PALEOGENE CORALS FROM SEYMOUR ISLAND, ANTARCTIC PENINSULA

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From the Sobral Formation (Paleocene) of Seymour Island solitary coralla of ?*Aulocyathus* Marenzeller, 1904 (suborder Caryophylliina) and branch fragments of *Madrepora sobral* Filkorn, 1994 (suborder Faviina) are described. In the overlying strata of the La Meseta Formation (Eocene) scleractinian coral fauna comprises solitary Caryophylliina (*Crispatotrochus antarcticus* sp. n., *Caryophyllia* sp., *Flabellum* sp.) and colonial Dendrophylliina (*Tubastraea* sp.). Reported are also octocoral holdfasts. The genera recorded from both formations are known also from modern seas. *Crispatotrochus antarcticus* sp. n. is the earliest representative of the genus. ?*Aulocyathus* and *Tubastraea* have no other fossil record.

Key words: Scleractinia, Octocorallia, taxonomy, Sobral Formation, La Meseta Formation, Tertiary, Antarctica.

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INTRODUCTION

The fossil corals from Antarctica were first investigated by FELIX (1909) who described six new scleractinian species (including the new turbinoliid genus *Bothrophoria*) from the Cretaceous sequence of Seymour (Marambio) and Snow Hill (Cerro Nevado) Islands. They were collected by NORDENSKJÖLD's Swedish South Polar Expedition (1901–1903), from the Upper Cretaceous López de Bertodano Formation. Although Cretaceous-Paleocene corals from this area had been reported in the geological literature (*e.g.* BIBBY 1966; MACELLARI 1988; STILWELL and ZINSMEISTER 1992), no systematic descriptions have been made until FILKORN's monograph (1994). He described from the Upper Cretaceous and Paleocene (López de Bertodano and Sobral Formations) sixteen scleractinian species including nine new species and four new genera. FILKORN's study remarkably increased the knowledge of fossil turbinoliids: with eight species in seven genera, the Seymour Island turbinoliid assemblage is one of the earliest and most diversified yet discovered. FILKORN (1994) also mentioned colonial scleractinians from the Eocene La Meseta Formation; these, however were not systematically described.

Here are studied corals from two Tertiary formations on Seymour Island: Sobral Formation and La Meseta Formation. The material was collected by Andrzej GAŹDZICKI during Argentine-Polish field parties in the austral summers of 1991–92, 1993–94 (GAŹDZICKI 1996 this volume) and is deposited at the Institute of Paleobiology of the Polish Academy of Sciences, Warszawa (abbreviation ZPAL H.XI).

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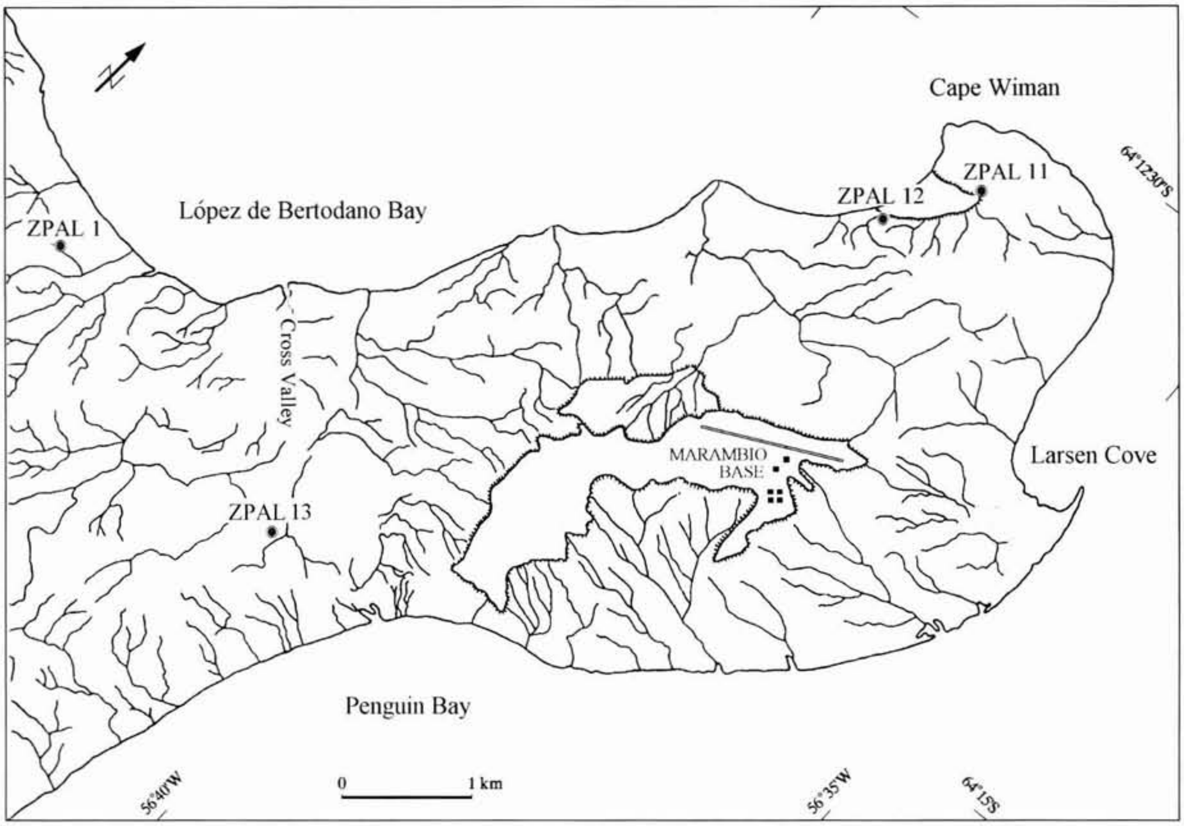

Fig. 1
Map of the northern part of Seymour (Marambio) Island showing the outcrops with coral fauna.

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GEOLOGICAL SETTING

The corals described here are from Tertiary sediments representing two marine formations on Seymour Island, the Sobral and La Meseta Formations (Text-fig. 1).

The Lower Paleocene Sobral Formation deposits (up to 255 m thick) unconformably overlie the López de Bertodano Formation (Upper Campanian to Paleocene) — see MACELLARI (1988); SADLER (1988). The Sobral Formation is subdivided into five lithologic units Tps1–Tps5 (SADLER 1988). The investigated Paleocene scleractinians are from the lowermost unit (Tps1), which crop out south of Cross Valley (fossil locality ZPAL 13 on Text-fig. 1); see also FILKORN (1994). The macrofauna is represented by gastropods (*Perissoptera*), pelecypods (*Pinna*, *Lahilla*, *Cucullaea*), bryozoans, abundant cidaroid spines and shark teeth (SADLER 1988).

The La Meseta Formation deposits (up to 800 m thick) unconformably lie on the upper Cretaceous/Paleocene erosional surface (ELLIOT and TRAUTMAN 1982; SADLER 1988; STILWELL and ZINSMEISTER 1992; PORĘBSKI 1995) and crop out at the northern part of Seymour Island and southwest of Cross Valley (Text-fig. 1). The La Meseta Formation is subdivided into seven lithofacies Telm1–Telm7 (SADLER 1988).

The corals described here are from the lowermost unit (Telm1) for which a late Early Eocene age is postulated (WRENN and HART 1988; COCOZZA and CLARKE 1992; see also TAMBUSSI *et al.* 1994). The deposits of Telm1 unit crop out at Cape Wiman (localities ZPAL 11 and ZPAL 12, *Sadler Stacks*) and west of Cross Valley (locality ZPAL 1, *Bill Hill*). These deposits, interpreted as trangressive, are composed of grey to red-brown limonitic sandy siltstones, sandstones and sandy pebble-conglomerates with intercalations of shelly hash at locality ZPAL 1 (the westernmost exposure) and of red-brown siltstones and sandstones associated with a megabreccia facies (Telmm) at localities ZPAL 11 and ZPAL 12 (the northernmost exposure) *cf.* SADLER (1988); STILWELL and ZINSMEISTER (1992). In addition to scleractinian corals, fossils from Telm1 include abundant gastropods (STILWELL and ZINSMEISTER 1992), serpulids, brachiopods (BITNER 1996 this volume), cyclostomate and cheilostomate bryozoans (GAŹDZICKI and HARA 1994; HARA 1995), asteroids, crinoids (BAUMILLER and GAŹDZICKI 1994; 1996 this volume), cidaroid echinoids (RADWAŃSKA 1996 this volume), large pelecypods (*Ostrea* and *Pecten*), and stylasterid hydrozoans (STOLARSKI in preparation).

SYSTEMATIC PART

Morphological terms:
GCD — Greater Calicular Diameter
H — Height of a corallum
LCD — Lesser Calicular Diameter
S_X, P_X — Septa and pali of a cycle designated by numerical subscript

Order **Scleractinia** BOURNE, 1900
Suborder **Faviina** VAUGHAN *et* WELLS, 1943
Family **Oculinidae** GRAY, 1847
Genus *Madrepora* LINNAEUS, 1758

Type species: *Madrepora oculata* LINNAEUS, 1758

Madrepora sobral FILKORN, 1994
(Pl. 14: 1–3)

Material. — About 150 branch fragments (with about 230 corallites) from site ZPAL 13 (ZPAL H.XI/27–32).

Remarks. — FILKORN's (1994) recent description and illustrations provided all necessary information. At least thirty nominal species of *Madrepora* have been reported from the Tertiary, including six from the Eocene (WELLS 1977). *M. sobral* FILKORN, 1994 is the earliest species of the genus.

Occurrence. — Seymour Island, Sobral Formation: ZPAL 13, Tps1 (Paleocene).

Suborder **Caryophylliina** VAUGHAN *et* WELLS, 1943
Superfamily **Caryophyllioidea** DANA, 1846
Family **Caryophylliidae** DANA, 1846
Genus *Caryophyllia* LAMARCK, 1816

Type species: *Madrepora cyathus* ELLIS and SOLANDER, 1786.

Caryophyllia sp.
(Pl. 16: 1–2; Text-fig. 2)

Material. — Four specimens ZPAL H.XI/39–42 from site ZPAL 11.

Description. — Corallum solitary. The largest specimen (ZPAL H.XI/39) is 45 mm tall (base not preserved), strongly compressed and internally crushed. A specimen with relatively well preserved internal parts (ZPAL H.XI/40) has a subcircular calice, 23 × 25 mm in diameter, and 56 septa. Septa arranged in 3 size classes of decreasing exsertness: 14 moderately exsert primaries, 14 paliferous secondaries and 28

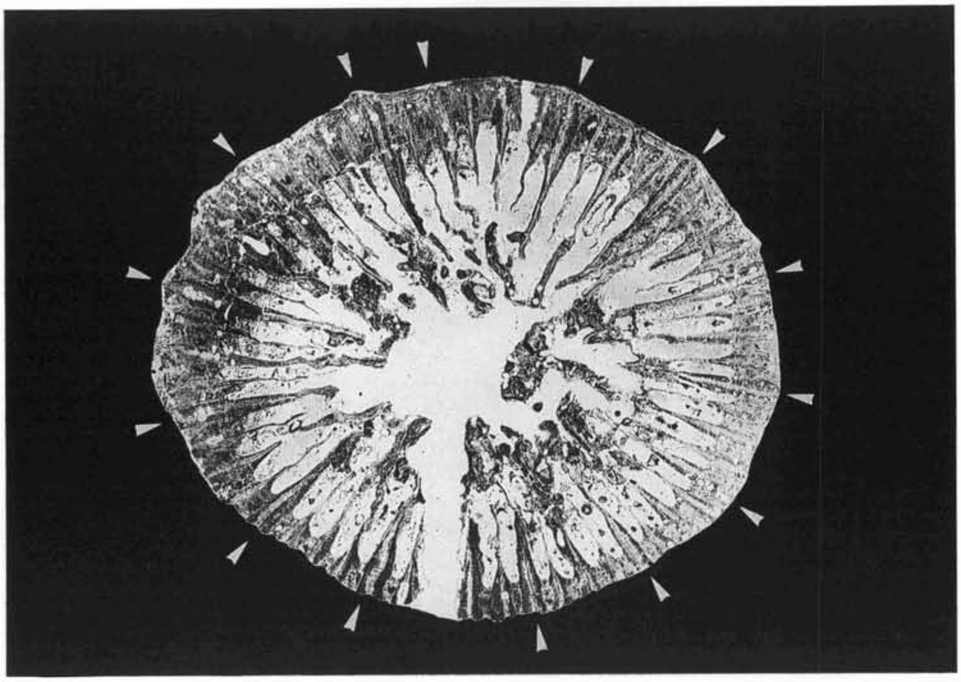

Fig. 2
Caryophyllia sp. Transverse section of ZPAL H.XI/40 specimen (ZPAL 11, Telm1). Marked are primary septa, × 3.5.

tertiaries. Columella fascicular. Wall of adult stage septothecal. Corallum proximally encircled by thick layers of tectura.

Remarks. — For a specific determination more complete specimens are needed. *Caryophyllia* sp. should probably be grouped with "attached" species, as thick tectural deposits (see STOLARSKI 1995) cover the proximal parts of preserved coralla.

Approximately 185 nominal fossil (ranging from the Late Jurassic) and 56 Recent valid species are placed within the nominative subgenus (CAIRNS 1991). *Caryophyllia* is cosmopolitan and occurs at depths of 0–3200 m (after KELLER 1981).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 11 (*Cape Wiman*), Telm1 (Eocene).

Genus *Aulocyathus* MARENZELLER, 1904

Type species: *Aulocyathus juvenescens* MARENZELLER, 1904.

?*Aulocyathus* sp.
(Pl. 14: 4; Text-fig. 3)

Material. — One fragmentary specimen ZPAL H.XI/33 (proximal part not preserved) from site ZPAL 13.

Description. — Specimen 27 mm in height, proximal part missing (extrapolated height of the complete, ceratoid corallum is about 40 mm). Diameter at distal edge 13.6 mm. Costae poorly defined. Septa hexamerally arranged in 4 cycles, the last cycle incomplete (S_4 missing in one system): 44 septa, $6S_1>6S_2>12S_3>20S_4$. S_1 independent and reach to axial part of calice. Inner edges of pairs of S_3 fused to their adjacent S_2 deep in calice; S_4 short. Septal faces bear many sharp granules. S_2 bear short paliform lobes. Rudimentary columella deep in calice. It is composed of tuberculate, widened lower inner edges of the S_{1-2} or paliform lobes. Proximal part of calice partially infilled with stereome. Wall on proximal and distal ends of preserved corallum septothecal.

Remarks. — Four Recent species are attributed to *Aulocyathus*: *A. juvenescens* MARENZELLER, 1904 (off Tanzania, 302–463 m); *A. recidivus* (DENNANT. 1906) (South Australia, New Zealand, Madagascar, off Japan, 128–1000 m); *A. atlanticus* ZIBROWIUS, 1980 (northeast Atlantic, 450–1716 m); and *A. matricidus* (KENT, 1871) (North Pacific, 84–207 m); after CAIRNS 1994; ZIBROWIUS 1980. All these Recent taxa reproduce by longitudinal fragmentation of parent coralla. The proximal part of the specimen described here is broken, thus, this important generic character cannot be observed. However, other features of the

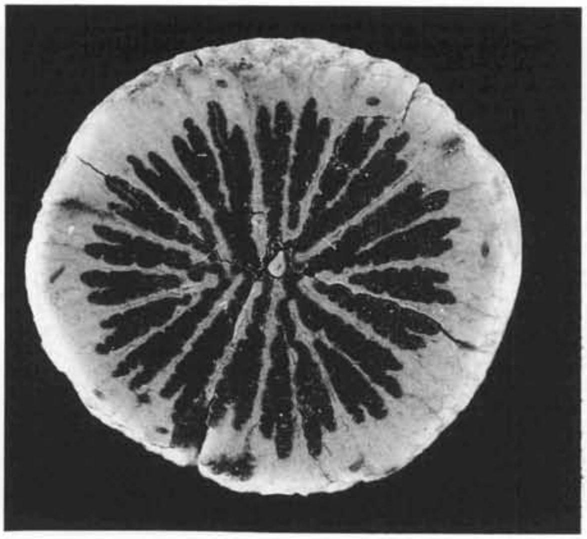

Fig. 3
?*Aulocyathus* sp. — transverse section of the middle part of specimen ZPAL H.XI/33 (ZPAL 13, Tps1), × 5.

specimen, *e.g.* deep calice, septal pattern, poorly defined costae, absence of pali and rudimentary columella, resemble those of *Aulocyathus*.

Occurrence. — Seymour Island, Sobral Formation: ZPAL 13, Tps1 (Paleocene). This is the first record of *Aulocyathus* as a fossil.

Genus *Crispatotrochus* Tenison Woods, 1878

Type species: *Crispatotrochus inornatus* Tenison Woods, 1878.

Remarks. — *Crispatotrochus* Tenison Woods, 1878 (= *Cyathoceras* Moseley, 1881) belongs to a group of probably closely related Recent genera having no pali and endotheca: solitary *Labyrinthocyathus* Cairns, 1979, *Oxysmilia* Duchassaing, 1870, *Conotrochus* Seguenza, 1864, and colonial *Lochmaeotrochus* Alcock, 1902. *Crispatotrochus* is distinguished by its fascicular columella composed of 2–30 twisted laths and its broad, robust pedicel. There are two fossil genera similar to *Crispatotrochus,* both having a fascicular columella and a broad pedicel: the Paleocene *Kangiliacyathus* Floris, 1972 and the Miocene *Psammocyathus* Chevalier, 1963 (with a columella formed by anastomosing paliform lobes P_{1-2}).

Crispatotrochus antarcticus, sp. n.
(Pl. 15: 1–7; Text-figs 4–5)

Holotype: The specimen ZPAL H.XI/17 figured on Text-fig. 4.

Paratypes: Specimens ZPAL H.XI/1–9,12 (Specimens ZPAL H.IX/1–4, 8–9 and 12 are figured on Pl. 15: 1–6).

Type horizon: Telm1, La Meseta Formation; Eocene.

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

Derivation of the name: From the Greek *antarktikos* — southern, which refers to the geographic area.

Material. — 43 specimens from site ZPAL 1 (*Bill Hill*: ZPAL H.XI/1–22), 3 specimens from ZPAL 11 (*Cape Wiman*: ZPAL H.XI/23–25).

Description. — Corallum ceratoid to trochoid, firmly attached by an expanded base; up to 11 × 12.5 mm in calicular diameter and 23 mm in height (Text-fig. 4). Wall thick, particularly at base and calicular edge of corallum. Costae slightly developed or absent. Septa hexamerally arranged in four cycles (S_1=S_2>S_3>S_4). The fourth cycle (48 septa) is complete at a calicular diameter of about 10 mm. Some specimens have a few additional S_5 (max. 52 septa). Only S_1 and S_2 extend to the columella. Columella variable in shape and structure, usually occupying an elliptical field (ca. 2 × 3.5 mm) and composed of 5–6 interconnected, twisted lamellae. However, sometimes there are only 2 or 3 twisted lamellae (Pl. 15: 5a) or the columellar lamellae are straight and closely spaced (Pl. 15: 6a).

Ontogeny and microstructure. — Initial skeleton consisting of 6 protosepta and marginotheca. Diameter of basal plate 1–1.5 mm. Columella styliform. Marginotheca and septa composed of a vertical

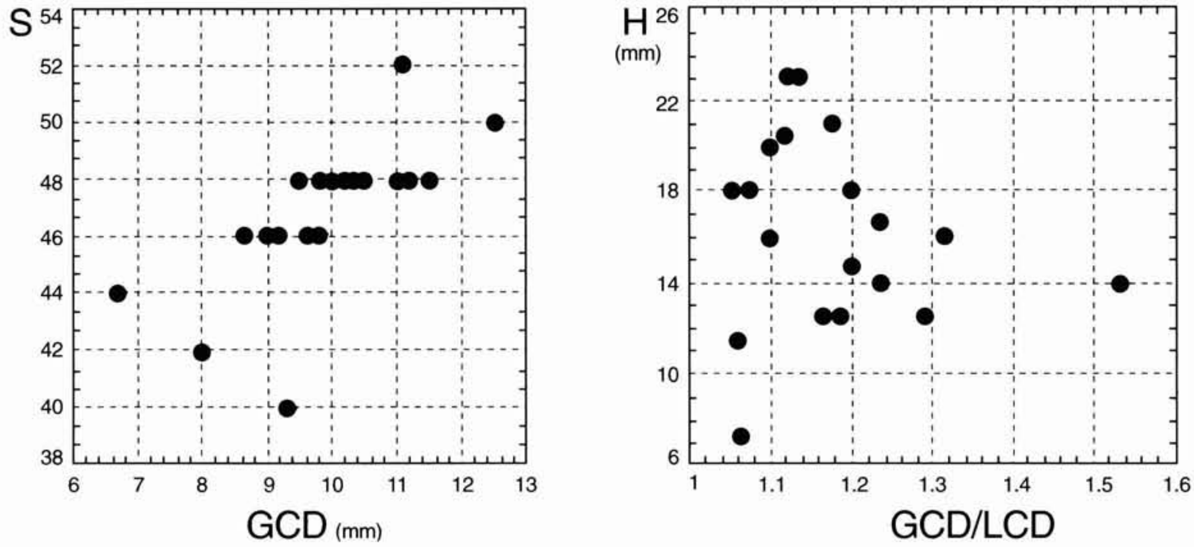

Fig. 4
Morphologic variability of *Crispatotrochus antarcticus* sp. n.
a —Scattergram of great calicular diameter *vs* septal number. b — Scattergram of GCD:LCD ratio *vs* height of the corallum.

minitrabecular palisade. Subsequently the corallum diameter decreases to ca. 0.9 mm. Initial part of corallum encircled by thick tectural layers (see STOLARSKI 1995) which are more developed in the following growth stages.

Juvenile stage starts with enlargement of corallum diameter and appearance of S_2. In later growth S_3–S_4 appear. Most specimens have hexameral, rarely octameral, symmetry. Wall trabeculothecal. Costal parts of septa weakly developed. Septa of successive cycles originate from interseptally situated trabeculothecal segments (the midline of a newly formed septum is a continuation of the midline of the theca). Thecal ring and costae are coated by tectural deposits, the bundled crystallites of which disclose centrifugal accretion. Succeeding tectural rings appear, resulting in a thick calcareous deposit at the proximal end of larger specimens (monocyclic development of DURHAM 1949).

Adult stage with four septal cycles and a columella composed of several twisted laths. Wall septothecal. At calicular edge, costae may be covered by a rim of a thick tectura.

Remarks. — Most specimens have a fascicular columella composed of a few twisted elements, which is typical of the genus, but in some specimens columellar elements are rather lamellar (see Pl. 15: 6a), resembling those of *Labyrinthocyathus* CAIRNS, 1979.

On the basis of septal symmetry they can be divided into three groups: (I) species with hexameral symmetry and four septal cycles (7 taxa), (II) species with hexameral symmetry and five septal cycles (3 taxa) and (III) species with decameral symmetry (4 taxa). Having hexameral symmetry and four septal cycles *C. antarcticus* sp. n. belongs to the first group of species. It resembles Recent *C. cornu* (MOSELEY, 1881) by its corallum shape, diameter of calice and columella composed of few twisted laths. *C. antarcticus* sp. n. differs from *C. cornu* by lesser number of septa. According to CAIRNS (1979) the lectotype of *C. cornu* (11.2 mm calicular diameter and 22.7 mm height) has 60 septa (six pairs of S_5) while the majority specimens of *C. antarcticus* sp. n. have only 48 septa at the same diameter.

Tentatively, the following fossil forms are here assigned to *Crispatotrochus*: those species with four cycles of hexamerally arranged septa, *C. tortonesis* (CHEVALIER, 1961), Miocene of Italy; *C. demarcqui* (CHEVALIER, 1963), Miocene of France; *C. periallus* (SQUIRES, 1962), Oligocene of New Zealand; with five cycles of hexamerally arranged septa and large corallum (more than 45 mm in height) *C.* cf. *C. rubescens* (SQUIRES, 1958), Pliocene of New Zealand; and one species with decamerally arranged septa, *C. galloprovicialis* (CHEVALIER *et* DEMARCQ, 1963), Miocene of France.

In modern seas *Crispatotrochus* is almost cosmopolitan in distribution (yet unknown from the eastern Atlantic) and occurs at depths of 82–2505 m (after CAIRNS 1995).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 1 (*Bill Hill*); ZPAL 11 (*Cape Wiman*), Telm1 (Eocene). This is both the earliest record of the genus and the first record from Antarctica.

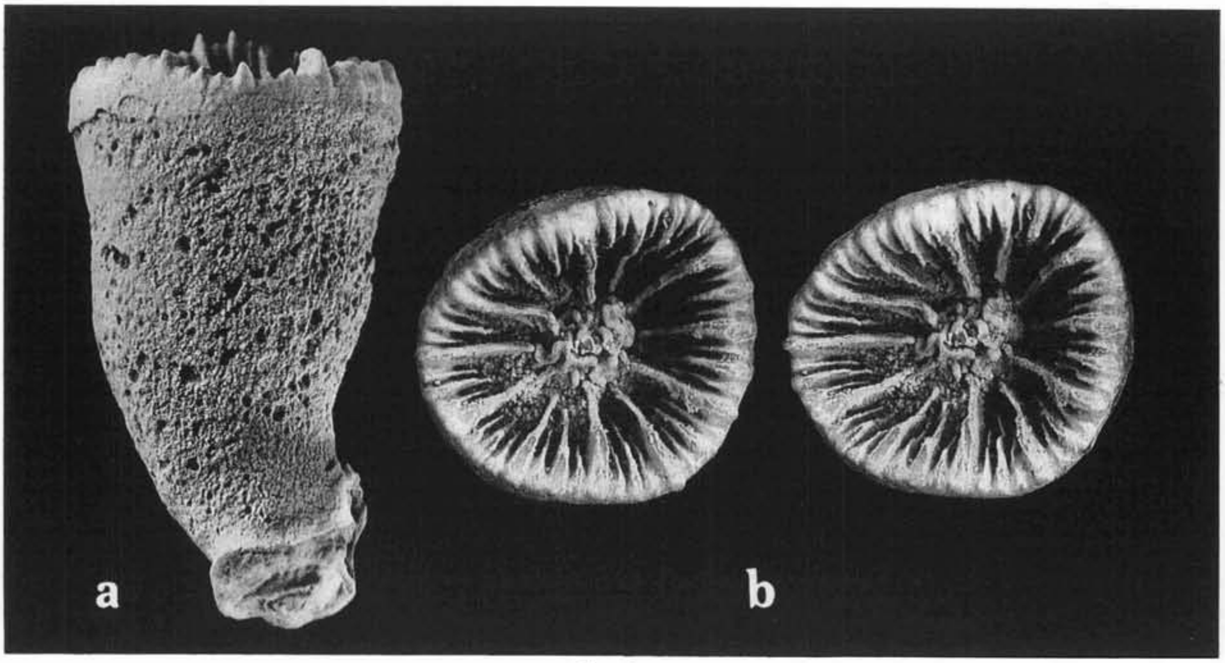

Fig. 5
The holotype of *Crispatotrochus antarcticus* sp. n. (ZPAL H.XI/17, ZPAL 1, Telm1); lateral (a) and calicular (b: stereo) views, × 5.

Family **Flabellidae** BOURNE, 1905
Genus *Flabellum* LESSON, 1831

Type species: *Flabellum pavoninum* LESSON, 1831.

Flabellum sp.
(Pl. 17: 1)

Material. — One strongly eroded specimen (ZPAL H.XI/26) from ZPAL 11 (*Cape Wiman*).

Description. — Corallum highly compressed (GCD:LCD = 2.1). Angle of thecal edges ca. 45°; inclination of thecal faces ca. 16°. Specimen 6.2 × 13.5 mm in calicular diameter and 20 mm in height (base not preserved). Septa octamerally arranged in two size classes $8S_1=8S_2>16S_3$. Septal faces bear small granules. Distal and some outer parts of corallum missing.

Remarks. — Features of this poorly preserved specimen allow only for its assignment to *Flabellum* sp. Octameral septal symmetry is uncommon in *Flabellum* (among ca. 45 Recent species it is consistent only in *F.* (*Ulocyathus*) *marenzelleri* CAIRNS, 1989 and *F.* (*U.*) *hoffmeisteri* CAIRNS et PARKER, 1992; in *F.* (*U.*) *deludens* MARENZELLER, 1904 octameral symmetry occurs sporadically). However, the small and compressed Late Cretaceous *Flabellum fresnoense* DURHAM, 1943 (possibly the oldest known species of the genus) has octameral symmetry as well. A preliminary review of Paleogene species shows that octameral forms were quite frequent (*F. clarki* BENTSON, 1943; *F. appendiculatum* (BRONGNIART, 1823); *F. johnsoni* VAUGHAN, 1900; *F. bellardii* HAIME, 1850, and maybe others).

From La Meseta Formation (unit Telm2) of Seymour Island, STILWELL and ZINSMEISTER (1992: fig. 45) noted the occurrence of *Flabellum* sp., probably with hexamerally arranged septa. ?*Flabellum anderssoni* (FELIX, 1909) was reported by FILKORN (1994) from the Late Cretaceous (?Campanian, Maastrichtian–Paleocene) strata. Originally described as a *Parasmilia*, it was tentatively transferred to *Flabellum* by FILKORN (1994). In fact, it shares flabellid morphology (shape, presence of marginotheca) but has caryophylliid-like type of tectural deposits ornamented with numerous granulations (see FILKORN 1994, fig. 25: 3). ?*F. anderssoni*, being one of stratigraphically oldest flabellids (*sensu* STOLARSKI 1995), may have retained features of its caryophylliid ancestors.

Other fossil *Flabellum* from Antarctica are: *Flabellum rariseptatum* RONIEWICZ and MORYCOWA, 1985 from the ?Late Oligocene–Early Miocene of King George Island; *Flabellum* sp. from the Early Oligocene of King George Island (RONIEWICZ and MORYCOWA 1985, 1987; GAŹDZICKI and STOLARSKI 1992).

About 144 nominal fossil (ranging from the Late Cretaceous) and 47 valid Recent species are attributed to *Flabellum* (CAIRNS 1989). The genus is cosmopolitan and occurs at depths of 22–2300 m (after CAIRNS 1989).

Occurrence. — Seymour Island, La Meseta Formation: ZPAL 11 (*Cape Wiman*), Telm1 (Eocene).

Suborder **Dendrophylliina** VAUGHAN *et* WELLS, 1943

Family **Dendrophylliidae** GRAY, 1847

Genus *Tubastraea* LESSON, 1829

Type species: *Tubastraea conccinea* LESSON, 1829.

Tubastraea sp.
(Pl. 17: 2–7; Text-fig. 6)

Material. — Most of the investigated colonies from site ZPAL 11 are strongly compressed and fragmented (ZPAL H.XI/43–48: about 120 branch fragments). Coralla from site ZPAL 1 (ZPAL H.XI/49–57, 60: about 100 branch fragments) and site ZPAL 11 (ZPAL H.XI/58–59: 3 branch fragments) are fragmented but not compressed.

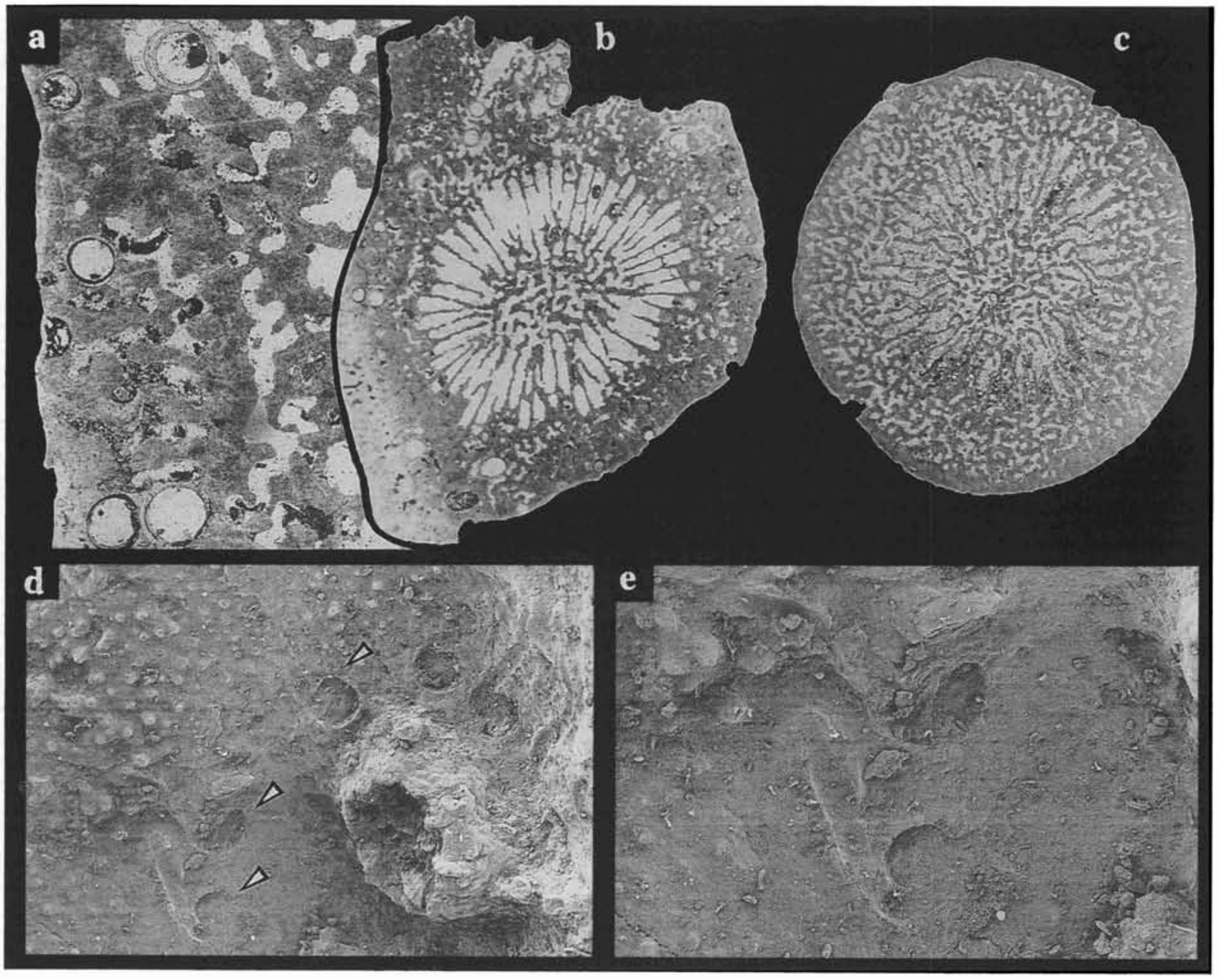

Fig. 6

Tubastraea sp.; a–b — transverse section of the specimen ZPAL H.XI/49 (ZPAL 1, Telm1) showing several serpulid tubes embedded within wall structure, × 25, × 7 respectively; c — transverse section of the specimen ZPAL H.XI/50, × 7. d–e — serpulid tubes with planispirally coiled initial part (arrowed) partially overgrown by coral skeleton, × 35, × 70 respectively.

Description. — Colonies dendroid or plocoid, all achieved by extratentacular budding from corallite walls and basal coenosteum. Calices circular or slightly elliptical. Septa arranged hexamerally. Most corallites have four septal cycles, only the largest ones have rudimentary S_5. S_1 and S_2 attain the columella. Usually S_4 unite before their adjacent S_3. Fossa moderately deep (about 3.5 mm), containing large spongy columella. Synapticulotheca porous and variable in thickness (ca. 2.5 mm at calicular edge). Corallites of juvenile colonies often covered by epitheca.

Remarks. — Within the wall of some specimens are embedded serpulid tubes (Pl. 17: 6; Text-fig. 6a–b). Some tubes are entirely overgrown by dense or porous skeletal tissue whereas some only partially. In latter case, external parts of tubes are often destroyed. Each tube begins with planispirally coiled initial part (diameter ca. 0.2–0.3 mm) followed by the straight part (ca. 6–12 mm length and 0.6 mm external diameter). Tubes are directed more or less parallel to the growth axis of the corallite. The presence of the tubes have no influence on the formation of the corallum. Most probably, the serpulid larvae settled on the exposed skeleton not covered by soft tissue. Their tubes were overgrown by succesive skeletal layers secreted in periods with inflated coral tissue.

The genus *Tubastraea* is distinguished from other dendrophylliids by having dendroid or plocoid colonies achieved by extratentacular budding, with tissue continuing between adjacent corallites (no epitheca) and normally arranged septa. These are also features of the investigated specimens but juvenile colonies usually have epithecate corallites (Pl. 9: 5). In subsequent growth, corallites were (?periodically) covered by the soft tissue resulting in the formation of succesive layers of thick and porous sclerenchyme (Pl. 17: 6–7). In some dendrophyllid genera the presence or absence of the epitheca is not permanent and may vary with age and/or growth form of the colony. For example in *Astroides* QUOY *et* GAIMARD, 1827 adjacent polyps may have (in cerioid or plocoid morphotypes) or may lose (in dendroid morphotype) tissue connection and, respectively, have epithecate or costate coralla (compare ZIBROWIUS 1980). Also some *Balanophyllia* species have epithecate adult coralla (*i.e. B. malouinensis* SQUIRES. 1961) whereas in other species they are fully costate (i.e. *B. europaea* (RISSO, 1826)).

As only one juvenile colony is sufficiently well preserved and the most of material consist of fragmented branches of dendroid colonies, a new species is not described. Among six Recent species attributed to *Tubastraea* (compare CAIRNS and KELLER 1993; CAIRNS 1994) the fossil specimens reported here are most similar to dendroid *T. micrantha* (EHRENBERG, 1834), a Recent species ranging from the northern Red Sea to Madagascar and the western Pacific (0–55 m). The genus has a broad circumtropical distribution (Pacific, Indian Ocean, western Atlantic) and occurs at depths of 0–110 m (after WELLS 1983).

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

Subclass **Octocorallia** HAECKEL, 1866
Order **Gorgonacea** LAMOUROUX, 1816
Suborder **Holaxonia** STUDER, 1887

Remarks. — Calcified holdfasts occur in several gorgonacean families: Plexauridae, Gorgoniidae, Primnoidae, Ellisellidae, Isididae, and Chrysogorgiidae (GRASSHOFF and ZIBROWIUS 1983; KOCURKO 1988). Discoidal holdfasts reported here are very similar to those (probably plexaurids) from the Early Oligocene of the Red Bluff Formation, Mississippi, U.S.A. (KOCURKO 1988; KOCURKO M.J. and KOCURKO D.J. 1992). No corresponding sclerites were available for this study. This is the first report of octocorals from Seymour Island.

Holdfast A
(Pl. 16: 3)

Material. — One calcified holdfast from ZPAL 12 (*Sadler Stacks*: ZPAL H.XI/37).

Remarks. — Specimen 25 mm in diameter and 5 mm in height. Surface striated. Central depression, formed by post-mortem removal of organic (gorgonine) axial cortex, relatively shallow (1.3 mm deep).

Transverse thin-section (Pl. 16: 3b) and polished and etched surface (Text-fig. 7a–b) of the holdfast show concentrically arranged layers of calcareous material. Regular and prominent undulations of the successive layers correspond to external ornamentation of the holdfast. Some layers reveal traces of

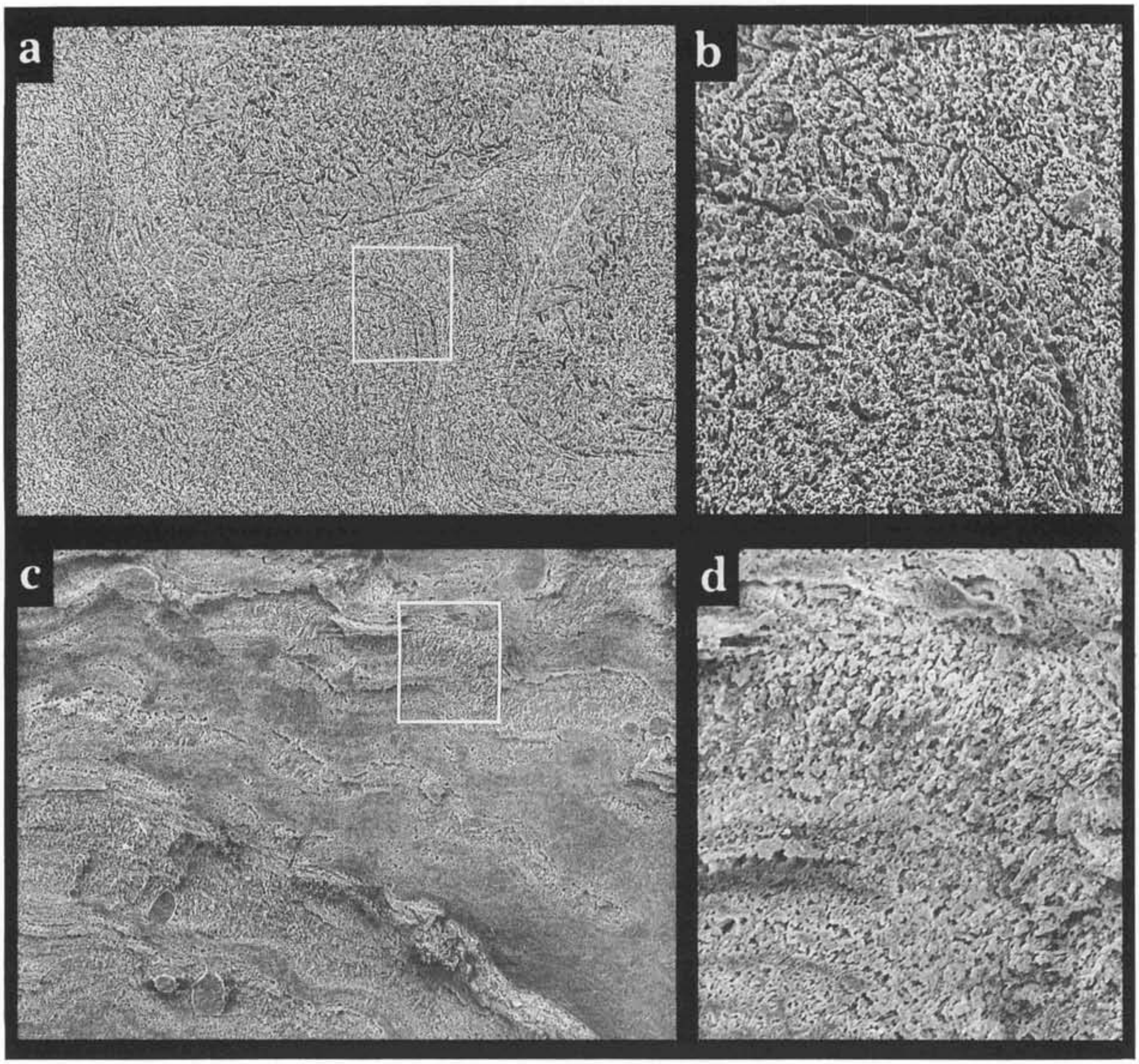

Fig. 7
Polished and etched surfaces of the octocoral holdfasts. a–b — Holdfast A — ZPAL H.XI/37 (ZPAL 12, Telm1), × 150, × 600 respectively. c–d — Holdfast B — ZPAL H.XI/36 (ZPAL 1, Telm1), × 150, × 600 respectively.

original radial orientation of the calcareous fibers (Pl. 16: 3b) but generally skeleton is diagenetically altered.

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

Holdfast B
(Pl. 16: 4–5)

Material. — Three calcified holdfasts from site ZPAL 1 (*Bill Hill*), ZPAL H.XI/34–36).

Remarks. — Specimens 15–21 mm in diameter and 5–8.5 mm in height. Surface smooth. Central depression deep (4–5 mm).

Polished and etched surface (Text-fig. 7c–d) of the holdfast shows concentrically arranged layers of calcareous material. Although surface of the holdfst is macroscopically smooth, in higher magnification, the successive layers are slightly undulated. In some diagenetically less altered layers radially oriented calcareous fibers are visible.

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

FINAL REMARKS

1. From the Paleocene Sobral Formation (Tps1) four scleractinian genera have been described: *Madrepora*, *Cladocora*, ?*Lophelia*, ?*Aulocyathus*, and *Flabellum* (compare FELIX 1909; FILKORN 1994). Recent bathymetric distribution of those genera is as follows: *Madrepora* (15–1500 m), *Cladocora* (0–274 m), *Lophelia* (60–2170), *Aulocyathus* (84–1716 m), *Flabellum* (22–2300 m). According to FILKORN (1994) the abundant fragmented branches of *Madrepora sobral* are remnants of a deep- or cold-water constructional azooxanthellate scleractinian deposit which were accumulated *in situ* at a depth of approximately 100 m. Other ahermatypic corals recorded from the Sobral Formation could, according to their Recent depth ranges, live at similar paleobathymetric conditions (overlap: 60–274 m).

2. From the La Meseta Formation (Telm1) four scleractinian genera have been described: *Tubastraea*, *Caryophyllia*, *Crispatotrochus* and *Flabellum*. Recent bathymetric distribution of these genera is as follows: *Caryophyllia* (0–3200 m), *Crispatotrochus* (82–2505 m), *Flabellum* (22–2300 m), *Tubastraea* (0–110).

Due to very low taxonomic diversity of coral fauna from Telm1 unit only very general approximations of paleodepths are possible. If bathymetric requirements of early Tertiary taxa did not differ significantly from those of Recent counterparts, then a paleodepth of a few dozen meters (subtidal zone) might be reliable for those corals.

3. The genera which occur in Paleocene deposits of the Sobral Formation are not known (except *Flabellum*) from overlying deposits of the Eocene La Meseta Formation, probably due to a facies change.

4. To the list of higher invertebrate taxa that have their first occurrences in polar regions of the Southern Hemisphere (see ZINSMEISTER and FELDMANN 1984; FILKORN 1994) the following three scleractinians are added: ?*Aulocyathus* (Paleocene: first record as a fossil), *Crispatotrochus* (Eocene: earliest record) and *Tubastaraea* (Eocene: first record as a fossil).

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PLATE 14

Madrepora sobral FILKORN, 1994 54

Fig. 1. Lateral (a) and calicular (b) views of the branch fragment with five calices (ZPAL H.XI/28, ZPAL 13, Tps1), × 1.5.

Fig. 2. Lateral view of a branch fragment with six calices (ZPAL H.XI/29, ZPAL 13, Tps1), × 1.5.

Fig. 3. Thin sections perpendicular to the axis of the large corallite (ZPAL H.XI/32, ZPAL 13, Tps1) which cut obliquely through the proximal (b) and middle (a) parts of newly formed bud, × 11.

?*Aulocyathus* sp. 55

Fig. 4. Distal (a), lateral (b) and proximal (c) views of fragmentarily preserved specimen (ZPAL H.XI/33, ZPAL 13, Tps1), × 1.5. d–f. The same specimen cut transversely on its distal (d, × 6) and proximal (f, × 7.5) end, the remaining fragment longitudinally broken to show distinct ornamentation of septal faces (e, × 5).

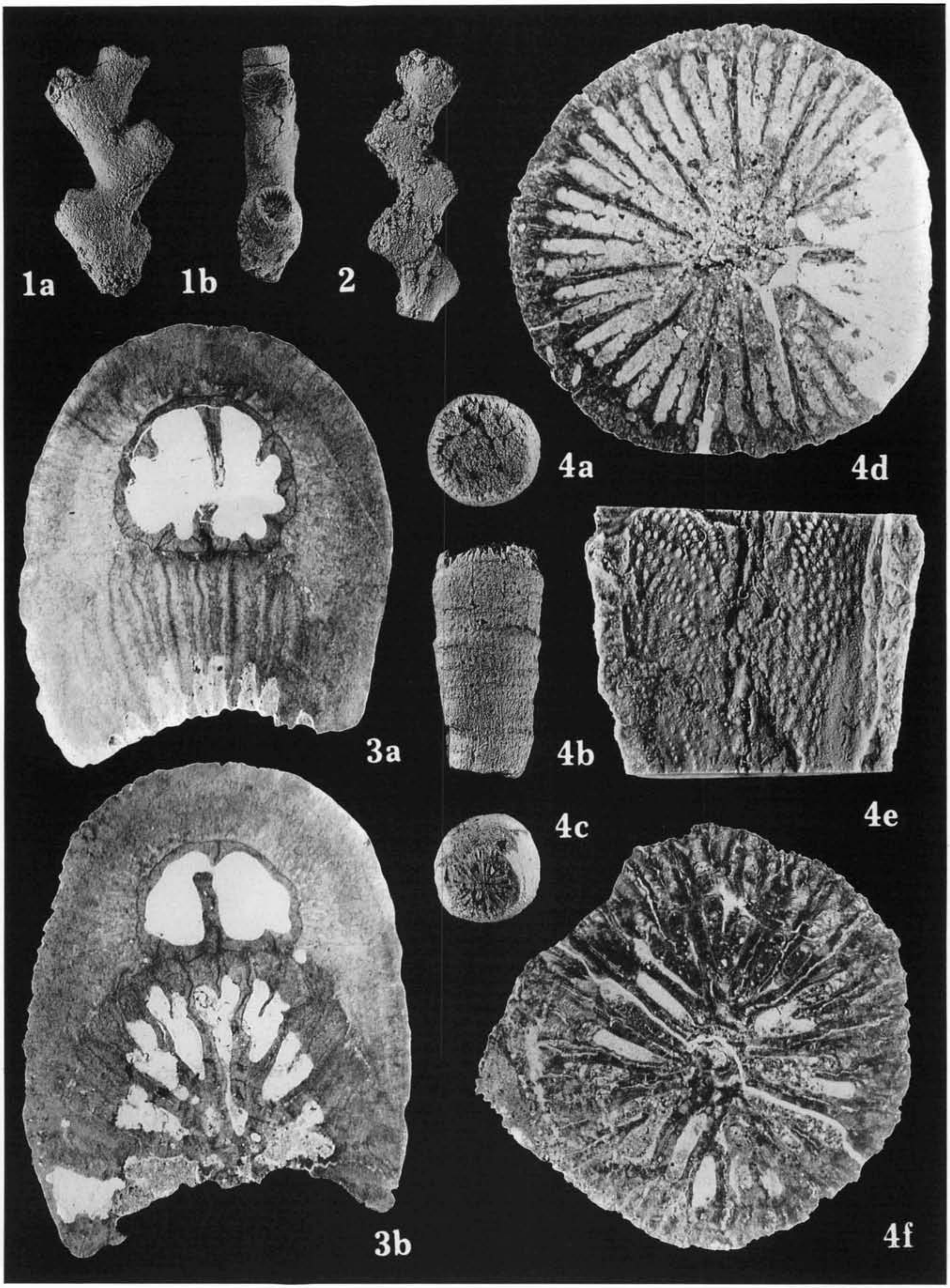

1a
1b
2
3a
3b
4a
4b
4c
4d
4e
4f

PLATE 15

Crispatotrochus antarcticus sp. n. 56

Fig. 1. Calicular (a) and lateral (b) views of the specimen ZPAL H.IX/4 (paratype), ZPAL 1, Telm1. Note numerous acrothoracic cirriped bioerosion trace fossils, × 2.

Fig. 2. Calicular (a) and lateral (b) views of the specimen ZPAL H.IX/1 (paratype), ZPAL 1, Telm1, × 2.

Fig. 3. Calicular (a) and lateral (b) views of the specimen ZPAL H.IX/2 (paratype), ZPAL 1, Telm1, × 2.

Fig. 4. Calicular (a) and lateral (b) views of the elongated specimen ZPAL H.IX/3 (paratype), ZPAL 1, Telm1, × 2.

Fig. 5. Calicular (a) and lateral (b) views of two attached to each other specimens (ZPAL H.IX/8–9 — paratypes, ZPAL 1, Telm1). Note relatively small columellas composed of 2–3 twisted lamellae, × 2.

Fig. 6. Calicular (a) and lateral (b) views. Specimen with lamellar columellar elements ZPAL H.IX/12 (paratype), ZPAL 1, Telm1, × 1.5.

Fig. 7. Transverse sections of the specimen ZPAL H.IX/23, ZPAL 1, Telm1, a. adult stage with septothecal wall, × 6; b. juvenile stage with trabeculothecal wall, × 6; c–d. early juvenile stage with marginothecal wall and thick tectural deposits, × 6, × 40 respectively.

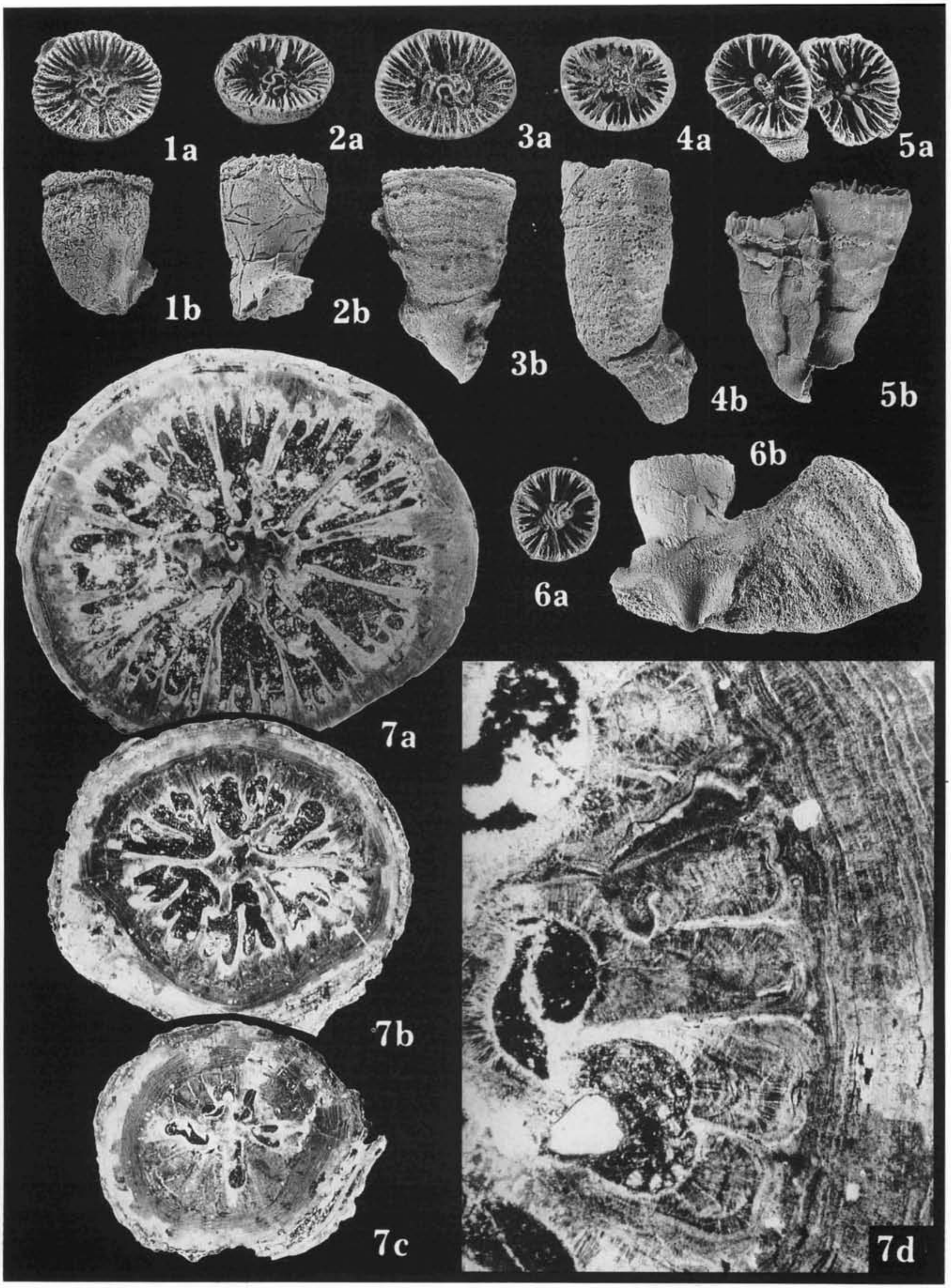

1a
2a
3a
4a
5a
1b
2b
3b
4b
5b
6b
6a
7a
7b
7c
7d

PLATE 16

Caryophyllia sp. 54

Fig. 1. Calicular (a) and lateral (b) views of the largest, strongly compressed specimen (ZPAL H.XI/39, ZPAL 12, Telm1), × 1.5.

Fig. 2. Calicular (a) and lateral (b) views of proximally broken specimen (ZPAL H.XI/40, ZPAL 12, Telm1), × 1.5. Transverse section (c), × 6.5

Octocoral holdfast A. 60

Fig. 3. a. Specimen (ZPAL H.XI/38, ZPAL 1, Telm1) with distinct striations on the surface, × 1.5. b. Transverse section of proximal part of the holdfast (ZPAL H.XI/38, ZPAL 1, Telm1), × 50.

Octocoral holdfast B. 61

Figs 4–5. Specimens (ZPAL H.XI/34–35 respectively, ZPAL 1, Telm1) showing deep central depression, and rather smooth surface, × 2.

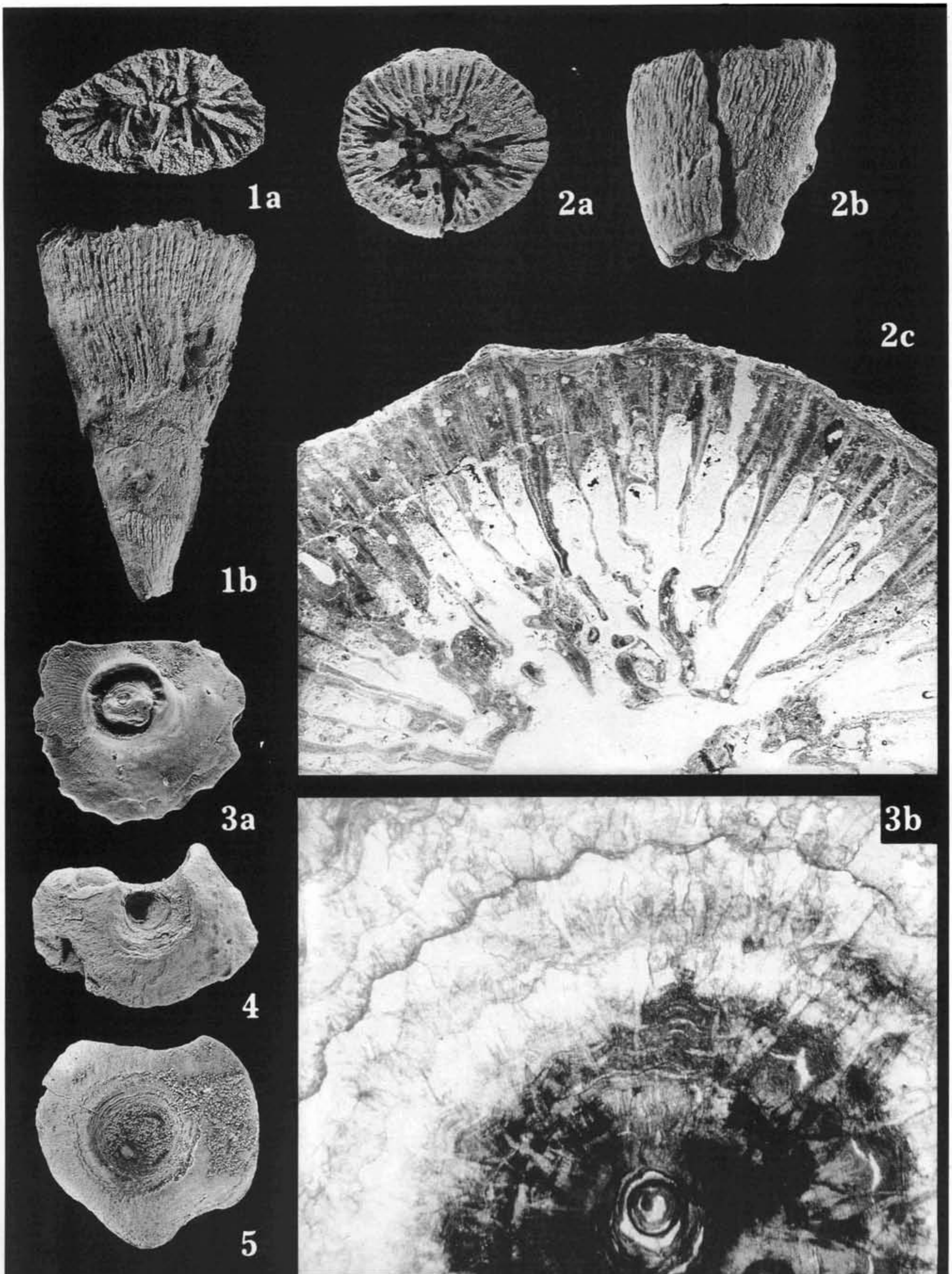

1a
2a
2b
1b
2c
3a
3b
4
5

PLATE 17

Flabellum sp. 58

Fig. 1. ZPAL H.XI/26 (ZPAL 12, Telm1), calicular (a) and lateral (b) views, × 2.

Tubastraea sp. 59

Fig. 2. Calicular (a) and lateral (b) views of the elongated corallite (ZPAL H.XI/46, ZPAL 12, Telm1), × 1.5.

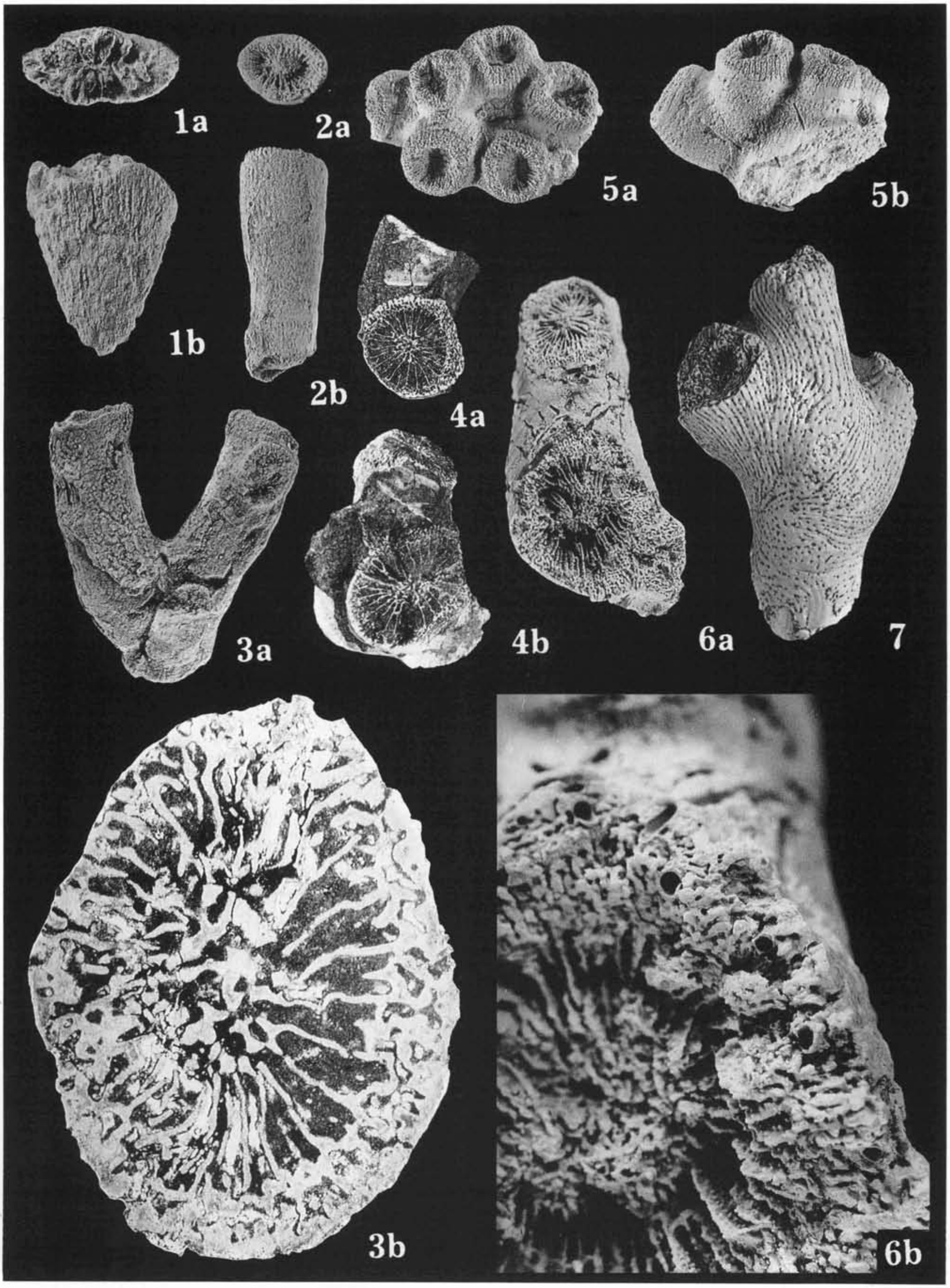
Fig. 3. a. Colony fragments (ZPAL H.XI/47, ZPAL 12, Telm1), x 1.5; b. transverse section of branch fragment, × 10.

Fig. 4. The specimen ZPAL H.XI/58 (ZPAL 11, Telm1), two corallites (a–b), × 2.

Fig. 5. Well preserved juvenile colony (ZPAL H.XI/53, ZPAL1, Telm1), calicular (a) and side (b) views, × 2.

Fig. 6. a–b. Calicular views of the specimen ZPAL H.XI/49 (ZPAL 1, Telm1) with numerous serpulid tubes embedded in wall structure, × 2; × 5 respectively.

Fig. 7. Lateral view of a branch ZPAL H.XI/54 (ZPAL 1, Telm1), × 2



J. STOLARSKI: PALEOGENE CORALS FROM SEYMOUR ISLAND, ANTARCTIC PENINSULA