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CENTENNIAL
OF THE SWEDISH SOUTH POLAR EXPEDITION
(1901–1903)

> *The demand of science, that no part of the globe shall remain untouched by the hand of investigation, was the force that drew our little band to the land of the farthest south.*
>
> Otto Nordenskjöld, 1905
>
> Antarctica, or, two years amongst the ice of the South Pole

Almost exactly one hundred years ago, on October 16th 1901, the Swedish South Polar Expedition, led by the explorer and geologist Dr. Otto Nordenskjöld, left Göteborg heading south on the ship *Antarctic* under the Norwegian Captain Carl Anton Larsen. After a stop in Buenos Aires and short visits to Nelson and Paulet Islands, the wintering party landed on Snow Hill Island on the February 12th 1902. Here, on the terrace above shoreline in the northernmost tip of the island that is free of ice, they found a suitable place to build the Snow Hill Station (Nordenskjöld's Hut), see Figs 1, 2.

Fig. 1. Northern and eastern sides of Snow Hill Island (upper part of the photograph) as seen from Seymour Island (Cape Lamb). *Photograph by A. Gaździcki, January 1992.*

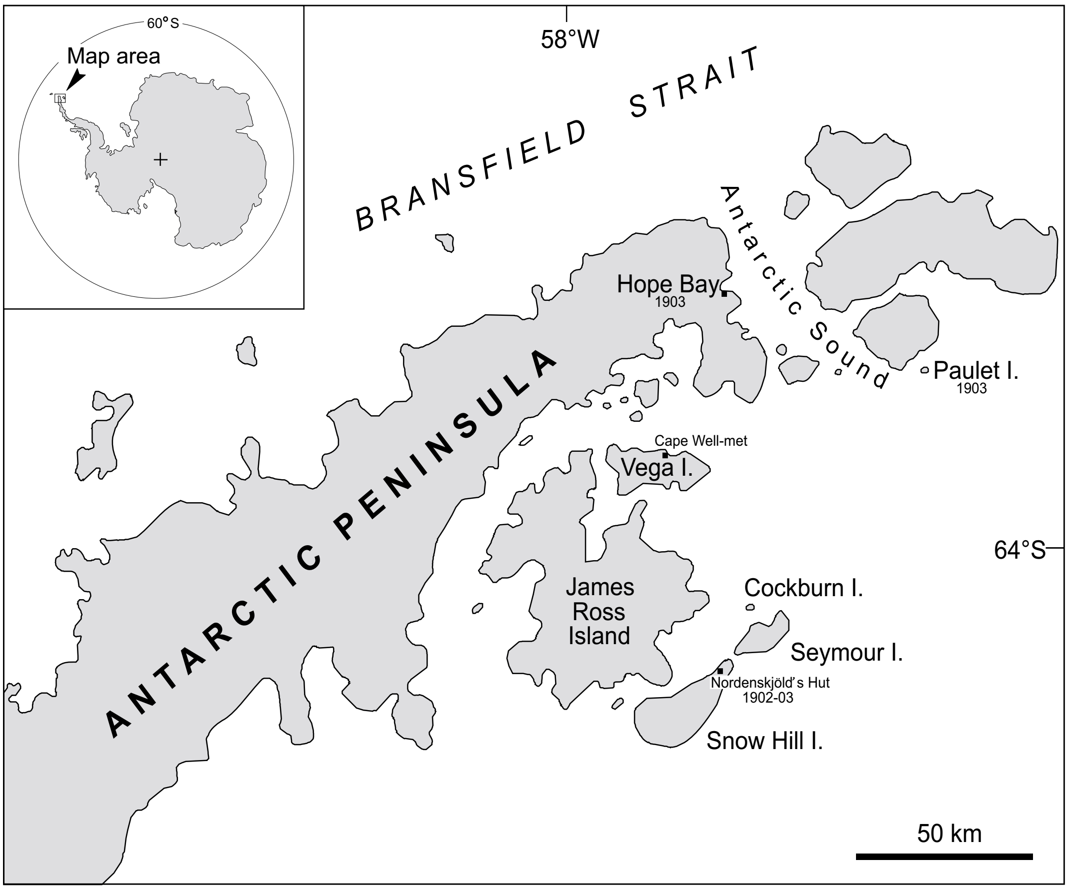

Fig. 2. Location map of Snow Hill, Seymour, Cockburn and Paulet Islands, and Hope Bay in the northern part of the Antarctic Peninsula.

On February 12th 1903 the *Antarctic* was crushed by the Weddell Sea pack ice. Having lost its ship, the Nordenskjöld's Expedition had to spend 23 months in Antarctica awaiting rescue. Their time was not wasted: they explored the northern part of the Antarctic Peninsula, including Snow Hill (Cerro Nevado), Seymour (Marambio) and Cockburn Islands, as well as the Hope Bay (Esperanza) area and Paulet Island (Fig. 2), and made many significant geological and paleontological discoveries. When rescue finally came in November 1903 with the arrival of the Argentinian corvette *Uruguay*, all but a single member of the expedition had survived. And so the Swedish South Polar Expedition remains as one of the most fascinating, incredulous, and productive in the annals of Antarctic exploration.

This volume of *Palaeontologia Polonica,* the third in the series of Palaeontological Results of the Polish Antarctic Expeditions devoted to Cretaceous and Eocene macro- and microfossils from Seymour Island, is dedicated to the brave participants of the Otto Nordenskjöld's Expedition on the occasion of its centennial to honour their scientific achievements in polar exploration accomplished under dramatic circumstances in the years 1901–1903.

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ANATOMY AND HISTOLOGY OF PLESIOSAUR BONES FROM THE LATE CRETACEOUS OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

ŁUCJA FOSTOWICZ-FRELIK and ANDRZEJ GAŹDZICKI

Fostowicz-Frelik, Ł. and Gaździcki, A. 2001. Anatomy and histology of plesiosaur bones from the Late Cretaceous of Seymour Island, Antarctic Peninsula. *In*: A. Gaździcki (ed.), Palaeontological Results of the Polish Antarctic Expeditions. Part III. *Palaeontologia Polonica* **60**, 7–32.

Remains of elasmosaurid plesiosaur have been collected from the lower part of the Late Cretaceous López de Bertodano Formation on Seymour Island, Antarctica. This well preserved bone material includes pectoral, dorsal, and caudal vertebral centra, femur, tibia, and fragments of the humerus, scapula, and ischia, that most probably belong to the one specimen. The microstructure of the bone tissue show rather dense structure with Haversian remodelling well underway and the areas of intensive growth, suggesting subadult stage of ontogeny. The dense pachyostotic character of the rib and girdle tissue, together with a relative small size of the bones (approximated length of the animal about two meters) may indicate that described material belongs to the not fully grown elasmosaur, which may have lived in shallow water environment. The studied remains share some similarities with those of *Mauisaurus* from the Maastrichtian of New Zealand – in the articular surface of the vertebral centra and the shape of the tibia.

Key words: Plesiosauria, bone histology, López de Bertodano Formation, Campanian–Maastrichtian, Seymour Island, Antarctica.

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INTRODUCTION

The plesiosaurs are Mesozoic group of large marine predators. They form a monophyletic order of reptiles within the Sauropterygia, probably originating from the Pistosauridae (Rieppel 1998). The first representatives of the order appeared in the Late Triassic and the latest are known from the Late Cretaceous (Brown 1981; Bardet *et al*. 1999). Plesiosaur remains from the Jurassic are found mainly in the Northern Hemisphere, until the Middle Jurassic the group is absent in the Southern Hemisphere (Persson 1963; Bartholomai 1966; Gasparini and Spalleti 1993; Gasparini 1997).

The record of marine vertebrates from the Campanian–Maastrichtian López de Bertodano Formation of Seymour Island (Marambio), West Antarctica includes remains of plesiosaurs and mosasaurs (Gasparini and del Valle 1981; Chatterjee and Zinsmeister 1982; Chatterjee, Small and Nickell 1984; Gasparini, del Valle and Goni 1984; Gasparini and Goni 1985; Chatterjee and Small 1989; Martin *et al*. 1999). Plesiosaur bone remains have been also reported from Campanian strata on Vega and James Ross Islands (del Valle, Medina

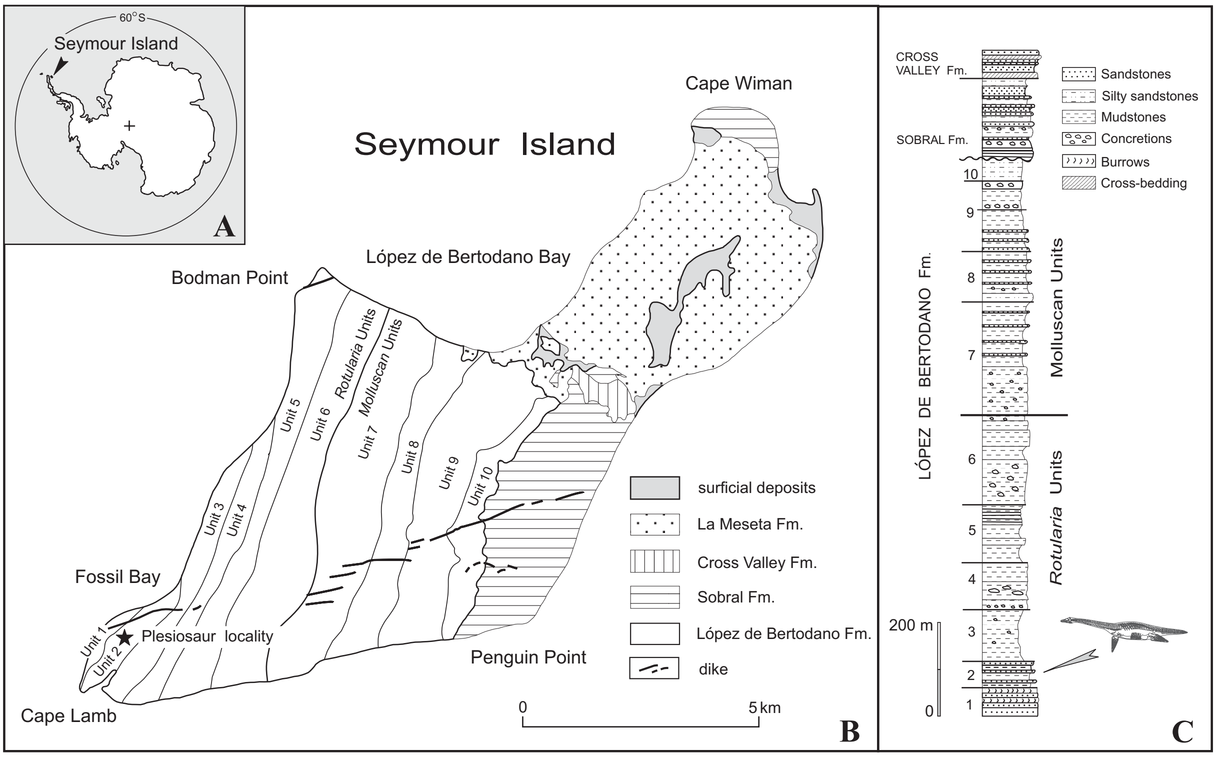

Fig. 1. Location map of Seymour Island in Antarctica (**A**) showing the locality where plesiosaur remains (asterisked) were collected (**B**) and stratigraphical column of the López de Bertodano Formation (**C**) along with location of plesiosaur site (arrowed). Section adopted from Macellari (1986).

and Gasparini 1977; Gasparini and Goni 1985). Most of the plesiosaur remains from Antarctica have been referred to Elasmosauridae, but Cryptoclididae are also present (Chatterjee and Small 1989). Pliosaurian genera have not yet been found in Antarctica, although they are known from Maastrichtian in Chile, New Zealand and Australia (Persson 1963; Chatterjee, Small and Nickell 1984; Gasparini, del Valle and Goni 1984; Gasparini and Goni 1985; Chatterjee and Small 1989).

The purpose of this paper is a description of plesiosaur bones and their histology based on material collected from the López de Bertodano Formation (Text-fig. 1). The plesiosaur bones were collected by one of us (AG) during the 1991–92 Argentine-Polish Field Party on Seymour Island. The specimens are housed in the Institute of Paleobiology, Polish Academy of Sciences, Warszawa, under the catalogue number ZPAL R.8.

Acknowledgements. — The field work conducted on Seymour Island during the 1991–92 austral season was made possible through an invitation from Professor Carlos A. Rinaldi, Director of the Instituto Antártico Argentino (Buenos Aires). We thank Magdalena Borsuk-Białynicka (Warszawa), Anusuya Chinsamy-Turan (Cape Town), Arthur R.I. Cruickshank (Leicester), Kristina Curry Rogers (Saint Paul, MN), and R. Evan Fordyce (Dunedin) for critical reading of the manuscript. Very special thanks go out to Andrzej Tatur (Warszawa) who assisted one of us (AG) during the course of the field program. We would like to extend our thanks to Grażyna Dziewińska for the photographs, Aleksandra Hołda for the drawings, and to Danuta Kościelska for the thin sections.

GEOLOGICAL SETTING

Seymour Island (Text-fig. 1A) is located in the northwestern part of Weddell Sea on the NE side of the Antarctic Peninsula, and contains a thick, well-exposed fossiliferous sequence of shallow marine, nonmarine, and glacial strata of Late Cretaceous to post-Pliocene age (Zinsmeister 1982; Feldmann and Woodburne 1988; Gaździcki 1998; Gaździcki *et al*. 1999). The López de Bertodano Formation (up to 1200

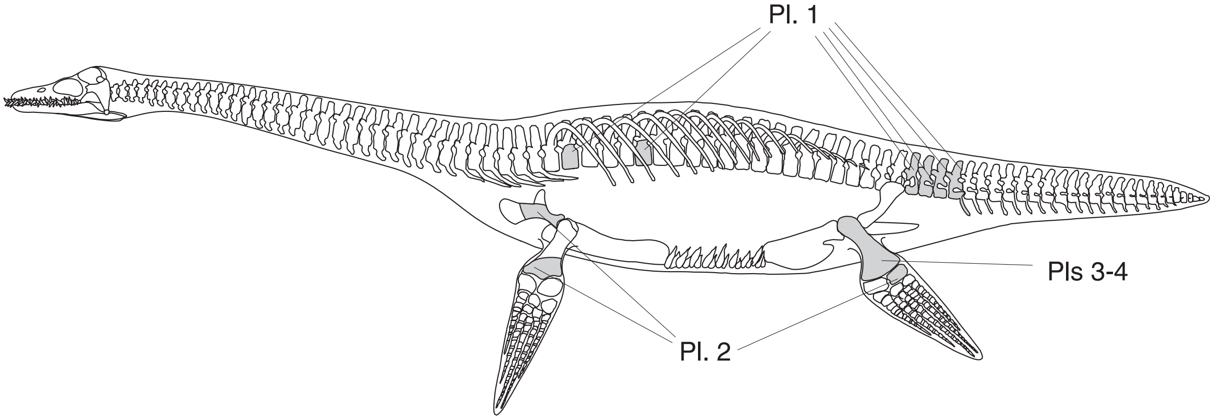

Fig. 2. Scheme of elasmosaurid skeleton with the described elements shaded.

m thick) contains these plesiosaur remains and is exposed in the southern part of the island (Text-fig. 1B, C). This clastic (poorly consolidated sandstones and siltstones) and richly fossiliferous formation represents shallow shelf marine to coastal and deltaic facies (Macellari 1986, 1988; Zinsmeister and Feldmann 1996).

The plesiosaur bones have been found in the lower part of the López de Bertodano Formation (Unit 2) within the *Rotularia* Units nearby Fossil Bay (Text-fig. 1B, C). The rocks from which the bones were collected consist of gray sandy siltstones with scarce annelid worm tubes (*Rotularia*) and poorly preserved gastropod and bivalve shells.

MATERIAL AND METHODS

The state of preservation of the bone tissue is very good, all anatomical characters of articular surfaces are easily recognizable. The bones were not articulated and appeared within a distance of about 20 m, although some of them were grouped (e.g. four caudal centra arranged closely together, more or less in articulation; Pl. 1: 6a–c). This arrangement and the similar size of the skeletal fragments suggest that all remains belong to the same specimen.

The bone histology was studied in detail using thin sections and a scanning electron microscope.

The elemental analysis (mass spectrography – EDAX) of the bone tissue supports data consistent with others found for fossil reptilian bone (Higby Schweitzer and Horner 1999). However the abundance of Sr^{2+} and Fe^{2+} is higher than expected. It could be an indicator of mild reducing environment.

SYSTEMATIC PALEONTOLOGY

Class **REPTILIA** Laurenti, 1768
Subclass **SAUROPTERYGIA** Owen, 1860
Order **Plesiosauria** de Blainville, 1835
Superfamily **Plesiosauroidea** Welles, 1943
Family **Elasmosauridae** Cope, 1869
Gen. et sp. indet.
(Text-figs 2–8, Pls 1–4)

Material. — The material including postcranial remains of a plesiosaur is listed in Table 1, and the anatomical situation of the remains is shown on the scheme (Text-fig. 2).

Table 1. List of the described material.

Anatomical part	Specimen number
fragment of broken cervical? vertebral centrum	ZPAL R.8/24, 27, 29
pectoral vertebral centrum	ZPAL R.8/15
anterior dorsal centrum	ZPAL R.8/5
broken dorsal centra	ZPAL R.8/19, 33, 34
anterior caudal centra	ZPAL R.8/1–4
fragments of caudal centra	ZPAL R.8/16–18, 22, 23, 25, 26, 28, 30, 35
fragments of vertebral centra – indet. region of the vertebral column	ZPAL R.8/20, 21, 31, 32
five fragments of ribs	ZPAL R.8/36–40
propodial (femur, nine pieces)	ZPAL R.8/6
head of the propodium	ZPAL R.8/7
fragment of the propodial shaft	ZPAL R.8/8
distal part of the humerus (four pieces);	ZPAL R.8/10
partly destroyed scapula (three pieces)	ZPAL R.8/11
fragment of the articular part of the scapula	ZPAL R.8/14
articular part of the girdle element (two pieces)	ZPAL R.8/12 a+b
four fragments of girdles – unrecognizable anatomical topography	ZPAL R.8/41–44
two parts of the girdle elements from the medial fusion area	ZPAL R.8/45–46
epipodial element (tibia?)	ZPAL R.8/13

ANATOMICAL DESCRIPTION

Vertebrae. — The neural arches are missing from the material, because they were not fully fused to the centra during the life of the animal. Most of the centra are represented only by fragments. They belong to three or four regions of the vertebral column: pectoral, dorsal, caudal, and, probably, cervical (Table 2). The identification of the cervical centrum is uncertain (only few fragments are present presumably belonging to a cervical centrum).

The pectoral centrum breadth-to-length ratio indicates a rather broad and short bone. The ventral surface is slightly circular in outline. The big facet for the rib is mainly formed by the centrum (parapophysis) and partly by the neural arch (diapophysis). The parapophysis is round and gently concave with pits and craters of diameters about 1–3 mm. The dorsal lip, made of the neural arch, is much smaller and triangular (Pl. 1: 2).

The dorsal region of the vertebral column is represented by one nearly complete centrum (ZPAL R.8/5; Pl. 1: 3) and a few fragments (ZPAL R.8/19, 33, 34). Specimens ZPAL R.8/5, 19 are from the anterior dorsal region. The complete anterior dorsal centrum is broad with a slightly dumbbell-shaped outline. Articular faces are slightly concave or platycoelous. There is an oval swelling with a small, shallow concavity in the center on the anterior articular face. The neural canal is broad and occupies about one third the width of the centrum. The ventral side of the centrum is circular in outline and has two pairs of nutrient foramina.

The four best preserved vertebral centra (ZPAL R.8/1–4; Pl. 1: 1a–b, 6a–c) come from the anterior caudal region. Centra are broader than long and high, with a general oval outline, with two grooves on dorsal and ventral side that makes them somewhat dumbbell-shaped. Anterior and posterior articular faces look very similar, and are platycelous. In the central part of each there is an oval swelling divided into two rounded small bumps with the shallow pit between them. The margins of the articular face are smooth and turned down. The ventral surface is nearly flat with one nutrient foramen constricted by two ridges. Laterally there are two smaller nutrient foramina. The sutures for the neural arch extend from the anterior border to more than a half the centrum length. The neural canal is very shallow and hourglass-shaped with an isthmus in the middle of the length of the centrum. This isthmus possesses a single nutrient foramen.

Ribs. — Ribs are represented only by small parts without tubercles and capitula. They are slightly flattened, with oval cross-sections.

Scapula. — The preserved part of the articular surface shows a complete glenoid cavity and most of the facet for the coracoid (Pl. 2: 1b). The glenoid facet is half-elliptical, gently concave. Its surface is rather smooth, slightly wavy with few small pits for blood vessels (maximum of 1 mm in diameter). The preserved

Table 2. Measurements of the vertebral centra (in mm, approximate values italicized).

Number of the specimen	Part of the vertebral column	Length (L)	Height (H)	Breadth (B)	H/L index	B/L index	H/B index	Length of the rib facets	Height of the rib facets	Breadth of the neural canal (max.)
8/24	?cervical	23.7						15.7	12.7	
8/27	?cervical	26.2	28.4		108.4					
8/29	?cervical	26.3						18.3		
8/15	pectoral	34.4	35.8	49.1	104.1	142.7	72.9	19.2	17.8	
8/19	anterior dorsal	35.3	37.0		104.8					
8/5	anterior dorsal	34.3	34.4	53.9	100.3	157.1	63.8			18.4
8/33	?dorsal	34.1								
8/34	?dorsal		40.7	45.5			89.5			
8/1	caudal	30.8	37.8	49.5	122.7	160.7	76.4	20.6	17.2	
8/2	caudal	29.2	37.1	49.6	127.1	170.0	74.8	left 20.4 righ 20.9	left 5.6 right15.2	12.1
8/3	caudal	29.5	37.8	49.7	128.1	168.5	76.1	19.1	16.2	
8/4	caudal	28.6	38.1	48.5	133.2	169.6	78.6	19.4	15.9	
8/16	caudal	27.1	34.3		126.6			19.1	12.4	
8/17	caudal	32.3		51.0		157.9		19.0	*23.0*	
8/18	caudal	25.1	33.9		135.1			17.3	12.3	
8/20	?caudal	33.6								
8/21	?caudal ?cervical	21.6	26.7	*40.1*	123.6	*185.6*	*66.6*			
8/22	?	30.5								
8/23	?	28.3								
8/25	?	30.0								
8/26	?	31.9								
8/28	caudal	19.2		29.2		152.1				
8/30	?caudal	35.1						16.9		
8/31	?	26.5								
8/32	?	34.2								

part of the articular surface for the coracoid is slightly convex and much more wavy and porous. Pits for blood vessels are up to 3 mm in diameter. The angle between these two articular facets is 116 degrees. The collum is slender and tear-shaped in cross section. From the ventral side the bone has a gentle longitudinal ridge, from which osteons are oriented in two directions: to the dorsal process and to the ventral plate, both of which are damaged (Pl. 2: 1a).

Table 3. Measurements of the scapula remains (in mm, estimates italicized).

Specimen number	Medio-lateral diameter of the articular surface	Ventro-dorsal diameter of the articular surface	Medio-lateral length of the glenoid cavity	Medio-lateral width of the collum	Ventro-dorsal thickness of the collum
ZPAL. R.8/11	56.6 (*73.8*)	42.1	37.7	29.8	18.1
ZPAL. R.8/14		44.0			

Pelvic girdle element. — The pelvic girdle is represented by the articular part of ischium (Pl. 2: 2). The articular surface is divided into two triangular parts connected with the bases, one of them is longer –

55.3 mm, smoother and slightly concave and it is probably a part of the acetabulum. The second one is shorter 45.6 mm, rough and convex. Both have pits and craters for blood vessels but the shorter has much more of them and they are bigger, 2.2–2.8 mm in diameter. The breadth of the common side of two articular facets is 37.9 mm, and the angle between them is 116 degrees.

Propodials. — The propodial region of the skeleton is represented by one nearly complete left femur (Pl. 3: a–c, 4: a–c), fragments of the proximal part of the right femur, and fragment of a shaft and distal part of the humerus (Pl. 2: 3a–b). The measurements of propodial element are included in Table 4.

Femur ZPAL. R.8/6 has well preserved proximal and distal ends, it lacks only a part of a shaft. The caput is distinct and hemispherical. The articular face is nearly round with a flattened dorsal margin. The caput is connected with the trochanter only by a very thin bone bridge 7.3 mm width and 13.5 mm long, and is set at an angle, facing 33 degrees medially from the vertical. The surface of the caput is rather smooth with many small round pits about 1 mm diameter. These are the openings of canals for blood vessels passing through the cartilaginous cover of the articular face of the femoral head (Brown 1981). The trochanter is elongated, oval-shaped, and slopes obliquely ca. 36 degrees in postero-distal direction. The surface of the trochanter is slightly convex and gently slopes to the shaft surface. The section of the shaft near the caput is nearly round. Remains of a big muscle scar, partly destroyed after fossilization, are situated under the caput, on the medial side.

The distal part of the femur (ZPAL R.8/6) is flattened medio-laterally and shows two articular facets for contacting the epipodial elements. The anterior margin is little rounded and dully beveled, whereas the posterior margin is slightly elongated. The surface of the distal part of the propodial is strongly porous, showing distribution of the blood vessels (Pl. 2: 3a, Pl. 4: a).

The distal part of the propodial referred to a humerus (ZPAL R.8/10) is more flattened medio-laterally than the femur. The distal surface is spindle-shaped with slightly rounded ends. This part shows also two articular facets, but they are gently concave in contrast to the previously described in distal fragment, that are flat. This element is also strongly protruded posteriorly, whereas the anterior outline is bevelled (Pl. 2: 3b).

Table 4. Measurements of the propodial elements (in mm).

Specimen number	Total bone length (L)	Width of the caput (antero-posterior)	Thickness of the caput (medio-lateral)	Breadth of the distal end (B)	Thickness of the distal end
ZPAL. R.8/6	163.0	52.5	47.9	94.2	37.2
ZPAL. R.8/10				106.2	34.2
ZPAL. R.8/7		55.8	44.9		

Epipodial element. — Only one epipodial element was found in the material. It is flattened medio-laterally, pentagonal, 58.3 mm broad (B) and 48.5 mm long (L) with pronounced epipodial foramen (Pl. 2: 4). Its B × 100/L index is 120. The facet for the propodium is nearly straight, 44.9 mm long. It broadens medially to the 24.7 mm. The posterior side of the bone is rounded and 15.3 mm thick. From the distal side there are two articular facets for metapodial elements – posterior and anterior. The former one is shorter (26.0 mm) and 20.2 mm thick, and is oriented 23 degrees from the horizontal to the distal direction, while the latter one, 29.8 mm long and 21.2 mm thick, slopes 34 degrees. The angle between them is 123 degrees. Medial and lateral sides are slightly concave, and the thickness of the central part of the bone is 15.5 mm. All articular facets are strongly porous and show the same bone pattern as the distal parts of the propodials. Medial and lateral sides have remains of smooth, strongly compact bone. The same tissue covers the anterior part of the epipodial.

BONE HISTOLOGY

Vertebral centra. — Several transverse and longitudinal cross sections were made. The demarcation between the periosteal cortical and endosteal trabecular regions is not very distinctive. Both areas are made of dense compacted bone tissue. The outermost parts of the cortex are partly eroded, showing sometimes

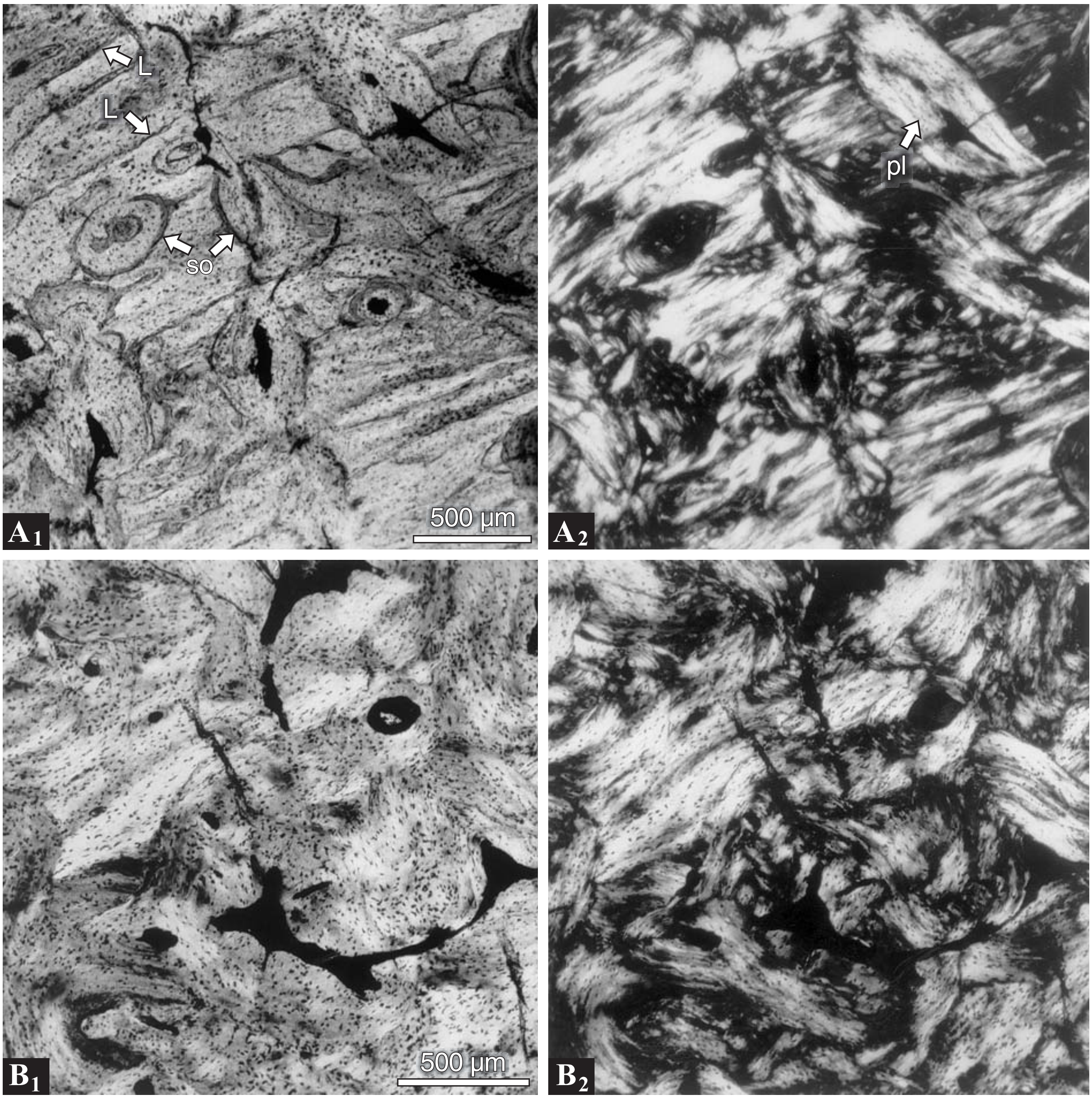

Fig. 3. Tissue of vertebral centra. **A**. Primary parallel-fibered bone overlapped by secondary osteons (so) in the deep cortex; A_1 in normal light, A_2 in polarized light. Abbreviations: L, Line of Arrested Growth (LAG); pl, pseudolamellar tissue. **B**. Endosteal compacted coarse cancellous bone from the medulla region; B_1 in normal light, B_2 in polarized light.

Sharpey's fibers. The compacta is occupied by rather small, generally circular and densely packed secondary osteons. In the periosteal region, primary parallel fibred bone occurred (with Lines of Arrested Growth – LAGs present, Text-fig. $3A_1$), in which secondary osteons (Text-fig. $3A_1$–A_2) consisting of pseudolamellar tissue occur (*sensu* Ricqlés 1975; Wiffen *et al.* 1995). Some small contributions of the lamellar tissue is possible. Resorption and cement lines are quite visible (Text-fig. $3A_1$). In some thin sections this region is nearly completely remodeled, apart from the most external cortex, and made of compacted cancellous bone. More internally, in the medullary area, the tissue shows a typical compacted coarse cancellous character, with irregular, convoluted, and dense structure (Text-fig. $3B_1$–B_2). The tissue becomes more cancellous toward the medullary region. Resorption areas are variably-shaped. Most commonly, they are narrow and convoluted. The trabeculae made of lamellar bone have sometimes the remains of primary woven-fibered bone in the cores. The areas between the trabeculae are also filled, apart from the fragments of woven-fibered bone, by lamellar tissue, which is deposited as short shreds arranged in various directions, often perpendicular to each

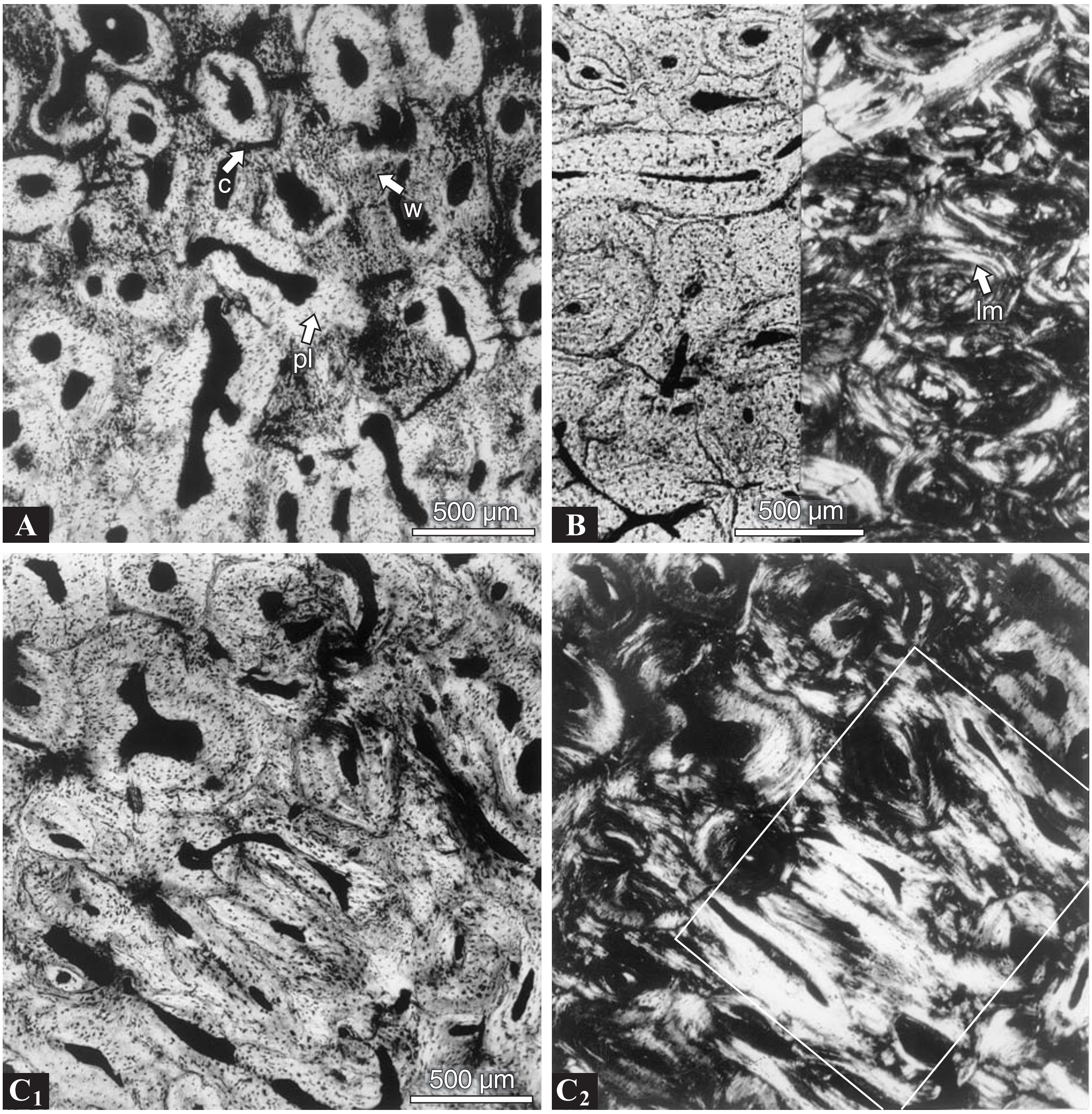

Fig. 4. Bone tissue in girdle and propodials. **A**. Propodial cortex: secondary osteons made of pseudolamellar bone (pl), and surrounded with cement (c) embedded in the woven-fibered (w) bone matrix. **B**. Dense structure of the girdle bone; left part – view in normal light, right – in polarized light; lm, lamellar bone tissue. **C**. Transition region between the deep cortex (left) and perimedulla region (right), observed change of osteon shape and orientation (frame); C_1 normal light, C_2 polarized light.

other. The most internal parts of the medulla contain also small assemblages of a globular, calcified cartilage between the trabeculae. The osteocytes of vertebral tissue are polygonal, sometimes more or less elongated, with weakly developed, or without canaliculi.

Girdle fragments and ribs. — Girdle elements and ribs show similar patterns of bone tissue type and organization. Both show very dense and compact internal structure, dominated by overlapping secondary osteons made of lamellar or, sometimes, by pseudolamellar tissue. There is no distinct division into cortex and medulla. The more external regions are occupied by densely packed secondary osteons, generally rounded or oval flattened dorso-ventrally. In the more internal regions the osteons become bigger, more elongated and sometimes slightly curved (Text-fig. 4B), but compacted in the same way as in the more external part. No calcified cartilage is incorporated into the bone, and remnants of primary woven-fibered bone are very rare. Internally the canals usually have a bigger diameter. They are surrounded by lamellar bone, but no

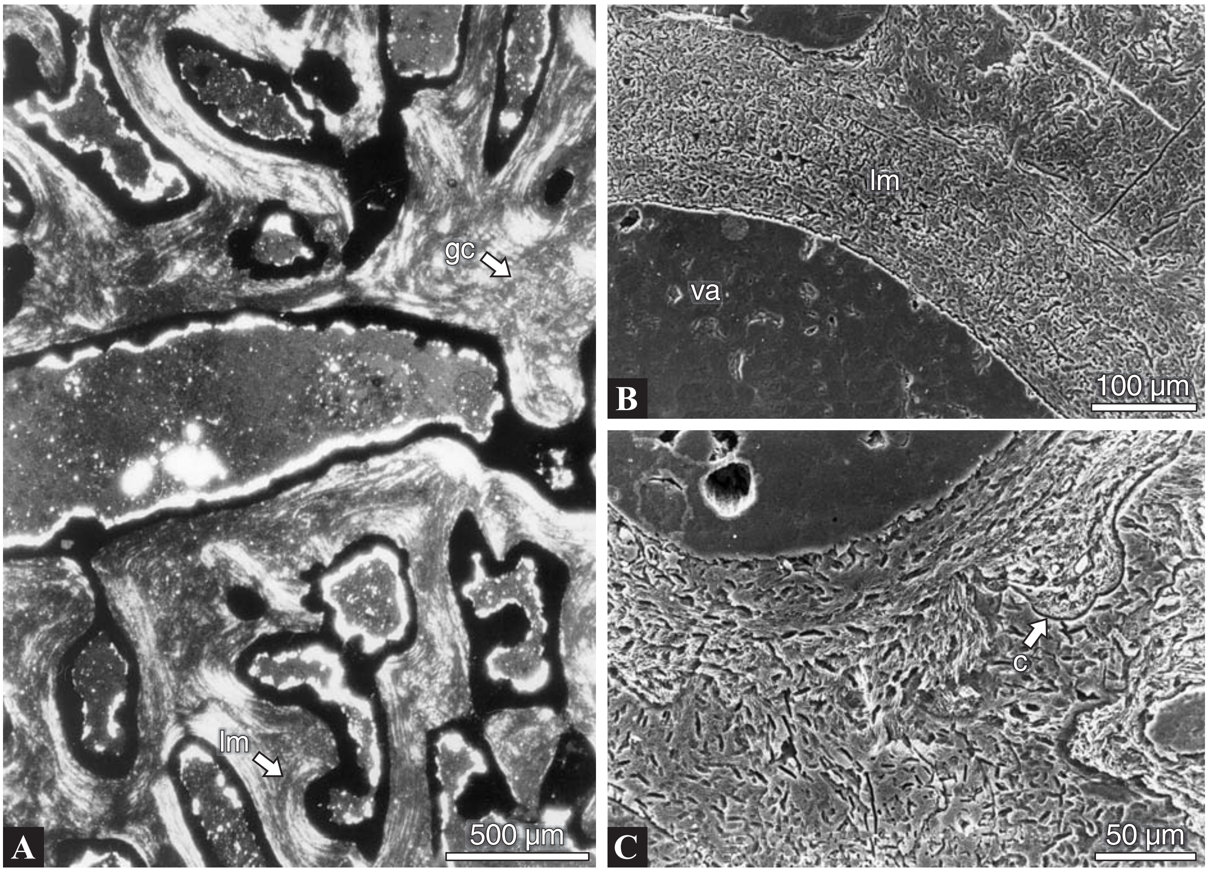

Fig. 5. **A**. Epiphyseal region of the propodium (cross section), large vacuities and well vascularized spongy structure indicate extensive growth (in polarised light); gc, globular cartilage; lm, lamellar bone tissue. **B**. Lamellar bone (lm) in the medulla of the propodium; va, vacuities in medulla. **C**. Remodelling lines (c) and the remains of woven-fibered bone in the compacted coarse cancellous bone of the propodial medulla region.

spongiosa appears. In girdle elements and rib tissue the osteocytes are variably-shaped and possess well developed canaliculi richly branching.

Propodials. — In cross section two distinct regions appear, one of them is periosteal bone tissue, which creates the cortex and the second one is the medullary region with trabeculae made of endosteal bone. The outer parts of the cortex are transparent and woven-fibered without any lamination. This region is rich in small, longitudinally oriented, vascular canals, not yet surrounded by lamellar bone. Internally the cortex displays a woven-fibered texture, very rich in osteoblasts, which is overlapped by secondary osteons densely spaced and often made of pseudolamellar bone (Text-fig. 4A). This region of the cortex frequently displays pronounced cement lines and traces of remodeling. The secondary osteons in the cortex are generally longitudinally oriented, and are more rounded and sparsely located than the osteons in the medulla, which are abundant, more elongated and variously oriented. The change in general osteon orientation occurs in the inner cortex area (Text-fig. 4C_1–C_2), where osteons become elongated radially. Inward the endosteal trabeculae made of lamellar bone show signs of remodeling and Howship’s lacunae. Between them there are small areas of remaining calcified cartilage and areas of woven-fibered primary bone. Cross section of the propodial shaft described above displays intensively remodelled structure. In the most external parts of the cortex processes of intensive growth occured. It is marked by a large number of small newly formed osteons and domination of woven-fibered bone tissue. In the medulla the tissue porosity increases, and the resorption vacuities surrounded by lamellar bone appear (Text-fig. 5B–C). A different pattern is visible in the cross section through the distal part of this bone near the articular facet (Text-fig. 5A). This part has an enormously porous structure, caused by intensive growth and vascularisation in the developing terminal part. The borders of vascular canals are covered by thin lamellar bone and between them the globular calcified cartilage is present.

DISCUSSION

INTERPRETATION OF BONE STRUCTURE IN TERMS OF INDIVIDUAL AGE AND LIFESTYLE OF THE ANIMAL DESCRIBED

The described material most probably belongs to a single individual. The similar size order of the skeletal remains and arrangement of some bones (especially vertebral centra) on the surface of the sediment seem to prove this assumption.

Anatomical investigations of the skeletal remains from Seymour Island show that they belonged to a subadult animal. The neural arches are not fused to the centra and thus indicate a juvenile or subadult ontogenetic status of the specimen (Brown 1981). Total presumed length of the described plesiosaur, approximated about two meters, indicates an animal not fully grown yet, when compared with the known range of plesiosaur body length from few meters up to 12 meters in *Hydrotherosaurus alexandrae* (Welles 1943). On the other hand, the head and the trochanter of the femur described here are well developed, and they are in fact separated, apart from a tiny connection formed by the thin bridge. This separation is not known in juvenile specimens (Brown 1981).

The microstructure of reptile bone, including that of plesiosaurs and other marine groups, is considered as indicative of ontogenic stage, biomechanical adaptations and physiology (Enlow 1969; de Buffrenil and Mazin 1990; Chinsamy 1990, 1995; Chinsamy and Rubidge 1993; Wiffen *et al.* 1995; Cruickshank *et al.* 1996; Chinsamy 1997; Curry 1999; Horner *et al.* 1999).

Bone thin sections show features that seem to represent the ontogenetic status between dense and unorganized – typical juvenile, and highly porous and remodelled – adult tissue. The observed developed Haversian remodelling and lack of plexiform vascularization is typical for adult and subadult specimens (Wiffen *et al.* 1995; Chinsamy 1997; Curry 1999). The presence of lamellar-zonal bone with Lines of Arrested Growth (LAGs), although not very distinctive in described vertebral centrum tissue (Text-fig. 3A_1–A_2), indicates a post-juvenile age (Curry 1999), comparable features were reported by Wiffen *et al.* (1995) for an adult plesiosaur centrum from New Zealand. However, the primary woven-fibered bone (abundant in the propodial cortex and in deep vertebral centrum medulla) is characteristic, among others, for fast growing specimens (Chinsamy 1997; de Buffrenil and Mazin 1990) and indicates that intensive bone growth has not stopped. Similarly, the remnants of globular calcified cartilage show that the bone is not completely remodeled. It is known that the density of secondary osteons increases during the ontogeny in many vertebrate groups (Chinsamy 1997), and cortical region is getting thinner, also in plesiosaurs (Wiffen *et al.* 1995). Secondary osteons in the cortical regions of a described propodium are quite numerous. Observations of development and density of secondary osteons in the radius and ulna cortex of *Apatosaurus* were used by Curry (1999) to establish age classes. Although sauropods and plesiosaurs are filogenetically distant, the pattern of described plesiosaur propodial cortex corresponds to age class III (subadult) of *Apatosaurus* that could give some ideas about the ontogenetic stage of the animal. The thickness of cortical region of the described propodium (5 mm in the average, i.e. 31% of the bone radius) is less than for the juvenile (ca. 65%), and corresponds to the values found in adult, according to Wiffen *et al.* (1995).

Another problem that must be discussed is the pachyostotic character of the bone tissue, seen especially in cross sections of the ribs and the girdle elements. Three types of pachyostosis can be recognized; bones (especially ribs or mandible) can be larger and more robust, the tissue can be more dense by filling in the free spaces by new deposits, and bones can have higher mineral content (Cruickshank *et al.* 1996). The first character, which was observed in new pliosaurian species *Pachycostasaurus dawni* was also regarded as a specific character (Cruickshank *et al.* 1996). Pachyostosis has been considered characteristic for young plesiosaurs which kept close to the shore (Cruickshank *et al.* 1996). In shallow water, pachyostosis is useful to control buoyancy for an animal, as it is observed in sea cows (Cruickshank *et al.* 1996). During plesiosaur growth its bones begin to change and become more porous, and osteoporosis develops (Wiffen *et al.* 1995). This is an adaptation to an open sea habitat, found also in other marine group, ichthyosaurs and cetaceans (de Buffrenil and Mazin 1990).

The remains from the López de Bertodano Formation do not display the first mentioned kind of pachyostosis, because the rib fragments are not swollen or enlarged. In this specimen pachyostosis is manifested through the increase of bone density in girdle elements and ribs. The other parts of the skeleton do not

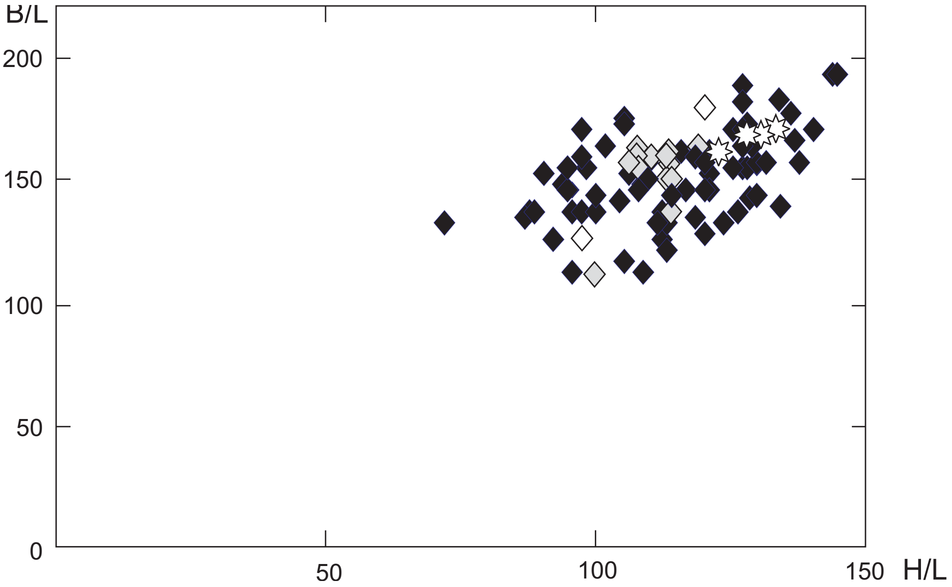

Fig. 6. Distribution of caudal centra indices in three Late Jurassic and Cretaceous plesiosaur families: elasmosaurs (black), pliosaurs (gray), cryptoclidids (white rhombs), and indices of the plesiosaur from the López de Bertodano Formations (asterisks).

display such a dense structure although vertebral centra tissue is not so porous as corresponding adult tissue described by Wiffen *et al.* (1995). This is another reason to classify the plesiosaur from the López de Bertodano Formation as subadult.

These histological characters indicate that studied plesiosaur as a subadult was a shallow water form. However, it is quite possible that as a fully grown animal it led a pelagic life.

TAXONOMICAL COMPARISONS

The problem of systematics and important diagnostic features within the Plesiosauria has been discussed by many authors and is still not resolved (Welles 1943, 1952; Tarlo 1960; Persson 1963; Carpenter 1999; Storrs 1999). In the case of large water dwellers, growing throughout life, the main difficulty is a strong ontogenetic variability of the skeleton, especially in proportions and shapes of vertebral centrae and girdle bones, which are among the most common found remains in this group of animals (Godefroit 1995; Bardet and Godefroit 1995; Carpenter 1996, 1999). Brown (1981) in his monograph on Late Jurassic Plesiosauroidea of England analyzed the 38 characters used by many authors as taxonomically important (Williston 1903, 1906, 1908; Russell 1935; Welles 1943, 1949, 1952, 1962; Tarlo 1959, 1960; Welles and Gregg 1971). He classified them into four groups according to the amount of variability they were subjected to in ontogeny. The most useful for the family level taxonomy are fairly stable characters (D-group of Brown 1981); those of skull architecture and the number and special character of the cervical centra, such as ventral and lateral keels, articular surface character, and general proportions.

These characters are possibly synapomorphic for plesiosaur families. Still some characters of Brown's (1981) D-group such as the shape of ventral process of the scapula, and the proportions of the propodial bones and length of the ischia do change significantly in ontogeny and, thus, only their adult states may be valid as taxonomic features.

In his C-group Brown (1981) collected characters predisposed to parallel evolution such as body size, double- or single-headed ribs, number and proportions of epipodial elements, and extent of hyperphalangy. Groups A and B of Brown (1981) are generic and specific characters insignificant for phylogeny and others highly variable in ontogeny.

Characters concerning the propotions of the cervical centra are important and useful because of frequent finds of isolated vertebrae and incomplete skeletons with preserved parts of vertebral column. Taxonomically important are: length to width and length to height indices. These characters are connected with elongation or shortening of the neck in some groups of the plesiosaurs; the largest elongation is reported in

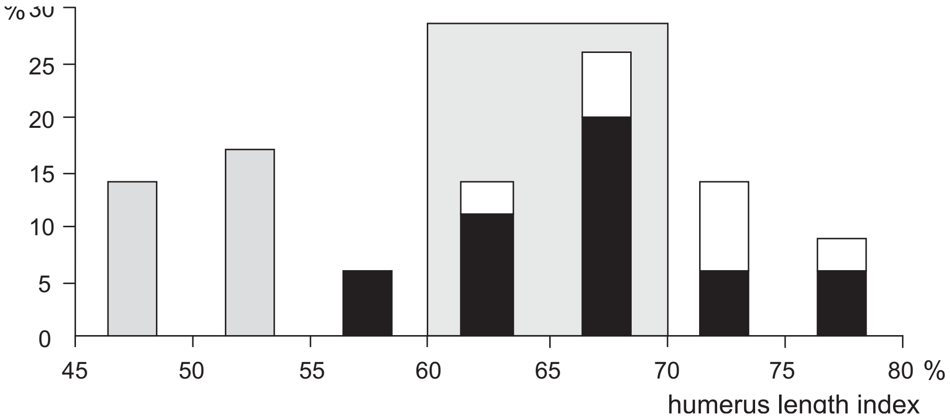

Fig. 7. Values of the humerus length index for the three Cretaceous families: pliosaurs (gray), elasmosaurs (black), and cryptoclidids (white). Striped field marks a probable range of values for the described humerus.

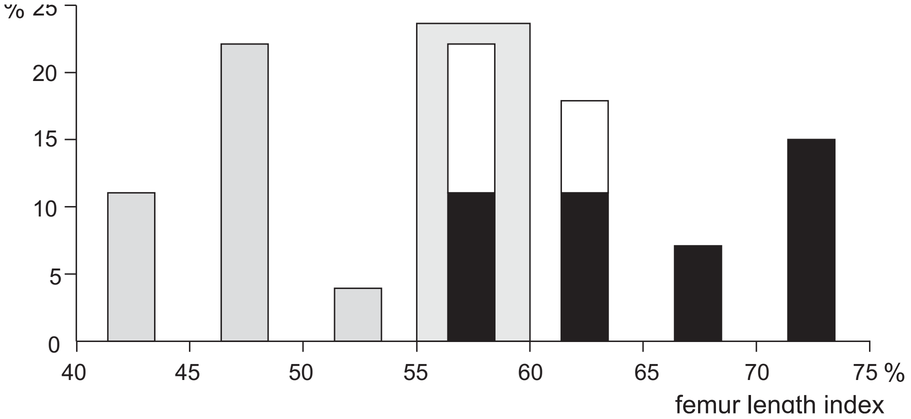

Fig. 8. Values of the femur length index for the three Cretaceous families: pliosaurs (dark gray), elasmosaurs (black), and cryptoclidids (white). Striped field marks the value for the described femur.

Elasmosauridae and the shortening in Pliosauridae (Brown 1981). Vertebral centra indices from the other parts of the vertebral column, especially presacrals, although not so characteristic, also could be useful in anatomical comparisons (Wiffen and Moisley 1986; Godefroit 1995).

The material from the López de Bertodano Formation consists of several fragments of relatively small plesiosaur skeleton. The recognition of the family and genus is uncertain due to the lack of the anterior part of the body with skull and cervical vertebrae of the animal. One can speculate about the systematic position on the basis of the shapes and proportions of the propodial elements and epipodium (Wiffen and Moissley 1986; Renesto 1993). The investigation of measurements and non-quantitative characters of the vertebral centra and their comparison with other species of plesiosaurs was also helpful.

Vertebral centra. — Caudal vertebrae indices (B × 100/L and H × 100/L) of seven elasmosaurs, one pliosaur and one cryptoclidid were compared with values of indices for the López de Bertodano specimen (Text-fig. 6). The caudals show a great range of values. With the proviso that pliosaurs are poorly represented, there seem to be no taxonomic differences between the families in caudal indices or there is a great amount of overlap of variability range. Among the non-quantitative features of the vertebral centra, the surface of the articular faces may be informative. The anterior and posterior surfaces bear a central swelling with a shallow central pit (Pl. 1: 1a–b) similar to the structures found on the centra referred to paralectotype of the Maastrichtian New Zealand species *Mauisaurus haasti*, and claimed to be characteristic for this species (Welles and Gregg 1971; Wiffen and Moisley 1986). The central pit is not so deep as in the dorsal vertebrae of Mangahouanga Stream specimen – NZGS, CD 430 (Wiffen and Moisley 1986: p. 222, figs 32, 33) and the vertebrae are also more flattened dorso-ventrally than in CD 430 specimen. The description of vertebrae of

Mauisaurus haasti from the Laidmore Formation (Welles and Gregg 1971) is very short and shows just a contour drawing with similar dorso-ventrally flattened central swelling (Welles and Gregg 1971: p. 26, fig. 5). The illustration, however, lacks details, and thus a full comparison of the vertebral centra of both specimens (C. M. zrf. 92 and ZPAL R.8/1–5) is impossible for the time being.

Proportions of the propodials. — Most authors emphasize the fact that pliosaurs have more slender ("pendulous") propodial bones than elasmosaurs and cryptoclidids (Welles 1943, 1962). Indeed, among 14 elasmosaurs, one cryptoclidid and 11 pliosaur genera, there is a strict separation between the length indices (B × 100/L) of pliosaurs and elasmosaurs. The pliosaur index is lower than that of the elasmosaurs. There is no distinct difference between elasmosaurs and cryptoclidids indices (Text-figs 7, 8). This relation may only hold true for Cretaceous and Late Jurassic species, because the genus *Occitanosaurus* from the Early Jurassic of France, recently reinterpreted as a new elasmosaur genus (propodial indices – 43% for humerus and 47% for femur; Bardet *et al.* 1999), is characterized by the values typical for Pliosauridae (Wiffen and Moisley 1986).

The material described from the López de Bertodano Formation contains one well preserved propodial bone (femur). Its length index (57%) is typical for Plesiosauroidea (Text-fig. 8). The value of the length index for the reconstructed length of the humerus is also between 60% and 69%, which are medium values in the range typical for Plesiosauroidea (Text-fig. 7).

Outline of the distal end of the propodials. — The majority of elasmosaurs and cryptoclidids have a horizontally expanded distal part of the propodials (Wiffen and Moisley 1986; Carpenter 1999), especially in the humerus, slightly larger than femur (Brown 1981). The specimens from the Seymour Island have a nearly flat, double articular facet with the distal end of the humerus expanded on one side (Pl. 2: 3a–b), typical for the Plesiosauroidea (Carpenter 1999; Welles 1943, 1949, 1952, 1962; Welles and Gregg 1971; Tarlo 1960). The shape of the humerus closely resembles the distal part of the humerus from Elasmosauridae from the Maastrichtian of Argentina, previously described as *Trinacromerum lafquenianum* (Gasparini and Goni 1985; Gasparini and Salgado 2000).

The distal parts of the elasmosaur femur show more variable shapes, and thus sometimes are similar to pliosaur propodials, but pliosaur femora have usually more rounded and narrow distal ends (Renesto 1993; Wiffen and Moisley 1986; Tarlo 1960). The distal end of the femur from the López de Bertodano is not particularly diagnostic. However, the general outline and appearance of the caput and trochanter (presence of deep anterior and posterior grooves) and the shape of a tibia are similar to the *Mauisaurus haasti* from the Maastrichtian of New Zealand (Welles and Gregg 1971: p. 24, fig. 4). Differences are in the maximal length of the New Zealand specimen, which is twice the length than specimen referred here and has higher (67%) length index.

Shape of scapula. — The shape of the scapula, especially the ventral process, could not be identified (Pl. 2: 1a). Both processes of the scapula are damaged and their reconstruction is difficult. The body of the scapula has a long, slender neck and lacked, probably expanded, ventral process. In juvenile and subadult specimens, the development of the ventral process of the scapula varies from slender, narrow bones to expanded triangular bars (Brown 1981; Carpenter 1999). Moreover not all of Plesiosauroidea species possess ventral process of the scapula developed to the same extent (Welles 1952, 1962; Carpenter 1999).

COMPARATIVE REMARKS

Comparisons with the New Zealand and Antarctic specimens (Welles and Gregg 1971; Wiffen and Moisley 1986; Chatterjee and Small 1989; Gasparini and Salgado 2000), as well as comparisons of vertebral and propodial length indices clearly show that the material from the López de Bertodano Formation of Seymour Island represents a small (body length about two meters long), probably subadult, elasmosaur. Genus and species could not be identified, but some features of the vertebral centra articular faces, and the anatomy of tibia and femoral head and trochanter suggest that these elasmosaurid remains most likely belong to *Mauisaurus* or to a closely related genus.

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PLATES

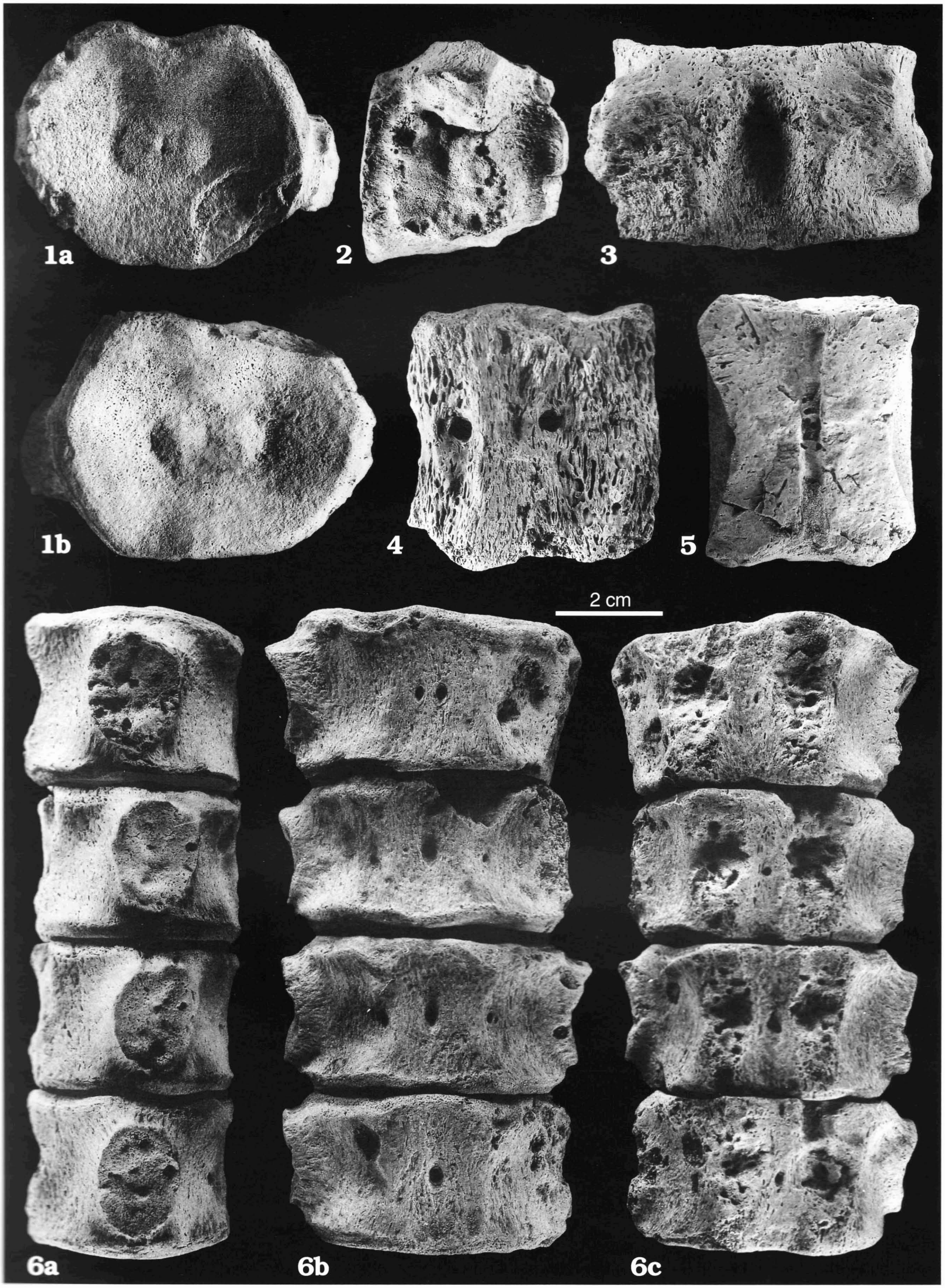
ANATOMY AND HISTOLOGY OF PLESIOSAUR BONES FROM THE LATE CRETACEOUS
OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 1

Elasmosauridae gen. et sp. indet. 10

Fig. 1. Caudal vertebral centrum ZPAL R.8/1; *a* anterior view, *b* posterior view.
Fig. 2. Pectoral vertebral centrum ZPAL R.8/15, lateral view.
Fig. 3. Dorsal vertebral centrum ZPAL R.8/5, dorsal view.
Fig. 4. Heavily weathered cervical ? centrum ZPAL R.8/27, with two well preserved ventral nutrient foramina, ventral view.
Fig. 5. Caudal vertebral centrum ZPAL R.8/17, view on the surface of the saggital section.
Fig. 6. Four caudal vertebral centra ZPAL R.8/1–4; *a* lateral view, *b* ventral view, *c* dorsal view.

All specimens natural size.
Unit 2. López de Bertodano Formation (Campanian–Maastrichtian).


1a
2
3
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5
2 cm
6a
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6c

ANATOMY AND HISTOLOGY OF PLESIOSAUR BONES FROM THE LATE CRETACEOUS
OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 2

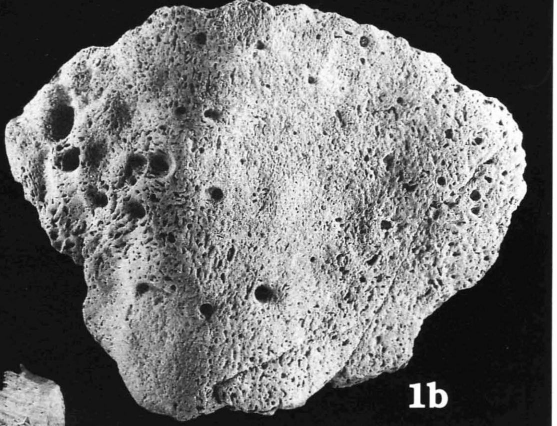
Elasmosauridae gen. et sp. indet. 10

Fig. 1. Right scapula ZPAL R.8/11; *a* stereopair, medial view × 1/3, *b* articular facet.
Fig. 2. Articular facet of ischium? ZPAL R.8/12.
Fig. 3. Distal part of right humerus ZPAL R.8/10; *a* distal view, *b* lateral view.
Fig. 4. Epipodial element, probably the tibia ZPAL R.8/13; lateral view.

Figs 1b–4 natural size.

Unit 2. López de Bertodano Formation (Campanian–Maastrichtian).

1a



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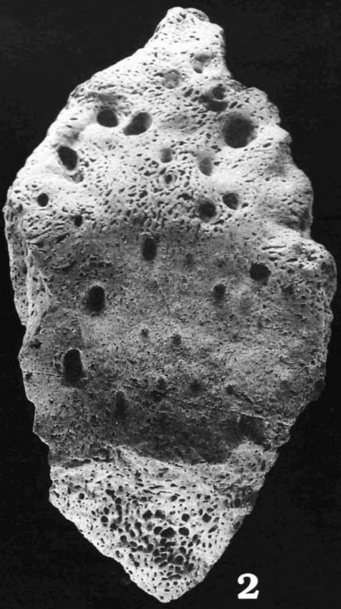

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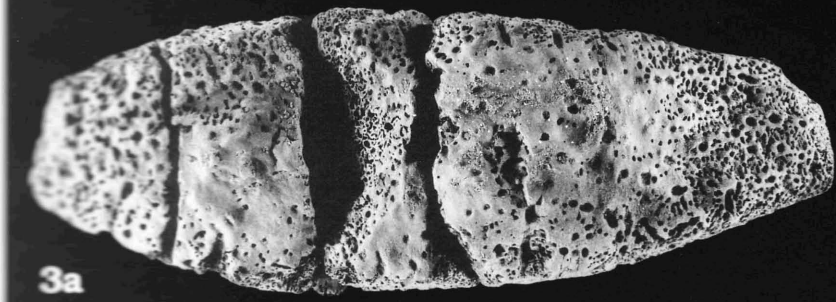

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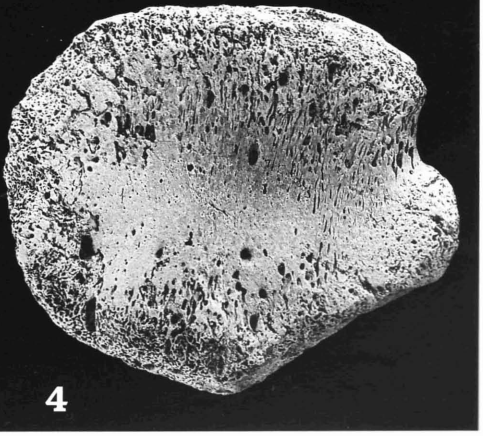

4

ANATOMY AND HISTOLOGY OF PLESIOSAUR BONES FROM THE LATE CRETACEOUS
OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 3

Elasmosauridae gen. et sp. indet. 10

Left femur ZPAL R.8/6; *a* proximal view, *b* medial, *c* anterior. Natural size.

Unit 2. López de Bertodano Formation (Campanian–Maastrichtian).

Ł. FOSTOWICZ-FRELIK and A. GAŹDZICKI: ANATOMY AND HISTOLOGY OF PLESIOSAUR BONES FROM THE LATE CRETACEOUS OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

ANATOMY AND HISTOLOGY OF PLESIOSAUR BONES FROM THE LATE CRETACEOUS
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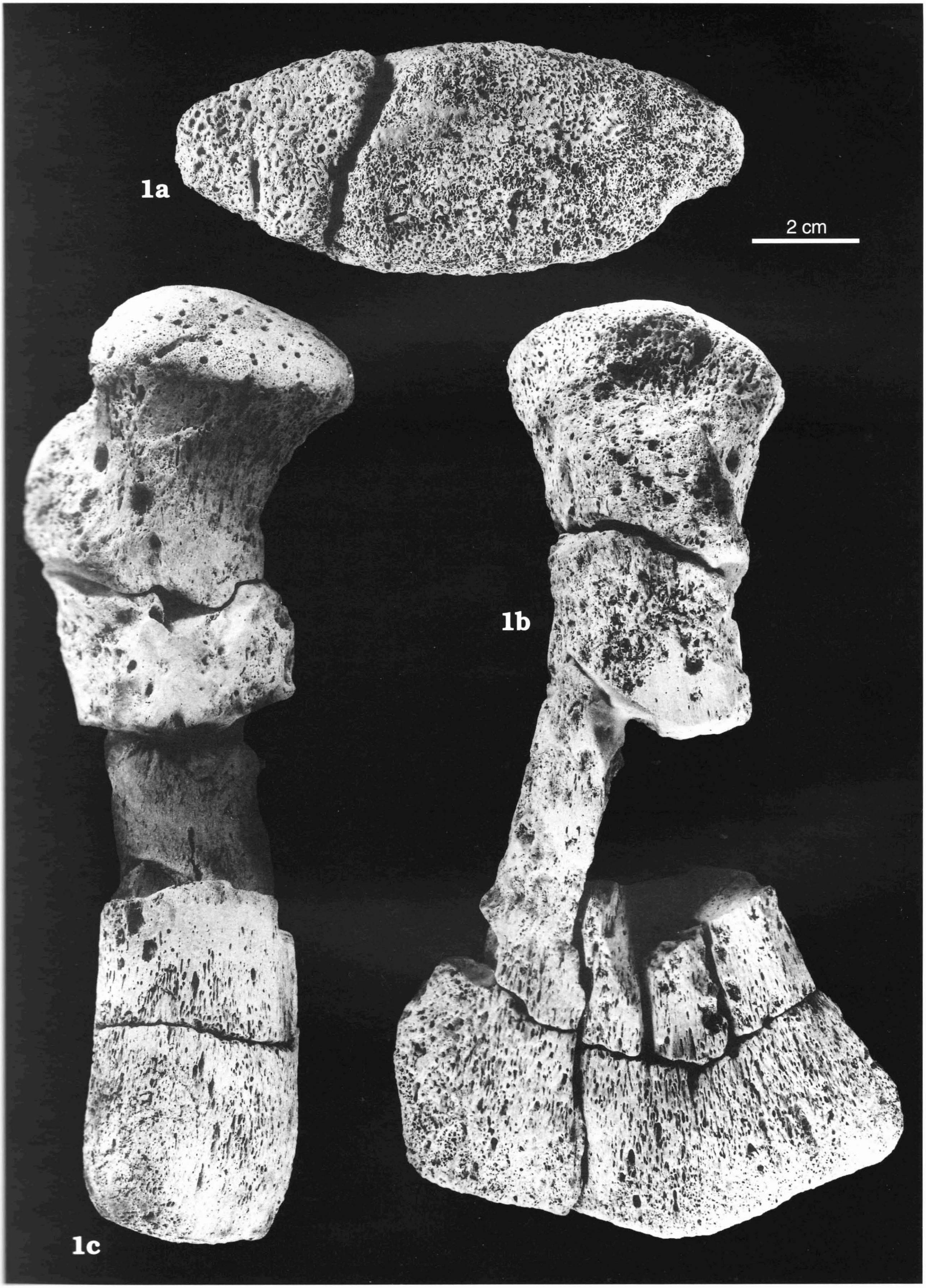
PLATE 4

Elasmosauridae gen. et sp. indet. 10

Left femur ZPAL R.8/6; *a* distal view, *b* lateral, *c* posterior. Natural size.

Unit 2. López de Bertodano Formation (Campanian–Maastrichtian).



Ł. FOSTOWICZ-FRELIK and A. GAŹDZICKI: ANATOMY AND HISTOLOGY OF PLESIOSAUR BONES FROM THE LATE CRETACEOUS OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

URSZULA HARA

Hara, U. 2001. Bryozoans from the Eocene of Seymour Island, Antarctic Peninsula. *In:* A. Gaździcki (ed.), Palaeontological Results of the Polish Antarctic Expeditions. Part III. *Palaeontologia Polonica* **60**, 33–156.

Bryozoans are a significant component of the rich biota of the Eocene La Meseta Formation on Seymour (Marambio) Island, Antarctic Peninsula. Within the formation thirty genera and forty-three species are recognized, of which 15 are cyclostomes and 28 are cheilostomes. Two genera and nineteen species are described as new taxa: *Retecrisina antarctica* sp. n., *Ceriopora hemisphaerica* sp. n., *Neofungella capitula* sp. n., *Reptomulticava clavaeformis* sp. n., *Reptomulticava seymourensis* sp. n., *Disporella marambioensis* sp. n., *Reticrescis plicatus* gen. et sp. n., *Aspidostoma multiformis* sp. n., *Aspidostoma pyriformis* sp. n., *Aspidostoma taylori* sp. n., *Celleporaria australis* sp. n., *Celleporaria gondwanae* sp. n., *Celleporaria mesetaensis* sp. n., *Celleporaria ovata* sp. n., *Dennisia eocenica* gen. et sp. n., *Smittoidea gazdzickii* sp. n., *Aimulosia lamellosa* sp. n., *Osthimosia globosa* sp. n., and *Rhynchozoon quadratus* sp. n. The most abundant bryozoan assemblage occurs in the transgressive facies of the lower part of the formation (Telm1 unit). The bryozoans from the upper part of the formation are represented by only two taxa, *Reticrescis plicatus* gen. et sp. n. and *Smittina* sp. The following genera are herein recorded for the first time from Antarctica: *Retecrisina*, *Crassohornera*, *Borgella*, *Ceriopora*, *Reptomulticava*, *Celleporaria*, and *Metroperiella*. Others such as *Crisia*, *Fasciculipora*, *Hornera*, *Cellaria*, *Smittina*, and *Reteporella* have been previously noted from the Oligocene of King George Island in the South Shetland Islands, and some of them from the Pliocene of adjacent Cockburn Island. Most of the colonies acquired a hemispherical shape with well-marked multilayered growth. The relationships between colony-form, growth pattern, inferred associated biota and sedimentary structure point to a nearshore, shallow-marine-estuarine, and wave-dominated environment for the La Meseta Formation. The distinct differentiation of the bryozoan assemblages between the lower part of the formation (Telm1) and upper one (Telm6–7) is most probably connected with the climatic cooling event interpreted from the upper part of the La Meseta Formation. Several genera such as *Borgella, Neofungella, Melicerita, Smittina*, *Smittoidea*, *Celleporaria*, *Aimulosia*, *Metroperiella*, *Osthimosia*, *Reteporella*, and *Rhynchozoon* have their oldest fossil records which suggests that this area played a significant role in the evolution of bryozoans, and from which they spread northwards before the development of the circum-Antarctic current in the Oligocene.

Key words: Bryozoa, taxonomy, paleoecology, paleobiogeography, Eocene, Antarctica.

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CONTENTS

INTRODUCTION

The aim of this monograph is a paleontological study of the Eocene bryozoan fauna from Seymour Island (Isla *Vicecomodoro Marambio* on Argentine maps), Antarctic Peninsula (Text-fig. 1). The bryozoans from the La Meseta Formation were collected by A. Gaździcki during the Argentine-Polish field parties in the austral summers of 1987–88, 1991–92, 1993–94 from eight localities on the island (Text-fig. 1). Preliminary accounts of the bryozoan fauna from this area have been published by Gaździcki and Hara (1993, 1994), and Hara (1995, 1997a, b, 1999).

The La Meseta Formation (Rinaldi *et al.* 1978; Elliot and Trautman 1982) on Seymour Island is a richly fossiliferous Eocene, shallow marine-estuarine, clastic formation which is exposed mostly in the northern portion of the island (Feldmann and Woodburne 1988; Sadler 1988; Stilwell and Zinsmeister 1992; Porębski 1995, 2000; Gaździcki 1996; Marenssi *et al.* 1998). The formation represents an almost 800 m thick sequence of sandstones and siltstones and preserves an exceptional record of the Eocene marine as well as terrestrial ecosystem of the Southern Hemisphere (Feldmann and Woodburne 1988; Aronson *et al.* 1997; Doktor *et al.* 1996; Gaździcki 1998). The bryozoans are a significant component of the rich La Meseta biota, especially in the lower part of the formation.

All bryozoan specimens described and illustrated in this paper are deposited at the Institute of Paleobiology of the Polish Academy of Sciences, Warszawa (Poland) under the catalogue number ZPAL Br.VIII.

Acknowledgements. — I am pleased to acknowledge the generous assistance of Professor Andrzej Gaździcki (Institute of Paleobiology, Warszawa) who encouraged me to study the Antarctic bryozoans, for surveying all the bryozoan location data, and for helpful discussions. Special thanks are kindly offered to the reviewers of this paper Professor Rodney M. Feldmann (Kent State University, Kent, OH), Dr Dennis P. Gordon (National Institute for Water and Atmospheric Research – NIWA, Wellington), Dr Paul D. Taylor (The Natural History Museum, London), Professor Norbert Vávra (Universität Wien) as well as

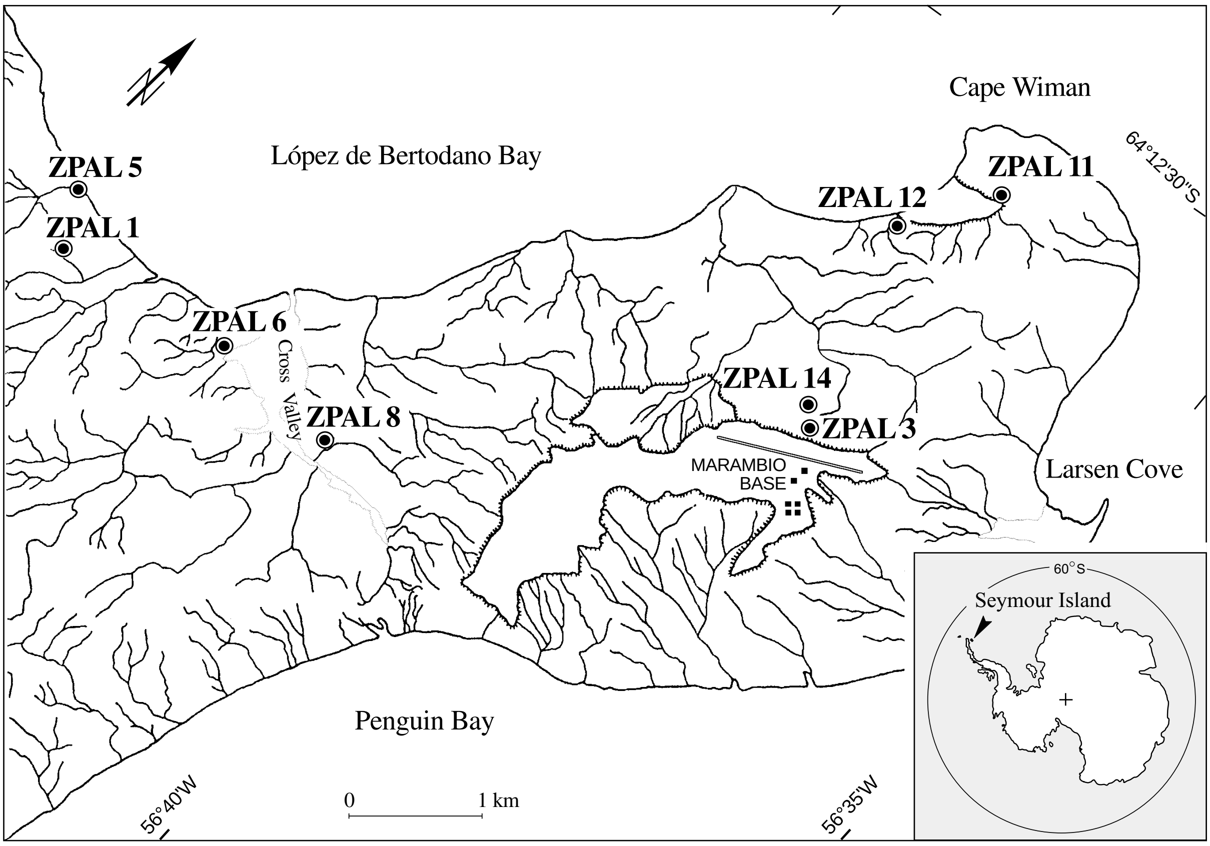

Fig. 1. Bryozoan locality index map of the La Meseta Formation on Seymour Island.

Professor Jerzy Dzik (Institute of Paleobiology, Warszawa), Professor Jerzy Trammer (Warsaw University) and Professor Adam Urbanek (Institute of Paleobiology, Warszawa) for their critical reading of the manuscript, comments on taxonomic classification and improvements of the English text. Professor Ehrhard Voigt (Universität Hamburg), was generous in his valuable taxonomic suggestions about the studied fauna. Many thanks are given to Ms Mary E. Spencer Jones (The Natural History Museum, London) who kindly offered me access to some bryozoan materials stored at the Museum. Warm thanks are also extended to Ms Janina Mierzejewska and Ms Alicja Wyszyńska (Polish Geological Institute, Warszawa) for their efforts in making macro- and microphotographs of the specimens. Assistance with SEM work was kindly provided by Dr Janusz Błaszyk (Institute of Paleobiology). Thin-sections were made by Mr Zbigniew Strąk and some microphotographs by Ms Grażyna Dziewińska (both from the Institute of Paleobiology). I wish to thank the Director of the Polish Geological Institute Associate Professor Marek Narkiewicz who granted the financial support to publish. Dr Andrzej Gąsiewicz, Andrzej Saternus M.Sc., Paweł Lewandowski M.Sc., and Ms Ewa Miłaczewska Eng. from the Polish Geological Institute, deserve the special thanks for their support during this study.

GEOGRAPHIC AND STRATIGRAPHIC SETTING

Seymour Island lies off the north-eastern coast of the Antarctic Peninsula (Text-fig. 1). The stratigraphic sequence of the island extends from the Cretaceous to Paleocene López de Bertodano Formation, through the Paleocene Sobral and Cross Valley formations, to the Eocene La Meseta Formation which is overlain by the post-Pliocene Weddell Formation (Feldmann and Woodburne 1988; Gaździcki *et al.* 1999).

The La Meseta Formation, which is up to 800 m thick, crops out around the flanks of the meseta in the northern portion of the island and also as a few small outcrops of the basal facies of the formation just above López de Bertodano Bay southwest of Cross Valley (Text-figs 1–4). It is composed of weakly consolidated marine sandstones, siltstones, claystones and shell beds containing a rich and superbly preserved marine fauna, ichnofauna and sedimentary structures indicative of nearshore, shallow marine–estuarine environ-

Fig. 2. Locality ZPAL 1 (*Bill Hill)* viewed from the López de Bertodano Bay, where the richest bryozoan assemblage has been collected in Telm1. *Photographed by A. Gaździcki, February 1994.*

ments (Feldmann and Woodburne 1988; Stilwell and Zinsmeister 1992; Gaździcki 1996; Porębski 1995, 2000; Marenssi *et al.* 1998). The formation was subdivided by Sadler (1988) into seven lithofacies units (Telm1–Telm7; see Text-fig. 5). Its age on the basis of dinoflagellates is late early Eocene for the base, and late Eocene for the upper part (Wrenn and Hart 1988; Askin *et al.* 1991; Cocozza and Clarke 1992). According to Sr isotope stratigraphy the uppermost part of the formation is Late Eocene (34.2 Ma) in age (Dingle and Lavelle 1998a).

BRYOZOAN-BEARING STRATA

Within the La Meseta Formation bryozoans were collected from eight localities (Text-fig. 1). Bryozoan-bearing horizons were recognized in the Telm1, Telm2, Telm6 and Telm7 units of the formation (Text-fig. 5). The lowermost unit containing abundant bryozoan colonies occurs in the lower part (Telm1) of the formation *sensu* Sadler (1988) and crops out south of the Cross Valley (South Section) at localities ZPAL 1 (*Bill Hill*; see Text-fig. 2) and ZPAL 5 (Text-figs 1–2). The Telm1 unit crops out also in the northern part of the island at sites near Cape Wiman (North Section) situated on the left side of Silent Valley (locality ZPAL 12) see Gaździcki and Tatur (1994), and in the higher part of the valley towards the east at locality ZPAL 11 (Text-figs 1, 3).

In unit Telm2 single bryozoan colonies occur at two localities, ZPAL 6 (south of the Cross Valley) and ZPAL 8 (north of the Cross Valley; see Text-figs 1, 5).

In the upper units of the formation, (Telm6 and Telm7) bryozoans occur at two localities: ZPAL 14 and ZPAL 3 (Text-figs 1, 4–5). Within Telm6 at locality ZPAL 14 biostromes are formed of the bryozoan *Smittina* (Text-figs 1, 4). In the uppermost part of the formation (Telm7) at locality ZPAL 3 only a few bryozoan colonies were collected (Text-figs 1, 5).

Bryozoan assemblage of Telm1. — Abundant bryozoans in Telm1 occur within a 2 m thick interval of the basal transgressive facies (Gaździcki and Hara 1994, Hara 1997b). This sequence is represented by grey

Fig. 3. Localities ZPAL 11 and ZPAL 12 (asterisks) of Telm1. Cockburn and James Ross Islands seen in the background. *Photographed by A. Gaździcki, February 1994.*

to red-brown limonitic sandy siltstones, sandstones and pebble conglomerates at locality ZPAL 1 (Text-fig. 1), and by grey sandy siltstones and sandstones at locality ZPAL 12 (Text-fig. 3). Intercalations of shelly hash occur within both sequences.

The bryozoans from the lowermost facies (Telm1) represent the largest and the most diverse bryozoan assemblage, containing 29 genera and 42 species including many new taxa (Text-fig. 5, Table 1). Within the four localities of unit Telm1 (ZPAL 1, ZPAL 5, ZPAL 11, ZPAL 12), locality ZPAL 1 is the richest bryozoan-bearing site, yielding more than 91% of all the specimens collected on Seymour Island (Table 1). The bryozoan fauna at this locality shows the highest taxonomic and morphologic diversity, and includes both cyclostome and cheilostome colonies represented by 28 genera and 40 species (Table 1). For the most part, the dominant bryozoan colonies comprise hemispherical or mound-shaped cerioporines with massive colony forms (Pls 1: 10, 12, 6–7, 10–11; see also Text-fig. 8, Table 1). They make a characteristic component of the cyclostome bryozoan fauna, which together with reticulate zoaria of *Reticrescis,* constitutes about 52% of all specimens from the studied locality (Text-fig. 8, Table 1). The other cyclostomes (tubuliporines, cancellates and rectangulates) exhibit different morphological shapes, and form a minor proportion of cyclostomes at this locality. Somewhat less abundant than cyclostomes are cheilostome bryozoans which exhibit a wide variety of shapes. They form either massive, hemispherical or mushroom-shaped colonies (Pls 17–22, 24–26) composed of many successive layers of zooecia, as well as bilamellar branching (Pl. 16) and sheet-like encrusting colonies (Pl. 15). The most frequent specimens collected at ZPAL 1 are lepraliellids such as *Celleporaria* (9%) and *Dennisia* (3%), the buffonellodid *Aimulosia* (8.4%), celleporoideans such as *Osthimosia* (1.8%) and *Rhynchozoon* (3%), and the aspidostomatid genus *Aspidostoma* (8.2%) (see Text-fig. 8). The cheilostome bryozoans also include some other morphological types of colonies such as articulated colonies; bilamellar, non-articulated zoaria; unilamellar encrusting sheets; and a few fragments of fenestrate colonies (Text-figs 27–28, Pl. 27).

Locality ZPAL 12 (*Sadler Stacks*) is very impoverished in number of specimens and species relative to locality ZPAL 1; however, it shows a similar taxonomic composition (Text-figs 5, 9, Table 1). Among the 13 species of cyclostomes and cheilostomes, the dominant specimens collected are massive, multilamellar cerioporines such as *Ceriopora* (45%), *Reptomulticava* (11%) and *Neofungella* (3%). Apart from these, the

Table 1. Frequency and percentage contribution (in parentheses) of the specific bryozoan taxa in Telm units of the La Meseta Formation on Seymour Island.

Locality and unit **Taxon**	**ZPAL 1 Telm1**	**ZPAL 5 Telm1**	**ZPAL 11 Telm1**	**ZPAL 12 Telm1**	**ZPAL 6 Telm2**	**ZPAL 8 Telm2**	**ZPAL 14 Telm6**	**ZPAL 3 Telm7**
Cyclostomata								
Crisia sp.		9						
Retecrisina antarctica	3 (0.3%)							
Fasciculipora sp.	1							
Hornera antarctica	7 (0.6%)							
Hornera sp.	3 (0.3%)							
Crassohornera sp.	2							
Calvetia sp.	1							
Borgella sp.	1							
Ceriopora hemisphaerica	409 (39%)	4	1	30 (45%)	1	2		
Ceriopora sp.				1 (1.5%)				
Neofungella capitula	31 (2.9%)	1		2 (3%)				
Reticrescis plicatus	49 (4.6%)			1 (1.5%)				5
Reptomulticava clavaeformis	4 (0.4%)							
Reptomulticava seymourensis	54 (5.1%)	1		11 (16%)				
Disporella marambioensis	3 (0.3%)							
Cheilostomata								
**Crassimarginatella* sp.	1							
Aspidostoma coronatum	3 (0.3%)							
Aspidostoma multiformis	15 (1.4%)	1						
Aspidostoma pyriformis	23 (2.2%)			1 (1.5%)				
Aspidostoma taylori	44 (4.2%)			1 (1.5%)				
Aspidostoma sp.	1							
**Macropora* sp.	3 (0.3%)							
Cellaria sp. 1	2							
Cellaria sp. 2	1							
**Paracellaria* sp.	1							
Melicerita sp.	1							
*?*Reptadeonella* sp.	2							
Celleporaria australis	7 (0.7%)							
Celleporaria gondwanae	23 (2.2%)			2 (3%)				
Celleporaria mesetaensis	25 (2.4%)		1	14 (21%)				
Celleporaria ovata	10 (0.9%)							
Celleporaria sp.	30 (2.8%)							
Dennisia eocenica	136 (13%)			1 (1.5%)				
*Escharoides sp.	1							
**Cellarinella* sp.	1							
Smittina sp.							biostrome	
Smittoidea gazdzickii	2							
Metroperiella sp.	6 (0.6%)							
Aimulosia lamellosa	86 (8.4%)		6	1 (1.5%)				
Osthimosia globosa	17 (1.6%)			2 (3%)				
?*Osthimosia* sp.	2							
Reteporella sp.	5 (0.5%)							
Rhynchozoon quadratus	32 (3%)			1 (1.5%)		1		
Total specimens	1048	16	8	68	1	3		5
Species assemblage	43	5	3	13	1	2		1

Explanation: newly erected taxa – underlined; identified taxa, but undescribed in the text – *

significant components are the lepraliellids *Celleporaria* (24%) and *Dennisia* (1.5%), the schizoporelloidean *Aimulosia* (1.5%), the celleporoideans *Osthimosia* (3%) and *Rhynchozoon* (1.5%) as well as microporoideans represented by the genus *Aspidostoma* (3%). A few other specimens belong to indeterminate anascan cheilostome, hornerid, and celleporid colonies.

At locality ZPAL 11 only eight bryozoan specimens have been found, single cerioporids and lepraliellids and a few very worn schizoporellid colonies (Text-fig. 5, Table 1).

Fig. 4. Outcrop of the *Smittina* bryozoan biostrome in Telm6 at the locality ZPAL 14 (asterisk).
Photographed by A. Gaździcki, February 1992.

Bryozoans at locality ZPAL 5 are represented by rare cerioporines, a single microporoidean (*Aspidostoma*), a hornerid colony, poorly preserved internodes belonging to *Crisia*, and fragments of indeterminate cyclostomes (Table 1).

Bryozoans in Telm1 unit are associated with gastropods and bivalves with characteristic large *Ostrea*, *Pecten* and limid shells (Stilwell and Zinsmeister 1992; Stilwell and Gaździcki 1998), brachiopods (Bitner 1996a), polychaete worms, corals and stylasterids (Stolarski 1996, 1998), asteroids (Blake and Zinsmeister 1988), crinoids (Baumiller and Gaździcki 1996), echinoids (Radwańska 1996), nautiloid cephalopods (Dzik and Gaździcki 2001), and palinurid lobsters (Feldmann and Gaździcki 1997). Microfossils are represented by ostracods (Szczechura 2001) and benthic foraminifera (Gaździcki personal communication).

Bryozoan occurrence in Telm2. — In this unit bryozoans were found at two localities ZPAL 6 and ZPAL 8 (Text-fig. 1). A single specimen of *Ceriopora*, which occurs a in grey- and rusty-colored calcareous sandstone, together with molluscs, comatulid crinoids (Baumiller and Gaździcki 1996), and a single echinoid, has been found at locality ZPAL 6. A few hemispherical cerioporine and celleporid colonies, as well as a single colony of *Rhynchozoon*, occur in the sandstones at locality ZPAL 8. They are associated with numerous brachiopods, mostly of *Macandrevia cooperi* (see Bitner 1996a), balanomorph barnacles (Zullo *et al.* 1988), shark teeth and chimaeroid fish remains (Ward and Grande 1991; Gaździcki 1995, personal communication).

Bryozoan occurrence in Telm6. — Within this unit at locality ZPAL 14 (Text-figs 1, 4–5), a distinct bryozoan-bearing horizon in fine sandstone was recognized. Abundant *Smittina* colonies form a biostrome layer up to 5 cm thick (Pl. 23: 4). In this sequence bryozoans co-occur with vertebrates i.e. penguins and gadiform fish remains (Myrcha *et al.* 1990; Jerzmańska and Świdnicki 1992).

Bryozoan occurrence in Telm7. — A few fragments of poorly preserved cyclostome bryozoan colonies with reticulate zoaria referable to *Reticrescis* (Text-fig. 21) were collected at locality ZPAL 3 (Text-figs 1, 5). They are accompanied by numerous crinoids (*Metacrinus fossilis*) (Rasmussen 1979; Meyer and Oji 1993; Baumiller and Gaździcki 1996), brachiopods (Bitner 1996a), gadiform fish remains (Jerzmańska 1988; Jerzmańska and Świdnicki 1992), penguin bones (Myrcha *et al.* 1990, in press) and whales (Borsuk-Białynicka 1988).

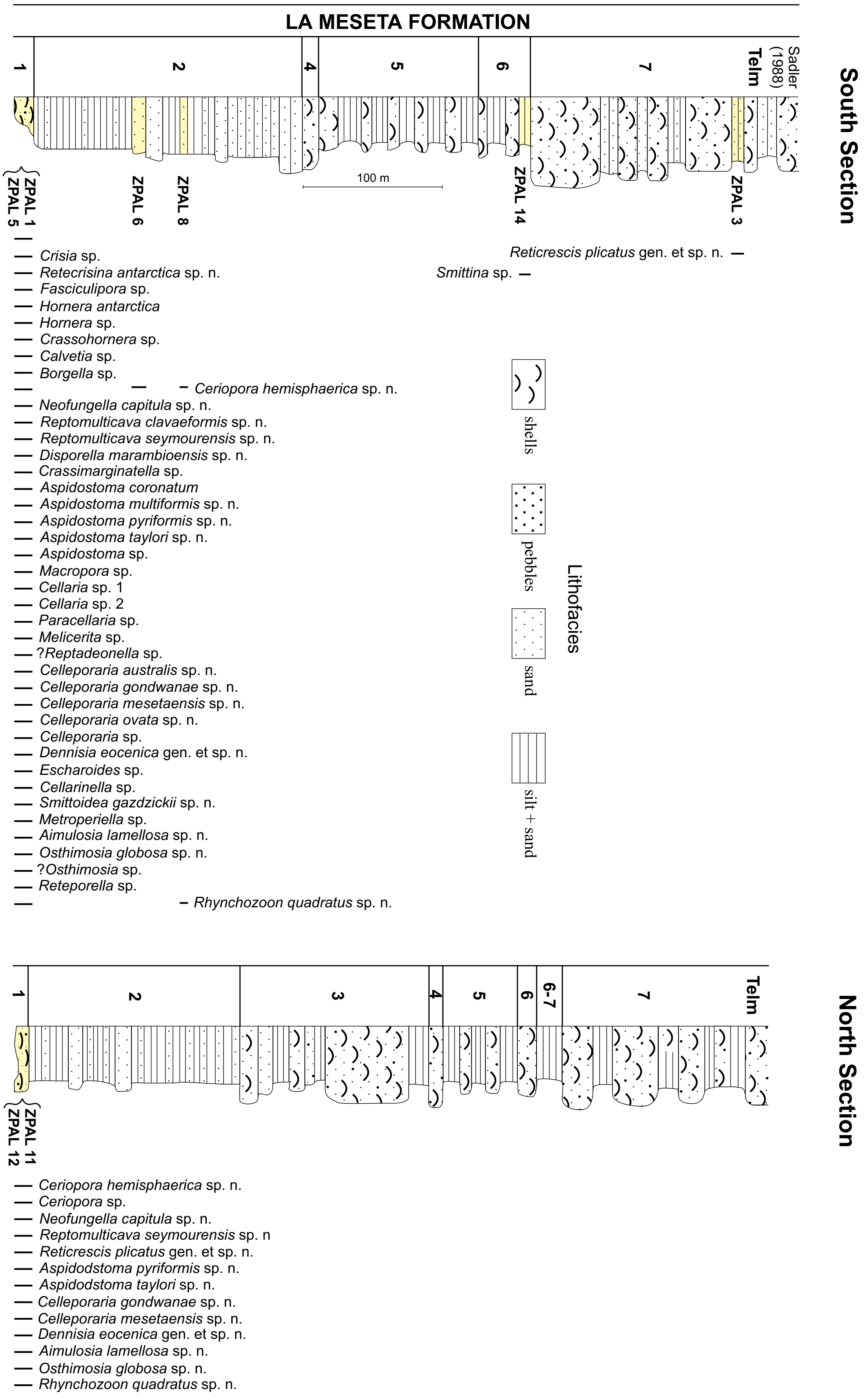

Fig. 5. Stratigraphical distribution of the bryozoans within two main sections (South and North) of the La Meseta Formation on Seymour Island (sections adapted from Sadler 1988). Locality numbers (ZPAL), at right of the sections, mark the horizons from which bryozoans were collected.

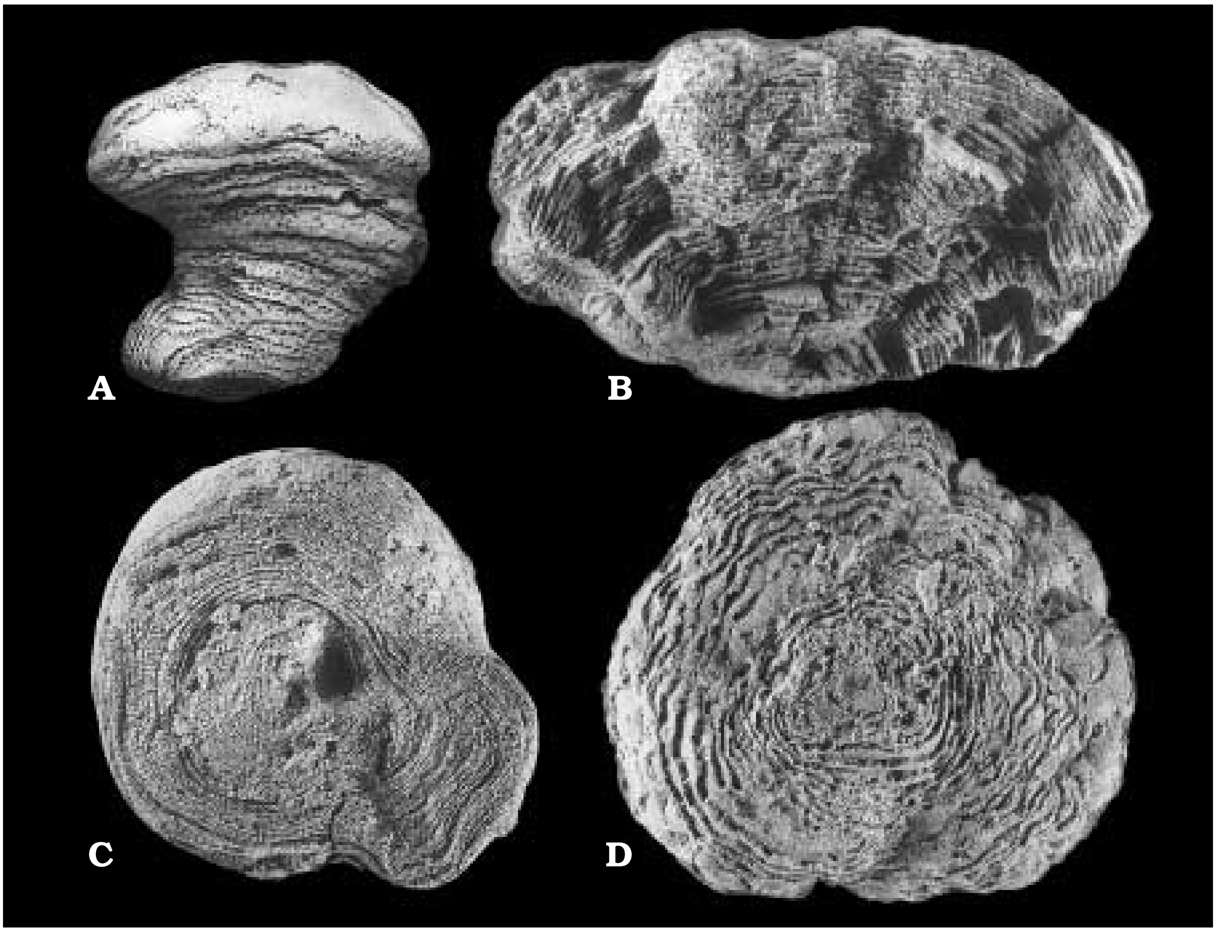

Fig. 6. Multilamellar colonies showing successive growth layers. **A**. *Aimulosia lamellosa* sp. n., ZPAL Br.VIII/ 255, × 3. **B**. *Celleporaria mesetaensis* sp. n. ZPAL Br.VIII/469, × 1. **C**. *Ceriopora hemisphaerica* sp. n., ZPAL Br.VIII/45, × 1.5. **D**. *Reptomulticava seymourensis* sp. n., ZPAL Br.VIII/73, × 1.5. ZPAL 1, Telm1.

MATERIAL AND METHODS

The studied bryozoan collection comprises a total of 1149 specimens. Numerically, they are dominated by cyclostomes, among which the majority are cerioporines (49%). The most common, conspicuous and generally well-preserved bryozoans were collected from the lower part of the formation (Telm1) at localites ZPAL 1 and ZPAL 12 (97% of the total number of specimens) (see Text-fig. 1, Table 1). They are mostly large-sized and acquire massive, hemispherical, mound-shaped colony forms with a well-marked, multilayered internal structure (Text-figs 6–7, Pls 7–8, 12–13). A smaller part of the bryozoan fauna from Telm1 consists of fragile colony forms of relatively small sizes. In contrast, the bryozoans of the upper part of the formation (Telm6–7) are impoverished and comprise bilamellar, branched colonies (Text-figs 4–5; Pl. 23). The frequency and percentage contribution of the bryozoan taxa are summarized on Table 1.

Ultrasonic cleaning has been employed to remove weakly-adherent matrix of sand and silt. All specimens have been examined with a WILD M10 binocular microscope equipped with planapochromatic objective 1.0 x. Morphometrical determinations have been made using an eyepiece micrometer affixed to a WILD M10 binocular microscope, or from SEM micrographs. Ten autozooecia per colony have been measured in most specimens. When present brood chamber measurements were made from only one specimen. Macrophotographs were prepared from colonies coated lightly in ammonium chloride.

Over 200 thin-sections of bryozoan colonies cut perpendicularly, longitudinally or tangentially to the growth surfaces were produced to examine the useful internal features (Pls 6: 1e, 7: 1d, 2d, 8: 2b, 13: 2c,

Fig. 7. Vertical sections through multilamellar colonies. **A**. *Reptomulticava seymourensis* sp. n., ZPAL Br.VIII/113; A_1 side view of the colony, × 2, A_2 section showing layering, × 4.5. **B**. *Ceriopora hemisphaerica* sp. n., ZPAL Br.VIII/43; B_1 underside of the colony showing layering, × 2, B_2 section showing zooecia with the radial growth, × 3. ZPAL 1, Telm1.

18: 2). The majority of the species were investigated with a Philips XL-20. All micrographs are secondary electron images of specimens coated with pure platinum.

In the course of the taxonomic studies of La Meseta bryozoans collections belonging to The Natural History Museum (London) (abbreviated NHM), and bryozoans from the Oligocene Polonez Cove Formation of King George Island, West Antarctica (prefix ZPAL Br.VI and Br.VII) have been used for comparison.

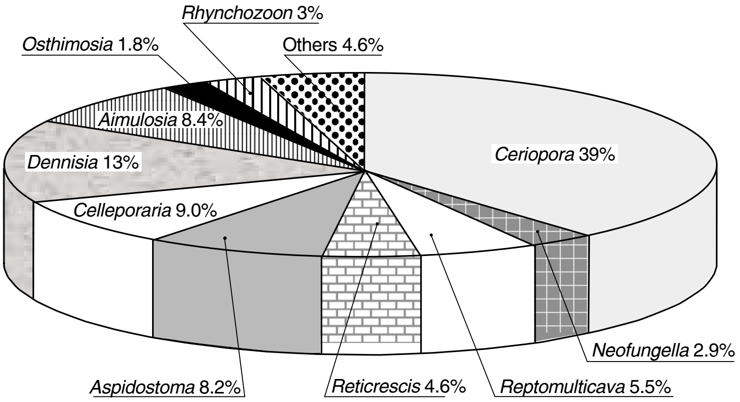

Fig. 8. The percentage abundance of specimens belonging to different bryozoan genera in the top layer at ZPAL 1 locality (*Bill Hill*).

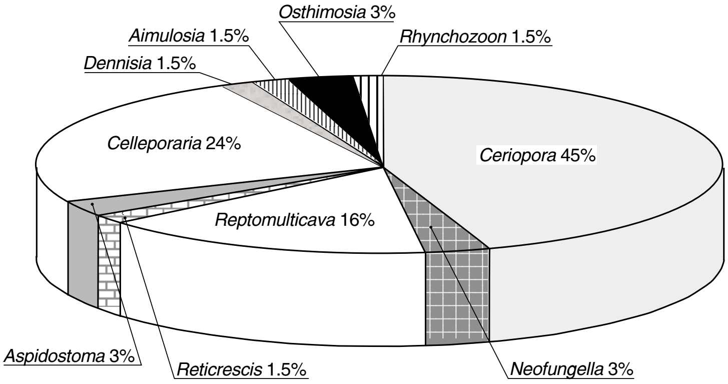

Fig. 9. The percentage abundance of specimens belonging to different bryozoan genera in the Telm1 unit at the locality ZPAL 12 (*Sadler Stacks*).

The mode of preservation of the bryozoans differs between the specimens from the lower (Telm1) and upper (Telm6–7) units of the formation. Bryozoans from Telm1 are well-preserved (Pl. 1). Their zoarial surfaces, however, in many cases are worn and bear traces of predation, different kinds of micro- and macroborings (Text-fig. 15A, B) and such as polychaete worms (Text-fig. 15, Pls 2: 1a, 2a, 19: 2a, b, 26: 4).

Owing to late diagenetic processes the zoarial surface of some cyclostomes and cheilostomes is sometimes strongly recrystallized (Pls 15: 3a, 17: 3, 27: 2). In some cerioporines zooecial openings can be fully sealed by calcite cement (Pl. 9: 1e, 11: 1c, 23: 3). Dolomitization, pyritization and silicification were observed within the internal structure of colonies. The characteristic feature of the bryozoans from the locality ZPAL 1 (Telm1) is their rusty or brown colour, the result of impregnation of zoaria by ferrous hydroxide, probably of early diagenetic origin (Text-figs 27–28; Pls 15: 2a, b, 19: 1, 2a, b, 21: 4a, b).

Colonies from the upper part of the formation (Telm6–7) are poorly-preserved (Text-fig. 21, Pl. 23). *Smittina* colonies, which form a biostrome in Telm6, are preserved in a sandstone, densely covered by sharp-edged quartz grains which also infill the autozooecial apertures (Pl. 23: 3–4). A few reticulate colonies found at the locality ZPAL 3 (Telm7) are especially worn (Text-fig. 21).

MORPHOLOGY

Colony form. — Multilamellar growth developed by vertical budding is common among the bryozoans of the La Meseta Formation and may be an expression of limited substrata (see also McKinney and Jackson 1989). According to Taylor (1976), the prime advantage of multilamellar growth is the ability of a single colonies to the use a substratum by repeated encrustation. This allows a considerable increase in the life-span of the colony. The nature of the substratum may have been the major factor determining whether colonies

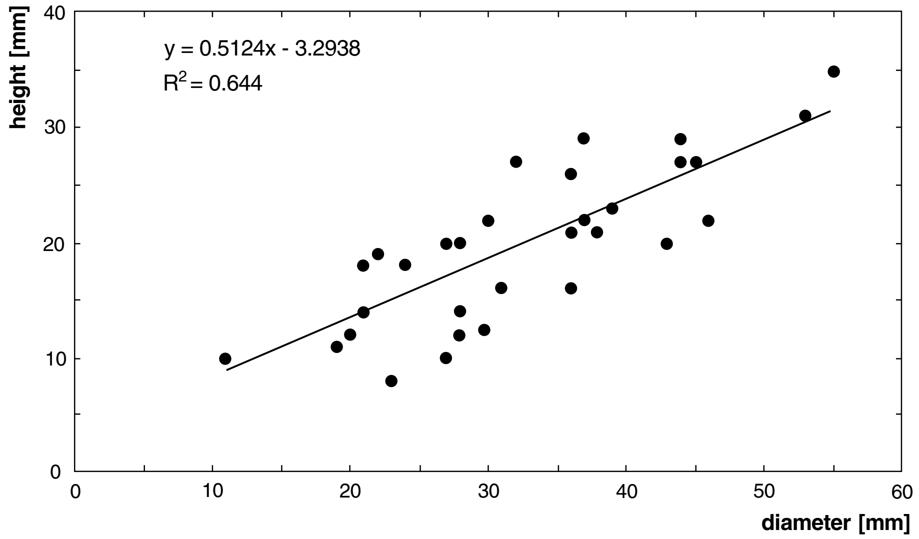

Fig. 10. Scattergram of diameter-height ratio for *Ceriopora hemisphaerica* sp. n.

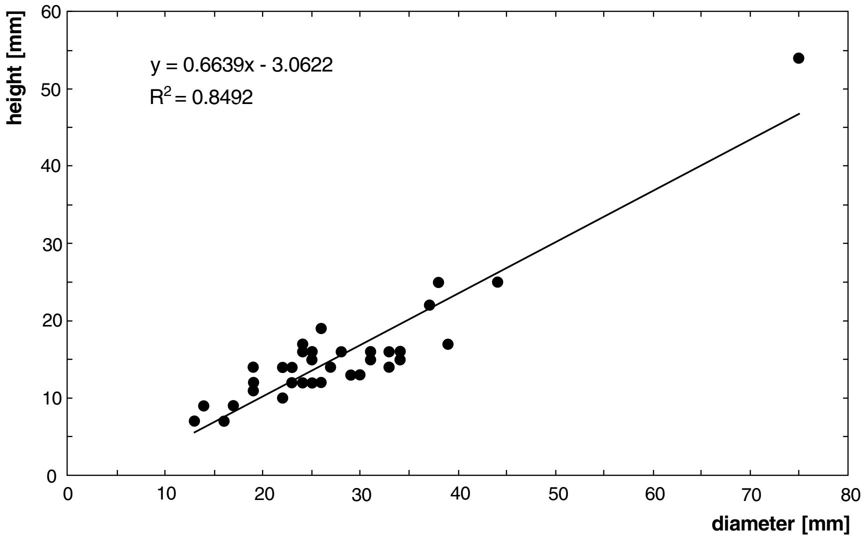

Fig. 11. Scattergram of diameter-height ratio for *Reptomulticava seymourensis* sp. n.

achieved circumrotatory growth (Balson and Taylor 1982). In the La Meseta environment subspheroidal colonies of *Celleporaria mesetaensis* sp. n. developed by totally overgrowing and encapsulating of their original substratum, thereby becoming essentially free-living and forming so-called ectoproctaliths or bryoliths (Text-fig. 29; see also Rider and Enrico 1979; Balson and Taylor 1982; Moissette and Pouyet 1991; Gaździcki and Hara 1994; Taylor 1999). The occurrence of such bryozoan structures is common in shallow-marine sedimentary environments, above wave base, where strong current action frequently reorients colonies. The semi-erect, or erect hemispherical colonies of *C. mesetaensis* sp. n. (Pl. 19), which attain diameters of up to 11 cm, belong to a free-lying morphotype.

Multiple layered bryozoan colonies formed by extensive self-overgrowth have a fossil record extending back to the Mid Jurassic, whereas large hemispherical forms first becoming abundant and diverse in the Early Cretaceous. They appear to have been regularly developed by many different taxa throughout the Tertiary (see McKinney and Jackson 1989). The frontal budding which commonly occurs among the studied bryozoans may be a strategy of persistence, providing greater resistance to both overgrowth and disturbance compared with single-layered growth (cf. Jackson and Buss 1975). Cerioporines such as *Ceriopora* and *Reptomulticava* show an intrazooidal fission *sensu* Hillmer (Text-figs 6C, D, 7; Pls 7: 1d, 2d, 12: 1b, 13: 2c). Zoaria of *Celleporaria* (Pls 18–21) can be referred to as celleporiform nodules (according to Stach's (1936) classifi-

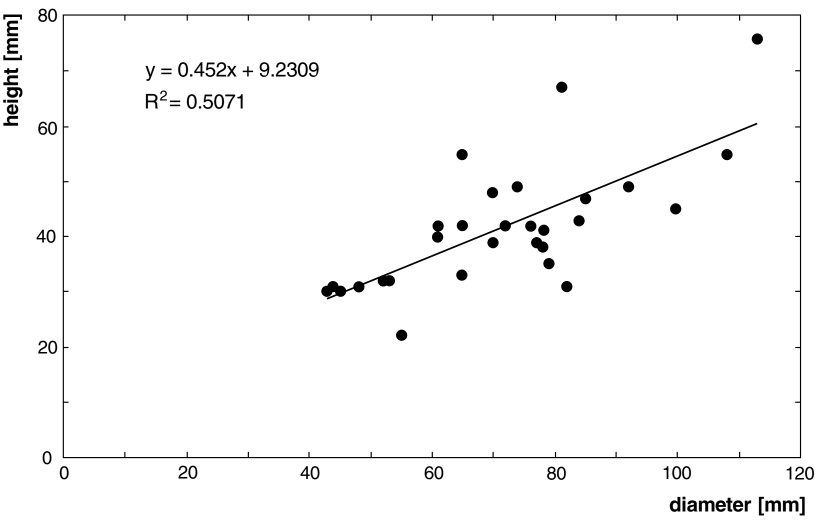

Fig. 12. Scattergram of diameter-height ratio for *Celleporaria mesetaensis* sp. n.

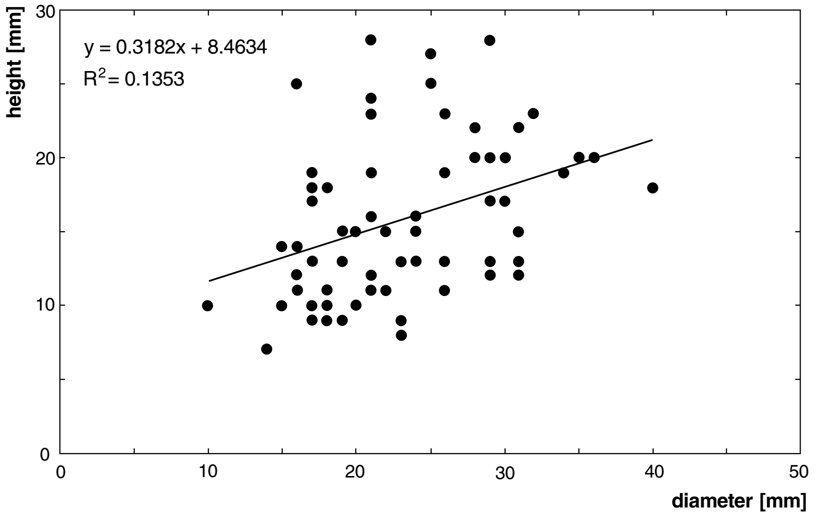

Fig. 13. Scattergram of diameter-height ratio for *Aimulosia lamellosa* sp. n.

cation), growing by frontal budding or as C-nodules (see Scholz and Hillmer 1995; Hillmer *et al.* 1996). Frontal budding permits upward growth in the third dimension and maintenence of occupied space. It is responsible for rapid growth, increased size, and for a significant increase in survivorship (cf. Lidgard 1985, Ristedt 1996), and has been a very important strategy for bryozoans since the Paleocene (Lidgard and Jackson 1989). The predominant, hemispherical, rather regular shape of many La Meseta bryozoans may be connected with regular budding (Pls 7, 19, 22; see also Ristedt 1996). C-nodules represent a high level of colonial integration where the entire colony is alive and reacts like a solitary organism. According to Scholz and Hillmer (1995), nodular bryozoan often reveal regenerative budding after periods of dormancy; the growth bands seen in Recent nodular bryozoans indicate age-correlated zones. Pätzold *et al.* (1987) have suggested that growth bands in larger bryozoan colonies result from cessation of growth due to lower food supply. This inference has been supported by Scholz and Hillmer (1995) who affirmed that a very important factor which may be responsible for rhythmic growth is high and seasonal supply of nutrients. In studies on Recent bryozoans by using X-rays analysis of *Celleporaria fusca,* more than 60 layers could be observed, and the growth rates of zooids were extremely synchronized (Scholz and Hillmer 1995).

The abundant colonies of *Ceriopora hemisphaerica* sp. n., as well as numerous zoaria of *Reptomulticava seymouriensis* sp. n. and *Celleporaria mesetaensis* sp. n. form rather regular hemispherical colony shapes with an average diameter to height ratio between 1:1.1 and 1:2.7 (coefficient of correlation 0.50 to 0.84) (see Text-figs 10–12). Colonies of *Aimulosia lamellosa* sp. n. form low cap-shaped to irregular mushroom-shaped

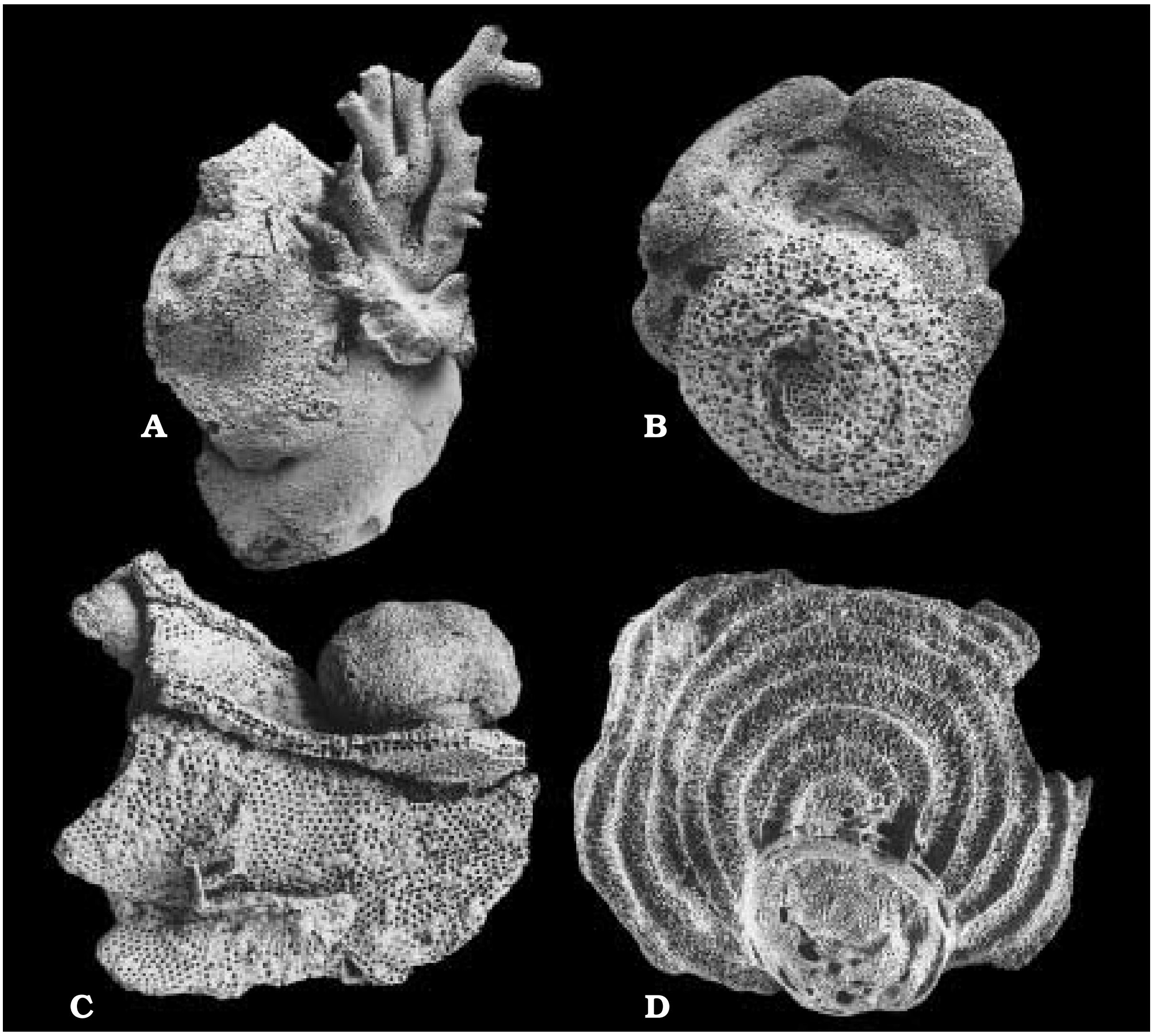

Fig. 14. **A**. *Hornera antarctica* Waters showing a strong supporting disc covered by kenozooecia, settled on an encrusting celleporid colony and encrusted by two discoidal tubuliporids (arrow), ZPAL Br.VIII/A49, × 2. **B**. Hemispherical zoarium of *Dennisia eocenica* gen. et sp. n. with *Osthimosia globosa* sp. n., growing on top ZPAL Br.VIII/359, × 2. **C**. Portion of the thick, bilamellar colony of *Aspidostoma multiformis* sp. n. fouled by a hemispherical *Osthimosia* sp. colony, ZPAL Br.VIII/59, × 2. **D**. Undersides of a hemispherical, multilamellar colony of *Osthimosia globosa* sp. n. and accompanying, smaller *Neofungella capitula* sp. n., showing polychaete worm tubes, ZPAL Br.VIII/61, × 2. ZPAL 1, Telm1.

colonies with poor sphericity and low coefficient of correlation (0.13) (Text-fig. 13). Such relatively regular shapes suggest rather stable environmental conditions within the lower part of the La Meseta Formation (Telm1); see also Moissette and Pouyet (1991).

According to Jackson and Hughes (1985), if levels of predation are extremely high, the single-layered encrusting species are excluded, and bryozoans are limited to massive, stationary species. The hemispherical La Meseta bryozoans after death with their large surfaces may represent attractive benthic islands, which allowing a post-mortem attachment of many kinds of epibionts e.g. bryozoans and polychaetes (Text-figs 14, 15C, D) (see Kauffman 1981; Seilacher 1982).

The incidence of multilamellar colonies in the La Meseta Formation thus suggests: (1) limited space on the substrate and competition with different groups of benthic fauna (such as corals, brachiopods, echinoderms); (2) dominance of colonies with frontal budding among cheilostomes, and with intrazooecial fission among cyclostomes; and (3) probable seasonality of the climate, consistent with the presence of growth rings observed in the pertified wood which is common in Lower Tertiary strata of the Antarctic Peninsula (Francis 1986, 1991, 1996; Frakes *et al.* 1992).

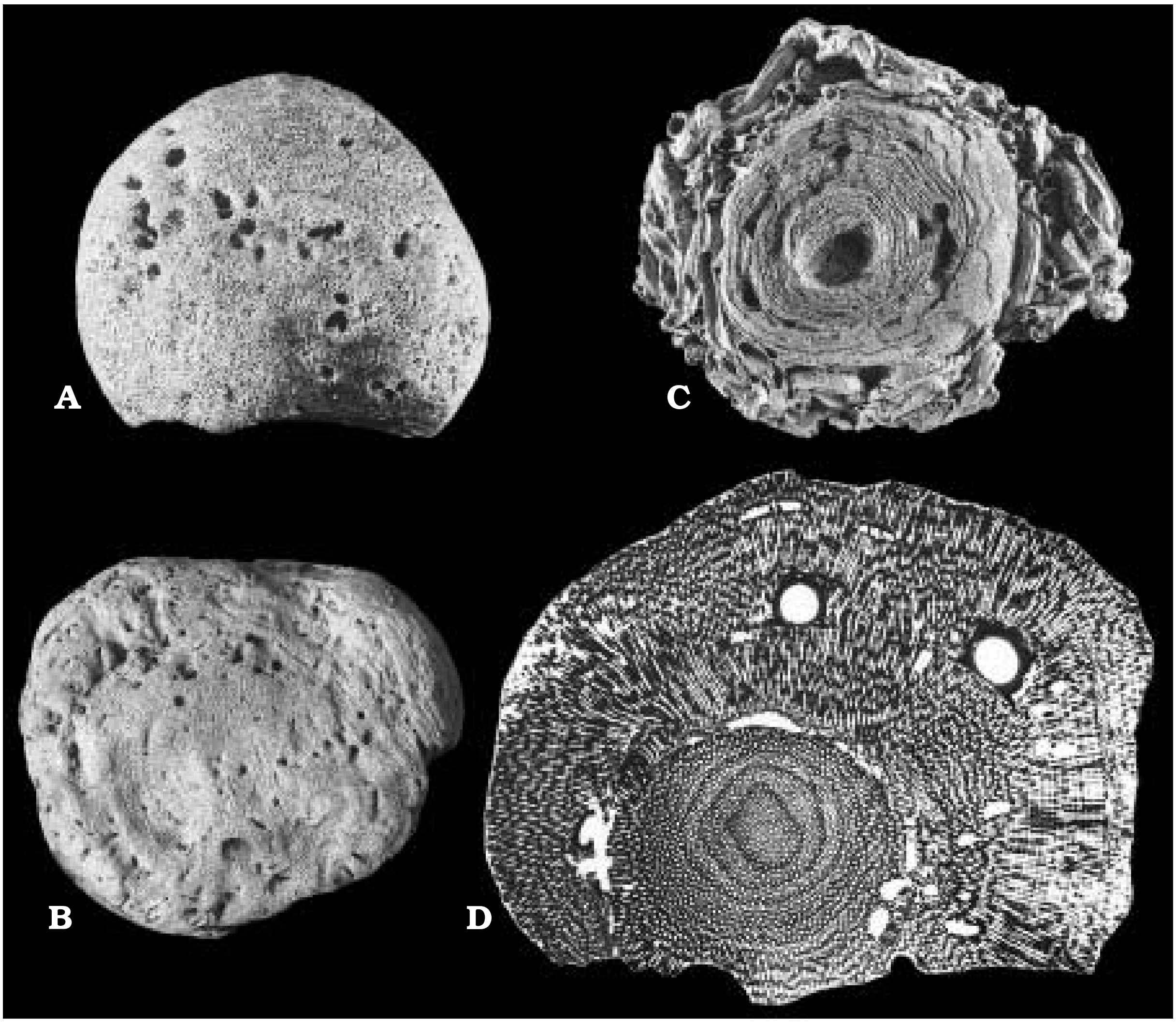

Fig. 15. **A**. Frontal view of a broken hemispherical colony of *Ceriopora* sp. with numerous *Trypanites* borings, ZPAL Br.VIII/3, × 2. **B**. Underside of *Ceriopora hemisphaerica* sp. n. colony showing layering and numerous clionid sponge borings, ZPAL Br.VIII/145, × 1. **C**. Underside of *Ceriopora hemisphaerica* sp. n. colony with a thick cover of polychaete worms at the top of the colony, ZPAL Br.VIII/40, × 3. **D**. Transverse section through *Ceriopora hemisphaerica* sp. n. colony showing epibionts (polychaete worms) which settled on the colony surface during a period of dormancy and were later overgrown, ZPAL Br.VIII/141, × 3.5. ZPAL 1, Telm1.

CLASSIFICATION OF BRYOZOA

The classification of bryozoans is in a continuing state of revision. The systematics of the phylum Bryozoa, especially with regards to order Cyclostomata Busk, 1852, used in this paper is that of Bassler (1953). Although study of the bryozoans from the La Meseta Formation is not intended as a revision of any particular taxon of cyclostomes, it has been necessary to make some remarks concerning the status of a few cyclostome genera based on the direct observation of the external and internal morphology of the zoarium and gonozooids of the studied specimens. Problems encountered in defining genera emphasize the need for through revisions of type species, as done by Nye (1976) for some of the cerioporine genera, including *Ceriopora* which is presented in the La Meseta fauna (see also Pitt and Taylor 1990). The genus *Reptomulticava* d'Orbigny (1854) is here included as family *incertae sedis* following designation of *Reptomulticava pyriformis* d'Orbigny, 1854 as the type species of this genus (Pitt and Taylor 1990). Topotypes of the type species of *Reticulipora* d'Orbigny, 1849, stored at the NHM, were used for comparision with the reticulate colonies from the La Meseta Formation. The comparative studies allow assignment of the reticulate colonies from the La Meseta Formation to the new genus *Reticrescis.* In the present paper this genus is questionably assigned to the family Cerioporidae, suborder Cerioporina von Hagenow, 1851.

Modern classification of cheilostomatous Bryozoa has been established by the following authors: Gordon (1984, 1989, 1993, 1997, 1999), Hayward (1995), Gordon and d'Hondt (1997). Differences of opinion concerning the names and status of taxa occur throughout the hierarchy up to the suborder level. A provisional list of cheilostome genera specifying the type species and family assignation of all genera has been produced for the revised version of the Treatise on Invertebrate Paleontology Part G by D.P. Gordon, P.L. Cook, E. Hakansson, P.J. Hayward and P.D. Taylor (1995). Gordon (1989, 1993, 1999) has made major steps towards a reappraisal of ascophorine systematics, based on studies of the frontal shield in a wide range of genera (see also Hayward 1995). The systematic position of taxa belonging the order Cheilostomata has been compiled by Gordon (1997, 1999) for the Treatise. The taxonomic scheme concerning the Cheilostomata accepted by the International Bryozoology Association (1997) is accordingly adopted in this monography. Among the La Meseta cheilostomes, only two suborders Flustrina Smitt, 1868 and Ascophora Levinsen, 1909 have been recognized. According to Gordon (1997) Flustrina is a senior synonym of Neocheilostomatina (Gordon 1989; Hayward 1995). The nature of the frontal shield of the cheilostome zooecium has a particular significance for the classification of Cheilostomata (Gordon 1999). The majority of the La Meseta Bryozoa species (Table 1) belong to the order Cheilostomata (28), among which the most common are placed in two families: Lepraliellidae Vigneaux, 1949 and Buffonelloididae Gordon *et* d'Hondt, 1997, respectively having umbonuloid and lepralioid frontal shields. The second newly erected genus *Dennisia* gen. n. in the fauna studied, which represents the order Cheilostomata, has been included into the family Lepraliellidae Vigneaux, 1949.

Determination of a few specimens from the La Meseta Formation was very difficult. These are encrusting or branching, single zoaria, which are incompletely preserved and lack gonozooids or ovicells. They belong to the orders Cyclostomata and Cheilostomata and their description is omitted in this paper. A few are illustrated under a name derived from the growth form, i.e. tubuliporid, hornerid or celleporid colonies.

TAXONOMIC DESCRIPTIONS

Class **Stenolaemata** Busk, 1926
Order **Cyclostomata** Busk, 1852
Suborder **Tubuliporina** Milne-Edwards, 1838
Family **Plagioeciidae** Canu, 1918
(= Diastoporidae Gregory, 1899)
Genus *Retecrisina* Gregory, 1899

Type species: *Retecrisina obliqua* (d'Orbigny, 1850).

Retecrisina antarctica sp. n.
(Pls 1: 11, 2: 1a–e, 2a, b; Text-fig. 16)

1997b. *Retecrisina* sp. 1.; Hara: p. 119, 125, fig. 4: 21.

Holotype: Specimen ZPAL Br.VIII/A36, illustrated on Pl. 2: 1a–e.
Type horizon: Telm1, La Meseta Formation; Eocene.
Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.
Derivation of the name: referring to Antarctica.

Diagnosis. — Colony of laterally compressed, bilamellar leaf-like branches with wavy bands. Autozooecial apertures on the sides of the branches, arranged roughly in quincunx, oval to elongate in shape, surrounded by projecting, slightly oblique peristomes. Secondary nanozooecia distinct, rare, irregularly distributed. Gynozooecium of the plagioeciid type.

Material. — Three reticulate, bilamellar colonies.

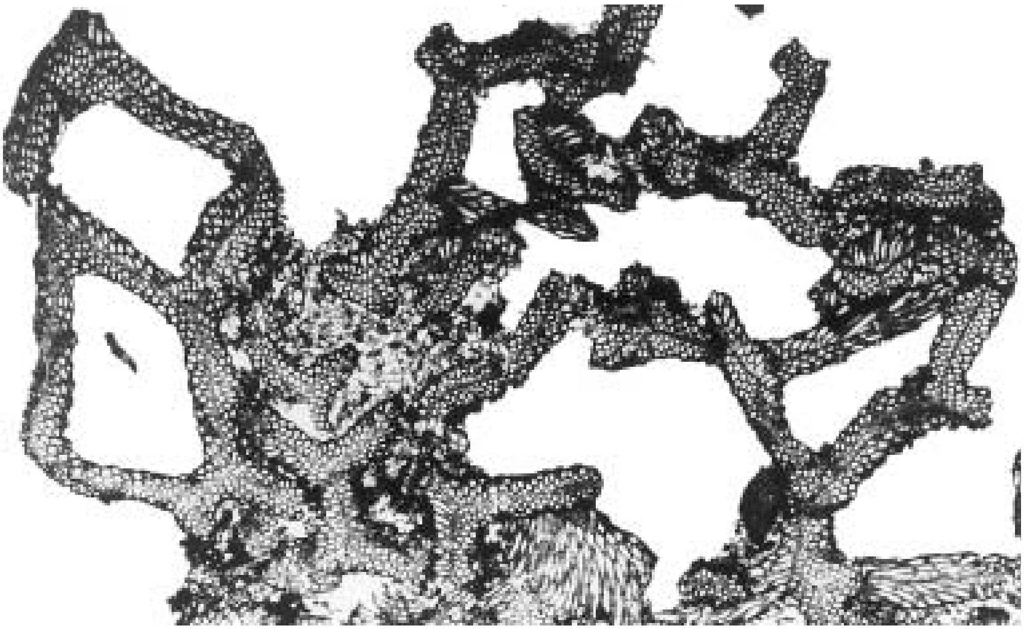

Fig. 16. *Retecrisina antarctica* sp. n., section of the colony showing bilamellar branches, × 7, ZPAL Br.VIII/A37; ZPAL 1, Telm1.

Dimensions. — Mean zoarium height 40 mm, width 55 mm; height of the holotype 37 mm, width 45 mm; frontal wall length (of autozooecia) 0.40–0.55 mm, width 0.12–0.13 mm; apertural width 0.12 mm, apertural 0.15 mm; peristome width 0.12–0.14 mm, length 0.18–0.2 mm; kenozooecial diameter 0.12 mm; gynozooecium length 2.1 mm, width 1.2 mm, ooeciostome diameter 0.2 mm, ooeciopore diameter 0.08 mm.

Description. — Colony is composed of thick, laterally compressed, bilamellar branches with median budding laminae (Text-fig. 16; Pl. 2: 1a, b, 2a). Branches are flat, expanded distally, irregular in shape, leaf-like, frequently anastomosing, with a thickness of 0.6–0.8 mm.

Autozooecial apertures are closely-spaced, more or less in quincunx (Pl. 2: 1b). Autozooecia are elongated, expanded slightly just below the aperture (Pl. 2: 1c–e). Apertures are oval in shape, projecting, usually surrounded by narrow, raised, slightly oblique peristomes (Pl. 2: 1c, e). Terminal diaphragms are numerous, occluding autozooecial apertures (Pl. 2: 1c, e). Secondary nanozooecia are occasionally present, round-shaped, almost of the same size as the autozooecial apertures, irregularly distributed (Pl. 2: 1d). Pseudopores are approximately circular in outline, numerous (Pl. 2: 1d, e). Colony surface, is ornamented by discontinous, transverse wavy bands, irregularly-spaced (Pl. 2: 1b, 2b). Gynozooecium is elongate, slightly arcuate, profusely pierced by autozooecial apertures. The ooeciostome is transversely elongate, slightly compressed (Pl. 2: 2b).

Remarks. — The difference between the type species of *Retecrisina – Reticulipora obliqua* d'Orbigny and the type species of the *Reticulipora – Reticulipora dianthus* (Blainville), from the Bathonian lies i.e. in different appearence and arrangement of autozooecia. A specimen of *Retecrisina obliqua* from the Santonian (Cretaceous), Craie de Villedieu, Chateau Mbr Bed 15, stored at the NHM (London) has been compared with *Retecrisina antarctica* sp. n. from Seymour Island. *Retecrisina antarctica* sp. n. differs in having larger zooecial apertures which are arranged more or less quincuncially, instead of forming long vertical rows, as is observed in *Retecrisina obliqua*. Nanozooecia in both *Retecrisina obliqua* and *Retecrisina antarctica* sp. n. are the same shape but slightly larger in *R. antarctica.* The oblique stripes on the zoarial surface are present in both species, but they are more distinct in *Retecrisina antarctica* sp. n. A species of *Retecrisina* from the Oligocene (Whaingaroan), McDonalds Limestone, of Everett's Quarry, North Otago, New Zealand (NHM BZ 3436) has a similar arrangement of autozooecial apertures as *Retecrisina antarctica* sp. n. but differs in having smaller apertures. The gynozooecium of the studied specimen of *R. antarctica* is crescent-shaped, pierced by autozooecia and has a tranversely elongate ooeciostome (Pl. 2: 2b). The morphology of the gynozoecium of this species, with broad, arcuate frontal walls which are profusely pierced by autozooecial apertures, suggests its placement in the family Plagioeciidae Canu, 1918; see also Hara and Taylor (1996).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene). This is the first report of the genus from Antarctica.

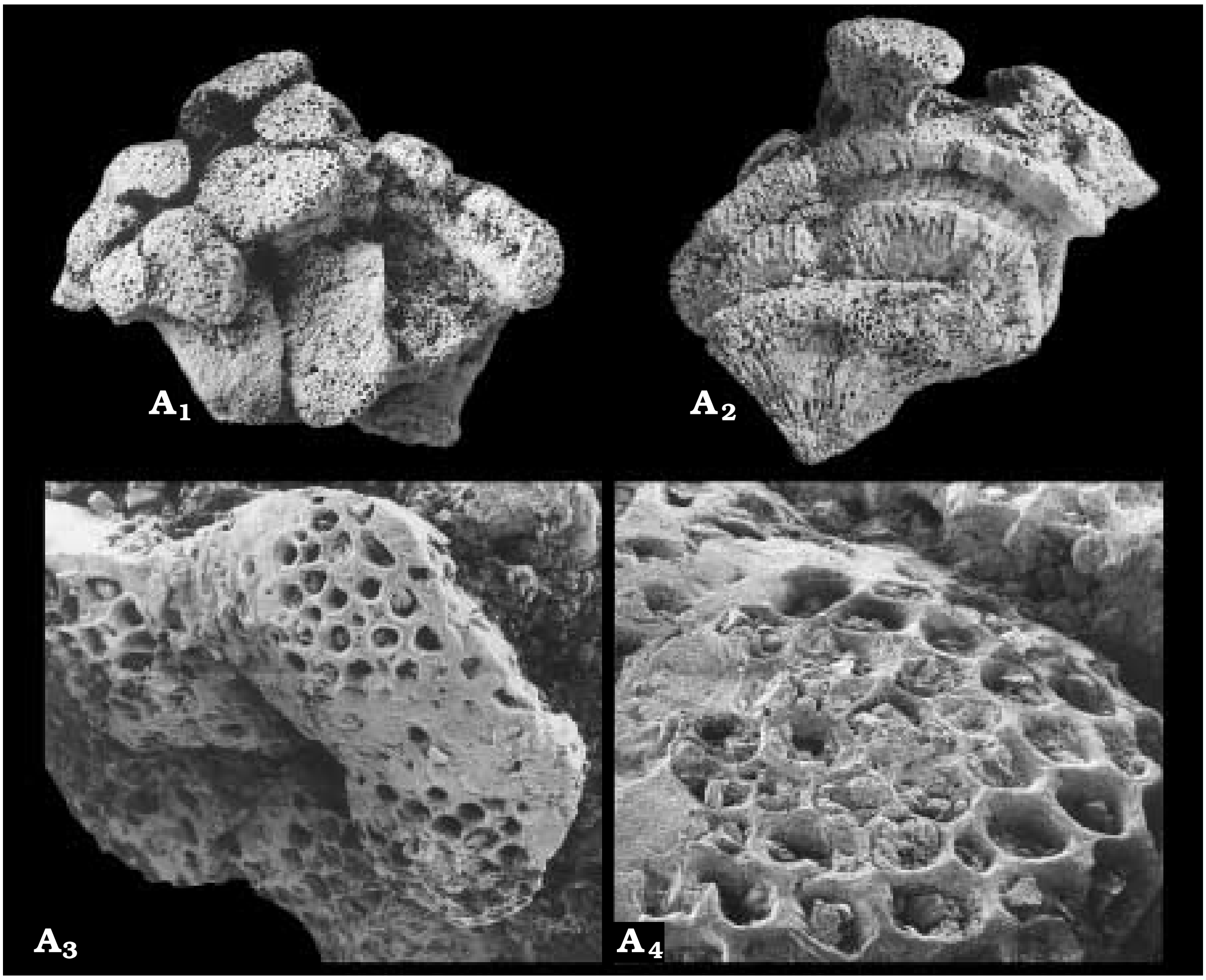

Fig. 17. *Fasciculipora* sp. ZPAL Br.VIII/A57; ZPAL 1, Telm1, bouquet-shaped colony; A_1 frontal view, × 4; A_2 dorsal view, × 4; A_3 fascicle with zooecial apertures on top of the colony, × 16; A_4 zooecial apertures, × 35.

Family **Fasciculiporidae** Walter, 1969

Genus *Fasciculipora* d'Orbigny, 1846

Type species: *Fasciculipora ramosa* d'Orbigny, 1849.

Fasciculipora sp.

(Text-fig. 17A_1– A_4)

1997b. *Fasciculipora* sp.; Hara: p. 119, 125, text-fig. 4: 9.

Material. — One incomplete specimen, with a broken basal portion.

Dimensions. — Zoarium height 15 mm, width 18 mm; apertural width 0.22–0.28 mm; peristome length 0.36 mm; diameter of proximal stem just before bifurcation 3.0 mm, diameter of stem at the top of colony 2.4–6.0 mm.

Description. — Zoarium is erect, bouquet-shaped, rising from a narrow stem, irregularly branched (Text-fig. 17A_1–A_4). Bundles of autozooecia coalescing at the top in a meander-like way (Text-fig. 17A_1). Autozooecial apertures are circular or more or less hexagonal in shape, close to each other, forming a honeycomb-like top area, open or sealed by a terminal diaphragms (Text-fig. 17A_1–A_3). Small conical apertural processes are present. The zoarial surface is covered densely by the pseudopores. The sides of the main branch are punctate and transversely corrugated with well-marked longitudinal lines of closely attached zooecial tubes (Text-fig. 17A_2). Gynozooecium has not been observed.

Remarks. — The sole, studied specimen of this species is provisionally assigned to *Fasciculipora* because of the erect bouquet-shaped, richly and irregularly branched zoarium with zooecia disposed in bundles at the top of the colony. There is a particularly close resemblance of this form to Recent South Atlantic *Fasciculipora meandriana* Borg 1944: pl. 10: 9 in having a similar bouquet-shaped zoarium and the same arrangement of the bundles of autozooecia coalescing at the top of colony in a meandroid pattern. The main distinguishing feature of the Antarctic Eocene species and *F. meandriana* Borg, 1944 is the larger size of the zoarium and its autozooecial apertures. *Fasciculipora cylindrica* Canu, 1908 from the Miocene of Patagonia (Canu 1908: pl. 13: 2–8) differs from *Fasciculipora* sp. from Seymour Island in having more slender colonies as well as smaller sizes of autozooecia. *Fasciculipora* cf. *ramosa* d'Orbigny, 1846 from the Oligocene of King George Island (Gaździcki and Pugaczewska 1984: figs 4–5; see also Birkenmajer and Gaździcki 1986), has larger sizes of colonies and autozooecia than *Fasciculipora* sp. from Seymour Island (Text-fig. 17A$_1$–A$_4$).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Suborder **Cancellata** Gregory, 1896

Family **Horneridae** Gregory, 1899

Genus *Hornera* Lamouroux, 1821

Type species: *Hornera frondiculata* Lamouroux, 1821.

Hornera antarctica Waters, 1904

(Pls 1: 1, 2; 3: 1a–e; 4: 1a–e, 2a–c)

1904. *Hornera antarctica* Waters; p. 93, pl. 9: 1–2.
1911. *Hornera antarctica* Waters; Hennig: 1911, p. 37, pl. 5; 8–11.
1944. *Hornera antarctica* Waters; Borg: pp. 186–189, pl. 14: 1–4.

Material. — Nine incompletely-preserved specimens, two with the supporting base.

Dimensions. — Maximum height of the colony 25 mm, width 17 mm; diameter of the branch at the top 0.8–1.2 mm, diameter of the branch at mid-height 2.0–2.5 mm, diameter of the branch at the base 2.0–2.5 mm; apertural width 0.09–0.11 mm, peristome width 0.14–0.17 mm; distance between the apertures 0.21–0.28 mm; gynozooecium width 1.2 mm, gynozooecium length 0.8 mm.

Remarks. — The studied specimens correspond well to *Hornera antarctica* Waters *sensu* Borg, 1944, although the descriptions of this species given by Waters (1904) and Hennig (1911) are somewhat brief and incomplete. Borg (1944) described four Recent species of *Hornera* from Antarctica (Borg 1944: pl. 14: 1) whose external morphology resembles the specimens from the La Meseta Formation (Pl. 3: 1a, b; Pl. 4: 1a, b, Pl. 4: 2a, b). The zoarium of the La Meseta species is characteristic; spreading out horizontally in one plane and forming a flabelliform colony or being funnel-shaped or even saucer-shaped. Very often small lateral stunted branches are formed and they grow at about right angles to the main branch which is oval in transverse section, with the frontal side considerably flattened. The sizes of branches of *Hornera antarctica* Waters, 1904 (Borg 1944) are much smaller than the specimen studied. The size of the apertures and the distance between them of the studied specimens agree well with the description given by Borg (1944). The zooecia of the La Meseta specimens are not enclosed in the rhomboidal spaces, as for instance, in *H. frandiculata* Lamouroux, 1821. The well-developed sulci along with cancelli (pores), are variable in number and shape. Autozooecial apertures are transversely oval in shape, arranged in somewhat varying patterns either in fairly regular quincunx (Pl. 4: 2c) or irregularly in transverse and obliquely transverse rows (Pl. 3: 1c, 1e). The apertures which are placed medially are excised, but those which are lateral ones are exserted. The gynozooecium is broken, situated dorsally, ovate, deeply-pitted, placed in the middle part of the colony, at the extremities of a lateral branch (Pl. 4: 1d). The gynozooecium of the examined specimen is larger than that described by Borg (1944). Towards the top of the colony the system of nervi is not so prominent; they are bridged over by a number of short transverse ridges forming the strongly granular frontal side of zoarium (Pl. 3: 1c).

The very distinctive feature of the examined specimens is the process of ontogenetic thickening of the zoarium with the well-developed system of mostly transverse ridges including cancelli, therefore the whole zoarial surface is covered by numerous prominent, longitudinally-transverse sulci winding between the apertures. On the basal side there are longitudinally to slightly transversely alternating dichotomously divided sulci which become more longitudinal towards the extremities of the colony with slit-like, elongate vacuoles of different lengths (Pl. 3: 1d). *H. antarctica* (Pl. 4: 2a–c) differs slightly in zoarial shape and mor-

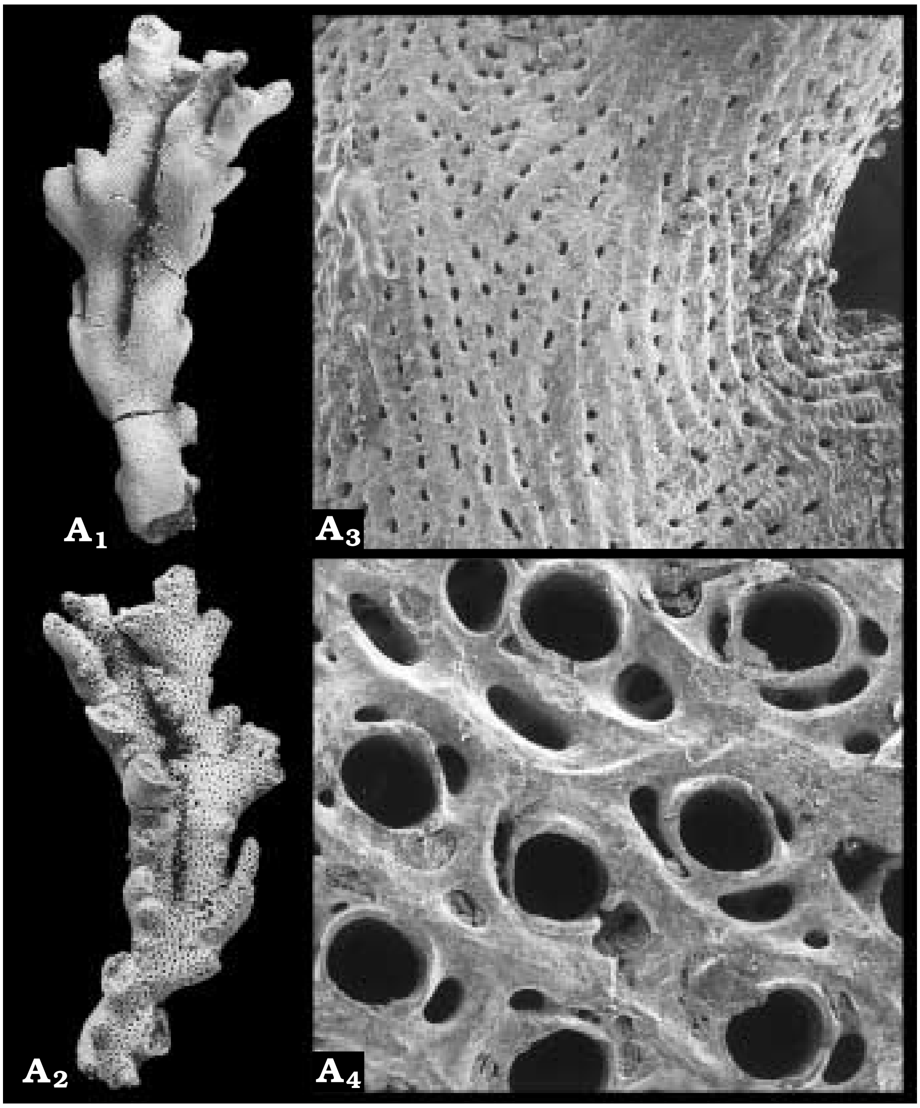

Fig. 18. *Hornera* sp. ZPAL Br.VIII/A44; ZPAL 1, Telm1, branched colony; A_1 basal view, × 4; A_2 frontal view, × 4; A_3 basal side showing longitudinal sulci with elongate vacuoles, × 38; A_4 zooecia with well-marked peristomes surrounded by oval cancelli, × 110 .

phology from the specimens illustrated (Pl. 3: 1a, b, Pl. 4: 1b, c, 1e); however, the problem of variation within this species was discussed by Borg (1944), which may have a direct connection with the ontogenetic thickening of the colonies. The presence of a characteristic obliquely transverse and very prominent system of sulci on the frontal wall of the zoarium (see Pl. 3: 1c, 1e; Pl. 4: 1a–c) does not occur in the specimen illustrated (Pl. 4: 2a–c), the ridges of which are not so prominent and extend longitudinally but not transversely.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene). In the Recent seas *Hornera antarctica* seems to be a species not uncommon in the Subantarctic region (Borg 1944). *H. antarctica* has been described from the Polonez Cove Formation (Oligocene) of King George Island (Gaździcki and Pugaczewska 1984). It has also been noted from Pliocene of the Cockburn Island (Hennig 1911).

Hornera sp.
(Text-fig. $18A_1$– A_4)

Material. — Three incomplete specimens.

Dimensions. — Length of the colony 18 mm, width 5 mm; diameter of the main branch 2 mm, diameter of the lateral branches 0.84 mm; apertural width 0.11–0.12 mm, peristome width 0.17 mm, distance between the apertures 0.10–0.17 mm.

Description. — Zoarium is slender in one plane, characteristically spout-shaped in form, the vertical axis slightly bent, with the concave side frontal (Text-fig. 18A$_1$–A$_2$).

Autozooecia are arranged in quincunx, in longitudinal rows, very close to each other (Text-fig. 18A$_4$). Autozooecial apertures are oval in shape, placed in transversely-horizontal position, surrounded by a deeply buried, projecting peristome, entire, surrounded by usually two apertural cancelli, but quite often three up to four, which are placed laterally (Text-fig. 18A$_4$). Longitudinal sulci sometimes coalescent, forming roughly oval-shaped, depressed spaces with very rare cancelli (Text-fig. 18A$_4$). The basal side of zoarium is covered by longitudinal sulci, interweaved with numerous elongate vacuoles and transverse ridges, forming a fibro-reticulate structure (Text-fig. 18A$_3$). Gynozooecium not been observed.

Remarks. — With respect to the morphology of the zoarial surface these incomplete specimens bear some resemblance to *Hornera frondiculata* Lamouroux, 1821 which is widely known from the Tertiary of Europe (see Canu and Lecointre 1933–1934: pl. 35: 8, 9; Lagaaij 1952: pl. 21: 1a, b; Mongereau 1972: pl. 5: 1–7, 10, pl. 7: 1–2), as well as from the Tertiary of Australia (see MacGillivray 1895: pl. 19: 7). In his major revision of Tertiary *Hornera* species, Mongereau (1972) described *Hornera frondiculata* Lamouroux giving all the morphometric characters of this genus, which correspond with the La Meseta specimens. However, another character – the very prominent peristomes around the aperture distiguishes the studied specimen from *Hornera frondiculata* whose peristomes are not entire but are wanting distally. The rhomboidal spaces which encircle the zooecial apertures, well-defined in *H. frondiculata,* are not very well-marked in the La Meseta specimens whose autozooecial apertures are encircled by roughly ovoidal depressions. The morphology of the basal side of the studied specimens and *H. frondiculata* is very similar, but in *H. frondiculata* it is more strongly longitudinally fibrillate with trabecular or granular fibrillae. The intervening sulci possess well-marked pores (MacGillivray 1895: pl. 19: 7; Mongereau 1972: pl. 5: 6). *Hornera frondiculata* is known as a species which shows a great variation of the zoarial morphology due to ontogenetic thickening of the colonies which is very common among this species (see Text-fig. 18A$_1$–A$_4$). MacGillivray (1895) described twelve species of *Hornera* from Tertiary of Australia; however, insufficient documentation of this material, as well as the lack of morphometric characters, makes closer comparison with the specimens from the La Meseta Formation impossible.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene).

Genus *Crassohornera* Waters, 1887

Type species: *Crassohornera waipukurensis* Waters, 1887.

Crassohornera sp.

(Pl. 5: 1a–c)

Material. — Two fragments of the upper parts of colonies without the base.

Dimensions. — Diameter of the proximal part of the branch 2 mm, diameter of the branch in the upper part 1.2 mm; apertural width 0.1 mm (mean), peristome width 0.2 mm (mean); gynozooecium total length 0.3 mm, gynozooecium width 0.4 mm.

Description. — Zoarium branching in one plane, composed of circular branches dichotomising in the distal part of the colony (Pl. 5: 1a, b). Circular autozooecial apertures are arranged more or less in quincunx, regularly covering the frontal surface (Pl. 5: 1a, b). Circular vacuoles are present on the front of a diameter of 0.05–0.06 mm (Pl. 5: 1c). Usually, there is one vacuole beneath each autozooecium. Peristomes are slightly exerted, distinct, circular in outline (Pl. 5: 1c). The frontal zoarial surface is smooth, without sulci. On the basal side of zoarium the sulci are present but rarely-seen, discontinous, covered by small, circular vacuoles of a diameter of 0.02 mm (Pl. 5: 1b). Gynozooecium is broken, oval-shaped, deeply-pitted, placed distally on the basal side of the zoarium.

Remarks. — The examined specimens show most of the characters of the genus *Crassohornera,* described for the first time by Waters (1887: pl. 18: 2–4) from the Tertiary of New Zealand. *Crassohornera* sp. resembles *Crassohornera waipukurensis* Waters, 1887 in most morphological features, but it differs in having smaller autozooecial apertures. *C. waipukurensis* has a well-developed system of sulci on the basal side, mentioned in the description given by Waters (1892: pl. 18: 9); the sulci in *Crassohornera* sp. show a slightly different appearence being barely seen and discontinuous. Owing to the thickly-calcified older basal parets of colonies the presence of the sulci on the basal side of colony, is speculative, therefore the erection of a new species name should be deferred until better-preserved material is found. Moreover, Waters (1887), did not say anything about the presence and appearence of the gynozooecium.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 *(Bill Hill)*, Telm1 (Eocene). This is the first report of the genus from Antarctica.

Family **Calvetiidae** Borg, 1944

Genus *Calvetia* Borg, 1944

Type species: *Calvetia dissimilis* Borg, 1944.

Calvetia sp.

(Pl. 1: 8; Pl. 6: 1a–f)

1997b. *Tetrocycloecia* sp.; Hara: p. 119, 126, fig. 4: 2.

Material. — One specimen.

Dimensions. — Diameter of branch near the expanded base 7 mm, diameter of the lateral branch 4 mm, diameter of the branch at the top 2 mm; apertural width 0.08–0.10 mm; peristome width 0.14–0.18 mm; kenozooecial diameter 0.03–0.06 mm; gynozooecium total length 3 mm, width 2 mm.

Description. — Zoarium is erect, solid dichotomously branching, branches are subcylindrical in the same plane, the colony base forming an expansion covered by autozooecia and kenozooecia (Pl. 1: 8; Pl. 6: 1a, b). The whole zoarial surface is coarsely sulcate, covered with a well-defined system of reticulation (Pl. 6: 1c, d, 1f). Autozooecial apertures are irregularly disposed all over the surface of the zoarium, alternating with depressed areas covered only by round-shaped, small kenozooecia (Pl. 6: 1c). Autozooecial apertures are circular to sub-circular in shape, slightly immersed, surrounded by a narrow peristome, encircled by small, slightly depressed kenozooecia (Pl. 6: 1f). The single preserved gynozooecium is oval-shaped, with interior walled-roof, placed in the distal part of the colony with a longer axis along the direction of growth of zoarium (Pl. 6: 1d). The exposed floor of the gynozooecium is covered by numerous kenozooecia (Pl. 6: 1b, d).

In thin section, the boundary between exozone and endozone is well-defined (Pl. 6: 1e). The endozone occupies about 3/4 of the branch diameter and is surrounded by the very thin exozone. Zooecial walls display submoniliform profiles in endozone and exozone. They are of varying thickness and distinctly laminated in the exozone. In the endozone zooecial walls are subcircular with rare interzooecial pores.

Remarks. — The detailed morphological features of the specimen studied, such as the mode of branching, the nature of the gynozooecium with interior-walled roof and the reticulations between the apertures are suggestive features of cancellate *Calvetia* Borg, 1944. The type of the gynozooecium and the pattern of arrangement of autozooecia and kenozooecia and the presence of slightly depressed areas filled only by kenozooecia strongly differ the genus *Calvetia* from the other representatives of the family Hetereporidae Waters, 1880 (see also Pitt and Taylor 1990: figs 118, 120–121). *Hornera reticulata* (Busk, 1859) is similar to the specimen studied from Seymour Island (Busk 1859: p. 125; Lagaaij 1952), however, its internal morphological structure and the morphology of the gynozooecium remain unknown. The mode of branching of *Calvetia* results in the formation of a zoarium which is different from that occurring in the Horneridae and more similar to those of certain species within the Heteroporidae (see Borg 1944). *Calvetia dissimilis* Borg, 1944 described from Recent of the Subantarctic region (see Borg 1944) differs from the La Meseta specimen by having twice as smaller in size zoarium and gynozooecium as well as in the posssessing of more slender zoarium which looks slightly differnt in outline (see Borg 1944: pl. 13: 5–6). In view of the sparse material available from Seymour Island, the specific determination is deferred.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Suborder **Cerioporina** Von Hagenow, 1851

Family **Densiporidae** MacGillivray, 1881

Genus *Borgella* Kluge, 1955

Type species: *Borgella tumulosa* Kluge, 1955.

Borgella sp.
(Pls 1: 6; 5: 2a–c)

1997b. *Borgiola* sp.; Hara: p. 119, 126, fig. 4: 13.

Material. — One specimen, very well-preserved, encrusting an *Aspidostoma* colony.

Dimensions. — Colony about 10 mm long, 8 mm wide and 2 mm thick; apertural width 0.09–0.11 mm; kenozooecial diameter 0.03–0.06 mm; brood chamber diameter 1.6 × 1.4 mm.

Description. — Zoarium is encrusting, roughly circular, being thicker in the middle, narrower towards the margins (Pls 1: 6, 5: 2a). The zoarial surface is rugose with slightly raised circular autozooecia surrounded by smaller kenozooecia, as well as with a few elongated depressions, composed of numerous kenozooecia (Pls 1: 6; 5: 2b, c). Autozooecia are surrounded by distinct peristomes. Kenozooecia with subpolygonal apertures, are mostly open and especially well-developed in elongated areas (Pl. 5: 2b).

The basal budding lamina extends rather narrowly around the margin of the zoarium, curving upward (Pl. 5: 2a).

The brood chamber is a spacious, roughly quadrate depression, 1.6 × 1.4 mm across. Autozooecia passing through the chamber are linked by septum-like radial walls (Pl. 5: 2c).

Remarks. — The very-well preserved, specimen shows all the characters of the type species of the genus *Borgella tumulosa* Kluge, 1955. It is characterized by uniformly distributed autozooecia and kenozooecia across the entire zoarial surface; circular autozooecial apertures and more numerous and smaller kenozooecia which surrounding these. *Borgiola pustulosa* Osburn, 1953 (see Osburn 1953: pl. 76: 11) from Alaska, included in the genus *Borgella* by Androsova (1965), has the same encrusting type of colony as *Borgella* sp. from Seymour Island. The morphology of the zoarial surface of both species is the same but *Borgiola pustulosa* Osburn, 1953 possesses autozooecia and kenozooecia that are twice as large. Another taxon described as *Borgella pustulosa* (Osburn) subsp. *asiaticus* Androsova (see Androsova 1965: fig. 39), also has the same encrusting type of colony but is slightly larger and differs from the specimen studied here by having larger autozooecia and kenozooecia. The morphology of the brood chamber, suggests that *Borgella* is close to *Heteropora* (Osburn 1953).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene). This is the first report of this genus from Seymour Island and the oldest occurrence in the fossil record.

Family **Cerioporidae** Waters, 1880

Genus *Ceriopora* Goldfuss, 1826

Type species: *Ceriopora micropora* Goldfuss, 1826.

Ceriopora hemisphaerica sp. n.
(Pls 1: 12; 7: 1a–d, 2a–d; Text-fig. 19A, B)

1994. *Ceriopora* Goldfuss; Gaździcki and Hara: pp. 109–110, pl. 1: 1–2; pl. 2: 1–2.
1997a. *Ceriopora* sp.; Hara: pp. 1002–1003, text-fig. 2b, text-fig. 3: 4a, b.
1997b. *Ceriopora* sp.; Hara: pp. 117–118, 126, fig. 4: 12; fig. 5D, E.

Holotype: Specimen ZPAL Br.VIII/21 figured in Pl. 7: 2a–d.
Type horizon: Telm1, La Meseta Formation; Eocene.
Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.
Derivation of the name: From the Latin *hemi-sphaeros* (= half-globe), referring to the shape of colony.

Diagnosis. — Colony massive, multilamellar. Autozooecial apertures circular; kenozooecial apertures about half the size, unevenly distributed. Zoarial brood-chamber stellate, extending as lobes between radial series of autozooecial apertures, very shallow, pierced by the autozooecia. Interzooecial walls with very thin endozone and thick exozone, strongly moniliform, distinctly laminated with pores. Growth layers distinct, forming short, concentric, regular bands of small width.

Material. — 447 well-preserved specimens; recrystallization of the zoarial walls occurs, therefore apertural size may be variable.

Dimensions. — Diameter of the holotype colony 55 mm, height 35 mm; apertural width 0.14–0.20 mm, kenozooecial diameter 0.06–0.08 mm; size of brood chamber: 2.5 × 2.2 mm.

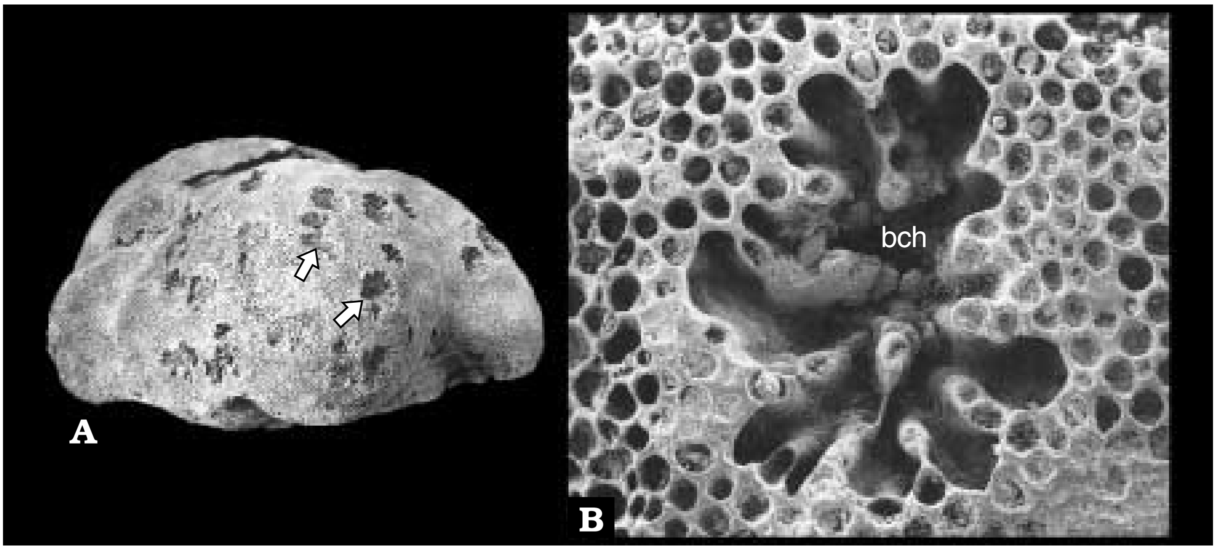

Fig. 19. *Ceriopora hemisphaerica* sp. n. **A**. Zoarial surface covered by numerous worn brood chambers (arrowed), ZPAL Br.VIII/106, × 2. **B**. Worn, stellate brood chamber (bch), ZPAL Br.VIII/107, × 28; ZPAL 1, Telm1.

Description. — Zoarium is massive, multilamellar, more or less hemispherical in shape, up to 70 mm across, the height of the colony ranges from 8 mm to 35 mm. The ratio between diameter and height of the colonies ranges from 1.1 to 2.7 (Text-fig. 10). Colony underside shows a distinct, narrow basal lamina (Pl. 7: 1c, 2c) and well-marked, numerous, concentric growth-lines (Pls 1: 12; 7: 1a, 1c, 2a, 2c; see also Gaździcki and Hara 1994: pl. 1: 1–2, Hara 1997a: figs 2b, 3: 4a, b; 1997b: fig. 4: 12). Upper surface is covered by autozooecial apertures of variable size, which are unevenly distributed among the smaller kenozooecial apertures. Zoarial surface is usually smooth but monticule-like elevations may occur. In thin section autozooecia radiate upwardly and outwardly, with distinct intrazoarial overgrowths observed in each colony where the number of laminae varies from 10 up to 94 and the thickness of laminae from about 0.25 mm in the distal part of the colony to 0.37–0.5 mm in the proximal part. The successive growth lines are very well-seen in the vertical sections (Pl. 7: 1d, 2d).

Autozooecial apertures are circular to irregularly polygonal in outline, kenozooecial apertures smaller and not so common as the autozooecia, circular to oval-shaped, distributed unevenly or scattered randomly among the autozooecial apertures. In some places there is no obvious size dimorphism. Apertural processes around the aperture are present. Diaphragms are rare but occur a little beneath the colony surface. The brood-chamber is stellate in frontal outline, shallow, solid-floored, pierced by autozooecial apertures arranged in a somewhat radiating pattern on the zoarial surface; its roof is broken (Text-fig. 19A, B).

In thin section the interzooecial walls are moniliform, composed of successive monili which are of different length and thickness. They have a nearly symmetrical profile across the zooecial boundary zone, but show large variation in thickness longitudinally. The moniliform profiles of the walls are enhanced by the occurrence of numerous interzooidal pores penetrating the walls along their whole length. The endozone of the zooecial walls is uniformly thin with a thickness of 0.02–0.07 mm and has a granular microstructure. Sometimes, there is no clear distinction between endozone and exozone. The zooecial walls within successive overgrowths are generally thick in exozone, fluctuating in thickness, from 0.07 up to 0.21 mm, with very distinct parallel lamination. Intermediate diaphragms are rare, subterminal porous diaphragms close to the intrazoarial overgrowths, of a thickness of 0.04 mm commonly occur. Overgrown roofs of brood-chambers visible in longitudinal section.

Remarks. — The genus *Ceriopora* is generally interpreted to include cerioporid species with multilamellar intrazoarial overgrowths, erect or semi-erect, usually massive colony-form with monoliform walls and indistinct dimorphism in zooecial aperture size and shape. The general aspects of the morphology of this new species are very similar to the type species, *Ceriopora micropora* Goldfuss, 1826, as redescribed by Nye (1976) with strong emphasis on the character of the internal morphology. However, the wall thickness, aperture diameter and number of interzooecial pores are greater in the specimens from the La Meseta Formation than in *C. micropora*. The brood-chambers of the specimens studied are preserved as stellate depressions and are similar to those of *Ceriopora farringdonensis* Gregory, 1909 (see Pitt and Taylor 1990: fig. 117D) as well as those of *Ceriopora rekohuensis* Gordon and Taylor, 1999 (Gordon and Taylor 1999: figs 25, 29). These two species differ, however, in having smaller autozooecial apertures than *C. hemisphaerica*. *Ceriopora tumulifera* Canu *et* Lecointre, 1934 (Canu and Lecointre 1934: pl. XLIII, XLIV: 1–16, 8–10; Tillier 1975: pl. 2: 2–9, pl. 3: 1), as well as *Ceriopora grandipora* (Canu *et* Lecointre, 1934), are very similar to the La Meseta species in colony-form and size of zoarium as well as in showing multilamellar structure. Both these species differ, however, in some aspect of the external and internal morphology of the zoarium from *C. hemisphaerica* sp. n. *C. tumulifera* has a very strongly mamillate zoarial surface which occurs only occasionally in *C. hemisphaerica* sp. n. Three common *Ceriopora* species from Pliocene deposits of Virginia, USA (see Cuffey and Sorrentino 1985: fig. 1A–I), have zooecia of slightly larger diameter than *C. hemisphaerica; Ceriopora avellana,* which bears the strongest resemblance to *C. hemisphaerica,* differs in having much smaller colonies with intrazoarial overgrowths observed in only a few colonies (Cuffey and Sorrentino 1985). Detailed morphological studies using SEM as well as studies of the internal characters of *Ceriopora hemisphaerica* sp. n. allow recognition of this new species which differs from the commonly known species described from Europe and America (cf. Canu and Bassler 1920, 1923, 1926; Canu and Lecointre 1933–1934; Voigt 1953; Brood 1972; Cuffey and Sorrentino 1985; Pitt and Taylor 1990; Gordon and Taylor 1999).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 *(Bill Hill),* ZPAL 5, ZPAL 12 (*Sadler Stacks*), Telm1; ZPAL 6, ZPAL 8, Telm2 (Eocene).

Ceriopora sp.

(Text-fig. $20A_1$–A_3)

1994. *Tetrocycloecia* sp.; Gaździcki and Hara: p. 110, pl. 1: 3, fig. 3.

Material. — One specimen, with worn, strongly calcified zoarial surface and numerous *Trypanites* borings on the upper zoarial surface.

Dimensions. — Diameter of the colony 27 mm, height 10 mm; apertural width 0.14–0.15 mm.

Remarks. — The internal morphology of the specimen studied shows all the features of the genus *Ceriopora* Goldfuss, 1826 see Nye (1976); however, the poorly preserved zoarial surface makes determination to species level impossible. In aperture size and internal characters the specimen studied is similar to the co-occurring *C. hemisphaerica* sp. n. (Text-fig. $20A_1$–A_3, Pl. 7). The worn, dark-brown zoarial surface of the studied specimen suggests recrystallization. The arrangement of large autozooecia in regular rows radiating from a common centre (see Text-fig. $20A_1$) seems to be somewhat similar to the pattern of autozooecia in *Tetrocycloecia* Canu, 1918 to which a poorly-preserved specimen was previously assigned (Gaździcki and Hara 1994: pl. 1: 3a, b). A very similar radial pattern of arrangement of zooecia is also observed in *Coscinoecia* (Nye 1976: pl. 13: 1b). A pattern of arrangement of autozooecia is the main feature which differs *C. hemisphaerica* from *Ceriopora* sp. from Seymour Island. However, the characters of the zoarial surface of the specimen presents some problems in assignment to species level: the internal morphological characters permit assignment of this specimen to the genus *Ceriopora* (Text-fig. $20A_2$).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene).

Genus *Neofungella* Borg, 1933

Type species: *Heteropora claviformis* Waters, 1904.

Neofungella capitula sp. n.

(Pls 1: 5; 8: 1, 2a, b, 3a, b, 4, 5, 6a, b, 7, 8a, b)

1997b. *Neofungella* sp. 1.; Hara: p. 119, 126, fig. 4: 4.

Holotype: Specimen ZPAL Br.VIII/229 figured on Pl. 8: 8a, b.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill),* Seymour Island, Antarctic Peninsula.

Derivation of the name: From Latin *capitulum* – small head – referring to the shape of the colony.

Diagnosis. — Colony pedunculate or hemispherical. Autozooecia circular, distributed unevenly among smaller, circular kenozooecia of about the same number. Zooecial walls strongly beaded in appearance. Brood-chamber forming a spacious cavity.

Material. — 34 complete specimens.

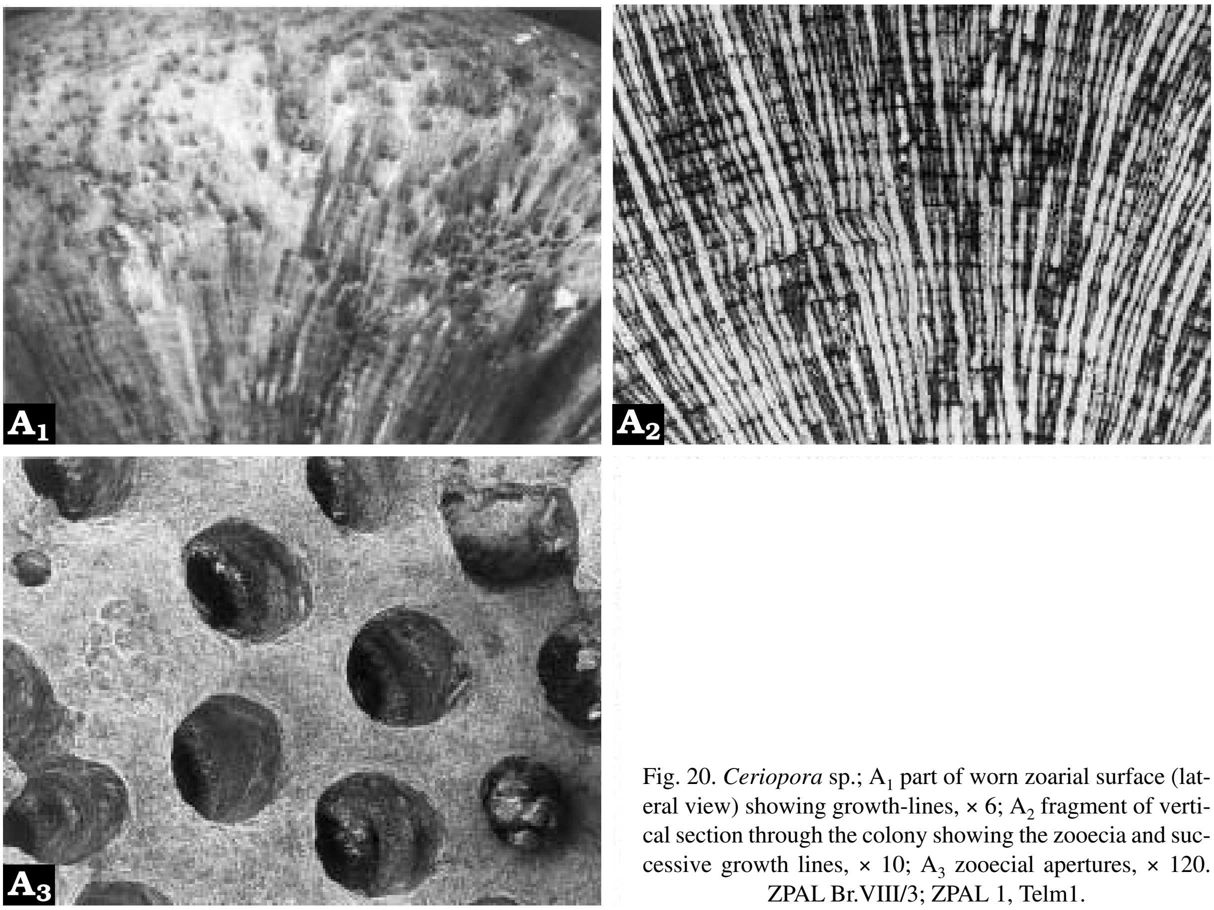

Fig. 20. *Ceriopora* sp.; A_1 part of worn zoarial surface (lateral view) showing growth-lines, × 6; A_2 fragment of vertical section through the colony showing the zooecia and successive growth lines, × 10; A_3 zooecial apertures, × 120. ZPAL Br.VIII/3; ZPAL 1, Telm1.

Dimensions. — Diameter of the holotype zoarium 19 mm, height 17 mm; the smallest colony diameter 10 mm, height 9 mm; diameter of the basal disc 4 mm, length of the stalk 12 mm; apertural width 0.10–0.15 mm; kenozooecial diameter 0.04–0.07 mm; brood chamber width 2.72 mm, length 2.36 mm, depth 0.3 mm; ooeciostome width 0.19 mm, length 0.6 mm; ooeciopore width 0.05 mm.

Description. — Zoarium varies in shape from pedunculate (Pl. 8: 1, 3–5, 7–8) to somewhat cylindrical in shape, multilamellar (Pl. 1: 5, Pl. 8: 2, 6) with narrow basal laminae (Pl. 8: 1, 2a, 3b, 5, 6a). Overgrowths varying in number, arising on the 'head' and growing down the 'stalk' of the zoarium (Pl. 8: 1, 2a, 3a, 4, 6a, 7, 8a).

Autozooecial apertures are circular in shape, arranged irregularly over the whole zoarial surface, sometimes grouped together. Some autozooecial apertures are closed by terminal diaphragms; sometimes they possess a pronounced, short, blunt apertural process, especially in the younger regions of zoarium (Pl. 8: 8b). The kenozooecial apertures are smaller in size, irregularly scattered between the autozooecial apertures, sometimes grouped together so as to separate the autozooecial apertures more or less completely from one another (Pl. 8: 8b). Kenozooecial apertures are more abundant than autozooecia.

A brood-chamber preserved as spacious, shallow depression on the zoarial surface, pierced by the radially arranged autozooecia and kenozooecia. Ooeciostome bigger than the autozooecial aperture, placed perpendicularly to the roof of ovicell.

In thin section the zoarium consists of a succession of capping overgrowths (Pl. 8: 2b). The zooecial walls are distinctly laminated with a characteristic moniliform or beaded appearance. Layers of superimposed intrazoarial overgrowths of about 0.8–1.2 mm in thickness. Interzooecial pores very rare. In thin section the brood chamber can be observed with its internal partitions and the flat roofs overgrown by the subsequent zooecia, varying from 2.0 to 3.6 mm (width) and 0.3–0.4 mm (length) roofed by a porous wall (Pl. 8: 2b). Usually, a few bundles of autozooecia or kenozooecia pass through the roof of the brood-chamber (Pl. 8: 2b).

Remarks. — All the external and internal characters of the La Meseta species allow assignment to *Neofungella*. Specimens of *N. claviformis* figured by Waters (1904: pl. 7: 8), Borg (1933: pl. 1: 1–3, 5–7), and Hillmer *et al.* (1997: pl. 2: 7, 9) show a close resemblance in their pedunculate colony shape to the La Meseta specimens (Pl. 8: 1, 4–5, 7–8). Borg (1933) did not figure any specimens with a cylindrical shape, but he mentioned the occurrence of hemispherical zoaria among his material. *N. capitula* sp. n. exhibits a characteristic pattern of irregularly-arranged autozooecial apertures. They are not in the preponderance to the kenozooecial apertures which are common. Borg's (1933) specimens of *N. claviformis* (Waters, 1904) and those described by Waters (1904) from Recent material from Antarctica generally have smaller zoaria than *N. capitula* sp. n. but larger autozooecial apertures. The internal morphology of the specimens studied shows a great similarity to *N. claviformis,* although the illustration presented by Borg (1933) is too schematic. The Seymour Island specimens exhibit characteristically distinctly laminated and strongly beaded walls (Pl. 8: 2b) and their zoaria are composed of a succession of over 60 transverse growth bands or superimposed layers (Pl. 8: 8a). In *N. claviformis* overgrowths do not exceed 20 (see Borg 1933: fig. 6). *Neofungella capitula* sp. n. shows the typical appearance of the brood-chamber which is characteristic for heteroporids. *Neofungella californica* Banta, 1967 is similar to *N. capitula* in a few morphological features, such as size and shape of colony, diameter of autozooecial apertures, presence of the apertural processes and in general arrangement of the autozooecia and kenozooecia; however, Banta (1967) did not describe the internal microstructure of the zoarium. The ooeciostome in *N. californica* is shorter, not flattened and has a smaller diameter than that of *N. capitula*. The Miocene species of *Neofungella ovata* Brood, 1981 differs from the studied specimens by possessing twice as many kenozooecia as autozooecia, and by the larger size of autozooecial apertures (see Brood 1981: pls 5: 6, 6: 1–3). *Neofungella claviformis* (Waters, 1904) was assigned by Moyano (1966) to the family Corymboporideae Smitt, 1866. Because of the morphological structure of the ovicell of the studied specimens it would be better to keep this genus within the family Cerioporidae Waters, 1880 (see Moyano 1966; Banta 1967), see also Taylor and Weedon 2000.

Occurrence. — Seymour Island, La Meseta Formation, ZPAL 1 (*Bill Hill*), ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene). This is the oldest fossil record of this genus from Antarctica.

?Suborder **Cerioporina** Waters, 1887

?Family **Cerioporidae** Waters, 1880

Genus *Reticrescis* gen. n.

Type species: *Reticrescis plicatus* sp. n.

Deriviation of the name: From the Latin *rete* – net, *crescere* – to grow.

Diagnosis. — Colony erect, reticulate, branches compressed horizontally, bilamellar, autozooecia exserted, arranged in quincunx, more or less irregularly or in short rows. Peristomes thick, slightly oblique. ?Kenozooecia numerous, more or less cordiform in shape, with a characteristic prominent projection which is similar to a pseudolunarium. Brood chamber subcircular in outline with a floor covered by zooecia.

Remarks. — This new genus has a reticuliporiform colony resembling *Reticulipora,* especially such species as *R. patagonica* Ortmann, 1900 from Patagonia (Ortmann 1900; Ortmann 1902: pl. 12: 2a–c; Canu 1904: fig. 6) and *R. transennata* Waters, 1884 (pl. 30: 3). The fixed-wall structures of *Reticulipora*, as exemplified by the Jurassic type species of *Reticulipora dianthus* (Blainville) B138 NHM from the Bathonian, Ranville, Calvados, Normandy, differs in having different shape, size and pattern of arrangement of autozooecia and kenozooecia. The general pattern of arrangement of autozooecia and ?kenozooecia in *Reticrescis* gen. n. closely resembles *Paracrescis boardmani* Pitt *et* Taylor, 1990, although the sizes of autozooecia and ?alveoli, in this encrusting species are smaller than in *R. plicatus* sp. n. The free-wall structure of both genera like *Crescis* d'Orbigny, 1852 and *Semicrescis* d'Orbigny, 1852 (see d'Orbigny 1850–1852: pl. 799: 8–10) is similar to the new genus as was earlier concluded for *Paracrescis* by Pitt and Taylor (1990). The small apertures between autozooecia are termed ?kenozooecia rather than alveoli as they would be if *Reticrescis* was assigned to the Suborder Rectangulata (cf. Pitt and Taylor 1990). The very characteristic features of *R. plicatus* are the prominent peristome and the shape of the ?kenozooecia with characteristic projection arising on the inner border and which may be interpreted as a pseudolunarium (Pl. 10: 3) (see also Pitt and Taylor 1990: fig. 164D).

The placement of *Reticrescis* in the family Cerioporidae is difficult to demonstrate in the absence of well-preserved brood chambers. The appearence of the floor of ovicell is more closely related to the cerioporine cyclostomes, therefore, the studied genus is here questionably assigned to the suborder Cerioporina.

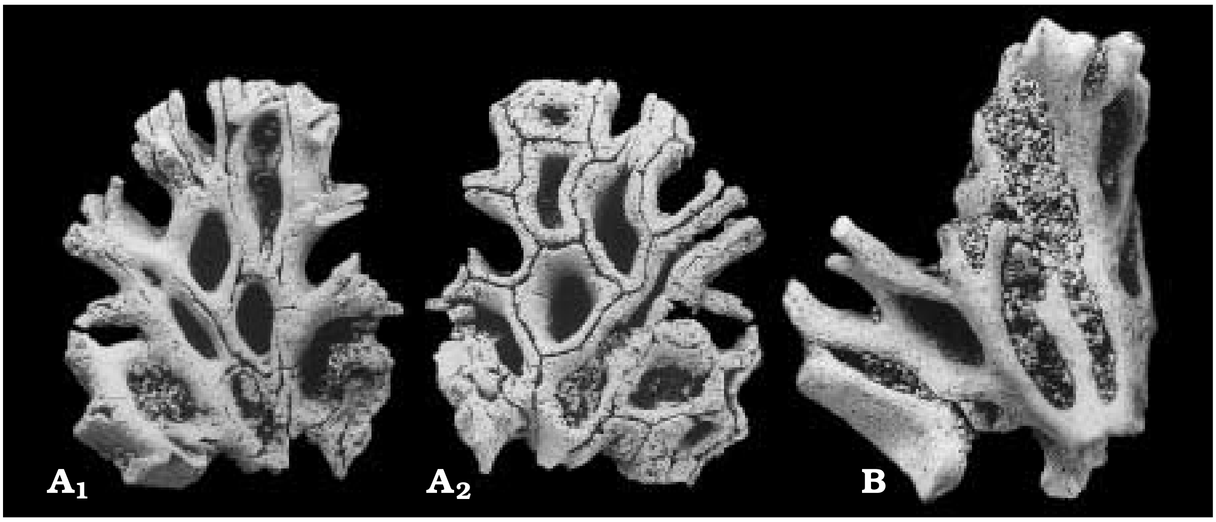

Fig. 21. *Reticrescis plicatus* gen. et sp. n. **A**. Fragments of colonies; A_1 dorsal view, A_2 frontal view; ZPAL Br.VIII/A88. **B**. Part of colony (dorsal view), ZPAL Br.VIII/A89; × 4; ZPAL 3, Telm7.

Reticrescis plicatus gen. et sp. n.

(Pls 1: 7; 9: 1a–c; 2, 3a, b, 4a, b; 10: 1a–d, 2; Text-fig. 21A_1–A_2, B)

Holotype: Specimen ZPAL Br.VIII/A69 figured on Pl. 9: 4a–c, Pl. 10: 3.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill)*, Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Latin *plicatus* – folded, referring to the mode of growth.

1997a. *Reticrescis* gen. n.; Hara: fig. 2g, fig. 3: 7.

1997b. *Reticrescis patagonica* (Ortmann, 1900); Hara: p. 120, 126, fig. 4: 19; fig. 5C.

Material. — 55 well-preserved fragments of colonies.

Dimensions. — Length of the holotype zoarium 50 mm; width 55 mm; branch width 0.4–0.8 mm; length of fenestrae of reticulation 2.5–3.2 mm; their width 0.6–1.2 mm; frontal wall length (of autozooecia) 0.21–0.24 mm; apertural width 0.08–0.11 mm; peristome length 0.14–0.18 mm; kenozooecial diameter 0.04 mm; brood chamber length 0.9 mm, width 1.25 mm.

Diagnosis. — As for the genus.

Description. — Zoarium is reticulate, erect, originating from an encrusting base (Pl. 9: 1a), consisting of compressed branches with horizontal (or radial) growth dominating in the lower part of the colony; and vertical growth in the upper part (Pl. 9: 1a–c, 2, 3a, b, 4a, b; 10: 1a–d). The branches show bilamellar structure and bifurcate in approximately the same plane (Pl. 10: 1a–d). The walls of the branches are covered by projecting, tubular, oval-shaped autozooecia arranged in quincunx and they are encircled by prominent, slightly oblique, thick peristomes (Pl. 10: 3). Between the autozooecial apertures are sunken apertures of polymorphs possibly ?kenozooecia, unevenly distributed, usually two or three close to each autozooecial aperture. Sometimes the ?kenozooecia are more frequent along the margin of the free wall, close to the dorsal side of the branch. On the inner border of ?kenozooecia, there are often acute projections, (pseudolunaria). The dorsal side of zoarium is densely covered by small, round knobs and large pores of 0.04–0.06 mm diameter, as well as by distinctive ridges running longitudinally along the whole length of the branches (Pl. 10: 1c). On the branch tip there is a distinct median ridge corresponding to budding lamina (Pl. 10: 2). A fractured subcircular brood chamber pierced by autozooecia has been found. Two specimens illustrated on the Text-fig. 21A_1–A_2, B, have a very worn zoarial surface.

Remarks. — The characteristic shape of peristomes, the sunken ?kenozooecia with a distinct, acute projection, as well as the pattern of arrangement of autozooecia and ?kenozooecia, distinguishes *Reticrescis plicatus* sp. n. from the Cretaceous species *Holostoma contingens* Lonsdale, 1850. The brood chamber of *R. plicatus* is a shallow, subcircular cavity, pierced by the autozooecia and does not allow placement of *R. plicatus* in the genus *Reticulipora*. There is a similarity in zooecial form with *Paracrescis boardmani* Pitt *et* Taylor, 1990, but the new species differs in its colony-form, the lack of maculae, and the larger size of the autozooecial apertures. However, the poorly known *Reticulipora patagonica* Ortmann, 1902 from the Miocene of Patagonia and *Reticulipora transennata* Waters, 1884 (Waters 1884: pl. 30: 3) from the Eocene of Aldinga, South Australia, show the same reticulate colony form as the specimens studied (Pl. 9–10; see also Canu 1904: pl. 5: 62, 63, 66). *R. transennata* Waters, 1884 differs, however, from *Reticrescis plicatus* from Seymour Island in having smaller autozooecial apertures and different pattern of arrangement of apertures. Unfortunately, the descriptions of *Reticulipora patagonica* Ortmann (see Ortmann 1900, 1902; Canu 1904) do not include full morphometric characters for the species and the name was used by Canu (1904) in a confusing way as *Retepora patagonica* (see Canu 1904: pl. 5: 62, 63, 66). *Reticulipora patagonica* Ortmann, which is very close to *R. transennata* Waters differs from *Reticrescis plicatus* in different pattern of arrangement of autozooecia.

Occurrence. — Seymour Island, La Meseta Formation, ZPAL 1 (*Bill Hill*), ZPAL 12 (*Sadler Stacks*), Telm1; ZPAL 3, Telm7 (Eocene).

Family *incertae sedis*

Genus *Reptomulticava* d'Orbigny, 1854

Type species: *Reptomulticava pyriformis* d'Orbigny, 1854.

Reptomulticava clavaeformis sp. n.

(Pls 1: 3; 11: 1–3)

1997b. *Reptomulticava* sp. 1.; Hara: p. 126, fig. 4: 3.

Holotype: Specimen ZPAL Br.VIII/71 figured on Pl. 11: 2a, b.

Type horizon: Telm 1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Latin *clava*, referring to the club-shaped zoarium.

Diagnosis. — Zoarium club-shaped to cylindrical, multilamellar comprising vertically-stacked subcolonies. Autozooecia thick-walled, arranged in regular quincunx pattern, round-shaped to polygonal. Brood chamber stellate in outline, located at the top of the subcolonies, with a very flat roof, pierced by fascicles of autozooecia.

Material. — Four complete specimens.

Dimensions. — Height of the holotype colony 12.2 mm, diameter of the distal part 4.3 mm, diameter near the base 1.1 mm; apertural width 0.11–0.15 mm; diameter of the brood chamber 2.55 mm.

Description. — Zoarium is clavate to more or less cylindrical in shape (Pl. 11: 1–3), multilamellar, composed of up to 15 stacked, subcolonies (Pl. 11: 1b) floored by very narrow basal laminae.

Thick-walled autozooecia with circular to polygonal apertures are arranged in quincunx (Pl. 11: 1c). Sometimes (Pl. 11: 1d) the apertures are surround by the rings which are the eroded central layers of the zooecial walls, located at zooecial boundaries (Pl. 11: 1d).

Porous terminal diaphragms are presented close to the aperture (Pl. 11: 1d). Apertural processes and kenozooecia are lacking.

Brood chamber approximately stellate in outline, very shallow, flat, pierced by fascicles of autozooecia arranged in a somewhat radial pattern of about 2.5 mm in diameter (Pl. 11: 1e). Ooeciopore not preserved.

In thin section, the multilamellar structure of zoaria is clearly evident, each layer is composed of a single subcolony about 0.6–0.8 mm in height, tapering towards the edges of a layer. Zooecia of each new subcolony bud interzooecially with well-visible budding centre; there are two or three of them in the distal part of each layer (Pl. 11: 1b). Zooecial walls moniliform, varying in thickness (Pl. 11: 1b) from 0.016 mm proximally, to 0.04 mm distally. Interzooecial pores are present, usually in the distal part of zooecia where the zooecial walls are moniliform. Walls have indistinctly granular microstructure. Intermediate diaphragms occasionally present.

Remarks. — The specimens studied consist of small, club-shaped, multilamellar zoaria constructed of a series of superimposed subcolonies. Many species of *Reptomulticava*, including the co-occuring *R. seymouriensis* sp. n., develop larger colonies. *R. brydonei* (Gregory, 1909) is similar in shape and size of colony to the studied specimens (Pl. 9: 3; cf. Pitt and Taylor 1990). There are a few other species, with even smaller colonies, such as *R. lobosa* (Keeping, 1883), *R. fungiformis* Gregory, 1909, *R. substellata* (d'Orbigny, 1850), *R. spongites* (Goldfuss, 1827), and *R. polytaxis* (von Hagenow, 1851) (see Gregory 1909). *R. fungiformis* (Gregory 1909: fig. 19; Canu and Bassler 1926: fig. 15), is also similar to *R. claveaformis* sp. n., in internal structure but differs in having smaller autozooecial apertures. *Defranciopora fungina* (Hillmer, 1971) (see also Walter 1991: fig. 1, pl. 1: 8; pl. 2: 1–2, 9, 11–12) – exhibits a zoarial morphology similar to the specimens studied in with each layer forming a separate subcolony. The morphology of brood chamber, however, clearly separates these two species at the generic level. The zoarial morphology of *R. clavaeformis* sp. n. resembles that of *Tholopora* (see Pitt and Taylor 1990: text-fig. 144) but can be distinguished by the absence of kenozooecia and presence of thick-walled autozooecia. The brood-chamber of *Defranciopora fungina* Hillmer is elongated in shape and differs from *R. clavaeformis* whose outline is stellate (see Walter 1991: p. 101, fig. 1, see also Pl. 11: 1e).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Reptomulticava seymourensis sp. n.

(Pls 1: 12; 12: 1a–c, 2a–d; 13: 1a–c, 2a–c; Text-fig. 22A–C)

1997a. *Reptomulticava* d'Orbigny; Hara: p. 1003, fig. 2a, fig. 3: 6, fig. 4: 1.
1997b. *Reptomulticava* sp. 2; Hara: p. 118, fig. 4: 18.

Holotype: Specimen ZPAL Br.VIII/289 figured on Pl. 12: 1a–c.
Type horizon: Telm1, La Meseta Formation; Eocene.
Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.
Derivation of the name: From the type area – Seymour Island.

Diagnosis. — Zoarium massive, multilamellar, mostly hemispherical to more irregular in shape, composed of subcolonies. Zoarial surface covered by numerous monticules. Autozooecia thick-walled, circular, arranged in quincunx, without peristomes. The brood-chamber stellate, pierced by zooecial apertures. Zooecial walls moniliform.

Material. — 66 complete specimens, of various sizes, some of them with strongly recrystallized zoarial surface.

Dimensions. — Diameter of the holotype colony 31 mm, height 15 mm; apertural width 0.14–0.18 mm, enlarged apertural width at the top of monticule 0.18–0.21 mm; diameter of brood chamber 1.8 × 2.1 mm; diameter of monticule 2 × 3 mm.

Description. — Zoarium is massive, monticulate, multilamellar, varying in size from 13 to 75 mm in diameter, composed of subcolonies projecting as monticules structures on the zoarial surface (Pl. 12: 1, 2a; Pl. 13: 1–2). Most commonly zoaria are hemispherical with a diameter varying from 16 up to 75 mm (Pl. 12: 1, 2a; Pl. 13: 1a); however, sheet-like morphologies with a diameter up to 43 mm, small nodular zoaria of about 17 mm in diameter, and zoaria composed of two or more hemispherical subzoaria forming differently-shaped colonies also occur (Text-fig. 22A). The zoarial surface usually has tuberculated relief, with the distinct subcolonies more or less circular in shape, and varying in size (Pl. 12: 1a, c, 2b; Pl. 13: 1a, b, 2a). The underside of the colony shows well-marked laminae (Text-fig. 22; Pls 12: 1b, 2a, 11: 2b). The number of laminae varies from 13 up to 54 and each layer consists of a few subcolonies, which merge along their margins. Each layer represents one stage of growth and thus the colony as a whole is multilamellar (Pl. 13: 2c). Autozooecial apertures are circular, oval to polygonal in outline (Pl. 12: 2d), many of them with rings surrounding the apertures which are eroded central layers of the zooecial walls located at zooecial boundaries (Pl. 13: 1c). Kenozooecia are absent. Zoarial surface is monticulated (Pl. 12: 1b, c; Pl. 13: a, b, 2a, b) Brood chamber is stellate in shape, or almost circular, very often a few occurring at the top of the zoarial surface, being pierced by radially-arranged autozooecial apertures (Pl. 12: 1a, 1c; Text-fig. 22C), they may also be seen in thin sections. No ooeciostome has been found. Interzooecial walls are pierced by numerous fine pores (Pl. 12: 2c). Mural spines and terminal diaphragms occur but they are rare.

In thin section the multilamellar structure is very distinct, composed of numerous overgrowing layers varying in thickness from 0.6 to 1.26 mm. In the exozone zooecial walls are more or less symmetrical in outline but they vary in thickness from 0.16–0.32 mm. The wall thickness in the distal part is 0.8–0.14 mm, in the proximal part 0.014 mm. Interzooecial pores are present in the proximal part of the walls produce the moniliform profiles. In longitudinal sections walls show indistinct lineation with granular patches (Pl. 13: 2c). Very thin intermediate diaphragms occur occasionally. Porous terminal diaphragms are covered by the basal laminae and they mark the next growth phase. Wide, rather shallow brood chamber stellate in shape, varying in diameter from 1.2 up to 2.5 mm are observed in the shallow tangential section. It is pierced by the radially arranged autozooecia (Text-fig. 22B).

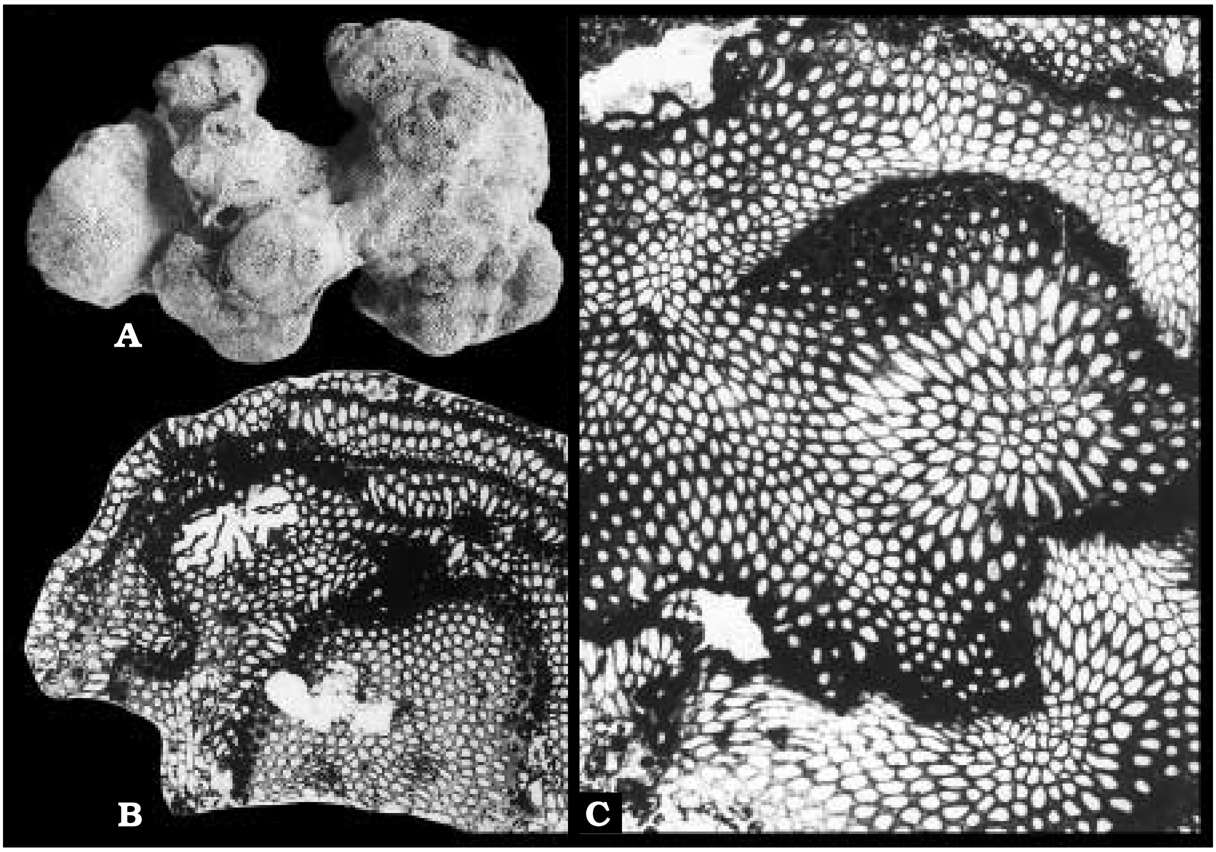

Fig. 22. *Reptomulticava seymourensis* sp. n. **A**. Complete colony composed of distinctive, numerous subcolonies, ZPAL Br.VIII/296, × 2. **B**. Tangential section showing centres of a few subcolonies, ZPAL Br.VIII/283; × 15. **C**. Tangential section showing layering and outline of a brood chamber (arrow), ZPAL, Br.VIII/109, × 8. ZPAL 1, Telm1.

Remarks. — *Reptomulticava heteropora* (Roemer, 1939) (illustrated by Hillmer 1971: pl. 11: 1–8, pl. 12: 1–3; Walter 1972: pl. 26: 13–15; Walter 1991; Voigt 1953: pl. 4: 1–2, 4) is very similar in shape and zooecial dimensions to *R. seymourensis* sp. n., but builds larger subcolonies with brood chambers of more elongate shape, less circular or stellate in outline. Moreover, the very distinctive feature of *R. heteropora* is the presence of proximally situated pseudolunaria, which have not been observed in *R. seymourensis* sp. n. Several Cretaceous species, such as *R. multigemmata* Hillmer, 1975 (see also Hillmer *et al*. 1975: pl. 11: 1), *R. heteropora* (Roemer) and *R. texana* Nye *et* Lemone, 1978 are related structurally to *R. seymourensis* sp. n. in the multilamellar growth and the wall structure. The occurrence of intrazooecial budding where new zooecia of each layer originate totally within the distal projection of a single pre-existing zooecium is a characteristic feature of the new species. Multilamellar species of *R. texana* Nye *et* Lemone, 1978 differ from the species studied in a greater thickness of the zooecial walls in the exozone and the presence of numerous intermediate diaphragms which are less common in the species studied. The growth layers in *R. texana* are very regular and seem to have the same thickness, whereas in *R. seymourensis* they are not so regular and are sometimes discontinuous.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 5, ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene).

Suborder **Rectangulata** Waters, 1887

Family **Lichenoporidae** Smitt, 1867

Genus *Disporella* Gray, 1848

Type species: *Discopora hispida* Fleming, 1828.

Disporella marambioensis sp. n.
(Pl. 1: 9; Pl. 14: 1a–f, 2)

1997a. *Disporella* Gray; Hara: p. 1004, fig. 3: 1.

Holotype: Specimen ZPAL Br.VIII/A3 figured on Pl. 14: 1a–f.

Type horizon: Telm1, La Meseta Formation; (Eocene).

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: In reference to Seymour Island called isla Marambio on Argentine maps.

Diagnosis. — Zoarium forming single saucer-shaped or compound rosette-like subcolonies. Central part of zoarium slightly concave, occupied by elongate, thick-walled alveoli (kenozooecia) from which numerous more or less raised radial fascicles of nonconnate autozooecia originate, each fascicle consisting of uniserial, biserial or multiserial autozooecial apertures separated by alveoli. Broad intermacular area comprising autozooecial apertures surrounded by alveoli. Brood chamber large, lobate, developed between the autozooecial fascicles.

Material. — Three complete, very well-preserved zoaria, one with a brood chamber.

Dimensions. — Mean zoarium length 14.6 mm; width 14.5 mm; height 7 mm; apertural width 0.14–0.17 mm; peristome width 0.21 mm; kenozooecial diameter (alveoli) 0.06–0.125 mm; brood chamber length 2.2 mm, width 2.0 mm.

Description. — Zoarium is simple oval or saucer-shaped, typically concave centrally (Pl. 14: 1a–c); compound zoarium of rosette-like form consisting of subcolonies, arising centrally; as many as 3 subcolonies may be present in one specimen, vertically arranged (Pl. 14: 2). Zoarium is surrounded by very thin basal budding laminae (Pl. 14: 1a). The growth lines can be observed in the section and on the inferior side of zoarium (Pl. 14: 1b, c).

The central area is depressed, variable in shape from rounded to elongate, occupied by thick-walled alveoli (kenozooecia), flanked by numerous radial fascicles of autozooecia, each consisting of a raised series of uniserial, biserial or multiserial autozooecial apertures, very close to each other but non-connate, separated by 2 to 6 interfascicular alveoli (Pl. 14: 1d, f). Intermacular area comprising non-connate, circular autozooecia, surrounded by alveoli, about twice as small as the autozooecial apertures. In later astogeny the radiating rows become diffuse, autozooecia assume a quincuncial, or more irregular pattern.

Autozooecial fascicles, up to 55 in number, vary in their length and comprise from 4 up to 19 autozooecia in the longest fascicle (Pl. 14: 1a). The autozooecial fascicles are mainly uniserial, but may become biserial, as well as multiserial. The height of the autozooecial fascicle is variable, diminishing toward the border of the colony and it may be different for each specimen (Pl. 14: 1a, 1d, 1f, 2). The peristomes are a little elevated, some with a blunt notch. Free part of peristome is variable in length, up to 0.6 mm, but usually less, the longest close to the centre of zoarium, diminishing towards periphery, circular or oval in shape (Pl. 14: 1f). Alveoli, are hexagonal to circular in outline, with rounded apertures, some partially or completely closed by constrictions, their size half or less compared with autozooecial apertures; alveoli in the central part of zoarium with thickly calcified walls (Pl. 14: 1d, f). Brood chamber is distinct, lobate, developed between autozooecial fascicles, extending outwards from the centre of zoarium to the autozooecial fascicles (Pl. 14: 1e). The ooeciopore which is usually situated at the end of one of the lobes is broken, leaving an empty space at its extremities (Pl. 14: 1e); it seems to be larger than the autozooecial aperture.

Remarks. — *Disporella marambioensis* sp. n. exhibits some variability in colony shape (Pl. 14: 1a–c; 2), forming either simple or rossette-like compound colonies with daughter subcolonies, arising centrally. The same manner of formation of daughter subcolonies occurs in *Disporella stellata* var. *pacifica* Osburn, 1953 (Osburn 1953: pl. 76: 10). The colonies of this species arise either by lateral or central budding, however. Variation in colony shape and formation of the subcolonies occur very often among colonies of *Disporella* (see Borg 1944; Brood 1972, 1976; Hayward and Ryland 1985; Alvarez 1992). *D. marambioensis* sp. n. differs from Recent species of *Disporella* (see Osburn 1953; Alvarez 1992; Hayward and Ryland 1985; and Taylor *et al.* 1989) in having more numerous autozooecial fascicles, large autozooecial apertures and variable length of autozooecial radii. This new, extemely well-preserved and very characteristic species exhibits, among other morphological features, a brood-chamber which is an important diagnostic feature of the genus *Disporella* Gray, 1848, distinguishing it from *Lichenopora* Defrance, 1823, (Osburn 1953; Brood 1972; Buge 1979; Gordon and Taylor 1997).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1.

Class **Gymnolaemata** Allman, 1856

Order **Cheilostomata** Busk, 1852

Suborder **Flustrina** Smitt, 1866

Superfamily **Microporoidea** Gray, 1848

Family **Aspidostomatidae** Jullien, 1888

Genus *Aspidostoma* Hincks, 1881

Type species: *Eschara gigantea* Busk, 1854.

Aspidostoma coronatum (Thornely, 1924)

(Text-fig. 23A, B)

1995. *Aspidostoma coronatum* (Thornely); Hayward: p. 180, fig. 129c, d.

Material. — Two well-preserved, encrusting specimens. One of the specimen studied was found on a shell of the brachiopod *Paraplicirhynchia gazdzickii* Bitner, 1996 (Bitner 1996b: pl. 1: 3b) the other on a celleporid colony (Text-fig. $23A_1$–A_2).

Dimensions. — Length of zoarium 2.5 cm, width 2.2 cm; length of zooecia 0.7–0.96 mm, width 0.6–0.9 mm; length of opesia 0.17–0.21 mm, width 0.2–0.3 mm; length of ovicell 0.56 mm, width 0.48–0.50 mm.

Remarks. — This is a very distinctive Antarctic endemic species, characterized by development of encrusting colonies, which form nodular, thick sheets on hard substrata; and by a centrally located ancestrula, 0.6 mm wide and 0.7 mm long, surrounded by radially arranged rectangular or roughly hexagonal autozooecia. The autozooecia are flat or slightly convex, bordered by well-marked grooves, sometimes with a few scattered, irregularly distributed frontal pores; opesia are triangular to subcircular, very often sealed. The proximal margin of opesia is slightly concave. The distal part of the cryptocyst is raised into a projecting hood, with paired disto-lateral processes, which may be very long and look like cervine horns. The irregularly shaped kenozooecia occur sporadically. The Recent Antarctic colonies of *A. coronatum* differ from the examined specimens from the La Meseta Formation in the possession of distinct marginal pores and interzooecial avicularia, as well as in the greater length of the autozooecia (cf. Hayward 1995: fig. 129c, d) which may be due only to diagenesis (Text-fig. $23A_1$–A_2). The characteristic paired disto-lateral processes have been observed on almost every zooecium in specimen ZPAL Br.VIII/A74 (Text-fig. $23A_1$–A_2) and occur sporadically on the second specimen (Text-fig. $23B_1$–B_3); their development probably depends on astogenetic stage.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene). At the present day this species is known from Antarctica (Ross Sea, Commonwealth Bay) and from the shelf of South Shetland Islands (Hayward 1995).

Aspidostoma multiformis sp. n.

(Pl. 1: 20; Pl. 15: 1a, b; Text-fig. $24A_1$–A_2)

Holotype: Specimen ZPAL Br.VIII/A67 figured on Text-fig. $24A_1$–A_2.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Latin *multiformis* – variable, multiform or polymorphic referring to the presence of numerous differently-shaped enlarged zooecia which form large patches on the zoarial surface.

Diagnosis. — Colony bilamellar, broad. Autozooecia irregularly hexagonal to rhomboidal in shape, cryptocyst deeply buried, concave in the middle part, narrow along margins of autozooecia. Numerous, rhomboidal to irregularly-shaped kenozooecia, which are pierced by large pores, forming unevenly distributed patches on the zoarial surface. Ovicell large, round, without ornamentation, with small aperture placed more or less centrally.

Material. — 15 fragments of bilamellar colonies.

Dimensions. — Length of zooecia 0.7–0.8 mm, width 0.66–0.75 mm; length of opesia 0.2 mm, width 0.2–0.3 mm; length of ovicell 0.60–0.75 mm, width 0.5–1.0 mm.

Description. — Colony forming broad bilamellar fronds (Text-fig. $24A_1$; Pl. 1: 20; Pl. 15: 1a). Autozooecia are roughly hexagonal to rhomboidal in shape, separated by deep grooves; calcification of the zooecia is thick and granular, giving a shagreened appearance; some of autozooecia bearing a few scattered

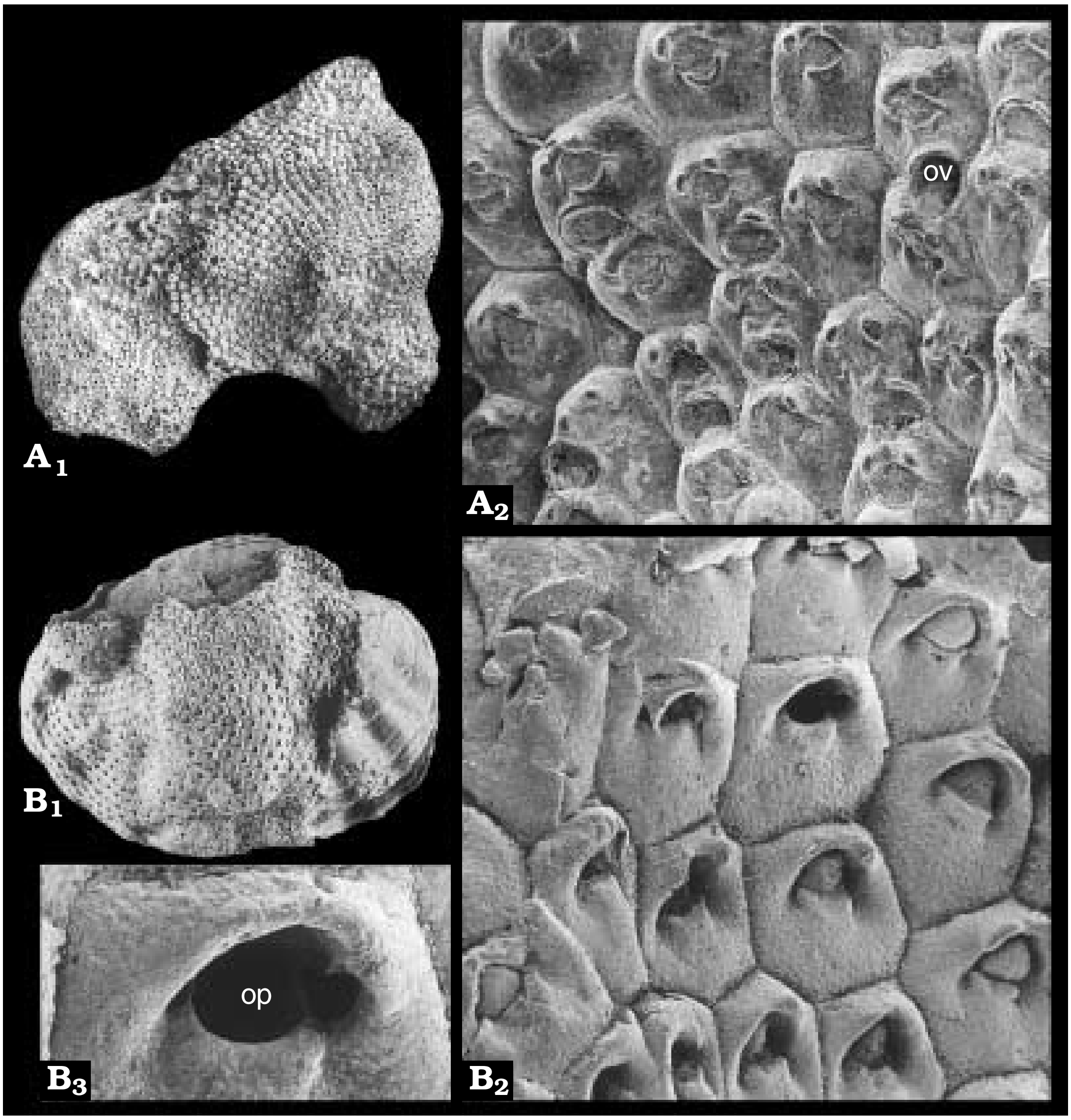

Fig. 23. *Aspidostoma coronatum* (Thornely, 1924); A_1 discoidal encrusting colony, × 2; A_2 autozooecia showing the cryptocyst distal to opesia with paired disto-lateral processes and some ovicelled autozooecia (ov), × 25, ZPAL Br.VIII/A74; B_1 bryozoan colony encrusting brachiopod *Paraplicirhynchia gazdzickii* Bitner, × 3; B_2 group of autozooecia, × 37; B_3 details of opesium (op), × 90, ZPAL Br.VIII/A75; ZPAL 1, Telm1.

frontal pores (Text-fig. 24A_2; Pl. 15: 1b). Cryptocyst is granular, deeply buried in its middle part with characteristic longitudinal striation, narrow along the border of zooecia. In the distal part of zooecium there are paired disto-lateral processes slightly raised, directed proximally; they occur occasionally (Text-fig. 24A_2). Opesia are wide, semilunar; proximal lip straight, deeply buried with an inconspicious ridge and paired opesiular channels. Kenozooecia are present, rhomboidal to hexagonal in shape, sometimes they form large patches distributed unevenly on the zoarial surface (Text-fig. 24A_2). Ovicells are globular, slightly wider than long, varying in size, imperforate. One broken ovicell is illustrated on Text-fig. 24A_2. Polymorphism is strongly developed revealed by the presence of the enlarged differently orientated zooecia, ovicelled autozooecia and unevenly distributed groups of kenozooecia. Some of kenozooecia may be slightly convex the other are flat. Specimen ZPAL Br.VIII/A15 (Pl. 15: 1a, b) shows the autozooecia being rather flat without the granular surface but only with a few pores on the frontal wall. Some specimens exhibit more convex zooecia (Text-fig. 24A_1–A_2). Particular zooecia (kenozooecia), are developed as a group of zooecia without apertures with a convex or bulbous frontal wall. There are also enlarged zooecia placed separately or grouped together on the zoarial surface (Text-fig. 24A_2).

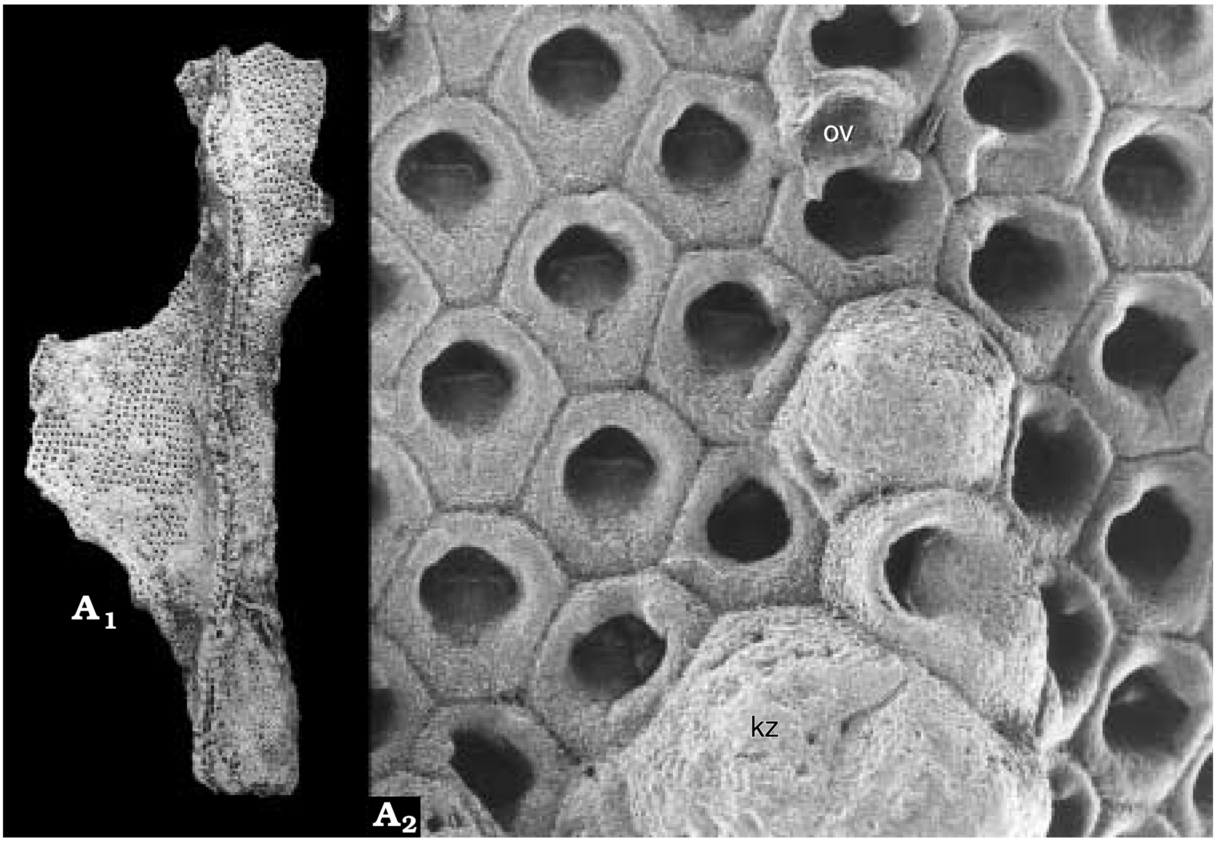

Fig. 24. *Aspidostoma multiformis* sp. n.; A_1 part of bilamellar colony, × 2.5; A_2 group of autozooecia with kenozooecia (kz) and one ovicellate autozooecium (ov), × 35. Holotype, ZPAL Br.VIII/A67; ZPAL 1, Telm1.

Remarks. — The very distinctive features observed in this species are the presence of globular ovicells varying in size by up to a factor of two, and the very well-developed kenozooecia, usually of the same shape and size as the ordinary autozooecia but with only a few pores which pierce the frontal wall. They may be grouped together or they are scattered irregularly on the zoarial surface. The other interesting feature of the specimens studied is the presence of the semilunar opesia bordered proximally by a deeply buried lip which is straight and broad, ornamented by a longitudinal striation. The investigated specimens show some resemblance in general appearance of the autozooecia to *A. hexagonalis* Canu, 1904 (Canu 1904: pl. 3: 28–30), but this species differs in having a concave proximal border of the lip and small interzooecial avicularia.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm 1 (Eocene).

Aspidostoma pyriformis sp. n.

(Pl. 15: 2–3; Text-fig. $25A_1$–A_3)

Holotype: Specimen ZPAL Br.VIII/17 figured on Text-fig. $25A_1$

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Latin *pirum* – pear, referring to pyriform-like autozooecia.

Diagnosis. — Colony branching, bilamellar, forming irregular sheet-like plates or lobes. Autozooecia close to pyriform in shape. Cryptocyst granular, moderately convex. Proximal lip of opesia straight with a characteristic anvil-shaped process, ovicell globular, round, imperforate.

Material. — 24 fragments of irregularly-folded fragments of colonies.

Dimensions. — The largest zoarium length 72 mm, width 60 mm; length of zooecium 0.64–0.80 mm, width 0.48–0.64 mm; length of opesia 0.1 mm, width 0.20–0.24 mm; length of ovicell 0.56 mm, width 0.48–0.50 mm.

Description. — Colonies forming thick, bilamellar branches or folded plates, ranging in size from small branches to very stout, anastomosing or twisted colonies (Text-fig. $25A_1$; Pl. 15: 2–3). Autozooecia are pyriform-like, in the distal part rounded, becoming narrower towards the proximal part, separated by distinct

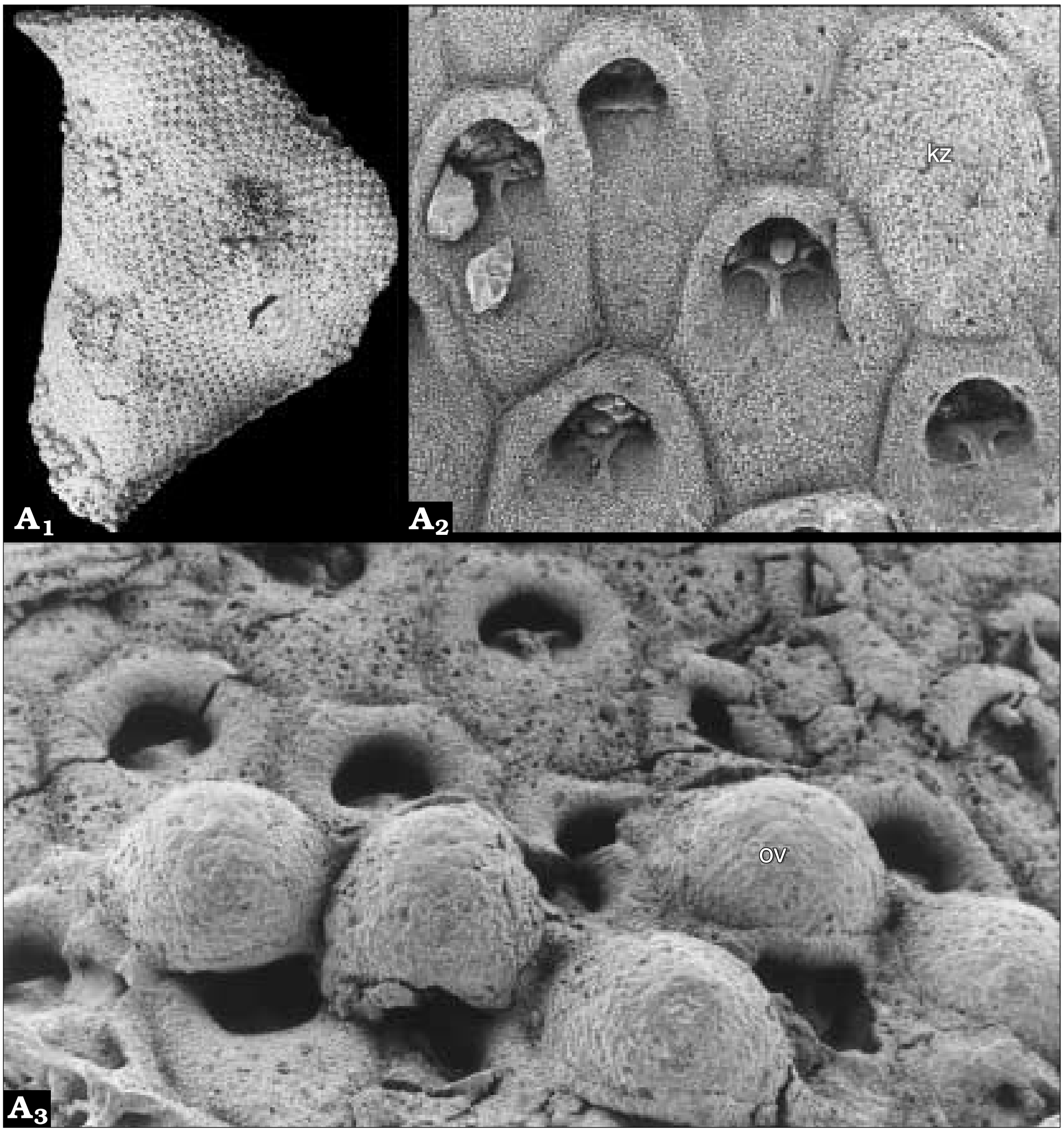

Fig. 25. *Aspidostoma pyriformis* sp. n.; A_1 part of a bilamellar colony, × 3; A_2 group of autozooecia and kenozooecium (kz); A_3 ovicellate autozooecia (ov), × 60. Holotype, ZPAL Br.VIII/A17; ZPAL 1, Telm1.

grooves, with a few frontal pores (Text-fig. $25A_1$–A_3; Pl. 15: 2b, 3b). Cryptocyst is moderately convex, granular, slightly depressed in the middle part, with the lower lip of the opesia straight and having an anvil-shaped prominent process placed medially (Text-fig. $25A_1$-A_3; Pl. 15: 2b, 3b). Small opesiular channels there are at the margins of the opesia. Interzooecial avicularia are present, pyriform to rhomboidal in shape, showing a few pores (Text-fig. $25A_2$). Ovicell is large, globular, recumbent on the succeeding autozooecia, imperforate, with centrally placed round-shaped aperture which very often is sealed (Text-fig. $25A_3$).

Remarks. — A very distinctive feature of this species is the presence of a straight-edged, anvil-shaped median process of the cryptocyst. In the older zooecia the cryptocyst is seemingly uneven and granular, the orifice and the median process appears to be deeply buried (Pl. 15: 2b–3b).

Very characteristic are the large, globular ovicells of *A. pyriformis* sp. n. (Text-fig. $25A_3$) and sporadically occurring large kenozooecia, usually of the same size as the autozooecial apertures, and a characteristic anvil-shaped process. *Aspidostoma pyriformis* sp. n. differs from *A. multiformis* sp. n. in having a differently shaped autozooecia and in the appearance of the proximal lip. The polymorphism of *A. pyriformis* sp. n. is not as strongly developed as it has been observed for *A. multiformis* sp. n.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 12, Telm1 (Eocene).

Aspidostoma taylori sp. n.
(Pls 1: 16; 16: 1–3)

1997b. *Aspidostoma* sp. 1.; Hara: p. 126, fig. 4: 10, 14.

Holotype: Specimen ZPAL Br.VIII/A50, figured on the Pl. 16: 1.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: In recognition of the contribution to bryozoology of Dr Paul D. Taylor (The Natural History Museum, London).

Diagnosis. — Colony erect, dendroid, composed of narrow bilamellar branches, attached to the substratum by an encrusting base. Autozooecia irregularly rhomboidal. Cryptocyst convex, granular, with a few scattered frontal pores, in the distal part raised into a projecting hood with one or two beak-like processes. Opesia large, semi-circular. Kenozooecia variable in shape, usually placed along the zoarial margins. Ovicell globular, imperforate.

Material. — 45 fragments of colonies.

Dimensions. — Maximum length of zoarium 30 mm, width 35 mm; length of the base up to 12 mm, width of a branch 5–7 mm; length of zooecium 0.6–1.1 mm, width 0.60–0.72 mm; length of opesia 0.12–0.18 mm, width 0.24–0.30 mm; length of ovicell 0.33–0.40 mm, width 0.42–0.48 mm; length of fenestrae 6 mm, width 2 mm.

Description. — Colony erect, composed of thick, narrow, bilamellar branches, which anastomose forming fenestrae (Pl. 16: 1). The supporting base is flat, wider than the branches (Pl. 16: 3a). Autozooecia are more or less rhomboidal, large, open on both sides of the branch, slightly convex, separated by distinct grooves, arranged alternating in longitudinal rows, covered by numerous pores, present also along the margins (Pl. 16: 1c, 2a, b, 3b). Cryptocyst is thick, pierced by numerous pores, irregularly scattered in the frontal wall; raised in the distal part, forming a projecting hood, with paired disto-lateral processes (Pl. 16: 1c, 3b). In the distal part of the colony there is usually one large process placed laterally (Pl. 16: 2b). Cryptocyst is deeply buried, concave, proximal to opesia (Pl. 16: 3b). Opesia are semicircular with distinct opesiular identations on both sides (Pl. 16: 1c, 2b, 3b). Kenozooecia are distributed unevenly, irregularly shaped, covered by numerous pores, especially present along the edges of the branches (Pl. 16: 1c). Ovicell, slightly longer than wide, recumbent, resting on the succeeding zooecia, with transversly elongated aperture placed in its proximal part (Pl. 16: 2b).

Remarks. — The specimens studied are characteristised by the appearence of the zooecia which are different in the distal and proximal parts of the zoarium (Pl. 16: 2–3). Because of strong diagenetic alteration of zoaria, the proximal lip is not very well-seen, the opesia of the zooecia become more circular and sometimes are barely visible (Pl. 16: 3b). Sometimes, the outline of zooecia has disappeared in the proximal part of the zoarium, which also has been previously observed in other *Aspidostoma* species (see Uttley 1949: pl. 29: 6; Gordon and Taylor 1999: text-figs 65–70).

Two distinct features – the perforate cryptocyst and characteristic disto-lateral, cervicorn processes – distinguish the species from the poorly known *Aspidostoma fallax* Uttley, 1949 (Uttley 1949: pl. 29: 6).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene).

Aspidostoma sp.
(Text-fig. 26A_1–A_2)

Material. — One specimen encrusting a celleporid bryozoan colony.

Dimensions. — Length of colony 16 mm, width 12 mm; length of zooecia 0.5–0.6 mm, width 0.4–0.5 mm; length of opesia 0.17 mm, width 0.25–0.28 mm; width of avicularia 0.07 mm.

Description. — Colony is encrusting, unilamellar, subcircular in outline (Text-fig. 26A_1). Zooecia are arranged radially, hexagonal to more or less circular in outline, divided by distinct grooves (Text-fig. 26A_2). Interzooecial avicularia placed at the margins of autozooecia, unevenly distributed, small, numerous, round-shaped (Text-fig. 26A_2). Opesia are subcircular to semilunar. Ovicell not observed.

Remarks. — The specimen bears most of the features of the genus *Aspidostoma* such as deeply buried semilunar opesia limited by a proximal lip of characteristic horseshoe shape. The relatively large number of

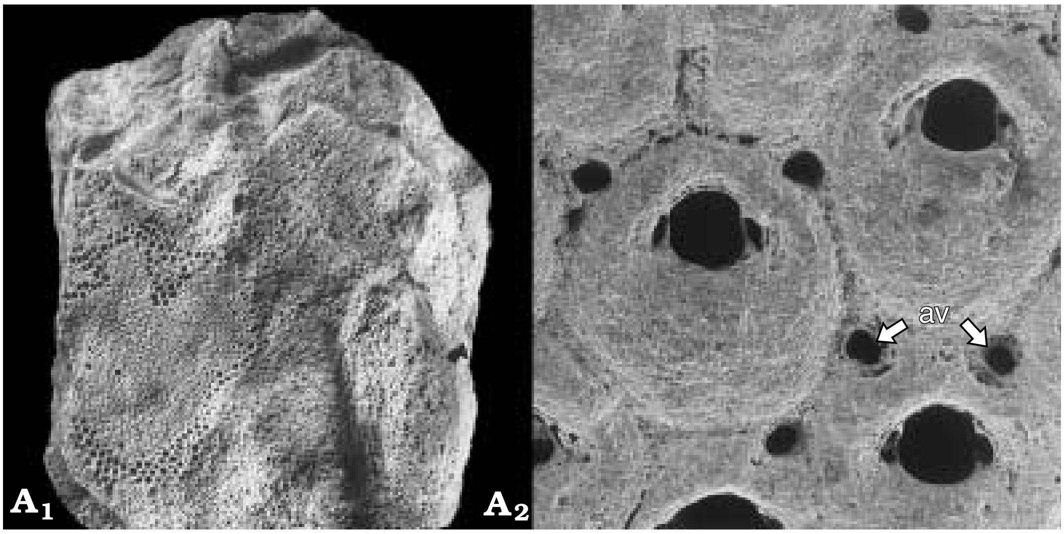

Fig. 26. *Aspidostoma* sp.; A_1 thick colony encrusting a celleporid bryozoan, × 2, A_2 group of autozooecia with small interzooecial avicularia (arrow), × 60. ZPAL Br.VIII/16a, ZPAL 12, Telm1.

interzooecial avicularia is a distinctive feature (Text-fig. 26A_2). Ovicells have not been observed. Owing to the paucity of available material, species determination is deferred. The specimen studied differs, however, from the other *Aspidostoma* species described from the La Meseta Formation and those already known from the Southern Hemisphere (Brown 1952; Uttley 1949; Hayward 1995; Gordon and Taylor 1999).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene).

Superfamily **Cellarioidea** Fleming, 1821

Family **Cellariidae** Fleming, 1821

Genus *Cellaria* Ellis *et* Solander, 1786

Type species: *Farcimia sinuosa* Hassall, 1840.

Cellaria sp. 1

(Text-fig. 27A)

Material. — Two broken colonies, found adherent to the reticulate bryozoan colony of *Reticrescis plicatus* gen. et sp. n.

Dimensions. — Colony length of 10 mm, internodes of 0.35–0.50 mm wide; length of zooecia 0.36–0.42 mm, width 0.34–0.42 mm; width of opesia 0.08–0.11 mm, length 0.06 mm.

Description. — Colony developing slender internodes, straight, dichotomously divided in the distal part of the colony. Autozooecia are arranged in longitudinal series of six; rhombic to roughly hexagonal in shape, separated by a distinct rim (Text-fig. 27A). Cryptocyst is granular, medially concave, flanked by curving lateral cryptocystal ridges which meet distally. Opesia are placed in distal half of autozooecia, distant from distal edge; the proximal edge slightly convex; anvil-shaped plate, very prominent and projecting above proximal lip of opesia. Avicularia and ovicell not found.

Remarks. — The zooecial and especially the opesial character of these specimens is similar to *Cellaria incula* Hayward *et* Ryland, 1993 described from Recent bryozoan faunas of Antarctica. The very distinctive feature of this species is the morphological character of opesia with the anvil-shaped articular plate, projecting above the proximal lip (see Hayward and Ryland 1993: fig. 3a, b). The La Meseta specimens differ, however, from *C. incula* in having six rows of zooecia instead of four, in the smaller length of zooecia; and with their proximal lip slightly convex, not straight. The specimens studied may represent a juvenile colony because neither ovicells nor avicularia had been developed.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 *(Bill Hill*), Telm1 (Eocene).

Cellaria sp. 2
(Text-fig. 27B)

Material. — A few fragments of one broken colony.

Dimensions. — Internodes up to 0.7 mm wide; length of zooecia 0.42–0.56 mm, width 0.35 mm; length of opesia 0.07– 0.08 mm, width 0.11–0.125 mm.

Description. — Colony is slender composed of broken internodes. Autozooecia are arranged in longitudinal rows of ten; rhomboidal in outline but longer than wide; separated by thin raised ridges (Text-fig. 27B). Cryptocyst is granular; medially concave with paired ridges flanking the opesia. Opesia are placed in distal half of autozooecia; about one seventh of total autozooecium length, reniform with rounded slightly curved proximal lip; small, acute, forwardly projecting denticules in each proximal corner; a pair of larger denticules present within the distal border, linked by the ridge with a characteristic depression in the middle part of the ridge. Ovicelled aperture is semicircular, more than half of width of opesia, placed at the distal margin of zooecia. Avicularia have not been found.

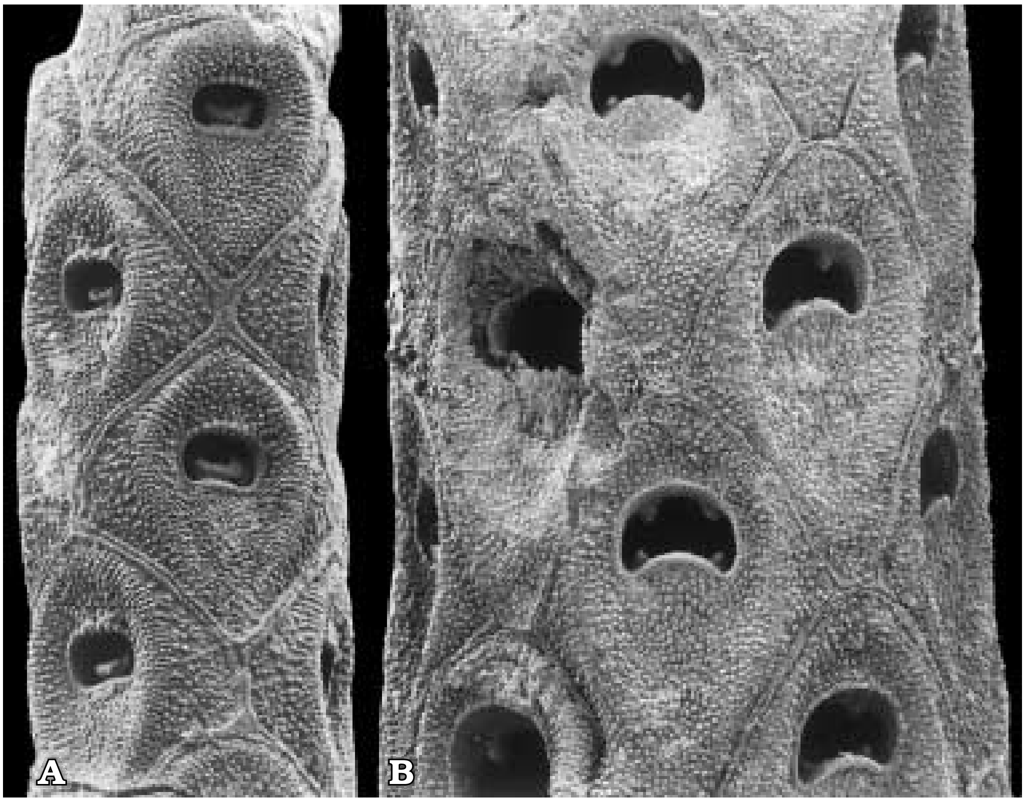

Fig. 27. *Cellaria* sp. 1. **A**. Fragment of internode showing zooecial apertures, × 110. ZPAL Br.VIII/A69a; *Cellaria* sp. 2. **B**. Part of internode with zooecial apertures, × 135; ZPAL Br.VIII/A69b; ZPAL 1, Telm1.

Remarks. — The specimen of *Cellaria* sp. 2 studied hithero from the Tertiary of the La Meseta Formation (Text-fig. 27B) displays all the characters of the genus *Cellaria*. *Cellaria clavata* (Busk, 1884) described from Recent faunas (see Hayward and Thorpe 1989; Hayward 1995) shows several similarities to the examined species such as reniform opesia in the distal half of the autozooecium, a low rounded proximal lip, a blunt forwardly projecting denticle in each proximal corner, and a pair of smaller pointed denticles present within a distal border linked by a finely denticulate ridge. The main distinguishing features by which *C. clavata* differs from the specimen studied are the greater width of the internodes and a difference in shape of the ovicelled aperture which is transversely oval, not semicircular. The La Meseta specimen differs in having a slightly different shape of autozooecia which are arranged in 10 longitudinal rows, not in 14 rows as was observed for *Cellaria clavata* (Busk). The fragmentary preserved material represented by a single specimen does not display all of the zoarial characters or the avicularium and therefore confident species determination is deferred.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

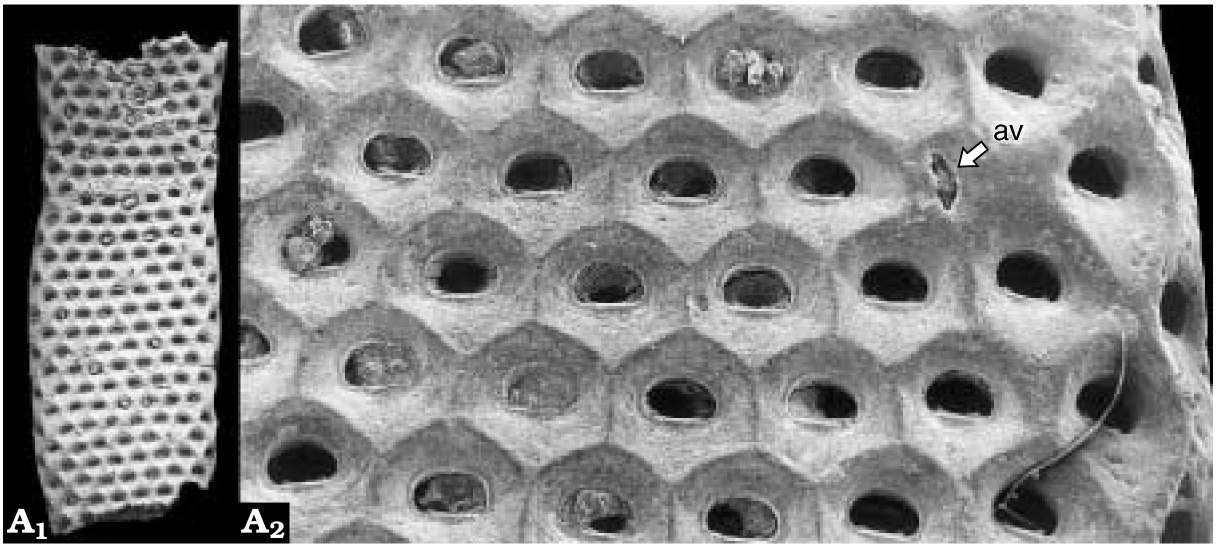

Fig. 28. *Melicerita* sp.; A_1 part of a colony, × 5, A_2 zooecial apertures with avicularium (av), × 35; ZPAL Br.VIII/A56; ZPAL 1, Telm1.

Genus *Melicerita* Milne-Edwards, 1836

Type species: *Melicerita charlesworthii* Morris, 1843.

Melicerita sp.

(Text-fig. $28A_1$–A_2)

Material. — One fragment of a colony.

Dimensions. — Length of the fragment of zoarium 12 mm, its width 5 mm; length of zooecia 0.64 mm, width 0.56–0.64 mm; length of opesia 0.18–0.20 mm, width 0.28–0.32 mm; width of avicularium 0.36–0.45 mm.

Description. — Colony is erect, forming a thin, bilamellar, flattened blade (Text-fig. $28A_1$). Autozooecia are regularly hexagonal, separated by thin but distinctly raised ridges, arranged in transverse, alternating rows of up to 8, which curve slightly towards colony margins (Text-fig. $28A_2$). Cryptocyst is deeply depressed, finely granular (Text-fig. $28A_2$). Opesia are rather large, about half of the total width of autozooecia, but only one-third of their length; occupying the whole central part of the autozooecia, semicircular in shape; proximal rim of opesia rather straight, sometimes gently concave, forming a distinct lip with a stout, broad median plate, slightly concave in the central part, forming a blunt denticle in each proximal corner (Text-fig. $28A_2$). Ovicell is immersed, with a narrow semielliptical aperture, at extreme distal end of autozooecia, 0.07 mm wide. Vicarious avicularia are infrequent, smaller than autozooecia, irregularly hexagonal or polygonal in shape, usually placed obliquely, but may be placed transversally or longitudinally, rostrum is semicircular, 0.25 mm wide (Text-fig. $28A_2$).

Remarks. — The specimen studied is characteristic in the appearance of opesia which are relatively large, occupying the whole central area of the cryptocyst; they are characterized by a regular, semicircular shape, and by the development of the median plate, slightly concave distally, forming a sort of depression with blunt, denticle-like projections in each proximal corner (see Text-fig. $28A_2$). By having hexagonal-shaped autozooecia and hexagonal to polygonal avicularia *M. latilaminata* Rogick, 1956, a well-known Antarctic endemic species, resembles the La Meseta specimen but differs in its smaller width of autozooecia, in the smaller length of the opesia and in their shape which is crescentic, not semicircular, as well as in the proximal rim which is convex in Recent species but straight in the La Meseta specimen (see Hayward and Thorpe 1989: fig. 14A; Hayward 1995: fig. 126D).

Melicerita ortmanni Canu, 1904 (Canu 1904: pl. 4: 1–2) closely resembles *Melicerita* sp. in most of the internal zoarial morphology except for a slightly smaller size of autozooecia.

The specimen studied is also similar to *M. blancoae* Lopez Gappa, 1981 in having regular hexagonal autozooecia of similar size. *Melicerita blancoae* differs, however, by not having avicularia and by possessing a pair of denticles linked by a thin ridge on the distal border of the opesia (see Hayward and Thorpe 1989: fig. 14B; Hayward 1995: fig. 126E, F).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Suborder **Ascophora** Levinsen, 1909

Infraorder **Umbonulomorpha** Gordon, 1989

Superfamily **Lepralielloidea** Vigneaux, 1949

Family **Lepraliellidae** Vigneaux, 1949

Genus *Celleporaria* Lamouroux, 1821

Type species: *Cellepora cristata* Lamarck, 1816.

Celleporaria australis sp. n.

(Pl. 17: 1a–d)

1997b. Celleporid colony, Hara: p. 121, fig. 4: 5.

Holotype: Specimen ZPAL Br.VIII/485 figured on Pl. 17: 1a–d.

Type horizon; Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Latin *australis* – southern.

Diagnosis. — Massive zoaria with very distinctive, large, barrel-shaped, erect or semi-erect autozooecia, chaotically oriented. Primary orifice semicircular, twice as long as wide, with straight proximal border. Secondary orifice orbicular, bearing a minute suboral avicularium. Adventitious tubular avicularia numerous, scattered throughout the zoarium, small spatulate avicularia occasionally present. Ovicellate zooecia very distinctive, larger than the usual ones.

Material. — Seven massive zoaria.

Dimensions. — Maximum length of colony 2.25 mm, width 2.15 mm; length of zooecium 0.6 mm, width 0.45–0.60 mm; length of orifice 0.12 mm, width 0.21–0.24 mm; length and width of ovicell 0.3 mm.

Description. — Zoaria are massive, usually barrel-shaped, but may also occur as spherical or mushroom colonies (Pl. 17: 1a, b). Autozooecia are large, well-raised, barrel-shaped to square, separated by grooves, with some pores scattered irregularly on the distal part of the frontal wall (Pl. 17: 1d). The zooecia are variously oriented, usually grouped in 3 to 5 close to each other. Primary orifice is D-shaped, nearly rectangular, deeply buried, twice as long as wide, without condyles but with straight proximal margin. The secondary orifice is orbicular, bearing a minute suboral avicularium (Pl. 17: 1d). Small spatulate, vicarious avicularia are present, a few of them with a ligulate rounded rostrum and a palatal shelf. Stout, long, adventitious columnar rostra are very common, scattered unevenly on the zoarial surface and placed in the proximo-lateral position. It is difficult to see if they bear an avicularium (Pl. 17: 1d). Large, spatulate, vicarious avicularia are missing. The early astogenetic zooecia have a suboral spine-like umbo. Ovicelled zooecia are slightly bigger than the usual ones. Ovicell is hyperstomial, large, cucullate, with a broken roof. In thin-section the zooecia are arranged chaotically (Pl. 17: 1c).

Remarks. — Specimens of *Celleporaria australis* sp. n. are very distinctive in having raised, barrel-shaped or square zooecia, which lie in groups of 3 to 5 around the early astogenetic ones; a small suboral and adventitious spatulate avicularia; numerous, circular tubular avicularium, with stout rostra, placed in various positions, very often adjacent to the autozooecia; and by the lack of large spatulate avicularia. The ovicellate autozooecia are larger than the others. The pattern of arrangement of zooecia on the zoarial surface and the presence of the numerous, stout, tubular adventitious avicularia make this species different from those described from the Tertiary of Australia and Europe (see MacGillivray 1895; Gordon 1989; Pouyet 1973). *Celleporaria ovata* sp. n. (Pl. 20: 3) has zooecia of similar shape and pattern to *C. australis* but differs, in other morphological features.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene). This is the earliest record of the genus from Antarctica.

Celleporaria gondwanae sp. n.

(Pl. 18: 1a–d, 2)

Holotype: Specimen ZPAL Br.VIII/356 figured on Pl. 18: 1a–d.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: Referring to Gondwana.

Diagnosis. — Massive, mushroom-shaped, multilamellar colonies; zooecia with primary orifice wider than long and straight proximal edge; suboral avicularium, small raised vicarious avicularia and large spatulate avicularia present. Ovicell hyperstomial.

Material. — 25 complete specimens.

Dimensions. — Maximum colony length 32 mm, width 52 mm; length of zooecium 0.28–0.35 mm, width 0.28–0.40 mm; length of orifice 0.12– 0.16 mm, width 0.14–0.16 mm; length of spatulate avicularia 0.56 mm, width 0.3 mm; length of vicarious avicularia 0.2 mm, width 0.14–0.16 mm; length of ovicell 0.25–0.30 mm, width 0.28–0.32 mm

Description. — Colonies are massive, multilamellar, composed of superimposed zooecial layers, up to 40 in number, mostly mushroom-shaped, many of them forming subcolonies at the top of zoarium (Pl. 18: 1a–c, 2). Autozooecia are rounded, wider than long, slightly erect, variously orientated, surrounded by a few randomly scattered marginal pores (Pl. 18: 1d). Primary orifice is wider than long, with straight proximal border. A pseudosinus may occur. Peristomial rim is thick. The small, round-shaped to transversely-oval suboral avicularium is situated within the peristome. Vicarious avicularia are frequent, oval-shaped with well-marked cross-bar slightly raised and surrounded by a few pores (Pl. 18: 1d). Large spatulate avicularia are rare, broken (Pl. 18: 1d). Ovicell is round-shaped, slightly longer than wide, hyperstomial. In thin-section the undulate growth-layers are well seen, with their thickness varying from 0.9–1.6 mm.

Remarks. — The morphological characters of the specimens examined agree well with *Celleporaria* in having a straight proximal border of the primary orifice, and suboral avicularia situated within a peristome. The very distinctive feature of the examined specimens is the large number of vicarious avicularia, which are very distinctive on the zoarial surface, as well as the presence of rare, long spatulate avicularia (see Pl. 18: 1d). Many colonies belonging to the family Celleporariidae Harmer, 1957, particularly those assigned to the genera *Cellepora* and *Celleporaria*, form massive, multilamellar colonies (see Canu 1908: pls 9–10; Pouyet 1973; Gordon 1989). Among the species of *Celleporaria* in the La Meseta Formation, *C. gondwanae* is most similar in its general architecture and in the shape of the primary orifice to *C. mesetaensis* sp. n. but differs in having shorter zooecia, slightly smaller orifices, and larger ovicells. Moreover, the specimens are smaller in diameter. The vicarious avicularia in *C. mesetaensis* sp. n. have a larger diameter, are more rounded in shape and have more numerous surrounding pores and, the spatulate avicularia show a characteristic narrowing in the middle part.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 11, ZPAL 12 *(Sadler Stacks)*, Telm1 (Eocene).

Celleporaria mesetaensis sp. n.

(Pls 1: 21, 19: 1–4; Text-fig. 29A$_1$–A$_2$)

Holotype: Specimen ZPAL Br.VIII/470 illustrated on Pl. 19: 2a, b.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: From the La Meseta Formation.

1997a. *Celleporaria* Lamouroux; Hara: p. 1004, figs 3: 9, 4: 3.
1997b. *Osthimosia* sp. 2; Hara: p. 118–119, 127, fig. 4: 22.

Diagnosis. — Colonies large, with well-defined layering. Primary orifice with the proximal border slightly concave, rounded indistinct condyles. Suboral avicularium present. Rare, large spatulate avicularia with a characteristic narrowing in the middle part; vicarious avicularia raised, circular, frequent, surrounded by a few pores at the margins. Ovicells without any ornamentation.

Material. — 40 specimens, some of them broken; two colonies represent oblate spheroidal bryoliths.

Dimensions. — Height of the holotype colony 46 mm, width 84 mm; maximum length 76 mm, width 113 mm; length of zooecium 0.32–0.38 mm, width 0.4 mm; length of orifice 0.13–0.16 mm, width 0.14–0.18 mm; length of spatulate avicularium 0.36–0.50 mm, width 0.20–0.28 mm, diameter of vicarious avicularia 0.14–0.20 mm; diameter of ovicell 0.24–0.28 mm.

Description. — Colonies are large, multilamellar, hemispherical (Pl. 19: 1, 2a, b) or oblate spheroidal (so called ectoproctaliths or bryoliths; Text-fig. 29A$_1$–A$_2$) composed of numerous superimposed layers, up to 80, seen clearly on the underside of the colony (Text-fig. 6: 2; Pl. 19: 1, 2b, 3). The ratio between the diameter

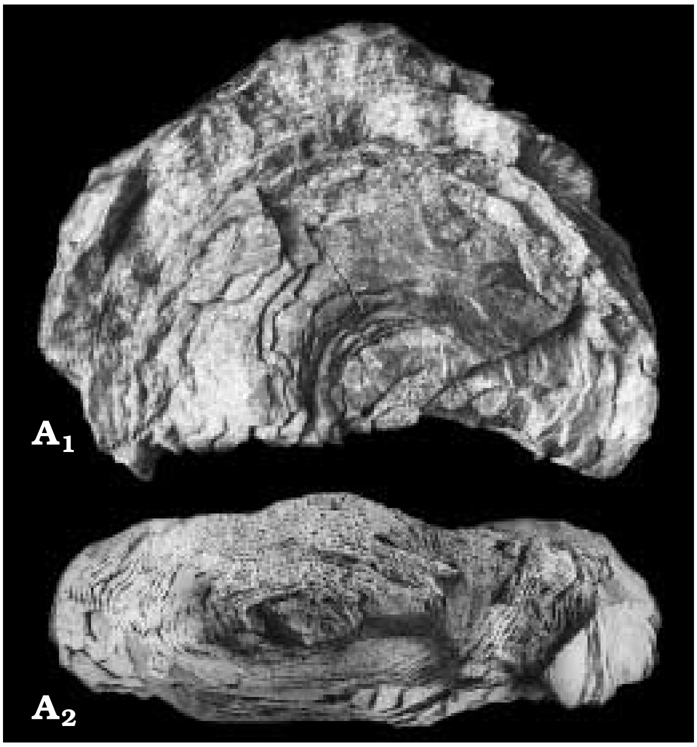

Fig. 29. *Celleporaria mesetaensis* sp. n., oblate spheroidal colony (bryolith), ZPAL Br.VIII/6, × 1; A_1 colony underside, A_2 fracture through the colony showing the concentric growth-lines. ZPAL 12, Telm1.

and height of the colony varies from 1.18 to 2.64 (Text-fig. 12). Autozooecia are thickly calcified, in some places closely packed, with irregular orientation, surrounded by a slightly raised peristome which is developed as a rather thin rim around the orifice, enclosing an indistinct, transversely oval suboral avicularium. Primary orifice is roughly D-shaped, longer than wide, the proximal border slightly concave, short, rounded indistinct condyles present. A pseudosinus occurs in some zooecia. Around the peristome there are unevenly distributed, irregularly-shaped marginal pores. The whole zoarial surface is covered by irregularly-shaped and unevenly distributed pores (Pl. 19: 4). The spatulate avicularia are common, with extensive palatal surface, complete rostral rim and characteristic narrowing in the middle part of the avicularium (Pl. 19: 4). Slightly elevated, vicarious columnar avicularia with a cross-bar are frequent. They are surrounded by numerous differently-shaped pores. Sometimes, the ovicells seem to be cucullate, without any ornamentation.

The layering is very well-seen along the borders of zoaria (Pl. 19: 2a, b) as well as in their vertical sections (Pl. 19: 1, 3). The thickness of the layers varies from 0.62 mm to 1.23 mm.

Remarks. — The primary orifice of the examined specimens shows features typical of *Celleporaria,* such as a D-shaped outline and suboral avicularium situated in a peristome. The specimens studied differ from the other *Celleporaria* species from the La Meseta Formation by the large size of the colonies. The layering is more clearly defined than in the other La Meseta species of *Celleporaria,* the autozooecia smaller, and numerous, large spatulate avicularia are present. The specimens of *C. mesetaensis* correspond to none of the species described from the Southern Hemisphere by MacGillivray (1895); Maplestone (1904); Brown (1952); Gordon (1984, 1989); Powell (1967); Hayward (1992, 1993).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 11, ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene).

Celleporaria ovata sp. n.
(Pls 1: 17, 20: 1–4)

1997a. *Celleporaria* Lamouroux; Hara: p. 1003, text-fig. 3: 3.

1997b. *Celleporaria tridenticulata* (Busk); Hara: p. 127, text-fig. 4: 20.

Holotype: Specimen ZPAL Br.VIII/393 figured on Pl. 20: 2.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Latin *ovatus* – egg-shaped referring to the shape of zooecia.

Diagnosis. — Colony massive, zooecia large, oval or egg-shaped, variably oriented, orifice D-shape, the proximal border slightly concave with five to seven denticulate processes (teeth). A suboral spine-like umbo terminated by the subcircular suboral avicularium. Small, adventitious avicularia as well as rounded vicarious avicularia present.

Material. — Ten complete specimens.

Dimensions. — Maximum height of colony 3.8 cm, width 6.2 cm; length of zooecia 0.6–0.9 mm, width 0.48–0.60 mm; length of orifice 0.15–0.20 mm; width 0.12–0.24 mm, diameter of the suboral avicularium 0.12–0.18 mm, mean 0.15 mm.

Description. — Zoarium is massive, variable in shape composed of many superimposed zooecial layers from 2 to 4 mm thick (Pl. 20: 1a, b, 2). Most of the colonies have a slightly expanded basal part (Pl. 20: 1a, b). Zooecia are recumbent at the growing edge to erect or semi-erect in older parts of the colony, oval or egg-shaped, longer than wide, variably oriented (Pl. 20: 3). Frontal wall is slightly granular and has marginal areolae (Pl. 20: 3–4). Primary orifice is roughly D-shaped to subcircular, usually being longer than wide. Indistinct lateral condyles are present; very rarely 1 or 2 bases of oral spines have been observed. The proximal rim bears five to seven delicate processes (teeth) (see Pl. 20: 4). A suboral spine-like umbo is very prominent, highly raised very often broken therefore, the semicircular suboral avicularium seem to be much larger; facing distally outward. Rostra and pivotal-bar have not been observed (Pl. 20: 3). Small, frontal adventitious avicularia are rarely present, placed obliquely in the proximal part of the zooecium. Small, round-shaped vicarious avicularia with a pivotal-bar are rare. Ovicells have not been found. In vertical section zooecia are irregularly-shaped, chaotically arranged (Pl. 20: 1c).

Remarks. — The characters of this new species, such as the denticulate processes (teeth), more or less D-shaped primary orifice, and the relatively large, umbo terminated by a suboral avicularium are known in only a few species of *Celleporaria* (see Harmer 1957; Gordon 1984, 1989; Powell 1967). The number of conspicuous processes (teeth) seems not to be an important diagnostic feature of this species, and it varies from five to seven (Pl. 20: 4). The suboral avicularium of the specimens studied seems to be larger and more variable in size than in any Recent specimens from New Zealand (Brown 1952: fig. 287; Gordon 1984: pl. 45E). However, this feature also may depend on the state of preservation. Moreover, the studied specimens do not show a rostrum. The striking difference of *C. ovata* from otherwise similar species, such as *C. tridenticulata* (Busk) (see Waters 1885; Gordon 1984), *C. emancipata* Gordon (1989) or *C. oculata* (Lamarck) (see Harmer 1957), is the presence of a larger number of teeth. The new species lacks large spatulate vicarious avicularia which occur in *C. tridenticulata* and *C. oculata.* Moreover, *C. ovata* also differs from these species in having additional avicularia of two types: small, subcircular adventitious avicularia oriented obliquely towards the orifice on the frontal wall, and small, round, unevenly distributed vicarious avicularia.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Celleporaria sp.
(Pl. 21: 1–3)

1997a. Celleporid colony, Hara: p. 1002, fig. 2c.
1997b. Celleporid colony, Hara: p. 121, fig. 4: 11.

Material. — 29 complete specimens.

Dimensions. — Maximum zoarium height 23 mm, width 24 mm; length of zooecium 0.35–0.42 mm, width 0.42–0.50 mm; length of orifice 0.16–0.21 mm, width 0.21–0.25 mm.

Description. — Zoarium is massive, spherical to mushroom-shaped, sometimes with globular subcolonies at the top (Pl. 21: 1), with indistinct growth lines along the lateral edges of the colony (Pl. 21: 1–2, 3a). Autozooecia are closely packed, semi-erect, with irregular orientation, circular, surrounded by a rather thin peristomial rim. A suboral avicularium slightly elongated transversely, is incorporated into the peristome; if the low peristomial rim develops around the orifice, a pseudosinus may occur adjacent to the avicularium. Zooecia are surrounded by large, areolar pores (Pl. 21: 3b). Primary orifice occupying more than half of the frontal wall, is wider than long, D-shaped. The proximal margin of the orifice is straight, sometimes with a characteristic collar. Vicarious, spatulate avicularia are rare, longer than the zooecia (0.30–0.54 mm), without any ornament. Adventitious small, interzooecial avicularia are frequent among the zooecia, semi-erect with a cross-bar and distinct lingula directed distally. Basal pore-chambers are present. Ovicells have not been found. In thin section the zooecia are irregularly arranged, closely packed (Pl. 21: 3c). Most of the autozooecia are damaged by abrasion of the colony surface, due to their convexity, and are difficult to measure and describe.

Remarks. — Based on Gordon's (1997) classification, *Celleporaria* is here included in the family Lepraliellidae Vigneaux (1949: p. 17) which replaces the former family Celleporariidae Harmer, 1957 (Gordon 1989: p. 32); this does not change Harmer's (1957) interpretation that the frontal wall of *Celleporaria* is truly umbonuloid (Gordon 1989). The specimens show typical characters of the genus *Celleporaria* in respect to the frontal wall ornamentation, the characteristic rounded D-shaped orifice with a straight proximal margin enclosing the suboral avicularium, and possessing additional avicularia of different kinds. A very inconstant feature of the specimens is the presence of an extremely small suboral avicularium in some autozooecia. The shape of the orifice is also variable and not perfectly D-shaped. Because of this instability of characters of *Celleporaria* sp., and the poorly preserved zoarial surface, specific determination is deferred. A slight similarity in the general pattern of arrangement of zooecia occurs in *C. albirostris* (Smitt, 1872) (see Canu and Bassler 1923: p. 174–175, pl. 32: 6–10). *Celleporaria* sp. resembles *C. australis* sp. n. in the general morphological architecture of the zoarial surface but differs in having smaller zooecia, which are more circular in shape rather than barrel-shaped as in *C. australis* sp. n.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Genus *Dennisia* gen. n.

Type species: *Dennisia eocenica* sp. n.

Derivation of the name: Dedicated to Dr Dennis Gordon (NIWA, Wellington), in recognition of his major contributions to the study of bryozoan faunas from the Southern Hemisphere.

Diagnosis. — Colony massive, mostly hemispherical. Frontal shield umbonuloid, bordered by large marginal areolar pores. Secondary orifice somewhat bipartite – with the proximal part occupied by a D-shaped primary orifice with straight proximal edge and the distal part occupied by the suboral trapezoidal avicularium, associated with two lateral cavities. Frontal mural septula present. Ovicell cucullate.

Remarks. — *Dennisia* gen. n. shows the umbonuloid morphology of the frontal wall; therefore, it is included in the infraorder Umbonulomorpha Gordon, 1989. The overall zooecial appearance is reminiscent of *Celleporaria* showing the D-shaped primary orifice and the same morphology of the ovicell. A very distinctive feature of *Dennisia* gen. n. is the bipartite character of the secondary orifice, expressed by having a transverse calcareous rim which divides the primary orifice from the suboral avicularium. The suboral avicularium has a characteristic trapezoidal shape and is associated with two lateral oral cavities. These features, based on the character of the internal zooecial structure of the secondary orifice, distinguish the genus from all other representatives of the Lepraliellidae Vigneaux, 1949.

Dennisia eocenica gen. et sp. n.
(Pl. 22: 1a–d, 2a–d; Text-fig. 30A_1–A_2)

1997a. Celleporiform colony; Hara: p. 1002, fig. 2d.

1997b. Celleporid colony; Hara: p. 121. fig. 4: 15.

Holotype: Specimen ZPAL Br.VIII/31 figured on the Pl. 22: 2a–d; Text-fig. 30A_1–A_2.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1, Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Eocene age of the specimens studied.

Diagnosis. — As for the genus.

Material. — 137 complete colonies.

Dimensions. — Length of holotype colony 1.7 cm, width 2.6 cm; mean length of zooecium 0.57 mm, width 0.42 mm; mean length of aperture 0.3 mm, width 0.27 mm; length of primary orifice 0.14–0.16 mm, width 0.08–0.10 mm; length of suboral avicularium 0.07 mm, width 0.11–0.12 mm; width of ovicelled zooecia 0.45–0.50 mm.

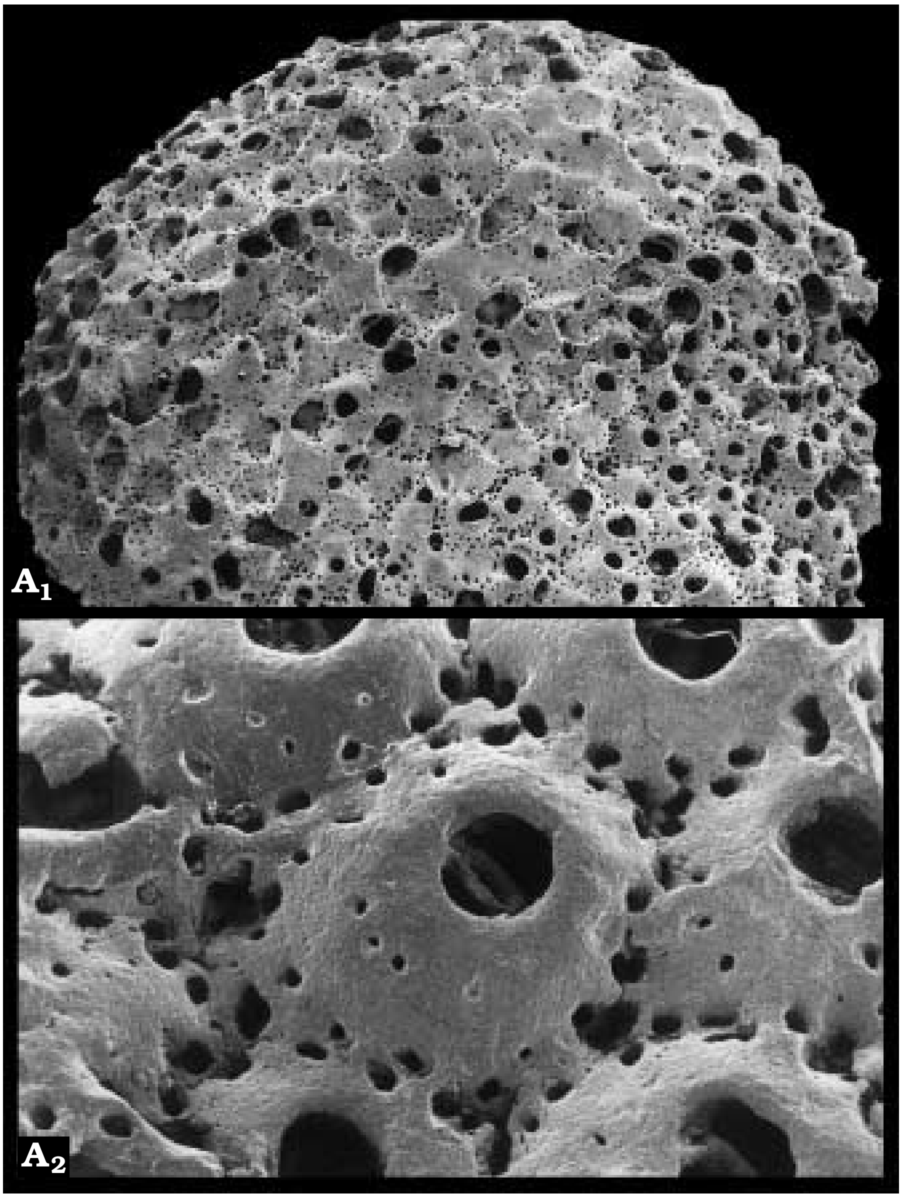

Fig. 30. *Dennisia eocenica* gen. et sp. n.; A_1 zoarial surface showing the arrangement of autozooecia, × 12, A_2 group of recumbent autozooecia, × 80. Holotype, ZPAL Br.VIII/31; ZPAL 1, Telm1.

Description. — Colonies are subspherical, massive (Pl. 22: 1a–c; 2a–c) rarely oblate, nodular bodies or small pea-like zoaria with a diameter of 7–10 mm. The autozooecia are semi-erect, circular to slightly oval-shaped, bordered by one row of areolar marginal pores (Text-fig. 30A_1–A_2). Some other additional pores are randomly scattered in the proximal part of the frontal wall. The secondary orifice is large, oval-shaped, centrally placed and occupies almost half of the frontal wall. A transverse calcareous rim with two lateral oral cavities divides the secondary orifice into two parts (the distal part occupied by the primary orifice and the proximal part with the suboral avicularium, of characteristic trapezoidal shape). On both sides of the calcareous rim there are two lateral oral cavities associated with the suboral avicularium (Text-fig. 30A_2). The primary orifice is D-shaped with a straight proximal edge. Ovicellate zooecia are cucullate, slightly greater in width than others zooecia. In transverse thin-section the zoaria are circular in shape showing the irregular radial arrangement of zooecia composed of a dozen or so circular rings (Pl. 22: 2d). In longitudinal section the superimposed layers of zooecia are well-visible (Pl. 22: 1d).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill),* ZPAL 12 (Sadler Stacks), Telm1 (Eocene).

Infraorder **Lepraliomorpha** Gordon, 1989

Superfamily **Smittinoidea** Levinsen, 1909

Family **Smittinidae** Levinsen, 1909

Genus *Smittina* Norman, 1903

Type species: *Lepralia landsborovii* Johnston, 1847.

Smittina sp.

(Pl. 23: 1–4)

1997a. *Smittina* Norman; Hara: p. 1004, fig. 2f.

Material. — Abundant colonies developing rossette-like or erect folded sheets, forming a shell bed up to 5 cm thick. The majority of the frontal wall surface is covered by coarse quartz grains; thus, the zoarial morphology is difficult to observe.

Dimensions. — Length of zooecia 0.84–0.90 mm, width 0.35–0.42 mm; length of orifice 0.11–0.14 mm, width 0.14–0.16 mm; length of ovicell 0.24–0.30 mm, width 0.35–0.42 mm.

Description. — Colony developing extensive, broad foliaceous, bilamellar fronds with a thickness of 1 to 1.5 mm (Pl. 23: 1–2). Most of the colonies are strongly embedded in a sandstone where only the margins of zoaria are seen (Pl. 23: 4). The zooecia are elongated, rather narrow, lancet-like in shape, bordered by indistinct sutures. Orifice subcircular, slightly wider than long, with a narrow, rectangular lyrula deeply buried and rounded cardeles (Pl. 23: 3). No oral spines. Peristome which encircles the primary orifice forms a distinct rim, slightly concave, with a few pores around (Pl. 23: 3). The small suboral median avicularium is situated at the pseudosinus, being irregular in shape, circular or elongated transversely. This feature, however, does not occur regularly. The frontal wall is thickly calcified, perforated irregularly by pores of different size, surrounded by indistinct areolae along margins of zooecia (Pl. 23: 3). The ovicell is roughly globular, wider than long, hood-like, with a straight proximal border, with a few marginal pores and some very small ones in the central part of the ovicell. Mural septula present.

Remarks. — Despite the poorly preserved material the investigated specimen agrees well in its external morphology with the diagnosis of the genus *Smittina* (Gordon 1984; Hayward 1995). *Smittina* sp. closely resembles *S. antarctica* (Waters) in its zooecial outline, ovicell appearence, and size of zooecia (Hayward 1995) but differs in the architecture of the primary orifice and peristome which in the La Meseta specimens is more circular and possesses the characterictic deeply buried peristomial rim. In some cases the morphology of the primary orifice and the peristome is similar to *S. diffidentia* Hayward *et* Thorpe, 1989. The variability in the development of the primary orifice, peristome and the suboral avicularium results from diagenesis; therefore species determination is deferred.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 14, Telm6. This is the oldest occurrence of *Smittina* genus in the Southern Hemisphere.

Genus *Smittoidea* Osburn, 1952

Type species: *Smittoidea prolifica* Osburn, 1952.

Smittoidea gazdzickii sp. n.

(Pls 1: 14, 24: 1a–d, 2)

Holotype: Specimen ZPAL Br.VIII/101 figured on Pl. 24: 1a–d.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: This species is named in honour of Dr Andrzej Gaździcki (Institute of Paleobiology PAS, Warszawa) who collected the bryozoans for this study.

Diagnosis. — Colony encrusting, composed of multiple zooecial layers. Autozooecial frontal wall granular, with a single row of marginal areolae. Autozooecia elongated, roughly rhomboidal. Primary orifice semi-circular with truncated lyrula and adjacent condyles. Pseudosinus present. Pair of oral spine bases. Suboral avicularium circular. Ovicell recumbent, wider than long.

Material. — Two complete specimens, one with a broken ovicell.

Dimensions. — Length of holotype zoarium 2.0 mm, width 1.6 mm; length of zooecium 0.56–1.1 mm, width 0.49–0.64 mm; length of orifice 0.14 mm, width 0.17 mm; length of suboral avicularium 0.08–0.11 mm, width 0.056–0.07 mm; width of lyrula 0.07–0.08 mm; length of ovicell 0.2 mm, width 0.3 mm.

Description. — Colony is encrusting, multilamellar, forming disc-shaped bodies up to 7 mm thick (Pl. 24: 1a, 2). Autozooecia are arranged on the colony surface in a somewhat radial pattern, showing several centres from which the zooecia originate (Pl. 24: 1b). Each centre exhibits frontal budding with about six autozooecia arranged in a quincunx pattern. Autozooecia are elongated, roughly rhomboidal in outline, smaller in the center of the subcolony and gradually becoming longer and more oval-shaped towards the extremities of the colony (Pl. 24: 1b). Primary orifice is subcircular, about as wide as long. A median lyrula is moderately broad, buried, truncated, with a characteristic suture running longitudinally, occupying about half of the proximal width of the orifice. In early astogenetic zooecia, however, a lyrula seem to be a double structure formed by the meeting of bars of calcification from the left and right with a characteristic suture running longitudinally (Pl. 24: 1d). Condyles are indistinct, very shallow, slightly rectangular. The secondary orifice is subcircular to slightly rectangular rimmed by a thin, indistinct peristome with a shallow proximal V-shaped pseudosinus, which may occur occasionally (Pl. 24: 1c). Base of a pair of oral spines is placed distally, towards the orifice (Pl. 24: 1d). Median suboral avicularium situated just proximal to pseudosinus, is not incorporated into the peristome. It is circular in shape, but in early astogenetic zooecia it looks more like a gap (?spiramen), beneath the two coalescing bars of calcification (Pl. 24: 1d). Rostrum oval, with a thin slightly raised rim; palate with a semicircular foramen directed proximally (Pl. 24: 1d). Additional avicularia are absent. Frontal wall is granular to slightly trabecular and convex, surrounded by a single row of large, distinct marginal areolar pores (Pl. 24: 1c). Ovicell is globular, slightly wider than long, recumbent, placed distally on the succeeding autozooecium, with the preserved margins, the partially preserved ovicell slightly is punctured. In the thin section zoarium is multilamellar, composed of about twenty-eight zooecial layers, each 0.20–0.25 mm thick (Pl. 24: 2).

Remarks. — *Smittoidea gazdzickii* sp. n. has all the characters typical of the Recent Pacific type species of *S. prolifica*. The morphological structure of the suboral avicularium, which gives an impression of being situated within the peristome as it shown on the Pl. 24: 1d, remain problematic. The suboral avicularium, better preserved on another specimen, reveals that it is not situated in the peristome. Furthermore, a suboral avicularium in the early astogenetic zooecia looks more like a gap (?spiramen) beneath the two coalescing bars of calcification (Pl. 24: 1d). There is some variation in the development of lyrula. In the early astogenetic zooecia it is unlike the true lyrula present in smittinids – a true lyrula is a single structure rather than the double structure formed by the meeting of bars of calcification from the left and right (Pl. 24: 1d). A number of zooecia have a single, relatively large hole in their frontal walls resembling boreholes of a predatory organism. Osburn (1952) assigned three Recent species to *Smittoidea*, one among which is the type species, *Smittoidea prolifica* Osburn. Later on Rogick (1956) who described a few Recent Antarctic species, included *S. prolifica*? Osburn within *S. reticulata* which first had been considered by Bassler (1953) to be a synonym of *Lepralia reticulata* (?) Johnston, 1847. The new species agrees with *S. reticulata* Johnston, 1847 (see Rogick 1956: pl. 35) in most of its morphometric features, but its suboral avicularia are smaller. *S. ornatipectoralis* Rogick, 1956 (see Rogick 1956: pl. 32; see also Hayward 1995: figs 164F, 165A, B) shows little resemblace to the specimen studied, and the length of its zooecia are greater, the oral spines are lacking and the suboral avicularium is smaller. *Smittoidea conspicua* (Waters, 1904) (see Hayward 1995: figs 163F, 164A, B) bears some resemblance to the species examined; it differs, however, in the morphology of the primary orifice and in not having any oral spines. Another species, *S. magna* Gordon, 1984, described from the Kermadec Ridge (New Zealand), is also similar to the specimens examined from the La Meseta Formation, but it differs in having larger zooecia. Unfortunately, no other morphometric features of *S. magna* Gordon, 1984 have been mentioned. However, a precise evaluation of the differences and relationships with *S. gazdzickii* sp. n. must await better comparative material; the new species corresponds to none of these, nor to any other species described from the Tertiary of South America, Australia and New Zealand (see MacGillivray 1895; Maplestone 1904; Canu 1904, 1908; Brown 1952).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Family **Bitectiporidae** MacGillivray, 1895
Genus *Metroperiella* Canu *et* Bassler, 1917

Type species: *Schizoporella lepralioides* Calvet in Jullien *et* Calvet, 1903.

Metroperiella sp.
(Pl. 21: 4a, b)

Material. — Six small, lobed fragments of zoaria.

Dimensions. — Length of the colony fragment 14 mm, width 11 mm; length of zooecium 0.70–0.84 mm, width 0.42–0.50 mm; length of orifice 0.11–0.14 mm, width 0.14–0.16 mm; length of the median avicularium 0.08 mm, width 0.05–0.07 mm; length and width of ovicell 0.3 mm.

Description. — Zoarium is bilamellar, forming broad, thin, irregularly-shaped lobes (Pl. 21: 4a). The frontal wall is slightly convex, perforated by a number of rounded pores, scattered over the entire surface. Autozooecia in radiating, linear series, irregularly hexagonal in outline, are arranged quincuncially and separated by distinct grooves which sometimes are barely seen (Pl. 21: 4b). The primary orifice is semicircular, deeply buried with a rounded, shallow U-shaped sinus, encircled by a narrow peristome (Pl. 21: 4b). Condyles are very small but distinct. Oral spines are absent. Avicularium is placed medially, more or less circular in shape, with complete cross-bar. Ovicell with a broken roof, hyperstomial, globular in shape, rather large. Some zooecia seem to be more convex than the others which may be due to diagenetic alteration. Mural septula have not been observed.

Remarks. — Only a few, rather poorly preserved fragments are present. The bryozoan colonies bear some resemblance to *Metroperiella* in the presence of a schizoporellid orifice, with a pyriform or rounded wide sinus, perforated frontal wall, and the absence of frontal spines. According to Gordon (1984), these features allow placement of some Australasian species in the genus *Metroperiella* which has been regarded by many authors as a junior synonym or (subgenus) of *Schizomavella* (Gordon 1984). I agree with Gordon (1984) who placed *Metroperiella* in the Schizoporellidae because *Metroperiella* shows obvious affinities with *Schizomavella*. *Schizomavella lepralioides* Jullien *et* Calvet, 1903, which is the type species of the genus *Metroperiella* see (Jullien and Calvet 1903: pl. 16: 4), bears a close resemblance to the La Meseta specimens. In view of the poorly preserved material, which shows an unevenly perforated frontal wall and broken ovicells without the characters of the roof, specific determination of the La Meseta Formation *Metroperiella* specimens is deferred.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), Telm1 (Eocene).

Superfamily **Schizoporellidae** Jullien, 1883
Family **Buffonellodidae** Gordon *et* d'Hondt, 1997
Genus *Aimulosia* Jullien, 1888

Type species*: Aimulosia australis* Jullien, 1888.

Aimulosia lamellosa sp. n.
(Pls 1: 15, 25: 1–10, Text-fig. 31A, B)

1997a. *Porella* Gray; Hara: p. 1004, fig. 2e; fig. 3: 5; fig. 4: 2.
1997b. *Porella* sp. 1; Hara: p. 127; fig. 4: 21.

Holotype : Specimen ZPAL Br.VIII/88 figured on Pl. 25: 2.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: Referring to the Latin word *lamella,* a thin plate, alluding to the layered nature of the colony caused by self-overgrowth.

Diagnosis. — Colony massive, multilamellar; autozooecia elongated to hexagonal; primary orifice subcircular to semi-lunar, rounded distally; short, truncated proximal denticle or lyrula present, condyles indistinctive. Secondary orifice with a prominent suboral umbo and small avicularium; large areolae (marginal pores) and basal pore chambers present. Ovicell globular, imperforate, hyperstomial.

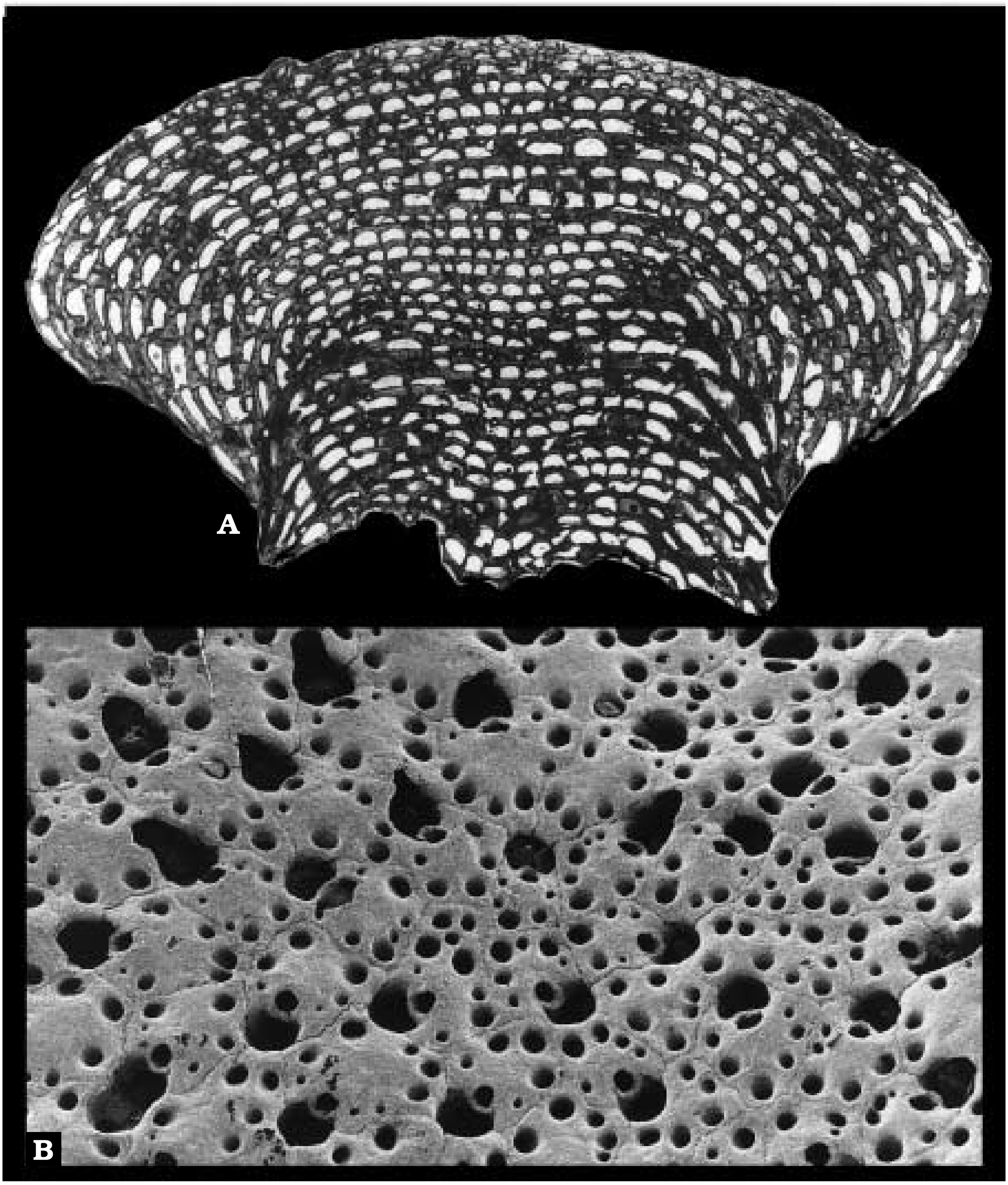

Fig. 31. *Aimulosia lamellosa* sp. n. **A**. Vertical section through a multilamellar colony, ZPAL Br.VIII/90, × 10. **B**. The uppermost layer of the colony showing radial growth from about six buds, ZPAL Br.VIII/91, × 54. ZPAL 1, Telm1.

Dimensions. — Length of holotype zoarium 17 mm, width 16 mm, height 9 mm; length of zooecium 0.50–0.75 mm, width 0.30–0.37 mm; length of orifice 0.10–0.125 mm, width 0.14–0.15 mm; length of avicularium 0.06–0.07 mm, width 0.056 mm; length of ovicell 0.20–0.25 mm, width 0.25–0.30 mm.

Material. — 93 multilamellar colonies, many of them with worn zoarial surface.

Description. — Colonies are massive, multilamellar forming variably-shaped zoaria ranging from cap-shaped (Pl. 25: 1a–c, 3) to, more often, mushroom-shaped (Pl. 25: 2, 4–10). Maximum ratio between the diameter and the height of the colony is 1 to 3.37 (Text-fig. 13). The frontal wall is imperforate, slightly convex, finely granular; raising distally into a projecting suboral umbo. Marginal areolar pores are large, prominent;

varying in number (Text-fig. 31B). Autozooecia are arranged in somewhat radiating rows, alternating; elongated to irregularly hexagonal in shape, separated by deep grooves. Centres of eruptive budding can be seen on the uppermost layers of the colony, showing about 4–6 buds arranged radially (Text-fig. 31B). The primary orifice is sunken, subcircular in shape. The secondary orifice is large relative to zooecium size, semicircular to somewhat semilunar or sinuate with a very low, truncated lyrula and indistinct, broad condyles (Text-fig. 31B). A prominent suboral umbo supports an oval-shaped avicularium, situated in the peristome (Text-fig. 31A). Oral spines as well as vicarious avicularia are absent. Ovicell, globular in shape, imperforate, deeply buried, hyperstomial. The multilamellar structure is very clear both in external view and in thin sections of colonies (Text-fig. 31A). Zoarium is composed of series of 9 to 76 superimposed zooecial layers (Text-fig. 31A, Pl. 25: 1–10), of an average thickness of 0.30–0.36 mm at the base of the colony but 0.24–0.30 mm in the upper part.

Remarks. — The specimens studied bear all the characters of *Aimulosia*, such as the development of a secondary orifice with the median denticle or lyrula, the so-called "dent arrondie" of Jullien (1888), a prominent suboral umbo which supports a small median avicularium with a pivot bar, and prominent imperforate ovicell (Gordon 1989). The presence of the medial convexity, in the proximal rim of the orifice is not a constant feature in this species. Undoubtedly it is a product of the state of preservation. According to Jullien (1888) this small median convexity in the proximal rim of the orifice corresponds to the lyrula of smittinids (Gordon 1989). *Aimulosia* has been included in the family Buffonellodidae Gordon *et* d'Hondt, 1997, however, in which the orifice possesses a median sinus or a broad poster; the latter may have a median convexity. The species studied lacks any additional avicularia and any distal oral spines, which are very often present in other species of the genus. The specimens studied bear a slight resemblance to *Porella marsupium* (MacGillivray, 1869) in having very similar architecture of the frontal wall (Gordon 1984: pl. 36B). *P. marsupium* differs in smaller sizes of autozooecia and orifices, and in possessing autozooecia more rectangular, than hexagonal in shape. Two distinctive features which distinguish the new species from the two Recent Antarctic species *A. antarctica* (Powell, 1967) and *A. australis* Jullien, 1888 are the larger size of the zooecia and the lack of oral spines.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 11, ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene).

Superfamily **Celleporoidea** Johnston, 1838
Family **Celleporidae** Johnston, 1838
Genus *Osthimosia* Jullien, 1888

Type species: *Cellepora eatonensis* Busk, 1888.

Osthimosia globosa sp. n.
(Pls 1: 18–19, 26: 1–5)

1997a. *Celleporaria* Lamouroux; Hara: p. 1003, figs 3, 8.
1997b. *Osthimosia* sp. 1; Hara: p. 119, p. 127, fig. 4: 16; fig. 5A.

Holotype: Specimen ZPAL Br.VIII/ 457 figured on Pl. 26: 4.
Type horizon: Telm1, La Meseta Formation; Eocene.
Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.
Derivation of the name: From the Latin *globosus* – ball-shaped, referring to the shape of the subcolonies.

Diagnosis. — Zoarium massive, multilamellar. Zooecia circular to elongate in frontal outline. Primary orifice with a shallow U-shaped sinus and blunt, broad condyles. Some of the orifices surrounded by a large peristome which may include one suboral avicularium placed medially. Two adventitious columnar, round-shaped laterally placed tubular avicularia and large spatulate avicularia present.

Material. — 19 complete specimens, two of them growing on the top of *Dennisia eocenica* gen. et sp. n. colony (Text-fig. 14D).

Dimensions. — Maximum length of zoarium 45 mm, width 22 mm; length of zooecium 0.28–0.35 mm, width 0.25–0.38; length of orifice with a sinus 0.10–0.14 mm, width of orifice 0.12–0.16 mm; width of secondary orifice 0.21 mm, sinus width 0.03–0.07 mm, depth 0.02 mm; length of suboral avicularia 0.05 mm; length of spatulate avicularia 0.35–0.42 mm, width 0.21 mm; the diameter of tubular cystid of lateral avicularia 0.10–0.14 mm, diameter of the ovicell 0.3–0.4 mm.

Description. — Zoaria are multilamellar, comprising up to 15 layers, large, massive and variable in shape, composed of globular subcolonies varying in number from 2 to 5 (Pl. 1: 18–19; Pl. 26: 1, 2a, 3–4). Autozooecia are circular to oval in frontal outline, with varying orientation, slightly raised, bordered by pores, irregularly scattered at the base of zooecium. Primary orifice slightly wider than long, with a U-shaped sinus, and distinct blunt condyles (Pl. 26: 5). The primary orifice is bordered by a prominent high peristome which includes a suboral avicularium placed medially (Pl. 26: 5). The secondary orifice is usually oval-shaped, larger than the primary orifice. On both sides of the zooecia there are usually two adventitious, tubular avicularia, distributed irregularly (Pl. 26: 5). Large, spatulate avicularia are slightly pyriform, with well visible hooded portion of the rostrum. Ovicell globular or immersed, imperforate with small circular opening. Growth-layers are visible along the lateral edges of zoaria (Pl. 26: 1, 2a, 3–4). In thin-sections the growth layers are well-defined, ranging in thickness from 1.5 to 2.4 mm (Pl. 26: 2b).

Remarks. — The specimens studied bear all the characters of the genus *Osthimosia* Jullien, i.e. sinuate primary orifice, the presence of the tubular avicularia, and presence of the large spatulate avicularia.

A very distinctive feature of the specimens studied is the massive, multilamellar colony; in other species of this genus massive zoaria up to 8.5 cm of diameter can also be found (Gordon 1984). The new species shows some similarities in its general colonial organization and in some respects of morphometric features with *O. bicornis* (Busk) (see also Rogick 1959: pl. 1: 1–15). *O. globosa* differs from *O. bicornis* in the slightly different shape of the primary orifice. The position and number of tubular avicularia is not a constant feature on the specimens studied. The morphology of the primary orifice of *O. globosa* seems to be similar to *O. malingae* Hayward, 1992 but this Recent species has a slightly larger orifice. *Osthimosia malingae*, however, differs in having longer spatulate avicularia and one columnar avicularium only.

Occurrence. — La Meseta Formation, Seymour Island: ZPAL 1 (*Bill Hill*), ZPAL 12 (*Sadler Stacks*), Telm1 (Eocene). It is the oldest representative of the genus *Osthimosia*.

?*Osthimosia* sp.

(Pl. 17: 4a, b)

Material. — Two specimens, one of them growing on an *Aspidostoma* colony (Text-fig. 14C).

Dimensions. — Height of colony 1.4 cm, width 1.7 cm; length of zooecium 0.16–0.20 mm, width 0.16–0.21 mm; length of interzooecial avicularia 0.20 mm, width 0.14 mm; diameter of vicarious tubular avicularia 0.14 mm.

Description. — The colony is encrusting, forming irregularly-shaped cylindrical zoaria attached to hard substrata. The zoarial surface is uneven, having a lace-like appearence (Pl. 17: 4a). Autozooecial openings are on the same level as the general colony surface; pentagonal to subcylindrical in shape, some sinuate (Pl. 17: 4b). The autozooecial openings are surrounded by the differently-shaped, convex patches, slightly raised above the zooecial openings with holes variably developed in size and shape. Interzooecial, avicularia rare, with a distinct pivotal-bar. The most raised parts of the zoarial surface bear tubular, round-shaped avicularia, usually one or two around each autozooecial opening. Ovicells have not been found.

Remarks. — The investigated specimens bear some resemblance to the genus *Osthimosia* in the sinuous shape of the autozooecial openings, and in the possession of small interzooecial avicularia which are tubular and project. The variable shape of the zooecial openings lack of ovicells make the generic affiliation of this species uncertain. Owing to the paucity of diagnostic characters the examined specimens are only tentatively included in the genus *Osthimosia*. It is also possible that the specimens studied may represent a new taxon.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill),* Telm1 (Eocene).

Family **Phidoloporidae** Gabb *et* Horn, 1862

Genus *Reteporella* Busk, 1884

Type species: *Reteporella flabellata* Busk, 1884.

Reteporella sp.

(Pls 1: 13, 27: 1–3)

1997b. *Sertella* sp.; Hara: p. 118 p. 127, text-fig. 4: 8.

Material. — One incomplete cup-shaped zoarium and four small fragments of reticulate colonies.

Dimensions. — Length of zoarium 27 mm, width 17 mm; length of fenestrulae 0.5–1.0 mm, width 0.2–0.4 mm; length of zooecium 0.42–0.56 mm, width 0.28–0.33 mm, length of orifice 0.11 mm, width 0.11 mm; length of avicularium 0.14–0.21 mm, width 0.11–0.14 mm; diameter of ovicell 0.5 mm.

Description. — The main fragment of colony forms a folded, reticulate cup (Pls 1: 13, 27: 2) but there are fragmentarily preserved fenestrate sheets (Pl. 27: 1a, b). Fenestrulae are oval to more elongated in shape; trabeculae consisting of three to four longitudinal series of autozooecia, doubling to eight at points of trabecular fusion (Pl. 27: 1c, d). Autozooecia are convex, separated by raised sutures, with two or three, large conspicuous marginal pores (Pl. 27: 3b). Primary orifice is bell-shaped, wider in the proximal part; proximal border gently concave with narrow condyles, placed marginally. No oral spines. Adventitious frontal avicularia are rather numerous, but not present on every zooecium; they are mostly oval in shape with a crossbar and distinct palate but without columella (Pl. 27: 3a, b). Ovicell is hyperstomial, oval in shape. The basal surface of colony is slightly granular with distinct tubercules, and it is covered by a network of sutures (Pl. 27: 1d). Small, oval or scaphoid avicularia are present, usually placed within the fenestrulae (Pl. 27: 1d).

Remarks. — The colonies investigated are very similar in their external morphology to *Reteporella antarctica* (Waters, 1904) (illustrated by Hayward and Taylor 1984 and Hayward 1995). This species is similar in having trabeculae consisting of three to four longitudinal series, and eight autozooecial series at points of trabecular fusion (Pl. 27: 1c), and convex autozooecia, separated by raised sutures with a few conspicious pores. The similarity extends to the primary orifice which is bell-shaped with a gently concave, proximal border, U-shaped condyles, placed marginally on the proximal border, adventitious avicularia which are mostly oval in shape with well-developed palate, and a stout crossbar, which is occasionally present on the frontal wall. This species has numerous short, oval or scaphoid avicularia placed within the fenestrulae (Pl. 27: 1d). *Reteporella* sp. differs from *R. antarctica* in having shorter autozooecia, fenestrulae and autozooecia. The frontal adventitious avicularia in *Reteporella* sp. are present only occasionally and not on each autozooecium. Triangular avicularia do not occur. The distal rim of the primary orifice in *Reteporella* sp. is not denticulate, as has been observed for *R. antarctica*. Fragmentary preservation of the material precludes determination of the species. On the other hand the lepralioid primary orifice and the characteristic frontal avicularia are very characteristic and sufficient to distinguish *R. antarctica* from other representatives of *Sertella* (see Hayward and Taylor 1984).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 *(Bill Hill*), Telm1 (Eocene).

Genus *Rhynchozoon* Hincks, 1895

Type species: *Lepralia bispinosa* Johnston, 1847.

Rhynchozoon quadratus sp. n.

(Pl. 17: 2a–b)

Holotype: Specimen ZPAL Br.VIII/A39 figured on Pl. 17: 2a–b.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1 (*Bill Hill*), Seymour Island, Antarctic Peninsula.

Derivation of the name: From the Latin *quadratus* quadrangle, referring to the almost quadrangular shape of the primary orifice.

Diagnosis. — Zoarium massive, erect with a strong supporting encrusting base, often multilamellar. Zooecia long, with 5–8 marginal areolar pores. The primary orifice quadrangular with distinct laterally placed condyles. The peristomial avicularium oriented transversely and located on the proximal border of the secondary orifice. A projecting peristomial process and a distinct V-shaped pseudosinus, both situated alternately may occur. Ovicell deeply buried, recumbent.

Material. — 34 massive specimens with strong supporting bases, sometimes with worn zoarial surface.

Dimensions. — Maximum length of colony 5.4 cm, width 3.7 cm; length of zooecia 0.5–0.6 mm, width 0.44–0.50 mm; length of orifice 0.08–0.11 mm, width 0.16–0.17 mm; width of ovicell 0.20–0.24 mm.

Description. — Colonies are erect, massive and foliaceous with a strong supporting base, often multilamellar (Pl. 17: 2a). Autozooecia are moderately elongated, closely packed, irregularly disposed in the centre of colony, towards the margins arranged alternately, recumbent with a smooth, slightly convex frontal wall, bordered by rather small marginal pores. Primary orifice is rectangular, with distinct, sharp condyles placed laterally, the distal margin straight, well-developed, slightly beaded (Pl. 17: 2b). Oral spines are absent. Peristome is rather thin, bearing a columnar stout process (mucron) projecting over the orifice and a peristomial avicularium orientated transversely, located on the proximal border of the peristome with a palatal surface placed distally. No pivot-bar is found. In some zooecia on the proximal border of the secondary orifice there are acute, projecting peristomial processes and an asymmetrical proximal V-shaped pseudosinus. The mucro as well as the peristomial avicularium may be located on the either side of the secondary orifice. Additional adventitious avicularia may occur frontally, one per zooecium, variously situated; they can be placed obliquely either distally or proximally. An ovicell is immersed into the peristome with the roof broken.

Remarks. — The characteristic feature of the specimens studied is the shape of zoaria (Pl. 17: 2a). Morphological features such as the encrusting growth of the colony, smooth zooecial frontal wall, bordered by marginal pores, primary orifice with a beaded distal border; sinuous or concave proximal margin of the secondary orifice; well-marked condyles; peristome with an asymmetrical sinus bearing a mucro and ovicell immersed within the frontal area, and the presence of adventitious avicularia, all accord well with the characters of *Rhynchozoon*. The distinctive features of the specimens studied are the almost rectangular shape of the orifice, with very characteristic sharp, laterally placed condyles, as well as the presence of the V-shaped pseudosinus and another uncinate projecting process which does not occur regularly. The small, adventitious avicularia located usually on the frontal wall, can be placed either distally or proximally. *R. quadratus* sp. n. is slightly similar to *R. larreyi* (Audouin, 1826) from New Zealand (see Gordon 1989) but differs in the distinctly quadrangular (rectangular) shape of primary orifice, in the different appearance of the condyles, and in the development of the proximal margin of the secondary orifice which in *R. larreyi* possesses three mucros. However, this latter feature may be variable (Powell 1967; Gordon 1989). In the studied specimens one or two uncinate projections have been observed. The above specified features distinguish *R. quadratus* sp. n. from all other species from Australia, New Zealand, and Antarctica (see Powell 1967; Gordon 1989; Hayward 1993, 1995).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*), ZPAL 12 (*Sadler Stacks*), ZPAL 8, Telm1–2 (Eocene). This is the stratigraphically the oldest occurrence of the genus *Rhynchozoon*.

LA MESETA BRYOZOAN PALEOECOLOGY

Bryozoans as modular, colonial benthic organisms play a significant ecological role in the La Meseta biota. Like other sessile suspension feeders, they prefer clear, at least slightly agitated water, and they are quite vulnerable to sedimentation and turbidity (Smith *et al.* 1995).

Epibionts. — Evidence that the bryozoan zoaria were colonized by epibionts is offered by fossil serpulid polychaetes (Gaździcki and Hara 1994: fig. 3). These are often found either encrusting at the top of zoaria or partly or wholly immersed within the zoaria (Text-fig 15D, Pls 2: 1a, 2a, 19: 2a, b, 26: 4). The bryozoan colonies were capable overgrowing such epibionts, before a new generation of overarching laminae or successive growth formed (Text-fig. 15D, see also Hara 1997b: fig. 5C). The bryozoan colonies settled by serpulids and spirorbids usually regenerated and could be built up further, due to a periodic supply of nutrients or other seasonal factors that may have determinated their cycles of growth (Text-fig. 15D). It seems possible that many of these encrusting epifaunal polychaetes developed during periods (?seasonal) of colony dormancy. In present day environments many tube-dwelling polychaetes share their ecospace with other organisms. Polychaetes, as suspension feeders, require permanent mobility of water to keep their branchial crown free from clogging sediment (Radwańska 1994). Usually, feeding movement of the worms stimulates the bryozoans to grow around the orifices of the tubes and can affect the growth rates at the points of contact (Text-fig. 15D); see (Gordon 1972). Rich, Recent associations of serpulids and bryozoans occur in the Ross Sea (Antarctica), on rocky or soft bottoms, in a range of depths from 40–100 m (Rosso and Sanfilippo 2000).

After their death, the La Meseta bryozoans commonly provided a substratum for attachment of other epibiotic organisms (Text-fig. 15C, Pls 1: 13, 2: 1a, 2a, 27: 2). Very often, polychaete worms encrusted or overgrew erect massive bryozoan colonies, forming a thick cover on top (Text-fig. 15C).

Substrata selection. — Bryozoans require a firm substratum for larval attachment. Molluscs, brachiopods and other bryozoans are frequently utilized by these bryozoans (Text-figs 14, 23, 26, Pls 16: 1a, 25: 8). Small, discoidal encrusting colonies and variably-shaped celleporids are common as epibionts which evidently lived attached to the zoarial surface of other bryozoans (Text-fig 14A–C, Pls 1: 6, 16: 1a, 20: 2, 25: 5). The very uneven and worn relief of the undersides of a comparatively large number of cerioporid and celleporid colonies may suggest that they settled the substrate inhabited by abundant other benthic organisms such as echinoids and other burrowing organisms (Text-fig. 14D, Pls 1: 21, 7: 1c, 2c; 19: 2a, b).

A massive colony of *Dennisia* is partly overgrown by a hemispherical celleporid colony (Text-fig. 14B). Branching colonies of *Hornera* often anchor their supporting discs, which are densely covered by kenozooecia, on the surfaces of celleporid colonies (Text-fig. 14A). A fragment of the same celleporid colony is also used as a substratum for a few small, tubuliporid bryozoans (Text-fig. 14A). A globular celleporid colony used as a substratum fragments of thick, bilamellar sheets of *Aspidostoma* colony (Text-fig. 14C). *Aspidostoma* which forms extensive nodular sheets and round-shaped, unilamellar colonies often encrusts or overgrows a variety of hard substrata. It settled upon the brachiopod *Paraplicirhynchia gazdzickii* Bitner and encrusted surfaces of other celleporid colonies (Text-figs 23A_1–B_1, 26A_1) see also Bitner (1996b). Colonies of *Osthimosia globosa* sp. n. and *Neofungella clavaeformis* sp. n. may both settle on the same primary substratum (Text-fig. 14D). Most probably during growth, the larger colony incorporated and covered the small *Neofungella clavaeformis* sp. n. colony, stopping its further growth. The other possibility is that the small colony, either living or dead, occupied a depressed substratum and formed a sort of an obstacle for the further growth of the larger colony (Text-fig. 14D). Sporadically observed, the epibiotic benthic foraminifera *Cibicides* chose a most convenient substratum within the interior of zooecial apertures of *Aspidostoma* colonies.

Bioerosion. — The colony surface has been bored by different groups of animals (Text-fig. 15A, B). Macroborings occur in the form of extended tubular spaces which are filled by sediment. Their shape and orientation within the colony are variable, with a size ranges from a few to some dozen or so millimeters. Microborings which have been observed in the cross-sections are developed irregularly; they occur after a few pairs of lamellae. They are usually single, variable in length, ranging in diameter from 0.01mm to 0.04 mm. Probably, this kind of boring may result from the activity of cyanobacteria, algae or fungae (see also Bitner 1996b). Numerous borings penetrating cerioporid colonies (Text-fig. 15B) may result from the activity of clionid sponges which usually occur in the littoral zone (Bromley 1970). The basal surface of many bryozoan colonies are often uneven and abundantly bored. They contain numerous cavities, holes, and depressions which can either reflect the character of the perished primary substratum or the intensity of borings after the death of the colonies (Text-fig. 14D). Numerous borings or ragged holes are referred to the ichnogenus *Trypanites* Magdefrau, 1932 which produces a spectrum of pouch-like, single-entrance excavations, perforating the calcificied upper surface of a *Ceriopora* colony (Text-fig. 15A) (see also Gaździcki and Hara 1994: pl. 1: 3a, b). *Trypanites* often penetrates consolidated substrata in the littoral and sublittoral zones (Pemberton and Frey 1985).

The exposed zoarial surfaces of some hemispherical cerioporid and celleporid colonies show many signs of bioerosion. Grazing marks, and injuries such as holes and scrapes, originated before burial; they are usually observed in the upper parts of multilamellar colonies, including small lesions or dead areas of a few zooecia (Pl. 25: 1a, b). Grazing traces of the life activity of echinoids were also observed on some cerioporid colonies. They form a series of star-shaped scratches and grooves probably made by regular echinoids. They are judged to have been responsible for scratches in the investigated assemblage (Bitner 1996b; Radwańska 1996).

***In vivo* transport**. — The role of transport in the assemblage studied is minimal and is proven only in case of the rooted cellariiform colonies (see Pl. 9: 4b). Those colonies, which have the ability to anchor themselves in bottom sediments by means of strong organic rootlets, have been found disarticulated, incorporated into the dorsal side of a large reticulate colony (Pl. 9: 4b). A small hornerid and fragmentary large echinoid spines were transported after their death, and are embedded in the same reticulate colony (Pls 9: 4a, b; 10: 1b, d).

La Meseta environment. — Correlation between bryozoan colonial growth forms and the environmental conditions in which the organisms live (substratum, water energy, sedimentation rate, etc.) provides the potential for growth forms to be used as paleoenvironmental indicators (Hageman *et al.* 1997; see also Reguant *et al.* 1991). The majority of the La Meseta bryozoans belong to the erect, massive growth-form especially represented by cyclostomes and cheilostomes with cerioporid and celleporiform zoarial types. The multilamellar cerioporines which form the dominant element fit the cerioporid zoarial type. According to Brood (1972) this growth from seems to be independent of water depth but dependent on the availability of a hard substratum. They are usually attached to the substratum by the strong basal laminae and are capable of growth in strongly agitated waters (Pls 7: 1a, 1c, 2c; 8: 2a). The celleporiform zoarial type is also often represented by variably-shaped, massive cheilostome colonies (Pls 18–19, 22, 25–26). Stach (1936) regarded this type of growth-form as adapted to life in the littoral and sublittoral zones (see also Lagaaij and Gautier 1965). The membraniporiform zoarial type is represented either by encrusting, unilamellar sheet-like colonies of cyclostomes (Pl. 5: 2a–c) and cheilostomes (Text-figs 23, 26). The erect multiserial, bilamellar, branching arborescent and foliaceous colonies are represented by adeoniform cheilostomes, as well as by hornerid and plagioeciid cyclostomes (Text-figs 16, 18, 24–25, Pls 1: 1–2, 11, 2–5, 15–16, 23). Usually, these colonies are attached to the substratum by a strong rigid base. Generally, both types of growth – membraniporiform and adeoniform – predominate in shallow waters of littoral and sublittoral zones. In the La Meseta biota, bryozoans of reteporiform and retiform zoarial growth-forms are relatively common, represented by erect, rigid fenestrate colonies of *Reticrescis* (Pls. 1: 7; 9–10) and *Reteporella* (Pl. 27). This type of colony lives on hard substrates at variable but mostly shallow depths (Brood 1972). They are adapted to life in regions where wave action and currents are strong. These factors are overcome by the rigidity and fenestration of the colony (Stach 1936; Brood 1972; Moissette 2000). A few finger-shaped, articulated colonies of *Cellaria* (Text-fig. 27) and separate internodes of *Crisia* colonies in the La Meseta belong respectively to cellariform and crisiid zoarial types. These types of growth are usually adapted to life in littoral zones, in areas of high rate of sedimentation, where the effect of wave action is overcome by the articulation of the colony (Stach 1936; Brood 1972; Moissette 2000). The relationship between dominant zoarial forms such as cerioporid and celleporiform and the environmental factors may suggest that the bryozoans settled on solid substrata at rather shallow depth, with moderate to strong current action and a slow rate of the sedimentation.

The high percentage of celleporiform colonies together with membraniporiform and reteporiform zoarial types may suggest a slow rate of sedimentation in the sequences studied. According to Smith *et al.* (1995) high diversity in bryozoans appears to require a low rate of sedimentation. The development of large, multilamellar colonies and the diverse epifauna confirms this low sedimentation rate, too. Bryozoan colony growth rate is rather poorly known; however, most authors agree that in respect to massive, multilamellar colonies the rate is slow (cf. Moissette and Pouyet 1991; Taylor and Voigt 1999).

Bathymetric evaluation of the fossil assemblage with its numerous bryozoans in the Telm1 unit of the La Meseta Formation, based on scleractinians and brachiopods, suggests water depths of less than 100 m (Bitner 1996a; Stolarski 1996, 1998). Studies of Recent bryozoans (Moissette 2000) have shown that there is a correlation between colonial growth forms and various physical factors of the environment, especially bathymetry. The dominance of celleporiform and membraniporiform zoarial types in the Algerian Miocene indicates an optimum of bathymetric conditions in the range of 50 to 80 m (Moissette 2000). The accumulation of celleporiform bryozoans in Miocene Mediterranean communities is characteristic of the sublittoral zone with a depth range of 20–65 m (Pouyet 1973). These bathymetric conditions may correspond to the inner sublittoral zone (see Thurman 1996).

The presence of abundant cyclostome and cheilostome bryozoans accompanied by corals, nautiloids, crinoids, echinoids and starfishes indicates normal marine salinity during the sedimentation of the Telm1 unit of the formation (see Baumiller and Gaździcki 1996; Radwańska 1996; Stolarski 1996; Dzik and Gaździcki in press). In Recent marine environments, cerioporine bryozoans are a stenohaline group; they favour waters of normal (c. 30–40‰) salinity (Borg 1972).

The scarcity and low diversity of bryozoans in higher parts of the formation (Telm2), may support suggestions of a prevailing marine-estuarine conditions (Porębski 1995, 2000). These conditions imply a low salinity (c. 20‰), which is environmentally stressful to marine bryozoans (Smith *et al.* 1995).

The exceptionally well-preserved articulated arms and pinnules in comatulid crinoids with attached spines, articulated crowns of isocrinids (Baumiller and Gaździcki 1996), numerous articulated brachiopod shells (Bitner 1996a, b), and complete echinoid tests (Radwańska 1996) may suggest quick burial (see Stolarski 1998). The Telm1 bryozoan assemblage, where the sizes of the *Ceriopora* and *Dennisia* colonies varies from 5 to 55 mm, regarding different ontogenetic stages, as well as the other groups of fauna in the lower part of the La Meseta Formation may suggest rapid burial and preservation of a thanatocenosis (Gaździcki 1999, personal communication).

The bryozoan fauna in the upper part of the formation (Telm6–7) is represented by the *Smittina* biostrome (Pl. 23), accompanied by a dense population of ophiuroids and echinoids, gastropods, bivalves and brachiopods (Stilwell and Zinsmeister 1992; Bitner 1996a; Aronson *et al.* 1997). The abundance of suspension-feeding organisms and the high diversity of biota was probably due to the combination of wellilluminated shallow water, moderate levels of current activity and also to high nutrient levels associated with tectonic activity (volcanism) and possible upwelling in the upper part of the La Meseta Formation (see Aronson *et. al.* 1997). According to Heckel (1972) and Waide *et al.* (1999) high species richness and diversity occur where more nutrients becomes available due to periodic upwelling. From the ecological standpoint, the foliaceous, bilamellar colonies of *Smittina* with the eschariform zoarial type (according to Stach's 1936 classification) is adapted for life in the inner sublittoral zones at depths of about 20 m (Stach 1936). The distribution of the bryofauna within the studied sequences as presented above is in accordance with the earlier interpretation of the La Meseta Formation as transgressive-regressive, marine-estuarine cycles of the La Meseta Formation, as originated within an incised-valley estuary (Porębski 1995, 2000; Doktor *et al.* 1996; Marenssi *et al.* 1998).

PALEOCLIMATIC AND PALEOBIOGEOGRAPHIC IMPLICATIONS

The La Meseta Formation bryozoans document climatic changes in the Tertiary of the Southern Hemisphere. The distribution of the bryozoan assemblages in the stratigraphic column differs significantly between the lower (Telm1) and upper part of the formation (Telm6–7) (Text-fig. 5). The occurrence of abundant, mostly multilamellar, globular or mound-shaped colonies is limited to the lower part of the unit (Telm1). This shallow-water bryozoan fauna together with the associated biota indicate the warm period during the deposition of this part of the formation (Long 1992a, b; Dzik and Gaździcki 2001). In the higher part of the profile (Telm2), bryozoans are scarce, comprising mostly specimens belonging to *Ceriopora*, which are very common in the lower part (Telm1). By contrast, bryozoans in the upper part of the formation (Telm6–7) are impoverished and reduced in taxonomic composition. A sharp decline in bryozoan diversity from 30 genera in the lower part (Telm1) to only 2 genera in the upper one (Telm6–7) see (Table 1) is most probably connected with climatic changes and the sedimentary environment in the Antarctic Eocene marine ecosystem. These changes within the stratigraphical column studied are supported by isotopic studies of fossil shell material from the La Meseta Formation (Gaździcki *et al.* 1992). The isotopic results indicate a climatic cooling-event, possibly the onset of glaciation, at the time of deposition of the upper (Telm6–7) units (Gaździcki *et al.* 1992). Moreover, a substantial decline in diversity of paleoflora in the upper part of the formation is consistent with this cooling pattern as recognized above (Zinsmeister and Camacho 1982; Askin 1992, 1997; Doktor *et al.* 1988, 1996). This cooling event may be correlated with the first phase of the late Eocene – early Oligocene continental glaciation in West Antarctica (Gaździcki *et al.* 1992; Birkenmajer 1996; Dingle and Lavelle 1998a, b).

The La Meseta bryozoans have also proved significant for biogeographical connections. Taxonomically, they comprise rich cyclostome and cheilostome taxa of a wide stratigraphical and geographical range as well as those restricted to the Southern Hemisphere or endemic to the James Ross Basin. Most significant in the taxonomic composition of the bryofauna studied are cyclostomes belonging to the suborder Cerioporina, reminiscent of the Cretaceous in the Northern Hemisphere, and cheilostomes, represented by the families Cellariidae, Lepraliellidae, Smittinidae, Celleporidae, and Philodoporoidae, which originated in and started to radiate during the Eocene. The majority of representatives of these families have the oldest fossil record on Seymour Island. Subsequently, they dispersed in the Neogene throughout South America, Australia, New Zealand and in the late Eocene and Neogene in the Northern Hemisphere. The Eocene La Meseta bryozoans have considerable evolutionary interest, including the oldest stratigraphical record of many genera: *Calvetia*, *Borgella, Neofungella, Paracellaria, Smittina, Smittoidea, Celleporaria, Cellarinella, Metroperiella*, *Aimulosia*, *Osthimosia, Reteporella*, and *Rhynchozoon*. It may be possibly confirmed that Seymour Island area has been the place of origin of those taxa, from here they migrated northwards, as other biota, too before the development of the circum-Antarctic current in the Oligocene time (Zinsmeister and Feldmann 1984; Crame 1986, 1992; Feldmann and Woodburne 1988; Gaździcki 1996). Genera such as *Retecrisina, Crassohornera, Borgella, Ceriopora, Reptomulticava,* and *Metroperiella* identified in the La Meseta have first fossil records in Antarctica. The bryofauna studied includes representatives of higher taxonomic level belonging to 7 families of Cyclostomata and 13 families of Cheilostomata. The major Paleocene–Eocene turnover, followed by a rapid increase in generic richness, is marked by the great diversity of new cheilostomes in the assemblage

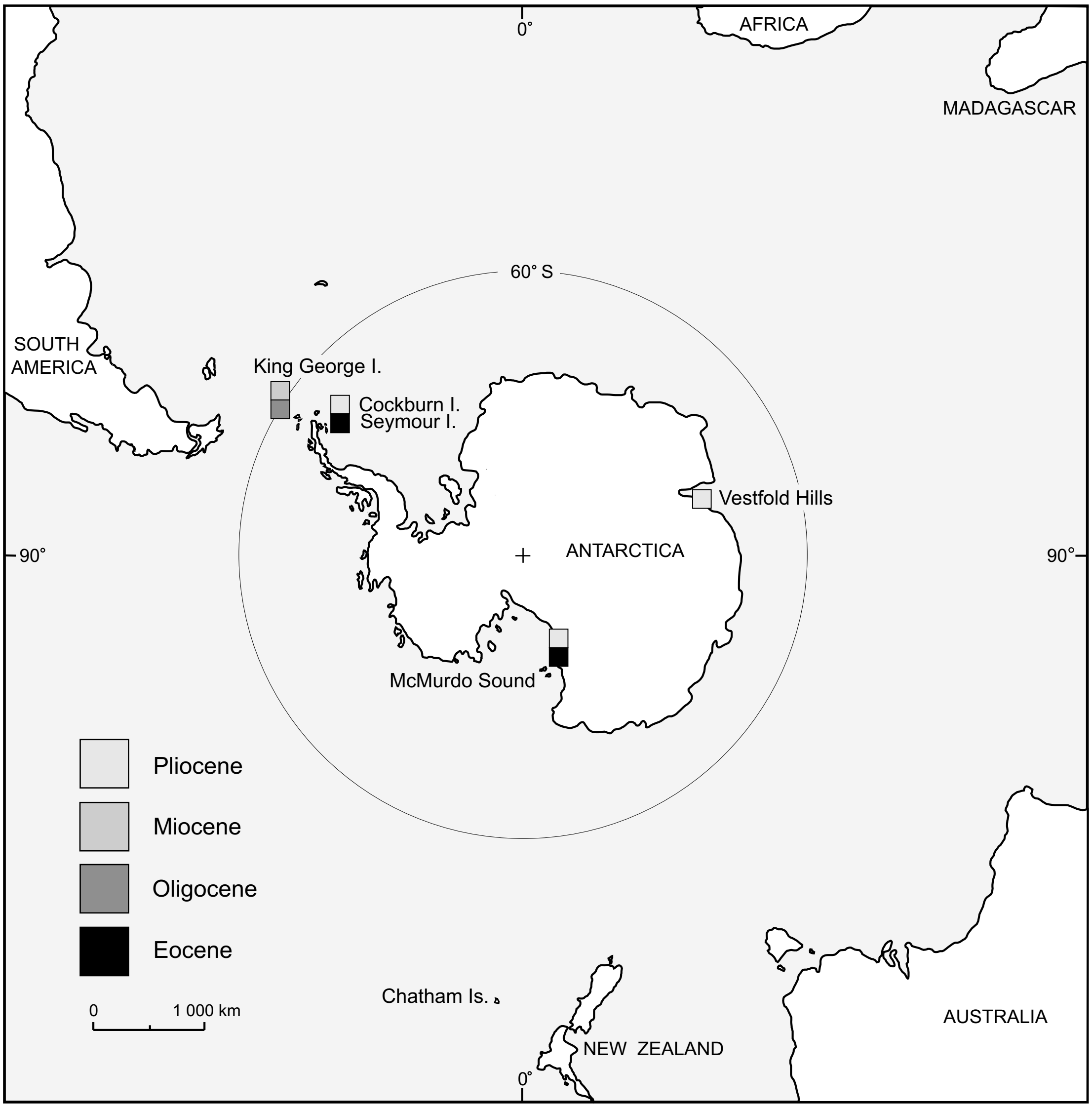

Fig. 32. Distribution of Tertiary (Eocene–Pliocene) Antarctic bryozoan fauna.

studied (see also Bottjer and Jablonski 1988). This is consistent with the overall evolutionary trends of this group of fossils, showing a decline in diversity of cyclostomes and the origination of many cheilostomes in the Late Cretaceous to early Paleogene (cf. Lidgard *et al.* 1993; Taylor 1996; Sepkoski *et al.* 2000).

A relationship of the described La Meseta bryozoans could be referred to the younger (Oligocene–Pliocene), rich Antarctic bryozoan assemblages. The widespread diversity pattern of those Antarctic faunas, is similar to present day data, which evidently were established by the end of the Paleogene (Bottjer and Jablonski 1988).

The rich Oligocene bryozoan assemblages from the glacio-marine Polonez Cove Formation on King George Island comprise 9 families of Cyclostomata and 19 families of Cheilostomata with a distinct preponderance of cheilostomatous taxa (Gaździcki and Pugaczewska 1984; Hara 1992). The taxonomic similarity at the genus level between the Eocene bryofauna from Seymour Island and those from King George Island is documented by a few shared genera such as *Crisia*, *Fasciculipora*, *Hornera*, *Cellaria*, *Melicerita,* ?*Celleporaria, Smittina*, and *Reteporella*. It should be added that abundant and diverse Eocene–Oligocene bryozoan assemblages, which have inhabited the Antarctic littoral shelf zones, are connected with favourable conditions of life in the temperate to cool-temperate climate (Hara 1997a). The connection between the Miocene bryozoan assemblage of the Cape Melville Formation on King George Island and the La Meseta bryozoans is shown only on the bases of rather a fragmentary preserved fauna of two genera *Aspidostoma* and *Cellaria* (Hara 1994) see also Pirrie *et al.* (1997).

Pliocene bryozoans are known from a shallow-marine biofacies preserved at the peripherial coastal Antarctic localities of Cockburn Island, McMurdo Sound and the Vestfold Hills (Text-fig. 32). Analogies between the bryofauna from the Pliocene Cockburn Island Formation *sensu* Jonkers (1998) of Cockburn Island, which has been reported for the first time by Henning (1911), and the La Meseta bryofauna are shown only by *Hornera antarctica* Waters. This cyclostome species is significant for the linkeage between Antarctica and South America (Text-fig. 32, see also Moyano 1996). Other Pliocene bryozoan-bearing strata are known from McMurdo Sound (i.e. Scallop Hill and Taylor Formations, Speden 1962) as well as from Marine Plain in Vestfold Hills (Quilty 1993, personal communication 1995). This fauna includes a few genera of cyclostomes and cheilostomes which are identical with bryozoans from the La Meseta Formation.

The individuality of the Tertiary Antarctic bryozoans as presented here may result from the fact that these assemblages are of a different age and show the biotic composition connected to the differentiated paleoclimatic conditions which have been recorded from Eocene to Pliocene (Birkenmajer 1996; Barrett 1996; Hara 1997a), see also Gaździcki and Webb (1996).

It also should be pointed out, that an extremely poverished, Eocene bryozoan fauna, has been recorded from glacial erratic sandstones at Minna Bluff, McMurdo Sound (Hara 2000) in the Eastern Antarctica. This differs considerably from the bryozoans of Seymour Island.

A rich bryozoan assemblage older than the La Meseta, from the latest Paleocene or earliest Eocene has been recently described from Chatham Island (Gordon and Taylor 1999). The characteristic shared by the Paleocene Chatham Island bryozoans and the La Meseta fauna is a great diversity enhanced by a significant proportion of new species. Only a few genera are in common (*Ceriopora*, *Disporella*, *Aspidostoma*, and *Cellaria*). Generally, the Seymour and Chatham islands bryofaunas are composed of a number of genera reminiscent of the Cretaceous of the Northern Hemisphere and of families that are common in the Neogene and the Recent Southern Hemisphere bryofauna (Gordon and Taylor 1999).

The spectacular increase in diversity and abundance of bryozoans is also evident in Oligocene–Miocene strata in the triangle of South America, New Zealand and Australia (MacGillivray 1895; Canu 1904; 1908, Brown 1952, 1958; Cockbain 1971). In respect to generic taxonomic composition, as well species abundance, the Southern Hemisphere bryofauna demonstrates similarity with bryozoans from the La Meseta Formation. Most probably, migration of the bryozoan fauna (Canu 1904, 1908; Gaździcki and Pugaczawska 1984) occurred within the zoogeographical Weddellian Province (Zinsmeister 1982; Case 1989), as shown by the close, shallow-water links existing between southern South America (Patagonia), Antarctic Peninsula, New Zealand and Australia during the Tertiary (see also Lawvrer *et al.* 1992: figs 12–13). The biogeographical connections of bryozoans of Seymour Island with those in the triangle of South America, New Zealand and Australia indicate migration routes of many taxa northwards (Zinsmeister and Feldmann 1984; Crame 1986, 1992; Feldmann and Woodburne 1988). Many genera which occur in the Eocene La Meseta Formation have been frequently encountered in Oligocene–Miocene strata of adjacent continents. Undoubtedly, the La Meseta bryofauna suggests closest connections with Southern American bryozoans as shown by the cyclostomes and cheilostomes (Hastings 1943; Hedgpeth 1969; Moyano 1996).

The majority of temperate-warm genera present in the La Meseta assemblage have moved equatorwards; e.g. *Hornera*, *Cellaria*, *Reptadeonella*, *Escharoides*, *Melicerita*, *Rhynchozoon*, *Osthimosia*, *Reteporella* as well as cosmopolitan genera such as *Crisia*, *Celleporaria*, *Smittina*, and *Smittoidea*. The general migration routes of many bryozoan taxa were directed northwards from the Antarctic Peninsula to New Zealand and Australia but also along the western coast of South America throught the region of Central America to the North Atlantic. Genera such as *Escharoides*, *Reteporella* and *Rhynchozoon* commonly live in Recent waters of the Atlantic, Atlantic-Mediterranean or even in Arctic-boreal realms. *Neofungella*, *Borgella, Aspidostoma*, and *Cellarinella* occur commonly in Recent seas of the Southern Hemisphere and they have never moved equatorwards being limited to the oceans south of the Antarctic Convergence.

At the present day, Antarctic bryozoans, with a preponderance of Cheilostomata, are among the most significant components of the marine benthic community over large areas of the Antarctic continental shelf (Arntz and Gallardo 1994; Hayward 1995; Arntz *et al.* 1997; Zabala *et al.* 1997). They exhibit a high degree of endemism (cf. Rogick 1965; Gallardo 1987; Ristedt 1995; Moyano 1996), which may also document the isolation of the Antarctic continent as a consequence of a general expansion of cooler conditions during the Cenozoic (Zinsmeister and Feldmann 1984; Gaździcki *et al.* 1992).

CONCLUDING REMARKS

The bryozoans reported from the Eocene La Meseta Formation of Seymour Island help to fill a major gap in our knowledge of taxonomy and paleobiogeography of this group of fossils in the Southern Hemisphere. The taxonomic study of this fauna has resulted in description of a remarkably rich and diverse bryozoan assemblage including 43 species of cyclostomes and cheilostomes. The endemic character of the La Meseta bryofauna is expressed by a high number of taxa new for science, including nineteen species and two genera. The abundant occurrence of bryozoans in the lower part of the La Meseta Formation (Telm1) may indicate a short episode in the history of early Paleogene Antarctic bryozoan faunas, by radiating into great number of taxa, what is connected with the global Paleocene–Eocene turnover, that marks a significant radiation of cheilostome ascophorans. The dominant taxon in the lower part of the formation, however, is the cyclostome genus *Ceriopora* (40% of specimens), which was widely distributed in the Jurassic–Neogene of the Northern Hemisphere.

The existence of many different kinds of colonial forms of bryozoans with a clear preponderance of massive, multilamellar colonies reflects the sedimentary environment of the La Meseta Formation. The temporary establishment of a rich late early Eocene bryozoan population dominated by massive, multilamellar bryozoans, limited to the lower part of the La Meseta Formation, suggests favourable environmental conditions for the development of bryozoans, such as shallow-water, moderate to high energy and nearshore environment with an abundant supply of nutrients (Sadler 1988; Wiedman and Feldmann 1988; Gaździcki and Hara 1993, 1994; Gaździcki 1996; Hara 1995, 1997a, b). Generally, multilamellar, globular colonies indicate strong hydrodynamic conditions and a rather shallow marine setting. Frequently, rocks formed under these conditions occur at the base of a transgressive series (see Walter 1989).

One may also conclude that other factors which may have influenced multilamellar growth of the La Meseta colonies were limited substratum space, resulting from competition between different groups of benthic organisms as well as the dominance of colonies which grew by frontal and intrazooecial budding, and most probably, seasonality of the climate, which directly controls the seasonal supply of nutrients (see Arntz and Gallardo 1994; Barnes 1995; Scholz and Hillmer 1995; Barnes and Clarke 1998; Craig 2000).

The analysis of zoarial growth-forms of the La Meseta bryozoan assemblage of the Telm1 unit with dominant massive cerioporids, celleporiforms and membraniporiform colonies suggests that the La Meseta Formation was deposited at a depth of approximately 50 meters in the inner sublittoral zone. The Tertiary and present-day records of the bryozoan assemblages with prevailing occurrence of the celleporiform colonies corroborate this interpretation (see also Pouyet 1973; Moissette and Pouyet 1991).

The considerable number of massive, multilamellar colonies, together with the associated biota such as corals, brachiopods, nautilids, echinoderms and sharks, suggests warm to temperate-warm conditions during the Eocene (Feldmann and Woodburne 1988; Zinsmeister 1991; Gaździcki *et al.* 1992, 1998; Dzik and Gaździcki 2001). The distribution of bryozoans in the stratigraphic column of the La Meseta Formation shows a distinct change in biodiversity between the lower (Telm1) and upper part (Telm6–7) of the formation. A distinct decrease in bryozoan diversity in the upper part of the formation is most probably connected with the latest Eocene glacial event which resulted in a changes of sedimentary environment in the Antarctic marine ecosystem (Askin 1988, 1997; Doktor *et al.* 1988, 1996; Gaździcki *et al.* 1992; Dingle and Lavalle 1998a, b).

The taxonomic composition of the late early La Meseta Formation bryozoans suggests that the Antarctic region was an important place of origin of many new bryozoan taxa, as documented by the stratigraphically oldest occurrence of such genera as *Calvetia*, *Borgella*, *Neofungella*, *Smittina*, *Smittoidea*, *Celleporaria*, *Metroperiella*, *Osthimosia*, *Reteporella,* and *Rhynchozoon*, as well as other shallow-water groups of fossils (Zinsmeister and Feldmann 1984; Clarke and Crame 1994).

The La Meseta bryofauna indicates paleobiogeographical links with Tertiary forms of the adjacent continents of the Southern Hemisphere, as well as reflecting a major dispersal event into lower latitudes as a consequence of the final stage of the breakup of Gondwanaland and general expansion of the cooler conditions during the Cenozoic (Zinsmeister and Feldmann 1984; Crame 1986, 1992, 1994).

The bryozoan fauna from Seymour Island reveals a high species diversity, and high level of endemism, the considerable large size of colonies, as well as the well-developed polymorphism of the colonies are remarkable. These features may suggest that the Seymour Island bryofauna shows a close resemblance in respect to the features as above specified to living Antarctic bryozoan faunas (Gallardo 1987; Clarke and Crame 1989, 1994; Arntz and Gallardo 1994; Arntz *et al.* 1997). The majority of the La Meseta species have become an extinct, however, they should, in all probability, be the ancestors of the rich living bryozoan communities of the Antarctic shelf environment.

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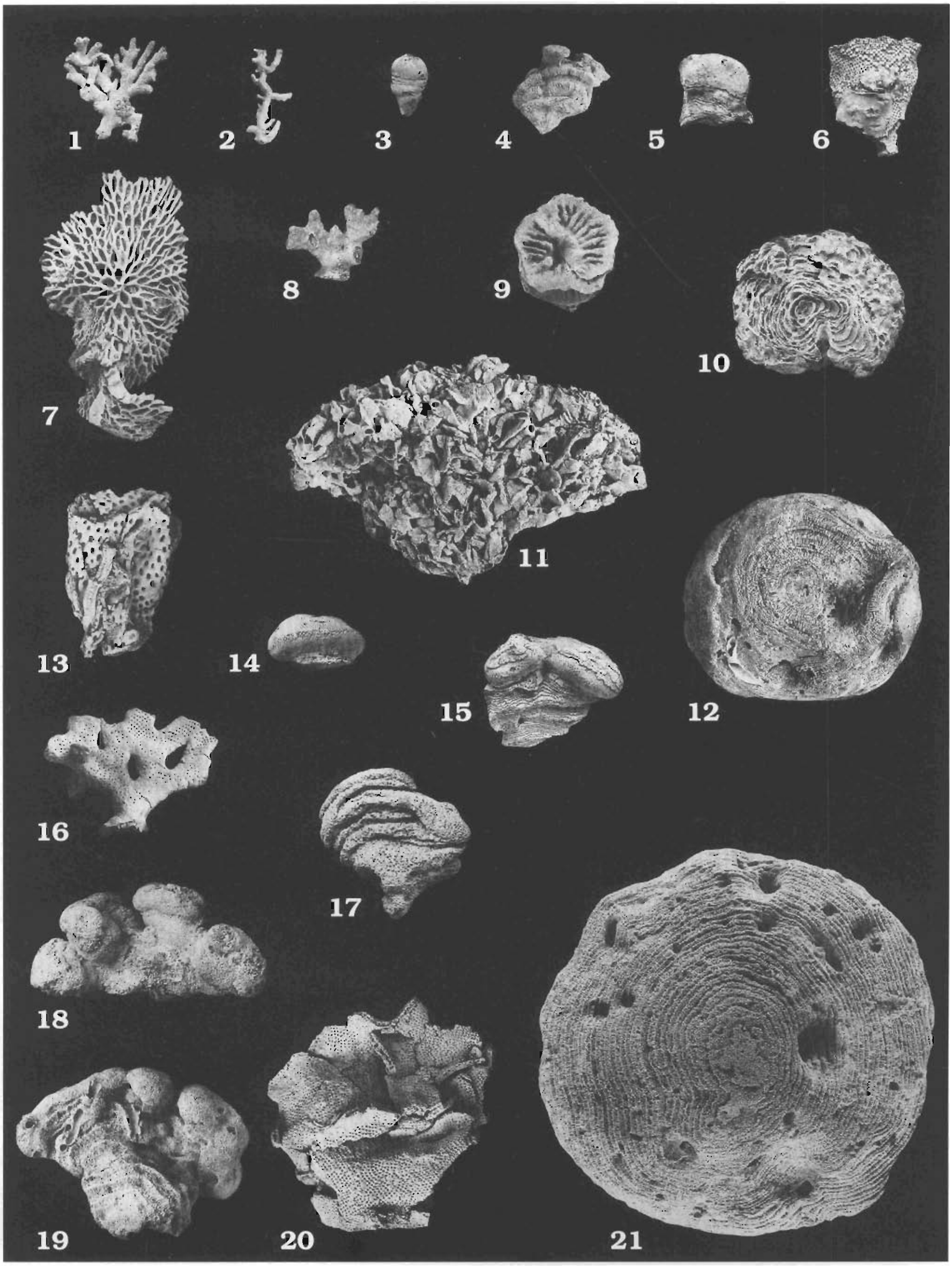
PLATES

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 1

Figs 1–2. Branched colonies of *Hornera antarctica* (Waters, 1904); 1. ZPAL Br.VIII/64; 2. ZPAL Br.VIII/43.
Fig. 3. Club-shaped zoarium of *Reptomulticava clavaeformis* sp. n.; ZPAL Br.VIII/69.
Fig. 4. Fan-shaped colony of *Fasciculipora* sp.; ZPAL Br.VIII/57.
Fig. 5. Hemispherical colony of *Neofungella capitula* sp. n.; ZPAL Br.VIII/48.
Fig. 6. Encrusting colony of *Borgella* sp.; ZPAL Br.VIII/A20.
Fig. 7. Reticulate colony of *Reticrescis plicatus* gen. et sp. n.; ZPAL Br.VIII/A66.
Fig. 8. Robust, dendroid colony of *Calvetia* sp.; ZPAL Br.VIII/A48.
Fig. 9. Colony of *Disporella marambioensis* sp. n. composed of rosette-shaped subcolonies; ZPAL Br.VIII/A3.
Fig. 10. Underside of a hemispherical colony of *Reptomulticava seymourensis* sp. n.; ZPAL Br.VIII/289.
Fig. 11. Colony of *Retecrisina antarctica* sp. n. composed of bilamellar branches; ZPAL Br.VIII/A35.
Fig. 12. Underside of a hemispherical colony of *Ceriopora hemisphaerica* sp. n.; ZPAL Br.VIII/105.
Fig. 13. Coil-shaped, reticulate colony of *Reteporella* sp.; ZPAL Br.VIII/A71.
Fig. 14. Cap-shaped colony of *Smittoidea gazdzickii* sp. n.; ZPAL Br.VIII/101.
Fig. 15. Mushroom-shaped, multilamellar colony of *Aimulosia lamellosa* sp. n.; ZPAL Br.VIII/88.
Fig. 16. Branched, bilamellar zoarium of *Aspidostoma taylori* sp. n.; ZPAL Br.VIII/A50.
Fig. 17. Mushroom-shaped, multilamellar zoarium of *Celleporaria ovata* sp. n.; ZPAL Br.VIII/393.
Fig. 18. Massive colony of *Osthimosia globosa* sp. n. composed of a few subcolonies; ZPAL Br.VIII/98.
Fig. 19. Massive, multilamellar colony of *Osthimosia globosa* sp. n. composed of subcolonies and encrusted by polychaete worms; ZPAL Br.VIII/457.
Fig. 20. Portions of the bilamellar sheets of *Aspidostoma multiformis* sp. n.; ZPAL Br.VIII/A15.
Fig. 21. Underside of a large multilamellar, hemispherical colony of *Celleporaria mesetaensis* sp. n. with polychaete borings; ZPAL Br.VIII/ 37.

All specimens natural size.
ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.



U. HARA: BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 2

Retecrisina antarctica sp. n. 49

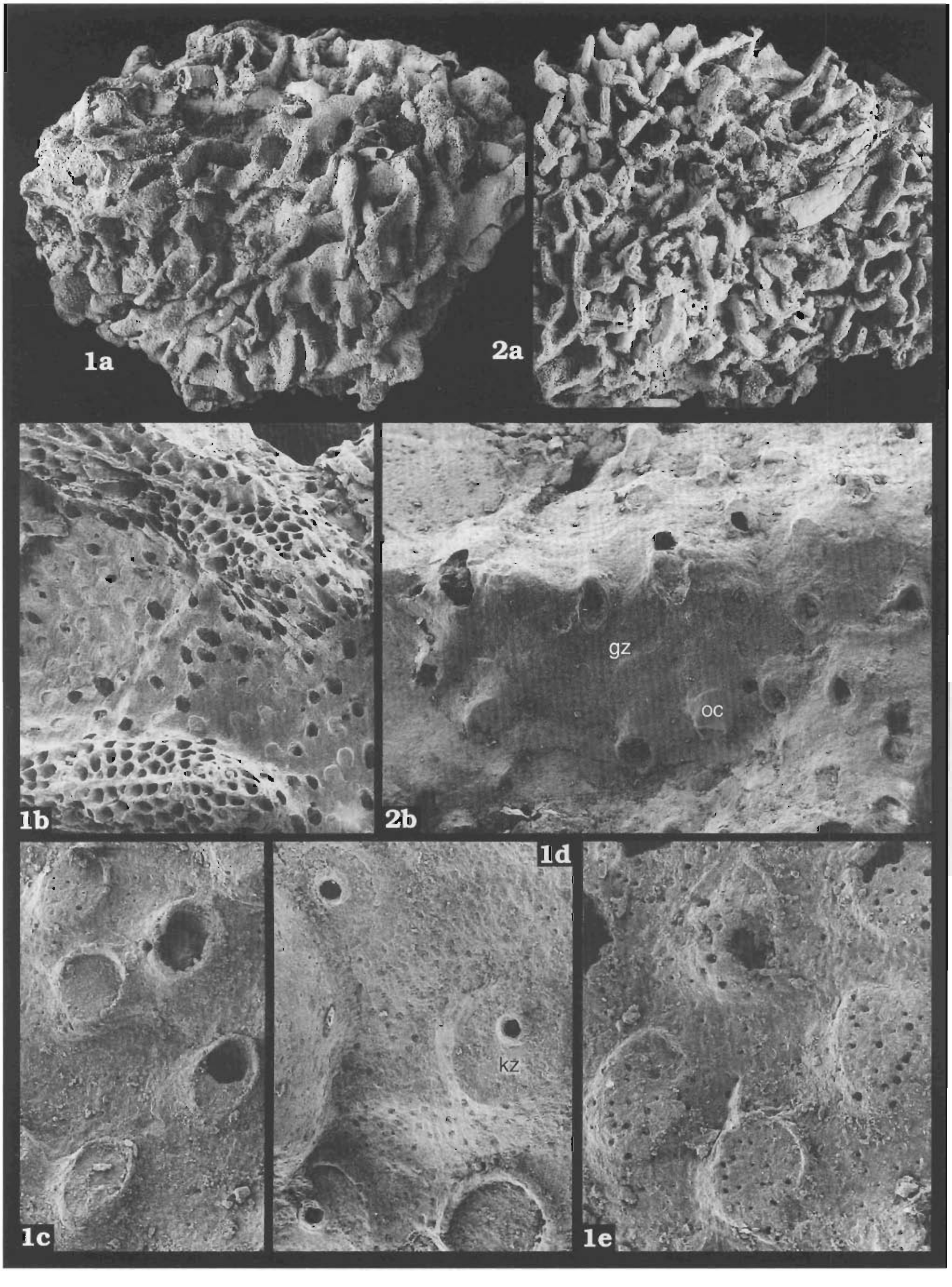
Fig. 1a. Reticulate colony composed of laterally-compressed bilamellar branches, × 2.
Fig. 1b. Fragment of zoarial surface with breakage through the bilamellar branches showing zooecial apertures from both sides of the budding laminae, × 25.
Fig. 1c. Slightly oblique autozooecial apertures, × 100.
Fig. 1d. Group of secondary nanozooecia (nz), × 150.
Fig. 1e. Group of zooecial apertures sealed by porous terminal diaphragms, × 150.

Holotype ZPAL Br.VIII/A36.

Fig. 2a. Fragment of a reticulate colony composed of bilamellar branches, × 2.
Fig. 2b. Gynozooecium (gz), pierced by zooecial apertures, with slightly compressed ooeciostome (oc), × 45.

ZPAL Br.VIII/A37.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
2a
1b
2b
gz
oc
1c
1d
kz
1e

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 3

Hornera antarctica (Waters, 1904) 52

Fig. 1a. Frontal view of branched colony with serpulid tubes on the left, × 3.

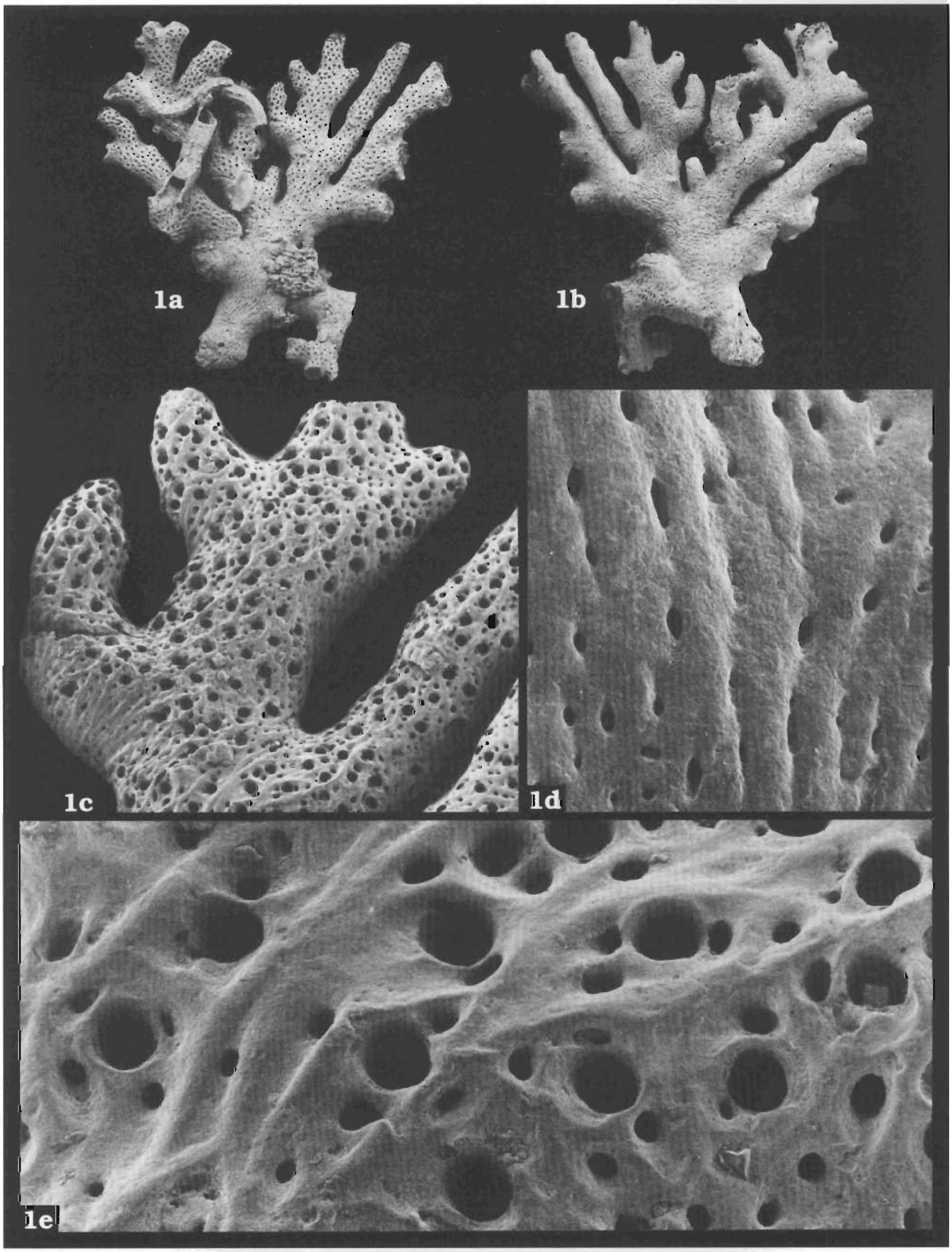
Fig. 1b. Basal view of the colony, × 3.

Fig. 1c. Distal end of the dichotomously branching colony; frontal view with autozooecial apertures and strong, transversely running system of nervi, × 17.

Fig. 1d. Basal side showing longitudinal sulci with elongate vacuoles, × 110.

Fig. 1e. Fragment of the zoarial surface with round-shaped zooecia surrounded by peristomes and irregularly scattered cancelli, × 110.

ZPAL Br.VIII/A64, ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
1b
1c
1d
1e

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 4

Hornera antarctica (Waters, 1904) 52

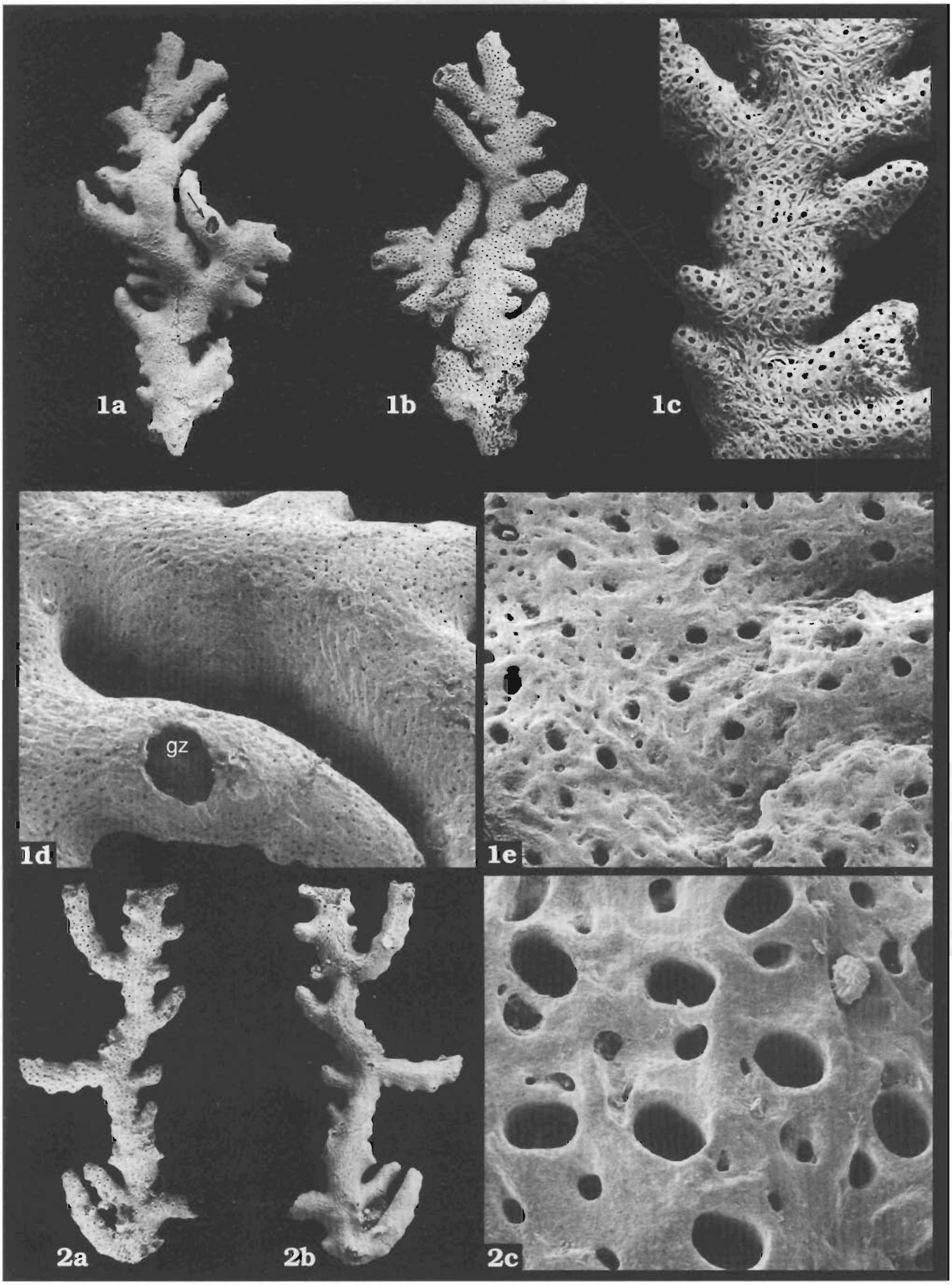
Fig. 1a. Basal view of branched colony with a gynozooecium (arrow), × 3.
Fig. 1b. Frontal view of branched colony covered by zooecial apertures, × 3.
Fig. 1c. Middle part of the main branch showing short lateral branches, autozooecia and well-marked system of nervi, × 10.
Fig. 1d. Damaged, deeply pitted oval gynozooecium (gz) placed in the extremities of the lateral branch, × 15.
Fig. 1e. Middle part of the branch from the frontal side showing arrangement of zooecial apertures and cancelli, × 35.

ZPAL Br.VIII/63.

Fig. 2a. Incomplete branched colony, frontal view, × 4.
Fig. 2b. Basal view, × 4.
Fig. 2c. Fragment of the zoarial surface showing the arrangement of the zooecial apertures and irregularly scattered cancelli, × 100.

ZPAL Br.VIII/43.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
1b
1c
gz
1d
1e
2a
2b
2c

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 5

Crassohornera sp. 54

Fig. 1a. Frontal view, × 4.
Fig. 1b. Basal view, × 4.
Fig. 1c. Circular autozooecial apertures and cancelli, × 70.

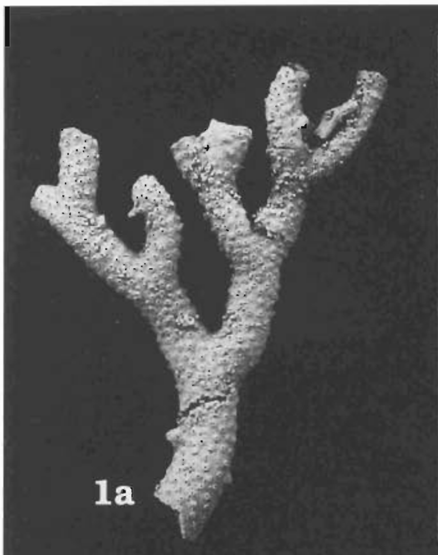
ZPAL Br.VIII/A47.

Borgella sp. 56

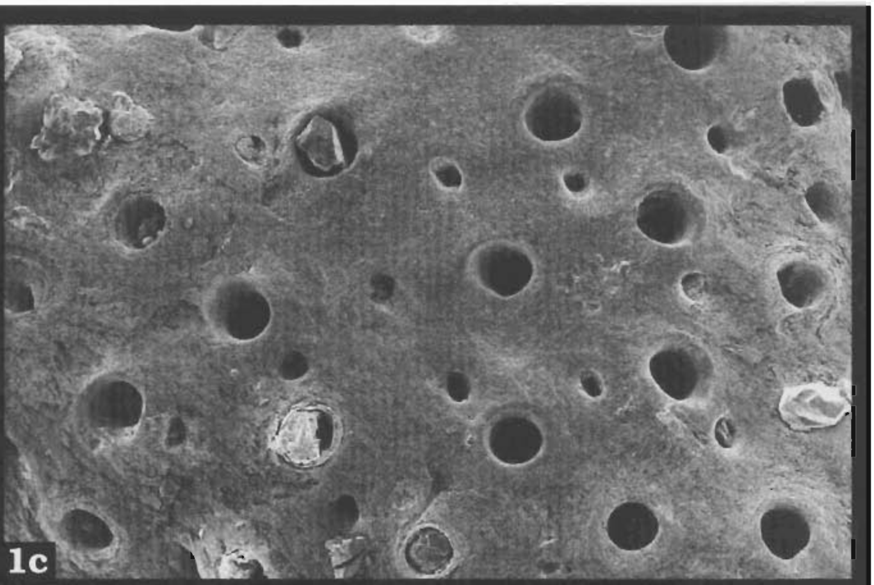
Fig. 2a. Discoidal encrusting zoarium with rugose surface showing a brood chamber (arrowed), × 6.
Fig. 2b. Part of zoarial surface showing the autozooecial apertures surrounded by kenozooecia and depressed area composed of kenozooecia (in the middle), × 42.
Fig. 2c. Worn brood chamber (bch) showing a floor with radially arranged autozooecia, × 50.

ZPAL Br.VIII/A20.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a


1b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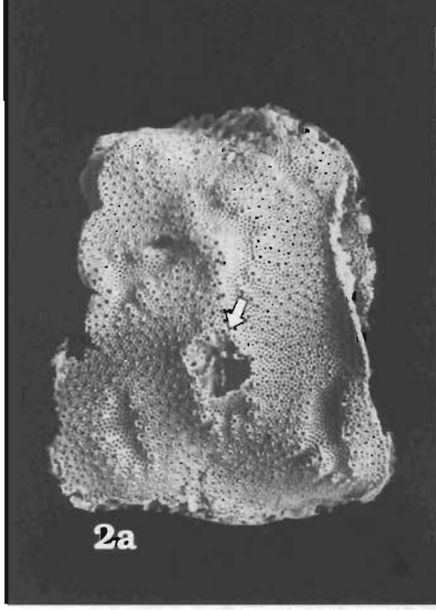
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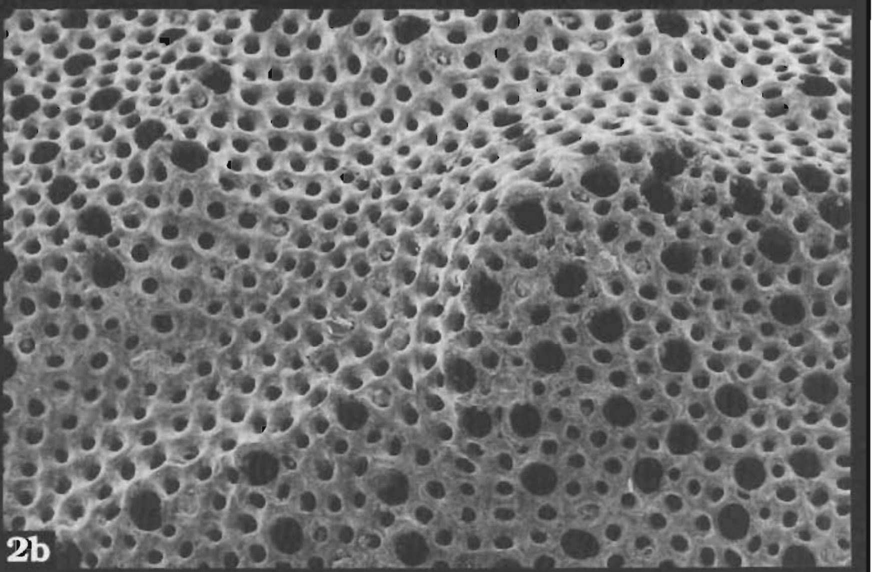
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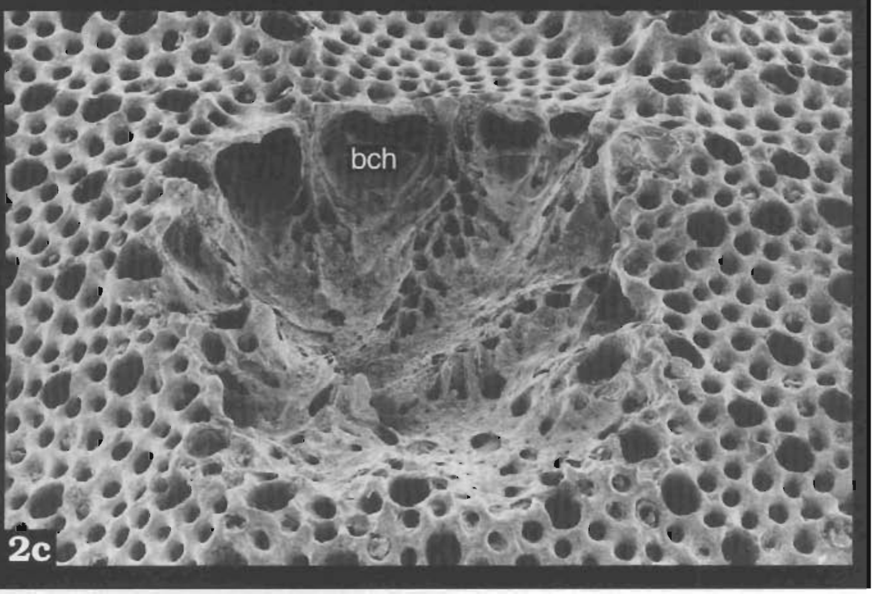

2c

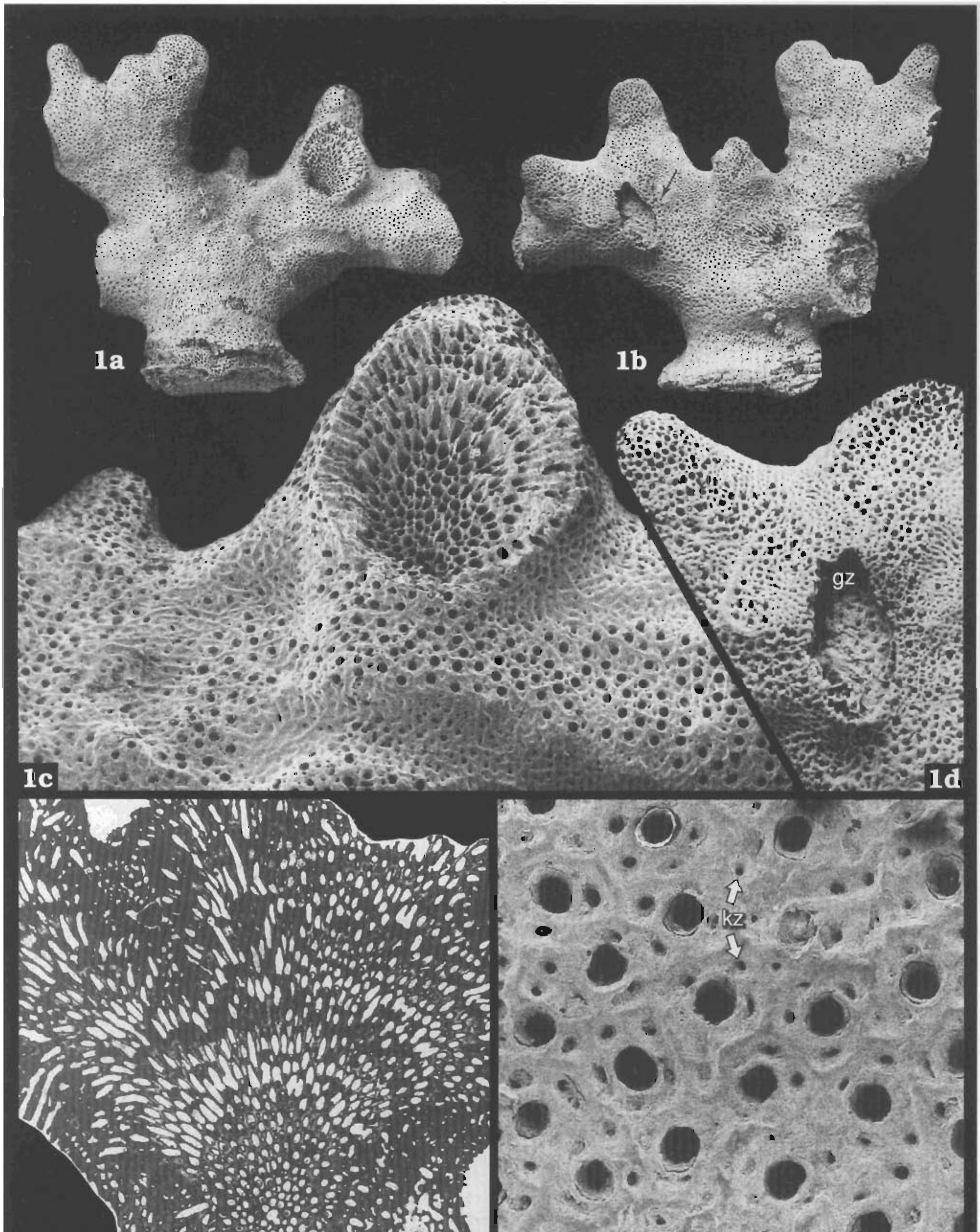
BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 6

Calvetia sp. 55

Fig. 1a. Side view of the dendroid colony with a supporting base and damaged lateral branch, × 4.
Fig. 1b. Reverse side of the colony showing a broken gynozooecium (gz), × 4.
Fig. 1c. Fragment of the upper part of the colony with concave proximal fracture surface of a branch, × 15.
Fig. 1d. Worn elliptical gynozooecium (gz), with interior walled roof × 10.
Fig. 1e. Oblique longitudinal section of a main branch, showing slightly marked overgrowths and submoniliform zooecial walls in endozone and exozone, × 9.
Fig. 1f. Autozooecial apertures surrounded by small kenozooecia (kz, arrow), × 70.

ZPAL Br.VIII/A48, ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
1b
1c
1d
gz
1e
1f
kz

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 7

Ceriopora hemisphaerica sp. n. 56

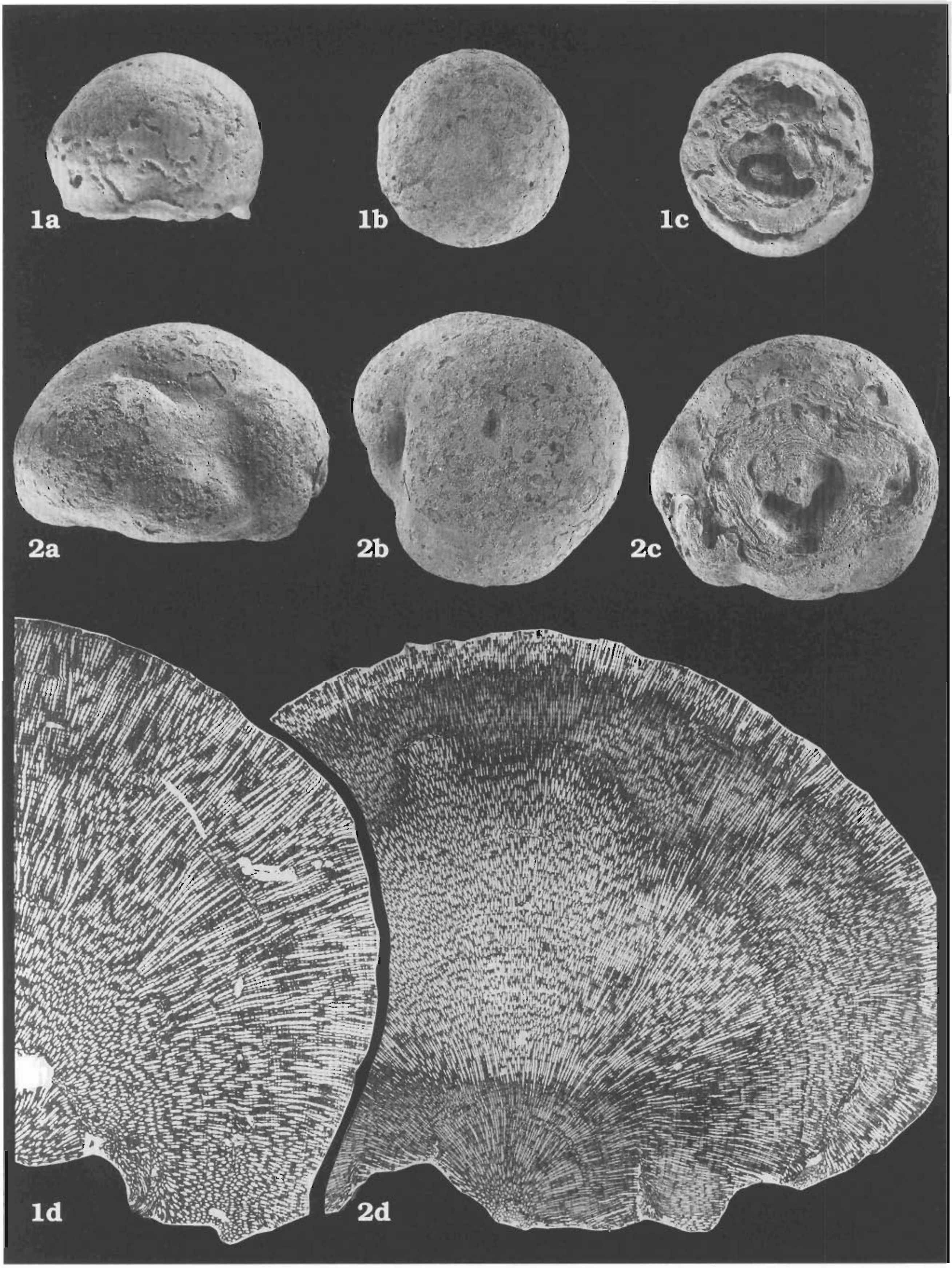
Fig. 1a. Complete hemispherical colony, side view, × 1.
Fig. 1b. Colony upper surface, × 1.
Fig. 1c. Underside of the colony showing slightly marked layering and borings, × 1.
Fig. 1d. Vertical section through the colony showing radially arranged bundles of zooecia, × 3.5.

ZPAL Br.VIII/22.

Fig. 2a. Side view of the complete hemispherical colony, × 1.
Fig. 2b. Colony upper surface, × 1.
Fig. 2c. Underside of the colony with layering and small cavity in the centre, × 1.
Fig. 2d. Vertical section through the colony showing radially arranged zooecia with distinct, short numerous growth lines, × 3.

Holotype ZPAL Br.VIII/21.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
1b
1c
2a
2b
2c
1d
2d

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 8

Neofungella capitula sp. n. 58

Fig. 1. Side view of the colony, × 3; ZPAL Br.VIII/30.
Fig. 2a. Side view of the colony showing capping overgrowths in the proximal part, × 3.
Fig. 2b. Vertical section through the colony showing numerous brood chambers (arrows) with internal partitions and roofs overgrown by the subsequent zooecia, × 10.

ZPAL Br.VIII/48.

Fig. 3a. Side view of hemispherical colony, × 3.
Fig. 3b. Upper surface of hemispherical colony, × 3.

ZPAL Br.VIII/33.

Fig. 4. Side view of the colony showing layering in the proximal part, × 3; ZPAL Br.VIII/54.
Fig. 5. Side view of hemispherical colony, × 3; ZPAL Br.VIII/68.
Fig. 6a. Side view of the complete colony with an expanded base and capping overgrowths in the proximal part, × 3.
Fig. 6b. Colony upper surface, × 3.

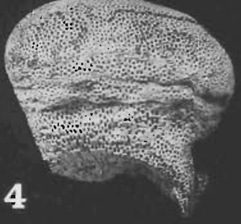
ZPAL Br.VIII/35.

Fig. 7. Side view of colony showing numerous overgrowth, × 3, Br.VIII/65.
Fig. 8a. Slightly abraded zoarial surface from the side view showing successive layers, × 3.
Fig. 8b. Zoarial surface showing arrangement of autozooecia and kenozooecia, × 50.

Holotype ZPAL Br.VIII/229.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.

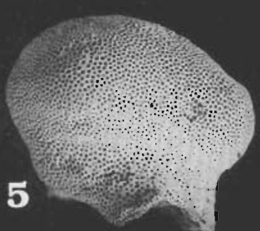
1



4

7

2a

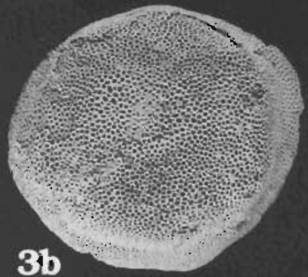


5

8

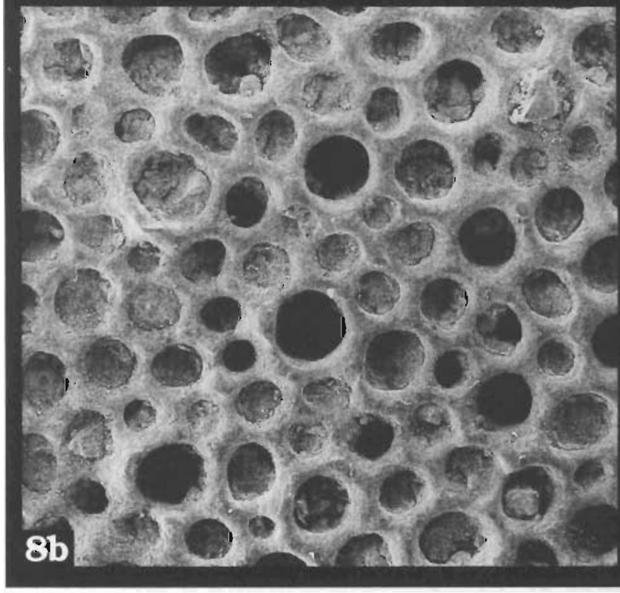
3a

6a

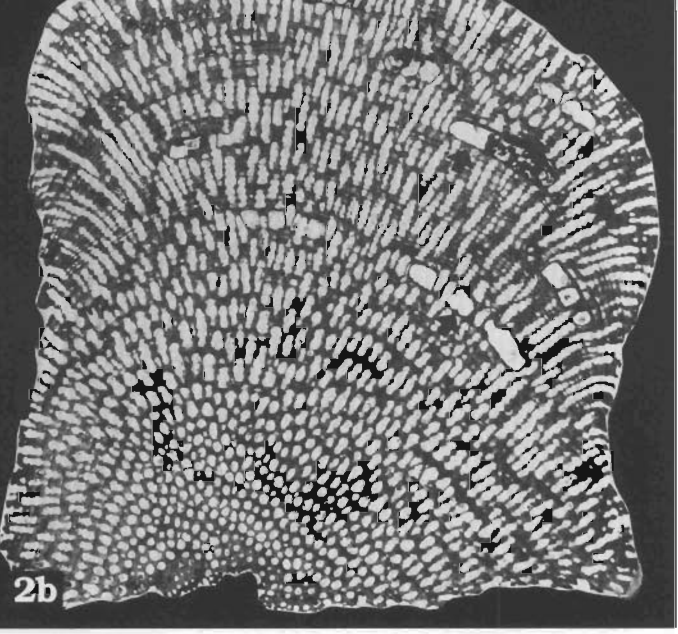


3b

6b



8b



2b

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 9

Reticrescis plicatus gen. et sp. n. 61

Fig. 1a. Reticulate colony, dorsal view showing the origin of the colony (in the centre) from where the branches ramify radially, × 1.5.
Fig. 1b. Side view of the same colony, × 1.5.
Fig. 1c. Upper view of the colony filled with sediment, × 1.5.

ZPAL Br.VIII/A66.

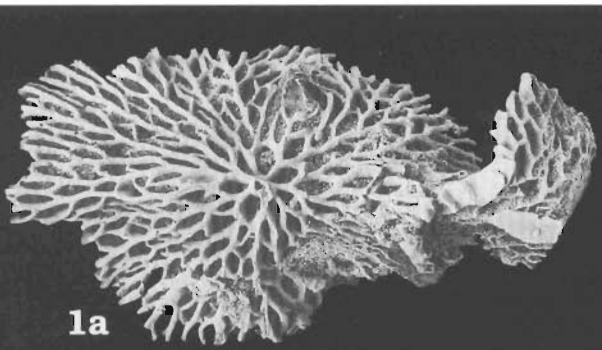
Fig. 2. Reticulate colony embedded into the sandstone, dorsal view, × 1.5; ZPAL Br.VIII/A13.
Fig. 3a. Upper view of the cup-shaped colony showing reticulation of the branches, × 3.
Fig. 3b. Side view of the colony showing reticulation of the branches, × 3.

ZPAL Br.VIII/A4.

Fig. 4a. Portion of a reticulate colony from the dorsal view, × 1.3.
Fig. 4b. Portion of the reticulate colony, frontal view with incidentally adherent hornerid and cellariid colonies, × 1.3.

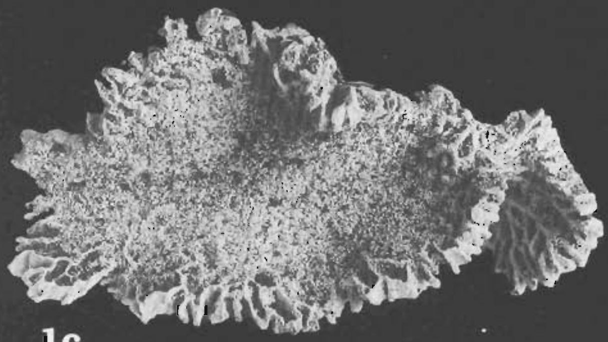
Holotype ZPAL Br.VIII/A69.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.



1a

1b



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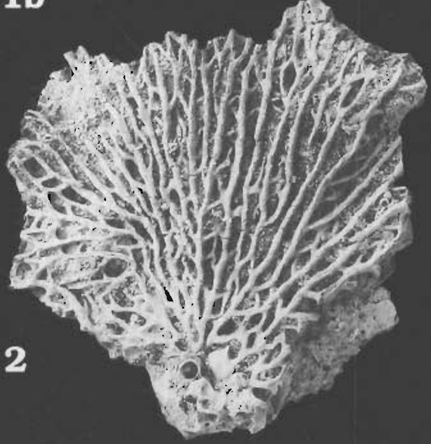

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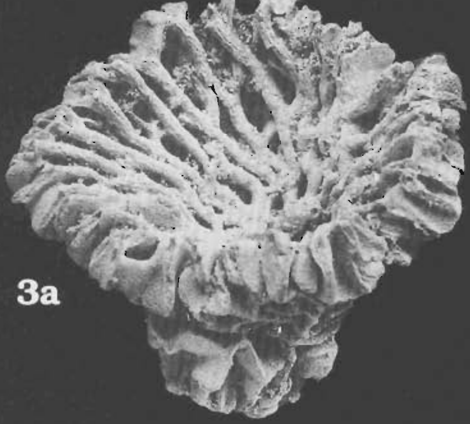

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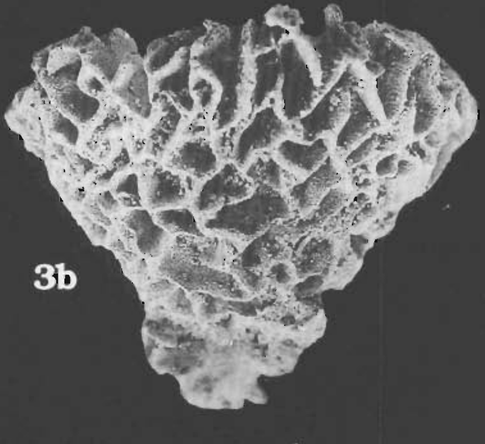

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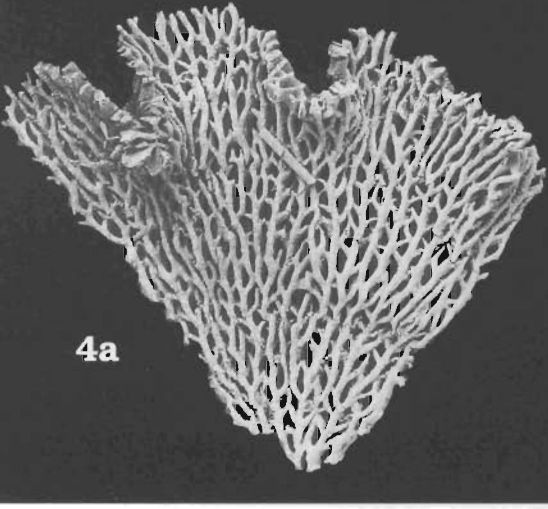
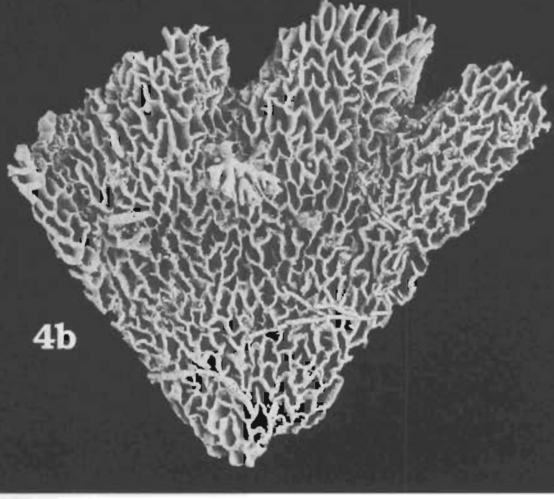


4a



4b

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 10

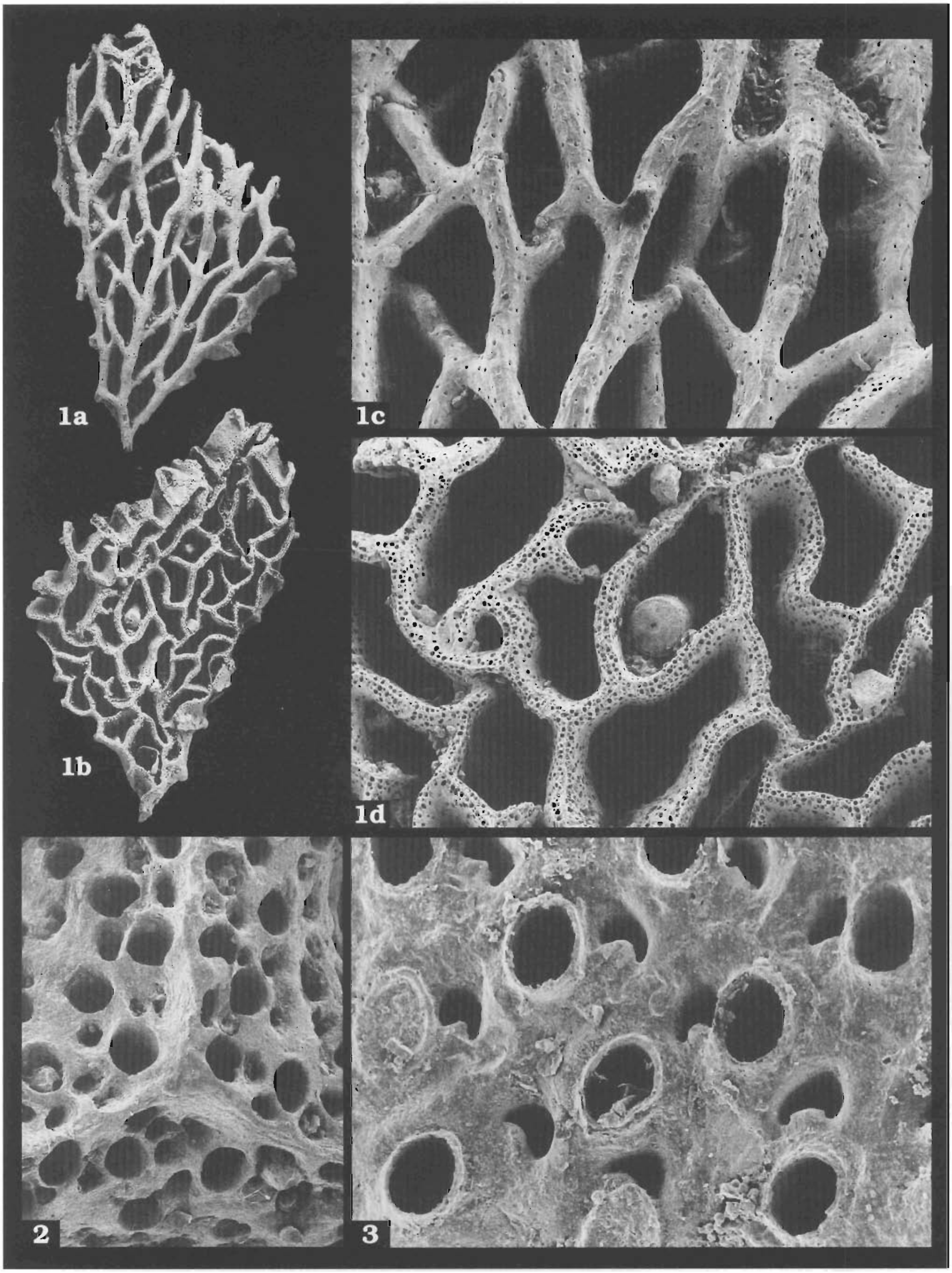
Reticrescis plicatus gen. et sp. n. 61

Fig. 1a. Fragment of reticulate colony, dorsal view, × 3.
Fig. 1b. Frontal view, × 3.
Fig. 1c. Fenestrae of reticulation of the dorsal side of branches with numerous pores, × 11.
Fig. 1d. Fenestrae of reticulation of the branches with budding laminae, frontal side, × 11.

ZPAL Br.VIII/42.

Fig. 2. Frontal side of a bilamellar branch showing budding laminae surrounded by zooecia, × 210; ZPAL Br.VIII/A8.
Fig. 3. External structure of the free-wall showing the tubular zooecia with prominent peristomes encircled by adjacent kenozooecia, × 135; holotype ZPAL Br.VIII/A69.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
1c
1b
1d
2
3

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 11

Reptomulticava clavaeformis sp. n. 62

Fig. 1a. Club-shaped colony, side view with a brood chamber (arrow) at the top, × 5.
Fig. 1b. Vertical section showing multilamellar internal structure, × 6.
Fig. 1c. Autozooecial apertures, × 95.
Fig. 1d. Autozooecial apertures with diaphragms, × 80.
Fig. 1e. Worn brood chamber (bch) at the top of colony, × 24.

ZPAL Br.VIII/69.

Fig. 2a. Side view of the colony showing successive overgrowths, × 4.
Fig. 2b. Reverse side of the same colony showing overgrowths, × 4.

Holotype ZPAL Br.VIII/71.

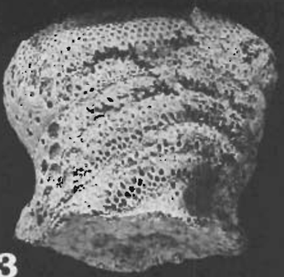
Fig. 3. Side view of the compete colony, × 5; ZPAL Br.VIII/70.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.

1a

2a

2b



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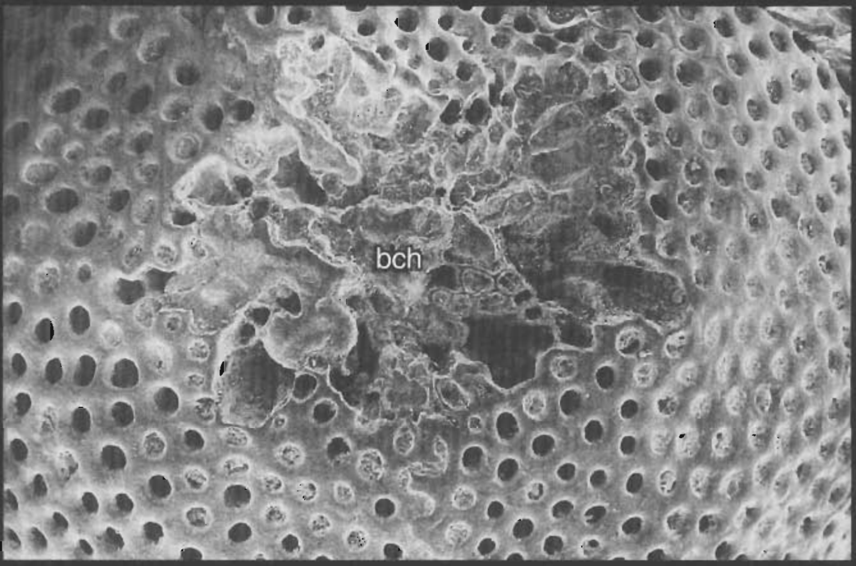
1b



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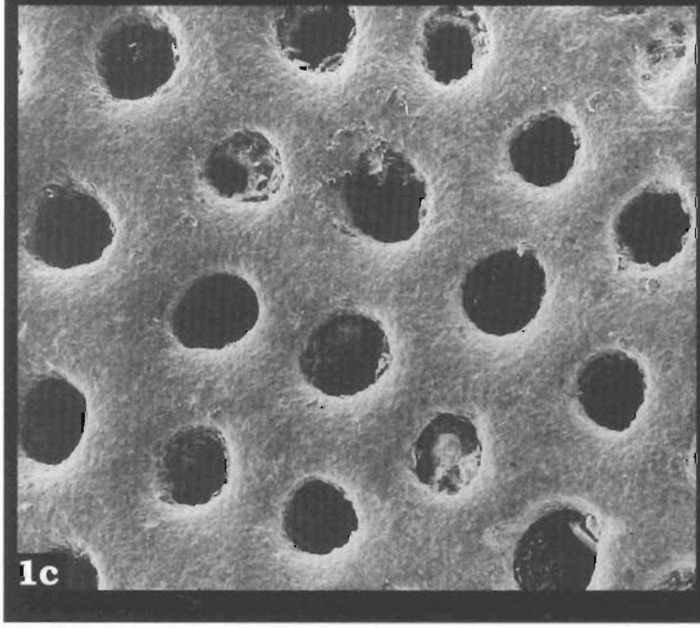

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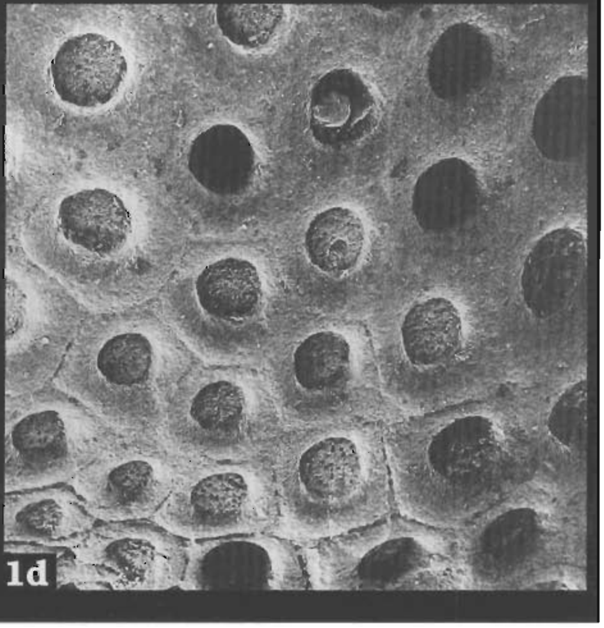


1d

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 12

Reptomulticava seymourensis sp. n. 63

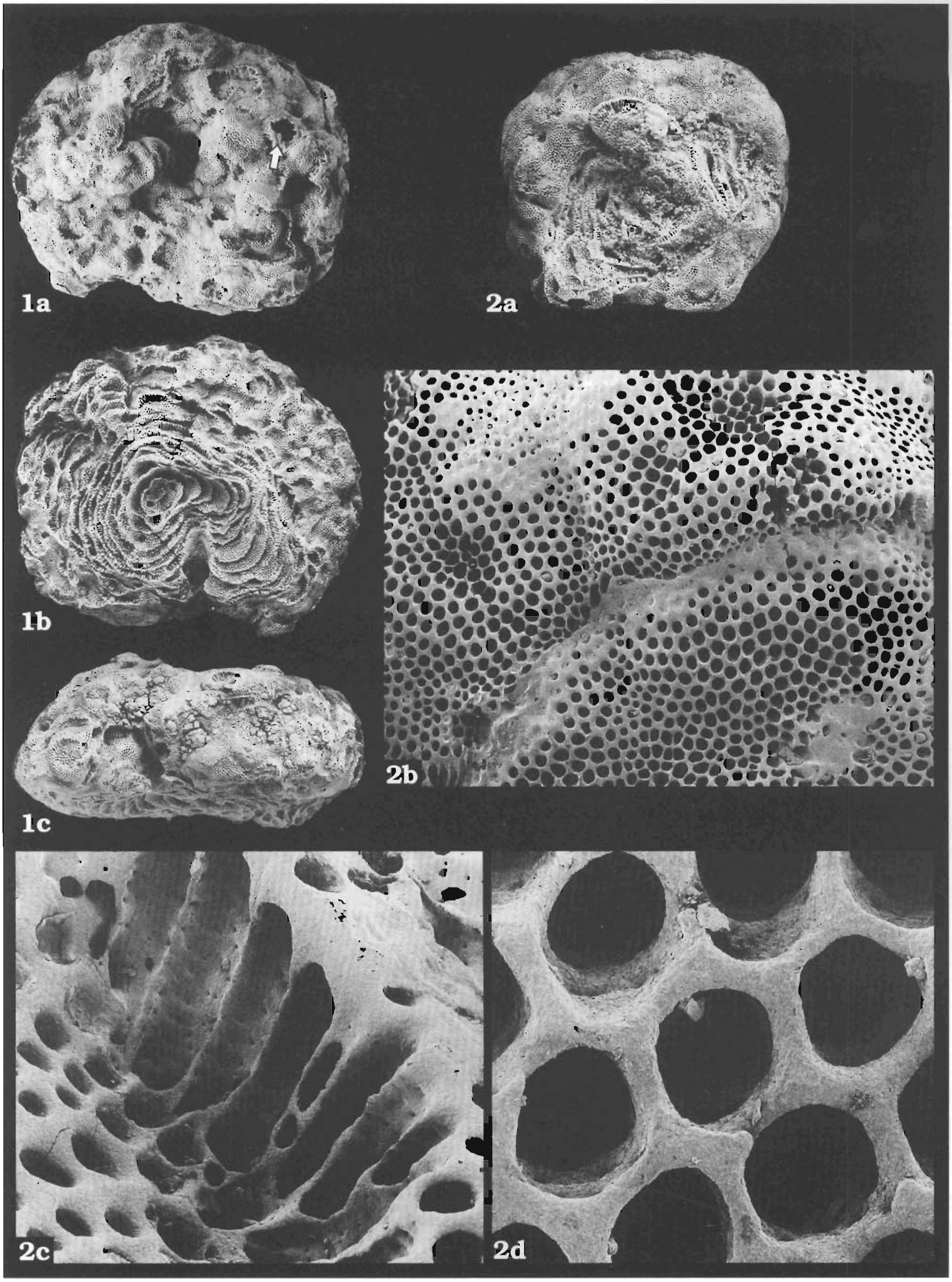
Fig. 1a. Upper surface of the complete multilamellar colony showing numerous subcolonies and a brood chamber (arrow), × 2.
Fig. 1b. Underside of the colony showing layering, × 2.
Fig. 1c. Slightly worn colony, side view, × 2.

Holotype ZPAL Br.VIII/289.

Fig. 2a. Underside of multilamellar colony with layering, × 2.
Fig. 2b. Fragment of the zoarial surface showing edge of a overgrowing subcolony, × 14.
Fig. 2c. Growing edge showing porous interior walls, × 70.
Fig. 2d. Circular autozooecial apertures, × 100.

ZPAL Br.VIII/117.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
2a
1b
2b
1c
2c
2d

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 13

Reptomulticava seymourensis sp. n. 63

Fig. 1a. Side view of the complete multilamellar colony, × 2.
Fig. 1b. Fragment of the zoarial surface with maculae, × 12.
Fig. 1c. Group of autozooecial apertures with well-marked borders, × 100.

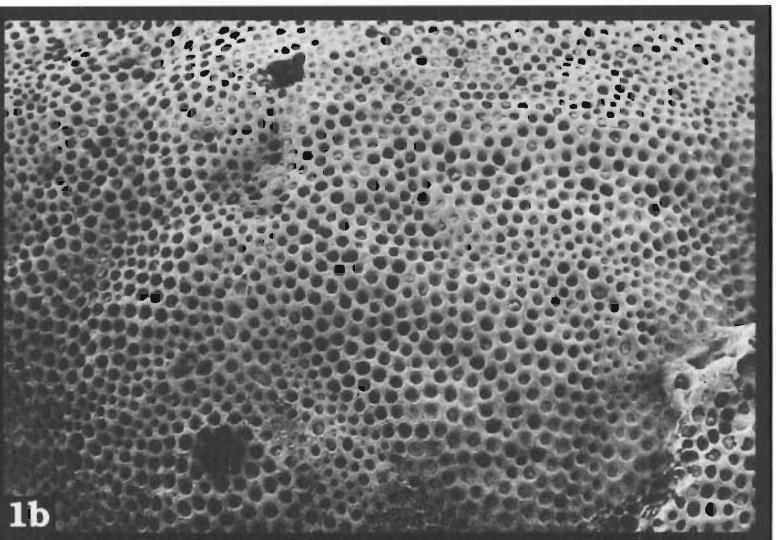
ZPAL Br.VIII/113.

Fig. 2a. Upper surface of a slightly worn, multilamellar colony, × 2.5.
Fig. 2b. Side view showing numerous successive growth layers, × 2.5.
Fig. 2c. Vertical section showing multilamellar structure of the colony, × 4.

ZPAL Br.VIII/284.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a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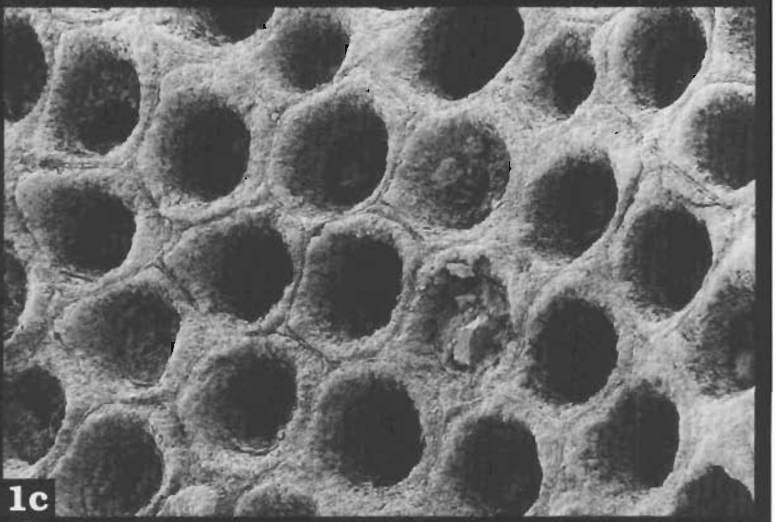
2a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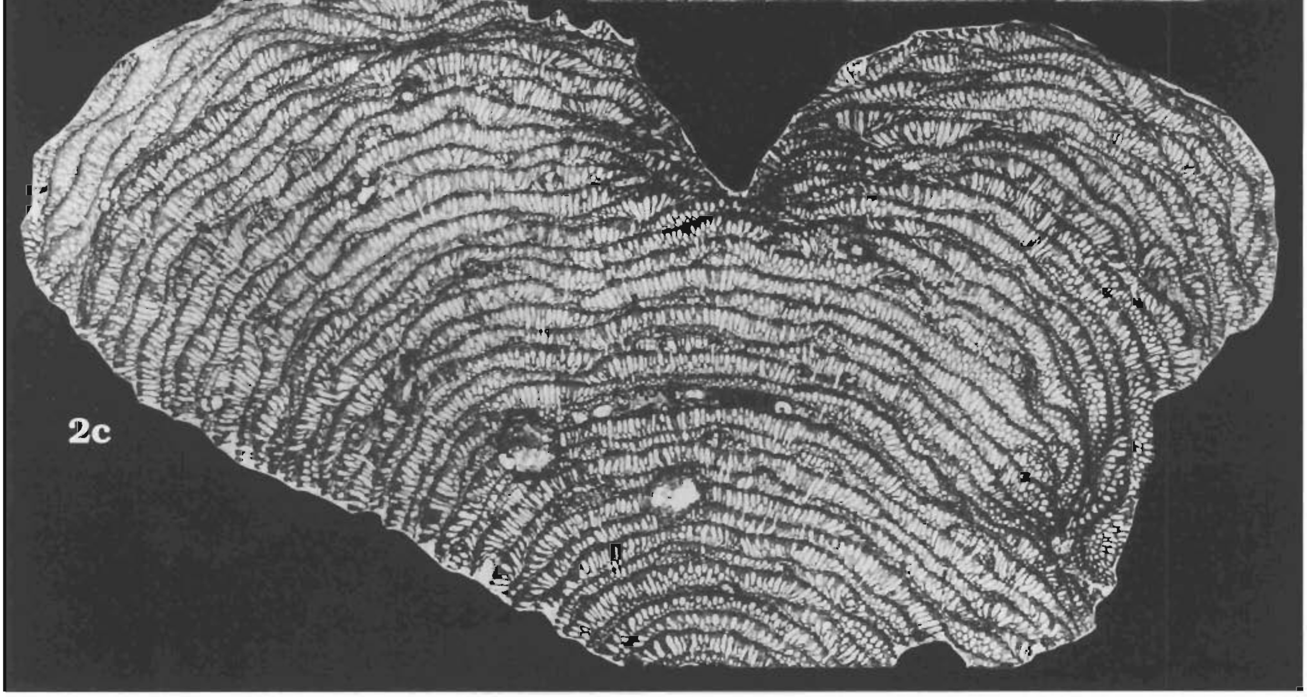
2b


2c

U. HARA: BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 14

Disporella marambioensis sp. n. 65

Fig. 1a. Saucer-shaped colony showing concave central part of zoarium with radially arranged radii of autozooecial apertures and slightly worn brood chamber (arrow), × 4.

Fig. 1b. Side view of the saucer-shaped colony with indistinct growth lines, × 4.

Fig. 1c. Colony underside, × 4.

Fig. 1d. Details of the zoarial surface with oval, depressed central area, radially arranged radii of autozooecial apertures and brood chamber on the left, × 10.

Fig. 1e. Slightly worn brood chamber developed as lobes between autozooecial radii (bch), × 30.

Fig. 1f. Part of the depressed central area with projecting autozooecial radii and alveoli in between, × 25.

Holotype ZPAL Br.VIII/A3.

Fig. 2. Composite colony with rosette-shaped subcolonies and well-projecting radii of autozooecial apertures, × 4; ZPAL Br.VIII/A1.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.

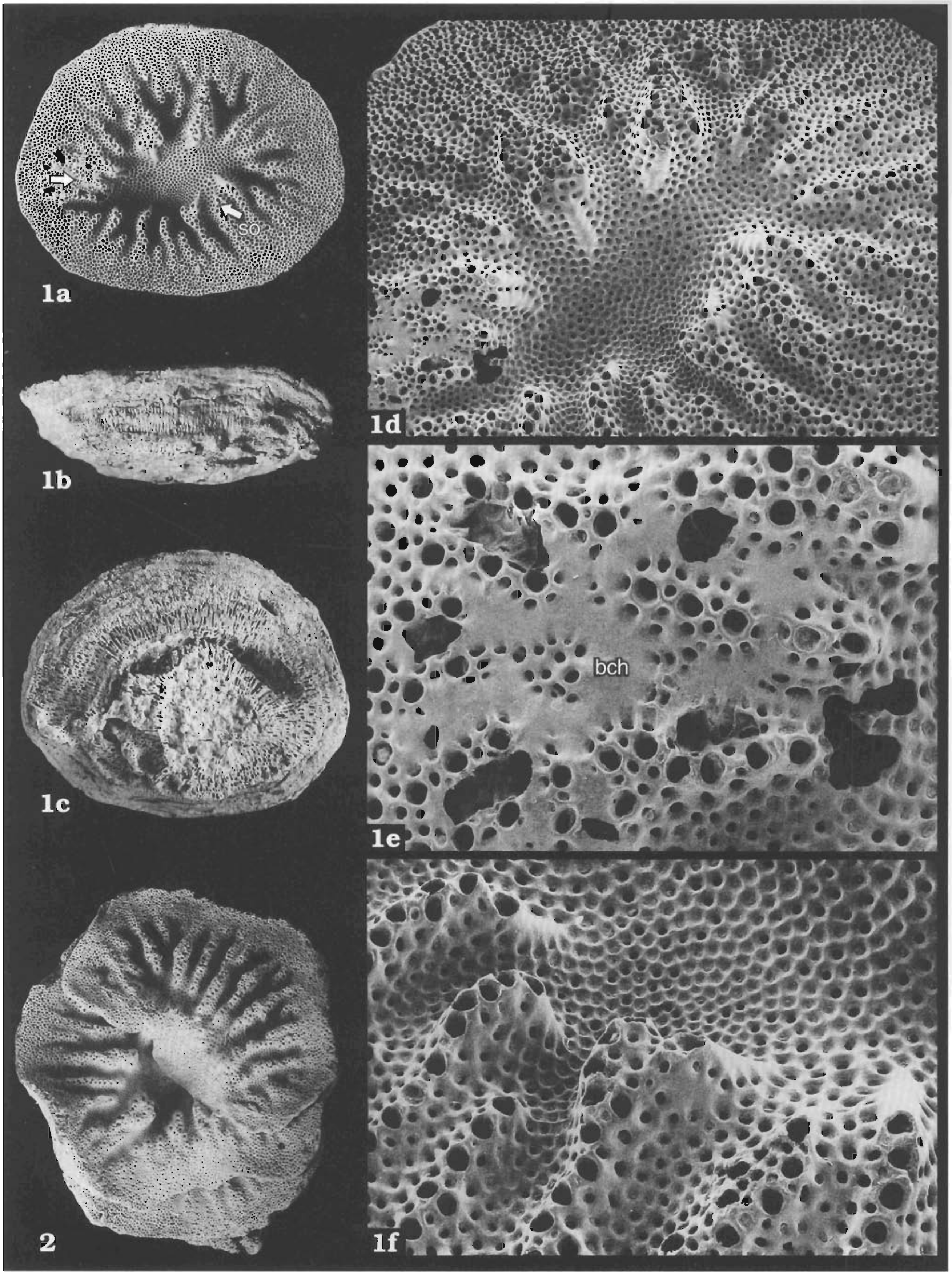

1a
so
1b
1c
2
1d
1e
bch
1f

PLATE 15

Aspidostoma multiformis sp. n. 66

Fig. 1a. Portions of thick, broken bilamellar sheets, × 1. 5.
Fig. 1b. Group of autozooecia, × 35.

ZPAL Br.VIII/A15; ZPAL 1, Telm1

Aspidostoma pyriformis sp. n. 68

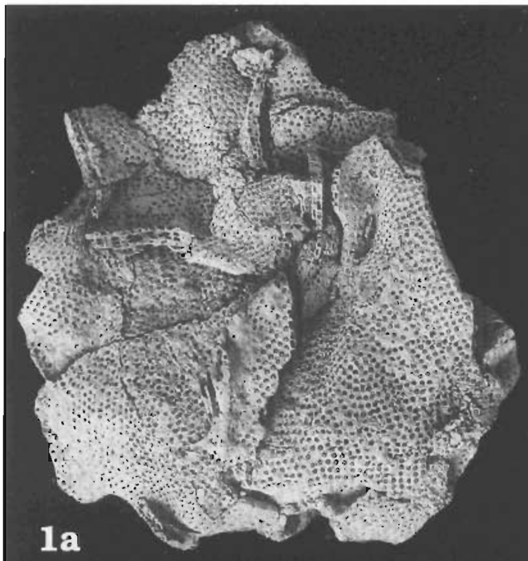
Fig. 2a. Fragment of thick, encrusting bilamellar colony with chaotically arranged autozooecia, × 2.
Fig. 2b. Group of autozooecia with avicularium (av), × 50.

ZPAL Br.VIII/A76; ZPAL 1, Telm1.

Fig. 3a. Thick, bilamellar branches forming spheroidal colony with interspaces filled with sediments, × 1.
Fig. 3b. A few worn zooecial apertures, × 70.

ZPAL Br.VIII/A70; ZPAL 12, Telm1.

La Meseta Formation (Eocene), Seymour Island.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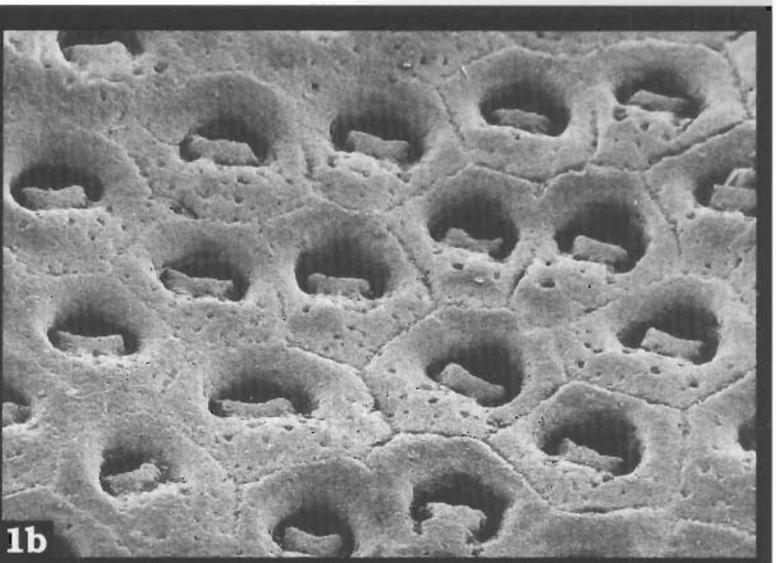
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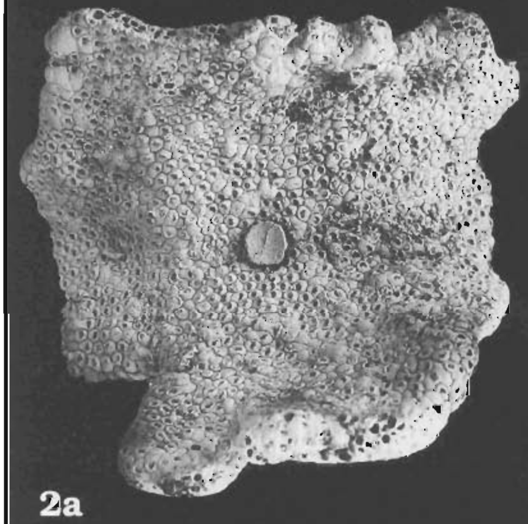
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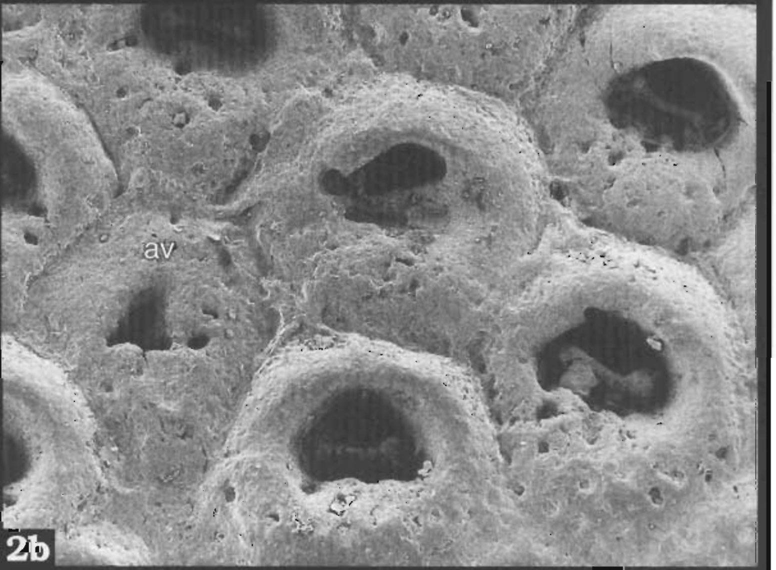
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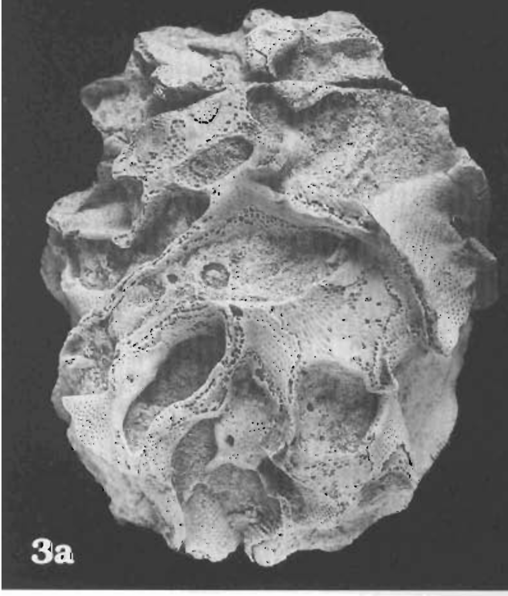
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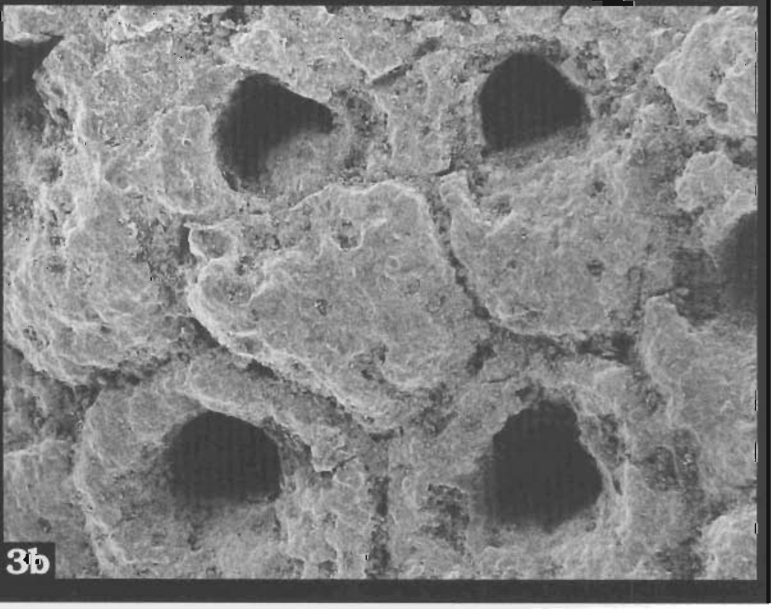

3b

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 16

Aspidostoma taylori sp. n. 70

Fig. 1a. Side view of a branched, bilamellar colony, with small encrusting tubuliporid specimens in the proximal part of the branch (arrows), × 3.
Fig. 1b. Reverse side of the same branched colony, × 3.
Fig. 1c. Middle part of the branch showing irregularly-pyriform autozooecia and kenozooecia (kz) at the margin of the branch, × 10.

Holotype ZPAL Br.VIII/A50.

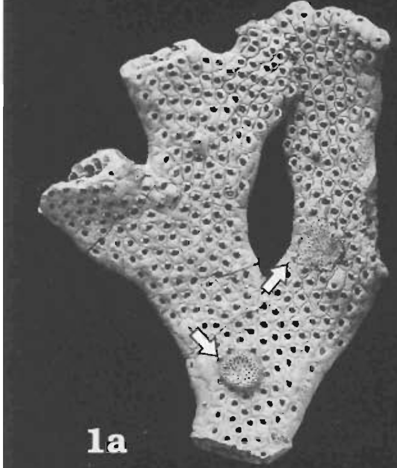
Fig. 2a. Growing tip of the branched colony, × 4.
Fig. 2b. Distal part of zoarium showing autozooecia, one with broken ovicell (ov), × 25.

ZPAL Br.VIII/A31.

Fig. 3a. Proximal part of a thick, broken bilamellar colony, × 3.
Fig. 3b. Group of autozooecia, × 43.

ZPAL Br.VIII/A30.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.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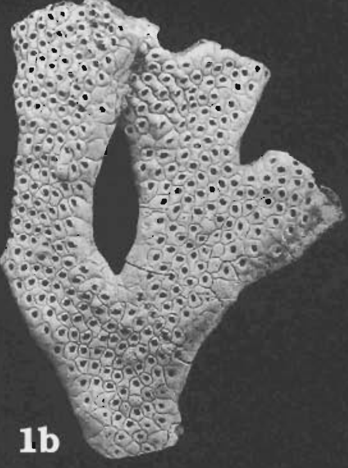
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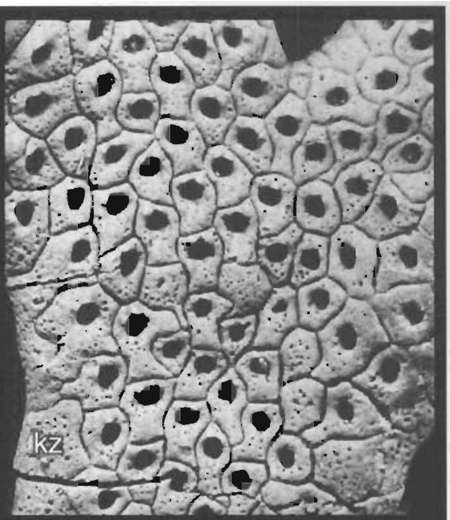

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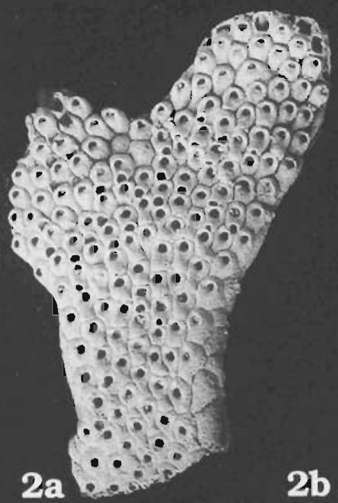
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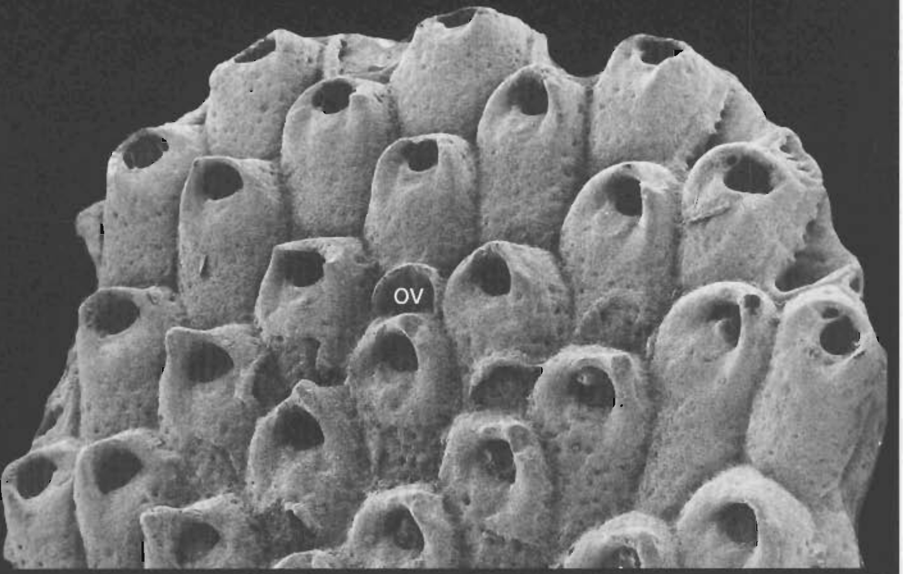

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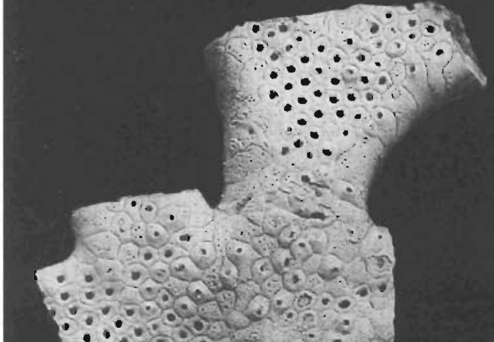
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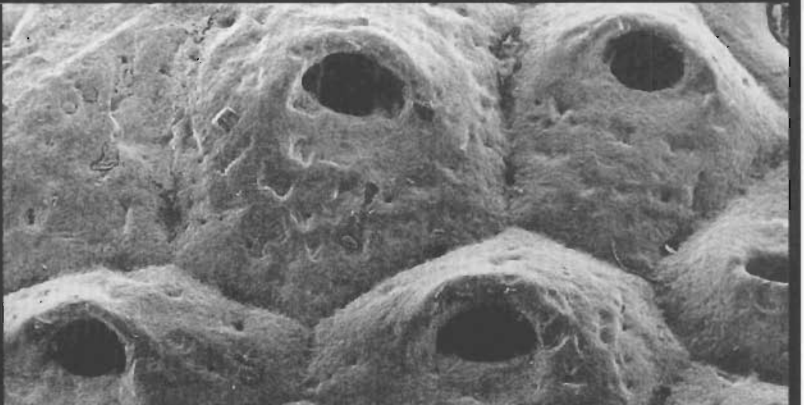

3b

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 17

Celleporaria australis sp. n. 74

Fig. 1a. Upper surface of the massive colony, × 2.
Fig. 1b. Side view of the same, massive barrel-shaped colony, × 2.
Fig. 1c. Longitidinal section through the massive colony showing chaotically arranged zooecia, × 8.
Fig. 1d. Group of erect to semi-erect, nearly square-shaped zooecia bordered by the distinct margins with areolar pores, among which there are ovicelled zooecia (ov), × 35.

Holotype ZPAL Br.VIII/485.

Rhynchozoon quadratus sp. n. 86

Fig. 2. Side view of leaf-like, massive colony with a strong supporting base, × 2.
Fig. 3. Group of zooecia surrounded by marginal pores, × 50.

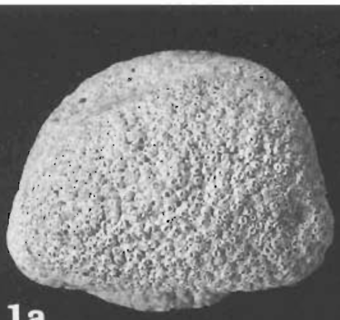
Holotype ZPAL Br.VIII/A39.

?*Osthimosia* sp. 85

Fig. 4a. Side view of the irregularly-nodular zoarium encrusting a portion of a bilamellar bryozoan, × 3.
Fig. 4b. Fragment of the zoarial surface showing arrangement of zooecia with primary orifices and avicularia, × 50.

ZPAL Br.VIII/370.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.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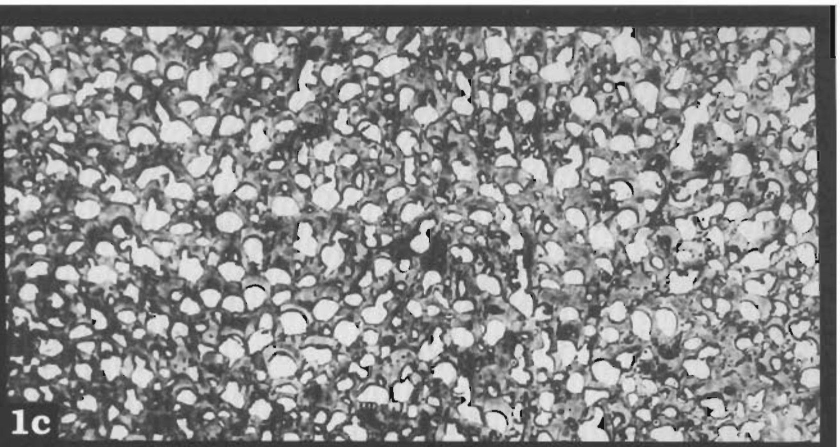
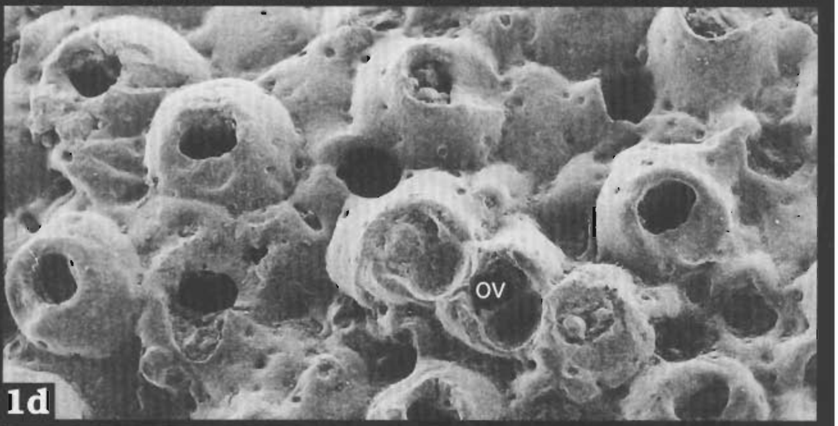
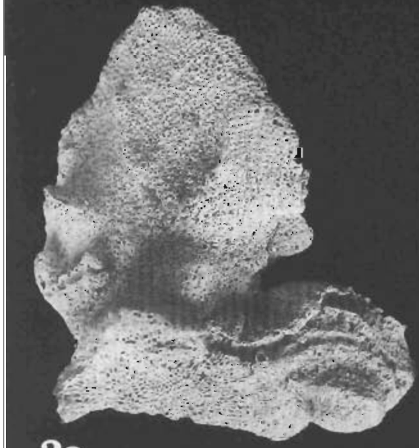

1c


1b


ov
1d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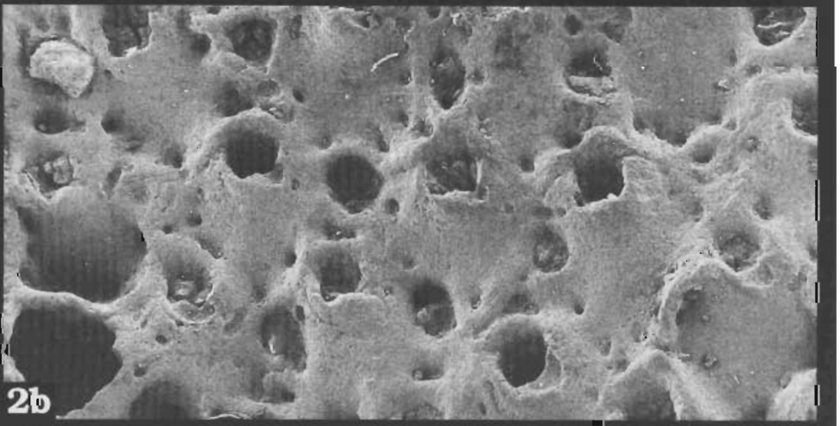
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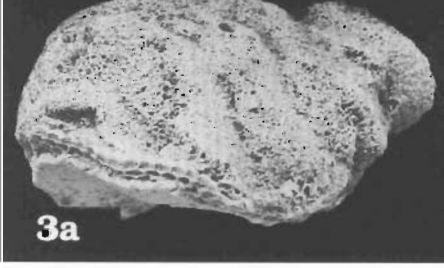
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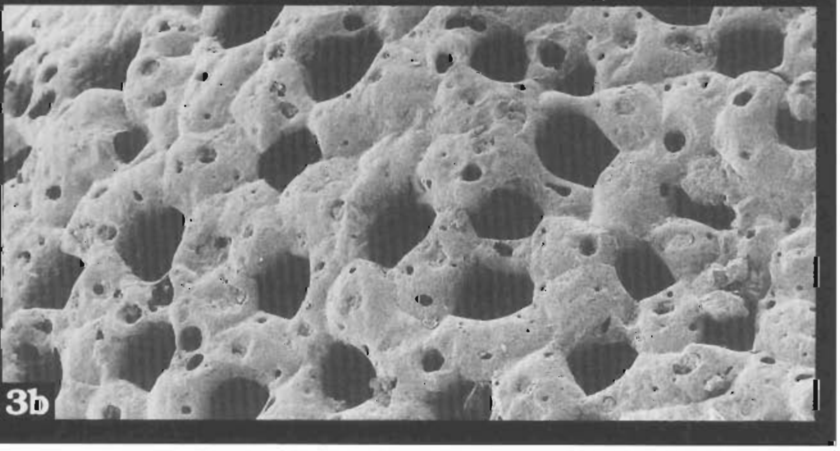
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BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 18

Celleporaria gondwanae sp. n. 74

Fig. 1a. Complete, massive mushroom-shaped multilamellar colony, side view, showing layering in the proximal part, × 1.5.

Fig. 1b. Slightly worn upper surface of the colony with a large depression in the centre, × 1.5.

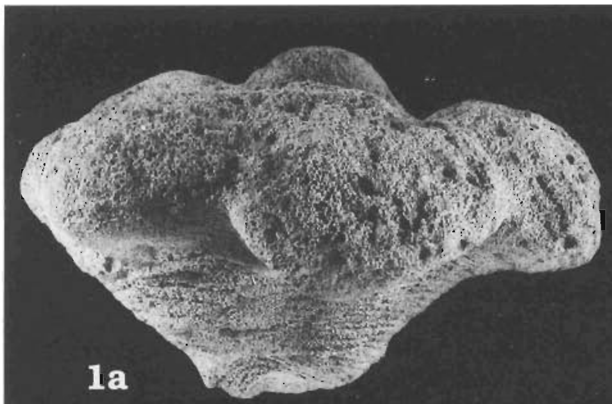
Fig. 1c. Underside of the multilamellar colony with well-marked layering, × 1.5.

Fig. 1d. Fragment of the zoarial surface showing pattern of arrangement of zooecia, avicularia (av), and broken spatulate avicularium (sa), × 60.

Holotype ZPAL Br.VIII/356.

Fig. 2. Vertical section through a multilamellar colony showing slightly undulate successive zooecial growth layers, × 7; ZPAL Br.VIII/334.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.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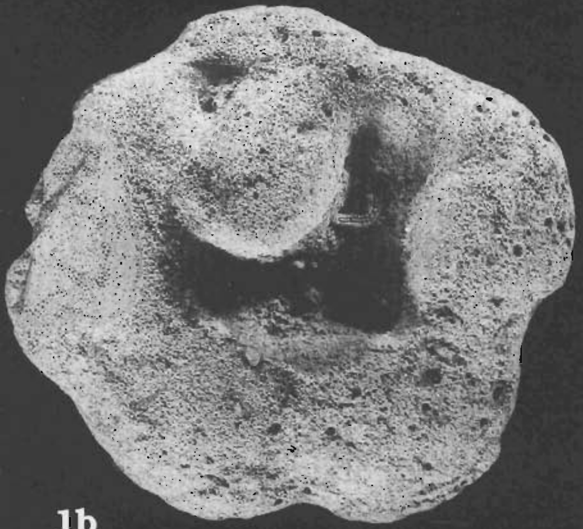
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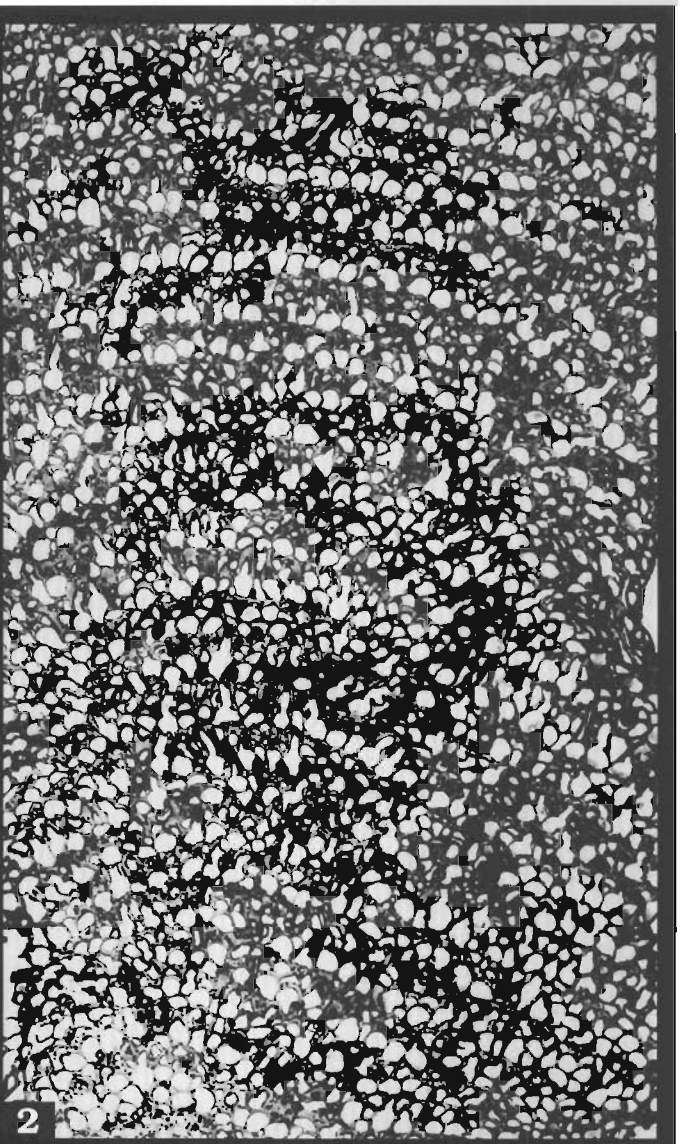
1c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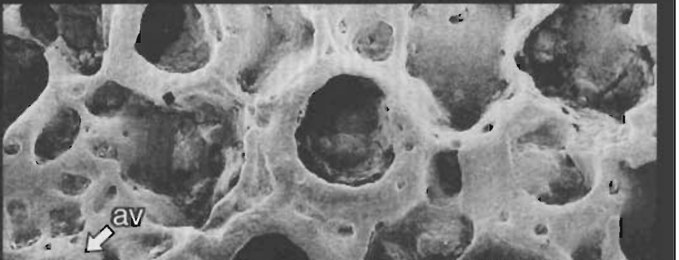

1d

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 19

Celleporaria mesetaensis sp. n. 75

Fig. 1. Vertical section through the hemispherical colony showing multilamellar structure of zoarium, × 1; ZPAL Br.VIII/471.

Fig. 2a. Upper surface of a colony with superimposed layers. Borings to be seen on the upper surface, × 1.

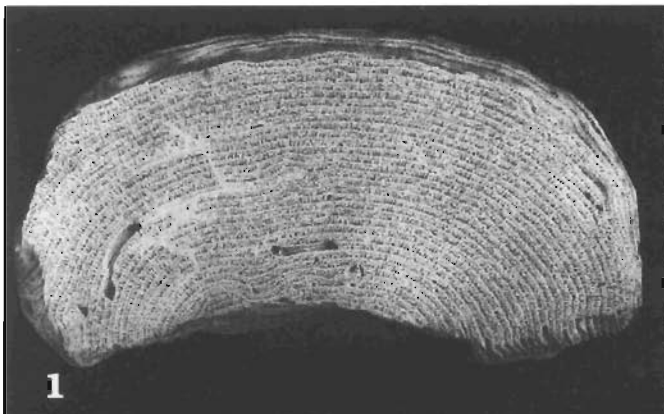
Fig. 2b. Underside of the colony showing numerous (over 40) growth layers and borings, × 1.

Holotype ZPAL Br.VIII/470.

Fig. 3. Vertical section through the colony showing successive layers of autozooecia, × 10; ZPAL Br.VIII/137.

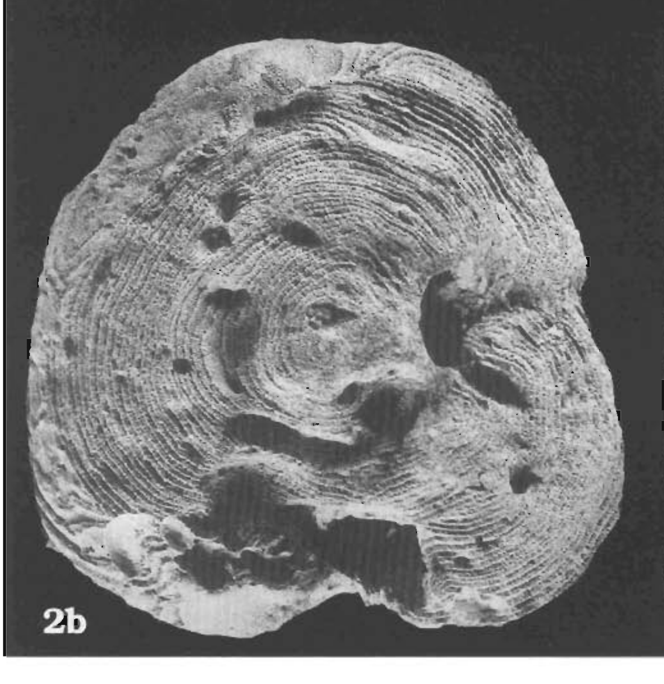
Fig. 4. Autozooecia, large spatulate avicularia and vicarious columnar avicularia, × 46; ZPAL Br.VIII/37.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.



1

2a



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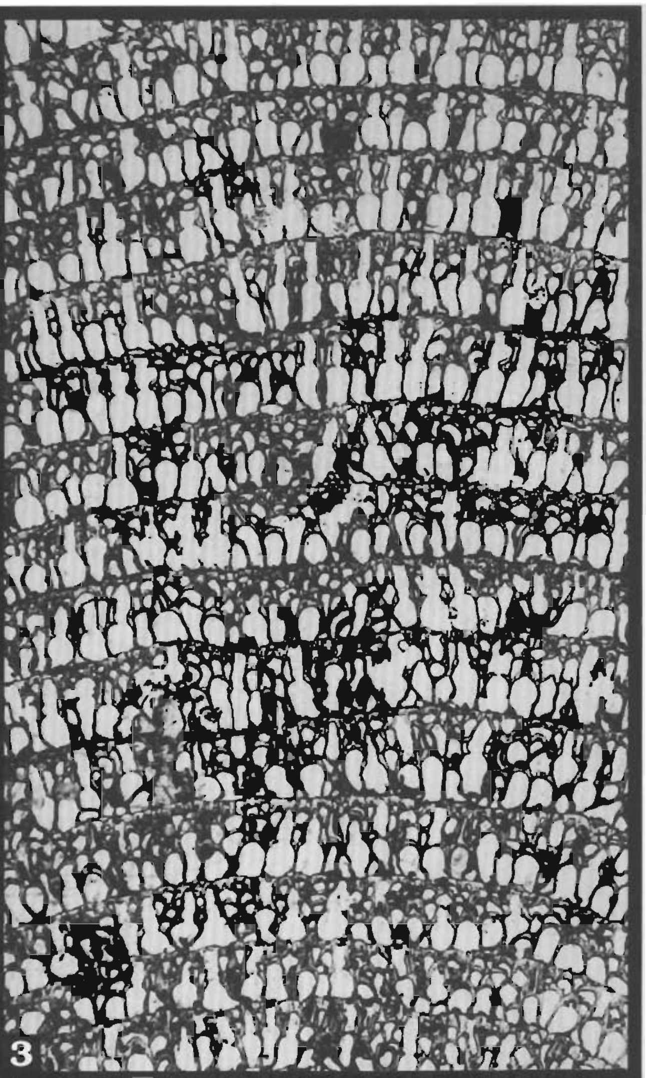

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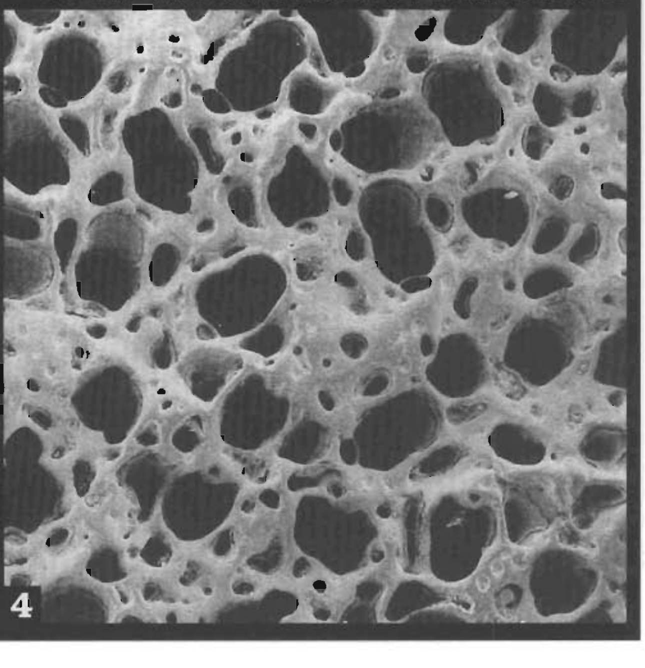


4

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 20

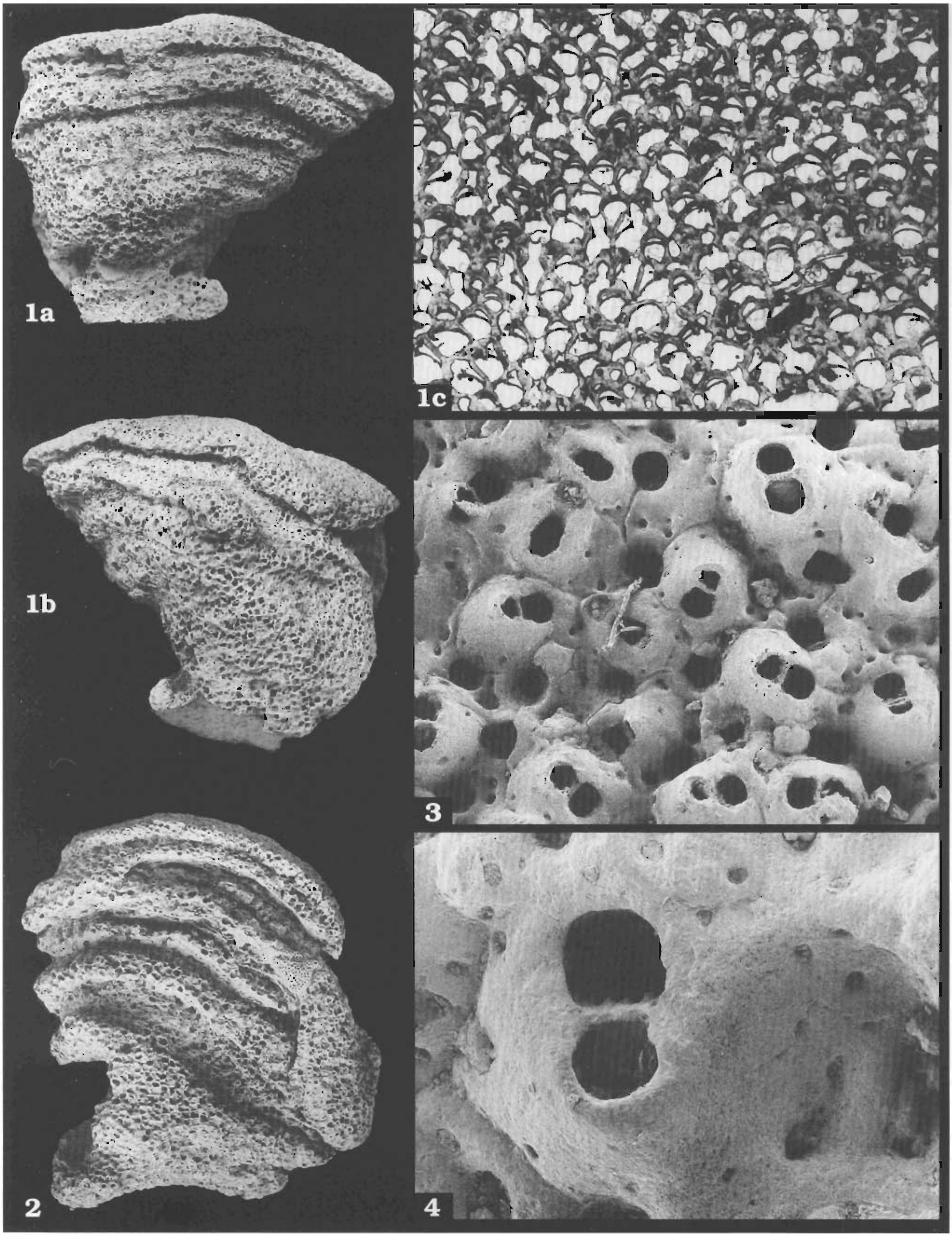
Celleporaria ovata sp. n. 76

Fig. 1a. Side view of the complete colony composed of a few superimposed encrusting layers, × 2.
Fig. 1b. Reverse side of the same colony, × 2.
Fig. 1c. Vertical section through the colony showing irregular accumulation of zooecia, × 10.

ZPAL Br.VIII/463.

Fig. 2. Side view of the colony showing succession of growth layers with small encrusting colony in the upper part, × 2; holotype ZPAL Br.VIII/393.
Fig. 3. External structure of the frontal wall, showing arrangement of zooecia, with primary orifices bordered by 5–7 processes (teeth) on the proximal rim, × 27; ZPAL, Br.VIII/118.
Fig. 4. Single zooecium showing primary orifice with five processes (teeth) on the proximal rim and large (worn) suboral avicularium, × 175; ZPAL Br.VIII/120.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1a
1c
1b
3
2
4

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 21

Celleporaria sp. 77

Fig. 1. Side view of a massive, mushroom-shaped colony, terminated by two distinct round-shaped subcolonies, × 2; ZPAL Br.VIII/337.
Fig. 2. Side view of a mushroom-shaped colony, × 2; ZPAL Br.VIII/133.
Fig. 3a. Side view of a massive, mushroom-shaped colony showing indistinct layering in the proximal part, × 3.
Fig. 3b. General pattern of the arrangement of zooecia bordered by distinct areolar pores, × 22.
Fig. 3c. Longitudinal section through the colony showing zooecia, × 10.

ZPAL Br.VIII/134.

Metroperiella sp. 82

Fig. 4a. Portion of a flat, bilamellar colony showing the arrangement of the autozooecia, × 5.
Fig. 4b. Fragment of the zoarial surface showing single zooecial apertures with a deep sinus, indistinct condyles and median avicularium, × 70.

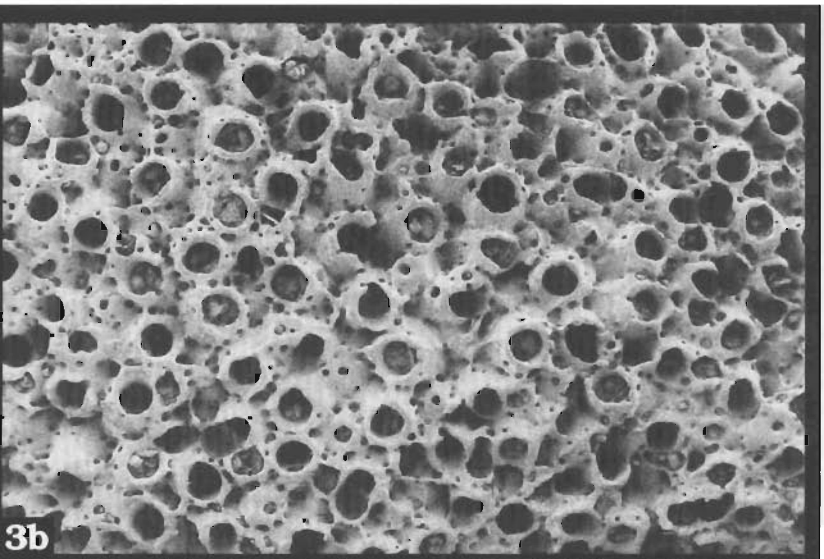
ZPAL Br.VIII/A53.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.


1


2


3a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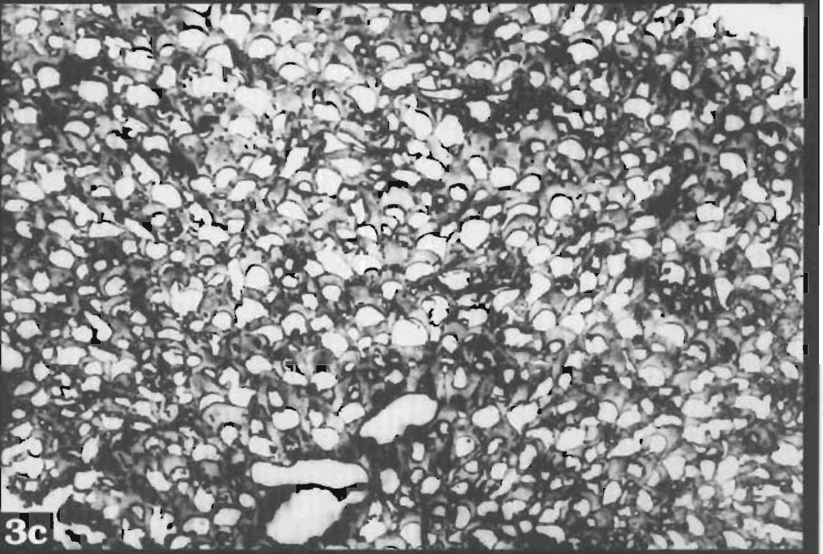
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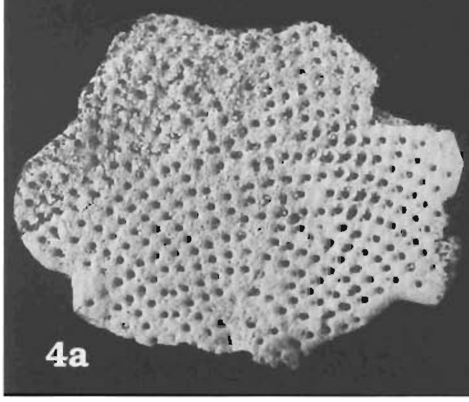
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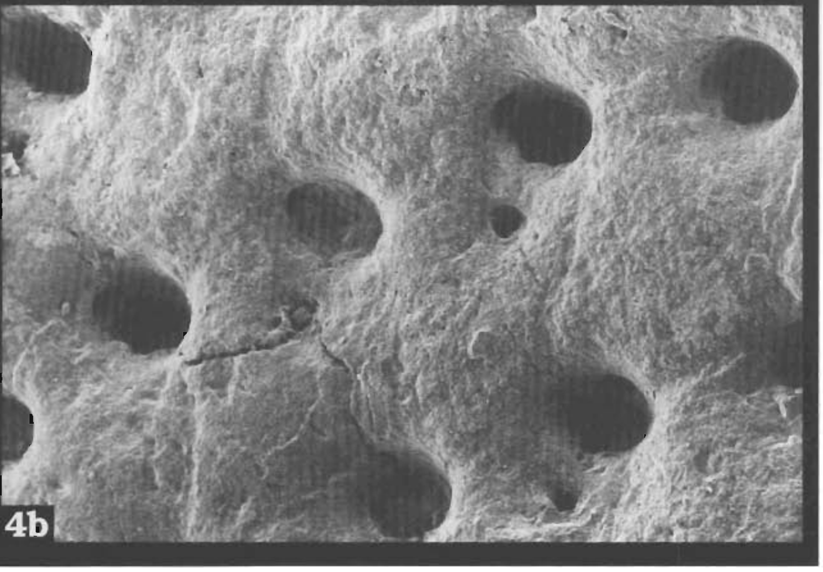

4b

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 22

Dennisia eocenica gen. et sp. n. 78

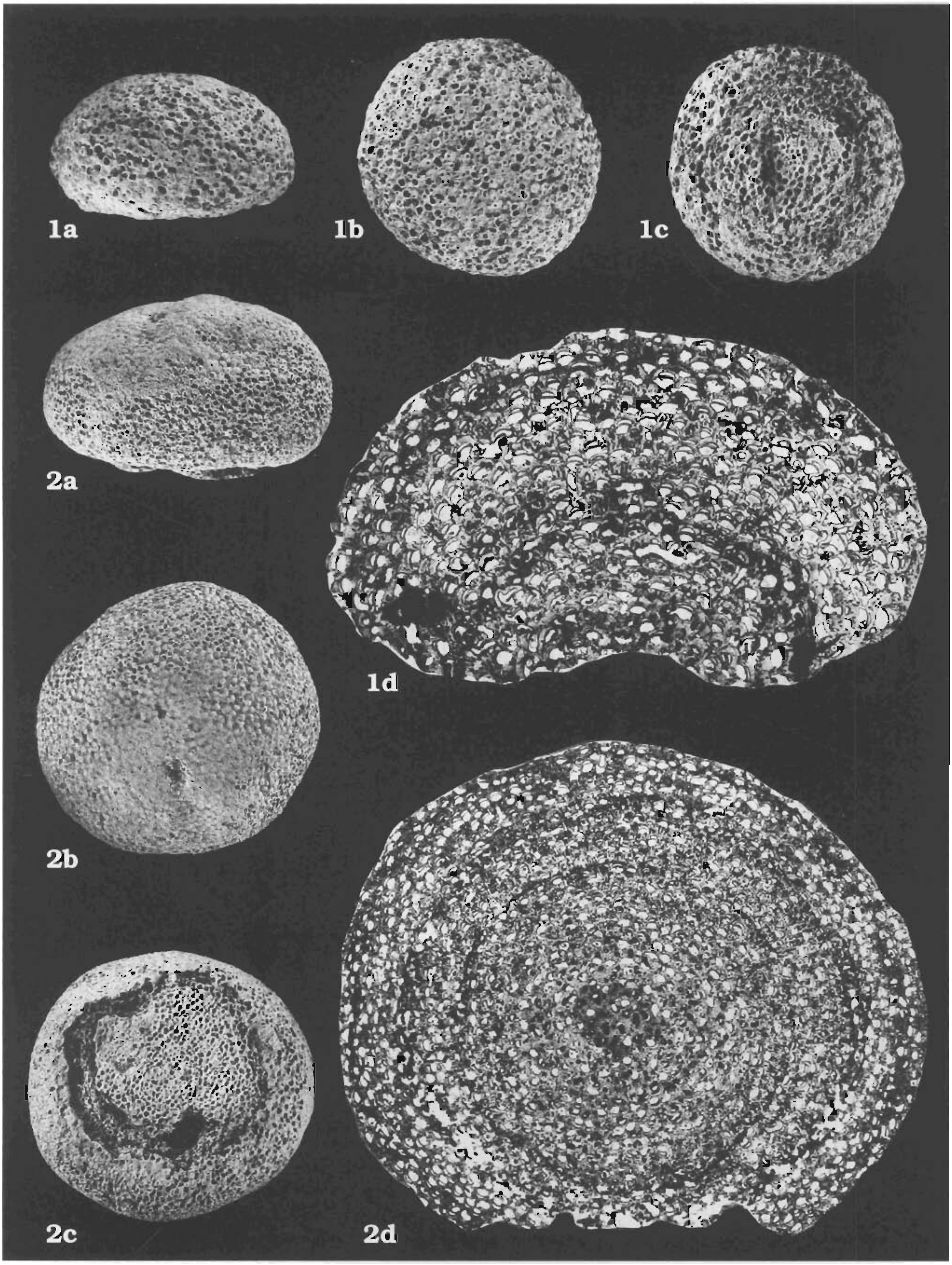
Fig. 1a. Side view of a complete hemispherical colony, × 3.
Fig. 1b. Upper surface of a hemispherical colony covered densely by the large zooecia, × 3.
Fig. 1c. Underside of a hemispherical colony, × 3.
Fig. 1d. Vertical section through the colony showing numerous successive growth layers of zooecia, × 7.5.

ZPAL Br.VIII/32.

Fig. 2a. Side view of a hemispherical colony, × 2.
Fig. 2b. Upper surface of a slightly worn hemispherical colony with well-marked zooecia, × 2.
Fig. 2c. Underside of a hemispherical colony, × 2.
Fig. 2d. Transverse section through a hemispherical colony showing concentric arrangement of zooecia, × 4.2.

Holotype ZPAL Br.VIII/31.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.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2d

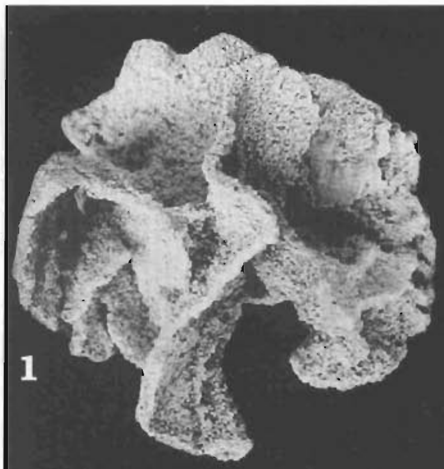
BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 23

Smittina sp. 80

Fig. 1. Portion of a foliaceous, bouquet-shaped, bilamellar colony, × 4; ZPAL Br.VIII/A91.
Fig. 2. Worn surface of a foliaceous, bilamellar colony in sandstone, × 1.5; ZPAL Br.VIII/A92.
Fig. 3. Group of zooecia, × 50; ZPAL Br.VIII/A93.
Fig. 4. Portions of bilamellar branches in *Smittina* biostromal layer, × 1; ZPAL Br.VIII/94.
Fig. 5. Thin section showing bilamellar branches of the colony, × 6; ZPAL Br.VIII/A95.

ZPAL 14, Telm6. La Meseta Formation (Eocene), Seymour Island.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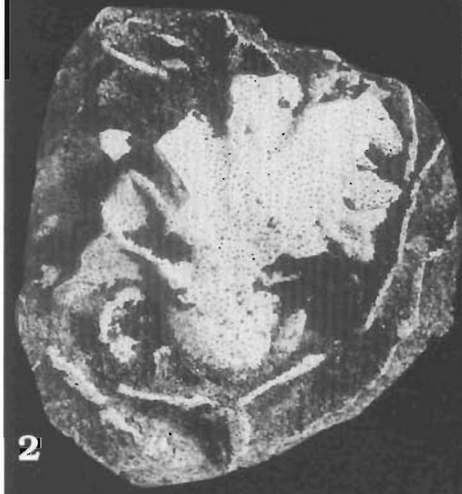
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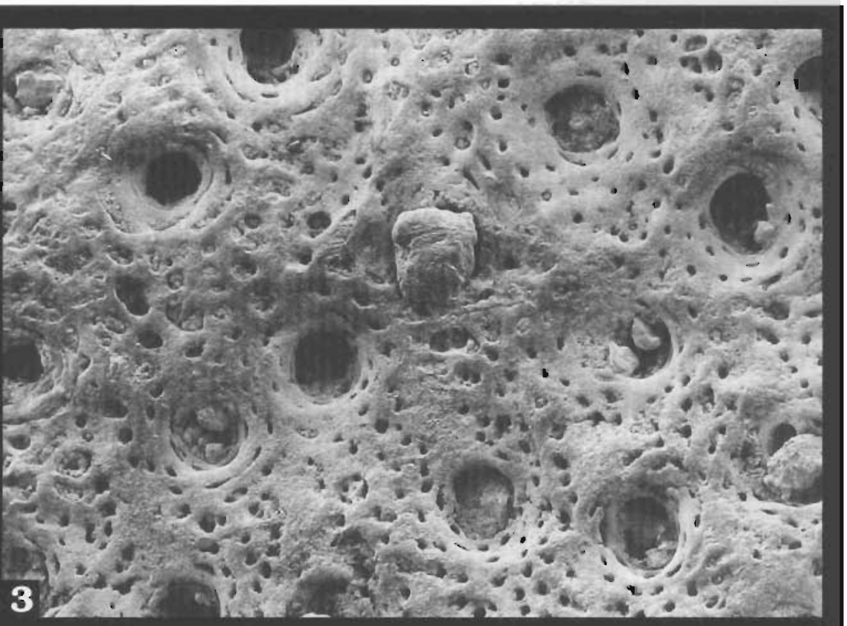
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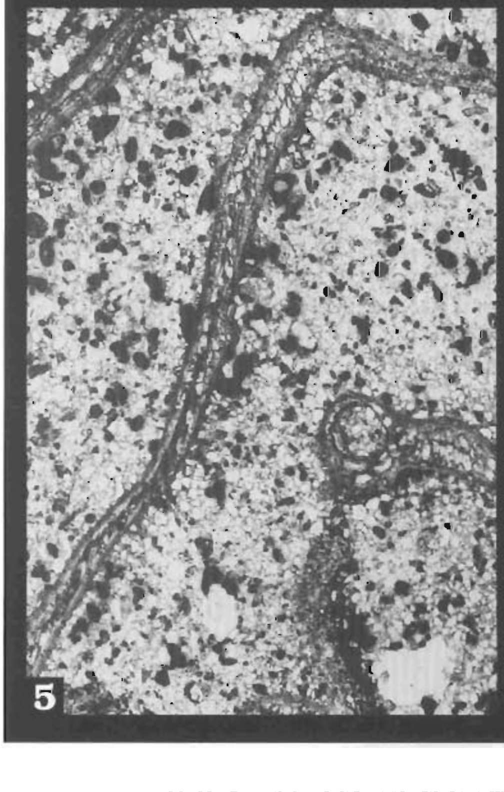
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BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

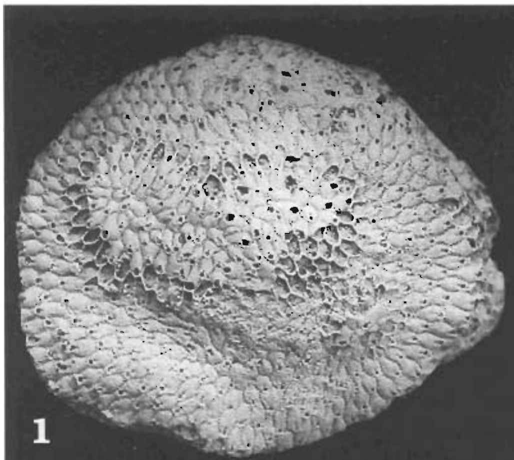
PLATE 24

Smittoidea gazdzickii sp. n. 80

Fig. 1a. Upper surface of a cap-shaped colony, × 4.
Fig. 1b. General pattern of arrangement of zooecia on the upper surface showing three centres of radially arranged zooecia, × 20.
Fig. 1c. Group of zooecia, with damaged lyrula (ly), avicularia (av, arrowed) bordered by distinct areolar pores, × 55.
Fig. 1d. Primary orifice with suboral avicularium, slightly worn lyrula (ly) and two bases of spines, × 130.
Holotype ZPAL Br.VIII/101.

Fig. 2. Vertical section through the colony showing successive layers of zooecia, × 10; ZPAL Br.VIII/102.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.



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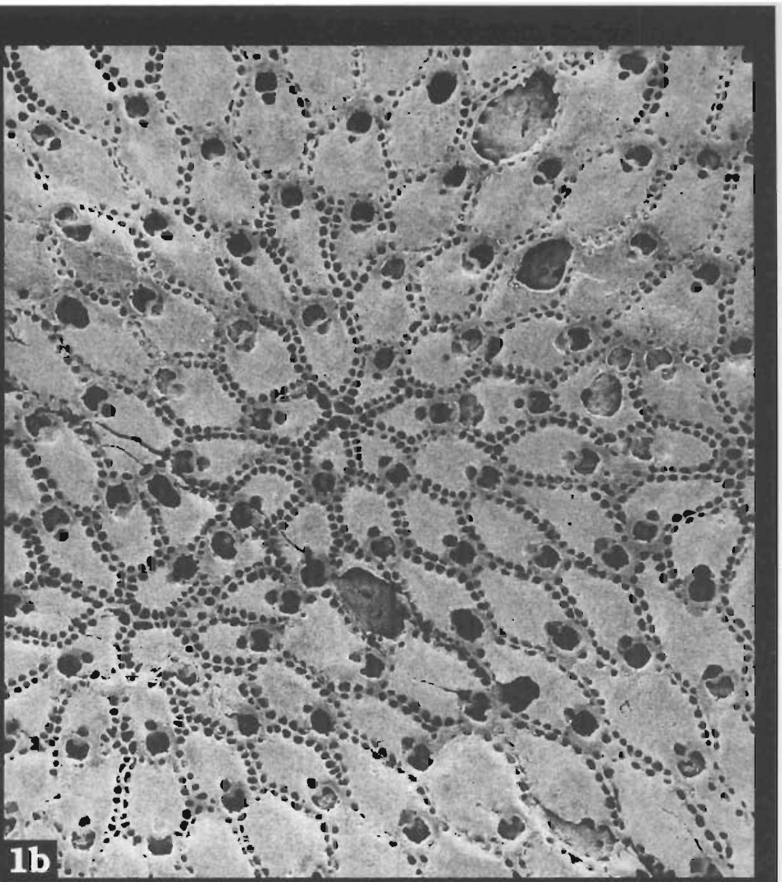

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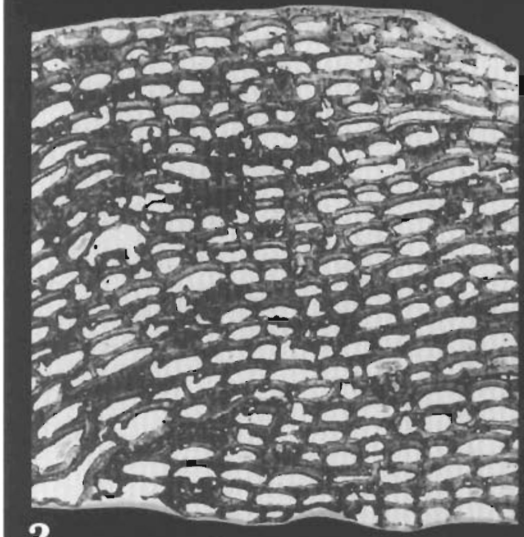

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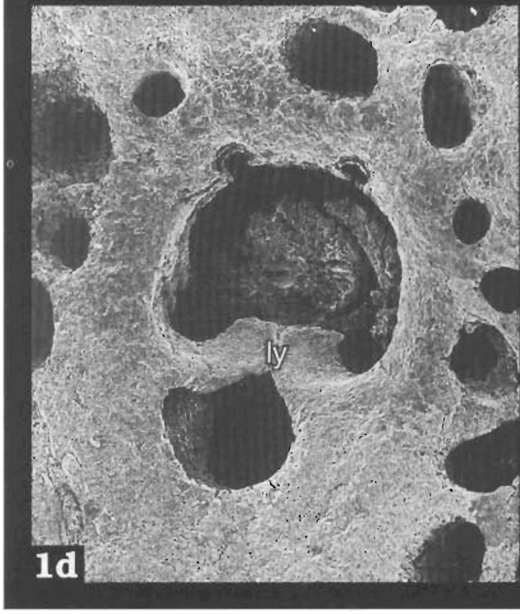

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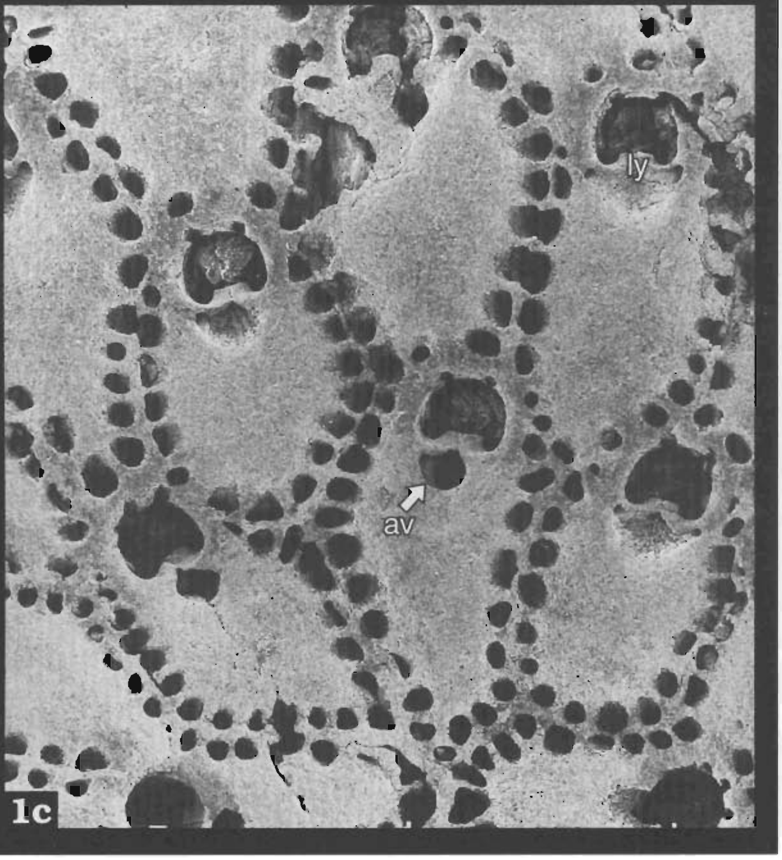

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BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 25

Aimulosia lamellosa sp. n. 82

Fig. 1a. Side view of a complete cap-shaped colony, × 3.
Fig. 1b. Upper surface of a cap-shaped colony, × 3.
Fig. 1c. Underside of the same cap-shaped colony, × 3.

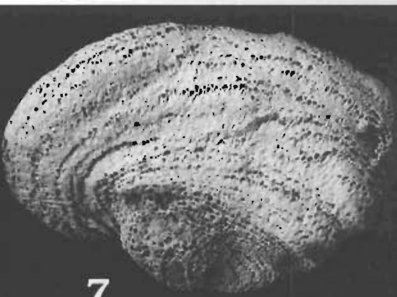
ZPAL Br.VIII/90.

Fig. 2. Side view of a massive, multilamellar colony with well-marked layering along the edge, × 2; holotype ZPAL Br.VIII/88.
Fig. 3. Side view of a cap-shaped colony, × 3; ZPAL Br.VIII/95.
Fig. 4. Multilamellar colony with distinct layering and two subcolonies at the top, × 3; ZPAL Br.VIII/247.
Fig. 5. Massive, multilamellar colony with small encrusting *Aspidostoma* colony (arrow) at the top, × 2; ZPAL Br.VIII/236.
Fig. 6. Underside of a massive mushroom-shaped multilamellar colony, × 2; ZPAL Br.VIII/240.
Fig. 7. Massive, multilamellar zoarium with distinct layering at the edge, × 1.5; ZPAL Br.VIII/241.
Fig. 8. Side view of a multilamellar colony growing on gastropod shell, × 3; ZPAL Br.VIII/94.
Fig. 9. Side view of a multilamellar colony, × 2; ZPAL Br.VIII/239.
Fig. 10. Side view of a mushroom-shaped multilamellar colony with layering, × 2; ZPAL Br.VIII/89.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.

1a

3



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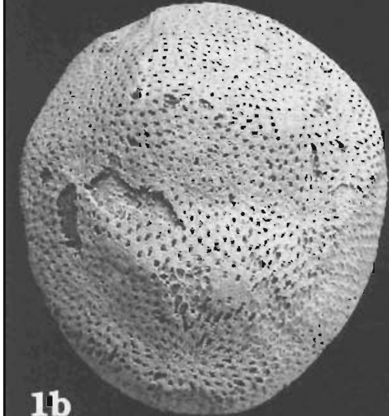

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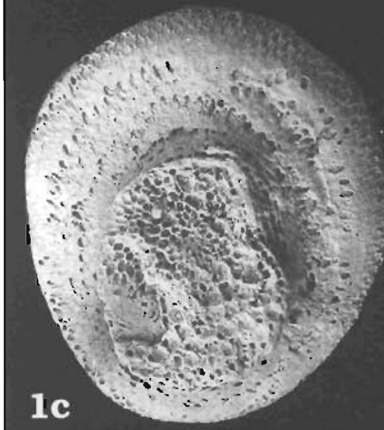

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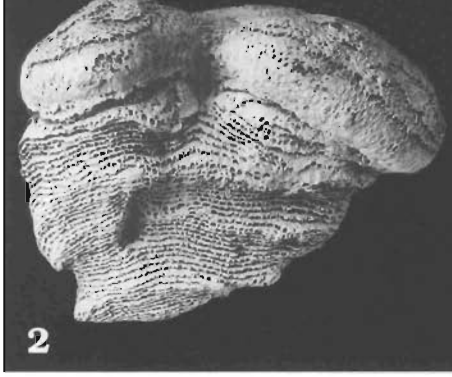

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10

BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 26

Osthimosia globosa sp. n. 84

Fig. 1. Side view of a multilamellar colony showing two subcolonies, × 3; ZPAL Br.VIII/343.
Fig. 2a. Multilamellar colony with two subcolonies on the top, × 2.
Fig. 2b. Vertical section through the multilamellar colony showing layering and subcolony on the top, × 6.5; ZPAL Br.VIII/100.
Fig. 3a. Side view of a massive, multilamellar colony with four subcolonies, × 1.5.
Fig. 3b. Upper surface with subcolonies at the top, × 1.5.

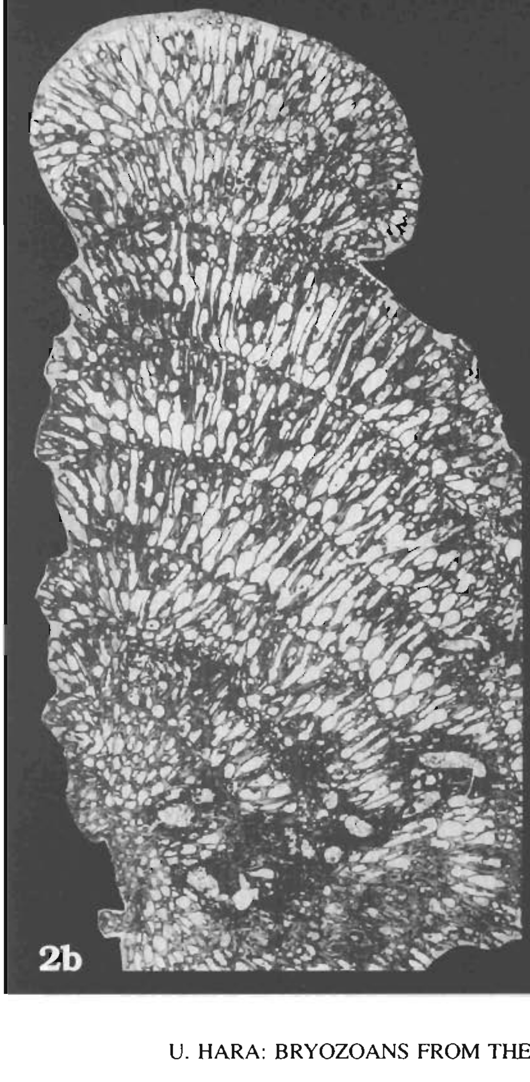
ZPAL Br.VIII/98.

Fig. 4. Side view of a massive multilamellar colony with some polychaete worms settled on the upper part of the colony and distinct layering in the proximal part, × 1.5; holotype ZPAL Br.VIII/457.
Fig. 5. General pattern of the morphology of the frontal wall showing primary orifices (or) with U-shaped sinus and distinct condyles, × 75; ZPAL Br.VIII/61.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.

1

2a



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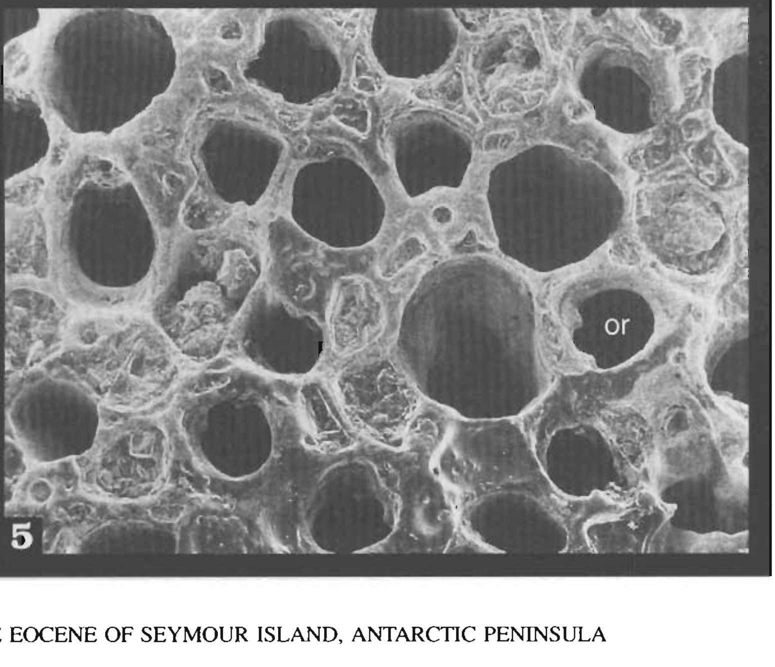
3a

3b

4



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BRYOZOANS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 27

Reteporella sp. 85

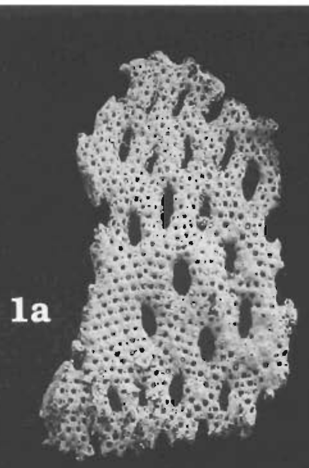
Fig. 1a. Frontal side of part of a reticulate colony showing zoarial morphology, × 5.
Fig. 1b. Part of reticulate colony from the basal side, × 5.
Fig. 1c. Trabeculae consisting of longitudinal series of primary zooecia with oval or elongated fenestrulae on the frontal wall, × 35.
Fig. 1d. Basal wall with slightly marked sutures, numerous scaphoid avicularia (av, arrows) within the fenestrulae and triangular avicularia occasionally present, × 35.

ZPAL Br.VIII/A54.

Fig. 2. Part of the coil-shaped or three-dimensional reticulate colony encrusted by serpulid worms, × 2; ZPAL Br.VIII/A71.
Fig. 3a. Frontal wall showing bell-shaped primary orifice with concave proximal border, two narrow U-shaped condyles, and adventitious avicularium (av), × 135.
Fig. 3b. Worn autozooecia with primary orifice and well-marked sutures showing a few large, conspicuous pores and avicularium, × 150.

ZPAL Br.VIII/A62.

ZPAL 1, Telm1. La Meseta Formation (Eocene), Seymour Island.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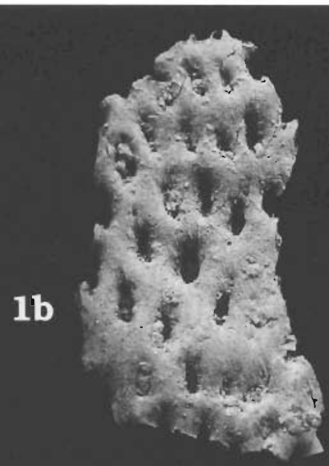
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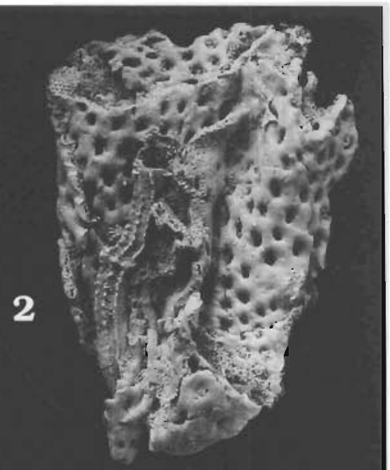
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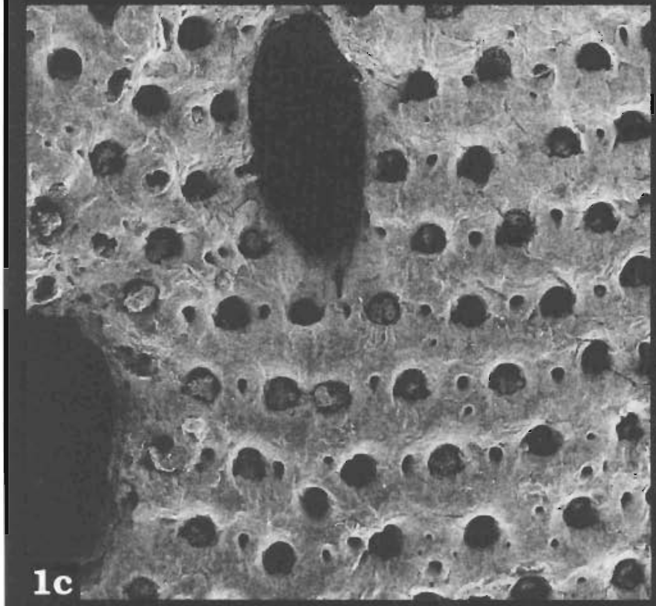
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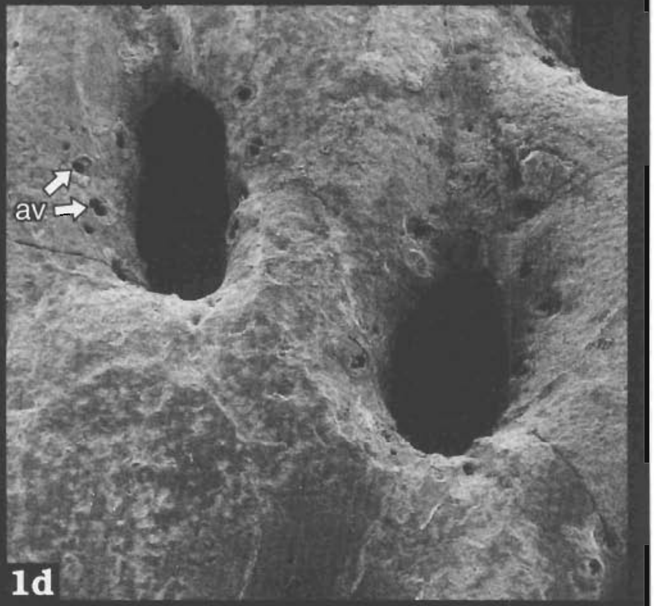
av
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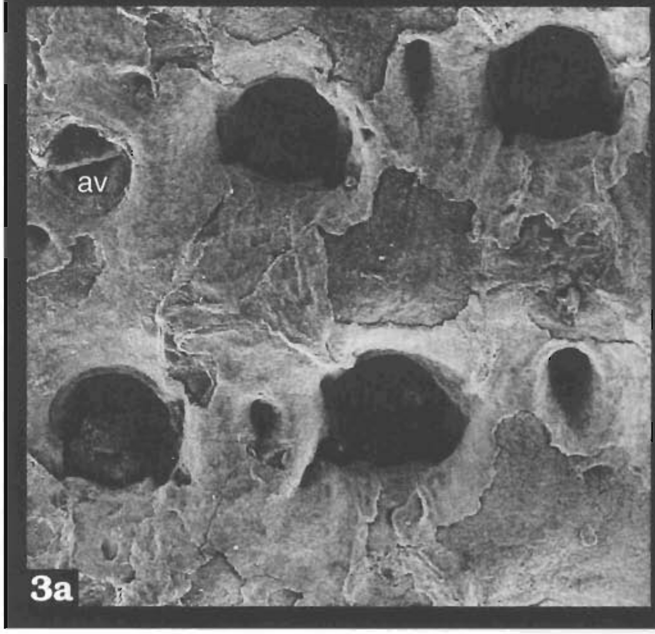
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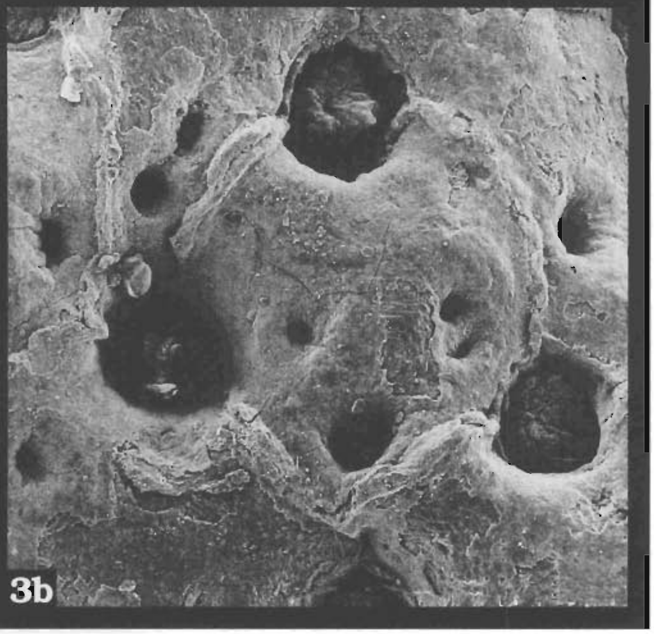
3a


3b

OSTRACODS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

JANINA SZCZECHURA

Szczechura, J. 2001. Ostracods from the Eocene of Seymour Island, Antarctic Peninsula. *In:* A. Gaździcki (ed.), Palaeontological Results of the Polish Antarctic Expedition. Part III. *Palaeontologia Polonica* **60**, 157–181.

Fifteen podocopid ostracod species, belonging to 16 genera and 9 families, are described from the Eocene La Meseta Formation of Seymour Island, Antarctic Peninsula. Most of the taxa are left in open nomenclature due to their rarity and/or poor state of preservation, however two new species, i.e. ?*Echinocythereis hartmann*i and *Majungaella antarctica* are erected. This ostracod assemblage is the first described from the Eocene of Antarctica. The fauna suggests a shallow-water environment and the close geographical proximity of West Antarctica and southern Argentina in the Eocene. The paleozoogeographic extent of the ostracod fauna indicates the existence of a marine connection between West Antarctica, New Zealand and Australia, as well as its bipolar exchange.

Key words: Ostracoda, taxonomy, paleoecology, paleobiogeography, Eocene, Antarctica.

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CONTENTS

INTRODUCTION

The present knowledge of the evolution of ostracods in the Tertiary of Southern Hemisphere is based mostly on data from Hornibrook (1953), Bertels (1973, 1976), McKenzie *et al.* (1991, 1993), Ayress (1995), Majoran (1996b), and Echevarría (1998). No evidence was available from Antarctica until a small collection of ostracod carapaces from the Eocene La Meseta Formation of Seymour Island has been assembled.

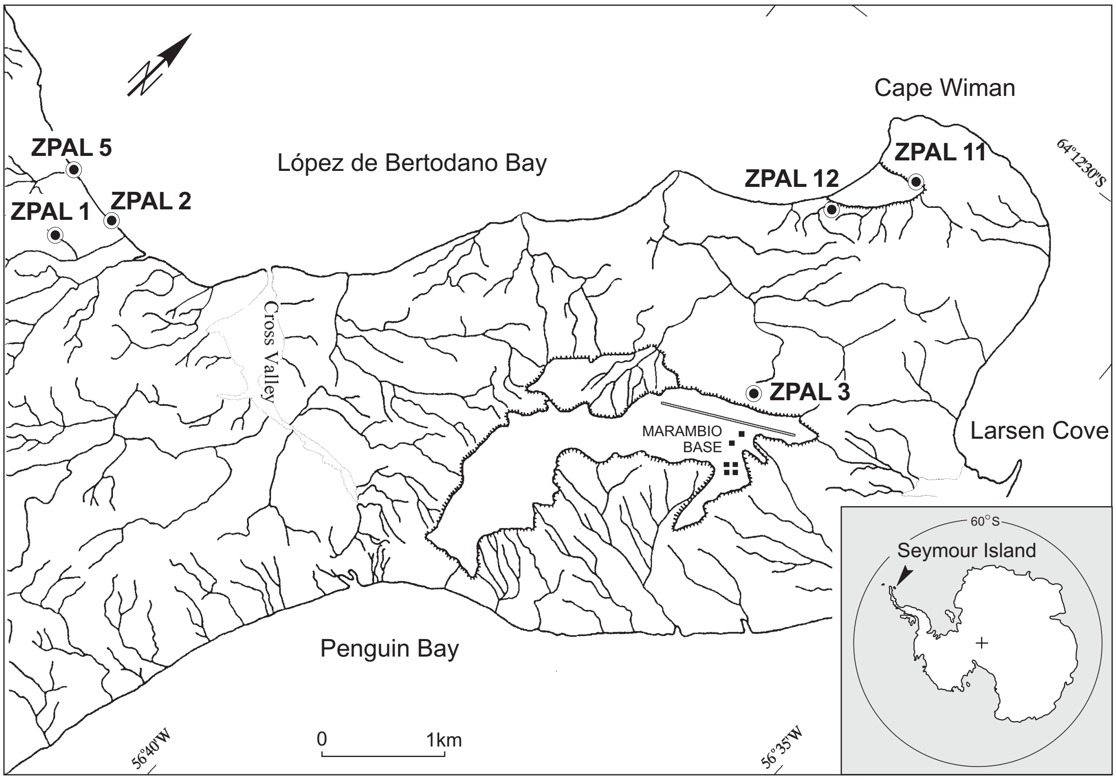

Fig. 1. Map of the northern part of Seymour Island showing the localities with ostracod fauna.

The ostracods described here were collected from the Eocene La Meseta Formation of Seymour Island (Text-fig. 1). This sequence represents the one of the youngest unit of the sedimentary infill of the James Ross Basin and yielded the most diverse Eocene biota known from Antarctica (Feldmann and Woodburne 1988; Stilwell and Zinsmeister 1992; Gaździcki 1998). In this paper the first ostracod fauna of Eocene age from Antarctica is described and some paleoecological and paleobiogeographical implications are discussed.

The material described is housed at the Institute of Paleobiology of the Polish Academy of Sciences in Warszawa under the catalogue number ZPAL O.49/1-63.

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MATERIAL

Samples collected by A. Gaździcki during the Argentine-Polish field parties on Seymour Island in the austral summers of 1987–88, 1991–92 and 1993–94 supplied (among other biota) the Eocene ostracod collection reported here.

The ostracod collection comprises 63 specimens, mostly complete carapaces, mainly of adults. In many cases they are poorly preserved, i.e. crushed, abraded or encrusted with sediment particles. There are few very well preserved specimens; this may indicate that they are of different origin. In comparison with the coexisting benthic foraminifera and various invertebrates, the ostracods are rather rare.

GEOLOGICAL AND STRATIGRAPHICAL SETTING

Seymour Island is located about 100 km southeast of the tip of the Antarctic Peninsula, West Antarctica (Text-fig. 1). The La Meseta Formation (Elliot and Trautman 1982) is an up to 800 metres thick, richly fossiliferous marine-estuarine sequence exposed in the northern part of the island (Stilwell and Zinsmeister 1992, Porębski 1995, Marenssi *et al.* 1998). The formation rests unconformably on Late Cretaceous to Paleocene units and is overlain by post-Pliocene glacial deposits (Feldmann and Woodburne 1988, Gaździcki *et al.* 1999). It is composed of poorly consolidated clastic sediments with very well preserved micro- and macrofossils (Stilwell and Zinsmeister 1992; Baumiller and Gaździcki 1996; Bitner 1996; Radwańska 1996; Stolarski 1996, 1998; Hara 1997, 2001). Sadler (1988) subdivided the formation into seven lithofacies Telm1–Telm7 (acronyms for Tertiary Eocene La Meseta). This division is accepted here (Text-fig. 2). The age of the La Meseta Formation, based on the marine palynoflora assemblages is late Early Eocene for the base (Cocozza and Clarke 1992) and Late Eocene for the uppermost part (Wrenn and Hart 1988; Askin *et al.* 1991; see also Dingle and Lavelle 1998).

The ostracods reported here were sampled at sites ZPAL 1, ZPAL 2, ZPAL 5, ZPAL 11, and ZPAL 12, and represent the lower part (Telm1) of the formation (Text-fig. 2). A single specimen, difficult to identify taxonomically, was also found at the locality ZPAL 3, taken from the upper part of the section (Telm7).

The ostracods of Seymour Island include representatives of *Wichmannella*, a genus known from southern Argentina from the Late Cretaceous to the Late Oligocene (Bertels 1976). They also include representative of *Henryhowella*, which, although described from the Cretaceous of southern Argentina, is considered by Bertels (1976) as appearing there only later in the early Tertiary (Late Eocene?–Early Oligocene). The presence of both these genera, as well as the general similarity of the Antarctic ostracod assemblage to those known from the Eocene of southern Australia, appear to prove the Eocene age of the studied ostracods.

PALEOECOLOGY

The rather poor state of preservation of the ostracod fauna, dominated by complete, adult carapaces of similar size, may suggest a high energy environment and rapid deposition (Whatley 1983; this author's observations). Their low frequency seems to result from their dilution in clastic sedimentation.

The ostracod fauna is fairly diverse, especially considering the low abundance of fossils. They comprise normal marine forms, such as those known from the Eocene of New Zealand and even southern Australia. Deeper water species e.g. belonging to the Cytherellidae, Bairdiidae, Krithiidae, Bythocytheridae, and (some) Thaerocytheridae, are absent. The genera *Argilloecia* and *Propontocypris* are poorly represented.

Among the recognized genera, particularly interesting as an indicator of the environment, is the quite well represented *Wichmannella*. This genus is known of the Late Cretaceous–Early Tertiary of southern Argentina where it occurs in shelf deposits intercalated with non-marine deposits, i.e. transgressive-regressive sedimentary sequences. The representative of the genus *Henryhowella*, found in the Eocene of Seymour Island, is often associated with *Wichmannella* in the above mentioned sediments from southern Argentina.

Among the other genera from the La Meseta Formation, particularly well represented are: ?*Maddocksella*, ?*Echinocythereis*, *Majungaella*, and ?*Hornibrookella*. In the Tertiary of southern Australia, *Maddocksella* is considered to be characteristic of shelf deposits, from inshore to 250 m (McKenzie *et al.* 1991). *Echinocythereis* is known (Van Morkhoven 1963) as preferring infraneritic and bathyal waters. *Majungaella* is considered in this paper as being related to ?*Loxocythere* sp., found (together with *Australicythere*) in the Pliocene of Cockburn Island, Antarctic Peninsula, where it probably lived in shelf zone, at depths above 250 m (Szczechura and Błaszyk 1996; see also Gaździcki and Webb 1996). According to Whatley (personal communication) all previous Mesozoic records of *Majungaella* are from warm and shallow waters. *Hornibrookella*, as well as *Quadracythere* and *Hermanites*, are regarded as predomi-

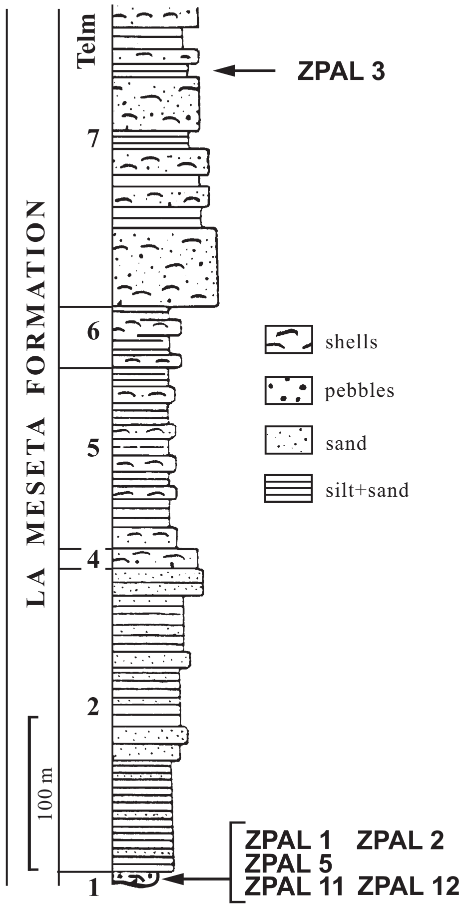

Fig. 2. Composite stratigraphical column of the La Meseta Formation on Seymour Island (South Section) adapted from Sadler (1988), showing the

nantly epi-neritic ostracod genera; this group of ostracods is common in the Miocene of Victoria, southeastern Australia, as a members of a fauna which has "a warm-temperate to subtropical character, and indicate a shallow-water, high-energy, near-shore environment of deposition, with abundant phytal associates" (Neil 1994: p. 1).

The remining genera, e.g. *Phlyctenophora*, *Kuiperiana*, and ?*Ameghinocythere* are represented by species close to those still living, i.e. *Phlyctenophora zealandica*, *Kuiperiana meridionalis*, and *Ameghinocythere reticulata*, respectively. *P. zealandica* occurs in the Gulf of Carpentaria, northeastern Australia, where it is a member of "a lower tidal and foreshore assemblage" (Yassini *et al.* 1993); *K. meridionalis* is known from the Antarctic and the Magellan Strait from a depth of 143 to 525 m (Whatley *et al.* 1996, 1998b), while *A. reticulata* is recorded from the continental shelves of the South West Atlantic (Whatley *et al.* 1997a).

Thus the taxonomic content of the La Meseta ostracod assemblage seems to indicate shallow-marine and rather high energy environments, which is consistent with other faunal assemblages (Sadler 1988; Stilwell and Zinsmeister 1992; Stilwell and Gaździcki 1998; Hara 2001).

As is known, however, e.g. Whatley *et al.* (1997b), the geographical distribution of ostracods is controlled not only by depth but also by the trophic level they occupy, as well as temperature and salinity of their environment.

PALEOBIOGEOGRAPHY

Of the fifteen ostracod genera recognized in the Eocene of Seymour Island, especially those of more certain taxonomic position, almost half also occurred in the Eocene of southern Australia and/or New Zealand (McKenzie *et al.* 1991, 1993; Ayress 1995; Majoran 1996a, b). They represent *Argilloecia*, *Propontocypris*, *Actinocythereis*, *Munseyella*, and *Kuiperiana*. It is probable, moreover, that also (at least) tentatively distinguished here *Hornibrookella* and *Maddocksella* are an additional element common to the Eocene of the mentioned areas. Considering a species level of comparision of the faunas, more similarity exists between the Eocene ostracods of West Antarctica and Australia.

The similarity of Eocene ostracods from southern Australia and New Zealand was demonstrated by Ayress (1995) and Majoran (1996b), both authors working on rich ostracod fauna from these areas. According to Ayress (1995) the late Eocene ostracods of New Zealand (South Canterbury) indicate their deeper neritic or upper slope origin, transgressive marine condition and their eastward direction of migration. Also the Eocene–Oligocene ostracods of Australia, i.e. Southern Australia and Victoria, are considered as the off-shore biofacies (McKenzie *et al*. 1991).

Some of the above mentioned genera, i.e. *Argilloecia*, *Actinocythereis*, and *Munseyella* are also recorded from the early Tertiary of southern Argentina (Echevarría 1998), where both *Actinocythereis* and *Munseyella* had appeared already in the Late Cretaceous (Bertels 1973). However, *Australicythere*, *Wichmannella*, and *Henryhowella*, which are present in the Eocene of Seymour Island, also occur in the Paleogene and/or Late Cretaceous of southern Argentina (Bertels 1973, 1975; Echevarría 1998) and are restricted to these areas being unknown from the Eocene of Australia and New Zealand. *Tumidoleberis* (recte *Majungaella*), on the other hand, besides the Eocene of Seymour Island, occurred in the Late Cretaceous of western Australia (Neale 1976) and Late Cretaceous of southern Argentina (Bertels 1975); Whatley and Ballent (1996) described *Majungaella* from the Early Cretaceous (Aptian–Albian) and the Late Cretaceous (?Late Campanian– Early Maastrichtian) of southern Argentina, and the Albian of the Falkland Plateau. Within these latter genera, *Wichmannella* deserves particular attention. According to Bertels (1976), it is an endemic genus typical for shallow-waters of the Southern Atlantic basins, known from the Late Cretaceous up to the Oligocene. Subsequent studies seem to proove Bertels's opinion; *Wichmannella bradyi* (Ishizaki) distinguished by Zhao and Wano (1988), within modern ostracod fauna from the shelf sea off China, belongs to a separate genus.

The shallow-water character of the ostracod biofacies containing *Australicythere*, *Majungaella*, and *Wichmannella* seems to be supported by the present studies.

As the above mentioned, Paleogene forms, common to West Antarctica and southern Argentina, have their ancestors in the Late Cretaceous of Argentina, one might suggests that these forms represent a relic fauna, which even in the Paleogene was at least partly restricted to the shallow seas of the Southern Ocean.

The similarity of the Eocene ostracod biofacies of southern Australia, New Zealand and West Antarctica suggests, however, that at that time there was marine connection between these areas, enabling exchange of faunas (Zinsmeister 1982; Case 1989; Shen 1998). Existing differences between these biofacies (mostly greater diversity and the deeper-water character of the Australian and New Zealand ostracods) evidently resulted from their different environment as a consequence of their different paleogeographic situation. The occurrence of common, shallow-marine (including rather endemic forms) ostracod biofacies in the Eocene of West Antarctica and the Paleogene of southern Argentina suggests the proximity of these areas and their shallow-marine connection. Wood *et al*. (1999) have examined the paleobiogeography of marine, benthic ostracods and they concluded that the epicontinental connection between southern Argentina (Patagonia) and West Antarctica existed up to the Oligocene–Miocene boundary.

Ostracods from the Eocene of Seymour Island (*Phlyctenophora* sp., ?*Echinocythereis hartmanni* sp. n., *Majungaella antarctica* sp. n., ?*Ameghinocythere* cf. *Cytheromorpha*? *flexuosa*, *Kuiperiana* sp.) are similar to those known as subfossils or forms still living in Antarctica, i.e. they have (to some extent) a modern character. Some similarity of the Eocene ostracods of southern Australia and New Zealand to the Recent (or subfossil) ones (representatives of this group of microfossils) of Antarctica has been also observed by Ayress (1995).

The longevity of some Tertiary ostracods of New Zealand was recognized by Ayress (1995), who followed similar observations by Hornibrook in the 1950s, while long lasting ostracods from the Tertiary of southern Australia were indicated by Majoran (1996b). All these observations are also in agreement with Hartmann's (1997) observations that the early Tertiary ostracods of Antarctica are the ancestral forms for the Recent fauna of that area. In the Eocene of Seymour Island there occur ostracod genera, e.g.: *Argilloecia*, *Propontocypris*, *Henryhowella*, *Echinocythereis*, *Hornibrookella*, and *Munseyella* which, at least from the early Paleogene up to the Recent, are also known from the North Atlantic and/or its borderlands (Keen 1977; Coles *et al*. 1990; Whatley and Coles 1991). It suggests that since the Tertiary there has existed bipolar migration of these faunas.

SYSTEMATIC PALEONTOLOGY

Suborder **Podocopina** Sars, 1866

Superfamily **Cypridacea** Baird, 1845
Family **Paracyprididae** Sars, 1923
Genus *Phlyctenophora* Brady, 1880
Phlyctenophora sp.
(Pl. 1: 9, 10)

Material. — Two adult carapaces, fairly well preserved.

Description. — Sub-lunate in side view, rather evenly and markedly laterally inflated, narrowly rounded anteriorly, more so posteroventrally, arched dorsally, highest in the middle, weakly concave ventrally. The left valve larger than right, overlapping the latter mostly anterodorsally.

Remarks. — All these features seem typical of *Phlyctenophora*, a genus described by Brady 1880, based on material found by him during the Challenger Expedition in the Southern Pacific. In comparison with *Phlyctenophora zealandica* Brady, 1880, the type species, as figured (only internally) by Yassini *et al.* (1993), from the Gulf of Carpentaria (northwestern Australia), the present specimens are much smaller, and more triangular in lateral view. The present species differ in details from all other species of this genus, especially those from the Neogene of Europe. It is possible that *Paracypris*? sp., described by Kielbowicz (1988) from the Late Oligocene–Early Miocene of Argentina (Austral Basin) should also be referred to *Phlyctenophora*. In comparison with this latter species, the present species is smaller and differs in outline and length to height ratio.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1, ZPAL 5; Telm1 (Eocene).

Family **Pontocyprididae** G.W. Müller, 1894
Genus *Argilloecia* Sars, 1866
Argilloecia cf. *A. mesa* McKenzie, Reyment *et* Reyment, 1993
(Pl. 1: 8)

Material. — One adult carapaces, well preserved.

Remarks. — The specimen resembles *Argilloecia mesa*, described by McKenzie *et al.* (1993), from the Eocene of Victoria, southeastern Australia, but is smaller, less pointed posteroventrally and has a smaller length to height ratio. Moreover, the valve overlap in the present species seems more pronounced. McKenzie *et al.* (l.c.) admit, however, rather large variability within *Argilloecia mesa* resulting from its sexual dimorphism.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 5, Telm1 (Eocene). *Argilloecia mesa* McKenzie *et al.,* 1993 is known from the Middle(?)–Late Eocene of Victoria, southeastern Australia.

Genus *Maddocksella* McKenzie, 1981
?*Maddocksella* sp.
(Pl. 1: 1–6)

Material. — Six adult carapaces, in most cases well preserved.

Description. — Smooth, oblong in lateral outline, evenly and rather weakly inflated laterally, broadly rounded anteriorly, less broadly rounded posteroventrally; dorsal and ventral margins nearly parallel, somewhat arched. The left valve larger than right and overlapping the latter, except at the anterior end, mainly along the posterodorsal and anterodorsal margin.

Remarks. — All these external features are close to those typical of *Maddocksella* McKenzie, 1981, and particularly to those of *Maddocksella tarparriensis* McKenzie *et al.*, 1993, from the Eocene of Victoria, southeastern Australia. According to these authors (l.c.) some specimens formerly recognized by them (McKenzie *et al.* 1991) as *Maddocksella argilloeciaformis* (Whatley *et* Downing, 1983), from the Late Eocene of Southern Australia, should be referred to *Maddocksella tarparriensis*. Majoran (1996a) also found *M. tarparriensis* in the Late Eocene of Southern Australia. In comparison with *Maddocksella tarparriensis*, as figured by McKenzie *et al.* (1993), the present specimens are much smaller and has less steep anterodorsal and posterodorsal margins. Because the internal features are unknown, the generic assignement is only tentative.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1, ZPAL 2; Telm1 (Eocene).

Genus *Propontocypris* Sylvester-Bradley, 1948

Propontocypris sp.

(Pl. 3: 1, 2; Pl. 1: 7; Pl. 3: 3)

Material. — Two adult right valves, one juvenile right valve and one ?adult carapace, poorly preserved.

Remarks. — The general appearance of the preserved parts of specimens, and as their internal features, mainly the inner lamella, allow assignation to *Propontocypris*. They resemble *Propontocypris* sp., described by McKenzie *et al*. (1993), from the Eocene of Australia. The present form is, however, much smaller, less pointed posteriorly and less angulated dorsally. The specimens presented on Pl. 1: 7 and Pl. 3: 3, somewhat different in side view from the above mentioned ones, are only tentatively included to this form.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1, ZPAL 5; Telm1 (Eocene).

Superfamily **Cytheracea** Baird, 1850

Family **Trachyleberididae** Sylvester-Bradley, 1948

Genus *Actinocythereis* Puri, 1953

Actinocythereis cf. *A. indigena* Bertels, 1969

(Pl. 4: 6)

Material. — One fragment of adult right valve.

Remarks. — Shape of the preserved, anterior part of the specimen and its ornamentation resemble *Actinocythereis indigena* Bertels, 1969, from the Early Danian of southern Argentina, especially as figured by Echevarría in Malumián *et al.* (1984). The Eocene specimen from Antarctica is, however, more densely tuberculated. It also seems close to *Actinocythereis tetrica* (Brady, 1880), a Recent species from Booby Island (near Australia), and later reviewed by Puri and Hulings (1976). Yassini *et al.* (1993) found this species in the Gulf of Carpentaria, northeastern Australia. The present fragment is particularly similar, regarding the development and arrangement of tubercles in its frontal part, to the specimen presented by Yassini *et al.* (1993) on pl. 7, fig. 131. More complete material from Antarctica is necessary to establish the taxonomic assignment of this form.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 11, Telm1 (Eocene). *Actinocythereis indigena* Bertels, 1969 is known from the Early Danian of southern Argentina (Rio Negro and Neuquén provinces).

Genus *Henryhowella* Puri, 1957

Henryhowella sp.

(Pl. 5: 5)

Material. — One adult left valve, rather well preserved.

Description. — Indistinctly plicate, with well developed eye tubercle and indistinctly marked subcentral tubercle. Valve surface covered by strong conjunctive, tubercle-like spines. Short spines extend along the free margin. Internal features obscured.

Remarks. — The ornamentation of this specimen distinguishes it from other representatives of the genus *Henryhowella*.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 5, Telm1 (Eocene).

Genus *Wichmannella* Bertels, 1966

Wichmannella cf. *W. meridionalis* Bertels, 1969

(Pl. 2: 1–4)

Material. — Three adult carapaces, two adult left valves, one adult right valve, two juvenile carapaces and one juvenile left valve, in most cases well preserved.

Remarks. — The deep and rather regular reticulation of the valve surface is very similar to that of *Wichmannella meridionalis* Bertels, 1969, described from the Early Danian of Southern Argentina. In comparison with representatives of this species, especially as described and figured by Bertels (1973), they are slightly larger, lack eye tubercle and have somewhat different ornamentation pattern anterolaterally. However, details of ornamentation of specimens, referred here to *Wichmannella* cf. *W. meridionalis*, are somewhat variable. Internally, the Eocene form reveals rather smooth median element of the hinge of the left valve, and rather narrow inner lamella with deep vestibulum. According to Whatley (personal communication) *Wichmannella* is a junior synonym of *Henryhowella*.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 11, ZPAL 12; Telm1 (Eocene). *Wichmannella meridionalis* Bertels, 1969 is known from the Early Danian of southern Argentina (Rio Grande, Rio Negro and Neuquén provinces).

Family **Thaerocytheridae** Hazel, 1967
Genus *Echinocythereis* Puri, 1954
?*Echinocythereis hartmanni* sp. n.
(Pl. 5: 1–4)

Holotype: adult carapace ZPAL O.49/27 figured on Pl. 5: 3.

Paratype: adult carapace ZPAL O.49/47 figured on Pl. 5: 2.

Type horizon: Telm1, La Meseta Formation; Eocene.

Type locality: ZPAL 1, Seymour Island, Antarctic Peninsula.

Derivation of the name: *hartmanni*, named in honour of Professor Gerd Hartmann, in recognition of his contribution to our knowledge of the Antarctic Ostracoda.

Diagnosis. — ?*Echinocythereis* species, subrectangular in lateral outline, inflated, covered by a reticulation formed by small ribs bearing weakly developed pappillae.

Material. — Two adult carapaces, one adult right valve, one adult left valve and one juvenile left valve, rather well preserved, obscured from inside.

Description. — Carapace subrectangular in lateral outline, with distinct cardinal angles, nearly uniform and moderate lateral inflation, and large, well developed eye tubercle. Shallow furrow occurs near and along the anterior margin. Anterior margin somewhat obliquely, but broadly rounded, posterior margin narrowly rounded, dorsal and ventral margin nearly straight and parallel to each other. The valve surface ornamentation (Pl. 5: 3d), consists of tiny pappilose ribs forming a net-like pattern. Small marginal denticles also occur along the anterior and posterior margins. Internal features unknown.

Dimensions (in mm):

ZPAL O.49/27, adult carapace, holotype	ZPAL O.49/47, adult carapace, paratype
Length 1.12	Length 1.12
Height 0.62	Height 0.62

Remarks. — In overall external appearance and ornamentation this species is not typical of any known ostracod genera. Their morphological features may be compared, however, to those characteristic of *Echinocythereis heros* Whatley, Staunton, Kaesler *et* Moguilevsky, 1996, a Recent species described from the Strait of Magellan, Chile; later this species, found in the South West Atlantic, was referred by Whatley *et al.* (1997a) to *Henryhowella*. In comparison with this species the Antarctic form is much smaller and more inflated, bearing a more or less distinct furrow (incision) along the anterior margin. It is interesting, that the authors of *Henryhowella heros* found some similarity between their species and *Henryhowella beckerae* Bertels, 1975, as well as *Wichmannella deliae* Bertels, 1975, both species known from the early Tertiary of southern Argentina (Patagonia).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1, ZPAL 5; Telm1 (Eocene).

Family **Progonocytheridae** Sylvester-Bradley, 1948, emend. Whatley *et* Ballent, 1996
Genus *Majungaella* Grekoff, 1963
Majungaella antarctica sp. n.
(Pl. 2: 5–8)

Holotype: adult right valve ZPAL O.49/33 figured on Pl. 2: 7.

Paratype: adult right valve ZPAL O.49/32 figured on Pl. 2: 8.

Type horizon: Telm1, La Meseta Formation; Eocene.
Type locality: ZPAL 12, Seymour Island, Antarctic Peninsula.
Derivation of the name: *antarctica*, occurring in Antarctica.

Diagnosis. — *Majungaella* species, subtriangular in lateral outline, most inflated ventrolaterally, covered by distinct, separate punctae and ribs, close and parallel to the free margin.

Material. — One adult carapace, two adult right valves and one adult left valve, well preserved.

Description. — Carapace of medium size, subtriangular in lateral view, longest at mid-height, highest in the anteromedian part. Left valve somewhat larger than the right and overlapping the latter along the entire margin. Dorsal margin straight, ventral margin nearly straight and slightly incised in the middle, anterior margin obliquely rounded, posterior margin narrowly rounded. Eye tubercle absent. Strong lateral inflation greatest above the ventral margin. Valve surface rather evenly and distinctly punctate with fine ribs along the free margin, which are most distinct on the ventral side.

Inner lamella moderately wide in the anterior part, without vestibulum. Muscle scars barely visible but seem to consist of four scars of the main group and one, round scar in front. Hinge margin rather poorly preserved, clearly entomodont, however, with distinctly dentate terminal teeth separated by a median, loculate groove, enlarging anteriorly, in the right valve.

Dimensions (in mm):

ZPAL O.49/33, adult right valve, holotype	ZPAL O.49/32, adult right valve, paratype
Length 1.04	Length 0.96
Height 0.65	Height 0.55

Remarks. — The specimens are very similar to ?*Loxocythere* sp., a Pliocene species described from Cockburn Island, Antarctic Peninsula (Szczechura and Błaszyk 1996). The Eocene form, however, is less coarsely punctate and may have (if well preserved) a somewhat different hinge. Both these forms seem to be related to that described by Bertels (1975) from the Late Cretaceous of Argentina, as *Tumidoleberis australis*. In comparison with Bertels's species, the Eocene (and Pliocene) species is punctate and not reticulate. The hinge of the Eocene form, although not well preserved, seems also similar to that of the Cretaceous one from Argentina. At the same time, however, all the above discussed forms, when compared with species referred to *Tumidoleberis*, from the Late Cretaceous of France (Deroo 1966) are much more angulated dorsally and have a different hinge. The Antarctic species is also similar (as kindly suggested by Dr M. Ayress, personal communication), to *Majungaella verseyi* Neale, 1975 from the Late Cretaceous of Western Australia. In comparison with this latter species the Eocene species is more punctate than costate, especially in its central part. In comparison with *Majungaella santacruziana* (Rossi de Garcia, 1972), from the Early Cretaceous of southern Argentina, especially as figured by Whatley and Ballent (1996) and Ballent *et al.* (1998), the Eocene species is not reticulate centrally. This species is the first progonocytherid recorded from the Cenozoic.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 5, ZPAL 12; Telm1 (Eocene).

Family **Hemicytheridae** Puri, 1953
Genus *Australicythere* Benson, 1964
Australicythere sp.
(Pl. 4: 3)

Material. — One adult right valve, badly preserved.

Remarks. — In size and external morphology, mostly its lateral outline and the arrangement of the posterior and ventrolateral ribs, this form is close to *Australicythere* sp. 2, a species distinguished by Echevarría (1998), from the Paleogene of Santa Cruz Province, southern Argentina. The lack of a median rib in front of the muscle scars field in the Eocene Antarctic form separate the species.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 5, Telm1 (Eocene).

Genus *Hornibrookella* Moos, 1965
?*Hornibrookella* sp.
(Pl. 4: 1, 2, 4, ?5)

Material. — Two adult carapaces and two adult right valves, rather well preserved.

Description. — The specimens large, thick-shelled, subrectangular in lateral outline, with large eye tubercle. Anterior margin broadly rounded, distinctly thickened at the border, the posterior margin somewhat pointed below mid-height, especially in the right valve. The dorsal and ventral margins nearly parallel; the ventral margin indistinctly incised anteriorly. Conspicuous lateral inflation increases posteriorly, where it abruptly disappears close to the posterior margin. The lateral inflation bordered, in its upper part, by subdorsal rib, which is somewhat downturned posteriorly, while anteriorly disappearing below the eye tubercle. Ventrolateral rib bounds the lower part of the lateral valve inflation. Valve surface coarsely reticulate, i.e. covered by thickened muri and deep intermural fossae; these are elongated anteriorly and tend to be fan-shaped, not reaching the anterior margin, while posteriorly, especially in the posteroventral part, they are also elongated and parallel but obliquely arranged. Some variability in details of ornamentation of specimens (mostly anteriorly), included within this species, may result from their different state of preservation.

Hinge holamphidont. Inner lamella narrow, with inner margin parallel to the valve margin. The scarcely visible muscle scars seem to contain few, elongated scars of the main group and three small, round antennal scars.

Remarks. — The general appearance, as well as the type of ornamentation and internal features of this species resemble those in representatives of *Hornibrookella* Moos, 1965, especially as reviewed by Liebau (1991) from the Paleogene of northwestern Europe. Additional material is necessary to decide the generic affiliation of this species. The Antarctic species does not seem to resemble closely any known species.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 5, Telm1 (Eocene).

Family **Pectocytheridae** Hanai, 1957

Genus *Munseyella* van den Bold, 1957

Munseyella sp.

(Pl. 3: 7)

Material. — One adult carapaces, well preserved.

Remarks. — The specimen is similar to *Munseyella* sp. described by Szczechura (1971) from the Paleocene of Greenland but is more rectangular in lateral outline and differs in details of the subcentral ornamentation. Small differences in lateral ornamentation as well as in arrangement of the posterodorsal rib also distinguish the present specimen from *Munseyella japonica* (Hanai, 1957) from the shelf seas of China, as illustrated by Zhao and Wano (1988).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1, Telm1 (Eocene).

Genus *Ameghinocythere* Whatley, Moguilevsky, Toy, Chadwick *et* Ramos, 1997

?*Ameghinocythere* cf. *Cytheromorpha*? *flexuosa* Bertels, 1975

(Pl. 3: 4–6)

Material. — Three adult carapaces, rather well preserved.

Remarks. — In size and shape as well as in the arrangement of the main external morphological features i.e. lateral reticulation tending to merge in frontal part of the carapace, this species is similar to *Cytheromorpha*? *flexuosa*, described by Bertels (1975) from the Late Cretaceous of Argentina. The present material is, however, more evenly inflated and more uniformly reticulate. Along the anterior margin they bear distinct, parallel ribs. The Eocene Antarctic specimens also remind valves recorded by Whatley *et al.* (1996) from the Strait of Magellan, Chile, determined as *Keijia falklandi* (Brady), but differ from specimens, referred to this species, mostly by being not ribbed laterally, described by Whatley *et al*. (1997a, 1998a) from the Atlantic coast of southern South America (see also remarks concerning *Keijia* sp.). The general apppearance as well as the type of ornamentation, especially lack of lateral ribs in the Antarctic specimens are similar to those in *Ameghinocythere reticulata* Whatley, Toy, Chadwick *et* Ramos, 1997, the genus and species so far known from the South West Atlantic. In comparison with this species the Antarctic form is, at first, covered by parallel instead of rather irregularly arranged ribs on the ventral side. Additional data, concerning internal features of the discussed form, are indispensable to decide its generic affiliation. Whatley *et al*. (1997a) compared *Ameghinocythere reticulata* with *Cytheromorpha*? *flexuosa* and suggested their congeneric affiliation.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 2, ZPAL 5; Telm1 (Eocene). *Cytheromorpha*? *flexuosa* Bertels, 1975 is known from the Late Cretaceous of Argentina.

Genus *Keijia* Teeter, 1975

?*Keijia* sp.

(Pl. 3: 8)

Material. — One adult left valve, rather well preserved, obscured from inside.

Description. — Small, elongate, subrectangular in lateral outline, compressed laterally, bearing spines on the posterior margin. Thin lateral ribs tend to follow valve outline and cross its central part; among these latter most characteristic seem subdorsal and median ribs which are joined by the vertical posterior rib. Coarse, irregular reticulation is developed over the entire valve surface. Internal features obscured.

Remarks. — The specimen is similar to *Keijia falklandi* (Brady, 1880) described from the Falkland Islands, also recorded by Whatley *et al*. (1997a) from the South West Atlantic, but is more evenly compressed laterally, not elevated along the anterior and the posterior margins, and differs in the details of ornamentation; the specimens from Brady's collection, assigned to *Cythere falklandi*, reviewed by Puri and Hullings (1976) seem to be markedly variable. Almost identical form, as that referred by Whatley *et al.* (1997a) to *Keijia falklandi* but assigned to *Munseyella fuegoensis* Echevarría, 1987, was recorded by Bertels and Martinez (1997) from the Holocene of Argentina; according to Whatley *et al.* (1998) these species are conspecific. The specimens figured Bertels and Martinez (l.c.), however, distinctly differ, mostly in ornamentation, from the holotype of this latter species.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1, Telm1 (Eocene).

Family **Loxoconchidae** Sars, 1925

Genus *Kuiperiana* Bassiouni, 1962

Kuiperiana sp.

(Pl. 3: 9, 10)

Material. — One adult carapace and one juvenile carapace, well preserved.

Remarks. — The size, general external appearance, as well as the type of ornamentation allow to suppose that the specimens belong to *Kuiperiana* (synonymous with *Myrena* Neale, 1967). They differ from *Loxoconcha similis* Bertels, 1973, described from the Paleocene of Argentina, in being a little smaller, more rounded in lateral view and not pointed posteriorly. They also seem close to *Kuiperiana meridionalis* (Müller, 1908), a Recent species known from the Antarctica. In comparison with the representatives of that species, figured by Müller (1908) and reproduced by Hartmann (1997), the Eocene specimens seem more densely and more deeply reticulated. When compared with the specimens referred to *Kuiperiana meridionalis* by Whatley *et al*. (1998b), from the Halley Bay (Antarctica), the Eocene form somewhat differs in lateral view, mostly in its posterior part, and lacks ventrolateral rib. In comparison with specimen described by Błaszyk (1987), from the Oligocene of King George Island (South Shetland Islands), referred to *Loxoconcha rolnickii*, the present material is more evenly and more pronouncedly reticulated; see also Whatley *et al.* (1998b: p. 128).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1, ZPAL 5; Telm1 (Eocene).

Family unknown

Gen. et sp. indet.

(Pl. 5: 6–8)

Material. — Two adult carapaces, one juvenile carapace, and one juvenile right valve, rather badly preserved, abraded.

Description. — The carapace of medium size, oblong and subovate in side view, with weakly marked cardinal angles, indistinct eye tubercle, and almost uniform, moderate lateral inflation. The left valve slightly larger than right and overlapping it along almost the entire margin. The anterior margin obliquely and broadly rounded, the posterior margin weakly truncate, narrowly rounded. The dorsal and ventral margins almost straight, slightly converging to the rear and bearing tiny dents. The entire valve surface rather regularly reticulate; the meshes of reticulation tend to converge near the dorsal margin, while arranged in parallel rows along the anterior and ventral margins. Internal features unknown.

Remarks. — Presented external features seem unlike those of the so far known ostracod genera and species.

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 12, Telm1 (Eocene).

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OSTRACODS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

The following abbreviations are used: a – adult, j – juvenile, C – carapace, RV – right valve, LV – left valve.

PLATE 1

?*Maddocksella* sp. 163

Fig. 1. aC; *a* right side, *b* oblique ventral view, × 60, ZPAL O.49/48, ZPAL 2.
Fig. 2. aC; *a* right side, *b* ventral view, × 60, ZPAL O.49/21, ZPAL 1.
Fig. 3. aC; *a* right side, *b* ventral view, × 60, ZPAL O.49/19, ZPAL 1.
Fig. 4. aC; *a* right side, *b* ventral view, × 55, ZPAL O.49/51, ZPAL 1.
Fig. 5. aC; *a* right side, *b* ventrolateral view, × 50, ZPAL O.49/52, ZPAL 1.
Fig. 6. aC; left side, × 60, ZPAL O.49/20, ZPAL 1.

Propontocypris sp. 164

Fig. 7. aC; left side, × 55, ZPAL O.49/24, tentatively referred to *Propontocypris* sp., ZPAL 1.

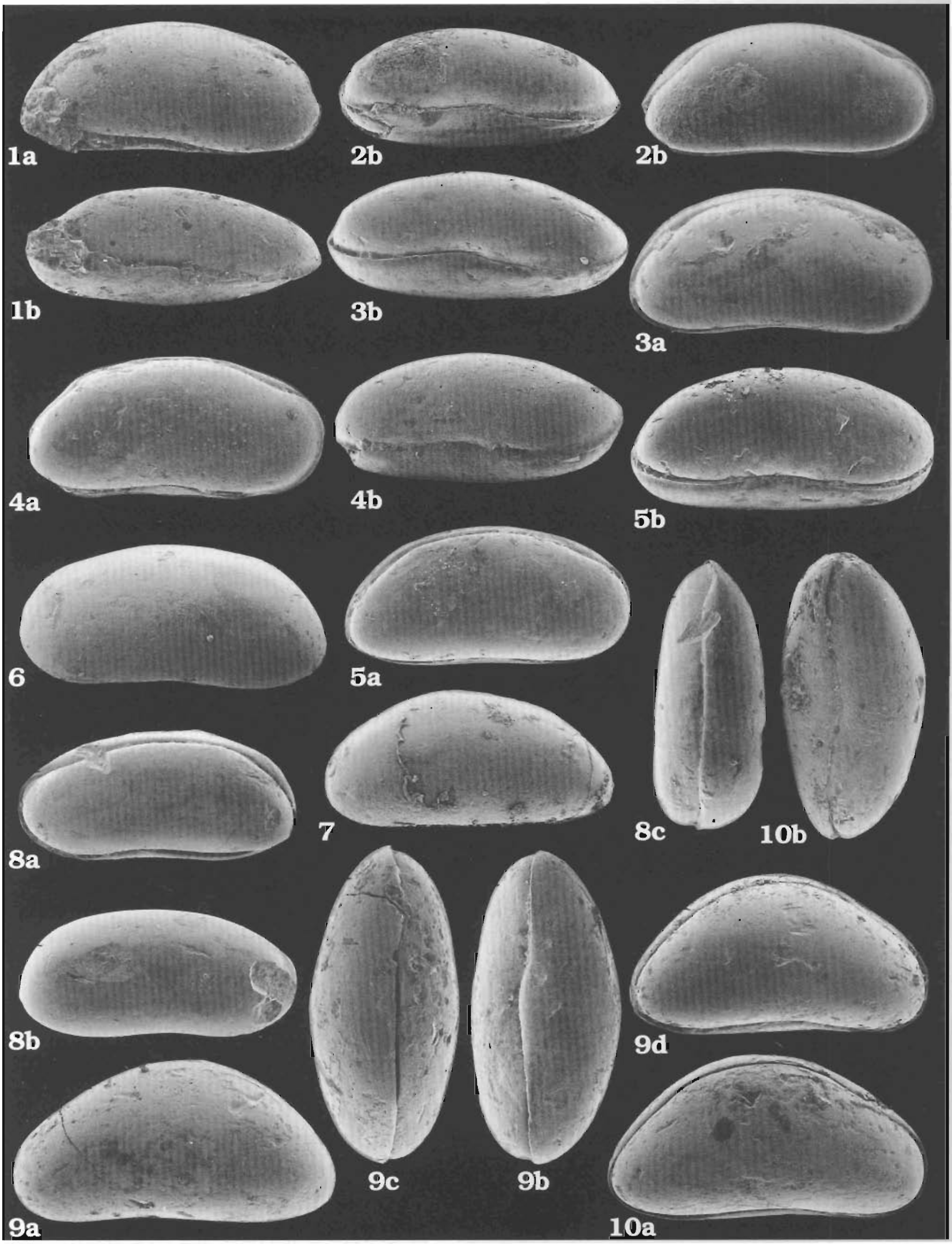
Argilloecia cf. *A. mesa* McKenzie, Reyment *et* Reyment, 1993 163

Fig. 8. aC; *a* left side, *b* right side, *c* dorsal view, × 50, ZPAL O.49/8, ZPAL 5.

Phlyctenophora sp. 163

Fig. 9. aC; *a* left side, × 56, *b* ventral view, × 60, *c* dorsal view, *d* right side, × 56, ZPAL O.49/1, ZPAL 1.
Fig. 10. aC; *a* right side, *b* ventral view, × 60, ZPAL O.49/41, ZPAL 5.

Telm1, La Meseta Formation (Eocene), Seymour Island.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OSTRACODS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 2

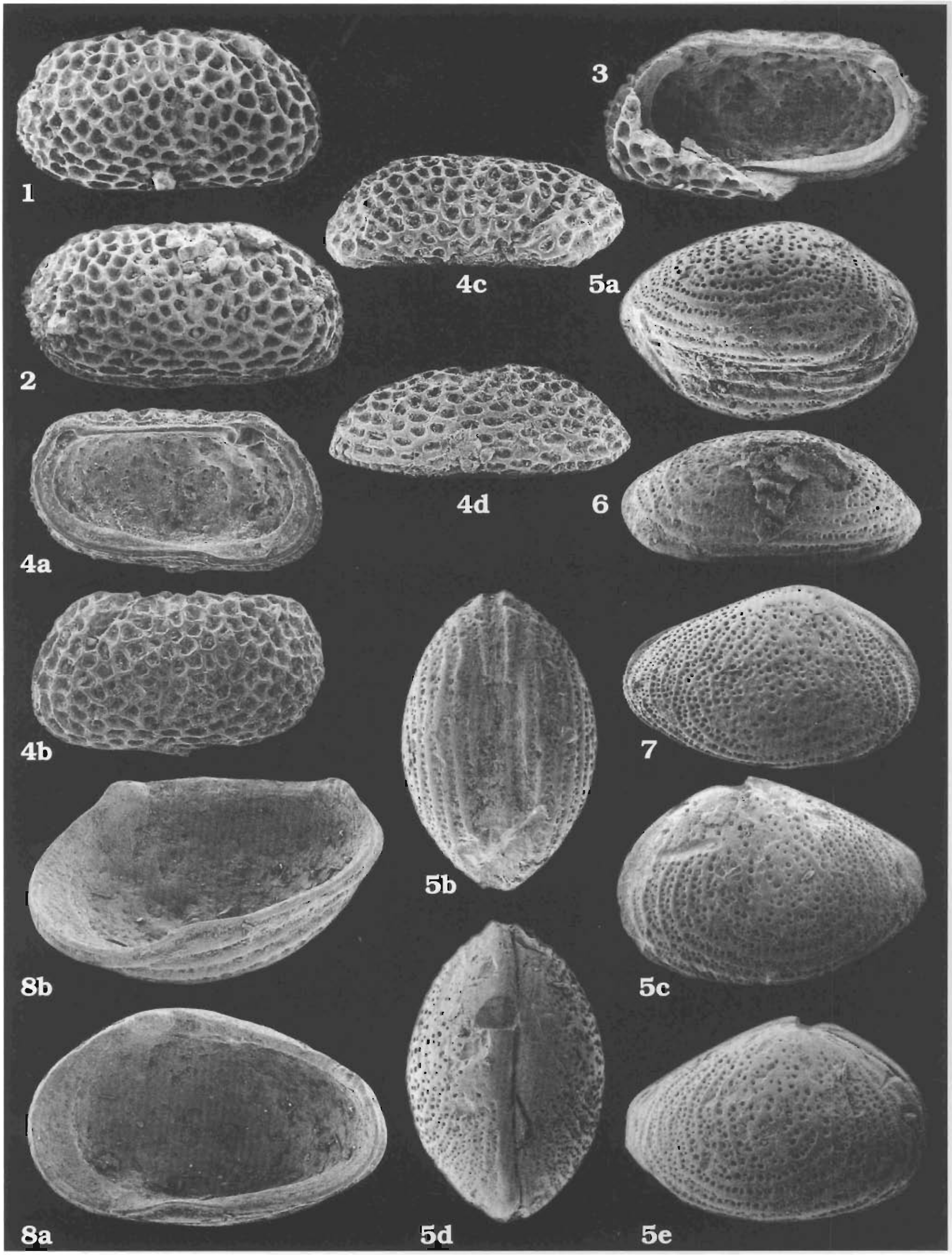
Wichmannella cf. *W. meridionalis* Bertels, 1969 164

Fig. 1. aRV; seen from outside, ×, 45, ZPAL.O.49/54, ZPAL 12.
Fig. 2. aC; right side, × 45, ZPAL O.49/5, ZPAL 12.
Fig. 3. aC; damaged carapace showing inner side of right valve, × 45, ZPAL O.49/55, ZPAL 12.
Fig. 4. aLV; *a* seen from inside, *b* seen from outside, *c* dorsal view, *d* ventral view, × 45, ZPAL O.49/13, ZPAL 12.

Majungaella antarctica sp. n. 165

Fig. 5. aC; *a* somewhat oblique ventral view, × 60, *b* ventral view, *c* left side, *d* dorsal view, *e* right side, × 55, ZPAL O.49/7, ZPAL 12.
Fig. 6. aLV; ventral view, × 60, ZPAL O.49/31, ZPAL 5.
Fig. 7. aRV, holotype; seen from outside, × 60, ZPAL O.49/33, ZPAL 5.
Fig. 8. aRV, paratype; *a* seen from inside, *b* oblique view of inner side, × 75, ZPAL O.49/32, ZPAL 5.

Telm1, La Meseta Formation (Eocene), Seymour Island.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OSTRACODS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 3

Propontocypris sp. 164

Fig. 1. Damaged aRV; *a* seen from inside, *b* seen from outside, × 65, ZPAL O.49/3, ZPAL 5.
Fig. 2. Damaged aRV; *a* seen from inside, *b* oblique ventral view, × 55, ZPAL O.49/25, ZPAL 1.
Fig. 3. jRV; seen from outside, × 75, ZPAL O.49/23, tentatively referred to *Propontocypris* sp., ZPAL 5.

?*Ameghinocythere* cf. *Cytheromorpha*? *flexuosa* Bertels, 1975 167

Fig. 4. aC; *a* dorsal view, *b* ventral view, *c* right side, × 90, ZPAL O.49/49, ZPAL 2.
Fig. 5. aC; right side, × 86, ZPAL O.49/40, ZPAL 2.
Fig. 6. aC; left side, × 86, ZPAL O.49/42, ZPAL 5.

Munseyella sp. 167

Fig. 7. Damaged aC; *a* oblique ventrolateral view, *b* left side, *c* oblique dorsal view, *d* right side, × 60, ZPAL O.49/53, ZPAL 1.

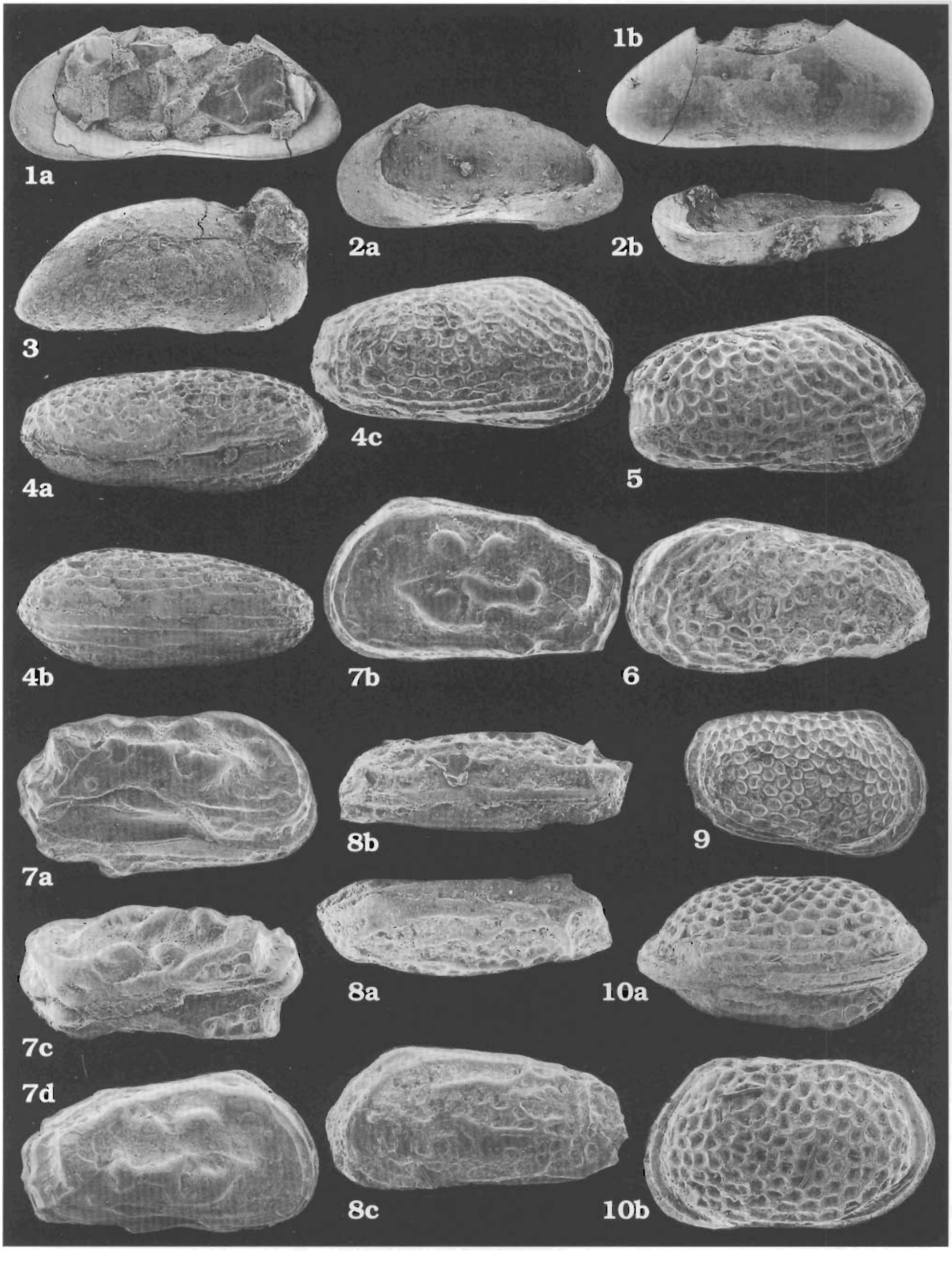
?*Keijia* sp. 168

Fig. 8. aLV; *a* oblique dorsal view, *b* ventral view, *c* seen from outside, × 40, ZPAL O.49/44, ZPAL 1.

Kuiperiana sp. 168

Fig. 9. jC; right side, × 45, ZPAL O.49/26, ZPAL 1.
Fig. 10. aC; *a* ventral view, *b* left side, × 60, ZPAL O.49/35, ZPAL 5.

Telm1, La Meseta Formation (Eocene), Seymour Island.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OSTRACODS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 4

?*Hornibrookella* sp. 166

Fig. 1. aC; *a* right side, *b* left side, *c* ventral view, *d* dorsal view, × 45, ZPAL O.49/37, ZPAL 5.

Fig. 2. aRV; *a* seen from outside, *b* oblique view of inner side, *c* seen from inside, *d* outer ventrolateral view, × 45, ZPAL O.49/11, ZPAL 5.

Fig. 4. aRV; *a* somewhat oblique outer view, *b* laterodorsal view, *c* ou ter view, × 45, ZPAL O.49/39, ZPAL 5.

Fig. 5. aC; *a* left side, *b* dorsal view, × 60, ZPAL O.49/46, tentatively referred to ?*Hornibrookella* sp., ZPAL 5.

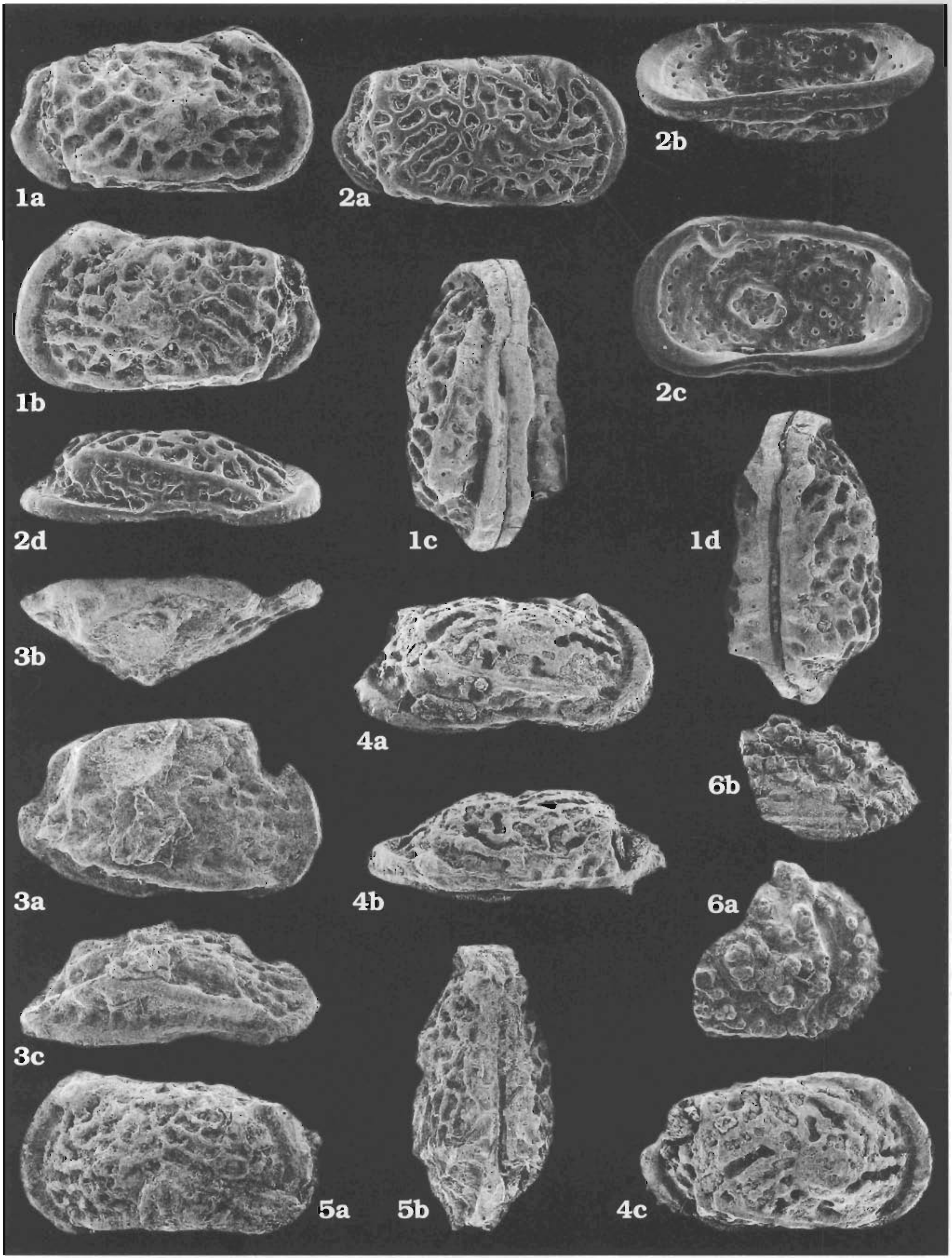
Australicythere sp. 166

Fig. 3. Damaged aRV; *a* outer side, *b* dorsal view, *c* ventrolateral view, × 45, ZPAL O.49/36, ZPAL 5.

Actinocythereis cf. *A. indigena* Bertels, 1969 164

Fig. 6. Fragment of aRV; *a* outer ventrolateral view, *b* outer view, × 60, ZPAL O.49/18, ZPAL 11.

Telm1, La Meseta Formation (Eocene), Seymour Island.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OSTRACODS FROM THE EOCENE OF SEYMOUR ISLAND, ANTARCTIC PENINSULA

PLATE 5

?*Echinocythereis hartmanni* sp. n. 165

Fig. 1. aRV; seen from outside, × 50, ZPAL O.49/34, ZPAL 5.
Fig. 2. aC; paratype, left side, × 50, ZPAL O.49/47, ZPAL 1.
Fig. 3. aC; holotype; *a* dorsal view, *b* left side, *c* oblique view of ventral side, × 50, *d* details of ornamentation, × 240, ZPAL O.49/27, ZPAL 1.
Fig. 4. aLV; *a* ventrolateral external view, *b* seen from outside, × 50, ZPAL O.49/22, ZPAL 1.

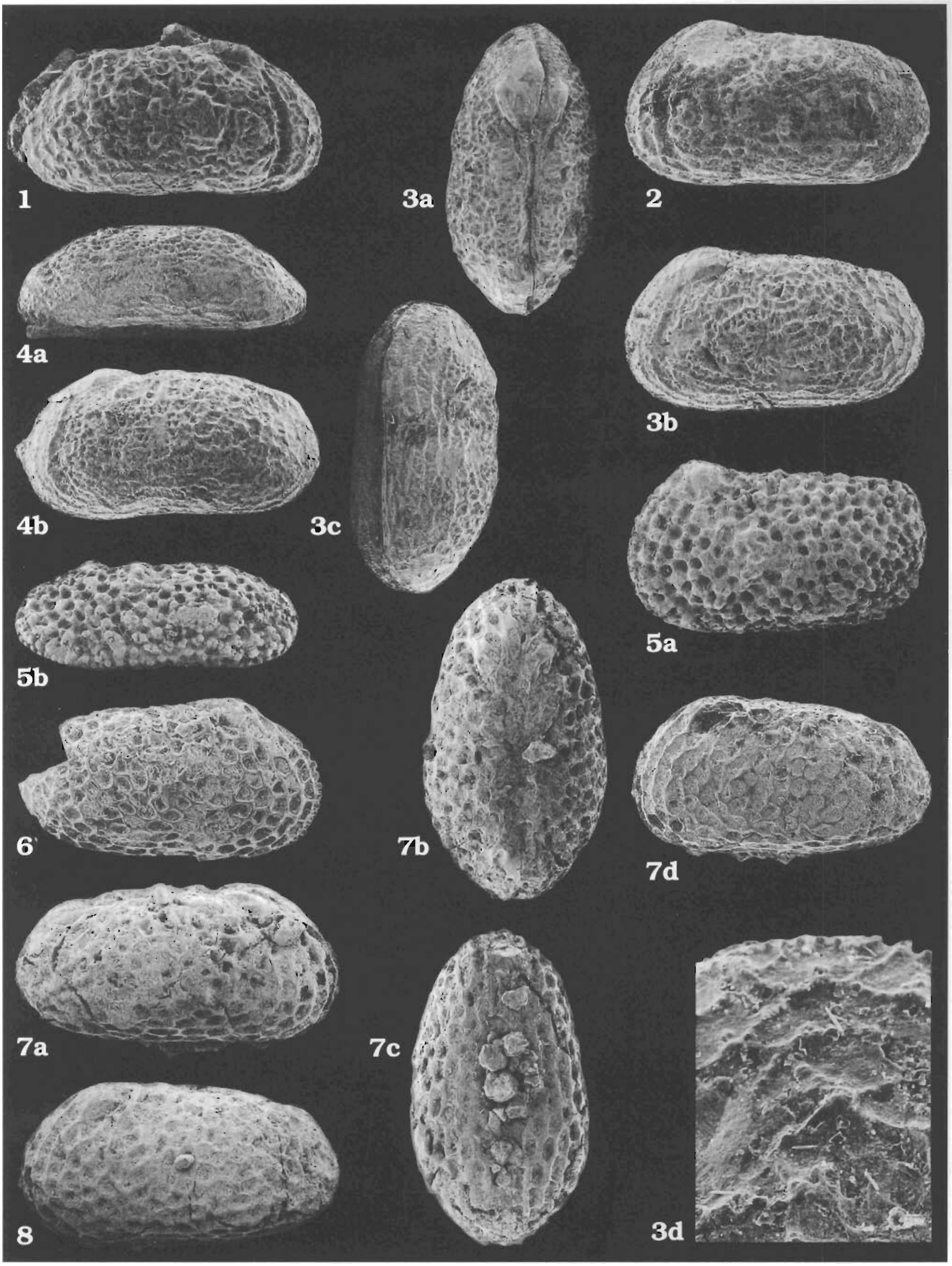
Henryhowella sp. 164

Fig. 5. aLV; *a* seen from outside, *b* lateroventral view, × 50, ZPAL O.49/30, ZPAL 5.

Genus et species indet. 168

Fig. 6. Damaged jRV; seen from outside, × 60, ZPAL O.49/12, ZPAL 12.
Fig. 7. aC; *a* right side, *b* dorsal view, *c* ventral view, *d* left side, × 45, ZPAL O.49/4, ZPAL 12.
Fig. 8. aC; left side, × 45, ZPAL O.49/56, ZPAL 12.

Telm1, La Meseta Formation (Eocene), Seymour Island.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INDEX OF GENERIC AND SPECIFIC NAMES

Explanation to index: * — text-fig., bold — description