

# Two new genera of hadromerid sponges (Porifera, Demospongiae)

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## ABSTRACT

Revision of families in the order Hadromerida (Porifera, Demospongiae) makes it necessary to establish two new genera. In the family Placospongiidae, the genus *Amphinolana* is introduced for a new species, *A. claudelevii*, from the Great Barrier Reef, Australian West Pacific. It is the second genus in the family and distinguished by the presence of cortical and choanosomal, dumb-bell-shaped sterrasters which derive from an amphiaster-like microsclere and are termed amphinolasters. The other spicules of *Amphinolana claudelevii* include small microspined spirasters and the usual megascleres (tylostyles). In the family Clionidae, the genus *Cervicornia* is named to accommodate *Alcyonium cuspidiferum* Lamarck, previously placed in *Spirastrella* and *Sphaciospongia*. This genus is separated from other clionids by large (up to 30 cm tall), ectosomal inhalant fistules and a pulp-like endopsammic choanosome. *Cervicornia cuspidifera* generates an unusual flow-direction of water which is taken in through its epibenthic, blind-ending fistules and exhaled through the coarse sand substrate.

## KEY WORDS

Porifera,  
new species,  
*Amphinolana claudelevii*,  
Placospongiae,  
Clionidae,  
*Cervicornia cuspidifera*,  
selenaster,  
amphinolaster.

## RÉSUMÉ

Deux nouveaux genres d'éponges hadromérides (Porifera, Demospongiae).

Une révision des familles de l'ordre Hadromerida (Porifera, Demospongiae) nécessite l'établissement de deux nouveaux genres. Dans la famille Placospongiidae, le genre *Amphinolana* est créé pour une nouvelle espèce, *A. claudelevii*, de la Grande Barrière d'Australie (Pacifique Ouest). Ce deuxième genre de la famille se distingue par la présence de sterrasters corticaux et choanosomiques en forme d'haltère, qui dérivent d'un microsclère de type amphiaster et sont dénommés amphinolasters. Les autres spicules de *Amphinolana claudelevii* comprennent de petits spirasters finement épineux et les mégasclères habituels (tylostyles). Dans la famille Clionidae, le genre *Cervicornia* est proposé pour recevoir *Alcyonium cuspidiferum* Lamarck, auparavant placé dans *Spirastrella* et *Sphaciospongia*. Ce genre diffère des autres clionides par de grandes fistules inhalantes atteignant 30 cm de haut et par un choanosome pulpeux endop-sammique. *Cervicornia cuspidifera* produit un courant d'eau de direction inhabituelle, l'eau étant inhalée par ses fistules épibenthiques et exhalée dans le substrat de sable grossier.

## MOTS CLÉS

Porifera,  
nouvelle espèce,  
*Amphinolana claudelevii*,  
*Placospongia*,  
Clionidae,  
*Cervicornia cuspidifera*,  
sclénaster,  
amphinolaster.

## INTRODUCTION

The following descriptions are the result of a revision of genera and higher taxa in the order Hadromerida, class Demospongiae, which is part of a comprehensive reexamination of the phylum Porifera known under the project title Systema Porifera (Hooper & Van Soest in prep.).

The family Placospongiidae has been known for over 120 years but only from a few species of a single genus, *Placospongia* Gray, 1867. A recent survey of intertidal reefs near Heron Island, Australia, revealed a sponge that is closely related but clearly belongs to another genus in this family.

The situation in the Clionidae is more complex because the family includes not only species in several genera of the typical excavating sponges which carve tissue-filled chambers into limestone substrata (alpha stage), but also massive stages (gamma form) and species which do not excavate but have typical clionid spiculation. Many of the latter have been previously included in the genera *Spirastrella* Schmidt, 1868 and *Sphaciospongia* Marshall, 1892 of the family Spirastrellidae although it has been suggested before to move some of these massive species to the Clionidae, such as *Anthosigmella varians* (Duchassaing & Michelotti, 1864) (to the genus *Cliona* Grant,

1826; Rützler 1990: 460) and *Sphaciospongia* spp. (Rützler in Vicente *et al.* 1991). Morphological, anatomical (including ultrastructure), and ecological study (strengthened by evidence from recent genetic analyses by Chombard 1998), suggests rearrangement and redefinition of these taxa and introduction of a new genus for the sponge that has been known as "*Spirastrella*" or "*Sphaciospongia*" *cuspidifera* (Lamarck, 1815).

## ABBREVIATIONS USED

MNHN Muséum national d'Histoire naturelle;  
LBIM DT Laboratoire de Biologie de Invertébrés marins et Malacologie, Toppent collections, Paris;  
QM Queensland Museum, Brisbane;  
USNM United States National Museum (collections now in the Smithsonian National Museum of Natural History), Washington, D.C.

## MATERIAL AND METHODS

*Amphinolana claudelevii* was collected by wading and turning over coral boulders on intertidal reef habitats near Heron Island, Queensland, on the Great Barrier Reef. Spicules were prepared for light and scanning electron microscopy (SEM) by

boiling several small fragments from different parts of the sponge in concentrated nitric acid and drying after several rinses in water and ethyl alcohol. For size measurements, 25 spicules were randomly selected under the light microscope; ranges and means with standard errors were determined. SEM images were taken on an Amray 1810 microscope with digital camera at 500×–2000× primary magnification. Skeleton structure was studied and photographed in ground and polished cross-sections of dehydrated and epoxy-embedded sponge pieces (graded ethyl alcohol series followed by propylene oxide and Spurr low viscosity media; Polysciences, Warrington, Pennsylvania, USA).

Proposition of a new genus for *Alcyonium cuspidiferum* Lamarck, 1815 is based on examination of the holotype, literature surveys, and recent studies of the type species (Rützler in Vicente *et al.* 1991: 217; Rützler 1997: 1393; as *Sphaciospongia cuspidifera*).

## SYSTEMATICS

### Family PLACOSPONGIIDAE Gray, 1867

DIAGNOSIS (revised). — Hadromerida with tylostyles as megascleres and selenasters or amphister-like sterasters (amphinolasters) as primary microscleres forming polygonal cortical crusts. Cortical plates separated by contractile ectosomal pore grooves bearing ostia and oscula. Tylostyles in tracts radiating from the base toward the surface and supporting the margins of the cortical plates. Accessory microscleres include spirasters, spherasters, and spherules.

### Genus *Amphinolana* n. gen.

TYPE SPECIES. — *Amphinolana claudelevii* n. sp.

ETYMOLOGY. — The name is composed of *amphi-* (Greek: double, on both sides) and *nola* f. (Latin: little bell) after the shape of the cortical spicules.

DIAGNOSIS. — Placospongiidae with dumbbell-like “amphisterrasters” forming the cortical plates and occurring densely scattered in the choanosome. The amphisterrasters have fused spines with free mammiform tips and a smooth or knobby shaft connecting the two heads; they are termed “amphinolasters”. Accessory spirasters are dispersed throughout the choanosome.

## TAXONOMIC REMARKS

The principal difference between the two genera of Placospongiidae at our present stage of knowledge is the nature of the cortical microscleres, selenasters in *Placospongia* Gray, 1867 and amphinolasters in *Amphinolana*. Although both start out as spiny diactines, their transformation into mature spicules is substantially different and separation of the taxa at genus level is warranted for the evolutionary significance attributable to cortical spicules over regular microscleres. A comparable situation is found in the genera *Spirastrella* and *Diplastrella* Topsent, 1918 which are very similar in morphology and spiculation except that in the latter the spirasters are replaced by diplasters, an astrose microsclere in which the spines radiate from two slightly distant points.

### *Amphinolana claudelevii* n. sp. (Figs 1-3)

HOLOTYPE. — **Heron Island**. North Point, Capricorn Group, Queensland, Australia, 23°26.56'S, 151°58.75'E. Reef crest on lee side of bay, intertidal, from lower surface of a coral boulder, 14.IX.1997, John A. Kennedy & Susan List-Hermitage (USNM 51356).

PARATYPE. — QM G 31 3420 (part of holotype); same data as holotype.

ETYMOLOGY. — Named after Professor Claude Lévi, Paris, eminent spongiologist.

DISTRIBUTION. — Tropical, intertidal, cryptic reef sponge; only known from the type locality on the Great Barrier Reef, Australia.

## DESCRIPTION

### *Morphology*

A thin (0.8–1.5 mm) crust covering about 10 cm<sup>2</sup>. The appearance in the field was described as “gelatinous-grey with blue streaks on microconulous surface”; on a photograph taken fresh after collection the sponge looked slimy black. In alcohol the consistency is leathery, the color is a light tan. The specimen photographed (Fig. 1A) is the alcohol-preserved holotype (USNM portion) with pore grooves closed. Under the stereo microscope, the surface shows characteristic polygonal fields corresponding to cortical plates of amphisterrasters separated by aquiferous grooves devoid of cortical spicules. The grooves are marked by a

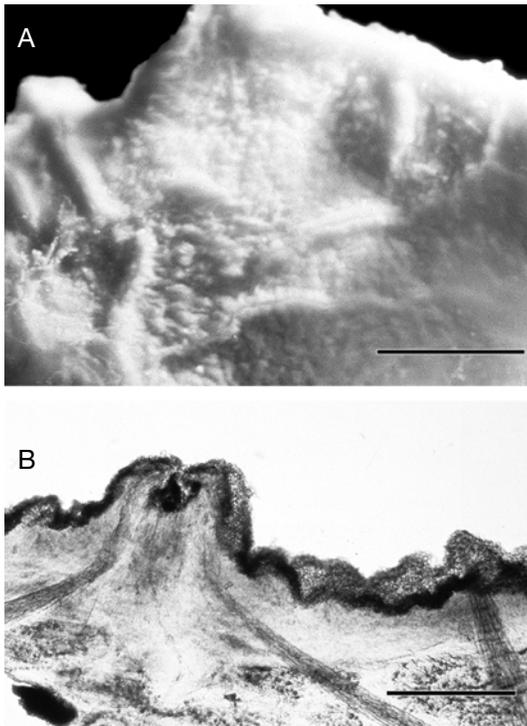


FIG. 1. — *Amphinolana claudelevii* n. gen. n. sp.; **A**, photomicrograph of surface with cortical plates (alcohol-preserved specimen); **B**, ground thick section, perpendicular to surface, showing cortex and aquiferous groove (contracted) supported by strands of tylostyles. Scale bars: A, 5 mm; B, 50  $\mu$ m.

slight elevation (0.2–0.6 mm high) of the abutting plate margins; in life they open to at least 0.5 mm and may have appeared as “blue streaks”, as reported by the collectors.

Tracts of spongin-bound tylostyles (100–200  $\mu$ m wide) radiate from the substrate toward the surface where they penetrate in places supporting the cortical plates on either side of the grooves (Fig. 1B). The cortex consists of a dense, 60–100  $\mu$ m thick top layer of tightly spongin-cemented amphinolasters, followed by a 250–300  $\mu$ m fibrous zone (700  $\mu$ m in the region of a groove), striation parallel to the sponge surface, devoid of spicules but rich in spongin and cells, presumably actinocytes and spongocytes. The choanosome is a 400–1100  $\mu$ m thick and includes most cellular components, aquiferous canals, and abundant but scattered amphinolasters (spaced on average 25  $\mu$ m apart) and

much rarer spirasters (Figs 2A; 3G). A spongin-rich base layer (25–50  $\mu$ m) attaches the sponge crust to the substratum.

The amphinolasters (Figs 2A; 3) start development as straight, slender, spiny rhabds with longer spines toward the ends of the shaft. Mature spicules have smooth or lumpy shafts (lumps are poorly developed spines) and two heads densely covered by bulbous or mammiform spines fused at the base. In transmitted light, the shafts show distinct axial canals; no such structures are seen in the spines. Most spines in fully developed amphinolasters are mucronate, some are connected by delicate siliceous ridges or bear thin secondary spines (Fig. 3A, E, G), possibly stages in the deposition of silica. Tylostyles are long, slender, gradually tapering toward the point, with inconspicuous oval heads; some heads are subterminal or show one or more constrictions (Fig. 2B).

#### *Spicule measurements*

Measurements are ranges; means and standard errors are in parentheses. Tylostyles, length  $\times$  width: 450–700 (578.0  $\pm$  24.2)  $\times$  5.0–7.5 (6.3  $\pm$  0.1)  $\mu$ m; tylostyle heads, length  $\times$  width: 8.8–15.0 (12.0  $\pm$  0.7)  $\times$  6.3–10.0 (7.8  $\pm$  0.3)  $\mu$ m. Mature amphinolasters, length  $\times$  width (head)  $\times$  width (shaft): 27.5–42.5 (39.0  $\pm$  1.4)  $\times$  15.0–20.0 (16.8  $\pm$  0.8)  $\times$  6.3–15.0 (8.5  $\pm$  0.8)  $\mu$ m; immature amphinolasters (rays free, not yet cemented along their lengths), length  $\times$  width (head)  $\times$  width (shaft): 25.0–33.8 (30.9  $\pm$  1.1)  $\times$  5.0–12.5 (8.3  $\pm$  0.9)  $\times$  1.3–5.0 (3.0  $\pm$  0.4)  $\mu$ m. Spirasters (bent or double-bent spiny rhabds), length  $\times$  width (n = 5): 8.8–12.5  $\times$  1.0  $\mu$ m.

#### REMARKS

*Amphinolana claudelevii* stands out among the species in the family Placospongiidae by the morphology and development of its cortical spicules and the simple complement of accessory microscleres which are absent in the cortex and canal walls. Five species are recognized in the only other genus, *Placospongia*, which share oval or bean-shaped cortical selenasters and are distinguished on the basis of their accessory microscleres (spirasters, spiny microrhabds, spherasters, spherules) and their location (cortex, canal walls), not by differences in cortical microscleres. These

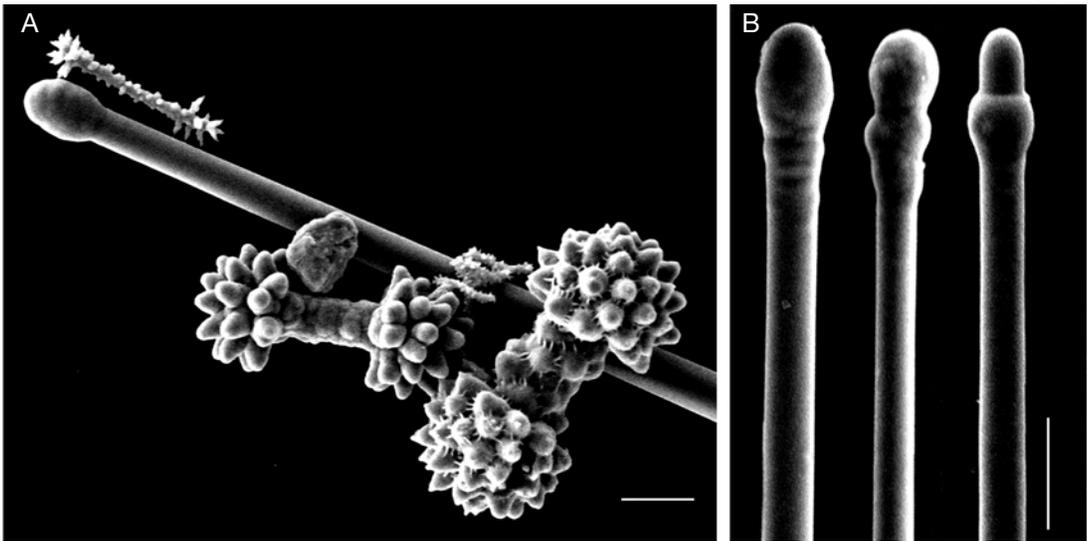


FIG. 2. — *Amphinolana claudedelevii* n. gen. n. sp.; **A**, part of tylostyle with microscleres; **B**, modifications in tylostyle heads. Scale bars: 10  $\mu$ m.

species include the genotype, *P. melobesioides* Gray, 1867, *P. carinata* (Bowerbank, 1859) (including *P. intermedia* Sollas, 1888 and *P. mixta* Thiele, 1900), *P. cristata* Boury-Esnault, 1973, *P. decorticans* (Hanitsch, 1895) (incl. *P. graeffei* von Lendenfeld, 1894) and *P. labyrinthica* Kirkpatrick, 1904 and are described in Vosmaer & Vernhout (1902), Kirkpatrick (1903), and Boury-Esnault (1973). Only *P. decorticans* has distinctive selenasters, pronouncedly bean-shaped instead of ovoid, but the structure and development of these spicules are identical to their counterparts in the other species of *Placospongia*.

Curiosity about the nature of the selenasters dates back to the earliest reports on *Placospongia*. Gray (1867), author of the genus, likened the "siliceous globules" of these sponges to the cortical sterrasters of the genus *Geodia* Lamarck, 1815. Several subsequent workers followed this view and assumed a close relationship between these two sponge groups until Keller (1891: 298) determined that the "siliceous balls" of *Placospongia* derive from spirasters while those of *Geodia* develop from euasters. Apparently unaware of these discussions, Hanitsch (1895: 214), describing the new sponge *Physcaphora* (= *Placospongia*) *decorticans*, named the "sausage-shaped" microscleres "selenasters". He points out

that they resemble sterrasters in structure and development but with the principal difference that in sterrasters the rays start from a point, whereas in the selenasters they originate from a more or less twisted rod. In a monograph of *Placospongia*, Vosmaer & Vernhout (1902: 6) discuss the earlier accounts but use the term "sterraster" instead of selenaster; they do however reject yet another term, "pseudosterraster", as confusing. During a recent review of spicule terminology (in Boury-Esnault & Rützler 1997: 46), selenaster is accepted as "a special type of spiraster approaching the shape of a sterraster..."

The architectural plan and development of the selenaster described in detail by Vosmaer & Vernhout (1902) is now confirmed by scanning electron microscopy (Rützler & Macintyre 1978; González-Farías 1989). It is based on circular arching of the original axis (a spiraster-like spiny microrhabd which is lost during development) and deposition of spines and cement between them toward a point of fusion, which results in an ovoid or bean-shaped spicule. In amphinolasters on the other hand, the axis remains straight and exposed (as shaft, with axial canal remaining visible) and spines extend radially from two distant points, the swollen extremities of a spiny microrhabd. Furthermore, spines in

mature selenasters become cemented almost beyond recognition and the tips are connected by an intricate network of siliceous ridges which is only interrupted by a hilum, a circular depression believed to mark the position of the scleroblast nucleus (Sollas 1888). Spines in mature amphinolasters remain discreet and retain their mamiform appearance, and there is no hilum. Selenasters are quite large in all species, ranging from about 50 µm (larger diameter) in *P. cristata* to more than 150 µm in *P. labyrinthica*, whereas amphinolasters average only 39 µm in length. Purple pigmentation described for selenasters of some specimens of *Placospongia* species (Vosmaer & Vernhout 1902) was not observed in amphinolasters of the present material.

The discrepancy between consistency and color observations made on the live sponge (gelatinous grey, slimy black on photograph) and appearance of the same specimen preserved in alcohol (leathery firm, light tan) could be attributed to a coating by cyanophytes or sciaphilous algae on the cortex which fell off during fixation because no pigment cells or granules can be seen in sections of the ectosome. A similar algal coating was noted on *Placospongia decorticans* (Hanitsch, 1895) in an ecologically comparable situation, from the lower surface of an intertidal rock, in the Adriatic Sea (Rützler 1965: 17).

#### Family CLIONIDAE Gray, 1867

DIAGNOSIS (revised). — Hadromerida with tylostyles (or derivatives), oxeas as accessory spicules or microscleres in some species, and spirasters, amphasters, or spiny microrhabds as microscleres. Excavating and living (at least part of the life cycle) in cavities made in calcareous substrata. Specialized incurrent structures (pore sieves, fistules) present in some massive forms.

#### *Cervicornia* n. gen.

TYPE SPECIES. — *Alcyonium cuspidiferum* Lamarck, 1815: 168 by present designation.

ETYMOLOGY. — The name is composed of *cervus* m. (Latin: deer, stag) and *cornu* n. (Latin: horn) to express the resemblance to staghorn and staghorn coral *Acropora cervicornis* (Lamarck). Lamarck himself com-

pared the appearance of this sponge to inverted stalactites (Topsent 1933: 41).

DIAGNOSIS. — Clionidae with large, exposed inhalant fistules and cryptic (endopsammic) choanosomal pulp with exhalant stolons ending underground; with large tylostyles in dense tracts in the fistules, disorganized in the choanosome, and small, rare spirasters and amphasters in ectosome and canal linings.

#### *Cervicornia cuspidifera*

(Lamarck, 1815) n. comb.

*Alcyonium cuspidiferum* Lamarck, 1815: 168.

*Spirastrella cuspidifera* (Lamarck, 1815). — Topsent 1933: 41.

*Sphaciospongia cuspidifera* (Lamarck, 1815). — Vicente *et al.* 1991: 217. — Rützler 1997: 1393. — Wiedenmayer 1977: 117, as *Xestospongia tierneyi* (Laubenfels, 1953).

MATERIAL EXAMINED. — Holotype at MNHN labelled "151. *Alcyonium cuspidiferum* Lmk, LBIM DT 652" and specimens examined by Rützler in Vicente *et al.* (1991: 217).

#### TAXONOMIC REMARKS

The type species was recently described and illustrated in detail (Vicente *et al.* 1991: 217, figs 3c, d, 4; as *Sphaciospongia*). In summary, *Cervicornia cuspidifera* forms erect, single or branching staghorn-like hollow cylinders which taper toward the top and are anchored in carbonate sand by a flaring base with root-like extensions. The epibenthic fistules are smooth to the touch, corrugated in places, without macroscopic openings (except for barnacle burrows in some specimens), and measure about 30 × 5 cm; they are cork-like in consistency and walnut brown owing to the presence of unusual zooxanthellae (Rützler 1990). The fistules have an ectosomal histology although a few choanocyte chambers are found here and there. The buried base is tan, incorporates sand and shell particles, is riddled by large canals, and extends deep into the substrate. The base consists primarily of choanosome. Spicular tracts with felted spicules in-between support the walls of the fistules; in the base the spicules are criss-cross, without orientation. Megascleres are tylostyles but modifications include strongyles, styles, and tylostrongyles; percentage-distribution of these types in a specimen varies between geographic regions. Megascleres measure about 330-

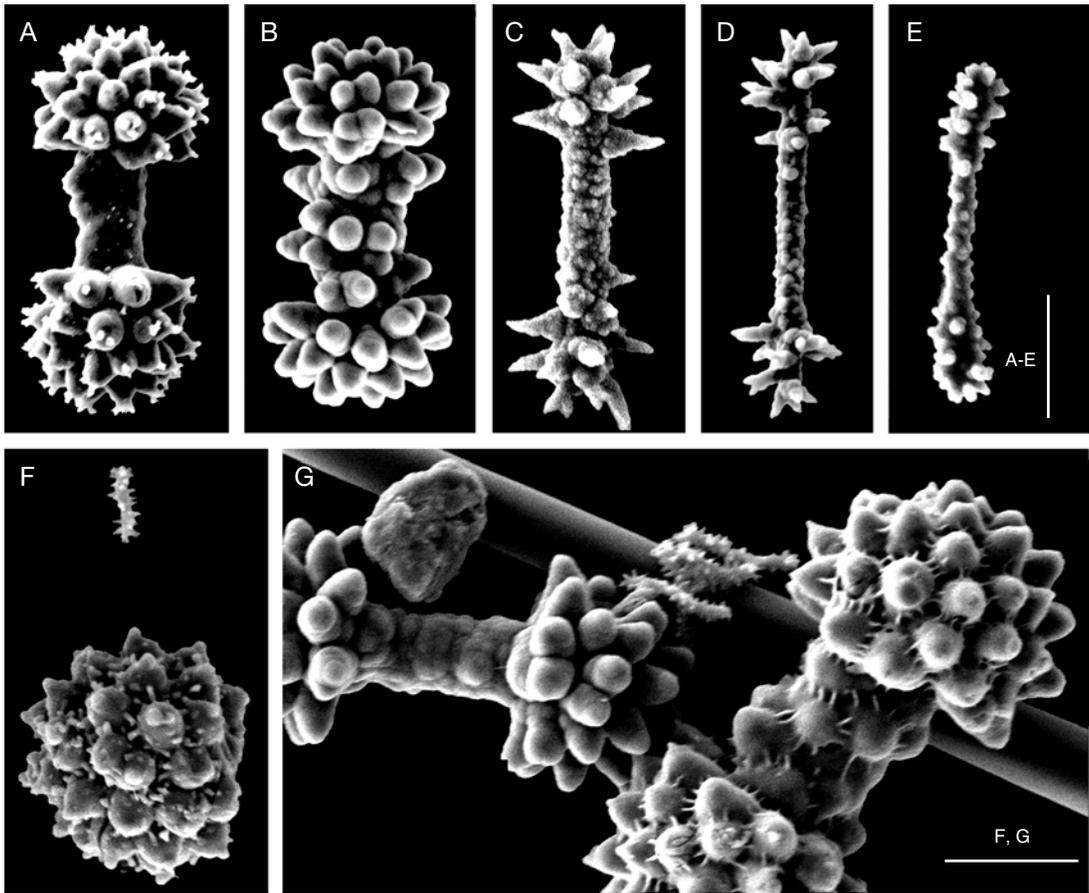


FIG. 3. — *Amphinolana claudelevii* n. gen. n. sp.; **A-E**, amphinolasters in different stages of development; **F**, spiraster and head of amphinolaster; **G**, spirasters and enlarged details of amphinolasters. Scale bars: 10  $\mu$ m.

400  $\times$  8–11  $\mu$ m. Microscleres are small, easily overlooked spirasters and amphiaster-like derivatives, 9–13  $\mu$ m long.

*Cervicornia cuspidifera* differs from other clionids by lack of an early chamber-excavating (alpha) stage, by its massive growth, and by possession of a specialized inhalant complex. Its large, hollow, blind fistules were considered by previous authors to comprise the entire sponge until *in situ* observations and fine-structure study showed their true nature and function (Rützler 1997). The latter work also showed that the choanosomal base of the sponge is burrowing and concealed in unconsolidated calcareous substrate into which exhalant water is discharged. Other massive clionids with specialized inhalant structures are

set apart in the genus *Sphaciospongia* (type species *Alcyonium vesparium* Lamarck, 1815: 78; redescribed by Topsent 1933: 30) by having pore sieves and multiple oscula. *Sphaciospongia* species are epibenthic although very early stages are found excavating and endolithic but they do not form chambers.

## CONCLUSION

*Amphinolana claudelevii* represents a new genus and species from the Great Barrier Reef, Australia. Its cortex plates, separated by aquiferous grooves, and a spiculation of tylostyles, spirasters, and sterraster-like microscleres places the

sponge in the family Placospongiidae. Spicules of the cortical armor, the main distinguishing characteristics, are derived from amphiaster-like spiny rhabds which develop into dumbbell-shaped amphisterrasters. These unusual microscleres are named amphinolasters to set them apart from the monocentric selenasters of the related genus *Placospongia* and from the euaster-derived ster-rasters of the Geodiidae.

The erect branching and partially endopsammic sponge "*Alcyonium*" *cuspidiferum* Lamarck does not fit into either of the two genera, *Spirastrella* and *Sphaciospongia*, it was assigned to since the original description. It is now placed into a new genus *Cervicornia* among massive Clionidae with special inhalant structures. This group has limestone excavating capacity but is without an alpha (chamber-excavating) stage. *Cervicornia* has staghorn-like, ectosomal inhalant fistules and an endopsammic choanosome. The related *Sphaciospongia* is epibenthic, cake-shaped, and has pore sieves for inhalant specialization.

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