

# Class Stenolaemata

## Order Cyclostomata

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### 1.1 Definition and general description

Stenolaemata is the most ancient bryozoan class, with a fossil record beginning in the earliest Ordovician, ~500 million years ago (Taylor and Ernst 2004; Ma *et al.* 2015). Seven orders are recognised currently (Taylor and Waeschenbach 2015), of which only Cyclostomata survives and includes all living stenolaemate species. Globally, the order Cyclostomata includes some 543 species assigned to 98 genera and 23 families (Bock and Gordon 2013). The group comprises, on average, ~11% of the species in any Recent bryozoan fauna (range 0–24%, Banta 1991) and only rarely dominates in terms of numbers of colonies or biomass.

Stenolaemates are commonly termed ‘tubular bryozoans’, in reference to their elongate, slender, usually cylindrical zooids. The basal and vertical walls of the zooid are heavily calcified, and the small terminal membrane at the distal tip of the tube represents the only area of flexible, uncalcified body wall. Colonies grow through the extension and sequential division of a multizoooidal budding zone, termed by Borg (1926) the ‘common bud’, which in some groups persists in later ontogeny as an extrazoooidal, hypostegal body cavity.

Living Cyclostomata are important as models for reconstructing the anatomy, biology and ecology of extinct stenolaemates, but their classification remains a problem at all taxonomic levels, and especially at family level. Colony form varies – they

may be encrusting or erect and branching or foliose. They are typically dense, opaque white in colour, occasionally flushed pink or purple, and the calcification can appear speckled because of the presence of numerous tissue-plugged pseudopores. In the Crisiidae, exemplifying the erect, branching Articulata, the zooids are arranged in narrow rows with openings on only one side of the slender, flexible colony of branches linked by cuticular joints (nodes). Erect colonies of species of Tubuliporina, Cancellata and Cerioporina are unjointed (with the single exception of the tubuliporine genus *Crisulipora*), gracile to robust, and have zooids arranged evenly, in clusters or in ordered transverse rows. Many species of Tubuliporina have encrusting colonies, occasionally taking the form of simple, uniserial chains, but more often narrow, oligoserial lobes or circular to irregular, flat disks or low domes. Colony form may be diagnostic for a given cyclostome species, or may show extraordinary variation apparently in response to environmental influences. Homeomorphy in colony form between species, genera and even families has been a considerable source of taxonomic confusion.

Fundamental morphological differences exist between cyclostome zooids and those of other extant bryozoans. The orifice, medially situated in the terminal membrane, can be closed by a sphincter muscle; below it, the body wall is introverted to form a tentacle sheath enclosing the lophophore,

and the entire polypide is enclosed within a further envelope of mesodermal tissue (= the **membranous sac**). The entosaccal cavity within the membranous sac is considered to be a coelom, but the exosaccal cavity surrounding the sac is probably a pseudocoel (Nielsen and Pedersen 1979). Basic zooid form varies little throughout the order, and polymorphism is limited. The hollow spines of some species, and the tubular units comprising the anchoring rootlets in Crisiidae, are coelomic chambers, with a lining peritoneum but no polypide, and can be considered **kenozooids**. Other types of kenozooids include the cancelli of Cancellata and the alveoli of Rectangulata. Species of Plagioeciidae may have distinctive, dwarf zooids, termed **nanozooids**, each equipped with a minute lophophore comprising a single tentacle that appears to serve a cleaning function (Silén and Harmelin 1974). The conspicuous brood chambers seen in most cyclostome species are highly modified zooidal polymorphs, termed **gonozooids**, that sometimes expand into space that would otherwise have been occupied by autozooids or kenozooids.

The reproductive cycle of cyclostomes is profoundly different from that of the other bryozoan classes and involves polyembryony. In all living cyclostomes, the fertilised ovum undergoes several cleavages to form a primary embryo. Blastomeres separate from the primary embryo, singly or in groups, and undergo further cleavage to form secondary embryos. The secondary embryos may then fragment and continue cleavage to form tertiary embryos, so that the gonozooid becomes packed with large numbers of clonal offspring (Hughes *et al.* 2005).

## 1.2 History of discovery

Busk (1852) first distinguished Cyclostomata from Cheilostomata, because of the round, non-operculate openings of the zooids, and recorded five species from Australian seas. Further Australian records were provided in the cyclostome volume of Busk's (1875) catalogue of the British Museum bryozoan collections, and in the second report of the

Bryozoa collected during the H.M.S *Challenger* Expedition (Busk 1886). Kirkpatrick (1888b) described five species (two of them new) from Port Phillip, Victoria, and later listed four from the Torres Straits (Kirkpatrick 1890a). Although additional species were described, or recorded from Australia by early writers, they have attracted very little specialist interest. Indeed, apart from minor taxonomic contributions, often appended to more detailed accounts of cheilostome-dominated faunas, present knowledge of the Recent Cyclostomata is due entirely to the research of very few authors.

S.F. Harmer made some of the earliest significant contributions with his work on the embryology of *Crisia*, *Lichenopora* and *Tubulipora* (see Harmer 1890, 1893, 1894, 1896, 1898). His first report on the Bryozoa of the *Siboga* Expedition (Harmer 1915) was an important contribution to the study of Indo-West-Pacific cyclostome faunas. However, the work of F. Borg provides the base-line for all modern studies of the Cyclostomata, in particular his morphological and systematic studies (Borg 1926, 1933), together with his monograph on the Antarctic cyclostome Bryozoa (Borg 1944). Significant subsequent publications include: Nielsen (1970) on metamorphosis and development of the ancestrular zooid; Nielsen and Pedersen (1979) on zooid wall structure and lophophore eversion in *Crisia*; a monographic systematic and ecological survey of Mediterranean tubuliporines by Harmelin (1976); research on skeletal ultrastructure, organisation and its relevance to cyclostome phylogeny (Taylor 2000; Taylor and Weedon 2000, and references therein); and Waeschenbach *et al.* (2009) on the molecular phylogeny of cyclostomes (see also Taylor *et al.* 2011; Waeschenbach *et al.* 2012). The ecology and morphology of living cyclostomes has attracted some recent research interest (e.g. McKinney 1988, 1993), but taxonomic and faunistic studies on regions other than the NE Atlantic (e.g. Hayward and Ryland 1985; Ramalho *et al.* 2009) and Mediterranean (e.g. Hayward and McKinney 2002) are still relatively few (e.g. Brood 1976).

1882, and currently is considered to comprise only *Tervia* with three species worldwide (Bock and Gordon 2013). The most distinctive feature of this genus is the presence of gonozooids on the dorsal surfaces of the erect branches, rather than their more usual location on the frontal surface among the autozooids.

The genus *Nevianipora* is assigned to the family Terviidae in some references (e.g. Bassler 1953), but is here included in Diaperoeciidae based on the morphology and frontal location of the gonozooids.

### Morphology

Colonies are erect with narrow, bifurcating branches typically ovate in cross section. Autozooids open on the branch frontal surface only, often in rows of three to four apertures diverging from the branch mid-line. The dorsal surface of branches is formed from the basal exterior walls of autozooids. Gonozooids are situated on the dorsal surface of branches and are elongate with a terminal ooeciopore.

### Australian diversity

*Tervia jellyae* was described by Harmer (1915), with a distribution including North Queensland, Torres Strait and Molo Strait, eastern Indonesia. The colony is erect with an encrusting base, composed of a few narrow branches, with short series of connate zooids opening on the frontal surface.

### Remarks

The first record of a fossil representative of the family is from the Early Eocene of the eastern United States (Taylor 1993); no Australian fossil terviids are known.

### *Family Tubuliporidae Johnston, 1838*

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The family Tubuliporidae was introduced by Johnston (1838). The three principal genera included within the family are characterised by oligoserial encrusting (*Tubulipora*) and erect branching

(*Idmidronea* and *Exidmonea*) colonies. Of the 11 genera and 105 species attributed to the family by Bock and Gordon (2013), only two genera and nine species are currently recorded for Australia, excluding the Australian Antarctic Territory.

### Morphology

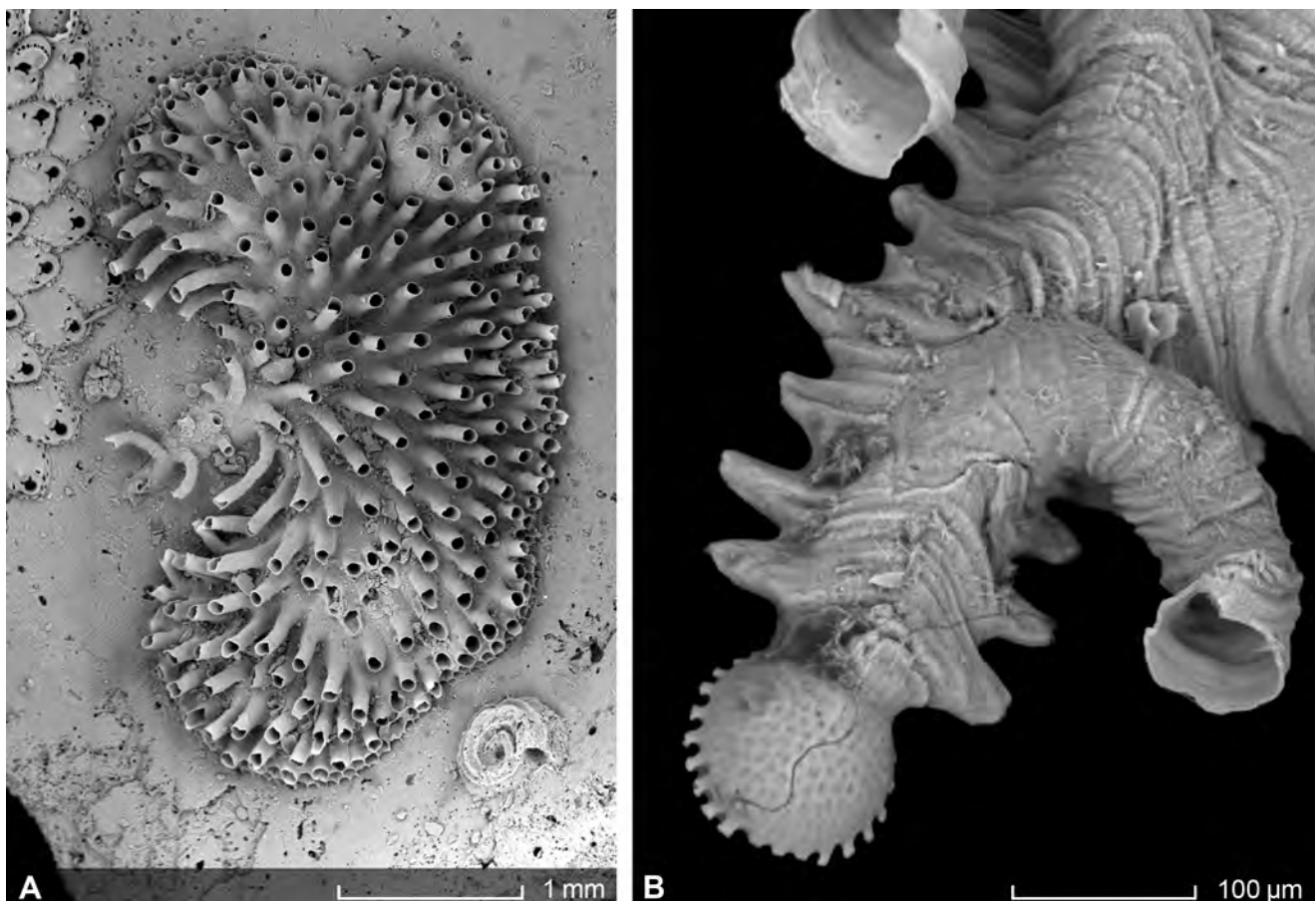
Autozooids are commonly, but not always, grouped into longitudinal or oblique connate rows. Peristomes tend to be long and delicate, diverging distally from those of adjacent connate zooids as they grow. Gonozooids open on the frontal surface of branches as large inflated expansions, usually growing around several series of autozooids. The ooeciostome is either adnate to an autozooidal peristome or separate, and has a simple circular or flanged ooeciostome. The surfaces of both the autozooids and gonozooids are pierced by numerous pseudopores. Kenozooids are often present, flanking the edges of the branches in encrusting colonies or reinforcing the dorsal sides of the branches in erect colonies.

Colonies of *Tubulipora* are encrusting, and typically spread from the ancestrula as one or several elongate or rounded lobes. In *Idmidronea* Canu and Bassler, 1920, the colonies have encrusting bases from which arise narrow branches, with the autozooids opening on the frontal surface and a layer of kenozooids overgrowing the dorsal surface. The autozooids are in connate rows radiating obliquely from the midline of the branch, and usually have long peristomes. Gonozooids are located centrally on the frontal surface of the branches, are elongate, and extend between several series of autozooids. *Exidmonea* is similar but lacks dorsal kenozooids (see Ostrovsky and Taylor 1996). However, the distinction between *Exidmonea* and *Idmidronea* is somewhat arbitrary, because kenozooidal layers in these tubuliporids may develop sporadically and not extend far above the colony base. Within-species variability has also been shown to occur in the shape and position of the ooeciostome (Ostrovsky 1998b), making these characters less reliable for diagnostic purposes than was previously thought.

### Australian diversity

Several species of *Tubulipora* are described from Australia, particularly by MacGillivray (1885a). These include *T. pulchra*, *T. concinna*, *T. connata*, *T. clavata* and *T. lucida*. Two other Australian species are *T. capitata* Hincks, 1881 and *T. pyriformis* Busk, 1875. Although *T. pulchra* was illustrated by Bock (1982), all the local forms need detailed investigation and revision. Some may need to be re-assigned to the related genus *Platonea* Canu and Bassler, 1920. *Tubulipora* species are also common in Antarctica. Colonies are found from shallow to deep water, encrusting algae, shells, rocks or other similar substrata. Examples of *Tubulipora* species are shown in Fig. 1.9.

*Idmidronea* has also been recorded from Australia. Some of the records were identified as species that were first described from overseas, such as *I. atlantica* (Forbes in Johnston, 1847) and *I. mari-onensis* (Busk, 1875) and have not yet been verified; they are not accepted as part of the Australian fauna. *Idmidronea parasitica* (Busk, 1875) and *I. australis* (MacGillivray, 1882) are based upon Australian material but need re-examination. The Antarctic fauna of erect tubuliporids is diverse. Five species are assigned to the genus *Idmidronea* and two to the genus *Exidmonea* by Ostrovsky and Taylor (1996) (see Fig. 1.10 for an example). Broken branches of colonies of these genera were able to regenerate colonies (Ostrovsky 1997).



**Figure 1.9:** *Tubulipora* sp. showing: (A) an encrusting colony with two gonozooids; and (B) part of a colony showing an ancestrula with the subsequent zooid and lateral processes. Specimens from Deal Island, Kent Group, Bass Strait (photos: P. Bock).





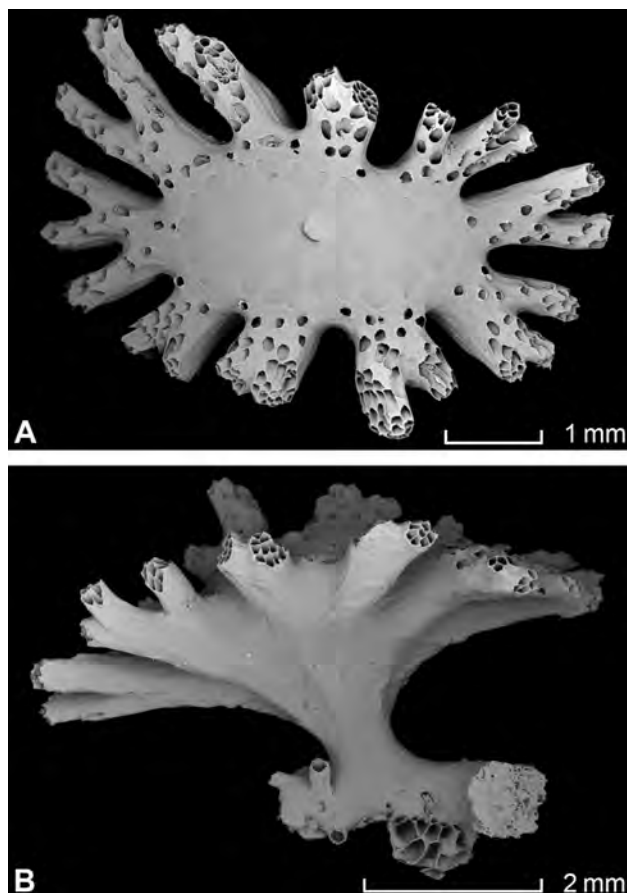
**Figure 1.10:** *Exidmonea* sp. showing the colony attachment point and three gonozooids. Specimen from Esperance, Western Australia (photo: P. Bock).

### Remarks

The earliest known fossil tubuliporids are recorded from the Upper Cretaceous of Europe and North America (Taylor 1993; Taylor and McKinney 2006). Fossils are also known from Tertiary sediments in southern Australia.

### Incertae sedis

Living and fossil species respectively attributed to the genera *Telopora* Canu and Bassler, 1920 and *Supercytis* d'Orbigny, 1853 are presently without a family. In the past, these genera have been included in the cerioporine family Cytididae, established by d'Orbigny (1854) for European Cretaceous fossil material, but it is clear from recent studies of living taxa that this relationship is untenable. *Telopora* and *Supercytis* are clearly members of Tubuliporina, but the stalked, inverse-umbrella-like colonies are highly distinctive and unlike typical members of the suborder. Gene sequencing is anticipated to shed light on their relationships.



**Figure 1.11:** *Telopora* sp. showing: (A) colony with a large central gonozooid; and (B) a lateral view of the colony. Specimen from Norfolk Island (photos: P. Bock).

### Morphology

The striking colony form has been termed 'fungi-form', with a stalk and a head bearing the autozooidal apertures, generally in radial rows. However, colonies of this general morphology are found among a range of cyclostomes in different suborders that differ in other skeletal characters (Taylor and Grischenko 1999). These differences include the position of the gonozooid, skeletal organisation (fixed- *v.* free-walled) and the occurrence of kenozooids, thus calling into question their taxonomic unity. See Fig. 1.11 for examples of colony morphology.

### Australian diversity

Only two species are presently known from Australia: one Recent and one fossil. *Telopora digitata*

(Busk, 1875) was originally described from Cape Capricorn, Queensland, but later recorded by Waters (1884) from the Tertiary of South Australia (River Murray Cliffs) erroneously as '*Supercytis? digitata* d'Orb.', which is a different, Cretaceous species. MacGillivray (1895) expressed doubts about Waters' (1884) identification and Harmer (1915) subsequently referred Waters' (1884) record to a new species, *Supercytis watersi*. Rare specimens with a similar colony form have been collected from Bass Strait, but are undescribed. In the first of these genera the roof of the gonozooid is complete, but in the second it is penetrated by autozooidal peristomes.

### Suborder Articulata Busk, 1859

The suborder was introduced by Busk (1859). Colonies are always erect, multibranched, with branches composed of calcified uniserial or biserial internodes joined by short cuticular joints (nodes). Gonozooids have a simple ovoidal shape. The suborder contains a single family, Crisiidae.

#### Family Crisiidae Johnston, 1838

This family was introduced by Johnston in 1838 for the genus *Crisia*. It includes all Recent cyclostomes with articulated colonies except for *Crisulipora* which is a tubuliporine. *Crisiona*, a Cretaceous to Recent unjointed cyclostome, has been assigned to this family although without clear justification; Canu and Bassler (1928) described a Recent species of *Crisiona* from Hawaii. A total of 92 species in six genera are described worldwide (Bock and Gordon 2013); three genera and 11 species are listed for the Australian fauna.

#### Morphology

Colonies are erect, anchored by rootlets (rhizoids), multibranched, and are composed of calcified internodes of one to more than 30 zooids articulated at cuticular joints called nodes. The basal encrusting parts of colonies may be constructed of kenozooids that are able to generate additional erect branches. The ancestrula has a low

dome-shaped protoecium from which emerges an erect distal tube and usually one or more rhizoids (see Jenkins and Taylor 2014). Internodes may be uniserial or biserial. Overgrowths are lacking. The autozooids are tubular, terminating in a circular aperture, always isolated (never connate) and opening on one side only of the internode. Articulated hollow spines may be present; in some species these are jointed and multizoooidal. The gonozooids are bulbous and inflated, with a circular ooeciopore at the end of a short ooeciostome. Both the autozooids and the gonozooids have pseudopores which are can be circular, longitudinally elliptical or slit-shaped.

#### General biology

No observations on live Australian crisiids are documented. Information is therefore lacking on tentacle number, reproductive behaviour and life cycles. Crisiids have been recorded from shallow coastal waters, attached to algae or to other bryozoans. Most records are from depths of less than 100 m. This may reflect sampling frequency, because records from the Northern Hemisphere show that crisiids can live at depths of over 1500 m (Harmelin and d'Hondt 1982). They appear to be eurythermal, and as a group are widely distributed. However, the almost cosmopolitan distributions of species such as *Crisia acropora* Busk, 1852 and *Bicrisia edwardsiana* (d'Orbigny, 1841) (Fig. 1.12) may, after detailed comparative study, prove to be false. Currently 11 species in three genera are listed for Australia (Bock 2017), and Bock and Gordon (2013) estimate the number worldwide to be 92 species in six genera.

#### Australian diversity

Eight species in the genus *Crisia* Lamouroux, 1812 and two in *Bicrisia* d'Orbigny, 1853 have been recorded from Australian waters. In addition, *Filicrisia geniculata* (Milne-Edwards, 1838) was recorded from Torres Strait by Harmer (1915). Species of *Crisia* are characterised by internodes with more than three zooids (in some cases more than 30), whereas those of *Bicrisia* usually have two or three

elongate, raised chambers on the frontal side of the branch, located just proximal to a bifurcation (Gordon and Parker 1991). They encompass two to four series of autozooids, with the ooeciostome located proximal to one of the autozooidal apertures. Distinctive, minutely porous areas with raised rims occupy the area between autozooid series.

### Australian diversity

The family is represented in Australian waters by *Mesonea radians* (de Lamarck, 1816), which is found

in eastern Australia, from the south-east (Bock 1982) to the tropics (Harmer 1915), including Torres Strait and the Paternoster Islands (Harmer 1915). Records indicating a wider distribution for *M. radians* are based on other species with similar colony forms (Gordon and Parker 1991).

Although *Mesonea radians* is often found growing on algae in shallow water, it is also recorded at depths of over 100 m.

### Remarks

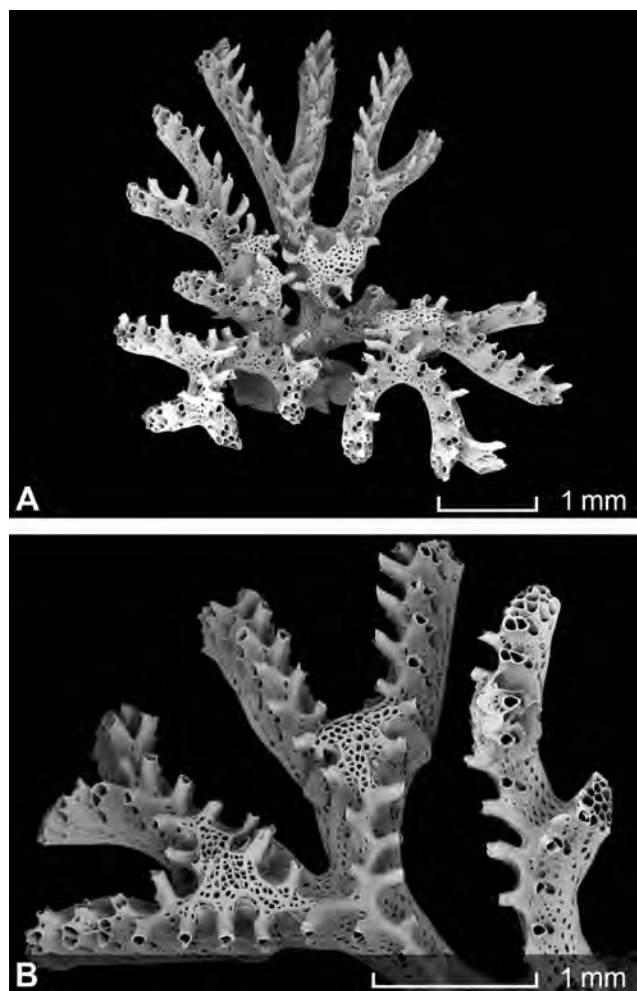
The family has a fossil record beginning in the Cretaceous of Europe (Voigt 1984), and occurs in the Miocene of Victoria (MacGillivray 1895).

### Family Horneridae Smitt, 1867

Smitt (1867) established this family for the European genus *Hornera* Lamouroux, 1821. It was overlooked by Busk (1875), but adopted by Gregory (1899) and subsequent authors. Borg (1926) examined the morphology of two European species as well as *H. antarctica* Waters, 1904 in detail, and expanded his concept of the family in describing the Antarctic species (Borg 1944). An extensive European Cretaceous fauna was reviewed by Brood (1972). Taylor and Jones (1993) examined the skeletal ultrastructure in two New Zealand species, and Smith *et al.* (2008) gave a list of all species of Horneridae and reviewed the taxonomy of the family. Twenty-two species in four genera are listed for the world fauna by Bock and Gordon (2013); including *Calvetia*, two genera and five species are recorded for Australian waters.

### Morphology

Hornerids develop massive, arborescent colonies attached to hard substrata by an encrusting base. The branches bifurcate repeatedly and irregularly, giving a complex three-dimensional structure, sometimes cervicorn with branches tapering towards their distal tips. Some species are characterised by a reticulate (fenestrate) colony form, the dividing and anastomosing branches enclosing gaps called fenestrules. Brood chambers are inflated gonozooids with porous roofs and are

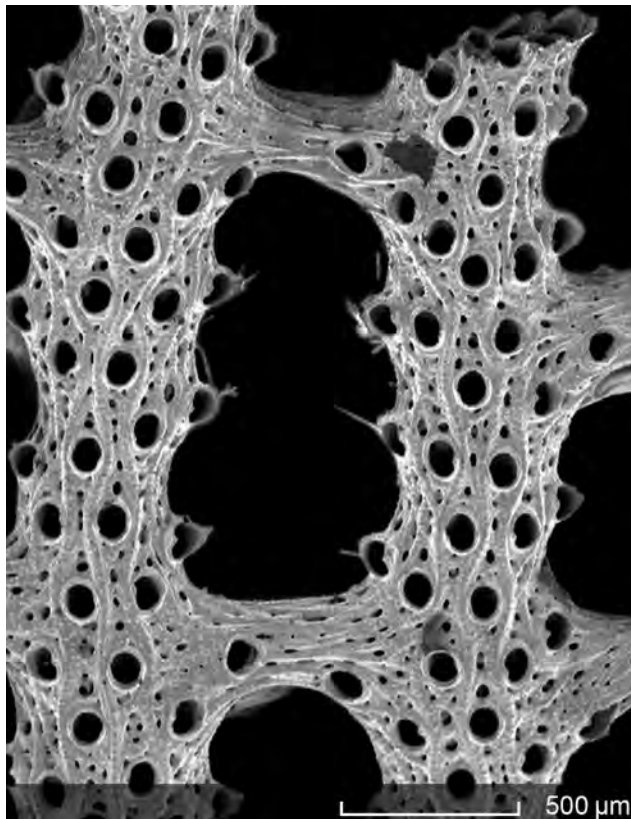


**Figure 1.14:** *Mesonea radians* (de Lamarck, 1816), showing: (A) a branching colony with several gonozooids, collected from *Sargassum* seagrass, Heron Island Queensland; and (B) part of a colony showing three gonozooids, collected from Deal Island, Kent Group, Bass Strait (photos: P. Bock).



situated on the dorsal (abfrontal or reverse) surfaces of the branches.

Another family, Calvetiidae, introduced by Borg (1944) for the new genus *Calvetia*, then monotypic for *C. dissimilis*, was synonymised with Horneridae by Taylor and Gordon (2003). *Calvetia* differs from *Hornera* in having autozooidal apertures opening around the entire branch circumference; there is no distinct abfrontal or dorsal side. Colonies form small, heavily calcified bushes. First known in the fossil record from the Eocene of the Antarctic (Hara 2001), the description of a second extant species of *Calvetia*, *C. osheai* Taylor and Gordon, 2003, extended the geographical range of the genus into northern New Zealand. Pseudidmoneidae Borg, 1944, represented only by the type genus *Pseudidmonea* Borg, 1944, differs minimally from Horneridae and may be synonymous.



**Figure 1.15:** *Hornera foliacea* MacGillivray, 1869, showing part of a fenestrate colony showing branches and crossbars. Specimen from Wilsons Promontory, Victoria (photo: P. Bock).

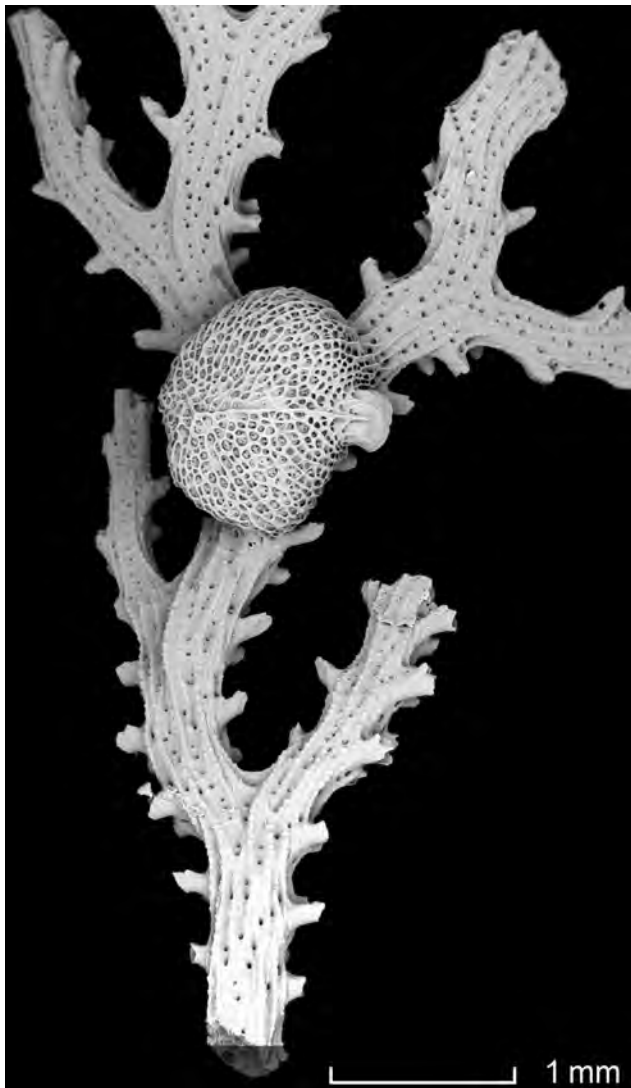
### Australian diversity

The type genus and type species of Horneridae are Mediterranean, but hornerids occur in shelf seas throughout the world. Harmer (1915) described and illustrated two species from the Indo-Malayan region. One was *Hornera spinigera* Kirkpatrick, 1888a, originally reported from Mauritius and designated as the type species of the new genus *Spiniornera* by Brood (1979); the other was *H. caespitosa* Busk, 1875, originally reported from Cape Capricorn, Queensland, as well as from Tierra del Fuego. Borg (1944) noted that Busk's species belonged to two distinct species, and reserved the name *H. caespitosa* for the species from Queensland, which was listed first. MacGillivray described three new species from Victoria, and illustrated two of them – *H. foliacea* MacGillivray, 1869 (Fig. 1.15) and *H. robusta* MacGillivray, 1883 (Fig. 1.16) – in detail in McCoy's *Prodromus* (MacGillivray 1886b). Bock (1982) also illustrated *H. foliacea*, which has very large, fenestrate colonies, the branches being joined regularly by crossbars. This species has sometimes been assigned to Kirchenpauer's genus *Retihornera* (see Smith *et al.* 2008). *Hornera robusta* has smaller colonies, up to 50 mm in height, with no crossbars. *Hornera ramosa* MacGillivray, 1887c (Fig. 1.17) is similar, but with narrower and less regular branches. Thus there are at least four Australian species of *Hornera* and probably a small number of additional, as yet undescribed, species. Unpublished data shows that most records are



**Figure 1.16:** *Hornera robusta* MacGillivray, 1883, showing part of a colony. Specimen from Port Phillip Bay, Victoria (photo: P. Taylor).





**Figure 1.17:** *Hornera ramosa* MacGillivray, 1887c, showing part of branching colony with an abfrontal gonozooid (centre). Specimen from east of Esperance, Western Australia (photo: P. Bock).

from less than 100 m depth, but rare records are from deeper water. MacGillivray (1895) also described a substantial Tertiary fauna of hornerids from Victoria. Waters (1904) described the Antarctic *H. antarctica* from three stations in the Bellingshausen Sea at depths ranging from 480 to 569 m, and temperatures of 0.8–0.9°C.

#### Remarks

Fossil hornerids are quite common in Tertiary sediments of southern Australia. The earliest recorded

hornerid may be from the Early Cretaceous of France (Taylor 1993), although the type genus itself probably dates back only to the Eocene.

#### Suborder Cerioporina von Hagenow, 1851

This suborder was first distinguished by von Hagenow (1851) based on some Upper Cretaceous fossils. Borg (1933) referred the Recent genera *Neofungella*, *Heteropora*, *Canuella* and *Densipora*, within the single family Heteroporidae, to his division Heteroporina, now considered synonymous with Cerioporina. Colonies may be encrusting, massive and mound-like, or erect and cylindrical, more rarely bifoliate. Autozooids are long and tubular, opening on all surfaces of the colony, usually interspersed with smaller kenozooids, both of these polymorphs normally showing a free-walled organisation (i.e. lacking calcified frontal walls). However, terminal diaphragms may close the apertures of the kenozooids and of moribund autozooids and, in some species, collar-like short peristomes are present in the autozooids (Ross 1973). The gonozooids of cerioporines are roofed by calcified exterior walls containing pseudopores. They are typically subcircular in overall shape, occasionally digitate or longitudinally ovoidal, and may occupy space at the expense of kenozooids, the large brood chamber extending around and between the autozooids. Continued branch thickening can result in total overgrowth of the gonozooid, which is then visible only when colonies are sectioned or broken open.

#### Family Cerioporidae Busk, 1859

The family Cerioporidae is here taken to include the Heteroporidae Waters, 1879, introduced by him for two Recent species that he attributed to the Cretaceous fossil genus *Heteropora* de Blainville, 1830. It remains to be determined if any modern species should be included in *Heteropora*, which is clearly related to *Ceriopora* Goldfuss, 1826. As currently constituted, the family comprises a moderately large number of late Mesozoic-Cenozoic genera and a few Recent genera with poorly known fossil

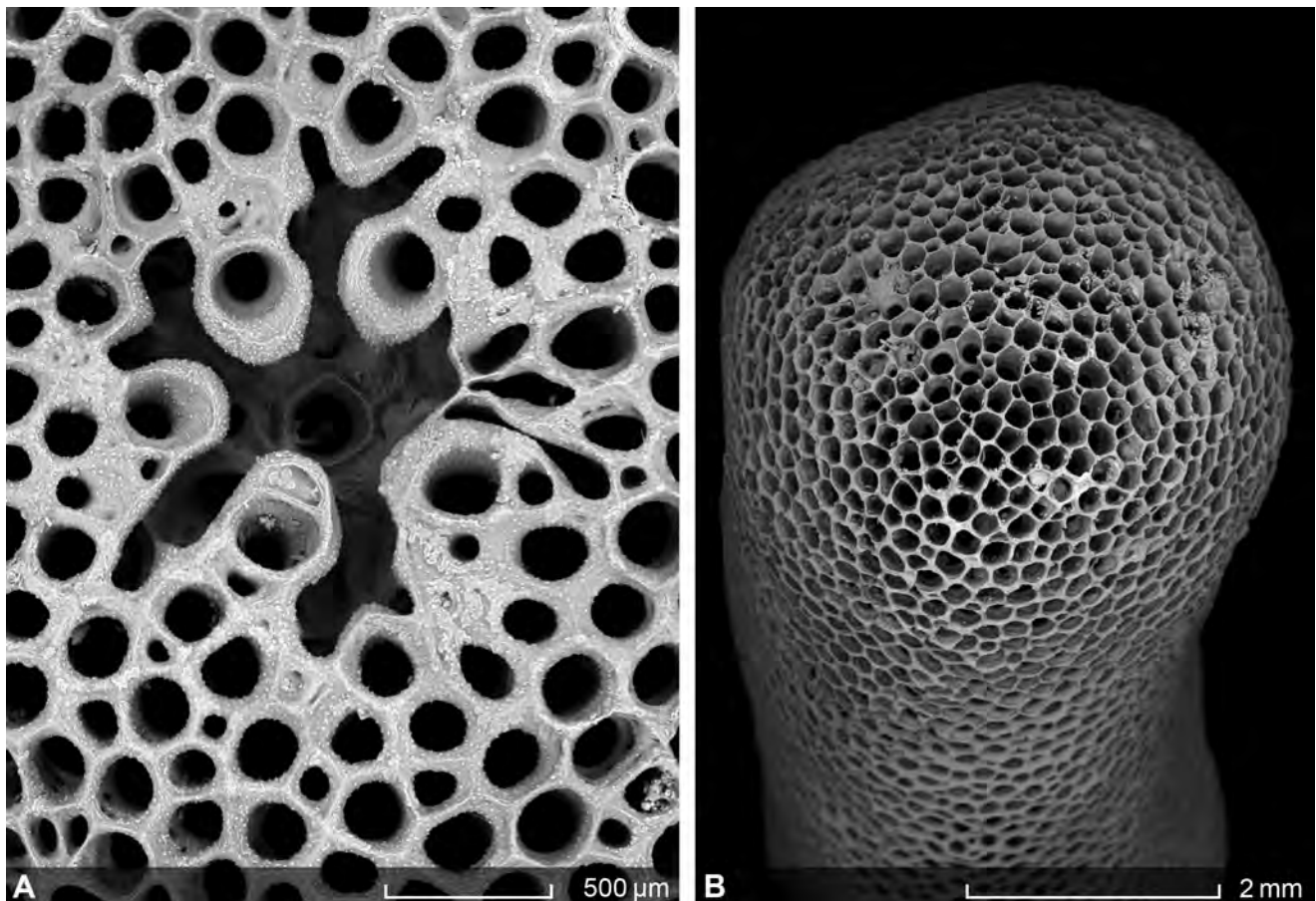
histories. Borg (1933) reviewed the Recent Heteroporidae, recognising four genera, but in 1944 proposed the families Canuellidae for *Borgiola* Strand, 1933 (formerly *Canuella* Borg, 1933) and Densiporidae for *Densipora* MacGillivray, 1881. He considered that *Tetrocycloecia* Canu, 1918b should be included in *Heteropora*, and that Tetrocycloeciidae Canu 1918b as a consequence be subsumed within Heteroporidae. Brood (1972) considered *Heteropora* to be a junior synonym of *Ceriopora* Goldfuss, 1826, and that Cerioporidae should be substituted for Heteroporidae; he also proposed that *Tetrocycloecia* be retained, within Cerioporidae, for all Recent species of *Heteropora*. Detailed studies of skeletal morphology in thin section (Nye 1976) and ultrastructure using SEM (Weedon and Taylor 1996) are needed to resolve outstanding issues.

### Morphology

Most Recent cerioporids are characterised by erect, capitate or branched colonies (very occasionally pedunculate) attached by an encrusting base. The colony surface appears honeycombed with autozooid apertures typically surrounded by smaller kenozooid apertures and closely packed everywhere. The brood chamber is visible as a smoother, and sometimes slightly swollen, area on the colony surface. Old brood chambers become overgrown but may be seen as cavities in sections or broken branches. Examples of the morphology of *Neofungella* species are shown in Fig. 1.18.

### Australian diversity

This family appears not to have been recorded from Australian coastal waters. However, *Heteropora neozelanica* Busk, 1879 is found from southern



**Figure 1.18:** *Neofungella* sp., showing: (A) the growing surface with a developing gonozooid; and (B) the distal growth tip. Specimen from Prydz Bay, Antarctica at a depth of 343 m (photos: P. Bock).