Late Cenozoic Bryozoa from diamictites of Cape Lamb, Vega Island, Antarctic Peninsula

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Abstract: Bryozoans were found in upper Cenozoic diamictite debris that crops out at the southwestern tip of Cape Lamb, Vega Island. The diamictite is the youngest deposit on the island and richly composed of foraminifers, brachiopods and scallops. The foraminifera assemblage recovered from the Cape Lamb diamictite and $^{87}Sr/^{86}Sr$ isotopic age obtained from the pectinid *Adamussium colbecki* in the nearby locality of Terrapin indicates a Pleistocene age for this deposit. The main goal of this contribution is to present a bryozoan assemblage of *Microporella stenoporta* Hayward *et* Taylor, *Hippothoa flagellum* Manzoni, *Ellisina antarctica* (Kluge), *Micropora notialis* Hayward *et* Ryland and an indeterminate crisiid constituting the first record of these bryozoan taxa in Cenozoic diamictites of the Antarctic Peninsula.

Key words: Antarctica, James Ross Basin, upper Cenozoic diamictites, bryozoans, Pleistocene.

Introduction

The bryozoan fauna of the extensive shallow seas around present-day Antarctica has been the focus of increasing systematic and ecological research in the last few decades. Bryozoans of Antarctic shelf seas constitute one of the most dominant benthic groups and include a substantial proportion of new and endemic species (Rogick 1955, 1962; Hayward 1995; Hayward and Winston 2011; Pabis *et al.* 2014; De Blauwe and Gordon 2014).

Pioneer studies on the early Cenozoic (late early Eocene) bryozoans from the La Meseta Formation (LMF), Seymour Island, include those of Gaździcki and Hara (1994) and Hara (2001). Bryozoans from the LMF are represented by 50 species (Hara 2001, 2002, 2007, 2015; Taylor *et al*. 2008), and they are dominated by cerioporine cyclostomes, along with microporoideans, ascophoran umbonulomorphs and lepraliomorphs, all adding a great amount of information to the Antarctic fossil records and having considerable biogeographical significance.

Oligocene–Miocene bryozoans from the glaciomarine sedimentary formations exposed on southeastern King George Island (South Shetlands), comprise those from the Oligocene Polonez Cove Formation and the earliest Miocene of the Cape Melville Formation (CMF). These were studied by Gaździcki and Pugaczewska (1984), Hara (1992, 1997) and Hara and Crame (2004).

Bryozoans were noted in the Miocene–Pliocene glaciomarine strata of the James Ross Island Group (Hobbs Glacier Fm) by Pirrie *et al.* (1997) and Marenssi *et al.* (2010). Studies of the rich scallop collections of *Australochlamys anderssoni* from the late Pliocene of Cockburn Island Formation (CIF) on Cockburn Island revealed the presence of a taxonomically diverse and well-preserved encrusting bryozoans (Hennig 1911; Gaździcki and Webb 1996). This assemblage included 31 species of cyclostomes and cheilostomes (Hennig 1911; see also Hara and Crame 2010). The post-late Pliocene terrestrial glacial deposits on Seymour Island from the Weddell Sea Formation yielded only a single species of the cheilostome genus *Escharella* (Gaździcki *et al*. 2004).

Late Quaternary bryozoans comprising 56 species, four of them new, have been described from the McMurdo Sound area (Speden 1962; Hendy *et al.* 1969). Those described by Speden (1962) were from 34 localities of the early Pleistocene Scallop Hill Formation and upper Pleistocene or Holocene Taylor Formation (Hayward and Taylor 1984).

Information on the late Cenozoic bryozoan assemblages of the James Ross Basin and surrounding islands remains scarce (Concheyro *et al.* 2007); therefore, the recognized new diamictite deposits interbedded with volcanic rocks of the James Ross Island Volcanic Group (JRIVG), and called the Cape Lamb diamictite comprise important new data (Lirio *et al*. 2007; Caramés and Concheyro 2013). The studied bryofauna was recovered from the youngest and most fossiliferous sedimentary rocks and includes five species belonging to five families, represented by the Crisiidae (Cyclostomata) and Calloporidae, Microporidae, Hippothoidae and Microporellidae (Cheilostomata). This fauna is accompanied by pectinids, brachiopods and a rich foraminiferal assemblage dominated by infaunal species (Caramés and Concheyro 2013).

The aim of this paper is to describe the newly recovered late Cenozoic Antarctic bryofauna collected at Cape Lamb, Vega Island, Antarctic Peninsula, to further understanding of the spatio/temporal distribution of Antarctic bryozoans.
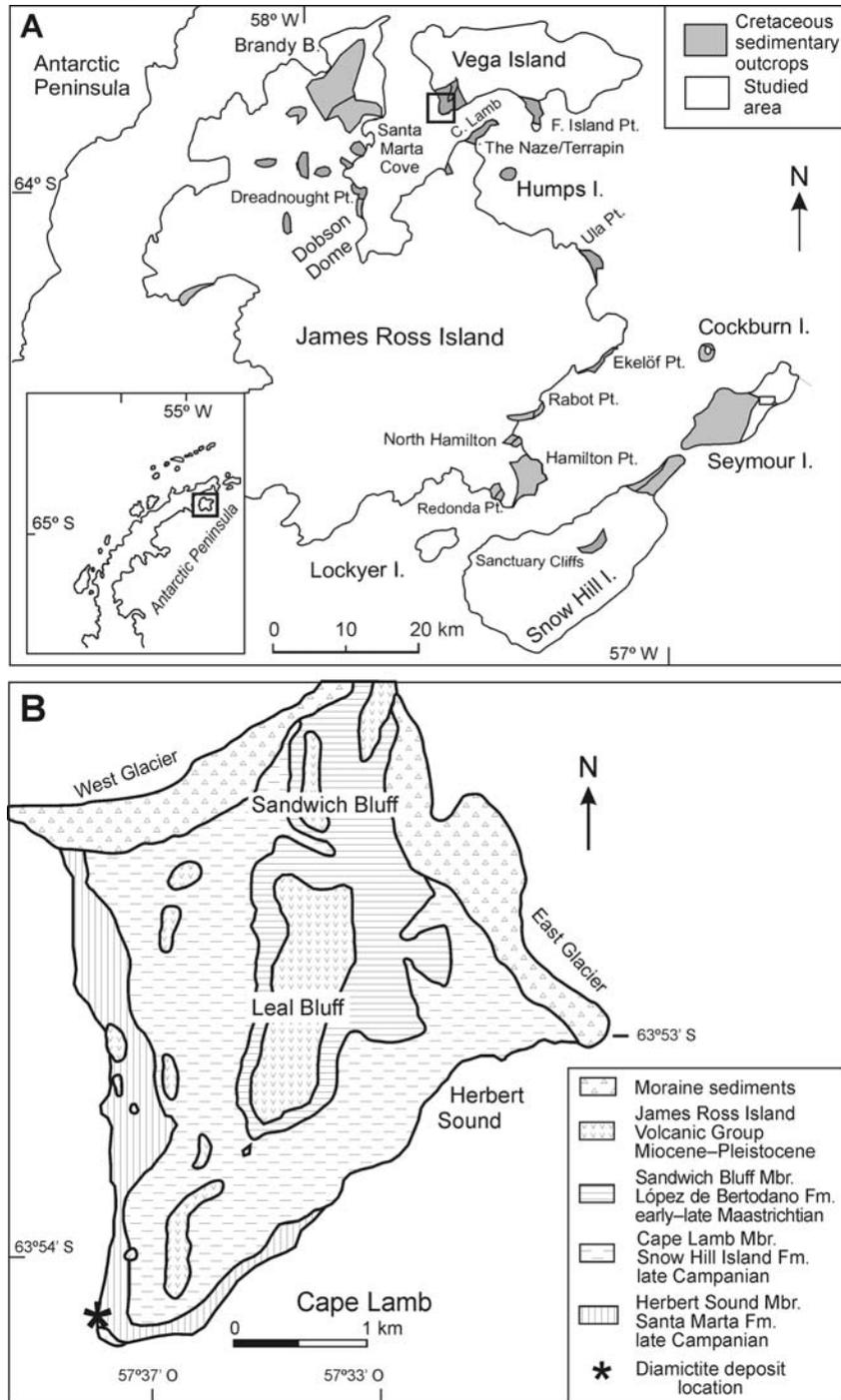
Fig. 1. **A**. Location of the Cape Lamb diamictite deposit area, Vega Island, Antarctic Peninsula. **B**. Geological map of Cape Lamb, Vega Island, Antarctic Peninsula. Modified from Marenssi *et al.* (2001).

Geological setting

Cape Lamb is located in the south-western sector of Vega Island, James Ross Basin (Rinaldi 1982; Elliot 1988; del Valle *et al*. 1992; see Fig. 1A, B). Outcrops are partially ice-free and built of Campanian and Maastrichtian marine sediments of the Santa Marta, Snow Hill Island and López de Bertodano formations (Marenssi *et al*. 2001; Olivero 2012; Caramés and Concheyro 2013). In the Sandwich Bluff area, sediments additionally include the Cretaceous/Paleogene transition, representing a few meters of the Sobral Formation (Roberts *et al.* 2014). Cretaceous sedimentary rocks are overlain by Cenozoic glacigenic debris flow deposits of the Hobbs Glacier Fm (Pirrie *et al.* 1997; Roberts *et al*. 2014), and by volcanic and volcanogenic rocks of the James Ross Volcanic Group (JRIVG) (see Smellie 1999).

Although information about the diamictites exposed at Vega Island is still scarce, some of these deposits at Sandwich and Leal Bluffs have been mentioned by Marenssi *et al*. (2001), Hambrey and Smellie (2006), Smellie *et al*. (2008), Concheyro *et al*. (2007), Nelson *et al*. (2009), and recently by Concheyro *et al*. (2014). Smellie *et al.* (2006) pointed out that Cenozoic sedimentary units of Vega Island consist of a multi-storey conglomerate, diamictites and sandstones, interpreted as till deltas or subaqueous morainic banks; and the presence of boulder pavement gives evidence of sliding at the base of a glacier (Hambrey and Smellie 2006).

Lirio *et al*. (2007) and Caramés and Concheyro (2013) recognized a new diamictite deposit interbedded with volcanic rocks of the JRIVG, named Cape Lamb diamictite, which is integrated by three distinct lithofacies. The basal one consists of a matrix-supported greenish to brownish diamictite with scallop shells, some of them in life position and others as part of a chaotic deposit (Fig. 2). The second lithofacies unconformably overlies the disrupted diamictite, and includes highly fossiliferous hyaloclastic breccia and pyroclastic sands. The third upper-most lithofacies is constituted by greenish fine-grained sandstone with abundant fragmented brachiopods, bivalves, encrusting bryozoans and spirorbins, as well as dispersed and fragmented echinoid spines, some ostracodes, an exceptionally well preserved foraminifers and scarce palynomorphs (Caramés *et al*. 2008; Caramés and Concheyro 2013).

This deposit constitutes the unit that yielded the studied bryozoan specimens, and also contains a well-preserved macrofauna composed of the bivalve *Adamussium colbecki* (a pectinid shell used as a hard substratum by the studied encrusting biota), accompanied by brachiopods, gastropods, serpulid tube worms and echinoderms (Lirio *et al*. 2003).

The presence of the pectinid *Adamussium colbecki* in the Cape Lamb section allows its correlation with the same species at the nearby locality of Terrapin Hills, dated as Pliocene–Pleistocene (1.95+1.12/0.52 Ma; see Lirio *et al.* 2003). The foraminifera assemblage recovered from the Cape Lamb diamictite and the isoto-
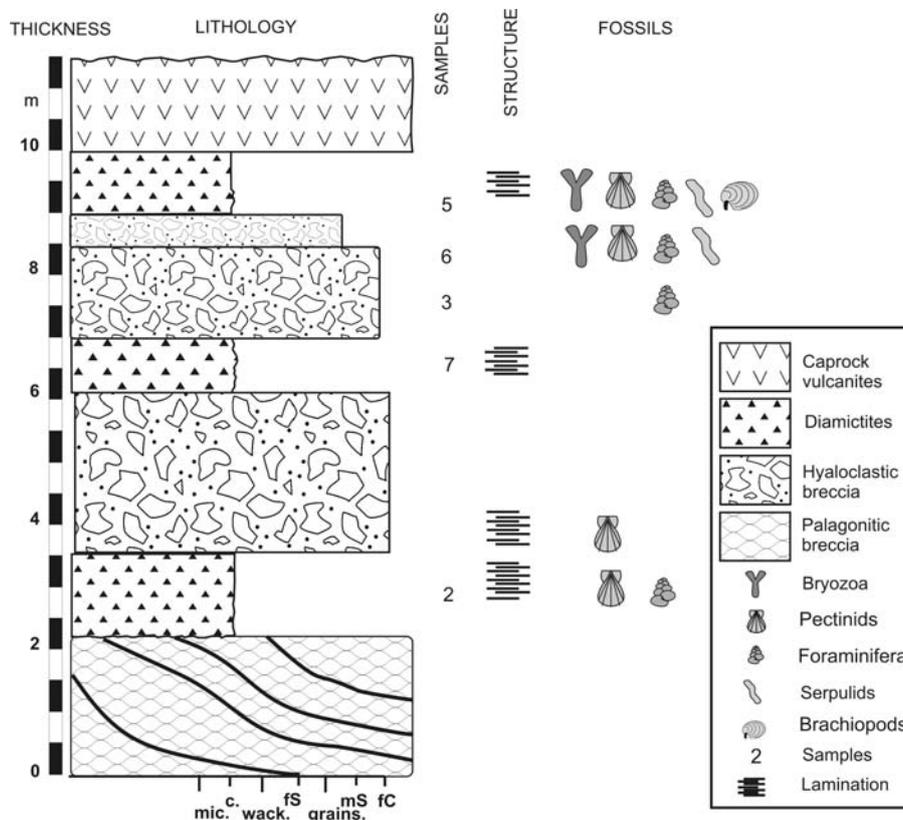
Fig. 2. Geological section of Cape Lamb diamictite deposit, Cape Lamb, Vega Island, Antarctic Peninsula. Modified from Caramés and Concheyro (2013).

pic age known from underlying basalts (2.09 ± 0.11 Ma) would indicate a Pleistocene age for this deposit (Caramés and Concheyro 2013).

Material and methods

The bryozoan colonies were collected from two levels of the Cape Lamb section, 10 m thick (level 5 and 6), exposed at Cape Lamb, Vega Island, where a single outcrop along 100 m of the coast occurs a few meters above sea level (Fig. 1B). Specimens were recovered using standard procedures. In order to remove sand and silt from encrusting bryozoans, ultrasonic cleaning was employed. The colonies were observed using a LEICA EZ4 binocular microscope. Each morphological character was measured ten times, giving the range of the smallest and the largest sizes. Scanning electron microscopy was carried out using a ZEISS instrument with back-scatter and low-vacuum for the uncoated specimens. Photomicrographs were taken using magnifications of 200–300 times.

Systematic palaeontology

Five taxa of Bryozoa were recognized in this study. Higher-level taxonomy of cheilostomes is based on an interim classification for the Treatise on Invertebrate Paleontology compiled by Gordon (2014). Open nomenclature has been used for taxa that do not correspond to published descriptions. Figured specimens are lodged in the micropalaeontological collections of the Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires (under the acronym CPBA), catalogue numbers CPBA 21690–21697 (Figs 3–4).

Order Cyclostomata Busk, 1852
Suborder Articulata Busk, 1859
Family Crisiidae Johnston, 1847
Crisiid sp. indet.
(Fig. 3A)

Material. — Four colonies showing different stages of astogeny, overgrowing the exterior surface of *Microporella stenoporta* from level 5 (CPBA 21694, 21695, 21696, 21697).

Measurements. — Ancestrular protoecial length 0.125 mm, width 0.10 mm; kenozooid length 0.30–0.32 mm, width 0.11–0.13 mm; budding-foramen width 0.025–0.030 mm.

Description. — Colonies are creeping-like, disposed on the *Microporella stenoporta* colony surface (Fig. 3A). Ancestrular protoecium centrally placed, slightly longer then wide, tatiform in shape with a circular foramen, placed medially. Kenozooids cylindrical, elongated, tubular, slightly dilated in the middle and distal parts, up to four derived from the ancestrular protoecium (Fig. 3A). Small, round foramen placed more or less in the middle of each kenozooid.

Remarks. — The four fragments of colonies, each with a centrally-placed ancestrular protoecium, show budding of up to four elongated kenozooids from the periphery of the protoecium, representing the early phase of astogeny typical of the Crisiidae (see Jenkins and Taylor 2013). This early phase appears distinctive, but not enough is known about astogeny in crisiids to be certain of the genus and the colonies are too small and fragmentary to be named formally. The present material could be accommodated in Crisiidae, but more and better-preserved specimens are needed to confirm their assignment to a particular genus or species.

Occurrence. — Cape Lamb, Vega Island, James Ross Basin.

Order Cheilostomata Busk, 1852
Suborder Neocheilostomina d'Hondt, 1985
Superfamily Calloporoidea Norman, 1903
Family Calloporidae Norman, 1903
Genus *Ellisina* Norman, 1903

Type species: *Membranipora levata* Hincks, 1882.

Ellisina antarctica (Kluge, 1914)
(Fig. 3B–D)

1995. *Ellisina antarctica*: Hayward, 74, fig. 65 A, B.

Material. — Fragment of a colony encrusting a bivalve shell from level 5 (CPBA 21692.1–2), adjacent to *Microporella stenoporta* along the shell margin.

Measurements. — Autozooid length 0.40–0.60 mm, width 0.26–0.33 mm; avicularium length 0.17–0.20 mm, width 0.11–0.13 mm; ooecium length 0.18 mm, width 0.18 mm.

Description. — Colony fragment spreading over the hard substratum, forming an unilaminar sheet (Fig. 3B). Autozooids oval to irregularly shaped, separated by distinct interzooidal grooves (Fig. 3C). Cryptocystal rim finely granular, with well-marked lineations. Smooth gymnocyst developed proximally in some auto-zooecia. Interzooidal avicularia frequent, situated at the distal end of autozooids, rostrum pointed, distolaterally directed (Fig. 3B–D); condyles well developed, not meeting medially. Ooecium present, prominent, as wide as long, immersed in a distal avicularium.

Remarks. — The studied specimen is assigned to *E. antarctica*, on the basis of the morphological and morphometrical features, which correspond well to the de-scription given by Hayward (1995). The ooecial surface is wholly smooth in *E. antarctica* and associated with an avicularium, but coarsely granular distally in *E. constantia* and not associated with an avicularium. Avicularia in *E. constantia* are also orientated laterally.

Ellisina antartica was recently documented from Admiralty Bay, King George Island (Pabis *et al.* 2014), and the Weddell Sea (De Blauwe and Gordon 2014), as well as from White Island (Recent) in McMurdo Sound (see Hayward and Taylor 1984).

Occurrence. — Cape Lamb, Vega Island, James Ross Basin.

Superfamily Microporoidea Gray, 1848
Family Microporidae Gray, 1848
Genus *Micropora* Gray, 1848

Type species: *Flustra coriacea* Esper, 1791.

Micropora notialis Hayward *et* Ryland, 1993
(Fig. 3E–H)

1993. *Micropora notialis* Hayward and Ryland: 131, fig. 2a–c.
1995. *Micropora notialis* Hayward and Ryland: Hayward, 154, fig. 120C, D.

Material. — Two fragments of the colonies encrusting a bivalve shell from level 5 (CPBA 21693).

Measurements. — Autozooid length 0.60–0.90 mm, width 0.44–0.64 mm; opesia length 0.2–0.25 mm, width 0.07–0.1 mm; avicularium length 0.30–0.35 mm, width 0.12–0.20 mm; ooecium length 0.35 mm, width 0.32 mm.
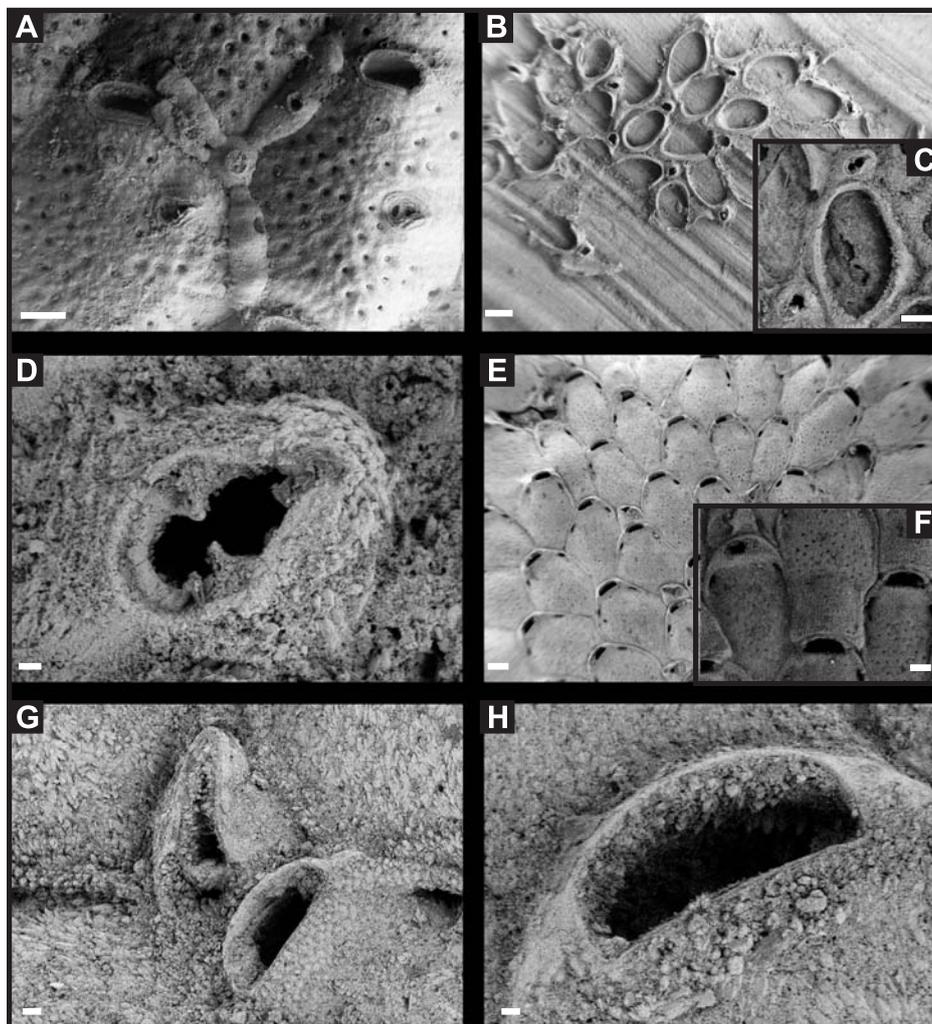
Fig. 3. **A**. Crisiid sp. indet., fragment of a crisiid colony showing the centrally placed ancestrular protoecium, level 5 (CPBA 21694, 21695, 21696, 21697), scale bar 100 μm. **B–D**. *Ellisina antarctica* (Kluge, 1914). **B**. Scattered zooids with avicularia, scale bar 200 μm. **C**. Close-up of a zooid, scale bar 100 μm. **D**. Close-up of avicularia, level 5 (CPBA 21692), scale bar 10 μm. **E–H**. *Micropora notialis* Hayward and Ryland. **E**. Arrangement of zooids and avicularia, level 5 (CPBA 21693), scale bar 100 μm. **F**. Finely-granular cryptocyst showing, one ovicelled zooid, level 5 (CPBA 21693), scale bar 100 μm. **G**. Close-up of avicularia, level 5 (CPBA 21693), scale bar 20 μm. **H**. Close-up of opesium, level 5 (CPBA 21693), scale bar 10 μm.

Description. — Colony forming an unilamellar sheet, encrusting a bivalve shell. Autozooids oval to hexagonal, rounded distally, tapering proximally; separated by a raised, thin margins; rather flat (Fig. 3E, F). Opesia semicircular, 2–2.5 times as wide as long, with proximal edge straight and distolateral rim rounded (Fig. 3E–H). Lateral walls adjacent to proximal corners of opesia may be slightly ele-

vated, smooth and knob-like in some autozooids. Two widely spaced bases of spines on distal edge of opesia are weakly discernible in some autozooids (Fig. 3H). Cryptocyst finely granular with numerous (30–40) rounded pores, which sometimes are missing, giving an uneven appearance to the frontal wall (Fig. 3F). Opesiules slit-like, oval; some pseudopores stellate, distinguishable only in a few autozooecia, typically obscured by calcification. Avicularia rare, sparsely distributed at distal end of some autozooecia, rostrum triangular, acute, distolaterally directed, crossbar complete, longer than width of opesia (Fig. 3G). Ooecia rare, never associated with avicularia, slightly longer than wide, bordered proximally by a narrow smooth rim, not peaked medially or sometimes having a small umbo (Fig. 3E, F).

Remarks. — Recent *Micropora notialis sensu stricto* has been reported from Cape Horn to the Falkland Islands, South Georgia and the Antarctic Peninsula (Hayward 1995), and more recently from the late Pliocene of Cockburn Island (Hara and Crame 2010). The newly erected species *M. aspinosa* De Blauwe and Gordon, 2014 from the Weddell Sea shows many similarities with the studied material from Vega Island. The distinctive features of *M. notialis* that distinguish it from *M. aspinosa* includes oral spines and minute knobs adjacent to the opesia. These features are weakly discernible in some of the autozooids from Vega Island and lacking in others. Avicularia in the studied specimen are longer than opesial width and 2–2.5 times than opesial length with the proximal edge straight and the distolateral border triangular and acute. Our material, *M. notialis* differs from *M. brevissima* Waters, 1904 by its longer opesia, much larger avicularium, paired spines on the autozooids close to the growing edge and ooecium immersed in the cryptocystal calcification of the distally succeeding autozooid and never surmounted by an avicularium (Hayward and Ryland 1993, Hayward 1995). *M. aspinosa* differs from the studied specimens of *Micropora notialis* in a number of morphometric features such as the smaller size of the ooecium, which is as long as wide, smaller length of the avicularia and smaller width and the length of the opesia. While the characteristic features of *M. notialis* such as knobs and spines are only barely seen in the studied specimens, or may be obscured by secondary calcification, the rest of the morphological and morphometric features of the Vega Island specimens correspond well to the description of *M. notialis* given by Hayward (1995).

Occurrence. — Cape Lamb, Vega Island, James Ross Basin.

Superfamily Hippothooidea Busk, 1859
Family Hippothoidae Busk, 1859
Genus *Hippothoa* Lamouroux, 1821

Type species: *Hippothoa divaricate* Lamouroux, 1821.

Hippothoa flagellum Manzoni, 1870
(Fig. 4A)

1995. *Hippothoa flagellum*: Hayward, 231–232, fig. 148D, E.

Material. — Fragment of colony from level 5 (CPBA 21691), encrusting a bivalve shell.

Measurements. — Autozooidal dilatation length 0.25–0.33 mm, dilatation width 0.15–0.20 mm; caudal length 0.10–0.12 mm, caudal width 0.05–0.07 mm.

Description. — Fragment of a diffuse colony ramifying widely over a bivalve shell, consisting of the filiform proximal portion (cauda) and the oval distal portion (dilatation) of autozooids that continue with the filiform parts of another (Fig. 4A); poorly preserved distal dilatations give rise to dichotomous branching with an angle of 45°. Autozooids elongate-oval, smooth and without median carina, connected proximally with the thread-like caudal portion, with no female zooids or zooeciules present. Only one of the autozooids shows the cauda of a midlateral bud. Primary orifice longer than wide, sinus and condyles not observed owing to the general poor preservation of the colony.

Remarks. — Although there are many species of this cosmopolitan genus, only two have been described from the Recent of Antarctica, *Hippothoa meridionalis* Morris, 1980 and *Hippothoa flagellum* Manzoni, 1870. The latter was originally described from the Pliocene of Italy and our specimens are probably the first occurrence of this species from the Pleistocene of Antarctica. Owing to the similarities between *H. flagellum* and *Hippothoa divaricata,* these species have sometimes been confused, but *H. divaricata* differs from *H. flagellum* in having a more semicircular orifice with a straighter proximal margin and central notch (Hincks 1877), not subovate or pear-shaped as in *H. flagellum*. Furthermore, autozooids of *H. flagellum* are usually smooth and the zooeciules (possibly male) that resemble short stolonate processes are rare, while *H. divaricata* has autozooids and female zooids with a longitudinal carina and zooeciules that are oval in shape, produced from autozooids. *H. flagellum* has only one pair of lateral pore chambers and *H. divaricata* two pairs. The synonymy of *H. flagellum* with *H. distans* (MacGillivray, 1889) and followed by later authors was discussed by Gautier (1961). Cook (1968) and Gordon (1984) concluded that they were different species. *H. distans* differs from *H. flagellum* by the presence of two pairs of conical pore chambers laterally, autozooecia are not carinate and ovicells have apical perforations. *Hippothoa flagellum* is known from the Ross Sea and other numerous localities in West Antarctica (Hayward 1995), and will probably be found to occur throughout Antarctic shelf seas. *H. flagellum* was recently documented from the Admiralty Bay, King George Island (Pabis *et al.* 2014) and the Weddell Sea (De Blauwe and Gordon 2014).

Occurrence. — Cape Lamb, Vega Island, James Ross Basin.

Superfamily Schizoporelloidea Jullien, 1882
Family Microporellidae Hincks, 1879
Genus *Microporella* Hincks, 1877

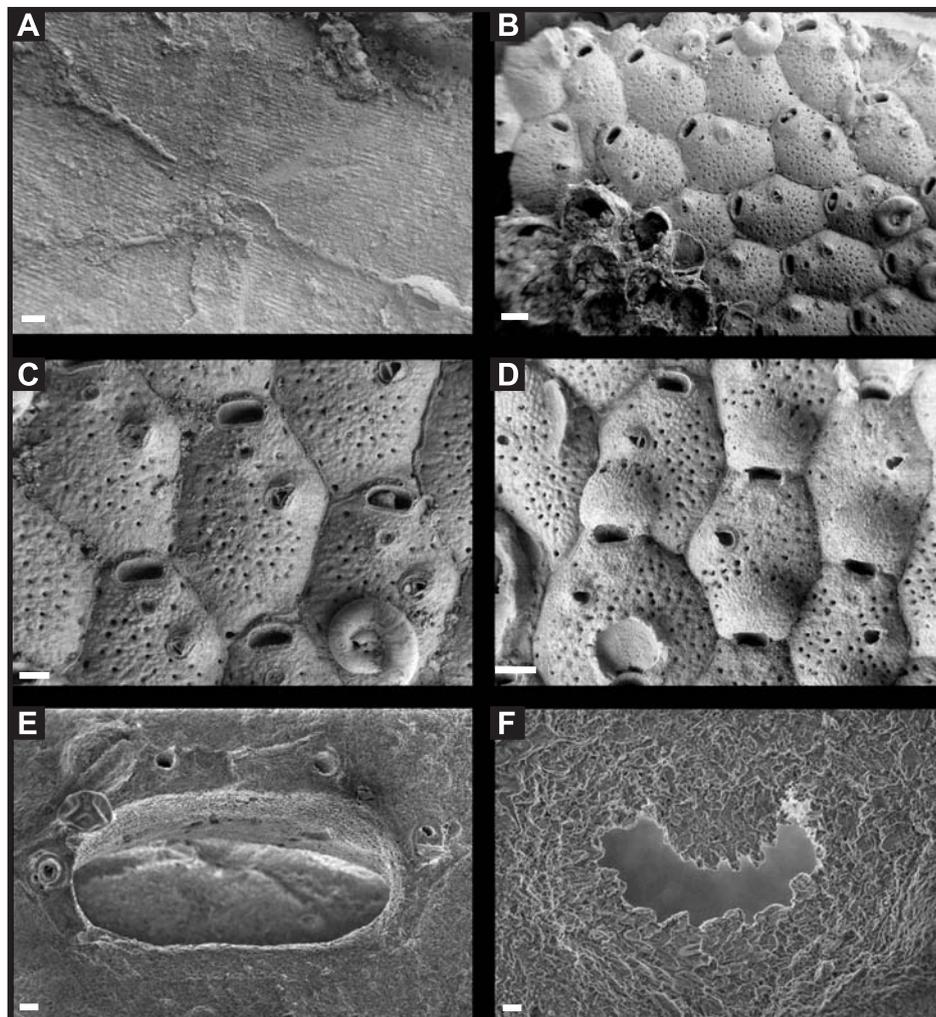Type species: *Eschara ciliata* Pallas, 1766.

Fig. 4. **A**. *Hippothoa flagellum* Manzoni, general view of the colony, level 5 (CPBA 21691), scale bar 100 μm. **B**–**F**. *Microporella stenoporta* Hayward *et* Taylor. **B**. Arrangement of autozooids, level 5 (CPBA 21690), scale bar 200 μm. **C**. Group of autozooids, showing the apertures, some with spine bases, level 5 (CPBA 21690), scale bar 100 μm. **D**. Ovicellate autozooids, some with a broken ovicell, level 5 (CPBA 21690), scale bar 200 μm. **E**. Close-up of orifice showing four spine bases, level 5 (CPBA 21690), scale bar 20 μm. **F**. Part of a crescent ascopore, level 5 (CPBA 21690), scale bar 2 μm.

Microporella stenoporta Hayward *et* Taylor, 1984
(Fig. 4B–F)

1984. *Microporella stenoporta* Hayward and Taylor, 86, figs 7F, 9.

1990. *Microporella stenoporta*: Hayward and Ryland, 1282, fig. 10C, D.

1995. *Microporella stenoporta*: Hayward, 291, fig. 171E, F.

Material. — Two complete colonies and six fragments on bivalve shells from level 5 (CPBA 21690.1–8).

Measurements. — Colony size 1.5×2.0 cm; autozooid width 0.41–0.58 mm, length 0.75–0.95 mm; orifice width 0.15–0.18 mm, length 0.07–0.09 mm; avicularium length 0.11–0.13 mm, width 0.08–0.09 mm; ooecium length 0.33–0.36 mm, width 0.33–0.40 mm; ascopore diameter 0.04 mm.

Description. — Colony forming rather large, irregularly shaped encrustations; some spirorbin polychaetes resting on the colony surface (Fig. 4A, B). Autozooids large, roughly hexagonal to oval, separated by a distinct grooves, arranged quincuncially (Fig. 4B–D). Frontal shield coarse or granular, with numerous, evenly spaced, large pores (Fig. 4B–D). Primary orifice terminal, roughly oval to transversely rectangular, wider than long, encircled by a distinct rim (Fig. 4B–D), the proximal border straight; four spine bases placed distally (Fig. 4E). Ascopore distinct, crescent, placed medially, close to orifice (Fig. 4B–C, F), but not always distinguished because of diagenesis. The adventitious avicularium single, present in most zooids, situated proximo-laterally to ascopore, on the right or on the left but closer to the middle part of the autozooid (Fig. 4B–D). Ooecium large, spherical, coarsely granular, resting on the succeeding zooid, sometimes with large frontal pores (Fig. 4D). Calcification and/or diagenesis may obscure the frontal pores and spine bases.

Remarks. — *Microporella stenoporta* is widely distributed off the Antarctic coasts where it is endemic. It is remarkable for its relatively large colony size, usually forming thickly calcified sheets. It was originally described from the Recent of White Island, McMurdo Sound, and from the Holocene of Black Island in East Antarctica (Hayward and Taylor 1984, 86–87, fig. 7F). *M. stenoporta* has also been recently recorded from the late Pliocene of Cockburn Island Fm. on Cockburn Island, where it forms thick encrustations on shells of *Austrochlamys anderssoni* (Gaździcki and Webb 1996, Hara and Crame 2010). The autozooids of *M. stenoporta* are distinguished by their dimensions, narrow orifice and coarsely granular ooecium with distinct peripheral pores, and all these features correspond with the Vega Island specimens as well as those described from the Pliocene of Cockburn Island (Hara and Crame 2010) and Holocene (Hayward and Taylor 1984). Moreover, all the morphometric features of the type material as well as late Pliocene Cockburn Island material correspond well with the studied specimens from Vega Island, which is probably Pleistocene in age (Caramés *et al*. 2008; Fig. 3A–D). The first record of *Microporella* sp. from the ?late Miocene of the James Ross Basin (Hobbs Glacier Formation) was given by Pirrie *et al.* (1997), who illustrated poorly preserved specimens similar in outline to *M. stenoporta* (Pirrie *et al.* 1997, 751, fig. 6). Two other species such as *M. crustula* Hayward *et* Winston and *M. antarctica* Hu *et* Wang have been described from the Recent of Antarctica. The former differs from *M. stenoporta* in having six spines, a nodular frontal shield with obvious areolar pores along the margins, 20–30 small pseudopores on the frontal shield and the ascopore situated at a distance equivalent to orifice length. *Microporella antarctica* has apparently no

oral spines and a pair of avicularia situated on the umbo present on the frontal shield of each zooid.

Occurrence. — Cape Lamb, Vega Island, James Ross Basin.

Discussion and conclusions

The bryozoan fauna of the diamictite deposit of Cape Lamb, Vega Island (northern Antarctic Peninsula) in levels 5 and 6 is represented by a rather small community of sheet-like colonies encrusting the fragmented shells of pectinids, represented by *Adamussium colbecki*. Systematically, the studied bryozoan assemblage is of low diversity, comprising only one indeterminate crisiid cyclostome and four cheilostome species belonging to Calloporidae, Microporidae, Hippothoidae and Microporellidae families. The colonies represent only an encrusting growth form, on both inner and outer shell surfaces of *A. colbecki* and on basalt blocks (Figs 3, 4). The pectinid shells are also occupied by the small coiled tubes of spirorbins or their traces. Most of the well-preserved bryozoan colonies were collected from level 5, where shell fragments are abundant. Level 6 yielded only two bryozoan colonies, both poorly preserved, but more spirorbins occurred there than in level 5. The colonies exhibit different types of interaction, including intra and interspecific ones. Generally, colonies stop growing at the point of encounter, as observed between *Micropora notialis* and *Microporella stenoporta*, but *M. notialis* was also observed partly overgrowing *Ellisina antarctica*. Bryozoans generally overgrew dead spirorbins or co-occurred with them.

Biogeographically, the studied fauna from the Pleistocene of Cape Lamb (Vega Island), which includes *Micropora notialis* and *Microporella stenoporta*, is similar to the Pliocene fauna of the Cockburn Island Formation (Hara and Crame 2010), as well as to the Recent assemblage documented from Admiralty Bay, King George Island, South Shetlands (Pabis *et al*. 2014). Neogene microporellids are represented in the studied Vega Island assemblage by *M. stenoporta*, an endemic species, which is widely distributed around Antarctica. This species was first recorded as a fossil from McMurdo Sound (Hayward and Taylor 1984), while *Microporella* sp. was reported from Miocene strata of the Hobbs Glacier Formation (Pirrie *et al.* 1997) and the Oligocene Polonez Cove Formation (Gaździcki and Pugaczewska 1984).

The commonest colony morphotype exhibited by living bryozoans globally is encrusting, found from the intertidal to the deep sea. Encrusting morphologies are especially common in strand-line settings, with moderate to high energy levels (Nelson *et al*. 1988) and in the shallow shelf environments, where the water energy decreases with increase of the depth. The studied colonies are all encrusting and they likely represent a small part of the original community. According to Barnes (1996), on artificial substrata, the percentage of total area colonized by bryozoans

increases with depth and shows different patterns of colonization depending on depth and surface as well. Moreover, Barnes (1996) showed that although the polychaete subfamily Spirorbinae occurs at great variety of depths, bryozoans occupy a larger area at 25 m depth. Even though the studied bryozoan colonies do not cover the fragmented bivalve shells completely, their percentage cover is higher in comparison with spirorbins, pointing out the dominance of bryozoans at the depth they had lived.

Finally, although the Vega Island bryozoan biota is limited, it represents a new record of high-latitude late Cenozoic invertebrates from the James Ross Island Basin.

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