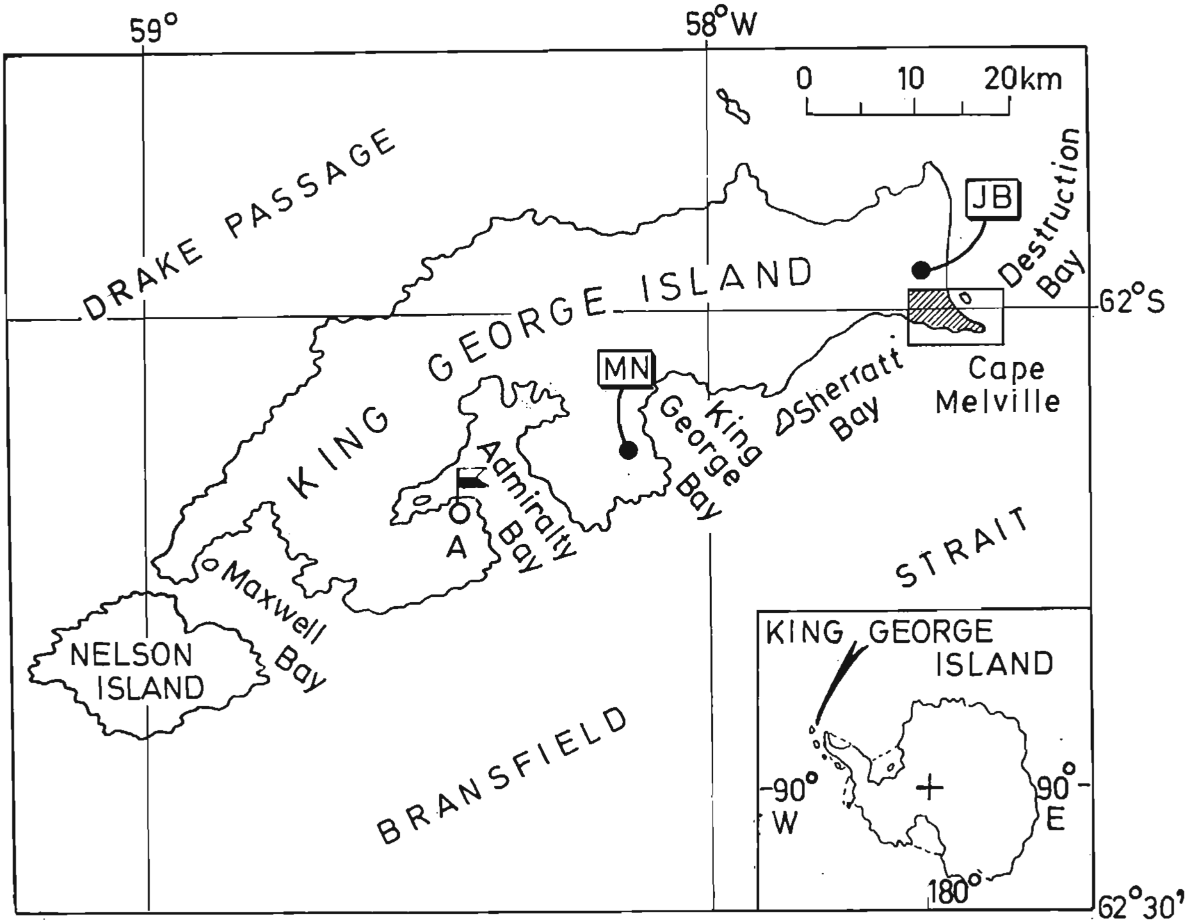

Fig. 1
Key map to show the area of occurrence of the Cape Melville Formation (shaded — see fig. 2), and comparable glacio-marine sediments (JB-Jenny Buttress; MN—Magda Nunatak) in King George Island. A—Arctowski Station (Poland).

MODE OF OCCURRENCE AND PRESERVATION OF BELEMNITES

The Lower Miocene glacio-marine sediments of the Cape Melville Formation yielded, besides abundant Tertiary fossils, also redeposited Cretaceous nannoplankton and belemnites (Dudziak 1984; Birkenmajer *et al.* 1983; Birkenmajer 1984). The Cretaceous nannoplankton is relatively abundant compared to scarce Tertiary discoasters, the belemnites are rather frequently encountered in the Cape Melville Formation, especially in its upper part, as well as in some parts of the Destruction Bay Formation (fig. 3), however they are much less frequent than the Tertiary macrofossils.

The belemnite rostra most frequently occur in a vertical position, cutting through horizontal stratification of fine-grained sediment (pl. 11 : 1). This is consistent with the fact that ice-rafted fragments (dropstones) of elongated shapes tend to be vertically oriented in the sediment (see Birkenmajer 1980: fig. 3; Visser 1983: fig. 10 A).

Concentric accumulations of hard, diagenetically altered sediment enriched in calcium carbonate occur frequently around particular rostra. They usually form cylindrical concretions overgrowing a central shaft formed by belemnite rostrum (pl. 11 : 1—4), with the concretion diameter varying from 2 to 5 cm. Concentric growth rings are visible on weathered surfaces of concretions (pl. 11 : 2, 3) and radial cracks on their natural cross-sections (pl. 11 : 2, 3).

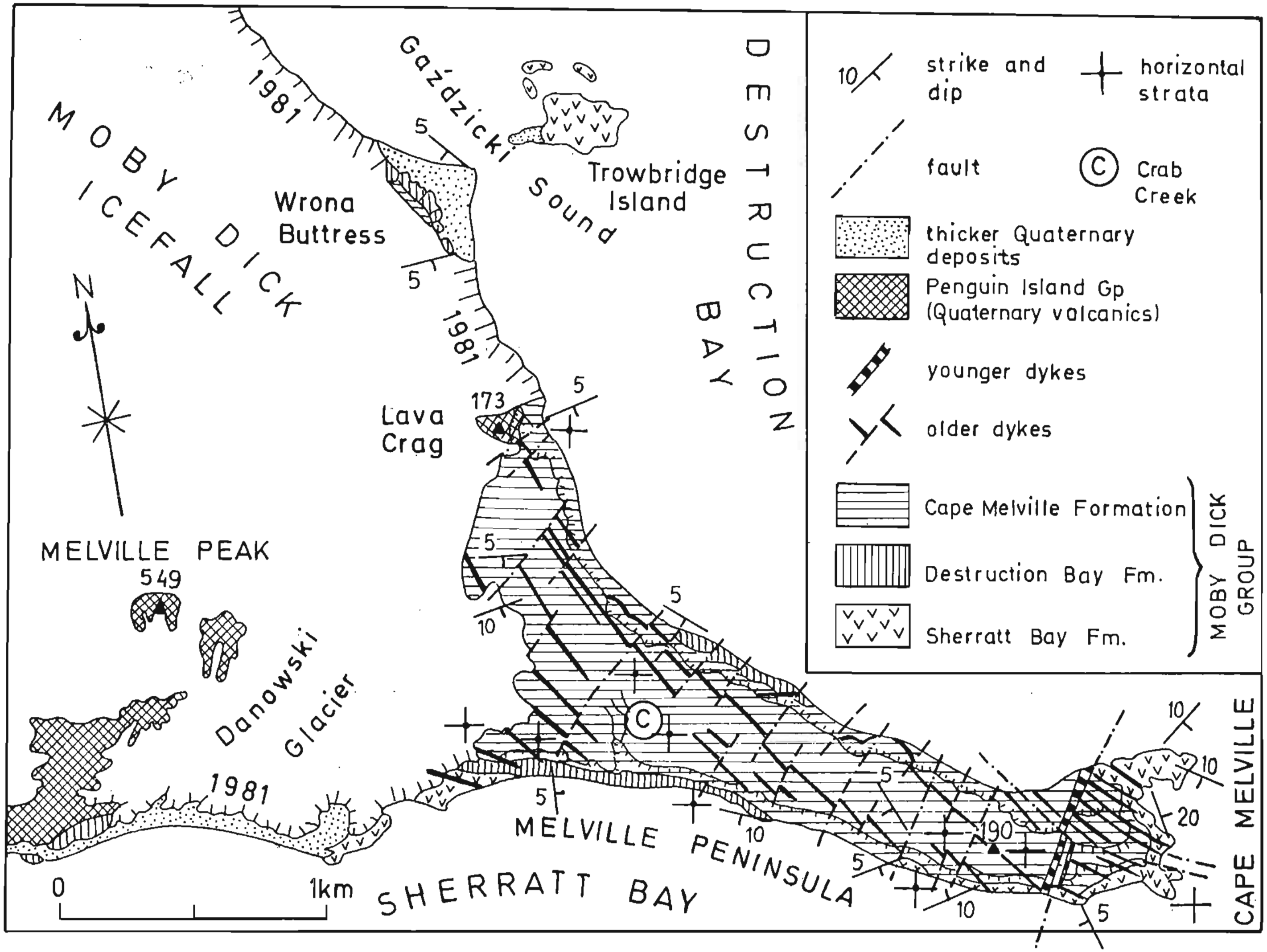

Fig. 2

Geological map of the Cape Melville area, King George Island (after BIRKENMAJER, 1982*b*, 1984). C — Crab Mound — Crab Creek area.

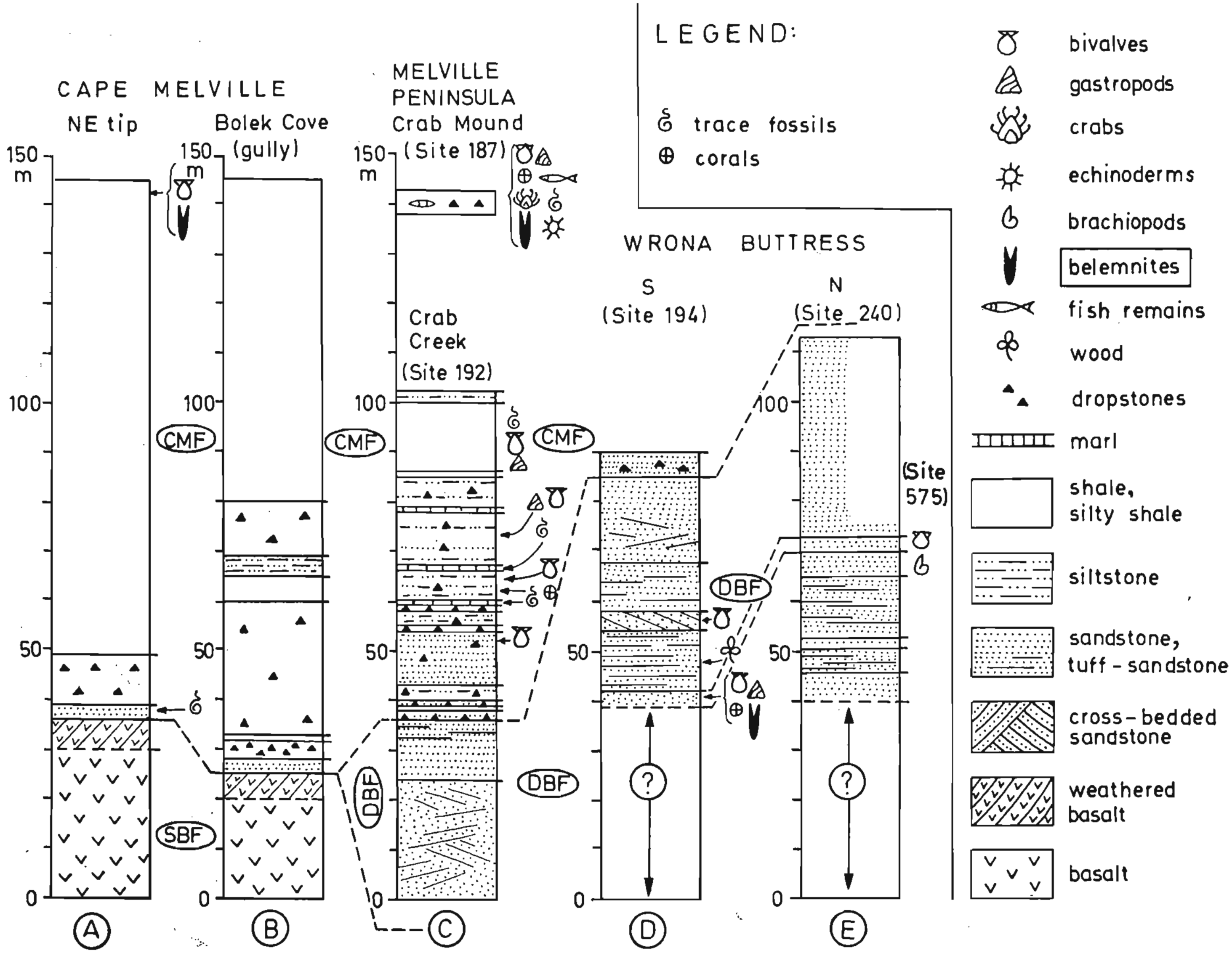

Fig. 3
Lithostratigraphic columns of the Moby Dick Group, and position of recycled Cretaceous belemnites (after BIRKENMAJER 1984). CMF — Cape Melville Formation; DBF — Destruction Bay Formation; SBF — Sherratt Bay Formation.

Fragments of belemnite rostra have also been found in hard, slightly concretionary calcareous siltstones together with fragments of corals of the genus *Flabellum* LESSON, 1831, skeletal fragments of echinoderms, and dropstones of Antarctic continent provenance. Fragments of belemnite rostra have also been encountered in sediment infilling crab-made burrows. Belemnite rostra lying loose in shale or siltstone are less frequent.

The fragments of rostra are 1—8 cm long, rarely preserving alveolar and apical parts (pl. 9 : 1, 2b; pl. 10 : 5a, 6). Particular fragments show abraded surfaces and are cracked longitudinally and transversally (pls. 9, 10; pl. 11 : 2—4), the cracks being filled with the surrounding sediment.

Among fossils found in the concretions surrounding belemnite rostra, have been found centric diatoms of the genus *Trinacria* HEIBERG, 1863 (pl. 11 : 5) and benthic foraminifera of the genus *Globobulimina* CUSHMAN, 1927 (pl. 11 : 6, 7). Similar microfossils occur in abundance in stratified sediments of the top part of the Cape Melville Formation. This indicates that the concretions were formed in the sediment, *in situ*, after deposition of belemnite rostra.

TIMING OF THE ICE-RAFTING EVENT

The Cretaceous belemnites of the genus *Dimitobelus* and *Peratobelus* here described occur as allochthonous, recycled fossils in the Lower Miocene sediments. Together with calcareous nannoplankton of Cretaceous age, and with numerous aften glacially scratched erratic boulders (dropstones) of all sizes up to about 2 m in diameter, they had been incorporated with the sediment of the Cape Melville Formation by the mechanism of iceberg-rafting during the Melville Glaciation (BIRKENMAJER 1982*b*, 1984; BIRKENMAJER *et al.* 1983). This glaciation was dated on radiometric and palaeontological grounds as a lowest Miocene event (BIRKENMAJER *et al.* 1985; BIERNAT *et al.* 1985).

PROVENANCE OF CRETACEOUS BELEMNITES

The Cretaceous belemnites in question could have been brought by drifting icebergs from the area of Alexander Island, some 1200 km south of King George Island, where Lower Cretaceous sediments with very similar belemnites are known (see WILLEY 1972). Reconstruction of iceberg drift-paths for the Tertiary Polonez Glaciation (BIRKENMAJER 1982*a*, fig. 25, 1983; BIRKENMAJER and WIESER 1985) makes this possibility plausible. However, taking into account the relative abundance of belemnites and Cretaceous calcareous nannoplankton in the Cape Melville Formation sediments, and the long drift path between Alexander Island (Fossil Bluff) and King George Island (Cape Melville) amounting to about 1200 km, it seems that we should look also for other sites of the Antarctic Peninsula sector situated closer to our site. Jurassic--Cretaceous and Lower Cretaceous marine strata crop out at Low Island (SMELLIE 1979) and Livingston Island (Byers Peninsula — see SMELLIE *et al.* 1980) in the South Shetlands, and at Dundee Island, NE tip of Antarctic Peninsula (fig. 4), however their belemnite content is different from those of Alexander Island and our Cape Melville site. We cannot exclude a possibility that some other Lower Cretaceous sequences with belemnites comparable with our recycled ones lie hidden under ice caps of the Antarctic Peninsula or South Shetland Islands or form part of their continental or insular shelves respectively.

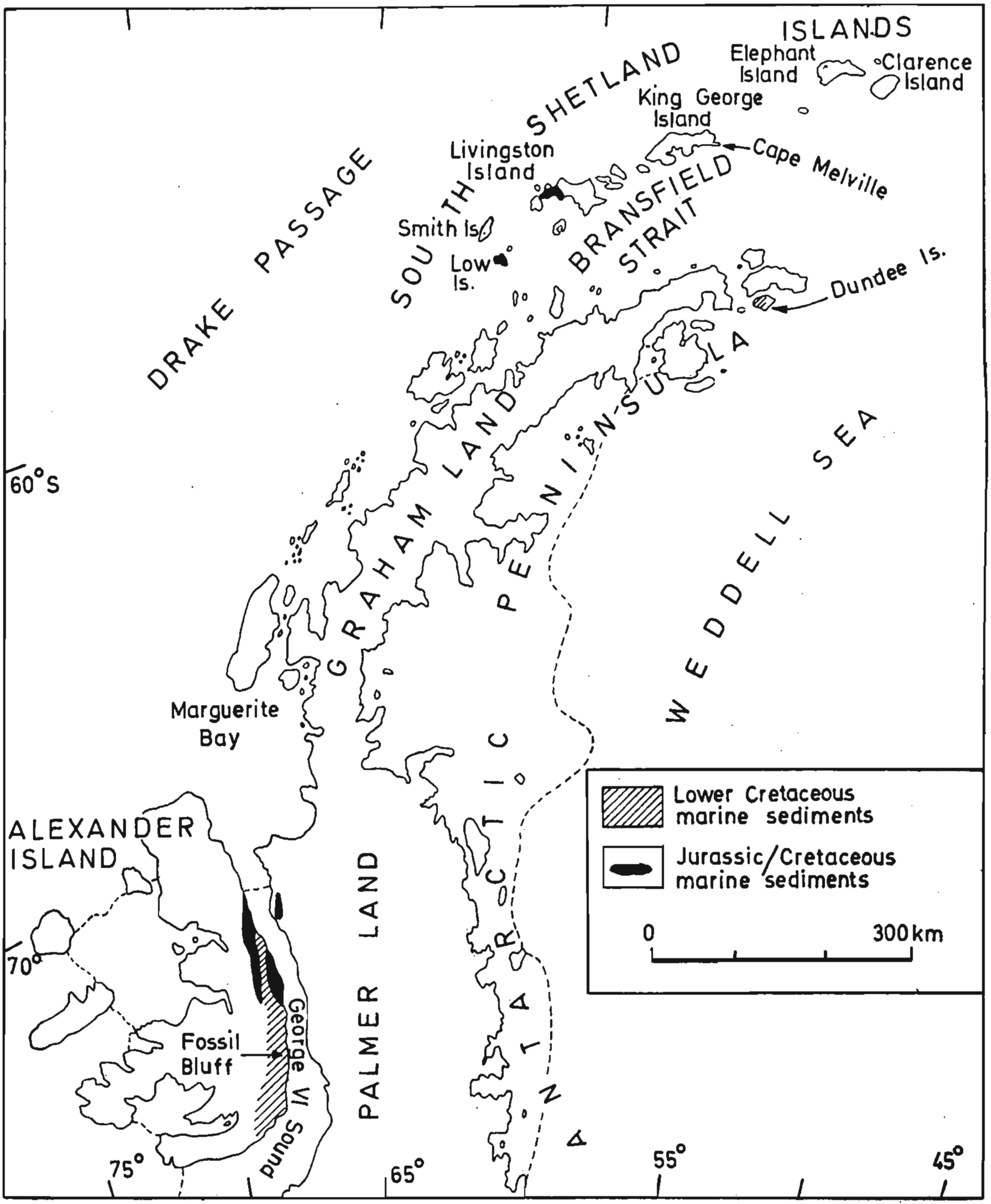

Fig. 4
Occurrence of Jurassic and Lower Cretaceous marine sediments in the Antarctic Peninsula sector (data from FLEMING and THOMSON 1979; SMELLIE 1979; SMELLIE *et al.* 1980; THOMSON 1981; THOMSON and HARRIS 1981, 1982).

SYSTEMATIC PALAEONTOLOGY

by

H. PUGACZEWSKA

Due to the incomplete, fragmented state of preservation of belemnite rostra, the only method applicable to analysis of their structure and systematic position was that of longitudinal and transversal sectioning of the rostra. In some rare cases it was also possible to study external morphology of the rostra. Conventional sectioning and measurements of rostra were carried out with respect to both main diameter of cross-sections in the upper, alveolar, and the lower, apical parts of the fragments (fig. 5).

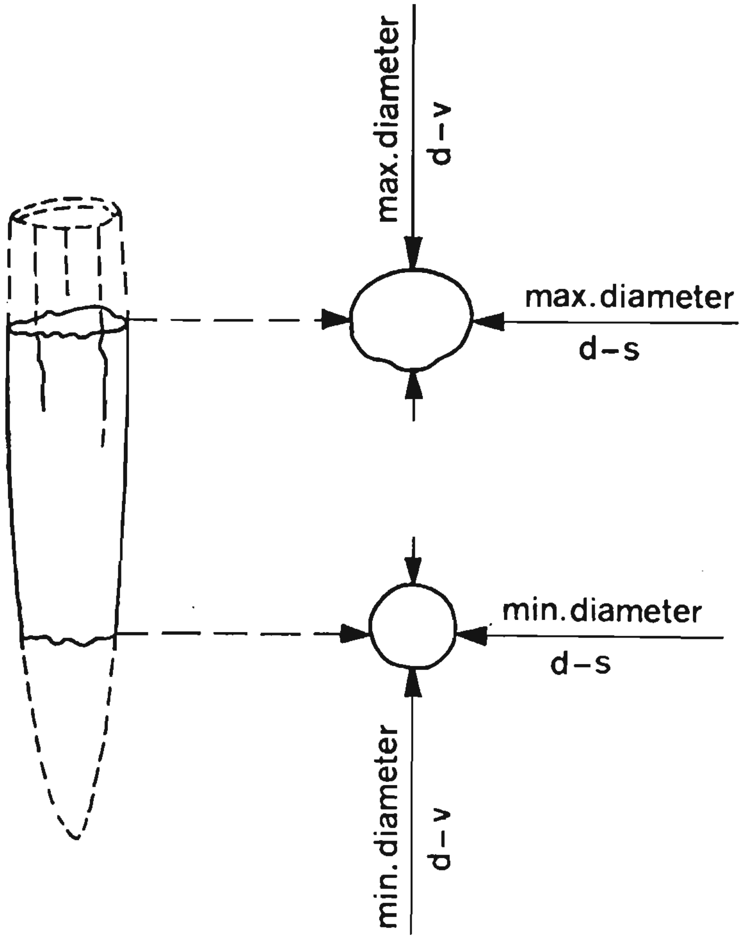

Fig. 5
Diagrammatic illustration of a belemnite guard showing the indices used in measurement.

Family **Dimitobelidae** WHITEHOUSE, 1924
Genus *Dimitobelus* WHITEHOUSE, 1924
Dimitobelus aff. *macgregori* (GLAESSNER, 1945)
(pl. 9: 1—8)

Material. — Twelve fragments of rostra, only 8 fragments suitable for palaeontological investigation. ZPAL Mo. XVII/2, 6—9, 11, 12, 19, 21, 24—25.

Description. — Rostra medium sized, strongly thickened, feebly hastate in lateral view (pl. 9 : 6), maximum diameter shifted towards apex, flattened ventral wall, slightly convex dorsal wall (pl. 9 : 2—8).

Table 1
Rostra dimensions (in mm)

ZPAL Mo. XVII/	max. Ø d-s	min. Ø d-s	max. Ø d-v	min. Ø d-v	Length of fragment
19/20	9	7.5	8.5	7	35
25	14	12	14	12	33
9	16.5	15	16.5	15	15
8	17	—	15	—	26
12	19	—	16	—	20
11	17	16	17.5	16	ca 19
6	20.5	18	16	17	42
7	21	—	18	—	20
2	—	—	14	12	30

Two shallow, wide (3 mm) furrows visible on the outer surface of the rostrum fragment, their position corresponds to dorso-lateral and ventro-lateral respectively (pl. 9 : 2a, 3—5, 7, 8). Rostra flattened dorso-ventrally, more in the lower than in the upper parts of the preserved fragments (pl. 9 : 7*a*, 7*b*).

Maximum transversal diameter (d-s) exceeds those of corresponding dorso-ventral ones (d-v) by 0.5—3 mm (table 1). Apical line shifted excentrically towards ventral side of rostrum. Growth-lines visible at transversal and longitudinal cross-sections of rostra, becoming thicker, more distinct in some parts of rostra where they correspond to successive growth stages. Taking into account their differential development, it is possible to distinguish the following main growth stages: nepionic, neanic, ephebic and gerontic.

(1) The nepionic stage is characterized by an oval or subquadrate transversal cross-section of rostrum, with slightly larger transversal diameter. Part of rostrum surrounding apical line is uniformly pigmented, growth-lines are invisible probably due to feeble calcitization of rostrum at this stage of growth (see Stevens 1965 : 123). Lateral walls, sometimes also dorsal wall, are distinctly flattened, ventral wall is slightly inflated (pl. 9 : 2—5, 7, 8).

(2) The neanic stage is characterized by faster growth of rostrum along dorsal and lateral walls, and by considerably weaker growth along ventral wall. This is marked in the cross-sections by denser growth-lines at the ventral, and more widely spaced ones at the lateral and dorsal sides. Transversal diameter of rostrum is still larger than the dorso-ventral one; in cross-section the outline is oval or subquadrate. Growth-lines running along lateral walls show faint depressions corresponding to the course of dorso-lateral and ventro-lateral furrows at the surface of rostrum.

(3) In the ephebic stage, the growth of rostrum becomes more uniform, and dorso-ventral flattening diminishes. In some cases, growth-rings become considerably more widely spaced at dorsal side of rostrum (pl. 9 : 3—5). Depressions, corresponding to lateral furrows, become more shallow and wider, eventually being transformed into wide dorso-lateral surfaces. Other cross-sections show folds and depressions of considerable amplitude, corresponding to furrows well expressed at the surface of rostrum (pl. 9 : 4).

(4) In the gerontic stage, the fastest growth is from dorsal side of rostrum. Dorso-lateral surfaces become wide and flat. Transversal cross-section of rostrum becomes asymmetric, with

dorso-lateral walls tilting inward, with narrowing and usually markedly inflated dorsal wall, flattened lateral walls and wide, faintly inflated ventral wall (pl. 9 : 2a, 3—5, 7, 8).

In general, the shape of the transversal cross-section changes from the alveola towards the apex. In the postalveolar part it is subquadrate (pl. 9 : 3, 4) and in the middle part—rounded (pl. 9 : 7a, 8) and in the apical one — transversally elongated, oval (pl. 9 : 7*b*, 5).

Remarks. — Our rostra resemble most those described as *Dimitobelus* sp. aff. *D. macgregori* (GLAESSNER, 1945) from the uppermost Aptian strata of Alexander Island by WILLEY (1972 : 32—33, figs. 3a—c, 5a—c). The features common to both comparable taxons consist of a similar outline of transversal cross-section in different parts of rostrum, presence of ventro-lateral and dorso-lateral furrows, similar characteristics or dorso-lateral surfaces, similar transversal and dorso-lateral diameter, and apical angle of about 30° (pl. 9 : 1, 2*b*). Some differences are apparent with respect to rostrum length (from protoconch to apex), as obtained by multiplying transversal diameter by 6 or 7. The species from Alexander Island would thus be about 70 mm long (WILLEY 1972 : 33), while our species would attain 63—147 mm in length. It should be noted, however, that WILLEY based his calculations on two specimens only, with the more complete one representing an „immature" rostrum (*op. cit.*).

Morphological studies of outer surfaces of the rostra have not been carried out due to the lack of suitably preserved specimens in our collection. However the analysis of transversal cross-section made it possible to distinguish basic features characteristic of the species *Dimitobelus* sp. aff. *D. macgregori* (GLAESSNER, 1945), as describcd by WILLEY.

Dimitobelus macgregori (GLAESSNER, 1945) described by STEVENS (1965) from the Upper Albian — Lower Cenomanian strata of South Island, New Zealand, shows considerable similarities to the species here described. It shows similarly developed ventro-lateral and dorso-lateral furrows, similar courses of lateral lines (see WILLEY 1972 : 33), similar sizes of rostra, but differs from our forms in the lack of lateral flattening of rostrum in its postalveolar part, in stronger dorso-ventral flattening of rostrum, and longer apical segment narrowing much slower towards apex (see STEVENS 1965 : 121—122, pl. 21 : 10—11; pl. 24 : 1—3; text-fig. 29c).

The holotype of the discussed species (GLAESSNER 1945 : 160—161, pl. 6 : 12a, b; 1958: 219—222, pl. 26: 5a—b; text-fig. 5a—c), described from the Aptian through Cenomanian Purari Formation, Paw Creek, Middle Purari Valley, Papua New Guinea, differs both from our species and from New Zealand one (see STEVENS 1965) in having slender, clavate rostrum narrowing more strongly in the postalveolar part, and the largest transversal diameter situated closer to apex.

Occurrence. — Melville Peninsula, King George Island (South Shetland Islands, West Antarctica): as recycled fossils in the Cape Melville Formation (Lower Miocene). *Dimitobelus* sp. aff. *D. macgregori* (GLAESSNER, 1945) has been described from the uppermost Aptian strata of south-eastern Alexander Island, West Antarctica.

Dimitobelus cf. *superstes* (HECTOR, 1886)
(pl. 10: 1—4)

Material. — Ten fragments of rostra, of which only 8 preserved well enough for palaeontological studies; ZPAL Mo. XVII/3, 4, 15, 17, 18, 22, 23, 26.

Description. — Rostra of medium size, cylindrical-hastate (pl. 10 : 2b), thickened. Probable length of entire rostrum, measured from protoconch to apex, has been calculated at 28—60 mm (this value is a result of multiplying the largest transversal diameter of rostrum by 3 or 4 — see STEVENS 1965 : 119). Outline of transversal cross-section variable. In postalveolar region, it is usually quadrate or subquadrate (pl. 10 : 2), with slightly larger transversal diameter, however sometimes both diameters are similar (pl. 10 : 1, 4) or the dorso-ventral one becomes slightly larger (pl. 10 : 3). In the middle and apical parts of the rostrum, the cross-section outline is oval, with larger transversal diameter.

Table 2
Rostra dimensions (in mm)

ZPAL Mo. XVII/	max. Ø d-s	min. Ø d-s	max. Ø d-v	min. Ø d-v	Length of fragment
23	7	6.5	6.5	6	15
26	8	7	6	5.5	23
22	9	8	8.2	6.5	12
15	11	10	10.5	10.5	7
4	12	11	12	11	23
18	12	—	12	—	10
3	14	13.5	15.3	15	15
17	15	13.5	13	12	48

Ventro-lateral furrows comparatively narrow and depressed (pl. 10 : 2, 4). Dorso-lateral surfaces wide, tilted towards dorsal wall (pl. 10 : 1—4). Apical line situated excentrically, closer to ventral wall. Around this line, growth-bands are invisible and the surrounding area is uniformly pigmented, not calcified (pl. 10 : 1—4).

Remarks. — The rostra in question resemble most those of *Dimitobelus superstes* (HECTOR, 1886) described from the Middle and Upper Albian through Coniacian-Santonian strata of New Zealand (STEVENS 1965: 117—121, pl. 21: 1—9; pl. 22, 23; text-fig. 26h, 28, 29a, b). The similarity refers to the characteristics of ventro-lateral furrows, dorso-lateral flattening and variable transversal cross-section in its postalveolar part (see STEVENS 1965 : 119). The variability of cross-section outline has been described by STEVENS as „depressed, equidimensional, and slightly compressed" but not subquadrate, though the latter shape is suggested by his photographs (STEVENS 1965: pl. 21 : 9; pl. 22 : 1, 3, 6).

Some differences between the species compared are expressed by considerably weaker dorso-ventral flattening of our rostra. Their maximum transversal diameters are larger than maximum dorso-ventral one by 0.5—2 mm, while analogous differences in the New Zealand material are 1.3—6.3 mm. It should be added that the New Zealand collection is nearly twice as large as that described here. Moreover, it consists predominantly of complete, well preserved specimens easily separable from the rock that allows a detailed analysis of the length and course of furrows, lateral lines, rostrum outline from all sides, and character of apex. Such features could not be studied in the present material because of its fragmented character. The specimens discussed do not resemble other species of the genus *Dimitobelus* WHITEHOUSE, 1924.

Occurrence. — Melville Peninsula, King George Island (South Shetland Islands, West Antarctica): as recycled fossils in the Cape Melville Formation (Lower Miocene). *Dimitobelus superstes* (HECTOR, 1886) has been described from numerous sites in New Zealand, from the deposits representing a long time span: Middle and Upper Albian through Coniacian-Santonian.

Genus *Peratobelus* WHITEHOUSE, 1924
Peratobelus sp.
(pl. 10: 5—9)

Material. — Five fragments of rostra. ZPAL Mo XVII/1, 5, 10, 14, 27.

Description. — Rostra medium sized, cylindrically-conical in ventral side view, faintly hastate, asymmetrical in lateral view (pl. 10 : 6).

Table 3
Rostra dimensions (in mm)

ZPAL Mo. XVII/	max. Ø d-s	min. Ø d-s	max. Ø d-v	min. Ø d-v	Length of fragment
1	13	—	13	—	21
10	14.2	14	15	14	22
5	15	14	14	15	65
14	15	15	15	15	11
27	—	—	14	6	50

In the middle and apical parts, the rostrum cross-section is circular or subcircular in outline (pl. 10 : 5b, 7b, 8, 9); in postalveolar part it is asymmetric, subquadrate, with slightly larger dorso-ventral diameter (pl. 10 : 7a). Ventral wall flattened, dorsal wall convex, lateral walls flattened in postalveolar parts (pl. 10 : 6—9). Apical line excentrically located closer to ventral wall. Apical segment long, gradually narrowing towards apex (pl. : 10 : 6). Apical angle, as measured at sagittal cross-section of rostrum, is approximately 22—24°C. Transverse cross-sections show faint depressions of growth-lines in earlier stages of growth. They correspond to ventro-lateral furrows that run along outer surface of rostrum (pl. 10 : 7, 9). Dorso-lateral furrows are expressed in cross-sections as flattened surfaces wedging out towards the dorsal side (pl. 10 : 7).

Remarks. — The specimens investigated resemble most *Peratobelus* sp. (?) nov. WILLEY from Lower Aptian of Alexander Island, West Antarctica (WILLEY 1972 : 34—37, figs. 4a—c, 5d). The similarity is shown in subcircular transversal cross-sections of postalveolar and apical parts, in lateral flattening of upper postalveolar part, shape of rostrum, its asymmetric side view, and traces of the courses of lateral furrows. Our rostra differ from those of Alexander Island in having larger diameters; their total length was probably longer, as may be calculated by multiplying transversal diameter by 9 (see WILLEY 1972 : 36). WILLEY's collection contains two specimens, 37 mm and 51 mm long. Using his calculation, our species would have been more than 130 mm long.

Taking into account their calculated length, our rostra resemble those of *Peratobelus oxys* (TENNISO-WOODS, 1884) but differ in the lack of dorso-ventral flattening, larger apical angle, and only faintly marked ventro-lateral furrows; the latter are deeply incised and fissure-like in *Peratobelus oxys* (WILLEY 1972 : 38). *Peratobelus oxys* (TENNISO-WOODS) resembles our rostra in having dorso-lateral flattenings (see WILLEY 1972 : 38).

Occurrence. — Melville Peninsula, King George Island (South Shetland Islands, West Antarctica): as recycled fossils in the Cape Melville Formation (Lower Miocene). *Peratobelus* sp. (?) nov. WILLEY is known from Lower Aptian of the south-eastern Alexander Island (West Antarctica).

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EXPLANATIONS OF THE PLATES 9—11

All belemnite specimens occurred as recycled fossils in the Cape Melville Formation (Lower Miocene) at Melville Peninsula, King George Island (South Shetland Islands, West Antarctica)

PLATE 9

Dimitobelus aff. *macgregori* (GLAESSNER, 1945)

1. Fragment of alveolar part of rostrum, lateral view; ZPAL Mo. XVII/21; × 1.5.
2. Alveolar part of rostrum; ZPAL Mo. XVII/8; *a* transversal cross-section, × 3; *b* lateral view, partially eroded guard showing a part of phragmocone, × 2.

3—5. Transversal cross-sections of rostra showing successive growth changes; ZPAL Mo XVII/25, 9, 7, × 3.

6. Longivudinal cross-section of rostrum fragment, juvenile stages well shown; ZPAL Mo. XVII/2; × 2.
7. Transversal cross-sections of rostrum fragment; *a* in upper (from alveolar side), and *b* in lower (from apical side) parts of rostrum; ZPAL Mo. XVII/6, × 3.
8. Transversal cross-sections of rostrum of mature individual. Well shown undulated growth lines at ventro-lateral furrows; ZPAL Mo. XVII/11, × 3.

PLATE 10

Dimitobelus cf. *superstes* (HECTOR, 1886)

1. Transversal cross-section of rostrum of a juvenile individual; ZPAL Mo. XVII/15, × 3.
2. Rostrum fragment of a juvenile individual; *a* transversal cross-section, *b* rostrum from ventral side; ZPAL Mo. XVII/22, × 3.

3—4. Transversal cross-sections of rostra of mature individuals, subquadrate outlines visible; ZPAL Mo. XVII/18, 3; 3 ×3; 4 ×4.

Peratobelus sp.

5. Rostrum fragment; *a* lateral view, partially eroded guard, × 2; *b* view of upper side (from alveolar side), × 3; ZPAL Mo. XVII/1, × 3.
6. Longitudinal cross-section of apical part of rostrum, earlier growth stages visible. Ventral wall flattened, dorsal wall convex (inflated); ZPAL Mo. XVII/27, ×0.6.
7. Transversal cross-sections of rostrum; *a* in postalveolar part, *b* in middle part; ZPAL Mo. XVII/5, × 3.

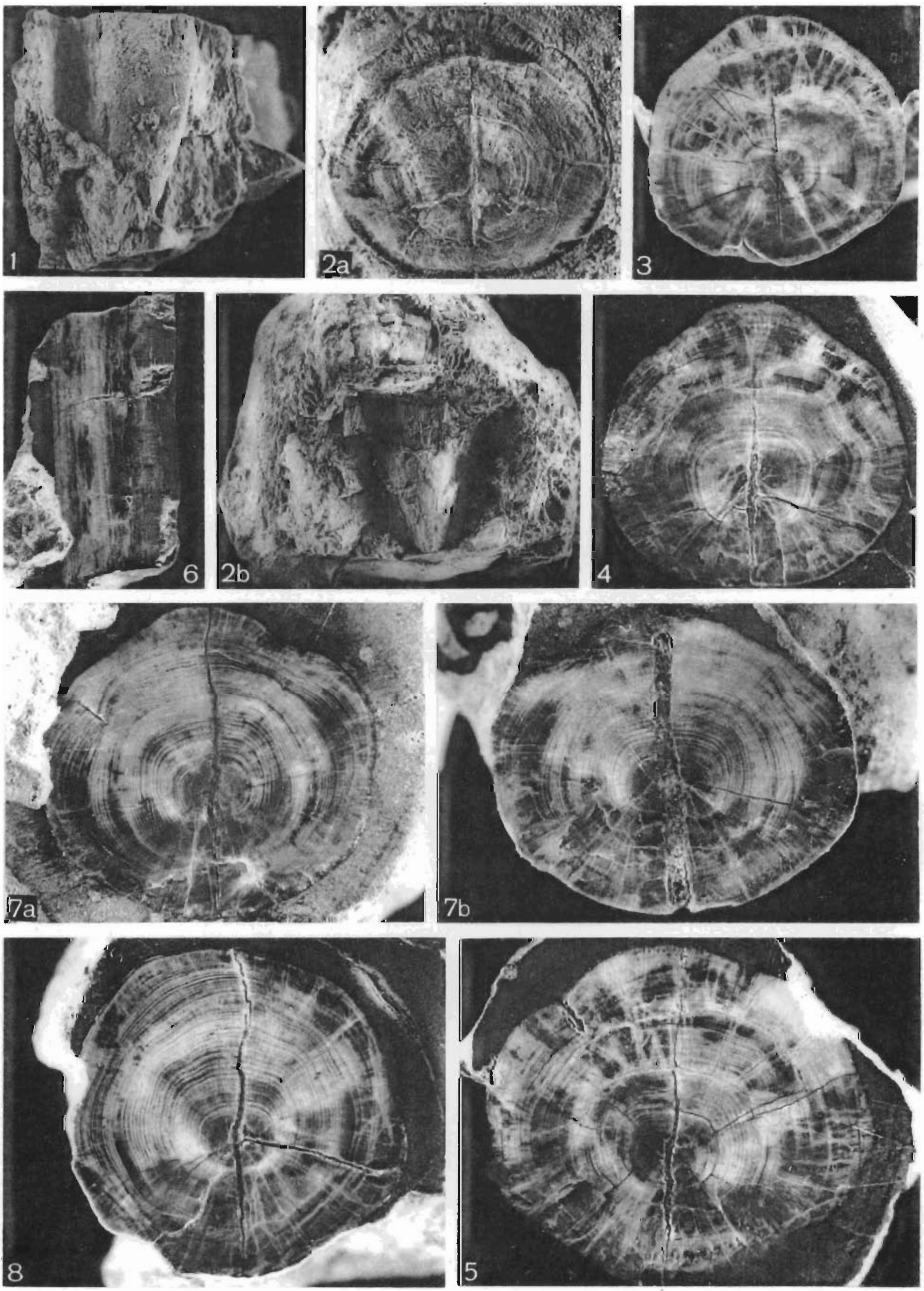
8—9. Transversal cross-sections of rostra in their apical parts; ZPAL Mo. XVII/10, 14, × 3.5.

PLATE 11

1. Crab Mound, Melville Peninsula: vertical orientation of a belemnite guard in horizontally stratified siltstone, Cape Melville Formation (Lower Miocene).

2—3. Weathered natural cross-section surfaces of cylindrical concretions with belemnite rostra. Concentric layers and radial cracks visible; ZPAL Mo. XVII/28, 29; natural size.

4. Transversal cross-section of a cylindrical concretion with belemnite guard, peels; ZPAL Mo. XVII/30; × 2.
5. Centric diatom of the genus *Trinacria* HEIBERG, 1863; SEM photomicrograph, × 700.
6. Foraminifer of the genus *Globobulimina* CUSHMAN, 1927, axial section, × 50.
7. *Globobulimina* sp., SEM photomicrograph, × 60.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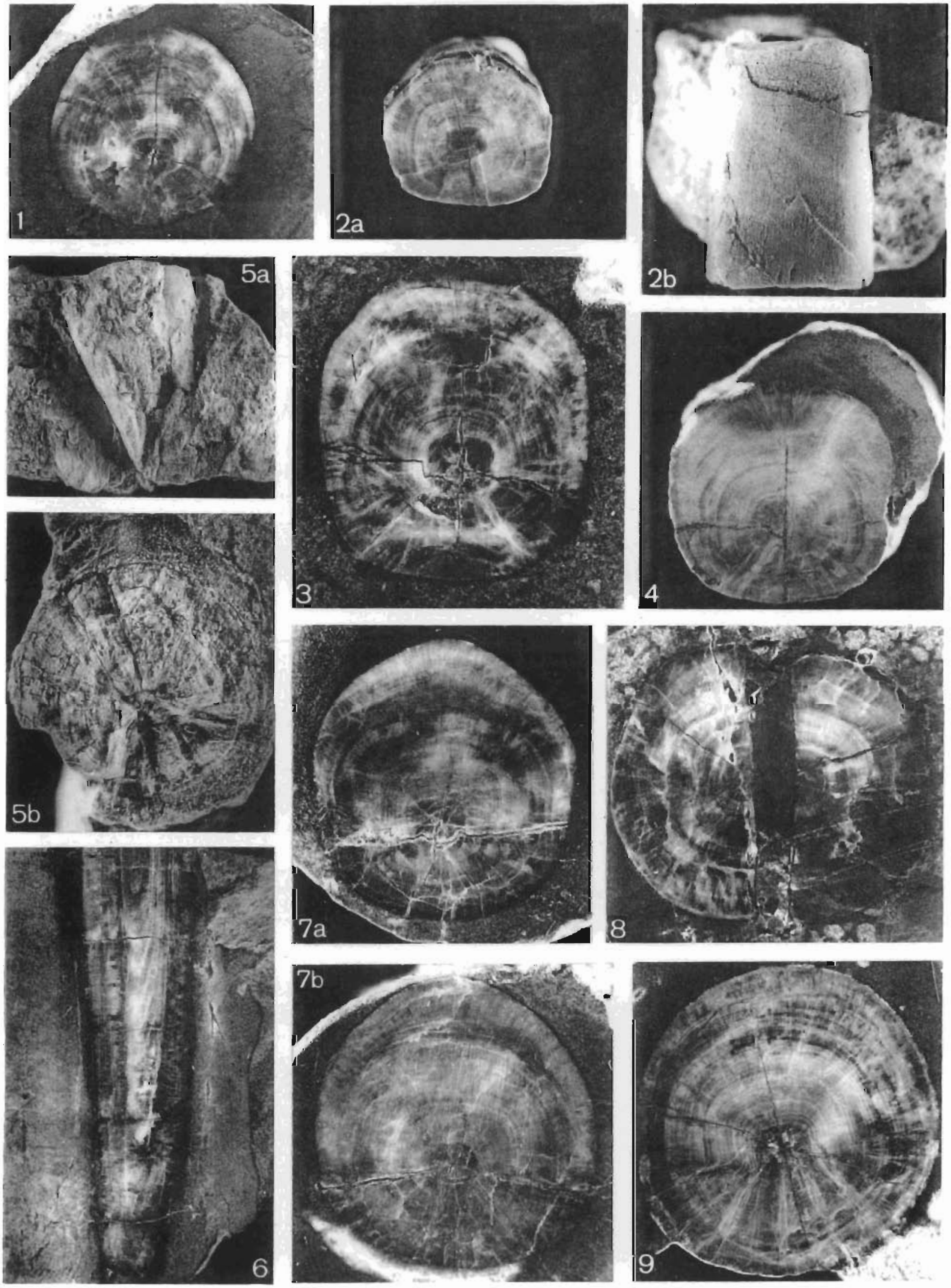
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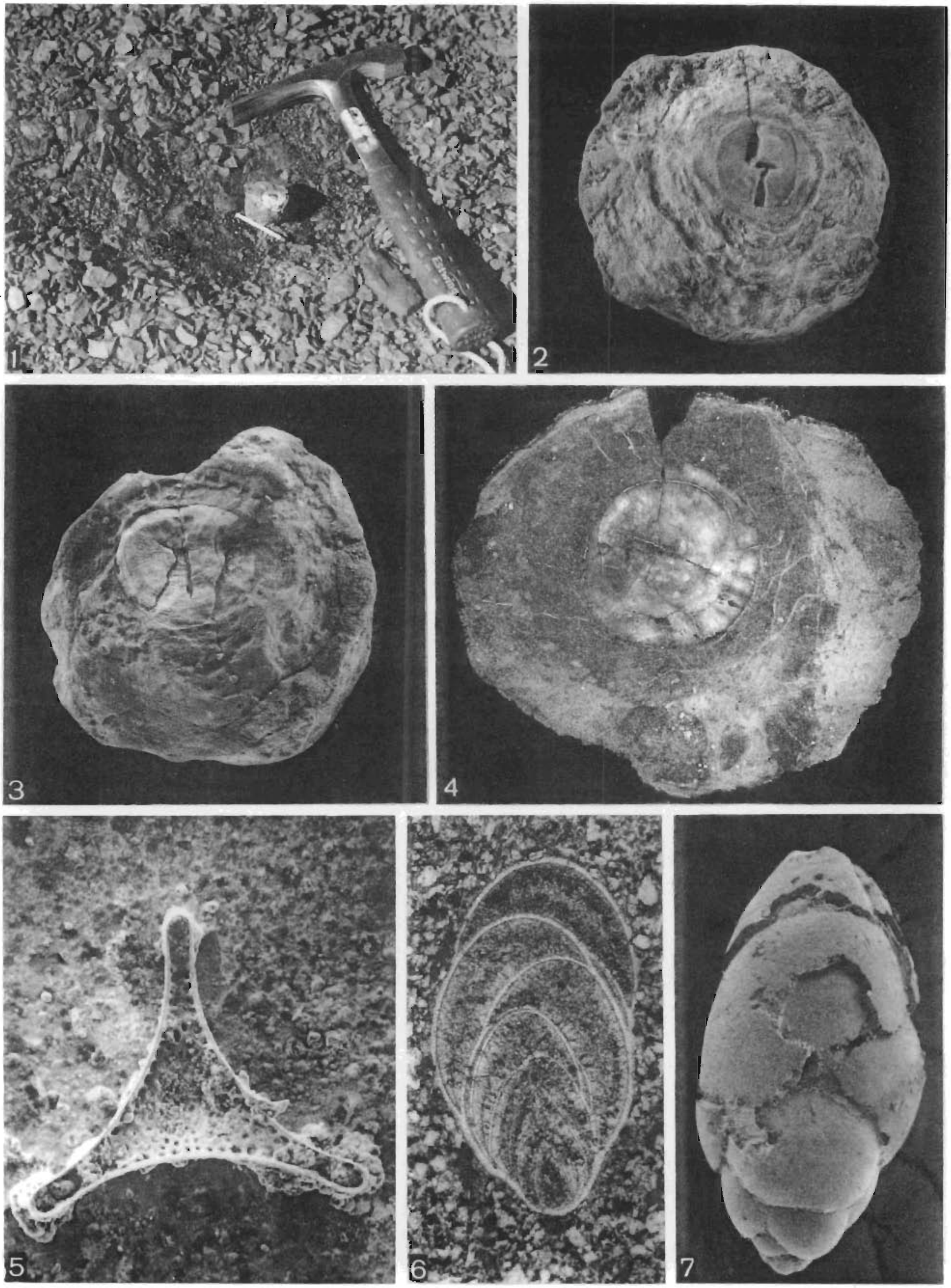

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