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A New Genus and Species of Gorgonian Octocoral (Anthozoa: Plexauridae) from Antarctic Waters

Gary C. Williams[1] and Pablo J. López-González[2]

[1] *Department of Invertebrate Zoology and Geology, California Academy of Sciences, 875 Howard Street, San Francisco, California 94103 USA; Email: gwilliams@calacademy.org;*

[2] *Departmamento de Fisiología y Biología Animal, Facultad de Biología, Universidad de Sevilla, Reina Mercedes 6, 41012-Sevilla, Spain; Email: pjlopez@us.es*

A remarkable new genus and species of gorgonian octocoral is described from the Scotia Sea in the South Atlantic Ocean. Although familial placement is problematic due to shared characteristics particularly with regard to the sclerites, the new taxon is here assigned to the Plexauridae because of features consistent with that family pertaining to morphology of the axis and polyps. Perhaps the most striking attribute of the colonies are the modifications of the margin of the calyces, caused by symbiotic polychaete worms. This association can produce finger-like, plate-like, or star-shaped processes. Additionally, arching processes from adjacent polyps can fuse at their apices to form arcades.

Recent southern polar and subpolar investigations via R/V *Polarstern* and other endeavors have revealed a wealth of marine invertebrate taxa, many new to science. Included among these are new genera of octocorals such as *Arntzia* (Primnoidae), *Gilibelemnon* (Stachyptilidae), *Sphaeralcyon* (Alcyoniidae), *Rosgorgia* (Subergorgiidae), and one described herein. Consequently, these efforts have significantly increased our knowledge of the Antarctic benthos (Arntz, Gutt, and Klages 1997; Lopez-Gonzalez and Gili 2001; Lopez-Gonzalez, Gili, and Orejas 2002).

Abbreviations used in the text are: BEIM (Biodiversidad y Ecología de Invertebrados Marinos, University of Seville); CAS (California Academy of Sciences, San Francisco); SMF (Senckenberg Museum, Frankfurt); USNM (National Museum of Natural History, Smithsonian Institution, Washington, D.C.); ZIZMH (Zoologisches Institut und Zoologisches Museum, Hamburg).

Methods

The material studied in this paper was collected on the *Polarstern* cruises ANT XV/3 (EASIZ-II, Ecology of the Antarctic Sea Ice Zone, 13 January to 26 March 1998), ANT XIX/3 (ANDEEP-1, Antarctic benthic deep-sea Biodiversity: colonization history and recent community patterns, 23 January to 26 February 2002), ANT XIX/5 (LAMPOS, Latin American *Polarstern* Study, 3 April to 5 May 2002). All these programs were sponsored by the Alfred Wegener Institut für Polar-und Meeresforschung (Bremerhaven), under the auspices of the SCAR (Scientific Committee for Antarctic Research). Additional specimens were examined from the R/V *Eltanin* cruise of 1963.

The colonies were collected using an Agassiz trawl or a bottom trawl at the Drake Passage and different localites of the Scotia Arc. The octocorals were fixed in buffered formalin (4% in sea water) then transferred to 70% ethanol.

The underwater photos were part of a photographic transect carried out by Dieter Piepenburg (Kiel) during the *Polarstern* cruise ANT XV/3 (EASIZ-II), stn 333, King George Island, 61°26.97′S 58° 07.87′W, 975–932 m depth, 19 March 1998. The total number of photographs taken at that station was 44, each photograph covering an area of approximately 1 m^2.

Systematic Account

Family Plexauridae Gray, 1859

Gorgonian octocorals often form copiously branched fans, but can also be sparsely branched; rarely whip-like and unbranched. Axis brown or black, often tough, fibrous, and flexible; larger colonies often have axes that are woody and relatively soft in texture. Axis composed of a hollow, relatively wide, cross chambered central core, with a surrounding area of concentric layers of gorgonin containing open spaces (loculi). These spaces may be filled with calcitic calcium carbonate, not in the form of sclerites. The holdfast region may contain aragonitic calcium carbonate.

Polyps monomorphic, retractile directly into coenenchyme, or often the anthocodiae retract into conspicuous calyces. Anthocodiae often with crown and points, but with a distinct neck zone that contains few or no sclerites.

In most cases, at least some of the sclerites of the anthocodiae, calyces, and coenenchyme, measure between 0.3 and 5.0 mm in length. Sclerites are mostly conspicuously tuberculated or thorny, with tubercles generally not arranged in regular whorls. Sclerite form highly diverse, including spindles, thornstars, thornscales, rooted leaves, stellate plates, rosettes, ovals, crutches, bifurcated rods, crescents, leaf spindles, leaf clubs, capstans, torches, double disks, and tuberulated spheroids.

The Plexauridae is a morphologically and taxonomically diverse family of approximately 38 genera, with widespread distribution in the Atlantic, Indian, Pacific, and Southern Oceans.

Bayergorgia Williams and López-González, gen. nov.

Type species: *Bayergorgia vermidoma* Williams and López-Gonzáles, sp. nov.

Diagnosis.— Colonies mostly unbranched. Axis proteinaceous with hollow cross-chambered core and loculated cortex. Anthocodiae retractile into prominent calyces. Margins of calyces often morphologically modified by symbiotic polychaetes. Polyps monomorphic and azooxanthellate. Coenenchymal sclerites are spindles < 0.9 mm in length and spiny rods < 0.4 mm long. Calyces with needle-like spindles < 1.2 mm long. Anthocodial sclerites present, neck zone sclerites absent. Sclerites colorless.

Etymology.— The new generic name is named for our colleague, Dr. Frederick M. Bayer, curator emeritus of the National Museum of Natural History, Smithsonian Institution; in combination with the Greek word, *gorgia* (a commonly used suffix in octocorallian nomenclature). Dr. Bayer began preliminary work on this taxon in the 1980s, but the project was subsequently discontinued by him.

Bayergorgia vermidoma Williams and López-González, sp. nov.

Figs. 1–13.

Material examined.— Holotype: CAS #171740; Drake Passage, 61°26.08′S 58°06.2′W; 1047–1227 m depth, 19 March 1998; *Polarstern* cruise ANT XV/3, stn 336, Agassiz trawl; single whole colony wet preserved, purple-violet in life. Paratypes: CAS #1717141; same data as holotype; single fragmented colony wet preserved, purple-violet in life. ZIZMH #C11691; Drake Passage, 61°26.08′S 58°06.2′W; 1047–1227 m

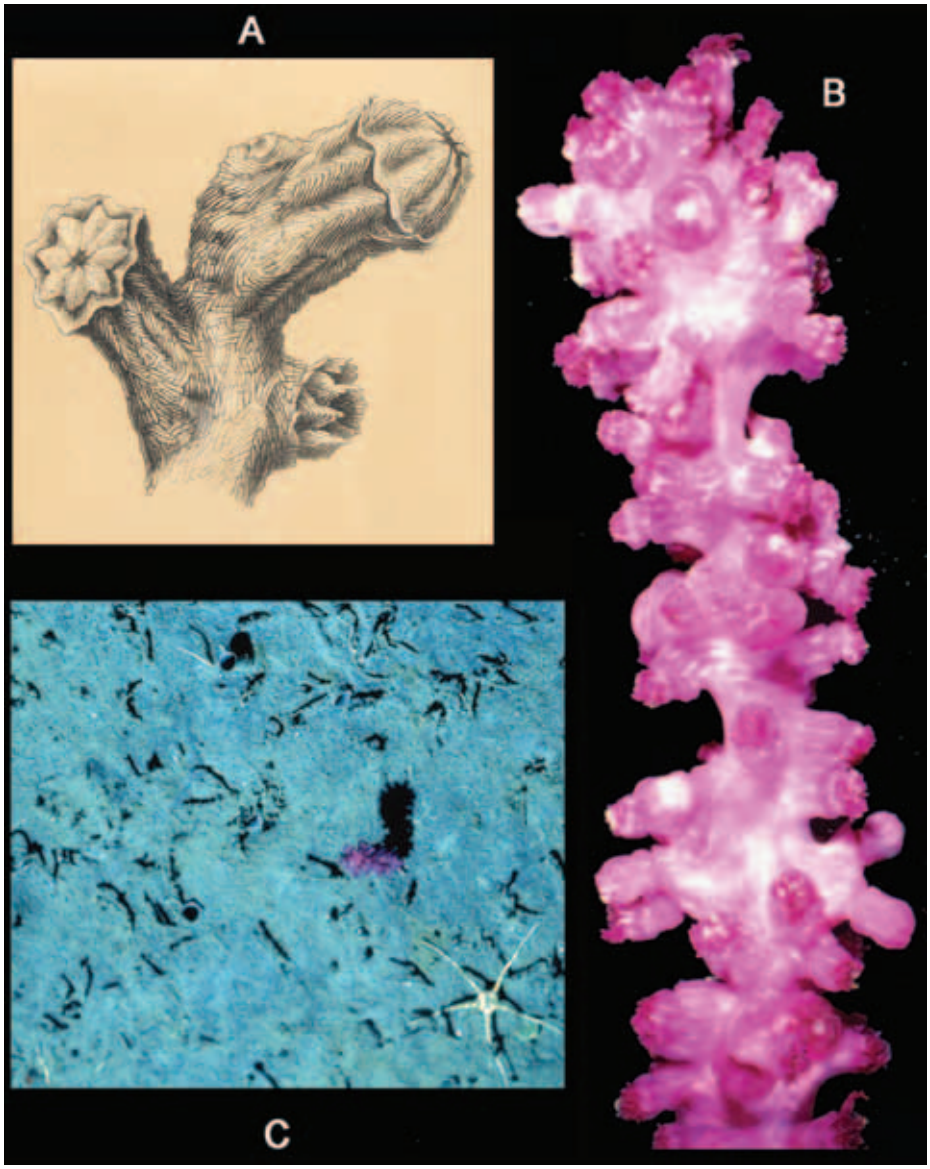

FIGURE 1. A. Polyps of *Anthomuricea argentea*; from Wright and Studer, 1889: plt. 23, fig. 1, scale not given; collected from Patagonia (southern Atlantic), 256 m depth. B. Distal region of a living colony of *Bayergorgia vermidoma* gen. and sp. nov.; portion shown approximately 65 mm in length; photograph of terminal portion of a colony (ANT-3337) by Martin Rauschert.. C. *In situ* photograph of *Bayergorgia vermidoma* gen. and sp. nov.; underwater photograph by Dieter Piepenburg, *Polarstern* Cruise ANT XV/3, Stn. 333, 61°26.8′S 58°08.1′W; 994 m depth; 19 March 1998; scale not given.

depth; 19 March 1998; *Polarstern* cruise ANT XV/3, stn 336, Agassiz trawl; two colonies. SMF #(unavailable at time of publication); Drake Passage; 61°26.08′S 58°06.2′W; 1047–1227 m depth; 19 March 1998; *Polarstern* cruise ANT XV/3, stn 336, Agassiz trawl; two colonies.

OTHER MATERIAL: BEIM #ANT-1550; NW Elephant Island, 61°18.14′S 56°8.27′W, 281.1–288.6 m, 2 February 2002, *Polarstern* cruise ANT XIX/3, stn 61-1, bottom trawl; two colonies. BEIM #ANT-1622; NW Elephant Island, 61°18.14′S 56°8.27′W, 281.1–288.6 m, 2 February 2002; *Polarstern* cruise ANT XIX/3, stn

61-1, bottom trawl; one colony. BEIM #ANT-1695; Shag Rocks, 53°23.59′S 42°41.78′W; *Polarstern* cruise ANT XIX/5, stn 145; 223.6–307.1 m depth; 9 April 2002; three colonies. CAS #171742; Shag Rocks, 53°23.59′S 42°41.78′W; *Polarstern* cruise ANT XIX/5, stn 145; 223.6–307.1 m depth; 9 April 2002; one fragmented colony. CAS # 171927; Shag Rocks, 53°23.59′S 42°41.78′W; *Polarstern* cruise ANT XIX/5, stn 145; 223.6–307.1 m depth; 9 April 2002; one partial colony. USNM #85223; South Atlantic Ocean, Antarctica, Antarctic Peninsula, South Shetland Islands, West of Elephant Island; 61°19′S 056°28′W; 403 m depth; 13 March 1964; coll. USARP, *Eltanin* R/V; one fragmented colony and one whole colony. USNM #85226; South Atlantic Ocean, Scotia Sea, South Georgia Island, off west tip of island; 54°29′S 039°22′W; 659–686 m depth; 8 February 1966; coll. *Eltanin* R/V; one fragmented colony. USNM #85224; South Atlantic Ocean, Scotia Sea, South Georgia Island; 54°55′S 038°05′W; 595–677 m depth; 25 August 1963; coll. *Eltanin* R/V; one fragmented colony. USNM #85225; South Atlantic Ocean, Scotia Sea, Antarctica, South Orkney Islands, Scotia Ridge, West of Islands; 60°22′S 046°50′W; 298–403 m depth; 15 April 1964; coll. USARP, *Eltanin* R/V; one fragmented colony and one whole colony.

Description of holotype.— *Axis*: Axis smooth and continuous, brown, dark brown, or black in color, with a conspicuously hollow but cross-chambered central core and a surrounding cortex that is loculated and uncalcified. Axis mostly 1.5 mm in width, and 30 mm in length from the base of the holdfast to the proximal region of the polyp-bearing portion of the colony; axis at base of holdfast 3.0 mm wide.

Growth form and size: Growth form is upright and unbranched. The colony is 145 mm in total length, and 10–12 mm wide in the polyp bearing region. The stalk, or region of the colony devoid of polyps between the holdfast and proximal region of the polypary, is 30 mm in length, whereas the polyp bearing portion of the colony is approximately 115 mm long.

Polyps: Anthocodiae are retractile into prominent calyces. Sclerites are absent in the neck zones (introverts). The anthocodiae have eight intersceptal tracts of more-or-less longitudinally placed spindles below the tentacles, whereas a crown is absent. The calyces are cylindrical in shape with eight intersceptal tracts of spindles mostly longitudinally placed, or somewhat oblique and converging distally to form weak chevrons. The tentacles have somewhat flattened rods in the rachises, which are presumably absent from the pinnules.

Sclerites: The coenenchyme contains two main kinds of sclerites. In the regions near the bases of the calyces, are needle-like spindles 0.60–0.90 mm long, that are mostly smooth in the midsections with tuberculation toward the ends (Fig. 6, top row). In the region of the stem below the polypary and in the flat regions between the calyces are tuberculated rods 0.12–0.27 mm long, that vary in shape from relatively thin and elongate (Fig. 7) to blunt and more robust (Fig. 8), as in the axial sheath. Immediately below the superficial coenenchyme is a very thin layer containing these short, blunt rods. Also present in the coenenchyme are sclerites of intermediate form and size 0.24–0.65 mm (Fig. 6, second and third rows). The calyces contain needles 0.6–1.2 mm in length, acutely pointed, with relatively sharp tubercles toward both ends (Fig. 9). These sclerites are either straight or somewhat curved and are longitudinally placed or in some polyps are oblique and converge distally to form chevrons. The anthocodiae have eight intersceptal tracts below the bases of the tentacles that resemble points formed by spindles 0.21–0.65 mm long. These sclerites are more or less longitudinally placed. The sclerites are mostly straight, vary in the proportion of width vs. length, and are sparsely tubercated near the ends (Figs. 10–11). The transverse placement of sclerites to form a crown below the points is not evident. The rachises of the tentacles contain somewhat flattened rods and spindles 0.20–0.26 mm long, sparsely and shallowly tubercated on opposite margins, most distinctly toward the ends of the sclerites (Fig. 12). These sclerites are not evident in the pinnules.

Color: Color in life is brilliant magenta (red-purple) to violet-purple (Fig. 1), fading to a pale tan-white or grey-white in alcohol (Fig. 2). The vivid coloration is therefore most probably provid-

ed by alcohol-soluble pigments. Sclerites are colorless.

Distribution.— Antarctic Region: Archipelagos of the Scotia Sea, the northwestern Antarctic Peninsula, and Drake Passage (Fig. 13); depth range 223–1227 meters.

Photographic transects of the seafloor were obtained during the expeditions ANT XV/3 in the King George area (Arntz and Gutt 1999). Each photograph covered approximately one square meter of the seabed. *Bayergorgia vermidoma* gen. and sp. nov. was present at the photographic transect Station 333 (Latitude: 61°26.97′S; Longitude 58°07.87′W; depth range 975–932 m). Three specimens of the new taxon appeared in three of forty-four photographs taken along the transect.(N. Teixidó, pers. commun.). Its abundance is therefore considered very low with a patchy pattern of distribution.

Etymology.— The specific epithet is derived from the Latin, *vermis* (worm) and *domus* (home or house), in reference to presence of commensal polychaetes that cause and inhabit the modified calyces of some polyps.

Remarks.—Two specimens (USNM 85229 and USNM 85230), both from Shag Rocks (Scotia Sea), are morphologically very similar to the new taxon with the exception that they show very sparse dichotomous or irregular branching. This material has not been included for examination in the present study, but is planned for a subsequent assessment.

Discussion

Familial Assignment: The new taxon shares general characteristics of the sclerites or axis with several gorgonian families — particularly the Acanthogorgiidae and the Plexauridae, therefore its proper placement as to family is problematic. The polyps of acanthogorgiid species are not retractile and are not separable into functional anthocodiae and calyces, the tentacles contract over the oral disc, and the neck zones are covered with spindles commonly arranged in eight double rows forming inverted ‘V’s. On the other hand, the polyps of plexaurids are either completely retractile into the coenenchyme or are distinctly differentiated into anthocodiae and calyces, whereas the neck zones have few or no sclerites (Bayer 1981; Fabricius and Alderslade 2001). Characteristics of the polyps of the new taxon conform to those of the Plexauridae as outlined above.

Symbiotic polychaetes: Perhaps the most remarkable aspect of the new taxon is the modification of the calyx due to a symbiotic association with polychaete worms. The margin of the calyx often forms finger-like (Fig.4C), star-shaped, or plate-like extensions (Fig. 4B). Occasionally, the modifications of adjacent polyps curve upwards and fuse at their tips forming arches or arcades (Fig. 4A). The worms that cause these modifications are presumably capable of moving around inside these extensions. In polyps with the most severely modified calyces, disk-like expansions result from the fusion of the prolongations and the filling in of the spaces between these prolongations with coenenchymal material.

Taxonomic identification of the worms as well as details of the association with the new taxon as host organism, are currently under investigation.

Martin, Núñez, Riera, and Gil (2002) record the presence of polychaetes of the genus *Haplosyllis* (Family Syllidae) with other gorgonians, namely the plexaurid genera *Paramuricea* and *Villogorgia*, and the acanthogorgiid genus *Anthogorgia*. These associations are described as symbiotic and either kleptoparasitic (stealing food from the host), or parasitic (feeding on the host), and at least partially mutualistic (cleaning the host).

Related Taxon (Fig. 1A): A superficially similar plexaurid gorgonian, tentatively identified as *Anthomuricea argentea* Wright and Studer (189:103–104; pl. 23, fig. 1), which is also noted in Bayer (1981) and Grasshoff (1977), differs from *Bayergorgia vermidoma* gen. and sp. nov. in hav-

ing dichotomous branching, more copious branching, white coloration in life, infrequent to absent calyx modification from worm symbiosis, and a geographical restriction to the Patagonian Atlantic and Burdwood Bank (256 m depth). Recently collected material has allowed for a comparison with the new taxon and the potential for a redescription of Wright and Studer's taxon, both of which are planned for future study. Grasshoff (1977) maintains that *Anthomuricea* is related to the more northern Atlantic genus *Swiftia*, with four or five species in the western Atlantic (Deichmann 1936: 186) and three species in the northern Atlantic, eastern Atlantic, and Mediterranean (Grasshoff 1977:62).

Acknowledgments

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Special thanks are extended to some friends and colleagues for their valuable assistance on board, especially M. Isabel Alfonso, Nuria Teixidó, Mercedes Conradi, Neus Vert and Estefania Rodríguez. Our thanks to Martin Rauschert for the photograph of a living colony (Fig. 1B) taken on board during the EASIZ-II cruise. Dieter Piepenburg and Nuria Teixido kindly provided the underwater photos and the information about the abundance of the new species in the photographic transect carried out at the station 333 during the EASIZ-II cruise. Participation on these cruises was supported by the Spanish CICYT projects ANT 98-173-E, REN2001-4269-E/ANT, REN2001-4929-E.

We express our gratitude to Stephen D. Cairns (United States National Museum, Smithsonian Institution, Washington, D.C.) for the loan of specimens and unpublished study materials relating to this new taxon.

Literature Cited

Arntz, W.E., J. Gutt, and M. Klages. 1997. Antarctic marine biodiversity — An overview. Pages 3–14 *in* Battaglia B., J. Valencia, and D.W.H. Walton, eds., *Antarctic Communities, Species, Structure and Survival*. Cambridge University Press, Cambridge, UK.

Arntz, W.E., and J. Gutt. 1999. The expedition ANTARKTIS XV/3 (EASIZ II) of RV 'Polarstern' to the eastern Weddell Sea in 1998. *Ber Polarforsch* 301:1–229.

Bayer. F.M. 1981. Key to the genera of Octocorallia exclusive of Pennatulacea (Coelenterata: Anthozoa), with diagnoses of new taxa. *Proceedings of the Biological Society of Washington* 94(3): 902-947.

Deichmann, E. 1936. The Alcyonaria of the western part of the Atlantic Ocean. *Memoirs of the Museum of Comparative Zoology at Harvard College* 3(49):1–317.

Fabricius, K. and P. Alderslade. 2001. *Soft Corals and Sea Fans — A Comprehensive Guide to the Tropical Shallow-Water Genera of the Central-West Pacific, the Indian Ocean and the Red Sea*. Australian Institute of Marine Science, Townsville, Australia. 272 pp.

Grasshoff, M. 1977. Die Gorgonarien des östlichen Nordatlantik und des Mittelmeeres III. Die Familie Paramuriceidae (Cnidaria, Anthozoa). *Meteor Forschungsergebnisse* (D) 27:5–76.

López-González, P.J., and J-M Gili. 2000. A new octocoral genus (Cnidaria: Anthozoa) from Antarctic waters. *Polar Biology* 23:452–458.

López-González, P.J., and J-M Gili. 2001. *Rosgorgia inexpectata*, new genus and species of Subergorgiidae (Cnidaria, Octocorallia) from off the Antarctic Peninsula. *Polar Biology* 24:122–126.

López-González, P.J., and J-M Gili, and C. Orejas. 2002. A new primnoid genus (Anthozoa: Octocorallia) from the Southern Ocean. *Scientia Marina* 66(4):383–397.

LÓPEZ-GONZÁLEZ, P.J., AND G.C. WILLIAMS. 2002. A new genus and species of sea pen (Octocorallia: Pennatulacea: Stachyptilidae) from the Antarctic Peninsula. *Invertebrate Systematics* 16:919–929.

MARTIN, D., J. NÚÑEZ, R. RIERA, AND J. GIL. 2002. On the associations between *Haplosyllis* (Polychaeta, Syllidae) and gorgonians (Cnidaria, Octocorallia), with the description of a new species. *Biological Journal of the Linnean Society* 77(4):455–477.

WRIGHT, E.P., AND T. STUDER. 1889. Report on the Alcyonaria collected by H.M.S. *Challenger* during the years 1873-1876. *Report of the Scientific Results of the Voyage of H.M.S. Challenger 1873–1876* 31(1):1–314.

FIGURE 2. *Bayergorgia vermidoma* gen. and sp. nov. A-B. Photographs of wet-preserved material. A. Non-Type specimen (USNM 85225), scale bar = 20 mm. B. Paratype (CAS 171741), scale bar = 40 mm. C. Holotype (CAS 171740), scale bar = 30 mm.

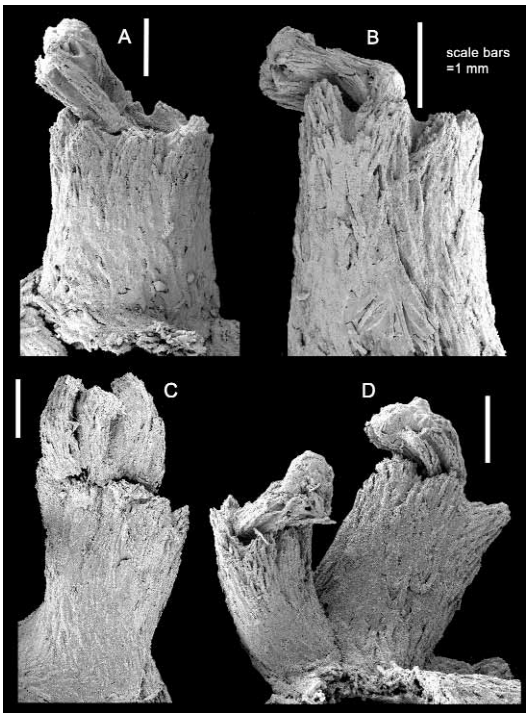


FIGURE 3. *Bayergorgia vermidoma* gen. and sp. nov. A, B, D. Scanning electron micrographs of unmodifed polyps, showing calyces and anthocodiae. C. Single polyp showing two digitate modifications of the calyx on either side of the anthocodia. Scale bars = 1 mm.

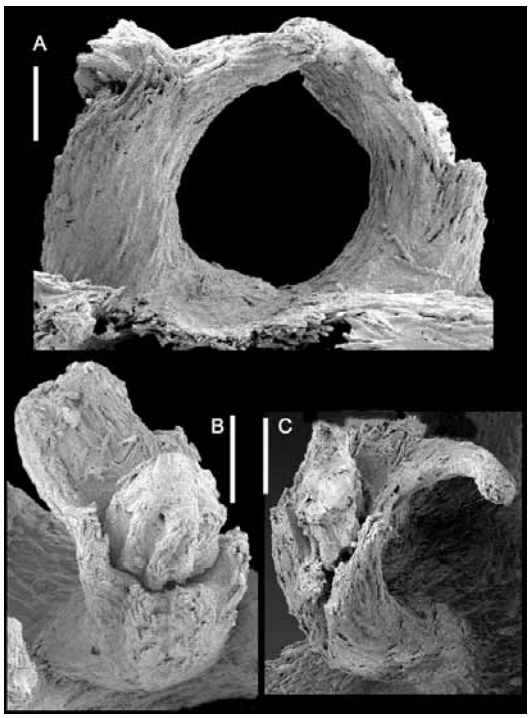
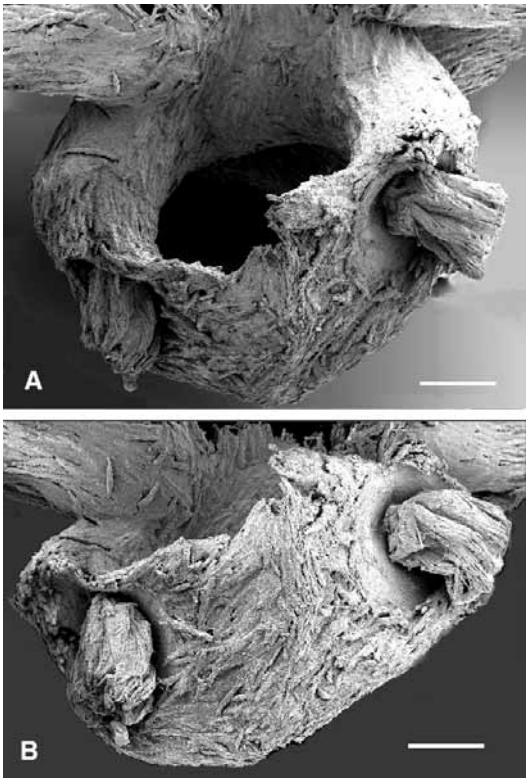


FIGURE 4. *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of polyps. A. Two polyps with calicular prolongations fused together apically to form an arch. B. Single polyp with a broad and flattened calicular expansion. Entire retracted polyp. C. Single polyp with curved fingerlike calicular expansion. Scale bars = 1 mm.



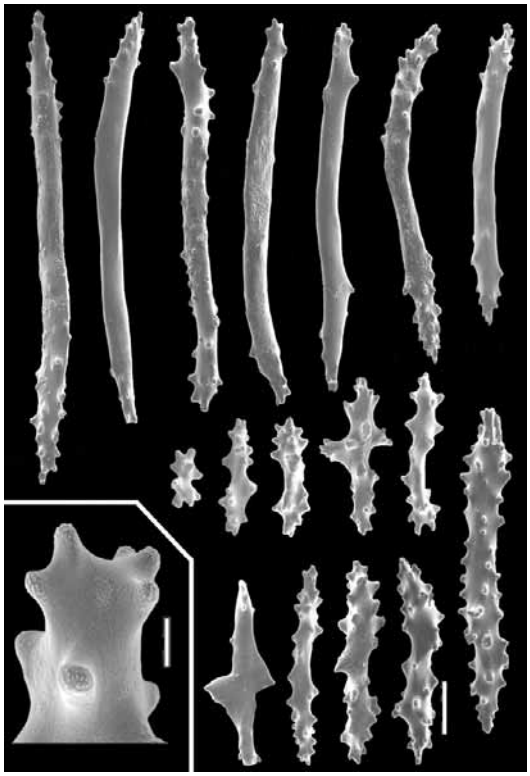


FIGURE 5 (upper left). *Bayergorgia vermidoma* gen. and sp. nov. A–B. Scanning electron micrographs of two polyps with apically fused calicular modifications (also shown in figure 4A). Scale bars = 1 mm.

FIGURE 6 (upper right). *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of sclerites. Variation in coenenchymal sclerites from the polyp-bearing portion of a colony, scale bar = 0.10 mm. Inset shows tip of a single coenenchymal sclerite, scale bar = 0.02 mm.

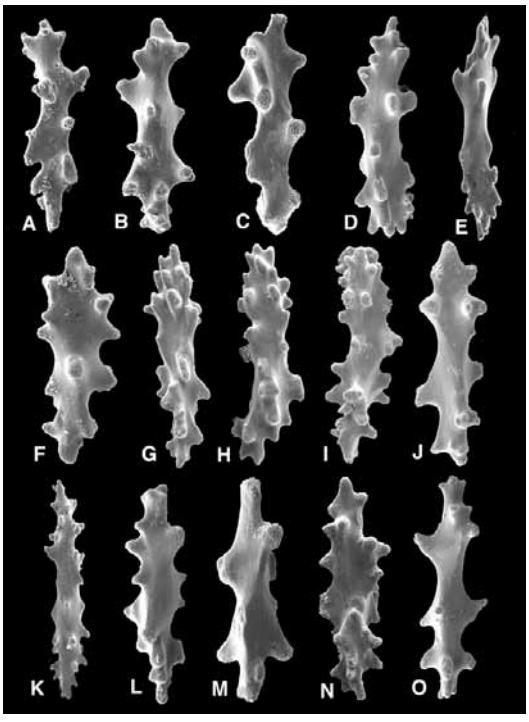
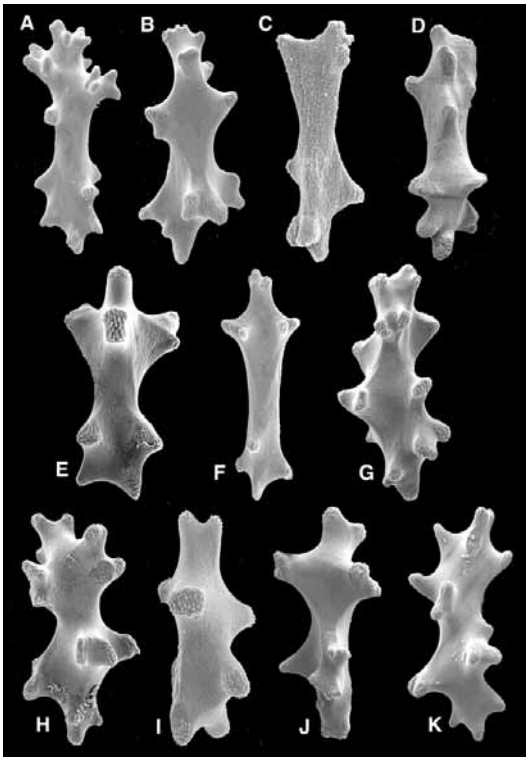
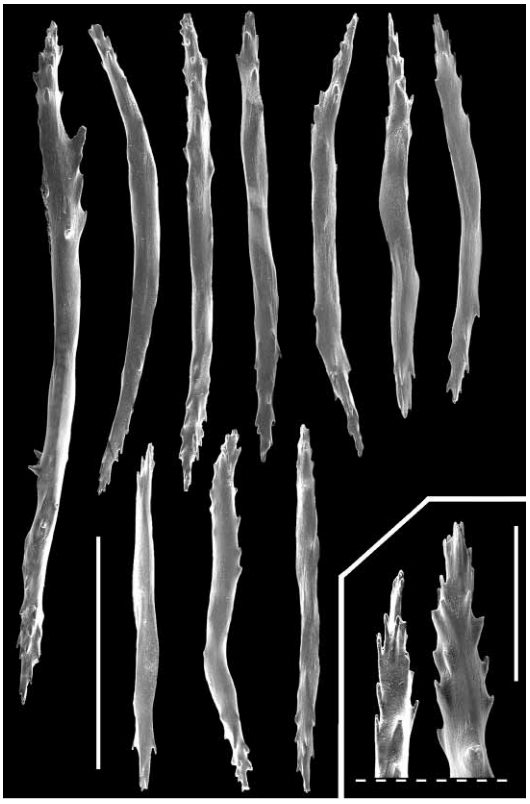


FIGURE 7 (lower left). *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of sclerites. Coenenchymal sclerites. A. 0.24 mm. B. 0.19 mm. C. 0.17 mm. D. 0.24 mm. E. 0.28 mm. F. 0.19 mm. G. 0.26 mm. H. 0.27 mm. I. 0.23 mm. J. 0.20 mm. K. 0.38 mm. L. 0.19 mm. M. 0.17 mm. N. 0.24 mm. O. 0.24 mm.





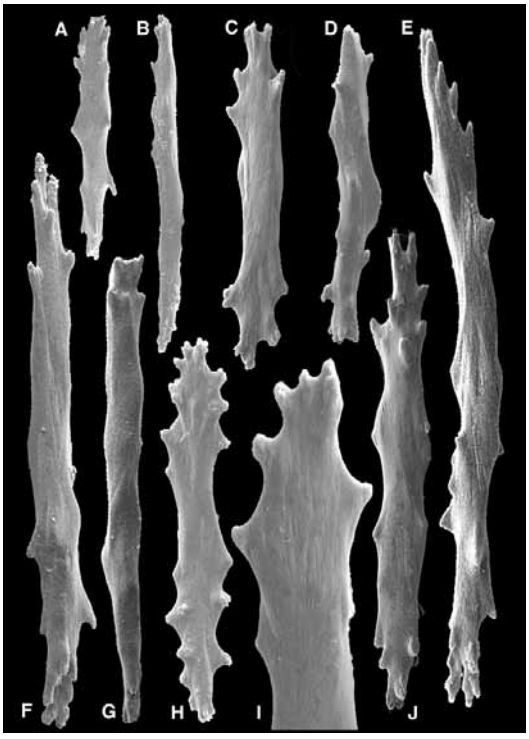


FIGURE 8 (upper left). *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of sclerites. Sclerites from the axial sheath. A. 0.27 mm. B. 0.20 mm. C. 0.12 mm. D. 0.17 mm. E. 0.17 mm. F. 0.20 mm. G. 0.19 mm. H. 0.19 mm. I. 0.14 mm. J. 0.18 mm. K. 0.22 mm.

FIGURE 9 (upper right). *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of sclerites. Variation of sclerites from the calyx of a polyp, scale bar = 0.40 mm. Inset shows enlargements of the tips of two calicular sclerites, scale bar = 0.15 mm.

FIGURE 10 (lower left). *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of sclerites. Anthocodial sclerites. A. 0.26 mm. B. 0.38 mm. C. 0.22 mm. D. 0.21 mm. E. 0.52 mm. F. 0.40 mm. G. 0.48 mm. H. 0.22 mm. I. 0.11 mm. J. 0.36 mm.

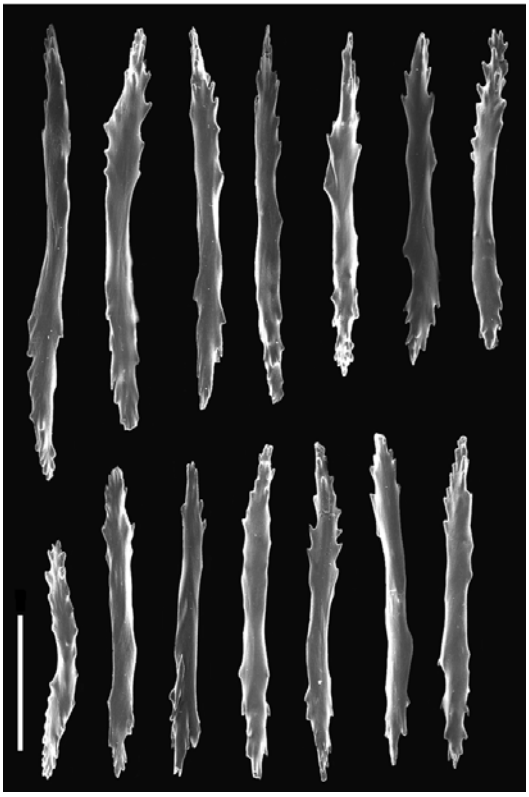


FIGURE 11. *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of sclerites. Anthocodial sclerites; scale bar = 0.20 mm.

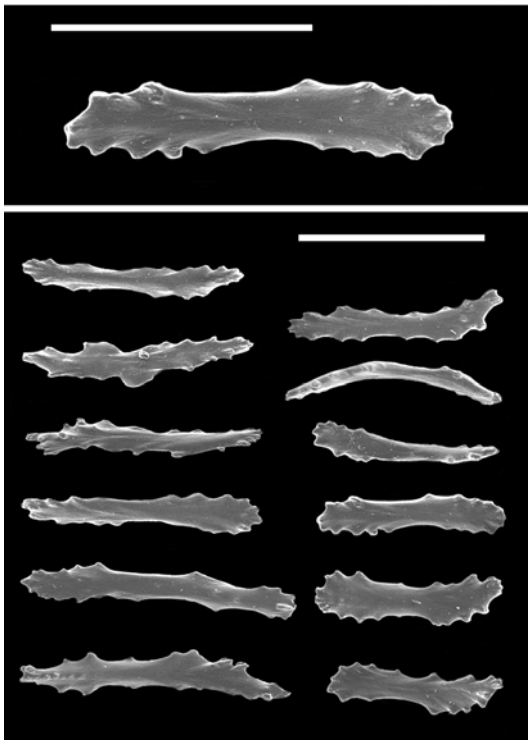


FIGURE 12. *Bayergorgia vermidoma* gen. and sp. nov. Scanning electron micrographs of sclerites. Sclerites from the rachis of the tentacles; top scale bar = 0.15 mm, bottom scale bar = 0.20 mm.

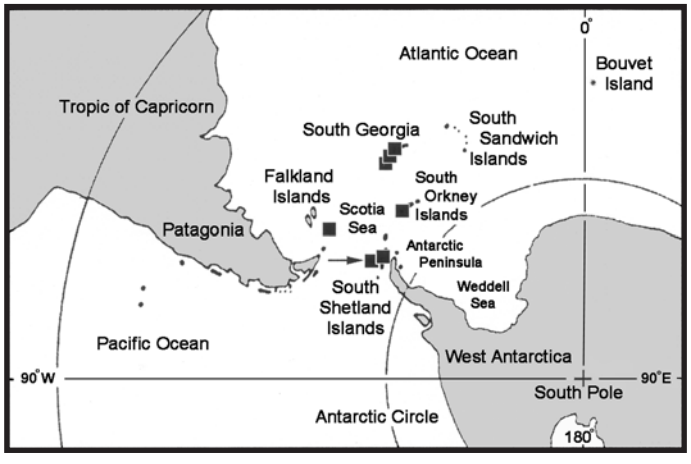


FIGURE 13. Map of the Scotia Sea showing collecting stations for *Bayergorgia vermidoma* gen. and sp. nov. Arrow points to type locality.