Some Antarctic and Sub-Antarctic Sea Anemones (Coelenterata: Ptychodactiaria and Actiniaria)

Daphne Fautin Dunn

Paper 1 in

Biology of the Antarctic Seas XIV
Antarctic Research Series Volume 39

Louis S. Kornicker, Editor

American Geophysical Union

SOME ANTARCTIC AND SUB-ANTARCTIC SEA ANEMONES (COELENTERATA: PTYCHODACTIARIA AND ACTINIARIA)

DAPHNE FAUTIN DUNN

BIOLOGY OF THE ANTARCTIC SEAS XIV
Antarctic Research Series Volume 39

LOUIS S. KORNICKER, Editor

Published under the aegis of the
Board of Associate Editors, Antarctic Research Series
Charles R. Bentley, Chairman
Samuel C. Colbeck, Robert H. Eather, David H. Elliott,
Dennis E. Hayes, Louis S. Kornicker, Heinz H. Lettau,
and Bruce C. Parker

Library of Congress Cataloging in Publication Data

Forthcoming

ISBN 0-87590-188-3
ISSN 0066-4634

Published by the
AMERICAN GEOPHYSICAL UNION
With the aid of grant DPP-8217043 from the
National Science Foundation
June 30, 1983

Printed in the United States of America

Biology of the Antarctic Seas XIV
Antarctic Research Series, Volume 39, Paper 1, Pages 1-67

SOME ANTARCTIC AND SUB-ANTARCTIC SEA ANEMONES (COELENTERATA: PTYCHODACTIARIA AND ACTINIARIA)

Daphne Fautin Dunn

Department of Invertebrate Biology and Paleontology, California Academy of Sciences
San Francisco, California 94118

Abstract. Fifteen species of sea anemones from Antarctic and sub-Antarctic seas are discussed. These include one member of Order Ptychodactiaria and 14 (in nine families) of Order Actiniaria. Three of the actiniarians are new species, one belonging as well to a new genus: Bolocera paucicornis n. sp., Bathyphellia australis n. sp., and Eltaninactis infundibulum n. gen., n. sp. Of the 12 previously described species, only Galatheanthemum profundale and Actinauge verrillii had not been recorded from south polar seas before. The other known species of Bathyphellia is boreal.

Contents

Introduction

The number of species of Antarctic sea anemones sensu lato (including members of orders Ptychodactiaria, Corallimorpharia, and Actiniaria) is generally held to be 31 [Carlgren, 1928a, cited by Dell, 1972]. Using Carlgren's [1949] catalog and more than a dozen subsequent publications on anemone systematics, as well as a few published prior to 1949, but omitted by Carlgren, I counted 99 nominal species of Antarctic and sub-Antarctic sea anemones.

This report on south polar actinians and ptychodactiarians is based on material collected under the auspices of the U.S. Antarctic Research Program (USARP) and made available to me through the Smithsonian Oceanographic Sorting Center. It contains redescriptions of 12 species that had gone under 27 different names; some of the synonymies had been proposed previously, but the abundance of specimens I had to study allowed me to reduce other names to synonymy as well. Two of these species, Galatheanthemum profundale and Actinauge verrillii, had not been reported from so far south before. Three new species are described, one of them in a new genus. All three came from deep seas (more than 580 m) and were rare in the USARP collections; these facts explain their having escaped detection earlier. With these deletions and additions, my list of nominal Antarctic and sub-Antarctic sea anemones stands at 94.

The 1042+ individuals studied for this report came from 180 stations. Most species were heretofore known from few individuals, which was both a cause and a result of taxonomic splitting. The 15 species discussed in this report are among the largest and/or most abundant in the USARP collection and hence are probably the most important ecologically or were selected for study because of their distinctiveness. Work continues on the USARP actinians, and data on other species will be published as they become available.

Each species is redescribed anatomically (better-known species in less detail), its cnidae are diagnosed, taxonomic/nomenclatural issues are discussed, its geographical and bathymetric ranges are given, and the material upon which my study as well as pre-

vious ones were based is listed. The lists are ordered by ship and cruise and station number; coordinates and depth of each station are provided. In the section, 'Distribution and size of cnidae,' for each species, 'n' refers to the number of capsules measured, and 'N' is the proportion of animals examined in which the cnidae were found. Thus, the numerator is the number of animals having that type of cnida and the denominator is the total number of animals examined. Not all tissues of each specimen were studied. A proportion for N such as 2/5 may mean that only 40% of the anemones contain that type of cnida in a particular tissue, or it may imply that the cnida is rare, so that there is only a 40% chance of seeing it in a smear. Either way, 'N' provides information on how much weight should be attached to each type of cnida in making taxonomic decisions.

Once identified, the specimens were deposited in either the U.S. National Museum of Natural History (USNM) or the Department of Invertebrate Biology and Paleontology, California Academy of Sciences (CAS); the number of specimens in each lot is noted following its catalog number. Discussions are illustrated with distributional charts, photographs of whole animals, and figures of histological sections and cnidae from them. All data are based on preserved animals; there are no notes on color, posture, dimensions, etc., in life. Few ecological inferences can be drawn from such specimens.

Order PTYCHODACTIARIA
Family PTYCHODACTIIDAE
Dactylanthus antarcticus (Clubb, 1908)

Cystiactis antarctica: Clubb, 1908, p. 5.
Dactylanthus antarcticus: Carlgren, 1911, p. 2--Stephenson, 1918a, p. 19--Pax, 1923, pp. 25, 26; 1926, pp. 4, 50, 51, 61--Carlgren, 1927, pp. 95, 97, 98, 100; 1928a, pp. 260, 261, 262; 1940, p. 19; 1949, p. 11.

Description

Body form and size. Column barrel shaped, 20-30 mm long, 20 mm diameter; body wall thin, pale yellow. Blunt mammiform to digitiform, sometimes longitudinally sulcate, hollow protuberances resembling tentacles in size (up to 4.0 mm x 1.5 mm diameter, most about 2 mm long) and shape, arrayed in 12 longitudinal endocoelic rows with average eight or nine protuberances per row; a few also arise from some exocoels (Figure 1). No fosse.

Base. Flat, surrounded by single circlet of 24 protuberances; pale yellow. Often contracted to about 5 mm diameter so that proximal edge of column is pulled in and overlaps pedal disc.

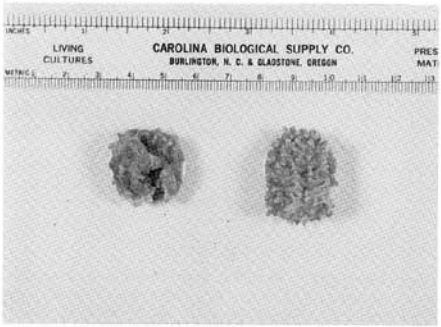

Fig. 1. Dactylanthus antarcticus. Specimen at left USNM 59803; at right from lot CAS 012894.

Tentacles and oral disc. Oral disc flat, about half as broad as column; central mouth 3 x 2 mm when open. Marginal circlet of 24 blunt digitiform tentacles, generally alternately longer (up to 5 mm long x 1.5 mm diameter) and shorter (1-2 mm long x 1 mm diameter); pale yellow.

Mesenteries and internal anatomy. Twenty-four, regularly arrayed mesenteries extremely thin; six primary pairs complete, six secondary pairs incomplete. All fertile with gonad on proximal portion; mesenterial filaments distal to gonad on secondaries, entire length of primaries. Basal edges of mesenteries fused. Actinopharynx short (about 5 mm long); smooth or with few deep sulci; two siphonoglyphs, if apparent, symmetrical, about twice as long as rest of actinopharynx; pale yellow.

Sphincter muscle not apparent. Basilar muscles absent. Mesenterial retractors weak, small, diffuse (Figure 2).

Distribution and size of cnidae (Fig. 3)

Tentacles
spirocysts(a), (15.6)17.2-23.0 x 2.3-3.1 μm, n = 20, N = 2/2
atrichs(b), (19.7)22.1-30.3 x 3.3-4.7 μm, n = 26, N = 2/2

Actinopharynx
atrichs(c), 14.8-27.1 x 2.9-4.1 μm, n = 24 N = 2/2

Mesenterial filaments
atrichs(d), 14.8-23.0 x 3.1-4.3 μm, n = 27, N = 2/2

Column, protuberances
spirocysts(a), 19.7-23.8 x 2.3-3.1 μm, n = 19, N = 2/2

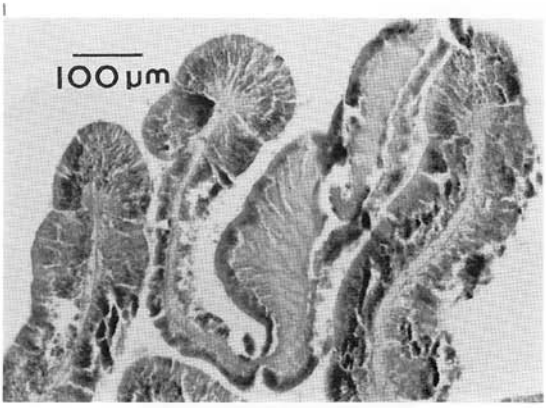

Fig. 2. Cross section through mesentery of Dactylanthus antarcticus (CAS 012894).

atrichs(b), 20.5-31.2 x 3.9-4.5 µm, n = 21, N = 2/2

Column, between protuberances
atrichs(d), 13.9-18.9 x 3.1-3.9 µm, n = 16, N = 2/2

Discussion

This species, representing half of those that constitute Order Ptychodactiaria, is highly distinctive. The column protuberances are identical in structure and cnidae to tentacles. Clubb [1908] assigned the species to Cystiactis, of Family Aliciidae, which is characterized by hollow vesicles on the column. Carlgren [1911], recognizing the unusual nature of the species, created the still monotypic genus Dactylanthus for it. He originally assigned it to family Ptychodactidae [sic], which he then considered a member of the primitive actinian tribe or suborder Protantheae. In his 1949 catalog, Carlgren placed family Ptychodactiidae in Order Ptychodactiaria, separated from Actiniaria by cnidom, and structure of the mesenterial filaments.

Carlgren's [1911] discussions of the anatomy and phylogenetic position of the species are comprehensive. The six specimens taken by the USARP conform well to the published descriptions. Clubb's and Carlgren's specimens were about twice as large as Stephenson's and those reported here. Carlgren [1940] reported sparse smaller atrichs in the tentacles; I found two such cnidae in the column protuberances of one individual, but could not ascertain that these were not contaminants. In larger specimens, apparently the secondary mesenteries are also complete; they may have 24 longitudinal rows of column protuberances, but 24 is the definitive number of tentacles.

This is clearly a rare species. It has been taken from depths of 37 to 610 m, mostly south of the 64th parallel, on both sides of Drake Passage between 56° and 65°W, and in the Ross Sea and north of it in the Pacific Ocean (162°W to 170°E).

Material examined (Figure 4)

Eltanin Cruise 5

Sta. 217, 54°22'-23'S, 64°42'-52'W, 106-110 m, CAS 029630 (x2)

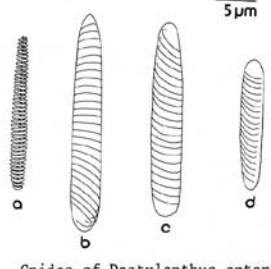

Fig. 3. Cnidae of Dactylanthus antarcticus; see text for explanation.

Fig. 4. Distributions of Dactylanthus antarcticus, Glyphoperidium bursa, and Galatheanthemum profundale.

Eltanin Cruise 27

Sta. 1941, 67°24'-25'S, 179°54'W, 124-161 m, USNM 60692 (x1)

Hero Cruise 721

Sta. 1074, 64°47.4'S, 64°07.4'-07.0'W, 106-110 m, USNM 59803 (x1)
Sta. 5429, 64°47.50'-47.45'S, 64°07.20'-05.60'W, 73-100 m, CAS 012894 (x2)

Deep Freeze II

Trawl AT-4, 78°10'S, 162°22'W, 610 m, USNM 50944 (x1)

Previous records

Clubb [1908] McMurdo Bay [77°S, 170°E], 20 fm (x1)
Carlgren [1911] 64°20'S, 56°38'W, 150 m (x1)
Stephenson [1918a] 77°13'S, 164°18'E, 207 fm (x1)

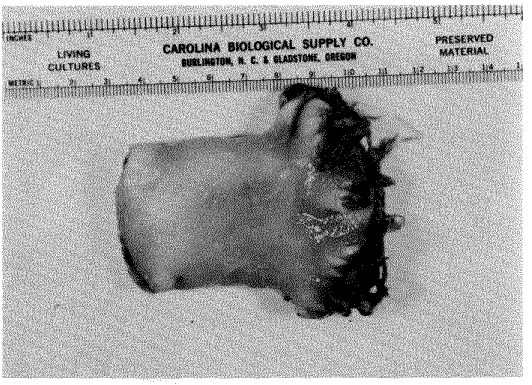

Fig. 5. Actinernus elongatus from lot CAS 013066.

Order ACTINIARIA
Family ACTINERNIDAE
Actinernus elongatus (Hertwig, 1882)

Porponia elongata: Hertwig, 1882a, p. 111; 1882b, p. 125.
Porponia antarctica: Carlgren, 1914, p. 50--Pax, 1926, p. 4, 50, 51.
Actinernus antarcticus: Carlgren, 1918, p. 35--Stephenson, 1922, p. 259--Carlgren, 1927, p. 97, 99; 1928a, p. 260; 1939, p. 791; 1949, p. 20.
Actinernus elongatus: Carlgren, 1918, p. 33--Stephenson, 1922, p. 259--Carlgren, 1949, p. 21.

Description

Body form and size. Column cylindrical, not divided into regions, expanded abruptly at distal end (Figure 5), very firm owing to thick and brittle mesoglea. Average column length of 35-40 mm, greater by 5-10 mm than its diameter; column mesoglea about 5 mm thick, endoderm dark. Column of largest specimen 50 mm long, of smallest 8 mm long and 5 mm diameter. Ectoderm sloughed from all specimens examined; exposed mesoglea white, almost hyaline in some; irregular shallow furrows in some may have been impressed by collecting gear. Mesenterial insertions may be visible at limbus. No fosse.

Base. Equal to or somewhat greater or less than column diameter. Pedal disc of some wrapped around elongate object such as worm tube or gorgonian branch. Thinner than column.

Tentacles and oral disc. Mesenterial insertions prominent, causing radial furrows in oral disc; ectoderm thin. Disc cannot be hidden; in some specimens it is extended but folded upon itself in the manner of a Venus's-flytrap plant, in others it is contracted peripherally so that its edge appears to be lobed. In the lobe-like condition, tentacles, which are evenly spaced around the margin, may appear to arise in bunches. Average size individual has tentacles each about 15-25 mm long; aboral thickening at basal end extends onto column; distal end very narrow, tapering to a filament (Figure 5); 50-67 tentacles counted, slightly more than number of mesenteries at mid-column. Mouth large and elongate, with prominent lips.

Mesenteries and internal anatomy. Mesenteries very thin, brittle; arrangement and musculature difficult to determine. All or nearly all mesenteries complete at mid-column; highest cycle present only at margin. Actinopharynx deeply sulcate, also with transverse folds at regular intervals; slightly more than half as long as column; very wide in directive plane, therefore directive mesenteries and those beside them much narrower than others. Endoderm of pharynx, column, tentacles and mesenteries refractile, brown to black (Figure 6).

No sphincter nor basilar muscles.

Distribution and size of cnidae (Fig. 7)

Tentacles
spirocysts(a), 24.6-50.0 x 3.5-5.7 μm, n = 42, N = 6/6
spirocysts(b), 45.9-76.3(82.0) x 5.7-11.5 μm, n = 29, N = 6/6
basitrichs(c), (32.0)34.4-52.5 x (2.7)3.3-4.5 μm, n = 49, N = 6/6

Actinopharynx
basitrichs(d), 33.6-50.8 x 3.1-4.9 μm, n = 34, N = 5/5

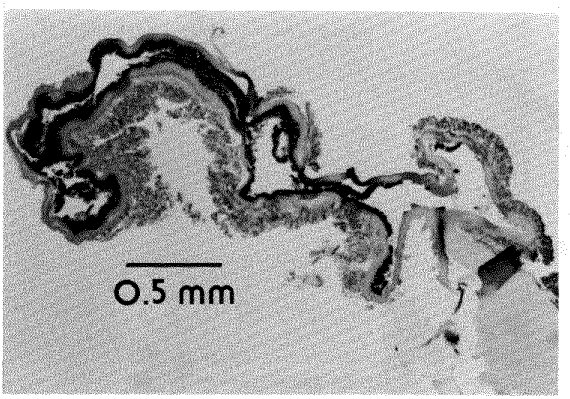

Fig. 6. Longitudinal section through tentacle of Actinernus elongatus (CAS 013066); note dark endoderm.

microbasic p-mastigophores(e), 34.4-43.5 x (4.1)4.9-7.0 μm, n = 25, N = 4/5
(few spirocysts also seen)

Mesenterial filaments
spirocysts(f), 30.3-45.9(50.8) x 4.9-7.0(9.8) μm, n = 19, N = 3/3
basitrichs(g), 31.2-43.5(48.4) x 3.1-4.1(4.7) μm, n = 26, N = 3/3
microbasic p-mastigophores(h), 31.2-38.5 x 4.9-6.2 μm, n = 12, N = 3/3

Discussion

Most specimens of Actinernus elongatus in the USARP collection were poorly preserved. This may have been due to the great depth from which they were taken or to the thickness of the body wall. Very fine sediment covered the oral disc and coated the enterons of many specimens, completely filling some tentacles. None of the specimens had columnar ectoderm, and ectoderm adhered to the tentacles only in patches. The endoderm was mostly macerated so that morphology of mesenterial filaments and retractors was problematical.

Hertwig [1882a, b] described a new genus, Porponia, for two new species of Challenger actinians, P. elongata and P. robusta. His account of the former species is in accord with my findings of USARP specimens, including the uncertainty about internal anatomy. Carlgren [1914] provided considerable detail about the internal anatomy of a new nominal species P. antarctica. His nematocyst data agree with my findings except that he recorded spirocysts in the actinopharynx; loose ones contaminating that tissue are not uncommon in actinians. Carlgren was reluctant to synonymize his species with either of Hertwig's, owing to the dearth of data on the

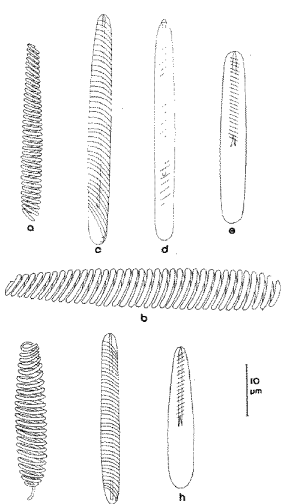

Fig. 7. Cnidae of Actinernus elongatus; see text for explanation.

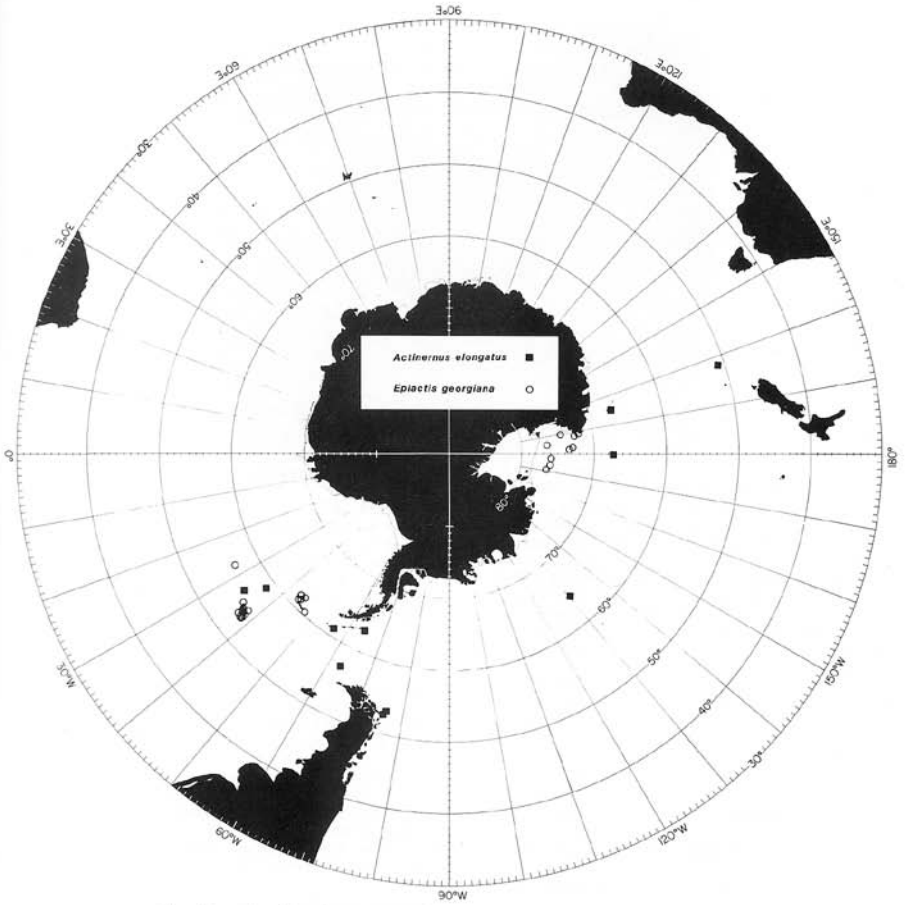

Fig. 8. Distributions of Actinernus elongatus and Epiactis georgiana.

latter, but he thought it was nearest to P. robusta. On the other hand, he provided a few nematocyst measurements from Hertwig's specimens, and those for P. elongata are in accord with what I found (again except for spirocysts in the actinopharynx); and the tentacle form of P. elongata is similar to that of P. antarctica, although different from that of P. robusta (which came from 35°N). Also, both species were collected in austral seas (albeit on opposite sides of Antarctica).

Carlgren suggested in 1914, and confirmed in 1918, that Verrill's [1879] generic name Actinernus is synonymous with Porponia. There were five nominal species in the genus [Carlgren, 1918, 1949]; synonymizing A. elongatus with A. antarcticus reduces that to four, and it is possible that the number will be diminished still more: all of the nominal

Fig. 9. Aulactinia sulcata; from lot USNM 60062.

species occur in deep water, and most are based on few, poorly preserved specimens. A lobed upper column/oral disc that is said to occur in only some individuals or species of the genus [Carlgren, 1918, 1949; Stephenson, 1922] is an artifact in A. elongatus, as it may be in some or all of the other species.

Hertwig's specimens represent the most northerly latitude from which Actinernus elongatus has been taken. The greatest depth from which it is recorded is 4575-4813 m (Eltanin cruise 13, station 1158) or 4755 m (Hertwig's specimens). The USARP specimens came from the Scotia Sea, around the Antarctic peninsula, and from the southwest Pacific (Figure 8). The shallowest depth recorded for A. elongatus is 1080 m.

Material examined (Fig. 8)

Eltanin Cruise 4

Sta. 126, 57°12'-14'S, 62°45'-51'W, 3733-3806 m, USNM 59799 (x2)
Sta. 135, 62°40'-37'S, 64°06'-63°57'W, 3715-3752 m, CAS 013067 (x2)

Eltanin Cruise 9

Sta. 709, 58°48'-46'S, 36°24'-23'W, 1733-1784 m, USNM 60649 (x1)
Sta. 722, 56°04'-00'S, 33°59'-57'W, 3138-3239 m, USNM 59711 (x2)

Eltanin Cruise 12

Sta. 991, 60°57'-54'S, 56°52'-58'W, 2672-3020 m, CAS 013360 (x17)

Eltanin Cruise 13

Sta. 1158, 64°15'-19'S, 130°13'-05'W, 4575-4813 m, USNM 60648 (x1)

Eltanin Cruise 16

Sta. 1412, 51°07'-09'S, 162°03'-01'E, 1647-1665 m, CAS 015076 (x2)

Eltanin Cruise 21

Sta. 282, 53°04'-09'S, 75°43'-49'W, 1896-1920 m, USNM 59800 (x1)
Sta. 283, 53°13'-16'S, 75°41'W, 1500-1666 m, CAS 013066 (x3)

Eltanin Cruise 27

Sta. 1946, 67°29'-32'S, 179°55'-57'W, 1080 m, USNM 59776 (x7)
Sta. 1949, 66°52'-49'S, 164°32'-26'E, 2507-2525 m, USNM 59802 (x7)

Previous records

Hertwig [1882a, b] 42°42'S, 134°10'E, 2600 fm (x2)
Carlgren [1914, 1939] 71°22'S, 16°34'W, 1410 fm (x17)

Family ACTINIIDAE
Aulactinia sulcata (Clubb, 1902) new combination

Urticina sulcata: Clubb, 1902, p. 295.
Urticina carlgreni: Clubb, 1902, p. 297.
Tealia carlgreni: Stephenson, 1922, p. 272.
Tealia sulcata: Stephenson, 1922, p. 272.

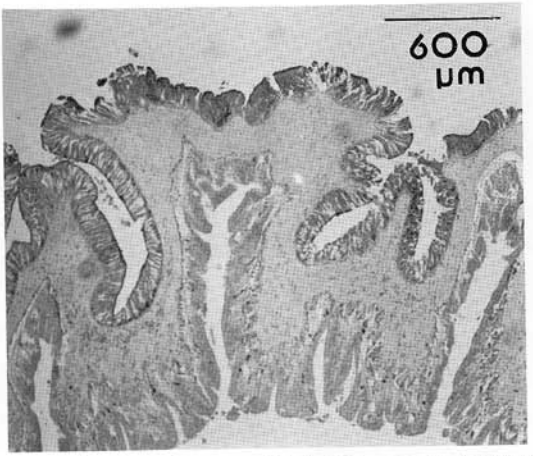

Fig. 10. Section through verruca of Aulactinia sulcata (CAS 017935).

Bunodactis sulcata: Carlgren, 1924, p. 196; 1927, p. 96 (=B. carlgreni); 1928a, p. 261--Carlgren and Stephenson, 1929, p. 11 (=B. carlgreni)--Carlgren, 1949, p. 65.
Bunodactis carlgreni: Carlgren, 1924, p. 196; 1949, p. 65.

Description

Body form and size. Cylindrical to barrel shaped (Figure 9), column generally 30-50 mm long by 20-35 mm diameter, most specimens brownish to rust red color. Simple verrucae (Figure 10) same color as column, arrayed in longitudinal rows from margin to limbus, one row (of about 40 verrucae) corresponds to each endocoel and exocoel (therefore 48 rows typical); all of equal size, about 1 mm diameter; gravel may adhere. Arrangement often obscure in strongly contracted individuals; some individuals lack proximal verrucae; and those on uppermost column of some individuals raised on longitudinal folds that may be mistaken for marginal spherules (which are, in fact, absent).

Deep circumferential furrows that do not completely encircle column can also obscure verrucae so that body appears rugose. Some folds about a quarter to a third of distance from margin to base function in retaining externally brooded juveniles. Circular endodermal column musculature strong.

Base. Flat, smaller than column diameter in most specimens, with lower column drawn down about it; same color as column. Adherent to small pebbles in some USARP specimens.

Tentacles and oral disc. Oral disc and tentacles same color, generally rusty or yellowish. Oral disc may be completely retracted so tentacles hidden; that of most widely expanded specimens about same diameter as pedal disc. Most tentacles near margin; nearest 5 mm from mouth. Full complement of tentacles 48; many specimens with somewhat fewer than number of mesenteries (e.g., 35 and 40, 41 and 48). Tentacles blunt digitiform (i.e., of uniform diameter through most of length), smooth or with shallow longitudinal furrows. Although they may be of equal length, commonly inner tentacles about 10 mm long (but up to 25 mm) by 2-3 mm wide, and outermost (i.e., exocoelic) ones 5 mm long, with intermediate ones of intermediate length. Terminal pore may gape open; tentacle wall of equal width all around. Longitudinal tentacle musculature mesoectodermal, circular endodermal; radial oral disc musculature mesoectodermal, circular endodermal.

Mesenteries and internal anatomy. Three orders of regularly arrayed mesenteries with filaments; all fertile except two pairs of symmetrically arrayed directives (and in some individuals those of the third order); all or only those of the first two orders complete. Mesenteries apparently added from proximal end, to judge by rare specimens with fewer than 48 mesenteries. Large oral and moderate to large marginal stomata; strong diffuse retractor muscles typically with longer

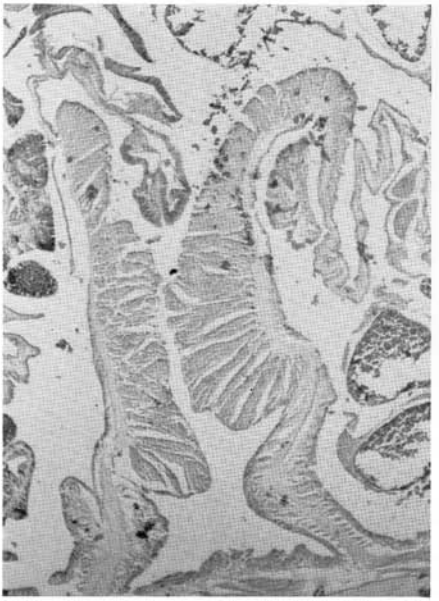

Fig. 11. Cross section through mesenteries at mid-column level of Aulactinia sulcata; debris is yolk granules from shattered ova (CAS 017696). Magnification as in Figures 10 and 12.

lamellae at peripheral end (Figure 11); narrow parietobasilar muscles with short free pennons (Figure 11).

Actinopharynx shallowly sulcate, about one- to two-thirds column length (depending on state of expansion); with two symmetrical shallow siphonoglyphs attached to the directive mesenteries, hardly to considerably longer than gullet. Circumscribed endodermal sphincter muscle strong, oblong, with primary lamella oriented nearly parallel to marginal wall of deep (5-6 mm) fosse (Figure 12); about half as long as fosse. Secondary lamellae pinnately arrayed, those on marginal and oral sides may be of unequal length.

Dioecious. Largest ova 700-800 μm diameter in preserved specimens; very yolky.

Distribution and size of cnidae (Fig. 13)

Tentacles
spirocysts(a), (24.6)26.2-41.0 x 2.3-3.9 μm, n = 40, N = 5/5
basitrichs(b), 26.2-34.4 x 2.3-3.5 μm, n = 32, N = 5/5

Actinopharynx
basitrichs(c), (26.2)28.7-42.6 x 2.9-4.1 μm, n = 40, N = 5/5
microbasic p-mastigophores(d), 29.5-42.6(43.5) x 3.7-5.1 μm, n = 20, N = 5/5

Mesenterial filaments
basitrichs(f), 18.9-27.1 x 1.8-2.7(3.3) μm, n = 9, N = 2/5
basitrichs(c), (32.0)33.6-41.0(42.6) x (2.7)3.1-4.1(5.3) μm, n = 21, N = 4/5
microbasic p-mastigophores(e), 33.6-40.2 x 3.9-5.7 μm, n = 43, N = 5/5

Column
basitrichs(f), 19.7-24.6 x 2.1-3.3 μm, n = 31, N = 5/5
basitrichs(g), 32.8-41.0 x (4.1)4.7-5.7 μm, n = 23, N = 5/5

Discussion

Clubb [1902] described two new species of the 'bunodactid' genus Urticina, U. sulcata, and U. carlgreni, combining discussion of them due to their similarity, particularly in regard to their external brood chambers. Clubb distinguished the two on the bases of prominence of verrucae, and slight differences in body proportions and degree to which upper column was modified and column circular muscles were developed. These are clearly quantitative differences, and a complete continuum in these features exists among the USARP specimens. Clubb's illustrations of sections through sphincter, body wall, and mesentery of both species are almost identical to mine. Although he placed them in Tealia, Stephenson [1922], who recognized the similarity of the two species, opined that they might belong to Bunodactis. Carlgren [1927, 1928a], and Carlgren and Stephenson [1929] did refer the two species to Bunodactis, and synonymized them, but inexplicably they were listed separately in Carlgren's [1949] catalog. This Antarctic species conforms in all regards to the definition of genus Aulactinia, the valid name of Bunodactis [Dunn et al., 1980].

Clubb [1902] reported a greenish cast that I did not observe in the animals; this difference is probably due to method of preservation. Two points in Carlgren and Stephenson's [1929] report are at odds with my findings. They stated that the directives may be fertile; since one of the specimens in which this was so was one studied by Clubb, who stated that the directives are sterile, there can be no question of misidentification. Their nematocyst data (the only ones previously published for Aulactinia sulcata)

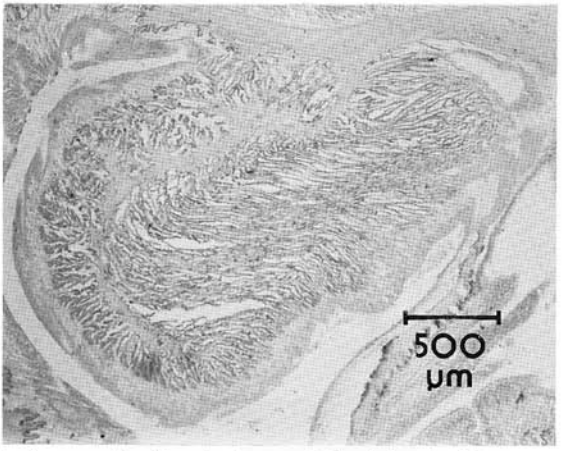

Fig. 12. Cross section through circumscribed endodermal sphincter muscle of Aulactinia sulcata (CAS 017959).

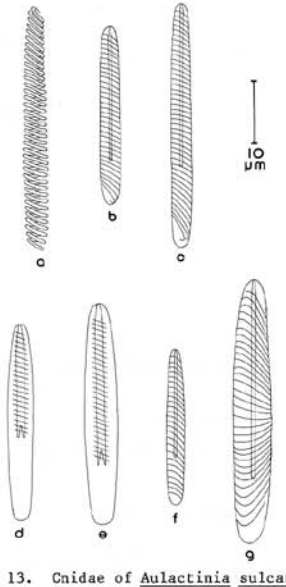

Fig. 13. Cnidae of Aulactinia sulcata; see text for explanation.

are incomplete but agree perfectly with my findings except for the tentacles, which show no overlap with my basitrich measurements. Carlgren and Stephenson [1929] disputed Clubb's [1902] description of the brood chambers. Only one of the specimens I examined showed evidence of such pockets (from CAS 017959), the anatomy of which was very difficult to comprehend. A portion of the upper column wall was clearly invaginated, its opening narrower than the chamber itself. Mesenterial filaments protruded through the wall of the chamber, but whether the perforation was a normal feature of the brood space or a result of stress during collection was impossible to determine. There were no embryos in that or any other specimen of A. sulcata that I examined; perhaps they were dislodged in collection, as happens with Epiactis georgiana. The individual with the brood chamber is a female, containing immature eggs. Other females in the USARP collection, including one with large, yolky ova, show no evidence of brood chambers.

Superficially, Aulactinia sulcata may resemble a small Glyphoperidium bursa. However, tentacles (and mesenteries) of the latter are much more numerous, its oral disc is undulate, and it lacks verrucae, among other differences.

The depth range for specimens of this species taken by the USARP was from 351-357 to 662-1120 m; previous records were considerably shallower. It is known from three

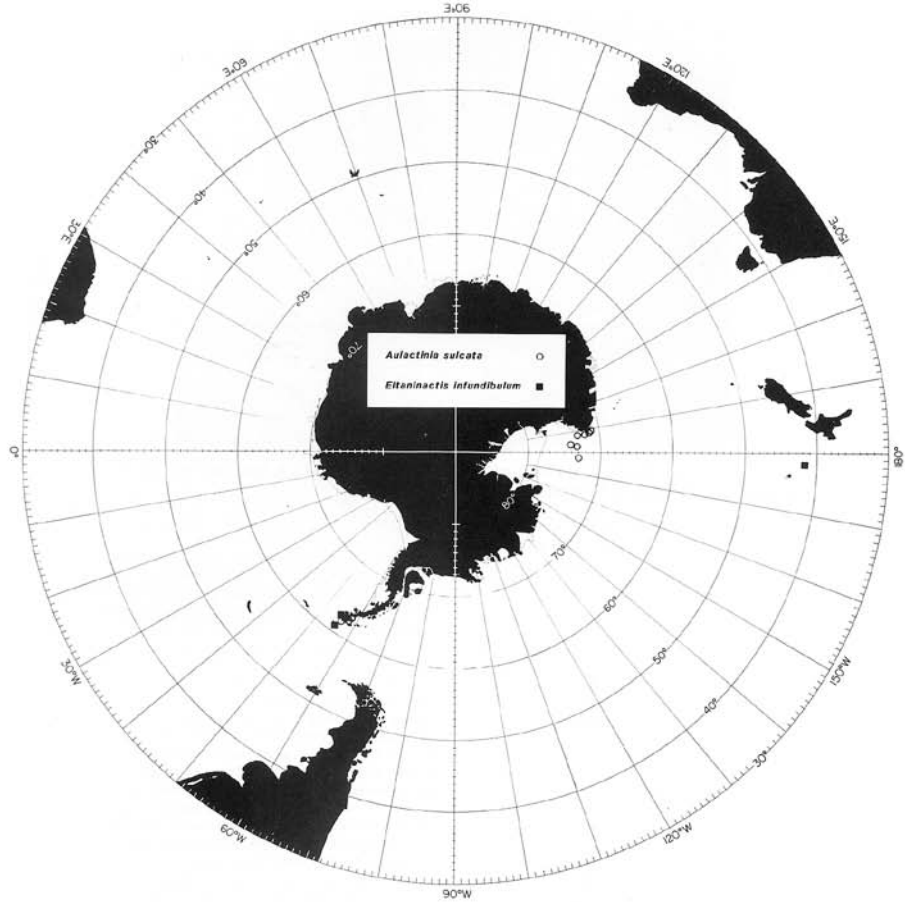

Fig. 14. Distributions of Aulactinia sulcata and Eltaniactis infundibulum.

widely separated areas: in McMurdo Sound, off the tip of the Antarctic Peninsula, and in the Davis Sea, off the Queen Mary coast.

Material examined (Fig. 14)

Eltanin Cruise 6

Sta. 426, 62°27'-34'S, 57°58'-49'W, 809-1116 m, CAS 017961 (x1)
Sta. 428, 62°41'-39'S, 57°51'-46'W, 662-1120 m, USNM 60691 (x1)

Eltanin Cruise 12

Sta. 997, 61°44'-46'S, 55°56'-54'W, 769 m, USNM 60061 (x2)

Eltanin Cruise 27

Sta. 1870, 71°17'-16'S, 171°33'-29'E, 659-714 m, USNM 60060 (x1)
Sta. 1871, 71°23'-24'S, 171°12'E, 351-357 m, CAS 017935 (x2)

Fig. 15. Bolocera kerguelensis; from lot CAS 006353.

Eltanin Cruise 32

Sta. 1997, 72°00.2'S, 172°28.2'E, 523-528 m, CAS 017696 (x1)
Sta. 2005, 73°02'S, 176°54'-50'E, 864-870 m, USNM 60063 (x1)
Sta. 2009, 73°00'S, 171°46'-40'E, 580-582 m, CAS 017959 (x2)
Sta. 2016, 73°58'-59'S, 176°11'-16'E, 581-586 m, USNM 60062 (x2)
Sta. 2117, 73°01.8'S, 178°06.3'W, 595-600 m, CAS 017960 (x2)

Previous records

Clubb [1902] Cape Adare, South Victoria Land [71°17'S, 170°00'E], 20-28 fm, (x 'upward of sixty')
Carlgren and Stephenson [1929] 65°20'S, 95°27'E, 240 fm (x3)

Bolocera kerguelensis Studer, 1879

Bolocera kerguelensis: Studer, 1879, p. 544--Andres, 1883, p. 214--Kwietniewski, 1896, p. 592--Stephenson, 1922, p. 276--Pax, 1926, pp. 52, 56--Carlgren, 1927, p. 97 (♀ B. longicornis); 1928a, pp. 144, 263; 1949, p. 54.
Polystomidium patens: Hertwig, 1882a, p. 59; 1882b, p. 67.
Bolocera occidua: McMurrich, 1893, p. 154--Stephenson, 1922, p. 276--Carlgren, 1927, p. 99; 1949, p. 54; 1959, pp. 7, 26.
Bolocera longicornis: Stephenson, 1918a, p. 20--Pax, 1926, pp. 4, 52, 54--non Carlgren, 1891, p. 242; 1893, p. 50--non Stephenson 1918b, p. 116; 1922, p. 275.
Bolocera capensis: Carlgren, 1928a, p. 146; 1938, p. 41; 1949, p. 54.
?Bolocera patens: Carlgren, 1949, p. 54.
Bolocera tuediae occidua: Riemann-Zürneck, 1980, p. 20.

Description

Body form and size. Column typically funnel shape (i.e., wider at oral than pedal end (Figure 15); some fungiform; typically short. One average size animal with oral disc 30 mm and pedal disc 16 mm diameter had column 20 mm long and 14 mm diameter just distal to pedal disc; oral disc of largest examined 50 mm wide, of smallest 15 mm. Column lacks verrucae but is wrinkled irregularly and/or circumferentially; most pale red to burnt umber color, rarely very dark red; easily torn. No fosse.

Base. Pedal disc same color as column, typically flat (Figure 15) but retracted in some so that it is enclosed by column wall; may be radially furrowed along mesenterial insertions (Figure 15).

Tentacles and oral disc. Oral disc flat to slightly domed; mouth very large (up to 15 mm wide on disc 25 mm diameter), typically gaping in preserved specimens so that actinopharynx may be everted, with prominent lips; tentacles arrayed in two or three cycles at margin. Oral disc, mouth, actinopharynx same color as column; tentacles may be somewhat lighter or darker. Tentacles deciduous owing

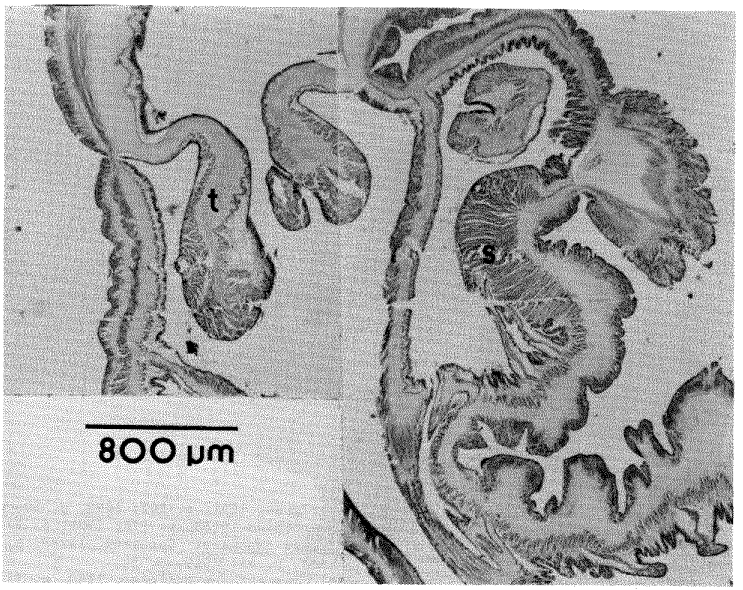

Fig. 16. Longitudinal section through top column and outer oral disc of Bolocera kerguelensis illustrating diffuse endodermal marginal sphincter muscle (s) and tentacular sphincter muscle (t) (CAS 006362).

to thin wall near oral disc and strong endodermal tentacular sphincter muscle (Figure 16). Rare specimens have all their tentacles; most have some tentacles, with pores marking positions of autotomized tentacles; and some completely lack tentacles, having only pores (commonly 3 x 4 mm) on oral disc. Tentacles blunt or pointed, digitiform, with narrow proximal end; up to about 20 mm long; commonly longitudinally ridged; outer ones generally smaller than inner (5 x 1.5 mm and 15 x 2.0 mm, respectively, in typical animal) but this may be confounded by regeneration of cast-off members. Generally fewer tentacles (and/or pores) than mesenteries.

Mesenteries and internal anatomy. Up to five cycles of fairly regularly arrayed mesenteries; at least and usually only primaries complete; highest mesenteries seem equally well developed proximally and distally, but may lack filaments; those of penultimate cycle usually sterile, with filaments. Mesenteries of at least first three orders, except for two pairs of symmetrically arrayed directives, may be fertile; dioecious. Diffuse retractor muscles strong with sparsely branched secondary lamellae (Figure 17); parietobasilar muscles strong, most with wide detached pennon (Figure 17).

Diffuse endodermal sphincter muscle (Figure 16) too weak to effect covering of oral disc; lamellae so short in some animals that sphincter is hardly distinguishable from general circular musculature of column. Marginal ectoderm glandular (Figure 16).

Tentacle longitudinal musculature ectodermal, circular endodermal; oral disc radial muscles ectodermal, circular endodermal.

Actinopharynx relatively long, shallowly sulcate with two shallow siphonoglyphs connected to directive mesenteries.

Distribution and size of cnidae (Fig. 18)

Tentacles

spirocysts(a), 30.3-56.6 x 2.9-4.3 µm, n = 25, N = 5/5

basitrichs(b), 43.5-86.1 x 3.5-4.9 µm, n = 38, N = 5/5

Fig. 17. Cross section through mesenteries of Bolocera kerguelensis (CAS 013682).

Actinopharynx
basitrichs(c), 36.9-60.7 x 3.5-4.7 μm, n = 50, N = 7/7
microbasic p-mastigophores(d), 21.3-31.2(33.6) x 4.1-4.9 μm, n = 23, N = 6/7

Mesenterial filaments
basitrichs(e) (scarce), 19.7-27.9(35.3) x 2.7-3.7 μm, n = 10, N = 4/5
basitrichs(c), 39.4-64.0 x 3.3-4.5 μm, n = 19, N = 5/5
microbasic p-mastigophores(d), 23.8-35.3 x 3.7-5.7 μm, n = 12, N = 2/5

Column
basitrichs(f), 20.5-40.2 x (2.5)3.1-4.7 μm, n = 44, N = 5/5

The length of tentacle basitrichs increases with size of the anemone, as seems typical of the genus [Carlgren, 1921; Riemann-Zürneck, 1980] although the width is rather similar in all individuals. The size range within any specimen is typically 10-15 μm. Thus the given range, which is an aggregate from several individuals, is not encountered in any one. Column basitrichs, on the other hand, are of similar size in small and large animals; those of the actinopharynx and mesenterial filaments tend to be slightly larger in larger individuals.

Discussion

The 105 specimens of Bolocera kerguelensis in the USARP collection fit Studer's [1879] original description very well, and those that have retained most or all of their tentacles greatly resemble his Figure 17. The musculature of those specimens, studied by Kwietniewski [1896], is also in accord with my findings. Although the sphincter muscle illustrated by Kwietniewski (Figure 11) has one rather circumscribed branch, I have found sufficient variability in this tissue to encompass such anatomy, and Carlgren [1928a] also noted its changeability. Kwietniewski pointed out the great resemblance between B. kerguelensis and the boreal B. longicornis Carlgren, 1891, and indeed, all species of the genus are rather similar [Carlgren, 1928a]. However, B. longicornis, to judge by Carlgren's description, may attain a larger size and have many more tentacles than B. kerguelensis, and the mesenterial retractors have a wide fold whereas the parietobasilar muscles have none. Stephenson [1918a] called austral specimens of Bolocera that he studied B. longicornis; his figures of it (entire and sectioned) look like B. kerguelensis, and although he stated that most or all of the mesenteries were complete, I agree with

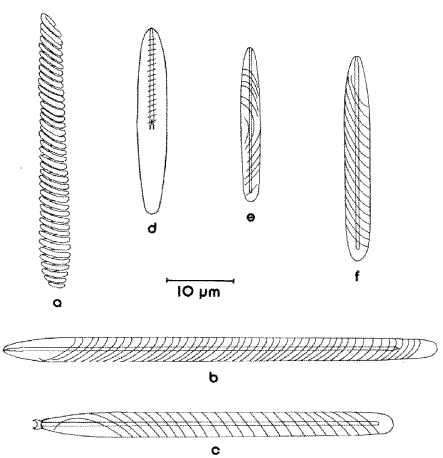

Fig. 18. Cnidae of Bolocera kerguelensis; see text for explanation.

Carlgren [1938] that these cannot be B. longicornis.

The single, mangled individual that prompted Hertwig [1882a, b] to create the new genus and species Polystomidium patens is undoubtedly attributable to this species. It lacked tentacles, but the large, gaping pores ('like buttonholes'), confined to the margin, showed an actiniid arrangement; the musculature illustrated by Hertwig is also reminiscent of that of B. kerguelensis, as is the animal's coloration. Stephenson [1922, p. 278], having examined Hertwig's specimen, declared the genus Polystomidium untenable, but offered no alternative; Carlgren [1949] questionably placed P. patens in Bolocera. Having seen similarly torn specimens, and having established that Hertwig's specimen was taken within the range of B. kerguelensis, I am confident in reducing P. patens to synonymy with it.

McMurrich [1893] speculated that his new species, B. occidua, might be identical to B. kerguelensis but chose to erect a new taxon because at the time there were no data on the internal anatomy of the latter; it is now clear that they are indeed synonymous. Nematocyst sizes and distribution in 'B. occidua' given by Carlgren [1959] agree with my findings, although K. Riemann-Zürneck (personal communication, 1981) measured those from Stockholm Riksmuseet specimen 1357, presumably the specimen on which Carlgren's data were based since only one was taken on the Lund University Chile Expedition (at station M27), and found considerable disparity with both Carlgren's published figures and my results. Cnidae sizes of B. kerguelensis provided by Carlgren [1928a] differ from what I found only in the column that reportedly had three classes of basitrichs, two of which spanned the range I found and the other of which was sparse. The nematocysts of B. capensis as originally given by Carlgren [1928a] are identical to those of B. kerguelensis; he later [Carlgren, 1938] reported an additional class of small nematocyst in the column that I have never found, but otherwise his data fit mine exactly. This new species was distinguished from B. kerguelensis by its sphincter muscle, which is not sufficiently distinctive in this genus to delimit species. Carlgren also said that at least three orders of mesenteries are complete. The number of perfect mesenteries can be difficult to ascertain in these animals, which may be quite contorted and torn. Although generally I have found only those of the first order complete, this feature is probably more variable, and should not be used as the sole species criterion. Carlgren [1928a] provided a differential diagnosis of B. capensis only with his newly described B. somaliensis, and that was not rigorous.

Riemann-Zürneck [1980] synonymized B. occidua and B. longicornis, considering that taxon a southern subspecies of B. tuediae, B. t. occidua (McMurrich, 1893). She did not explain why she chose not to include B. kerguelensis, B. capensis, and ?B. patens in the synonymy as well, remarking only that these are poorly known. It is clear that she and I are dealing with the same species, despite some differences. Nematocyst differences are confined to basitrichs of the tentacles, which in these animals are deciduous; the facts that tentacles of one animal may vary in age (some regenerating at all times) and that tentacle nematocyst size varies with specimen size in these anemones (K. Riemann-Zürneck, personal observation, 1980) very likely account for the discrepancies. Riemann-Zürneck herself listed several differences between boreal B. tuediae and the austral 'subspecies.' One of these is a copepod parasite that is apparently distinct from a species specific parasite of Bolocera tuediae. Another is internal brooding, a phenomenon that has not been discovered in B. tuediae despite samples having been taken from a variety of localities throughout the year for more than a century; the few samples in which Riemann-Zürneck found brooding were taken in austral winter, and all that I examined were collected in summer, explaining that discrepancy between her data and mine. She considered brooding to be an adaptation to the sub-Antarctic, but it is difficult to understand why the sub-Arctic should not elicit a similar response if indeed a single species is involved. Moreover, she pointed out that brooding would tend to restrict gene flow. Such a difference in reproductive biology, coupled with a disjunct distribution, seems good grounds for recognizing Bolocera kerguelensis as specifically distinct.

My actions reduce the eight nominal species of Bolocera listed by Carlgren [1949] to five. The genus is morphologically rather uniform, so all species must be critically examined in order to erect good criteria for separating them. I have also described a new species, B. paucicornis, herein; its anatomy and cnidae clearly separate it from B. kerguelensis.

This eurybathic species is most commonly taken between about 100 and 1000 m, but is known from 45 to at least 3500 m. It occurs from as far north as 33°S and from around about half of Antarctica, excepting those portions between about 88° and 180°W, and 70° and 165°E.

Material examined (Fig. 19)

Eltanin Cruise 4

Sta. 138, 62°00'-05'S, 61°09'-08'W, 1437 m, USNM 59787 (x1)

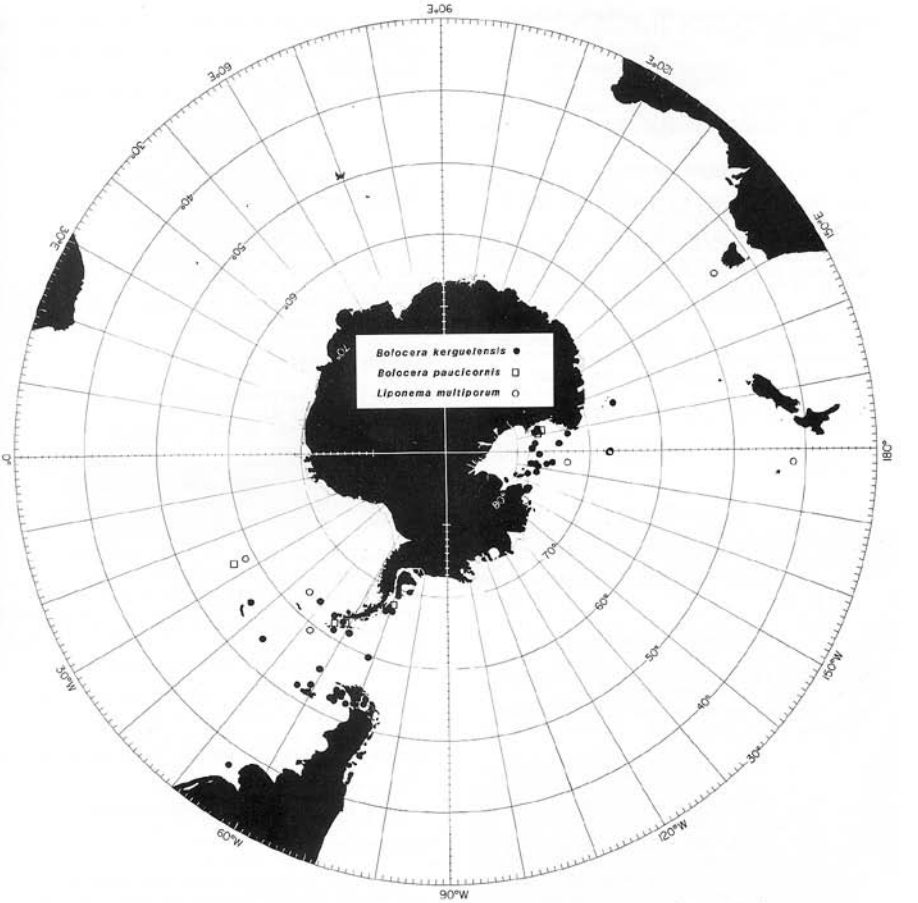

Fig. 19. Distributions of Bolocera kerguelensis, Bolocera paucicornis, and Liponema multiporum.

Eltanin Cruise 5

Sta. 254, 59°49'-46'S, 68°52'-53'W, 512-622 m, USNM 60701 (x1)

Eltanin Cruise 6

Sta. 339, 53°05'-08'S, 59°31'-24'W, 512-586 m, USNM 59759 (x2)
Sta. 353, 55°15'-18'S, 58°55'-58'W, 3514-3642 m, USNM 60704 (x1)
Sta. 370, 53°54'-55'S, 64°36'-52'W, 104-115 m, CAS 006362 (x3); USNM 60702 (x1)
Sta. 428, 62°41'-39'S, 57°51'-46'W, 662-1120 m, USNM 59777 (x1)

Eltanin Cruise 7

Sta. 474, 55°56-56°25'S, 44°43-52'W, 3486 m, CAS 013683 (x2)
Sta. 529, 63°03'-00'S, 49°11'-20'W, 2653-2941 m, CAS 029661 (x1)

Sta. 558, 51°58'-52°01'S, 56°38'W, 646-845 m, USNM 59755 (x2)

Eltanin Cruise 9

Sta. 690, 56°18'-23'S, 37°04'-36°57'W, 3413-3446 m, USNM 59757 (x1)

Eltanin Cruise 11

Sta. 962, 53°56'-55'S, 71°15'-12'W, 256-320 m, CAS 013684 (x2)
Sta. 963, 53°48'-45'S, 70°53'W, 485 m, USNM 59750 (x1)
Sta. 966, 53°40'-41'S, 66°20'-19'W, 81 m, USNM 59790 (x1)
Sta. 967, 53°42'-46'S, 66°19'-13'W, 81 m, CAS 013682 (x1)
Sta. 974 53°32'-34'S, 64°57'-55'W, 119-124 m, USNM 59780 (x4)
Sta. 976, 52°35'S, 65°08'W, 128 m, CAS 006361 (x5)
Sta. 977, 52°32'S, 63°53'W, 229 m, CAS 006353 (x8)
Sta. 980, 52°30'-31'S, 67°14'W, 82 m, USNM 60703 (x1)

Eltanin Cruise 12

Sta. 991, 60°57'-54'S, 56°52'-58'W, 2672-3020 m, CAS 006357 (x4)
Sta. 1003, 62°41'S, 54°43'W, 210-220 m, USNM 59781 (x1)

Eltanin Cruise 27

Sta. 1907, 77°03'-04'S, 166°15'-13'E, 891 m, CAS 013685 (x2); USNM 59768 (x3)
Sta. 1949, 66°52'-49'S, 164°32'-26'E, 2507-2525 m, USNM 59769 (x5)

Eltanin Cruise 32

Sta. 2009, 73°00'S, 171°46'-40'E, 580-582 m, CAS 006355 (x3)
Sta. 2016, 73°58'-59'S, 176°11'-16'E, 581-586 m, USNM 79732 (x4)
Sta. 2047, 77°03'-02'S, 178°10'-13'W, 584-585 m, USNM 59772 (x1)
Sta. 2050, 77°01'-03'S, 168°38'-23'E, 909-923 m, USNM 59765 (x3)
Sta. 2057, 77°35'S, 174°58'-59'E, 731 m, USNM 59695 (x1)
Sta. 2059, 77°58'-59'S, 178°02'-08'E, 655 m, USNM 59676 (x3)
Sta. 2065, 78°23'S, 173°06'-02'W, 473-475 m, CAS 006358 (x1)
Sta. 2070, 78°29'-28'S, 165°39'-22'W, 491-493 m, USNM 59694 (x1)
Sta. 2082, 75°50'-51'S, 173°08'W, 476 m, USNM 59678 (x1)
Sta. 2085, 77°32'-31'S, 172°32'-23'W, 468-482 m, CAS 013681 (x1)
Sta. 2088, 76°58'-59'S, 171°07'W, 430-433 m, USNM 59801 (x3)
Sta. 2099, 77°02'S, 166°44'-50'W, 408-415 m, USNM 59779 (x1)
Sta. 2108, 74°55'-57'S, 174°12'-16'W, 2022-2060 m, USNM 59782 (x1)

Islas Orcadas Cruise 575

Sta. 2, 54°39.7'S, 37°24.1'W, 182-327 m, CAS 006354 (x4)

Hero Cruise 721

Sta. 1083, 67°15.6'-13.2'S, 70°12.0'-15.2'W, 630-650 m, USNM 59688 (x20)
Sta. 1084, 67°04.6'-02.3'S, 69°21.7'-51.8'W, 460-500 m, USNM 59751 (x3)

Previous records

Studer [1879] northwest of Kerguelen [~48°30'S, 69°40'E], 120 fm (x2)
Hertwig [1882a, b] 38°6'S, 88°2'W, 3329 m (x1)
McMurrich [1893] 51°02'30"S, 74°08'30"W, 122 fm (x2); 53°06'S, 70°40'30"W, 77.5 fm (x3); 51°34'S, 63°W, 50.5 fm (x2)
Stephenson [1918a] 52°23'S, 63°50'W, 125 fm (x5)
Carlgren [1928a] 48°57.8'S, 70°0.6'E, 88m (x28); 33°43.6'S, 18°4.2'E, 106 m (x5)
Carlgren [1938] 34°21'S, 17°57'E, 178 fm (x4); False Bay [34°15'S, 18°40'E], ~50 fm (x8); Agulhas Bank [~35°S, 20'E], 40-42 fm (x1)
Carlgren [1959] 41°49'40"S, 73°08'W, 45 m (x1)
Riemann-Zürneck [1980] 40°54'S, 56°49'W, 310 m (x1); 50°01'S, 57°16'W, 410 m (x1), 54°27'S, 65°45'W, 60 m (x1); 37°44'S, 55°04'W, 505 m (x3), 51°28'S, 56°26'W, 545 m (x2)

Bolocera paucicornis new species

Description

Body form and size. Oral disc domed so that margin extends basally to level of pedal disc; thus individual appears as hemisphere on substratum. Column very short, funnel shape; average width of entire animal 50 mm, height 30 mm (Figure 20). Pink to rust red column, oral disc, tentacles, actinopharynx; texture firm. No fosse.

Base. Pedal disc flat, circular, somewhat flared beyond width of lower column. Half or less total width of animal.

Tentacles and oral disc. Tentacles blunt digitiform, typically 20 mm long and nearly 3 mm in diameter at widest point, just above junction with oral disc; deciduous owing to endodermal tentacular sphincter muscle. Most

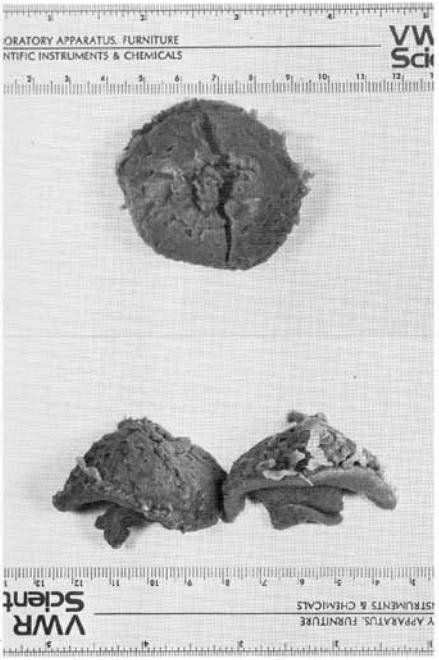

Fig. 20. Bolocera paucicornis: holotype; USNM 60065.

individuals in USARP collection nearly devoid of tentacles; relatively large pore (4 x 2 mm; short axis radially oriented) marks position each had occupied (Figure 20). Pore typically surrounded by shallow rim that may be raised over its oral end; pores/tentacles communicating with exocoelic spaces at margin; those communicating with endocoelic spaces scattered on disc, lower order ones more orad, nearest 5-10 mm from mouth; one pore/tentacle per exocoel and endocoel. Radial furrows on oral disc mark positions of mesenterial insertions; furrows deviate around tentacles/pores, which are wider than most of interseptal space. Pores evenly spaced, perhaps 150 maximum per animal. Mouth moderately large (15-20 mm diameter) with ribbed, everted lips.

Mesenteries and internal anatomy. Five orders of mesenteries in average size animal; all except directives and those of highest order may be fertile; those of first two or three cycles complete; small marginal, moderate oral stomata. Retractor muscles diffuse, weak (Figure 21); short free parietobasilar pennon (Figure 21).

Sphincter muscle endodermal, diffuse, marginal (Figure 22), too weak to cover oral disc.

Distribution and size of cnidae (Fig. 23)

Tentacles
- spirocysts(a), 38.5-46.7 x (4.1)4.9-5.7 μm, n = 8, N = 2/3
- spirocysts(b), (57.4)61.5-76.3 x 6.2-8.2 μm, n = 11, N = 1/3
- basitrichs(c), (21.3)23.8-28.7 x (2.5)2.9-3.3 μm, n = 10, N = 3/3
- basitrichs(d), (42.6)64.0-86.1 x 3.5-4.1(4.9) μm, n = 10, N = 3/3

Actinopharynx
- basitrichs(e), 23.0-46.7 x 2.9-4.9 μm, n = 15, N = 7/7
- basitrichs(f), 51.7-73.0 x 3.9-4.9 μm, n = 55, N = 7/7

Mesenterial filaments
- basitrichs(c), 18.9-27.1 x 2.5-3.3 μm, n = 19, N = 3/3

Fig. 21. Cross section through mesenteries of Bolocera paucicornis (holotype; USNM 60065). Magnification as in Figure 22.

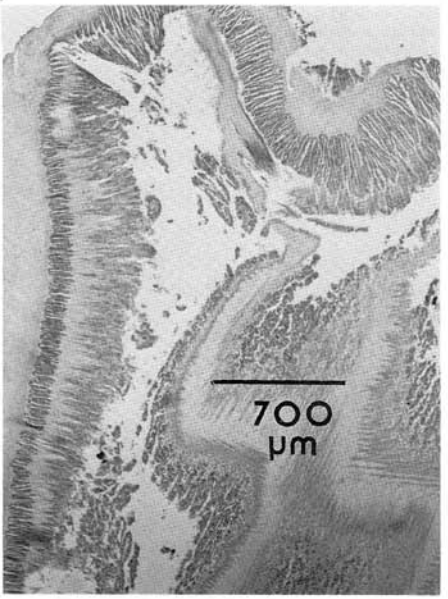

Fig. 22. Longitudinal section through marginal area of Bolocera paucicornis (holotype; USNM 60065).

basitrichs(f), 50.8-64.8 x 3.3-4.7 µm, n = 14, N = 2/3
microbasic p-mastigophores(g), 27.1-36.1 x 4.1-5.7 µm, n = 8, N = 2/3

Column
basitrichs(h), 18.0-22.1 x 2.5-2.9 µm, n = 7, N = 1/3
basitrichs(i), 32.8-43.5 x 3.3-4.1 µm, n = 31, N = 3/3

Cnidae of larger animals tend to be at the upper end of each range and vice versa for smaller individuals.

Discussion

The hemispherical body form of Bolocera paucicornis is much like that of individuals belonging to the genus Liponema. Both genera are characterized by deciduous tentacles, but Liponema, which is in its own family [Dunn and Bakus, 1977], has many more tentacles than has Bolocera, arrayed so that more than one communicate with each exocoel. Bolocera, a member of family Actiniidae, has one tentacle per exocoel as well as endocoel. The nine specimens of this species in the USARP collection clearly show an actiniid arrangement of tentacles/pores.

This species of Bolocera is clearly distinguishable from the other Antarctic representative of the genus, B. kerguelensis. Tentacles of the latter are confined to the margin, and its oral disc is flat rather than domed. Cnidae, especially of tentacles and actinopharynx, also separate the species. It is possible that some earlier records of B. kerguelensis actually had to do with this species. There is no way to tell without examination of the specimens, but if the proportions taken by the USARP (105 versus 9) are typical, that is unlikely.

To judge by the limited data available, this is a moderately deep-water species, found from about 600 to 1600 m. It is known from a small area in the Scotia Sea, from west of the Antarctic peninsula, and from McMurdo Sound; it is sympatric with Bolocera kerguelensis (Figure 19).

Etymology. The name is derived from the Latin words paucus, meaning few, and cornu, meaning horn and in this case referring to tentacles. It alludes to the small number of tentacles in individuals of the species, relative to those of similar-appearing species.

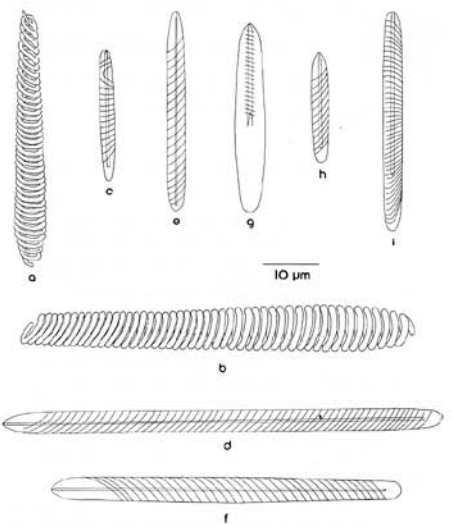

Fig. 23. Cnidae of Bolocera paucicornis; see text for explanation.

Fig. 24. Epiactis georgiana. Top specimen from lot CAS 013064; note attached young proximal to collar. Bottom specimens from lot CAS 013209.

Type Specimens

Holotype. USNM 60065 from Eltanin cruise 6, station 413, 62°07'-08'S, 55°58'-56°05'W, 1113-1153 m (x1).

Paratypes. CAS 014248 from Eltanin cruise 6, station 426, 62°27'-34'S, 57°58'-49'W, 809-1116 m (x2).

CAS 029662 from Eltanin cruise 27, station 1905, 76°28'-29'S, 167°52'-168°00'E, 741-747 m (x1).

CAS 029663 from Eltanin cruise 32, station 2050, 77°01'-03'S, 168°38'-23'E, 909-923 m (x1).

CAS 014249 from Islas Orcadas cruise 575, station 60, 56°53.5'S, 26°54.8'W, 1532-1590 m (x1).

CAS 029664 from Hero cruise 721, station 1082, 67°40.2'-39.4'S, 70°16.2'-16.3'W, 580-650 m (x3).

These were the only specimens of the species in the USARP collection.

Epiactis georgiana Carlgren, 1927

Epiactis georgiana: Carlgren, 1927, pp. 40, 96, 99; 1949, p. 58; 1959, pp. 8, 24.
Epiactis crateriformis: Carlgren, 1928a, pp. 260, 261 [nomen nudum]--Carlgren and Stephenson, 1929, p. 14--Carlgren, 1949, p. 58.

Description

Body form and size. Roughly cylindrical (Figure 24), or slightly conical with proximal end wider than distal. Column lacks verrucae, but irregular circumferential folds common in preserved specimens. Height to 50 mm, typically about 30 mm; pedal disc to 45

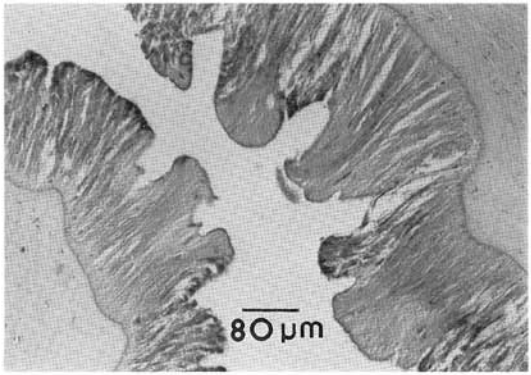

Fig. 25. Section through brood area of Epiactis georgiana (CAS 013069); note glandular ectoderm.

mm, generally equal to or somewhat greater than column length, and wider than column. Conspicuous collar (Figure 24) may extend upper surface of animal to diameter of base, although oral disc itself is rarely fully expanded and may be only half as wide as pedal disc; deep fosse separates collar and oral disc. Juvenile actinians up to 7 mm pedal disc diameter may be attached to column proximal to collar, which seems to fold over them, forming a brood space. Glandular patches (Figure 25) in the ectoderm of that region probably function in their adhesion; there is no indentation in the column, so the young are readily dislodged in preserved material. Many lots contained some very small animals along with large ones. It is probable that the small ones had been brooded by the large anemones. Ectoderm of preserved specimens tan to reddish; often sloughed off, in which case column appears glossy yellowish, mesenterial insertions are visible, and body texture is more gelatinous/less firm than in animals possessing ectoderm.

Base. Flat to slightly undulate, same color as column. Edge may be scalloped due to indentations at mesenterial insertions.

Tentacles and oral disc. Tentacles digi-

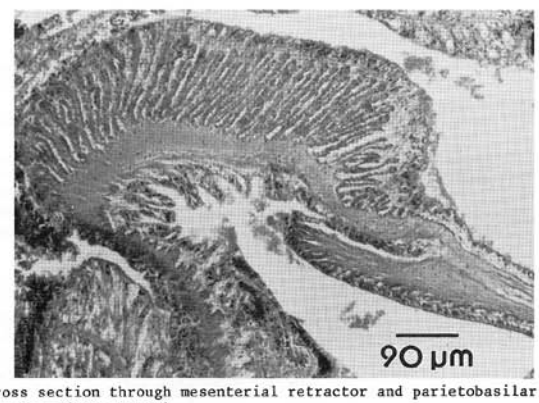

Fig. 26. Cross section through mesenterial retractor and parietobasilar muscles of Epiactis georgiana (CAS 013064).

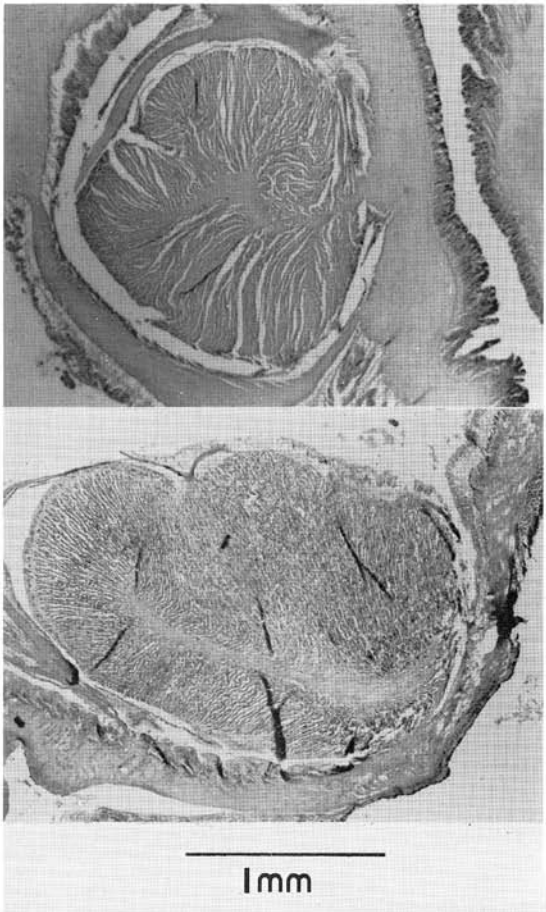

Fig. 27. Cross section through circumscribed endodermal sphincter muscles of Epiactis georgiana (top CAS 013069, bottom CAS 013064).

tiform, blunt-ended and hardly tapered, many longitudinally sulcate; all approximately equal size, to 15 mm long by 3 mm diameter but some only 3 x 1 mm; up to 96; commonly completely involuted, or visible only as a tuft in center of the oral disc. Oral disc flat, mostly covered by tentacles; small mouth elongate with low lips. Tentacles and oral disc same color as column. Longitudinal tentacle and radial oral disc muscles ectodermal; circular tentacle and oral disc muscles endodermal.

Mesenteries and internal anatomy. Up to 48 pairs regularly arrayed mesenteries (36 pairs counted in a large juvenile); all except those of highest (fourth) order complete; equal number proximally and distally; large marginal stomata. Two pairs of direc-

tives attached to two symmetrical siphonoglyphs that are much longer than rest of irregularly sulcate actinopharynx. Directives sterile; all other mesenteries, or all except those of highest order may be fertile; dioecious. Retractor muscles not very strong; diffuse, with long secondary lamellae that are unbranched or have very short branches (Figure 26). Parietobasilar muscles strong with detached pennon on proximal portion (Figure 26).

Sphincter endodermal, circumscribed, pinnate, round to ovoid in cross section (Figure 27); primary mesogleal lamella may be thickened. Length about 2 mm in animals examined; thus it is relatively small in large individuals, and large in small ones. Arises on marginal side of fosse.

Distribution and size of cnidae (Fig. 28)

Tentacles
- spirocysts(a), 28.7-52.5 x 2.9-4.9 μm, n = 72, N = 10/10
- basitrichs(b), 27.9-36.9 x 2.5-3.3 μm, n = 64, N = 10/10

Actinopharynx
- basitrichs(b), 28.7-37.7(40.2) x 2.5-4.1 μm, n = 61, N = 8/8
- microbasic p-mastigophores(c) (scarce), 20.5-32.8 x 3.1-4.9 μm, n = 32, N = 7/8

Mesenterial filaments
- spirocysts(a) (scarce), 23.0-51.7 x 3.3-4.1(4.7) μm, n = 13, N = 4/7
- basitrichs(d), 13.9-19.7(23.0) x 2.1-3.1 μm, n = 44, N = 7/7
- basitrichs(b) (scarce), 29.5-37.7(40.2) x 2.5-3.1 μm, n = 13, N = 4/7
- basitrichs(e), 36.1-46.7 x 3.9-5.7 μm, n = 45, N = 5/7
- microbasic p-mastigophores(c), 22.1-29.5 (34.4) x 3.3-4.9(5.3) μm, n = 23, N = 6/7

Column
- basitrichs(d), (14.8)19.7-25.4 x 1.8-3.3 μm, n = 47, N = 6/6

Discussion

Morphology of body and cnidae of the 171 animals examined fit two of the seven nominal species of Epiactis known from austral seas. Carlgren [1927] described E. georgiana based on two specimens, then he and Stephenson [1929] described E. crateriformis from four specimens, with no explicit statement differentiating the two. The nematocyst measurements given in the two descriptions are nearly identical except that Carlgren and Stephenson found microbasic p-mastigophores in the actinopharynx that had apparently been overlooked in the previously described species, and their reported range of spirocyst

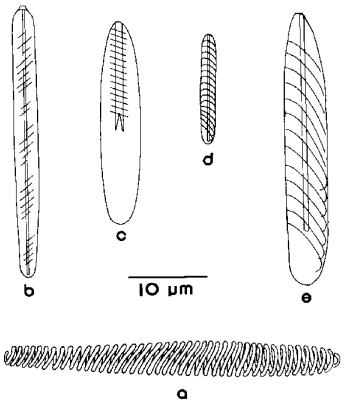

Fig. 28. Cnidae of Epiactis georgiana; see text for explanation.

length was greater; the cnidae conform precisely to what I found in specimens of the USARP collection. The mesenterial arrangement of E. crateriformis was not strictly hexameral in all specimens, but some irregularities occur in even the most regular species, so that alone cannot be a specific criterion. I found one individual that indisputably belongs to E. georgiana that had been traumatized; it has 68 tentacles, 24 regularly arrayed mesenteries in one half, and 19 in the other. The specimen of E. crateriformis in Carlgren and Stephenson's Figure 4 resembles many from the USARP collection; they noted a ruff below the sphincter and a very deep fosse, which are consistent with my observations and diagnostic of the species.

The crateriform upper end, the source of Carlgren and Stephenson's specific name, is produced by contraction of the sphincter that raises the collar around the retracted and constricted oral disc. Growth of the sphincter muscle appears not to keep pace with that of the rest of the animal (see above). Thus juveniles commonly are dome-shaped, their tentacles completely involuted; the upper surface of moderate size animals is crateriform because the sphincter cannot completely close over the oral disc, leaving a tuft of tentacles visible in the center; and the tentacles of large animals are usually quite exposed.

Carlgren and Stephenson [1929] distinguished Epiactis adeliana from E. crateriformis by the regular hexametry of the former. However, their Figure 8 shows re-

tractor and parietobasilar muscles that are clearly different from those of E. crateriformis, and the nematocysts of tentacles and actinopharynx also distinguish the two. Carlgren [1939] differentiated his new species E. brucei from these other three nominal species on the bases of cnidae and sphincter muscle; I agree that it is separable on both counts. A fifth nominal species of Epiactis in austral seas, E. mortenseni Carlgren, 1924, also broods its young externally at the margin. It seems to lack a 'ruff,' is smaller than any adult specimen of E. georgiana that I have seen and occurs intertidally; but the few nematocysts for which Carlgren provided data are not very different from those of E. georgiana. Thus it is possible, but unlikely, that the two species are identical. In 1924, Carlgren believed that E. thompsoni (Coughtrey, 1875) and E. novozealandica Stephenson, 1918a, were identical, but in his 1949 catalog, Carlgren listed them separately. The former broods its young internally [Stuckey, 1909], and occurs intertidally, features that are probably sufficient to distinguish it from E. georgiana; Stephenson's illustration of the latter shows a very different animal to E. georgiana, and its sphincter and retractor muscles are distinct.

The USARP specimens of Epiactis georgiana were collected in two discrete areas, in the Ross Sea, and, nearly halfway around the continent, in the Weddell and Scotia Seas (Figure 8). Carlgren's [1927] original specimens of E. georgiana were taken near South Georgia, in the Scotia Sea, and Carlgren and Stephenson's [1929] specimens of E. crateriformis were from off Adélie Land, not far from the Ross Sea. Carlgren's Chilean specimen represents not only the northernmost record for the species, but the shallowest as well. The shallowest USARP specimens were from 122-124 m, and the deepest 864-870 m; most were taken in less than 500 m of water.

Material examined (Fig. 8)

Eltanin Cruise 7

Sta. 499, 62°06'S, 45°08'-10'W, 485 m, CAS 013206 (x9)
Sta. 538, 60°31'-29'S, 47°34'-29'W, 616-662 m, CAS 013425 (x2)

Eltanin Cruise 27

Sta. 1873, 72°10'-11'S, 171°22'-16'E, 448-454m, CAS 015075 (x19)
Sta. 1875, 72°32'S, 171°26'-28'E, 329-337 m, USNM 60694 (x1)
Sta. 1885, 74°30'-32'S, 170°10'-12'E, 311-328 m, CAS 013063 (x1)
Sta. 1901, 76°30'-33'S, 174°54'-58'E, 445-448 m, CAS 013069 (x5)
Sta. 1933, 73°22'S, 177°37'-41'E, 465-474 m, USNM 60696 (x1)

Eltanin Cruise 32

Sta. 2005, 73°02'S, 176°54'-50'E, 864-870 m, CAS 013209 (x20)
Sta. 2045, 76°00-01'S, 176°48'-44'W, 566-569 m, CAS 013210 (x2)
Sta. 2075, 76°25'S, 170°24'-32'W, 568 m, CAS 013207 (x9)
Sta. 2082, 75°50'-51'S, 173°08'W, 476 m, CAS 013211 (x15)

Islas Orcadas Cruise 575

Sta. 11, 53°38.0'S, 38°01.8'W, 132-143 m, USNM 59721 (x14)
Sta. 12, 53°38.2'S, 37°54.7'W, 130-137 m, USNM 59723 (x6)
Sta. 13, 53°44.2'S, 37°59.5'W, 128-137 m, USNM 59713 (x2)
Sta. 14, 53°41.8'S, 37°57.2'W, 144-150 m, CAS 013208 (x1)
Sta. 15, 53°37.7'S, 38°04.0'W, 130-133 m, USNM 59775 (x10)
Sta. 16, 53°38.2'S, 38°01.1'W, 130-133 m, USNM 59718 (x3)
Sta. 17, 53°36.0'S, 38°03.0'W, 122-124 m, USNM 59795 (x20)
Sta. 65, 56°44.3'S, 26°58.6'W, 302-375 m, USNM 59740 (x3)
Sta. 84, 55°07.3'S, 35°47.2'W, 130-132 m, USNM 59742 (x1)
Sta. 89, 54°44.2'S, 37°11.2'W, 225-265 m, USNM 59717 (x1)
Sta. 90, 54°50.6'S, 37°23.8'W, 223-227 m, USNM 59784 (x1)
Sta. 101, 54°14.1'S, 37°54.2'W, 164-183 m, CAS 013064 (x16)

Islas Orcadas Cruise 876

Sta. 122, 61°20.2'S, 44°25.5'W, 274-285 m, USNM 59774 (x2)
Sta. 128, 60°55.5'S, 44°41.1'W, 236-238 m, USNM 59670 (x3)
Sta. 129, 60°56.9'S, 44°36.2'W, 225-234 m, CAS 013065 (x4)

Previous records

Carlgren [1927] South Georgia, 54°17'S, 36°28'W, 75 m (x2)
Carlgren and Stephenson [1929] 66°32'S, 141°49'E, 157 fm (x2); 65°48'S, 137°32'E, 230 fm (x2)
Carlgren [1959] 41°50'30"S, 73°28'30"W, 50-60 m (x1)

Glyphoperidium bursa Roule, 1909

Glyphoperidium bursa: Roule, 1909, p. 11--Pax, 1923, pp. 25, 26; 1926, pp. 4, 50--Carlgren, 1927, pp. 34, 96, 97 (=G. vas), 98 (=E. stephensoni), 99; 1928a, pp. 166, 260, 261, 262--Carlgren and Stephenson, 1929, p. 11--Carlgren, 1930, p. 4; 1939, p. 791; 1945, p. 11; 1949, p. 60.
Glyphoperidium vas: Roule, 1909, p. 13--Pax, 1923, pp. 25, 26; 1926, pp. 4, 50.
Epiactis bursa: Stephenson, 1922, p. 274--Pax, 1926, p. 61.
Epiactis vas: Stephenson, 1922, p. 275--Pax, 1926, p. 61.
Epiactis(?) stephensoni: Pax, 1922, p. 79; 1923, pp. 6, 26; 1926, p. 60.

Description

Body form and size. Column barrel-shaped (Figure 29), from a few centimeters to 120 mm long, and a few centimeters to 100 mm diameter, typically but not consistently slightly longer than wide. Wall of well-preserved specimens raw umber to rust brown color, rugose, leathery, commonly with circumferential folds; ectoderm of poorly preserved specimens friable, eroded in places, dark brown to black. Uppermost column smooth, collar-like; fosse deep.

Base. Flat; edge of most specimens contracted so diameter considerably less than that of column (Figure 29b) although in some it is slightly flared; same color as column.

Tentacles and oral disc. Oral disc equal to or wider than column, edge wavy in large specimens; cannot be retracted much. Only inner 10-15 mm tentacle-free (Figure 29a); raised lips and oral disc same color as column; central mouth moderately large, usually about twice as long as wide. Tentacles digitiform with broad base and blunt tip; rare ones swollen in center, slightly longitudinally ridged, invaginated, and/or bifurcate; inner ones to 20 x 4 mm, outer ones to 6 x 1.5 mm (in smaller individuals 5 and 2 mm long, respectively); color like that of column and oral disc or more yellowish. Largest animal examined estimated to have in excess of 2000 tentacles.

Mesenteries and internal anatomy. Mesenteries thin, delicate; sufficiently numerous at margin to retain actiniid arrangement of one tentacle per exocoel and endocoel; very large oral, large marginal stomata. First one or two orders sterile; higher order mesenteries fertile, possibly excepting those of the very highest few orders which are present only marginally; dioecious (ova in fixed animals larger than 1 mm diameter; appears that least mature ova occur near retractor end of gonad, most mature near filament end). First two cycles complete; all or all except very highest mesenteries with filaments. Retractor muscles diffuse with thick, sparsely branched lamellae (Figure 30); parietobasilar muscles well developed, with or without short detached pennon. Two pairs of directives attach to two symmetrical siphonoglyphs (Figure 29a) that are deep and prolonged beyond rest of actinopharynx nearly to base; pharynx same color as oral disc.

Sphincter muscle endodermal, circumscribed, pinnately branched, with broad primary mesogleal lamella (Figure 31); weak, small relative to size of animal. Circular tentacle muscles endodermal, longitudinal mesoectodermal to ectodermal (Figure 32).

Distribution and size of cnidae (Fig. 33)

Tentacles
- spirocysts(a), 23.0-44.3 x 2.5-4.0 μm, n = 59, N = 6/6
- basitrichs(b), 26.2-40.2(45.1) x 2.5-3.3 μm, n = 58, N = 6/6

Actinopharynx
- basitrichs(b), 33.6-42.6 x 2.5-3.9 μm, n = 65, N = 6/6

Mesenterial filaments
- basitrichs(c), 14.8-23.8 x 2.1-3.3(3.9) μm, n = 41, N = 7/7
- basitrichs(b) (scarce), 32.8-41.8 x 2.5-3.3 μm, n = 23, N = 5/7
- microbasic p-mastigophores(d), 23.8-35.3 x 3.3-4.9 μm, n = 36, N = 6/7

Column
- basitrichs(c), 17.2-24.6 x (2.1)2.5-3.3 μm, n = 54, N = 6/6 (occasional spirocysts and large basitrichs seem to be contaminants)

Discussion

Glyphoperidium bursa is among the most distinctive species of Antarctic actinians, and may attain the largest size of any. I have provided only a brief description of it because of Carlgren's [1927] excellent and comprehensive coverage. His findings differed only on minor points from mine: He found that three cycles of mesenteries were perfect and that those of the highest three orders lacked filaments. These features probably change during ontogeny and therefore are not of diagnostic importance. Carlgren [1945] reported only basitrichs of the larger, scarcer class from the mesenterial filaments of G. bursa, and they were broader than those I found; otherwise the nematocysts are in excellent agreement.

Roule [1909] described two new species of a new genus, Glyphoperidium bursa and G. vas, differentiating them largely on the basis of bodily proportion; this feature changes with

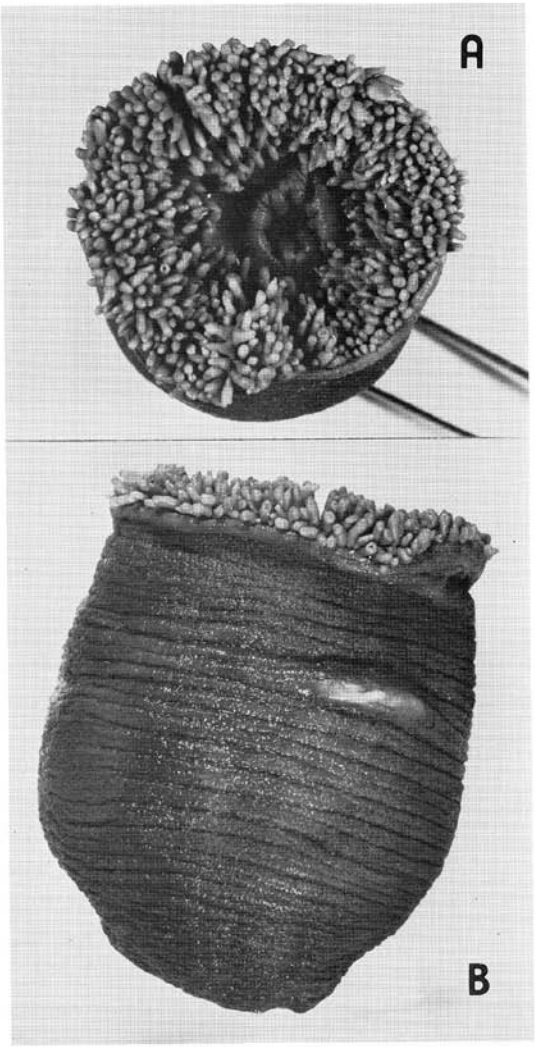

Fig. 29. Glyphoperidium bursa (specimen CAS 012905); diameter about 100 mm.

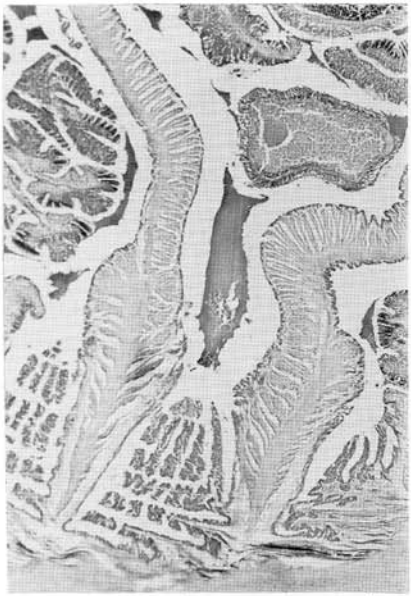

Fig. 30. Cross section through mesenteries of Glyphoperidium bursa (CAS 012906).

state of contraction in G. bursa, and Roule's spectrum of variability can be seen in specimens of the USARP collection. Roule [1909] described a second new genus, Glyphostylum, from one specimen collected at the same locality as the others. The illustrations of this species, G. calyx, bear a remarkable resemblance to those of the other two nominal species except for body form (which could be another artifact of contraction, although I have not seen an animal so thin and elongate). Roule distinguished the genus mainly by its lack of a sphincter muscle. However, I have failed to find the sphincter in some sections of G. bursa and therefore strongly suspect that Glyphostylum calyx is another junior synonym of Glyphoperidium bursa.

Pax [1922, 1923] gave information on the live appearance of this animal, which he described as a new species, Epiactis(?) stephensoni. Carlgren [1927], having examined Pax' type specimens, confirmed that this is a synonym of G. bursa; he also pointed out some errors in Pax' discussion of the species but failed to note that the maximum length should read 90 rather than 900 mm!

Stephenson [1922] also assigned this species to Epiactis. Epiactis is defined as having more mesenteries at the base than at the margin, whereas the reverse is true of Glyphoperidium [Carlgren, 1949]. This is the only character that clearly differentiates the genera for other features, including the pattern of perfect and fertile mesenteries [Dunn, 1975], may be identical in the two.

Many specimens of Glyphoperidium bursa taken by the USARP and previous expeditions were from the Scotia Sea, from South Georgia to the west side of the northern Antarctic Peninsula. The species is also known from the Ross Sea and from several scattered localities in the eastern hemisphere of Antarctica. All records are from south of 53°S. The known depth range of G. bursa is 18-1210 m, but this animal is most commonly encountered between about 100 and 400 m.

Material examined. (Fig. 4)

Eltanin Cruise 6

Sta. 444, 62°56'-59'S, 62°02'-04'W, 732-750 m, USNM 59798 (x1)

Eltanin Cruise 12

Sta. 1003, 62°41'S, 54°43'W, 210-220 m, USNM 59763 (x1)

Eltanin Cruise 27

Sta. 1896, 76°10'S, 168°17'E, 71-81 m, USNM 59681 (x1)
Sta. 1907, 77°03'-04'S, 166°15'-13'E, 891 m, CAS 012906 (x4); USNM 59796 (x3); USNM 59684 (x1)
Sta. 1931, 73°56'S, 178°56'W, 399-401 m, CAS 012904 (x1)
Sta. 1965, 59°54'-46'S, 155°23'-24'E, 340-382 m, CAS 012905 (x1)

Eltanin Cruise 32

Sta. 2063, 78°17'S, 177°58'-55'W, 636-637 m, USNM 60683 (x1)
Sta. 2101, 77°42'-44'S, 167°44'-39'W, 547-552 m, USNM 59703 (x1)
Sta. 2116, 73°16'-13'S, 177°05'-18'W, 1210 m, USNM 59794 (x2)
Sta. 2117, 73°02'-00'S, 178°06'-09'W, 595-600 m, CAS 012908 (x1)
Sta. 2121, 72°27'-26'S, 177°04'-12'E, 1883-1890 m, USNM 59762 (x1)

Islas Orcadas Cruise 575

Sta. 8, 53°35.8'S, 37°35.2'W, 254-366 m, CAS 012895 (x1)
Sta. 11, 53°38.0'S, 38°01.8'W, 132-143 m, USNM 59727 (x2)

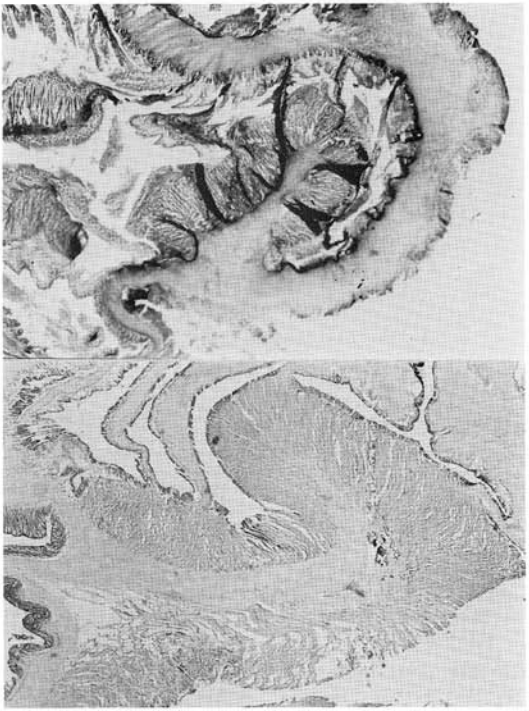

Fig. 31. Cross section through circumscribed endodermal sphincter muscles of Glyphoperidium bursa (top CAS 012907, bottom CAS 012904). Magnification as for Figure 32.

Sta. 14, 53°41.8'S, 37°57.2'W, 144–150 m, CAS 013436 (x1)
Sta. 15, 53°37.7'S, 38°04.0'W, 130–133 m, USNM 59679 (x2)
Sta. 16, 53°38.2'S, 38°01.1'W, 130–133 m, USNM 59766 (x1)
Sta. 17, 53°36.0'S, 38°03.0'W, 122–124 m, USNM 59685 (x2)
Sta. 19, 54°01.7'S, 37°40.0'W, 46–69 m, USNM 59754 (x1)
Sta. 24, 54°01.3'S, 36°50.7'W, 108–119 m, USNM 59739 (x1)
Sta. 32, 54°21.6'S, 35°58.7'W, 144–164 m, USNM 59767 (x1)
Sta. 62, 56°40.6'S, 27°00.8'W, 360–486 m, USNM 59702 (x1)
Sta. 84, 55°07.3'S, 35°47.2'W, 130–132 m, USNM 59809 (x1)
Sta. 101, 54°14.1'S, 37°54.2'W, 164–183 m, CAS 012907 (x2)

Hero Cruise 824

Sta. 22, 64°22.10'–22.39'S, 61°28.30'–29.30'W, 152 m, USNM 60682 (x1)

Previous records

Roule [1909] Booth-Wandell[sic] Island [~65°05'S, 66°20'W]; 25 m (x1), 25–30 m (x5)
Pax [1922, 1923] South Shetland Islands, 62°12'S, 60°55'W, 75 m (x5)
Carlgren [1927] South Georgia, 54°11'S, 36°18'W, 252–310 m (x18); between South Georgia and Falkland Islands, 53°34'S, 43°23'W, 160 m (x1)

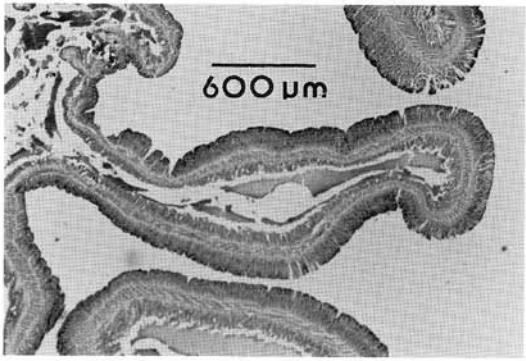

Fig. 32. Longitudinal section through tentacle of Glyphoperidium bursa (CAS 012906).

Carlgren [1928a] Bouvet Island, 54°28.7'S, 3°30.0'E, 457 m (x2)
Carlgren and Stephenson [1929] 65°6'S, 96°13'E, 325 fm (x15); 66°44'S, 97°28'E, 358 fm (x3)
Carlgren [1930] South Shetland Islands [~63°S, 61°W], 75 m (x1); Bouvet Island 200 m (x1)
Carlgren [1939] South Orkney Islands [~60°30'S, 45°W], 10 fm (x1)

Family ACTINOSTOLIDAE
Hormosoma scotti Stephenson, 1918

non Actinia papaver: Dana, 1846, p. 143; 1849, Plate 4 Figure 29--Milne-Edwards, 1857, p. 249--Dana, 1859, p. 9.
Paractis papaver: Clubb, 1908, p. 3--Pax, 1926, pp. 4, 51, 53, 56, 61.

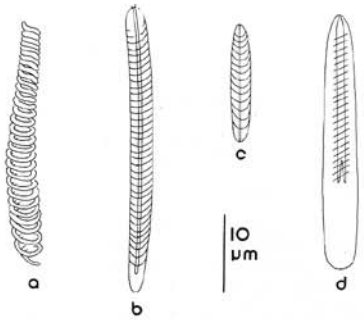

Fig. 33. Cnidae of Glyphoperidium bursa; see text for explanation.

Hormosoma scotti: Stephenson, 1918a, p. 29; 1920, pp. 553, 554--Carlgren, 1921, p. 185--Pax, 1926, pp. 4, 51, 61--Carlgren, 1927, pp. 47, 96, 97, 98, 99; 1928a, p. 262--Carlgren and Stephenson, 1929, p. 21--Carlgren, 1949, p. 82.
Hormosoma violaceum: Pax, 1922, p. 82; 1923, p. 13; 1926, p. 60.
Actinostola rufostriata: Pax, 1922, p. 85; 1923, p. 17; 1926, p. 60.

Description

Body form and size. All specimens of Hormosoma scotti in USARP collection contracted; much broader proximally than distally so shape pyramidal (Figure 34); up to 35 mm tall (typically slightly less than half basal diameter). Ectoderm generally partly or entirely abraded. Intact areas with irregularly wrinkled yellowish to brown (some with reddish cast) ectoderm and, in some, adherent sand. Upper column may be lighter color and shallowly longitudinally furrowed; lower column darker, rugose, encircled by shallow transverse folds, and thicker walled (3 versus 0.25 mm in average size animal); however, distinct body regions absent. Mesoglea thick, firm (Figure 35).

Fosse as deep as several millimeters; conspicuous margin; collar in some helps to conceal tentacles completely in contracted specimens.

Base. Pedal disc flat; circular in outline; ectoderm same brown color as column, wrinkled, but sloughed in many USARP specimens. Pedal disc edge/lower column rarely pulled in along mesenterial insertions. Expanded; width 25-80 mm.

Tentacles and oral disc. Tentacles mostly or completely hidden in USARP specimens. Up

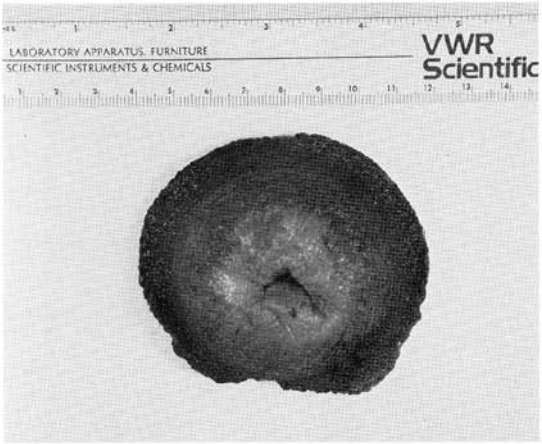

Fig. 34. Hormosoma scotti; from lot USNM 60057.

to 96, but typically fewer than number of mesenteries. Arrayed in indistinct cycles over outer half (?or more) of yellow, radially furrowed oral disc; exocoelic ones marginal, primary ones nearest elongate mouth. Stubby; blunt digitiform to pointed; brown ectoderm longitudinally ridged; wall thickness equal on all sides; inner tentacles average 8-10 mm long and 3-4 mm basal diameter, outer ones 5 mm long by 3-4 mm across base; some with obvious terminal pore. Longitudinal tentacle and radial oral disc musculature mesogleal; circular tentacle and oral disc musculature endodermal (Figure 36).

Mesenteries and internal anatomy. Up to four, regularly arrayed orders of delicate mesenteries that do not follow Actinostola rule; equal number proximally and distally; mesoglea thicker distally. Those of first two or three orders complete. All mesen-

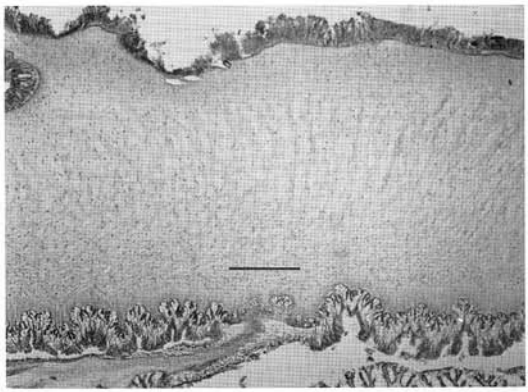

Fig. 35. Longitudinal section through top column wall of Hormosoma scotti (CAS 017695); scale bar = 400 μm.

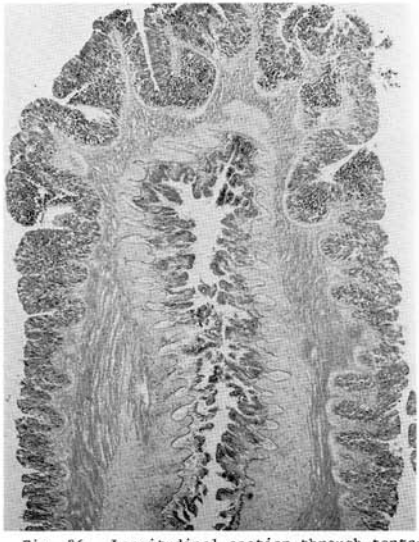

Fig. 36. Longitudinal section through tentacle of Hormosoma scotti (CAS 017698); magnification as for Figures 35 and 37.

teries except directives may be fertile, although primaries may be hardly fertile and secondaries may have only short gonad; dioecious; ova up to 600 μm diameter. Retractor musculature diffuse, wide, poorly developed (Figure 37); extremely long detached parietobasilar pennon (Figure 37) may extend centrally nearly as far as retractor. No stomata discernible. Two symmetrical directive pairs attached to very long siphonoglyphs; actinopharynx shallowly ribbed.

Strong mesogleal sphincter fills margin, extends proximally from it along endoderm hardly at all; ectodermal and central portions alveolar, endodermal reticular (Figure 38).

Basilar muscles weak.

Distribution and size of cnidae (Fig. 39)

Tentacles
- spirocysts(a), 26.2-64.0(68.1) x 3.3-5.3(5.7) μm, n = 95, N = 7/7
- microbasic b-mastigophores(b), 23.0-31.2(36.1) x 3.9-5.3 μm, n = 41, N = 5/7 (mostly in outer tentacles)
- microbasic b-mastigophores(c), 52.5-78.7 x 7.8-9.8 μm, n = 41, N = 6/7 (almost exclusively in outer tentacles)

Actinopharynx
- spirocysts(a), 26.2-53.3(58.2) x 3.3-4.1(4.9) μm, n = 21, N = 5/6
- microbasic p-mastigophores(d), (24.6)27.1-36.9(40.2) x (4.1)4.5-6.8(7.4) μm, n = 54, N = 6/6

Mesenterial filaments
- spirocysts(a), 21.3-53.3 x (2.5)3.3-4.9 μm, n = 28, N = 5/7
- microbasic p-mastigophores(e), (15.6)19.7-23.8 x (2.9)3.5-4.1(4.9) μm, n = 15, N = 5/7
- microbasic p-mastigophores(d), 25.4-37.7 x 4.5-6.6(8.2) μm, n = 52, N = 7/7

Column
- basitrichs(f), 19.7-26.2 x 3.9-4.9 μm, n = 30, N = 5/5 (rare in upper portion)

Smaller individuals tend to have smaller cnidae.

Discussion

Many specimens of Hormosoma scotti in the USARP collection were poorly preserved: The interior was macerated and the ectoderm sloughed. Among the mesenteries, low in their bodies, several females were brooding spherical embryos 1+ mm in diameter and lighter yellow than the ova still in the gonads; all appeared in the same stage of development, with rudimentary mesenteries.

According to Stephenson's [1918a] description of Hormosoma scotti, type species of the genus, the expanded oral disc is wider than the column. This species is very colorful in life [Pax, 1922, 1923; Carlgren, 1927].

Carlgren [1927, pp. 47, 49, 97] synonymized Clubb's [1908] 'Paractis papaver' with Hormosoma scotti, based on Clubb's published description and examination of the nematocysts from his specimen. The collar, strong mesogleal sphincter, form and musculature of the tentacles, and provenience all agree with what is known of Hormosoma scotti, but the 'small and insignificant' [Clubb, 1908, p. 4] parietobasilar musculature is very different from what I found. Carlgren questioned whether Clubb's species was indeed what Drayton [in Dana, 1846, 1859] had described as Paractis papaver, type species (designated by Stephenson [1920]) of the genus. Not only is the habitat wrong, as Carlgren recognized, but the appearance [Dana, 1849] is quite unlike that of Hormosoma scotti.

Carlgren [1927] referred to stinging batteries containing large nematocysts on the tentacles of Hormosoma scotti; I could not discern discrete batteries, but my nematocyst data are in perfect accord with his. His opinion that collar form is dependent on degree of sphincter contraction is well taken,

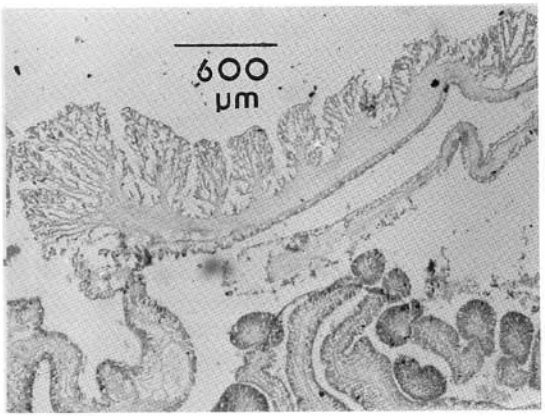

Fig. 37. Cross section through mesentery of Hormosoma scotti (CAS 017695).

and deemphasizes the taxonomic importance of that feature and the fosse (in this species, at least).

Pax [1922] described two species of Antarctic actinians (expanding slightly on those descriptions in 1923) that Carlgren [1927, pp. 47, 49, 98] synonymized with Hormosoma scotti. The published descriptions call to mind H. scotti, yet there are differences: inter alia, the proximal portion of the sphincter of H. violaceum, lies along the ectoderm, the retractors are described as circumscript, and the pedal disc is of smaller diameter than the column; Actinostola rufostriata reportedly possesses in excess of 100 tentacles, all of equal length, and the mouth is set on a cone. The majority of features, however, are in excellent agreement with what is known for H. scotti. Carlgren [1927], who examined Pax' specimens from the Pourquoi Pas, and measured their nematocysts, attributed these differences to poor preservation and individual variation of the anemones and to faulty taxonomic technique by Pax.

Specimens of Hormosoma scotti were collected by the USARP between 55° and 65°S, and 27° and 64°W, in the South Atlantic north of the Weddell Sea, and off the Antarctic Peninsula (Figure 40). Published records are mostly from this limited area, but there are some from McMurdo Bay. The known depth range is 16-769 m.

Material examined (Fig. 40)

Eltanin Cruise 12

Sta. 997, 61°44'-46'S, 55°56'-54'W, 769 m, CAS 017697 (x6)

Eltanin Cruise 22

Sta. 1581, 56°19'-20'S, 27°29'-28'W, 148-201 m, USNM 60056 (x5)

Islas Orcadas Cruise 575

Sta. 61, 56°42.3'S, 27°00.4'W, 93-121 m, CAS 017700 (x2)
Sta. 66, 56°42.8'S, 26°59.7'W, 121-228 m, USNM 60055 (x4)
Sta. 67, 56°44.6'S, 27°02.7'W, 137-155 m, CAS 017699 (x6)
Sta. 73, 56°16.0'S, 27°30.0'W, 208-375 m, USNM 60053 (x1)
Sta. 84, 55°07.3'S, 35°47.2'W, 130-132 m, USNM 60686 (x2)

Islas Orcadas Cruise 876

Sta. 108, 60°25.9'S, 46°23.6'W, 152-159 m, USNM 60054 (x1)

Hero Cruise 691

Sta. 3, 64°49'S, 63°29'W, 15-46 m, CAS 017695 (x2)

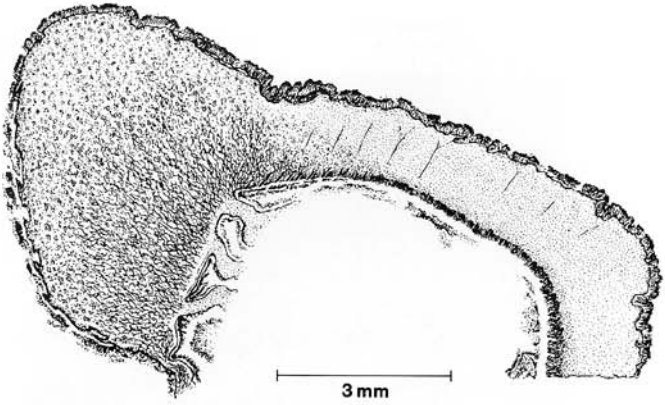

Fig. 38. Longitudinal section at margin through mesogleal sphincter of Hormosoma scotti. Drawing by Steve Sechovic.

Sta. 5, 64°49.3'S, 63°30.3'W, 18-37 m, USNM 60057 (x10); CAS 018725 (x5)
Sta. 14, 64°19'56"S, 63°58'20"W, 16-27 m, CAS 017698 (x3)

Hero Cruise 702

Sta. 447, 64°49'13"S, 63°30'03'-15"W, 20-27 m, USNM 60687 (x3)
Sta. 448, 64°49'10"-17"S, 63°30'06"-32"W, 18-27 m, USNM 60688 (x4)

Previous records

Clubb [1908] McMurdo Bay, 20 fm (x1)
Stephenson [1918a] 77°13'S, 164°18'E, 207 fm (x3)
Pax [1922, 1923] South Shetland Islands 62°12'S, 60°55'W, 75 m (x3)
Carlgren [1927] South Georgia 54°24'S, 36°22'W, 195 m (x2); 54°17'S, 36°28'W, 75 m (x1)
Carlgren and Stephenson [1929] 66°50'S, 142°06'E, 354 fm (x1)

Family BATHYPHELLIIDAE
Bathyphellia australis new species

Description

Body form and size. Elongate, gently tapering evenly from proximal to distal end; about 30 mm long by 10 mm diameter in mid-column (Figure 41). Column divided into short (about 10% column length), smooth, light colored (yellowish or reddish) scapulus, and dark scapus covered with cuticle-covered tenaculi (Figure 41) that may have adherent debris. Tenaculi extraordinarily long (up to 2.5 mm) and thin (100-250 μm across); portion near body contains extension of mesoglea with ectodermal covering and distal portion composed of concentric thin cuticular sheets (Figure 42); give scapus appearance of being covered by hard fuzz. No cinclides. No fosse.

Base. Spread over and tightly adherent to surface of substratum (in two cases, small, dense, shiny, irregular but smooth stones) (Figure 41); wider than column (about 20 mm); edge smooth.

Tentacles and oral disc. Tentacles blunt digitiform, arrayed near margin; most same

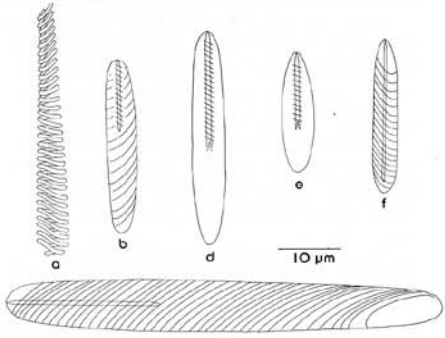

Fig. 39. Cnidae of Hormosoma scotti; see text for explanation.

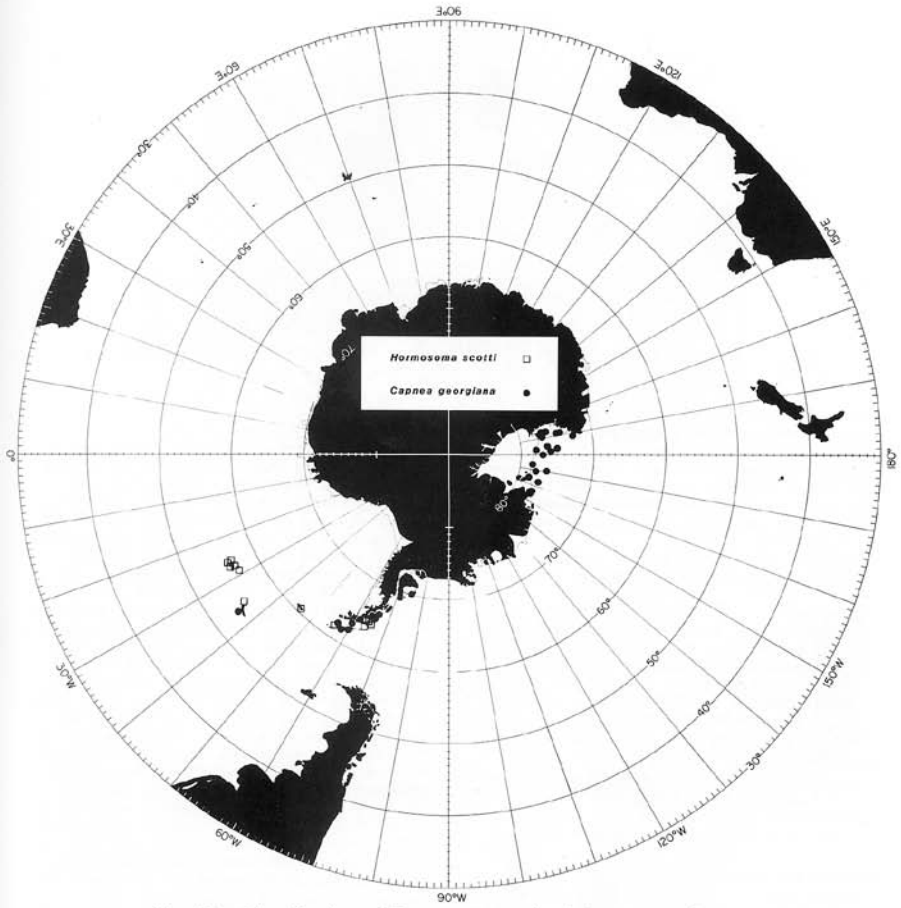

Fig. 40. Distributions of Hormosoma scotti and Capnea georgiana.

size, about 3 x 1 mm, but some seemingly with filamentous end; somewhat fewer than mesenteries. Oral disc same yellowish color as tentacles, radially furrowed; lipless mouth central. Tentacle musculature strong; longitudinal ectodermal, circular endodermal. Radial oral disc musculature ectodermal, circular endodermal. Tentacles not completely hidden although oral disc of USARP specimens retracted.

Mesenteries and internal anatomy. Six pairs macrocnemes complete and fertile (sexes seemingly separate), including two pairs directive mesenteries; two orders microcnemes; all regularly arrayed; all extend entire length of column. No stomata; acontia small, at proximal end of macrocnemes. Retractor muscles strong, but narrow, diffuse; lamellae with many extremely short side branches (Figure 43). Parietobasilar muscles small, lack detached pennon (Figure 43).

Mesogleal sphincter reticulate, very

Fig. 41. Bathyphellia australis: at left holotype USNM 60194; at right paratype CAS 017958.

strong (Figure 44); fills most of width of scapulus and extends, slightly narrowed, for short distance into scapus.

Actinopharynx about half length of column and nearly as wide; with few (about 12) shallow sulci and two symmetrical shallow siphonoglyphs (may be hardly perceptible) attached to directives.

Basilar musculature poorly developed.

Distribution and size of cnidae (Fig. 45)

Tentacles
spirocysts(a), 26.2-41.0(47.5) x 3.3-4.3 μm, n = 21, N = 3/3
spirocysts(b), (32.0)36.1-63.1(72.2) x (4.9)5.7-9.8 μm, n = 26, N = 3/3
basitrichs(c), (30.3)33.6-43.5 x (3.7)4.1-5.3 μm, n = 28, N = 3/3

Actinopharynx
basitrichs(d), 27.1-32.8(36.1) x 3.1-4.3 μm, n = 24, N = 3/3
microbasic p-mastigophores(e), (22.1)25.4-36.9 x 3.7-5.5 μm, n = 28, N = 3/3

Mesenterial filaments
basitrichs(f), 13.5-19.7 x 2.1-3.1 μm, n = 33, N = 3/3
microbasic p-mastigophores(e), 26.2-32.0(35.3) x 3.5-5.7 μm, n = 21, N = 3/3

Acontia
basitrichs(h), 13.1-23.0 x 2.1-2.5 μm, n = 20, N = 2/2
basitrichs(g), 28.7-40.2(45.1) x 2.5-3.7 μm, n = 30, N = 2/2

Only one nematocyst was found on the column; it was a basitrich measuring 18.9 x 3.9 μm in the scapulus ectoderm.

Discussion

The five representatives of Bathyphellia australis in the USARP collection are highly distinctive. Their familial affinity was somewhat difficult to establish because the basilar muscles are poorly developed and the small acontia are confined to the most proximal stretch of the macrocnemes. Obscure acontia are not unknown in the family; Carlgren [1956] was uncertain that they actually occur in Daontesia mielchei. Although Carlgren's [1949, p. 87] definition of the family describes the mesenterial retractor muscles as 'more or less restricted to circumscribed,' those of Daontesia Carlgren, 1942, are diffuse. Therefore, the definition of Bathyphelliidae Carlgren, 1932, must be changed to read as follows: Thenaria with broad base and generally elongate column that may be divisible into scapus and scapulus. Sphincter mesogleal. Mesenteries divisible into macrocnemes and microcnemes; retractors diffuse to circumscribed; acontia bear only basitrichs.

This species conforms in all respects to the definition of Bathyphellia. It resembles the type species, B. margaritacea (Danielssen, 1890), in many respects, but differs in cnidae (especially tentacle and acontia basitrichs and filament mastigophores) [Carlgren, 1942] and in the fact that B. margaritacea has been recorded only in the far North Atlantic. Thus Bathyphellia seems to be bipolar. The tenaculi of B. australis are more like those of Daontesia praelonga than those of its congener [Carlgren, 1942]. The four known species of the bathyphelliids Bathyphellia and Daeontesia are confined to the deep seas; the three species of the other two genera in the family, Phelliogeton and

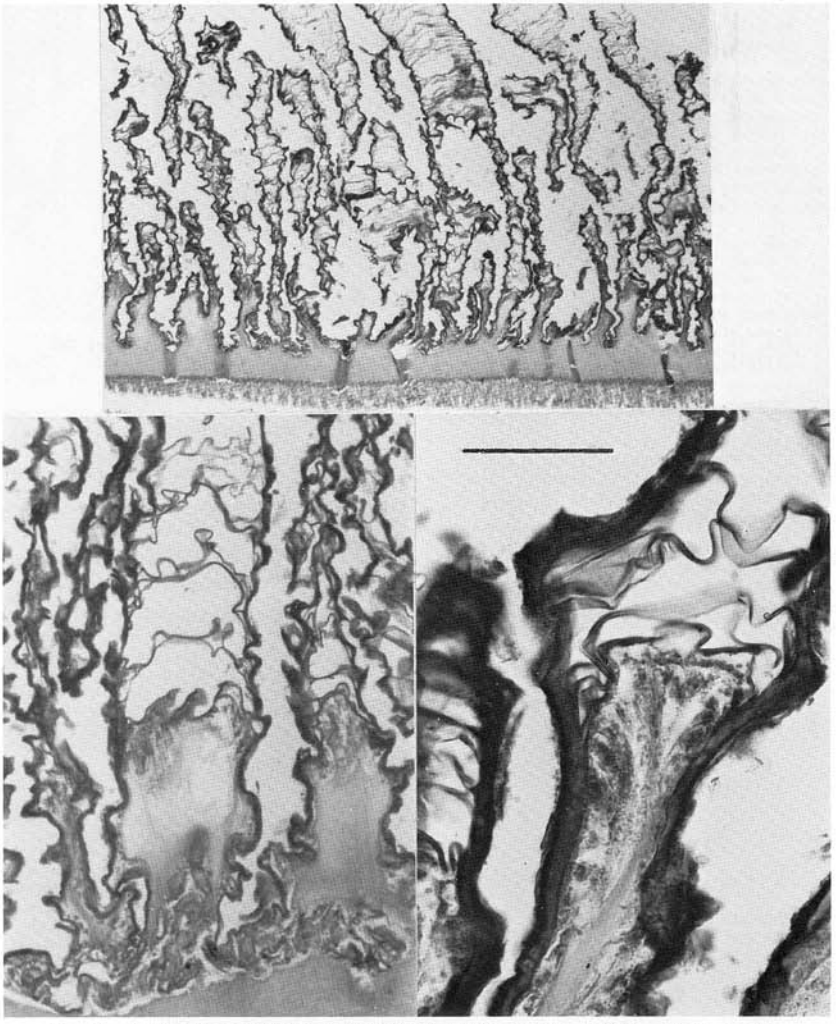

Fig. 42. Tenaculi of Bathyphellia australis (paratype; CAS 017958). Scale bar represents 800 μm at top, 200 μm at bottom left, and 50 μm at bottom right.

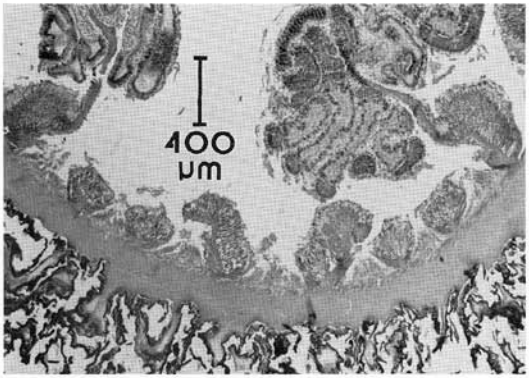

Fig. 43. Cross section through mid column of Bathyphellia australis (paratype; CAS 017958).

Acraspedanthus, occur in shallow (less than 20 m), austral waters [Carlgren, 1949].

Bathyphellia australis was taken from the west end of Drake Passage, just southwest of the tip of South America, westward to 145°W in the South Pacific, at depths in excess of 3200 m (Figure 46).

Type Specimens

Holotype. USNM 60194 from Eltanin cruise 10, station 876, 55°22'S, 78°21'-08'W, 4319 m (x1).

Paratypes. CAS 017958 from Eltanin cruise 10, station 843, 58°57'-58'S, 74°47'-32'W, 4575 m (x1).

CAS 029636 from Eltanin cruise 10, station 856, 62°55'-51'S, 78°54'-43'W, 4575 m (x1). Attached to this specimen are two empty tubes that resemble those of Galatheanthemum profundale.

CAS 029637 from Eltanin cruise 17, station 18-51, 67°55'-54'S, 110°55'-57'W, 3954-4042 m (x1).

USNM 60705 from Eltanin cruise 20, station 134, 59°48'-51'S, 144°45'-49'W, 3200-3259 m (x1).

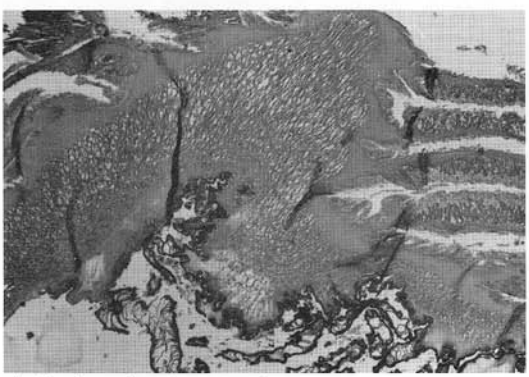

Fig. 44. Longitudinal section through reticular mesogleal sphincter of Bathyphellia australis (paratype; CAS 017958); magnification as in Figure 43.

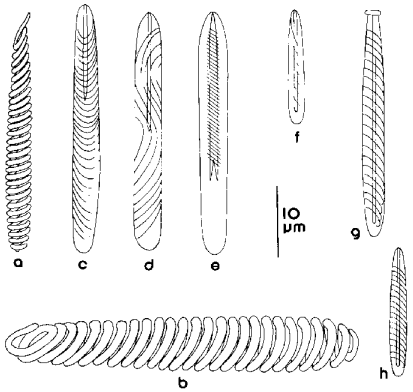

Fig. 45. Cnidae of Bathyphellia australis; see text for explanation.

Family CAPNEIDAE
Capnea georgiana (Carlgren, 1927)
new combination

non Actinia nymphaea: Dana, 1846, p. 146; 1849, Plate 4 Figure 33; 1859, p. 10.
Leiotealia nymphaea: Hertwig, 1882a, p. 33; 1882b, p. 38--Pax, 1926, p. 52.
Aureliania nymphaea: Stephenson, 1922, p. 293.
Aureliana[sic] nymphaea: Carlgren, 1928a, p. 263.
Aureliana[sic] georgiana: Carlgren, 1927, pp. 91, 96, 99; 1949, p. 71.
Aureliana[sic] tricirrata: Carlgren, 1928a, p. 261 [nomen nudum].
Aureliania tricirrata: Carlgren and Stephenson, 1929, p. 28.

Description

Body form and size. Expanded specimens hour-glass-shaped to cylindrical, contracted ones pyramidal (Figure 47). Pedal disc 10-100 mm diameter, height 10-40 mm; oral disc about equal to pedal disc in expansion. Column smooth; short capitulum may be expanded; below it is prominent fosse. Deep (to 1 mm in average size individual) circumferential furrow in distal part of scapus a short distance below fosse, due to diffuse, strongly developed endodermal circular musculature; furrow usually conspicuous even in strongly contracted specimens. Reddish to brown ectoderm usually eroded to some degree; foreign debris adherent to patches that remain. Mesenterial insertions visible where ectoderm absent.

Base. Flat; mesenterial insertions may be visible through it when tan ectoderm sloughed.

Tentacles and oral disc. Oral disc of expanded specimens flat. Tentacles hardly more than bumps, marginal (Figure 47); two to four per radial endocoelic row alternate with two per radial exocoelic row; about 30 rows of each in average-size animal. Centralmost tentacle of endocoelic row may be hardly defined, tapering onto oral disc at central side. Tight packing produces tentacles that are triangular or diamond-shaped viewed from above. Color of tentacles and oral disc same as rest of animal.

Mesenteries and internal anatomy. Up to four cycles of thin mesenteries; regularly arrayed but those of highest cycle may develop asynchronously so that there may be, for example, 17 or 33 pairs; added from proximal end. All except highest cycle may be fertile (including directives); all or all except highest cycle complete. Two pairs symmetrically arrayed directives, typically one siphonoglyph; actinopharynx moderately long, shallowly sulcate. Depending on degree of contraction, enteron may be very spacious.

Strong, elongate, pinnate endodermal sphincter with wide mesogleal primary lamella (Figure 48), up to 8-10 mm long in large animal, arises from bottom of fosse. Mesenterial retractor muscles highly circumscribed (Figure 49), very strong; parietobasilar muscles with long detached pennon extending centrally as far as main lamella of retractor. Column mesoglea thick.

Distribution and size of cnidae (Figure 50)

Tentacles
spirocysts(a), 32.8-51.7(54.9) x 2.3-3.7 µm, n = 37, N = 5/5
basitrichs(b), 18.9-27.9 x 2.3-4.1 µm, n = 32, N = 5/5
basitrichs(c) (rare), 38.5-46.7 x 3.9-4.7 µm, n = 16, N = 2/5

Actinopharynx
basitrichs(b), (13.1)14.8-25.4 x 2.9-4.1 µm, n = 52, N = 6/8
basitrichs(c), (27.9)35.3-48.4(55.8) x 3.9-5.1(5.7) µm, n = 45, N = 5/8
microbasic p-mastigophores(d), (33.6)36.1-49.2(53.3) x (5.7)6.2-8.2 µm, n = 47, N = 6/8

Mesenterial filaments
basitrichs(e), 12.3-18.0 x 2.5-3.5 µm, n = 35, N = 6/6
basitrichs(f), 19.7-24.6(28.7) x 4.1-5.1(5.7) µm, n = 17, N = 4/6
microbasic p-mastigophores(g), 29.5-43.5 x (4.9)5.5-7.4 µm, n = 55, N = 6/6

Fig. 46. Distributions of Bathyphellia australis, Actinauge verrillii, and Hormathia lacunifera.

Column
basitrichs(h), 18.9-28.7 x (2.5)3.3-4.7 μm, n = 52, N = 8/8
basitrichs(c), 30.3-44.3 x 3.7-4.9 μm, n = 18, N = 2/8 (confined to capitulum)
(few spirocysts also seen)

Discussion

Specimens of Capnea georgiana may assume two quite different body forms: hour-glass shape to cylindrical or pyramidal. This originally led me to believe that I was dealing with two taxa, but identity of cnidae and musculature confirmed that the two forms belong to a single species. Carlgren [1927] described Aureliana georgiana from two cylindrical specimens; he and Stephenson [1929] described A. tricirrata from a single pyramidal one. Other features were supposed to distinguish the two, but by 1949, Carlgren had realized their identity. Both descrip-

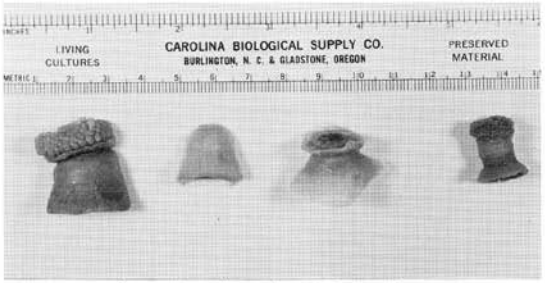

Fig. 47. Capnea georgiana. Specimens from left to right from lots CAS 013213, 013356, 013212, and 013212.

tions conform well to what I found. In the USARP collections, the largest specimens are pyramidal, but smaller ones may be of either morphology. All specimens from a single station are alike in body form, suggesting that local conditions or circumstances of collection may influence this feature.

Stephenson [1922] recognized that Hertwig's [1882a, b] Leiotealia nymphaea probably belonged to Aureliania, an opinion shared by Carlgren [1927]. In fact, Hertwig's excellent and thorough description undoubtedly referred to this species. Hertwig 'consider[ed] the small Actinia . . . as identical with a small form found by Dana . . .'[1882b, p. 40]. Dana's [1846, 1859] written description of Actinia nymphaea is not diagnostic, but his [1849] figure (Plate 4 Figure 33) illustrates an animal that clearly differs from Capnea georgiana. According to Article 49 of the International Code of Zoological Nomenclature, the name 'nymphaea' cannot be used for Hertwig's species despite the fact that it is now in a different genus than Dana's species (which was subsequently assigned to Paractis and Sagartia, and must probably be considered a nomen dubium). The next available name for the species is Aureliana georgiana Carlgren, 1927. Therefore, the valid name of this species is Capnea georgiana (Carlgren, 1927).

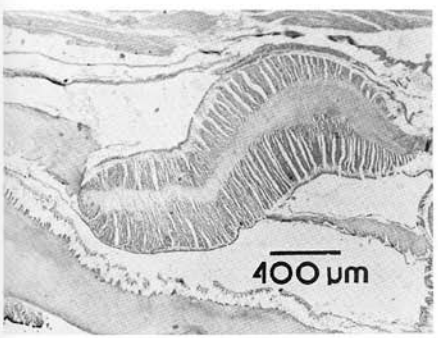

Fig. 48. Cross section through circumscribed endodermal sphincter muscle of Capnea georgiana (CAS 013212).

The name Aureliania was created by Gosse [1860, p. 282] for a new species A. augusta and one that had been described by Thompson [1853] as Corynactis heterocera. Carlgren [1949] synonymized both of these with Capnea sanguinea Forbes, 1841, but gave Aureliana [sic] heterocera Thompson as type species. Stephenson [1922] had been doubtful about the identity of Aureliania and Capnea. The latter genus was spelled with a 'K' in the title of the description [Forbes, 1841] and by Neave [1939b]; 'Capnea' is the rendering throughout the text of the description and is also listed in Nomenclator Zoologicus [Neave, 1939a]. As first reviser (International Code of Zoological Nomenclature Article 32(b)), I elect to follow majority usage, with Capnea sanguinea Forbes type species of the genus.

Gosse [1860] included Aureliania and Corynactis, as well as Capnea (of which C. sanguinea was the only known species), in family Capneadae. Andres [1883] later created family Aurelianiidae. Clearly the family name must be based on Capnea, and properly derived is Capneidae.

The northernmost record of Capnea georgiana is Hertwig's original specimen, taken from Kerguelen. It has been collected twice in latitudes between 50° and 60° but is most common south of 60°S. It is known to extend from South Georgia (36°W) west to Kerguelen (69°E), encircling nearly three quarters of the continent. Most of the 124 specimens

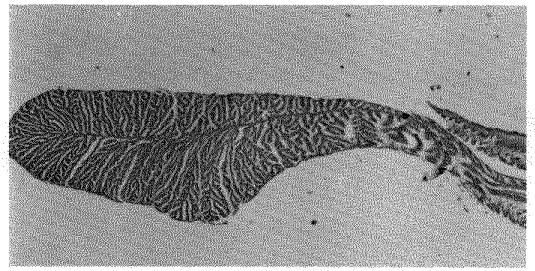

Fig. 49. Cross section through circumscribed mesenterial retractor muscle of Capnea georgiana (CAS 013215); magnification same as that of Figure 48.

were taken deeper than the previously known greatest depth (421 m) for C. georgiana. The greatest number of specimens were collected at depths of about 500 to 1200 m, but one was found as deep as 1967-2186 m. Previous records suggested that this is a rare species, but that is not borne out by the USARP collections.

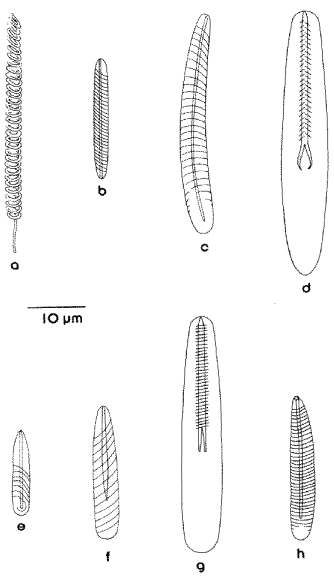

Fig. 50. Cnidae of Capnea georgiana; see text for explanation.

Material examined (Fig. 40)

Eltanin Cruise 6

Sta. 413, 62°07'-08'S, 55°58'-56°05'W, 1113-1153 m, CAS 013216 (x29), USNM 59699 (x10)
Sta. 426, 62°27'-34'S, 57°58'-49'W, 809-1116 m, CAS 013215 (x1)
Sta. 430, 62°38'-41'S, 59°37'-23'W, 681-1409 m, USNM 59761 (x2)
Sta. 432, 62°52'-55'S, 59°27'-15'W, 884-935 m, USNM 59735 (x1)

Eltanin Cruise 27

Sta. 1901, 76°30'-33'S, 174°54'-58'E, 445-448 m, CAS 013214 (x1)
Sta. 1907, 77°03'-04'S, 166°15'-13'E, 891 m, CAS 013212 (x14)

Eltanin Cruise 32

Sta. 2009, 73°00'S, 171°46'-40'E, 580 m, CAS 013213 (x2)
Sta. 2029, 75°00'S, 176°42'-40'E, 335-338 m, USNM 59786 (x13)
Sta. 2034, 74°32'S, 168°13'-16'E, 888-892 m, USNM 60679 (x2)
Sta. 2036, 75°01'-02'S, 168°23'-32'E, 334-335 m, USNM 59785 (x1)
Sta. 2041, 75°58'-59'S, 178°10'-18'E, 513-517 m, USNM 60678 (x2)
Sta. 2047, 77°03'-02'S, 178°10'-13'W, 584-585 m, USNM 59789 (x6)
Sta. 2050, 77°01'-03'S, 168°38'-23'E, 909-923 m, USNM 59760 (x3)
Sta. 2053, 77°09'-08'S, 165°59'-49'E, 820-826 m, USNM 59751 (x10)
Sta. 2059, 77°58'-59'S, 178°02'-08'E, 655 m, USNM 59778 (x4)
Sta. 2065, 78°23'S, 173°06'-02'W, 473-475 m, CAS 015062 (x1)
Sta 2070, 78°29'-28'S, 165°39'-22'W, 491-493 m, CAS 013356 (x1)

Fig. 51. Tubes of Galatheanthemum profundale from lot CAS 018325.

Sta. 2075, 76°25'S, 170°24'-32'W, 568 m, USNM 59783 (x1)
Sta. 2101, 77°42'-44'S, 167°44'-39'W, 547-552 m, USNM 59747 (x2)
Sta. 2104, 77°33'-31'S, 163°02'-05'W, 606-638 m, USNM 59748 (x2)

Islas Orcadas Cruise 575

Sta. 28, 53°26.7'S, 36°32.6'W, 1967-2186 m, USNM 59792 (x1)

Hero Cruise 721

Sta. 1110, 64°53.7'S, 64°47.2'-52.9'W, 460-500 m, USNM 59749 (x1)

Hero Cruise 824

Sta. 9, 66°07.70'S, 66°35.50'W, 140-210 m, CAS 029632 (x4)
Sta. 12, 65°15.3'S, 64°13.9'W, 270-320 m, USNM 60680 (x2)
Sta. 13, 65°14.0'S, 64°12.0'W, 310-360 m, CAS 029631 (x6)
Sta. 26, 64°14.3'-13.8'S, 61°57.6'-58.3'W, 238-285 m, USNM 60681 (x1)

Previous records

Hertwig [1882a, b] Christmas Harbor, Kerguelen, Challenger Sta. 149k [~48°40'S, 69°04'E], 120 fm (x1)

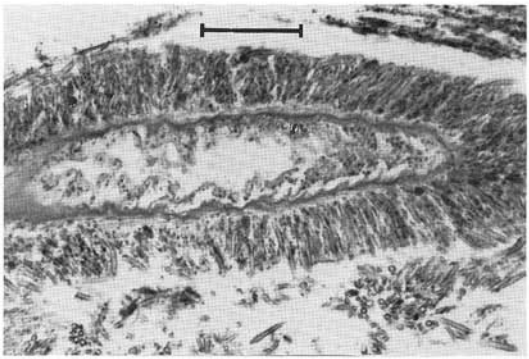

Fig. 52. Longitudinal/oblique section through tentacle of Galatheanthemum profundale (CAS 018323); scale bar = 100 μm.

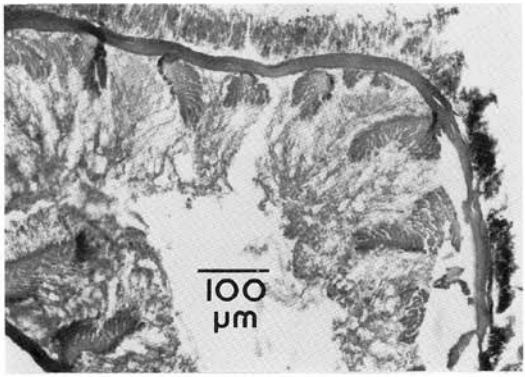

Fig. 53. Cross section through mid column of Galatheanthemum profundale (CAS 018325).

Carlgren [1927] 54°11'S, 36°18'W, 252-310 m (x2)
Carlgren and Stephenson [1929] 65°48'S, 137°32'E, 230 fm (x1)

Family GALATHEANTHEMIDAE
Galatheanthemum profundale Carlgren, 1956

Galatheanthemum profundale: Carlgren, 1956, p. 10.

Description

Body form and size. Cylindrical column up to twice as wide at distal end as proximally, 2.0-4.5 mm maximum diameter and 30 mm (or more?) long in preserved state. Column colorless; mesenterial insertions may be visible as longitudinal light lines or column may be indented along them. Tough yellowish-brown, thin chitinous cuticle appressed to body; one or two darker, thicker separate chitinous tubes surround it; tapered so that proximal part of one fits within distal part of lower one [see Carlgren, 1956, Figure 2a]; as many as three such seated tubes, each no more than 10 mm long, in one cross-sectional plane. Total length of tube commonly exceeds 50 mm, some more than 100 mm (Figure 51) but proximal portion empty, and in USARP material, animal is withdrawn about 10 mm below distal end.

Many specimens appear branched into two or three. In such situations, outermost tube encloses two separate tubes, the occupants of which are totally separated. One usually larger than the other(s).

Base. Rounded, not adherent; lacks basilar muscles.

Tentacles and oral disc. Tentacles digitiform, blunt-ended, and not tapered, about 1.5 mm long by less than 0.5 mm diameter, so rather stubby. Longitudinal tentacle musculature mesoectodermal to ectodermal, seemingly more strongly developed on aboral than oral side; circular tentacle muscles endodermal; mesoglea thick (Figure 52). Oral disc of every specimen studied involuted, so distribution and number of tentacles problematic.

Mesenteries and internal anatomy. Only primary mesenteries extend entire length of animal; two orders of mesenteries typical at distal end, with some members of third order visible; in one individual with 16 pairs, tertiary mesenteries developed on only one side of secondaries (Figure 53). Apparently dioecious, but pattern of fertile mesenteries obscure in rather disintegrated USARP material. Retractor muscles occupy entire width of mesenteries; diffuse with long, sparsely branched lamellae (Figure 53).

Actinopharynx up to a quarter body length.

Sphincter mesogleal, strong, long, occupying entire width of upper column; alveoli oriented longitudinally (Figure 54).

Distribution and size of cnidae (Fig. 55)

Tentacles
spirocysts(a), 22.1-41.0 x 3.1-5.3(5.7) µm, n = 31, N = 5/6
spirocysts(b), 38.5-57.4(77.1) x 4.7-7.0(8.2) µm, n = 37, N = 6/6 (typically broken)
basitrichs(c), (13.1)15.6-23.8(27.9) x 2.5-3.7(4.1) µm, n = 19, N = 6/6

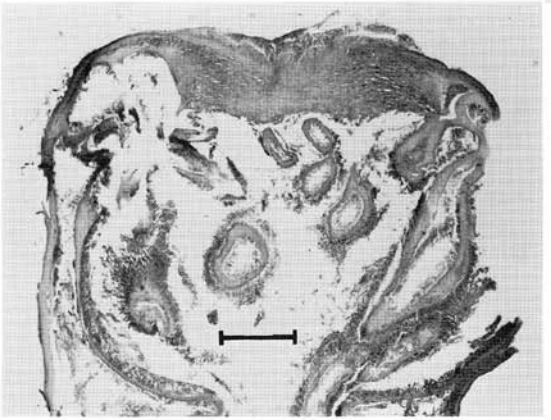

Fig. 54. Longitudinal section through top part of Galatheanthemum profundale showing mesogleal sphincter (CAS 018323); scale bar = 400 μm.

Actinopharynx
basitrichs(d), 22.1-31.2 x 2.9-4.5 μm, n = 27, N = 4/5
microbasic p-mastigophores(e), 20.5-26.2 x 3.3-4.1 μm, n = 25, N = 4/5

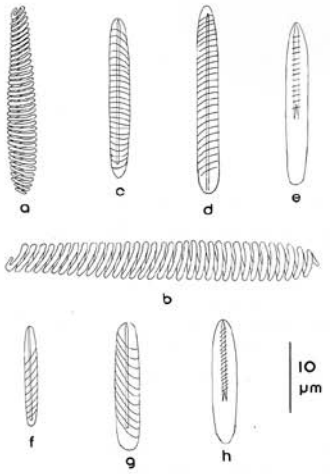

Fig. 55. Cnidae of Galatheanthemum profundale; see text for explanation.

Mesenterial filaments
basitrichs(f), (13.1)14.8-20.5 x 1.6-2.3 μm, n = 26, N = 4/6
basitrichs(d), 20.5-28.7 x 2.5-4.1 μm, n = 25, N = 4/6
microbasic p-mastigophores(e), 19.7-26.2(30.3) x 2.9-4.1(4.5) μm, n = 48, N = 6/6

Column
basitrichs(g), (12.3)16.4-26.2 x (2.7)3.1-4.3(4.9) μm, n = 56, N = 7/7
microbasic p-mastigophores(h), 14.8-18.0 x 3.1-4.1 μm, n = 15, N = 4/7

This tabulation includes data from a paratype of Galatheanthemum profundale housed in the University of Miami, School of Atmospheric and Marine Science.

Discussion

Carlgren's [1956] original description of Galatheanthemum profundale was incomplete owing, no doubt, to its posthumous publication. Through study of a paratype from the University of Miami School of Atmospheric and Marine Science, taken from the type locality, Galathea Expedition Station 658 (Kermadec Trench, at 6660-6720 m), I was able to ascertain that the USARP specimens indeed belong to Carlgren's species. Carlgren apparently examined specimens of a wider size range than I had available; I did not see very small ones lacking a cuticle, and the paratype is somewhat larger than any in the USARP collection. Nor did I examine any ad-

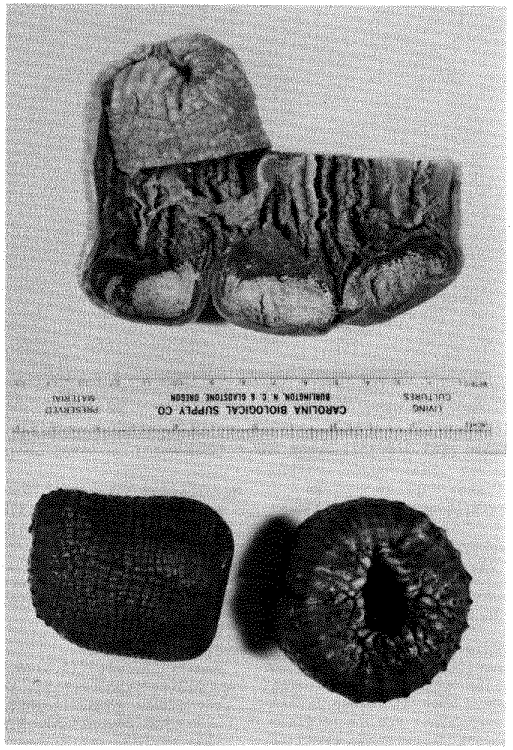

Fig. 56. Actinauge verrillii. Both specimens from lot CAS 013747.

herent to a substratum. Regrettably, Carlgren did not illustrate the sphincter, and I did not make sections of the sole paratype at my disposal, but the written description conforms to what I found. I could not confirm the presence of directive mesenteries and siphonoglyphs, nor could I ascertain the number of complete and fertile mesenteries in the rather decomposed USARP specimens. (S. D. Cairns (personal communication, 1979) could not identify siphonoglyphs in paratypic material of G. profundale either.) Carlgren's description of the retractor muscles agrees with what I found. Although lamellae of the USARP specimens seem longer than what Carlgren figured, the written description concedes that they may actually be stronger. In the paratype, I was unable to find small basitrichs in the column and actinopharynx reported by Carlgren, and I found a class of larger basitrich in the mesenterial filaments that he did not mention. Carlgren did not find microbasic p-mastigophores in the column nor did I in the paratype and one USARP specimen studied, although I did in four others. Because all other cnidae are in such excellent agreement, and the column is the most difficult tissue to study because of the debris that accumulates around the tube, I do not attach great significance to that discrepancy.

Regions of the body were not apparent in the USARP specimens, perhaps because all were completely retracted into their tubes. I agree with Carlgren that the 'branching' of tubes is probably due to settlement by larval actinians on tubes of established adults, although how a common tube is produced around

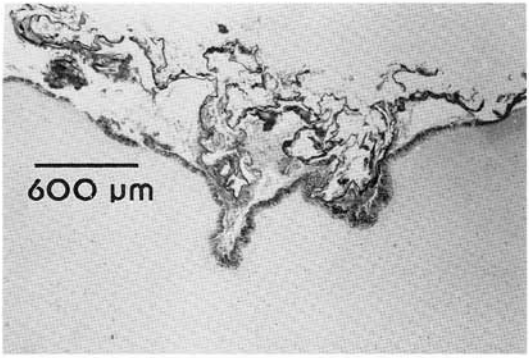

Fig. 57. Section through body wall of Actinauge verrillii (CAS 013747).

such a pair is difficult to envisage. Although Carlgren illustrated a barnacle on a Galatheanthemum tube, none of the USARP specimens harbored epizoites other than conspecifics. Two empty tubes, probably made by these anemones, were attached to a specimen of Bathyphellia australis (CAS 029636).

The Antarctic specimens were taken at depths of about 4000-5000 m, and between 54° and 66°S, around one third of Antarctica from 15° to 130°W (Figure 4). This extends the known bathymetric range of Galatheanthemum profundale upward considerably. The records also extend the known geographic range of the species, which was previously recorded only from the Kermadec Trench near New Zealand. Belyaev [1972], summarizing reports mainly from the Russian literature, reported that members of the Galatheanthemidae have been taken at a minimum of 26 stations in most Pacific trenches, the shallowest record being 5850 m [Carlgren, 1959], but none other than Carlgren's specimens were definitely identified as G. profundale. Figures in Belyaev and Mironov [1977] labeled 'Galatheanthemum sp.' of actinians taken in central Pacific deeps resemble USARP specimens of G. profundale. In situ photographs of what are probably individuals of this genus include that on page 56 of Heezen and Hollister [1971] from the Puerto Rico Trench, and Figure 10c of Lemche et al. [1976] from a trench in the Southwest Pacific.

Material examined (Fig. 4)

Eltanin Cruise 10

Sta. 848, 56°57'-56'S, 74°54'-43'W, 4209 m, USNM 56294 (x5)

Eltanin Cruise 11

Sta. 913, 65°48'-39'S, 115°00'-114°55'W, 4773 m, USNM 56295 (x26)
Sta. 916, 66°46'-34'S, 115°36'W, 4676 m, USNM 56296 (x10+)
Sta. 951, 65°11'-64°59'S, 86°52'-27'W, 4529-4548 m, USNM 56297 (x7)

Eltanin Cruise 12

Sta. 1018, 64°07'-09'S, 40°48'-41°00'W, 4465-4557 m, USNM 56298 (x20)
Sta. 1095, 56°06'-21'S, 89°54'-47'W, 5087-5124 m, USNM 60700 (x2)

Eltanin Cruise 13

Sta. 1146, 65°56'-54'S, 112°30'-56'W, 4789-4795 m, CAS 018319 (x23)
Sta. 1150, 65°37'S, 121°06'-120°37'W, 4758-4804 m, CAS 018320 (x12+)
Sta. 1154, 65°37'-32'S, 123°55'-30'W, 4709 m, CAS 018321 (x3)
Sta. 1158, 64°15'-19'S, 130°13'-05'W, 4575-4813 m, CAS 018322 (x4)

Eltanin Cruise 22

Sta. 1571, 54°51'-55°00'S, 14°54'-47'W, 3947-4063 m, CAS 018323 (x18)

Eltanin Cruise 23

Sta. 1640, 61°24'-19'S, 101°14'-32'W, 4868-4923 m, USNM 60064 (x3)
Sta. 1660, 61°31'-22'S, 108°00'-24'E, 5042-5045 m, CAS 018325 (x80+)
Sta. 1668, 63°53'-52'S, 108°39'-109°02'E, 4930-4963 m, CAS 018324 (x3)
Sta. 1673, 64°08'-02'S, 115°17'-36'E, 4866-4881 m, CAS 018326 (x3); USNM 60699 (x1)

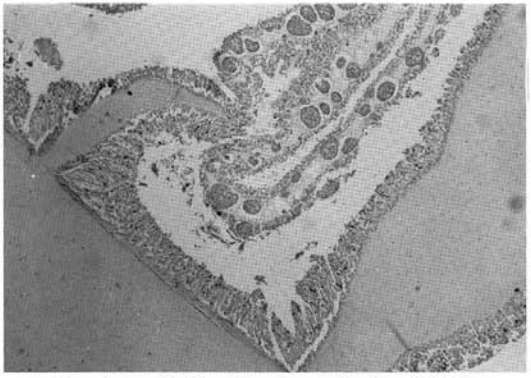

Fig. 58. Cross section through body wall and mesenteries of Actinauge verrillii (CAS 013747); magnification as for Figure 57.

Eltanin Cruise 25

Sta. 359, 63°03'-12'S, 128°12'-11'W, 4682 m, CAS 018327 (x2)

Previous records

Carlgren [1956] 35°16'S, 178°40'W, 8210-8300 m (x8), 32°20.5'S, 176°54'W, 6620 m (x30); 32°10.5'S, 177°14W, 6960-7000 m (x13); 32°09'S, 176°35'W, 6140-6160 m (x16); 32°10'S, 175°54'W, 5850 m (x11); 35°20'S, 178°55'W, 7630 m (x?); 35°51'S, 178°31'W, 6660-6720 m (x40).

Family HORMATHIIDAE
Actinauge verrillii McMurrich, 1893

Actinauge verrillii: McMurrich, 1893, p. 184--Hargitt, 1914, p. 249--Verrill, 1922, p. 94--Pax, 1926, p. 55--Carlgren, 1928b, p. 292; 1932, p. 263; 1933, p. 28; 1949, p. 94; Reimann-Zürneck, 1973, p. 292.
Actinauge verrilli [sic]: Carlgren, 1942, p. 39--?Widersten, 1976, p. 872.

Description

Body form and size. Column cylindrical, typically 60-75 mm long and 40-50 mm across (Figure 56); cartilagenous, owing to thick mesoglea (2-3 mm; comprises bulk of body wall width). Scapulus, which is never completely introverted, comprises a fifth to a quarter of the length, with 24 longitudinal, endocoelic rows of 4-5 more or less confluent, more or less prominent tubercles which are mesogleal thickenings; they are smaller distally; there may be 1-2 tubercles just below margin in highest endocoels. Scapus typically with fine, shallow longitudinal and circumferential furrows 4-6 mm apart that give it a reticulate appearance (furrows have nothing to do with mesenterial insertions) (Figure 56); rarely with larger, more irregularly arrayed tubercles. Entire body apparently covered by brown cuticle in life; where this is abraded, animal appears pale brownish red to pink. Furrows may accumulate fine debris and retain cuticle (Figure 57). No fosse.

Base. Pedal disc reddish brown, usually concave, wrapped around bolus of sand or mud (Figure 56) so that only a small, central opening remains, or around elongate object. Rarely slightly flared.

Tentacles and oral disc. Tentacles arise at margin; 67 counted in two individuals, all about the same size. Stubby, tip pointed, with greatly thickened mesoglea on aboral side, often elongate along oral/aboral axis; in one tentacle 7 mm long, 3 mm of 4 mm width was mesoglea; some tentacles only a few millimeters long and nearly as wide. Oral disc and lips pinkish brown; mesenterial insertions may form shallow radial furrows.

Mesenteries and internal anatomy. Four cycles of regularly arrayed mesenteries, all or all except those of highest order with filaments; same number proximally and distally; seem to grow from basal end. All except six primary pairs may be fertile; dioecious. Small to moderate oral stomata; acontia few, not coiled, arise from distal half of mesenteries. Retractor muscles diffuse, weak (Figure 58); mesoglea of higher-order mesenteries thick. Only primaries complete; two directive pairs connect to sym-

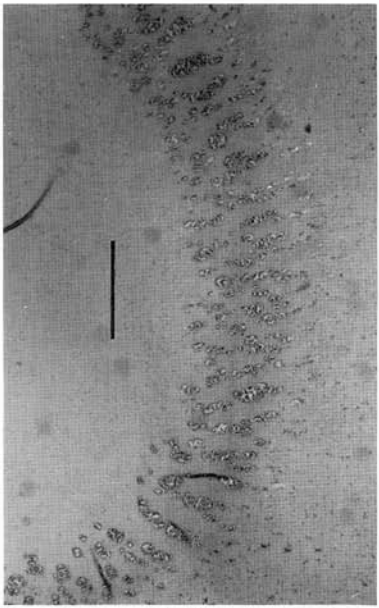

Fig. 59. Longitudinal section through mesogleal sphincter of Actinauge verrillii near its marginal end (CAS 013747); scale bar = 500 μm.

metrical siphonoglyphs that are considerably longer than actinopharynx. Actinopharynx tan to reddish brown, shallowly sulcate; about a third of the column length.

Sphincter muscle mostly in center of mesoglea but may near one side or other at tapered basal end; narrow (25% or less total width of mesoglea in central portion) and long, extending into scapus; not very strong. Consists of small, scattered alveoli that may be transversely stratified (Figure 59). Tentacle longitudinal musculature mesogleal to mesoectodermal, most highly developed on oral side. Radial musculature of oral disc mesogleal to mesoectodermal, interrupted at mesenterial insertions.

Distribution and size of cnidae (Fig. 60)

Tentacles
- spirocysts(a), 26.2-47.5 x 3.7-6.6 μm, n = 43, N = 5/5
- basitrichs(b), 14.8-18.0 x 1.8-2.5 μm, n = 10, N = 3/5
- basitrichs(c), (21.3)25.4-33.6 x 2.5-3.5 μm, n = 21, N = 5/5

Actinopharynx
- basitrichs(b), 16.4-21.3 x 2.1-2.7 μm, n = 8, N = 3/6
- basitrichs(d), (27.9)32.0-43.5 x 2.9-3.9 μm, n = 52, N = 6/6
- microbasic p-mastigophores(e), 25.4-32.0 x 3.5-4.1(4.7) μm, n = 20, N = 4/6

Mesenterial filaments
- basitrichs(b), 14.8-23.0 x 1.6-2.7(3.1) μm, n = 35, N = 6/6
- basitrichs(d) (scarce), 29.5-40.2 x 2.9-4.1 μm, n = 9, N = 3/6
- microbasic p-mastigophores(e), 21.3-31.2 x 3.3-4.7 μm, n = 34, N = 6/6

Acontia
- basitrichs(b), 18.0-23.8 x 1.8-2.9 μm, n = 20, N = 3/3
- basitrichs(f), 35.3-45.9 x 2.9-3.9 μm, n = 34, N = 3/3

Column (scapus, scapulus same)
- basitrichs(g), 17.2-26.2 x 3.1-3.9 μm, n = 41, N = 4/4

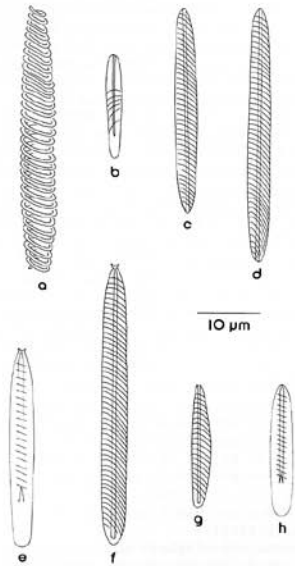

Fig. 60. Cnidae of Actinauge verrillii; see text for explanation.

microbasic p-mastigophores(h), 18.9-30.3 x 3.3-3.9 μm, n = 12, N = 4/4

Discussion

The nomenclature of Actinauge, which is very complex, was discussed by Haddon [1889]. This led McMurrich [1893] to create the new name A. verrillii for some specimens that had gone by the name A. nodosa; his description was based on eight individuals collected in the southern hemisphere and seven from 33°N. Carlgren [1933] summarized the earlier taxonomic and nomenclatural issues in addition to suggesting (as he had in 1932) that Verrill's [1922] A. rugosa was also synonymous with A. verrillii, but questioned [Carlgren, 1933, 1949] whether McMurrich's [1893] austral and boreal specimens were assignable to a single species. Indeed, nearly all records of A. verrillii are from the North Atlantic. The southern specimens that I examined conform to McMurrich's description. Verrill's [1922] northwest Atlantic specimens were slightly larger than those I studied, and some of the upper tubercles had a hard sharp tip while the lower ones were progressively smaller, but otherwise they resemble those described here. Cnidae measurements given by Carlgren [1942] are in excellent agreement with what I found except for column basitrichs; that tissue is difficult to analyze because of erosion and contamination (as Carlgren himself noted). Carlgren's [1942] morphological description and figures also reinforce the identity of his specimens and mine. Therefore, I choose to use McMurrich's name.

I have also examined specimens from the North Pacific that are indistinguishable from austral species in morphology and cnidae. Riemann-Zürneck [1973] pointed out the difficulty in delimiting species of Actinauge, noting that cnidae is not a good species criterion except for A. verrillii and A. abyssorum. Widersten's [1976] data on cnidae from Atlantic coast American specimens accord poorly with my findings, so it is likely that he had to do with a different species.

Nematocysts of the two species of Actinauge known only from austral seas, viz. A. granulata Carlgren, 1928a (regarded by Riemann-Zürneck [1973] as a possible synonym of A. longicornis), and A. chilensis Carlgren, 1959 (regarded as incertae sedis by Riemann-Zürneck [1973]), are very different from those of the specimens I examined. This is also true of the type species, A. longicornis (Verrill, 1882), which is known from both North and South Atlantic [Reimann-Zürneck, 1973].

Southern hemisphere collections are from near the Galapagos, Chile, and Tasmania, all in the southern Pacific basin. Boreal records are from both North Atlantic and North Pacific. Further study is required to establish whether the distribution of A. verrillii is genuinely disjunct, whether it is continuous in deep water, or whether two or more species are being confused under one name. The previously known depth range of the species is 128-2008 m [Verrill, 1922; Carlgren, 1928b]; these records extend that to at least 2840 m, and possibly 3001 m.

Material examined (Fig. 46).

Eltanin Cruise 27

Sta. 1980, 48°09'-10'S, 148°17'-15'E, 1790-1803 m, USNM 59704 (x1)
Sta. 1986, 45°33'-30'S, 147°18'-08'E, 2840-3001 m, CAS 013747 (x11)
(Eltanin cruise 32, sta. 1988, Port Chalmers Wharf, South Island, NZ (45°49'S, 170°37'E), USNM 59797 (x6). The provenance of this lot is questionable. It seems highly unlikely that the species occurs so shallowly. The station data do not note that actinians were taken, but some were trawled at Eltanin cruise 32, Station 1989, from 584-594 m, which may be the actual source of these anemones. Moreover, C. Hand (personal communication, 1981) has never found this species in Otago Harbor where he has made extensive searches for actinians.)

Previous records (southern hemisphere)

McMurrich [1893] 38°08'S, 75°53'W, 677 fm (x7); 0°29'S, 89°54'30"W, 392 fm (x1).

Hormathia lacunifera (Stephenson, 1918)

Lilliella lacunifera: Stephenson, 1918a, p. 33; 1920, p. 544--Carlgren, 1921, p. 185--Pax, 1923, p. 25; 1926, pp. 4, 51, 61.
Paranthus erythrosoma: Pax, 1922, p. 80; 1923, pp. 8, 26; 1926, p. 60.
Parantheoides rhododactyla: Pax, 1922, p. 83; 1923, pp. 20, 26; 1926, p. 60.
Hormathia erythrosoma: Carlgren, 1927, pp. 88, 96, 98; 1928a, p. 261; 1949, p. 93.
Hormathia rhododactyla: Carlgren, 1927, pp. 89, 96, 98; 1928a, p. 261; 1949, p. 93.
Hormathia bouvetensis: Carlgren, 1928a, pp. 205, 262.
Hormathia lacunifera: Carlgren, 1927, p. 97; 1928a, p. 261--Carlgren and Stephenson, 1929, p. 24--Carlgren, 1949, p. 93.

Description

Body form and size. Column cylindrical; divided into scapus and scapulus (Figure 61), latter 10-40% length of former; diameter of scapus generally constant, about one third total column length; scapulus may be narrower. Largest seen 100 mm long (scapulus

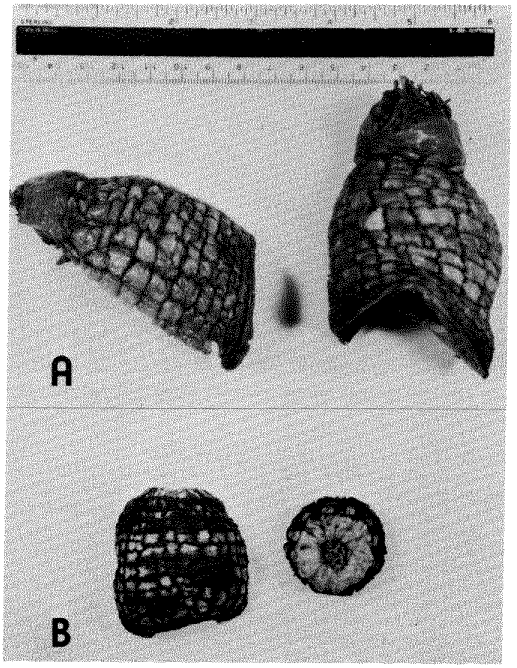

Fig. 61. Hormathia lacunifera. (a) from lot CAS 013355; (b) from lot CAS 013357.

represents 15 mm of this), 50 mm diameter; smallest 9 mm long, 12 mm diameter. Rare strongly contracted specimens almost globose, scapulus entirely retracted. Scapulus rarely involuted, smooth or shallowly longitudinally ridged, no coronal tubercles or 12 rows of two small ones each. Scapus tuberculate; tubercles commonly arrayed in rows and columns so that scapus appears reticulate; position of longitudinal furrows unrelated to that of mesenterial insertions; tubercles typically 4-6 mm on a side; square to rectangular; bryozoan or hydroid colonies may occur on individual tubercles. Body wall of average specimen 5 mm thick through tubercles; indentations between them up to 2 mm deep. Thin, brownish scapus cuticle may be eroded on surface of tubercles and present only in furrows between (Figure 61) that also trap debris; ectoderm thin, may also be eroded, in which case scapulus appears white (Figure 61b). No fosse.

Base. Pedal disc generally circular, flat or slightly concave so that lower column projects below it. Diameter about same as that of column and oral disc, between one and two thirds extended column length. Many found attached to rocks, rarely pedal disc completely encloses one.

Tentacles and oral disc. Oral disc commonly covered and retracted in preserved specimens; radially ridged; tentacles cover much of its surface. Tentacles yellowish, reddish, or brownish, conical to nipple-like, tapering to a point; longitudinally ridged; equally thick all around; rather stiff.

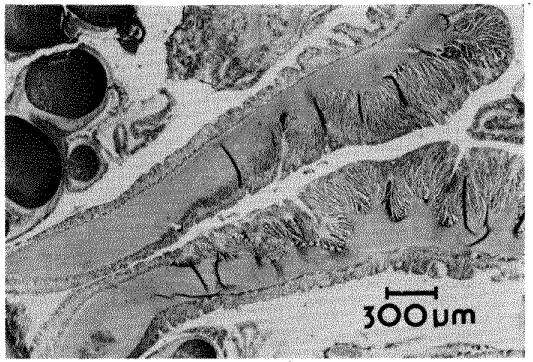

Fig. 62. Cross section through mesenteries of Hormathia lacunifera (CAS 013434).

Inner 48 tentacles longer than marginal 48 (20-25 mm long by 2-3 mm basal diameter, and 6-8 mm x 1-2 mm, respectively, in average size anemone).

Mesenteries and internal anatomy. Only six primary pairs of 48 total pairs mesenteries complete; mesenteries widest proximally; those of highest order may extend only to distal end of scapus; regularly arrayed; thin but tough, all with filaments (which may be reddish brown). All except primary mesenteries fertile; dioecious; ova may exceed 1 mm diameter in preserved specimens. Two symmetrical directive pairs attached to siphonoglyphs; actinopharynx as much as two-thirds total column length but in some only siphonoglyphs extend so low, deeply to hardly sulcate (perhaps dependent on state of expansion of entire animal). Acontia few, short, coiled, attached at basal end of mesenteries. Diffuse retractor muscles short, weak (Figure 62); parietobasilar muscles poorly developed although may be wide at proximal end of body.

Sphincter muscle mesogleal, moderately strong. Quite variable, probably related to state of expansion of animal: typically long, 30 mm long in one animal 70 mm long, but extends only to scapus in some; may occupy nearly entire width of mesoglea at margin (Figure 63) and taper proximally, but narrow throughout in others; muscle bundles dense or sparse, of equal or unequal size. Transversely stratified (Figure 63), in center of mesoglea or slightly off-center but does not hug either ectoderm and endoderm.

Ectodermal tentacle musculature longitudinal, endodermal circular. Oral disc radial muscles ectodermal to mesoectodermal; circular endodermal to mesoendodermal.

Distribution and size of cnidae (Fig. 64)

Tentacles
spirocysts(a), (27.1)32.0-49.2 x 3.3-5.7 µm, n = 58, N = 7/7
basitrichs(b), 25.4-31.2 x 2.5-3.7 µm, n = 52, N = 7/7

Actinopharynx
basitrichs(c), (27.1)30.3-41.8(49.2) x 2.5-4.7 µm, n = 86, N=9/9
microbasic p-mastigophores(d), (21.3)26.2-33.6(36.9) x 3.9-5.3 µm, n = 43, N = 7/9

Mesenterial filaments
basitrichs(e), 12.3-18.9 x 1.8-3.5 µm, n = 39, N = 5/8
basitrichs(f), 18.0-22.1 x 4.3-5.1 µm, n = 16, N = 3/8
(these two basitrichs appear to be mutually exclusive)
basitrichs(c), 23.0-43.5 x 3.1-4.9(5.3) µm, n = 24, N = 7/8
microbasic p-mastigophores(g), 17.2-27.1 x 3.7-4.9 µm, n = 49, N = 6/8

Acontia
basitrichs(h), 36.1-49.2 x 3.5-4.9 µm, n = 38, N = 4/4

Scapulus
basitrichs(i), 17.2-26.2 x (2.5)3.1-4.1 µm, n = 48, N = 7/7

Scapus
spirocysts(a) (scarce), 25.4-50.8 x (2.3)3.3-4.9 µm, n = 10, N = 4/7
basitrichs(i), 16.4-21.3 x 2.9-4.1(4.9) µm, n = 39, N = 5/7

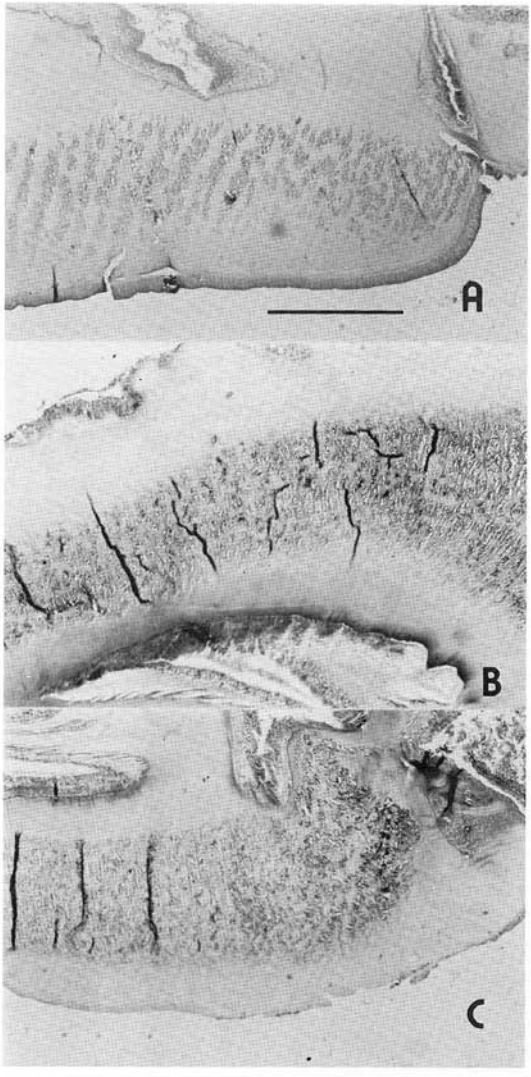

Fig. 63. Longitudinal sections through upper columns of Hormathia lacunifera illustrating variability of mesogleal sphincter muscle; margin toward right in all figures. (a) CAS 013359; (b) CAS 013434; (c) CAS 013357. Scale = 800 μm.

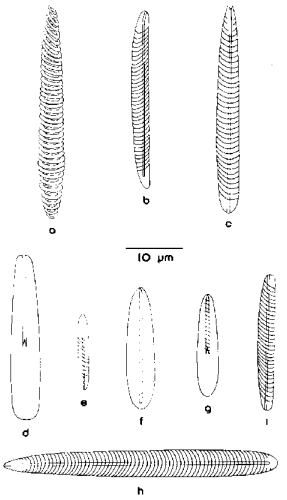

Fig. 64. Cnidae of Hormathia lacunifera; see text for explanation.

Discussion

Although only 30 specimens of Hormathia lacunifera have been documented in the literature, Dayton et al. [1970] identified this species as one of the largest and most conspicuous members of the benthic fauna immediately below the zone influenced by anchor ice (i.e., their zone II, 15-33 m). It is the most numerous of the larger actinians taken by the USARP.

With over 150 specimens to examine, it is not surprising that I found a considerable range of variation. Differences in one feature do not covary with those in others, however, so I included all of those listed below in a single species, Hormathia lacunifera. On the other hand, a number of specimens that clearly belong to Hormathia were sufficiently divergent (in nematocysts, form and position of sphincter, appearance) that they could not be included. Carlgren [1949] listed seven nominal species of Hormathia from southern seas and another one questionably as Hormathia; inexplicably he omitted H. bouvetensis Carlgren, 1928a. I have synonymized four of the nine. The nematocysts of H. pectinata (Hertwig, 1882a, b), H. georgiana Carlgren, 1927, and H. castanea (McMurrich, 1904) differ from what I found in H. lacunifera; H. spinosa (Hertwig, 1882a, b) has a bark-like cuticle with pointed papillae; and the questionable species, described by Stephenson [1918a] as Leptoteichus insignis, has rather stout but flaccid tentacles and a wrinkled column. These features clearly differentiate the five remaining nominal species from H. lacunifera, but there may be synonymy among some or all of them.

Stephenson [1918a] established a new genus Lilliella for his new species L. lacunifera, based partly on the absence of acontia [Stephenson, 1920]; in fact, they are present [Carlgren and Stephenson, 1929]. Specimens in the USARP collection conform to published data for Hormathia lacunifera except that the sphincter lies against the ectoderm, according to the original description; this could have been due to a sloughing of the outer body surface, which is likely because the single specimen was badly preserved.

Two species were described by Pax [1922] from a single locality. Paranthus erythrosoma was originally said to have a smooth column wall; elaborating on his earlier paper, Pax [1923] stated that that was because most of the ectoderm had been sloughed off, and traces of a reticulate pattern were visible in the mesoglea. The reticulation of Parantheoides rhododactyla was remarked on in both papers but did not show up in the figure. The brief descriptions of bodily proportions and internal anatomy are consistent with Hormathia lacunifera except that P. rhododactyla was said to have 24 pairs of complete mesenteries. Carlgren [1927] found that only six pairs were complete, and assigned both species to Hormathia. In fact, he suggested that the two were synonymous with one another [Carlgren, 1927; Carlgren and Stephenson, 1929] and with H. lacunifera (Carlgren did not repeat this 1927 proposal in 1929). Nematocyst measurements, provided by Carlgren [1927] from Pax' material, fit what I found in USARP specimens.

The nematocyst measurements of Hormathia bouvetensis Carlgren 1928a, are also in accord with my findings. Moreover, Carlgren's text-figure 43 of various portions of sphincter muscles is remarkably like my figure 63, and Figure 3, Plate III, showing the entire animal greatly resembles some specimens in the USARP collection.

Nearly all records of Hormathia lacunifera are from the western hemisphere of Antarctica. The only occurrences of the species between 4°E and 160°E were documented by Carlgren and Stephenson [1929]. Their records were sufficiently scattered, however, that H. lacunifera can be considered to be circumpolar. Most specimens have been taken between 100 and 1000 m, but there is one record of it from 2672-3020 m, and Dayton et al. [1970] found it to be abundant between 15 and 33 m.

Material examined (Fig. 46)

Eltanin Cruise 4

Sta. 138, 62°00'-05'S, 61°09-08'W, 1437 m, USNM 59736 (x3)

Eltanin Cruise 6

Sta. 426, 62°27'-34'S, 57°58'-49'W, 809-1116 m, USNM 59758 (x1)
Sta. 430, 62°38'-41'S, 59°37'-23'W, 681-1409 m, USNM 59691 (x9)
Sta. 432, 62°52'-55'S, 59°27'-15'W, 884-935 m, USNM 59696 (x1)
Sta. 444, 62°56'-59'S, 62°02'-04'W, 732-750 m, USNM 59683 (x10)

Eltanin Cruise 7

Sta. 538, 60°31'-29'S, 47°34'-29'W, 616-662 m, USNM 59708 (x3)
Sta. 558, 51°58'-52°01'S, 56°38'W, 646-845 m, USNM 59710 (x2)

Eltanin Cruise 12

Sta. 991, 60°57'-54'S, 56°52'-58'W, 2672-3020 m, USNM 59682 (x20)
Sta. 997, 61°44'-46'S, 55°56'-54'W, 769 m, USNM 59722 (x6)
Sta. 1078, 61°27'-26'S, 41°55'W, 604 m, USNM 59733 (x1)
Sta. 1079, 61°26'-24'S, 41°55'W, 593-598 m, CAS 013435 (x4)
Sta. 1083, 60°51'-50'S, 42°57'-59'W, 284 m, USNM 59700 (x3)
Sta. 1084, 60°22'-23'S, 46°50'-52'W, 298-403 m, CAS 013355 (x2); USNM 59680 (x3)
Sta. 1089, 60°47'-48'S, 53°30'-31'W, 641 m, USNM 59788 (x1)

Eltanin Cruise 22

Sta. 1535, 53°51'-52'S, 37°38'-36'W, 97-101 m, USNM 59719 (x2)
Sta. 1581, 56°19'-20'S, 27°29'-28'W, 148-201 m, USNM 59733 (x4)

Eltanin Cruise 26

Sta. 1829, 42°08'-11'S, 160°05'-57'E, 1000-1750 m, CAS 013359 (x1)

Eltanin Cruise 27

Sta. 1889, 75°00'S, 169°28'-26'E, 324-329 m, USNM 59692 (x1)
Sta. 1892, 75°27'S, 168°50'-52'E, 364-366 m, USNM 59726 (x2)
Sta. 1907, 77°03'-04'S, 166°15'-13'E, 891 m, CAS 013358 (x2)
Sta. 1946, 67°29'-32'S, 179°55'-57'W, 1080 m, USNM 59791 (x2)

Eltanin Cruise 32

Sta. 2012, 73°59'-58'S, 170°51'-58'E, 589-608 m, USNM 59728 (x1)
Sta. 2016, 73°58'-59'S, 176°11'-16'E, 581-586 m, USNM 59707 (x3)
Sta. 2029, 75°00'S, 176°42'-40'E, 335-338 m, USNM 59693 (x2)
Sta. 2036, 75°01'-02', 168°23'-32'E, 334-335 m, USNM 59705 (x2)
Sta. 2047, 77°03'-02'S, 178°10'-13'W, 584-585 m, USNM 59751 (x2)
Sta. 2050, 77°01'-03'S, 168°38'-23'E, 909-923 m, USNM 59731 (x1)
Sta. 2053, 77°09'-08'S, 165°59'-49'E, 820-826 m, USNM 59745 (x2)
Sta. 2063, 78°17'S, 177°58'-55'W, 636-637 m, USNM 59756 (x1)
Sta. 2075, 76°25'S, 170°24'-32'W, 568 m, USNM 59701 (x1)
Sta. 2082, 75°50'-51'S, 173°08'W, 476 m, USNM 59706 (x1)
Sta. 2099, 77°02'S, 166°44'-50'W, 408-415 m, USNM 59746 (x1)

Islas Orcadas Cruise 575

Sta. 2, 54°39.7'S, 37°24.1'W, 182-327 m, USNM 59686 (x3)
Sta. 8, 53°35.8'S, 37°35.2'W, 254-366 m, CAS 013357 (x4)
Sta. 9, 53°43.3'S, 37°30.6'W, 271-313 m, USNM 59741 (x1)
Sta. 10, 53°47.8'S, 37°26.7'W, 165-234 m, USNM 59689 (x6)
Sta. 11, 53°38.0'S, 38°01.8'W, 132-143 m, USNM 59770 (x2)
Sta. 12, 53°38.2'S, 37°54.7'W, 130-137 m, USNM 59716 (x1)
Sta. 14, 53°41.8'S, 37°57.2'W, 144-150 m, CAS 013434 (x7)
Sta. 17, 53°36.0'S, 38°03.0'W, 122-124 m, USNM 59674 (x2)
Sta. 24, 54°01.3'S, 36°50.7'W, 108-119 m, USNM 59729 (x1)
Sta. 28, 53°26.7'S, 36°32.6'W, 1967-2186 m, USNM 59687 (x1)
Sta. 30, 53°50.6'S, 36°18.6'W, 185-205 m, USNM 59690 (x1)
Sta. 31, 54°05.6'S, 36°30.8'W, 130-143 m, USNM 59676 (x2)
Sta. 32, 54°21.6'S, 35°58.7'W, 144-164 m, USNM 59675 (x1)
Sta. 36, 56°59.9'S, 26°43.7'W, 146-526 m, USNM 59738 (x6)
Sta. 51, 57°22.6'S, 26°34.0'W, 2248-2402 m, USNM 59698 (x3)
Sta. 60, 56°53.5'S, 26°54.8'W, 1532-1590 m, USNM 59672 (x1)
Sta. 64, 56°45.4'S, 26°54.4'W, 731-749 m, USNM 59671 (x2)
Sta. 65, 56°44.3'S, 26°58.6'W, 302-375 m, USNM 59614 (x4)

Sta. 84, 55°07.3'S, 35°47.2'W, 130-132 m, USNM 59771 (x2)
Sta. 90, 54°50.6'S, 37°23.8'W, 223-227 m, USNM 59725 (x7)

Islas Orcadas Cruise 876

Sta. 108, 60°25.9'S, 46°23.6'W, 152-159 m, USNM 59737 (x1)
Sta. 110, 60°28.1'S, 46°27.2'W, 115-132 m, USNM 59724 (x1)
Sta. 113, 60°29.7'S, 46°43.1'W, 124-128 m, USNM 59709 (x1)
Sta. 126, 61°17.2'S, 44°29.0'W, 283-305 m, USNM 59720 (x1)
Sta. 128, 60°55.5'S, 44°41.4'W, 236-238 m, USNM 59697 (x1)
Sta. 133, 59°25.9'S, 26°55.8'W, 1071-1152 m, USNM 59670 (x3)

Hero Cruise 721

Sta. 816, 62°20.5'-20.7'S, 58°45.4'-47.2'W, 50 m, USNM 59764 (x1)
Sta. 1074, 64°47.4'S, 64°07.4'-07.0'W, 106-110 m, USNM 59793 (x1)
Sta. 1110, 64°53.7'S, 64°47.2'-52.9'W, 460-500 m, USNM 59712 (x1)

Hero Cruise 731

Sta. 1756, 64°47.25'-47.02'S, 64°07.30'-06.13'W, 91 m, USNM 59715 (x1)
Sta. 1885, 65°05.0'-05.7'S, 64°55.0'-59.0'W, 220-320 m, USNM 59734 (x1)
Sta. 1944, 64°46.28'-46.51'S, 63°26.5'-24.6'W, 100-150 m, USNM 59730 (x4)

Previous records

Stephenson [1918a] McMurdo Sound [~77°S, 170°E], 200 fm (x1)

Pax [1922, 1923] South Shetland Island, 62°12'S, 60°55'W, 75 m (x8)
Carlgren [1928a] Bouvet Island, 54°29.3'S, 3°43.0'E, 567 m (x16)
Carlgren and Stephenson [1929] 65°48'S, 137°32'E, 230 fm (x1); 64°44'S, 97°28'E, 358 fm (x1); 65°6'S, 96°13'E, 325 fm (x2); 65°20'S, 95°27'E, 240 fm (x1)

Family ISANTHIDAE
Eltaninactis new genus

Isanthidae with weak mesogleal sphincter. Column divided into scapus and short scapulus; scapus with tenaculi and cuticle. Mesenteries divisible into six pairs of complete and fertile macrocnemes, each provided with a strong, circumscribed retractor, and six or more pairs of microcnemes, which are added from the proximal end. Two pairs of directive mesenteries; siphonoglyphs lacking or indistinctly developed. Tentacles equal to or fewer in number than mesenteries. Body with broad, non-adherent base.

Cnidom. Spirocysts, basitrichs, microbasic p-mastigophores.

Type species. Eltaninactis infundibulum n. sp.

Etymology. The generic name is a compound of 'Eltanin' and 'actis,' the latter referring to sea anemones. Eltanin is the name of the USARP ship that collected the specimens forming the basis of this description. The ship, in turn, was named for the double star forming the dragon's head in the northern constellation Draco [Allen, 1963].

Discussion. See that for type species.

Eltaninactis infundibulum new species

Description

Body form and size. Pyramidal (Figure 65) with basal end typically 30-50 mm across. Most specimens moderately to strongly contracted making oral disc diameter difficult to ascertain, but less than half basal diameter. Height somewhat less than basal diameter (generally 25-45 mm). Majority of column length comprises scapus furnished with tenaculi and cuticle (Figure 66) to which debris adheres; ectoderm commonly abraded from lowermost portion so that mesenterial insertions visible through body wall as light lines. Column of intact specimens brown. Scapulus short (few millimeters), smooth, without cuticle, totally involuted in many preserved specimens. No fosse; no marginal protuberances.

Base. Flat to slightly convex; wrinkled ectoderm same color as that of scapus but mostly abraded so base light in color with visible mesenterial insertions. Apparently not adherent. Base or lowermost column of some specimens torn, allowing mesenterial filaments to protrude.

Tentacles and oral disc. Tentacles stiff; pale hue; 24 in all specimens studied; scattered over most of oral disc. Marginal (exocoelic) ones 7-11 mm long; inner ones generally half but may be nearly equally long; basal width 2 mm. Pointed but of uniform diameter most of length (Figure 65). Longitudinal musculature mesoectodermal, better developed on oral side, circular musculature endodermal and poorly differentiated; oral disc radial musculature mesoectodermal, circular endodermal.

Mesenteries and internal anatomy. Generally 12 pairs of mesenteries comprising six pairs of macrocnemes, all of which are complete and fertile, and six pairs of microcnemes, all of which are incomplete and sterile; two pairs of symmetrically arrayed

Fig. 65. Eltaninactis infundibulum from lot CAS 005997 (paratypes).

directive mesenteries; a third order of mesenteries at the basal end of some; dioecious. No stomata discernible; acontia lacking; mesenterial filament along distal part of macrocnemes thick and light colored compared with portion below. Retractor muscles strong, restricted, with highly branched main lamellae (Figure 67). Well-developed parietal muscles of similar appearance (Figure 67).

Circular endodermal musculature of column wall well developed (Figure 68), but not particularly concentrated in upper scapus where body wall bends. Mesogleal sphincter very weak (Figure 68) or perhaps absent in some individuals; with few muscle bundles scattered between upper scapus and base of tentacles hugging endodermal side of mesoglea; width at most a quarter that of scapulus wall. Actinopharynx somewhat more than half as long as column; with 15-20 deep sulci; portions where directive mesenteries attach not distinguishable as siphonoglyphs, although in some specimens there are hints of one. Color of actinopharynx, lower mesenterial filaments, mesenteries rust red. Basilar muscles very weak. There also appear to be endodermal muscles in the pedal disc extending from mesentery to mesentery, aligned perpendicularly to them (and to the basilar muscles).

Distribution and size of cnidae (Fig. 69)

Tentacles
spirocysts(a), 23.8-41.0 x 2.9-4.3 μm, n = 33, N = 4/4
basitrichs(b), 20.5-32.0 x (2.3)2.9-3.9

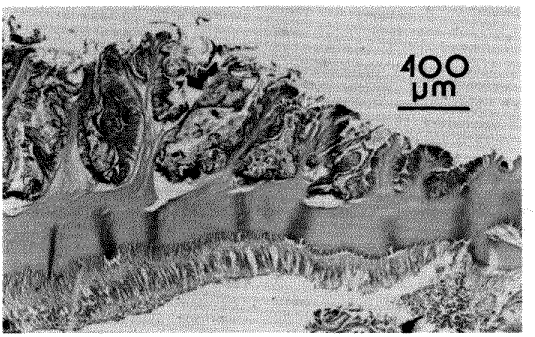

Fig. 66. Longitudinal section through upper scapus/lowermost scapulus of Eltaninactis infundibulum (CAS 005997; paratype).

Fig. 67. Cross section through mesentery of Eltaninactis infundibulum (CAS 005997; paratype). Magnification as for Figure 66.

μm, n = 24, N = 4/4 (most are at the upper end of the size spectrum)

Actinopharynx
basitrichs(c), (25.4)28.7-37.7(40.2) x 2.9-3.9(4.7) μm, n = 32, N = 4/4
microbasic p-mastigophores(d), 28.7-36.1(37.7) x (4.3)4.9-5.9(6.6) μm, n = 39, N = 4/4

Mesenterial filaments
basitrichs(e), 16.4-22.1 x 2.7-3.3 μm, n = 20, N = 3/5
microbasic p-mastigophores(f), 23.0-36.1 x 4.1-5.5 μm, n = 48, N = 5/5

Column (scapus and scapulus)
basitrichs(e), 16.4-24.6 x 2.7-3.9 μm, n = 50, N = 5/5

Discussion

The appearance of Eltaninactis infundibulum is highly distinctive. Its anatomy conforms most closely to that of the family Isanthidae, although its sphincter is not well developed. This is only a matter of degree, and so I propose to alter the family definition as given by Carlgren [1949, p. 76] to read as follows: Thenaria (Mesomyaria) with mesogleal sphincter. Mesenteries divisible into macrocnemes and microcnemes. No acontia. Retractors of mesenteries very strong; strongly restricted (reniform) to almost circumscribed.

Although the column of Eltaninactis infundibulum is differentiated into regions, its mesenteries are divisible into macrocnemes and microcnemes, its weak sphincter is mesogleal, and it lacks acontia, some aspects of its musculature are problematic. Basilar muscles are obvious, although weak, in some individuals, but imperceptible in others, and additional muscles run between adjacent mesenteries, normal to the mesenteries and basilar muscles. The pronounced muscle band along both faces of each mesentery at its junction with the body wall appear in section (Figure 67) to constitute parietal musculature; on the other hand, its bundles are arrayed not longitudinally [cf. Stephenson, 1928] but diagonally, with the marginal edge higher than the central. Despite the fiber orientation, they are not parietobasilar muscles, for each is of uniform width throughout its length except for a slight broadening where it inserts on the base.

Thus is some respects this species appears transitional. Nonetheless, it does not fit in families lacking basilar muscles, the taxonomic importance of which is open to debate (summarized by Riemann-Zürneck [1979]), or a sphincter, because other features, such as mesenterial arrangement and differentiation of the column, are clearly defined. Its placement in the Isanthidae is thereby reinforced.

However, none of the four genera in the family can accommodate this species. Carlgren [1949] listed two monotypic genera, Isanthus, with a smooth column and six pairs of macrocnemes, and Neophellia, which has 12 pairs of macrocnemes and a column differentiated into scapus and scapulus. Hand [1955] described the monotypic genus Zaolutus, characterized by a uniform column that may have microscopic papillae, a double mesogleal sphincter, and up to 12 pairs of macrocnemes. The most recently described genus, Austroneophellia, also monotypic, has

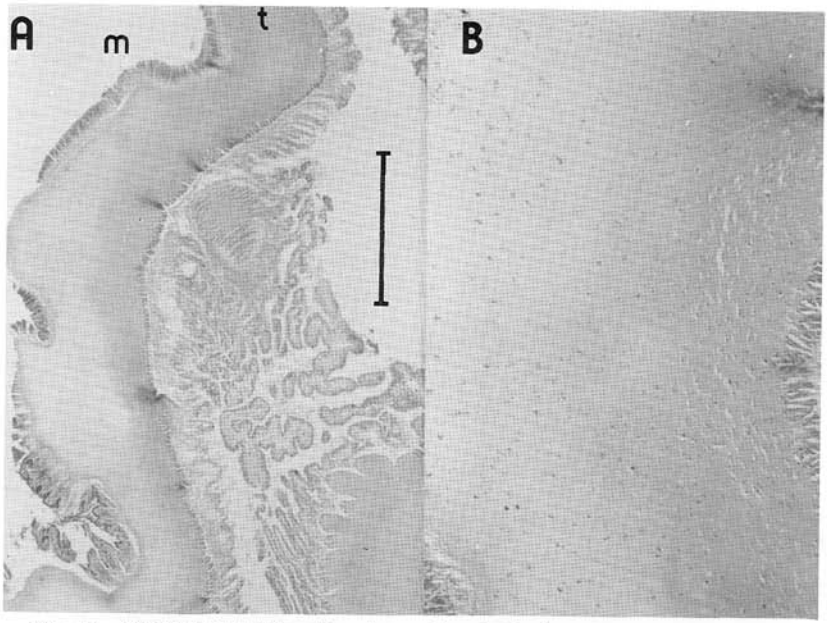

Fig. 68. Longitudinal sections through scapulus of Eltaninactis infundibulum (CAS 005997; paratype) showing weak mesogleal sphincter just below tentacle (t) and strong circular endodermal musculature; m = margin. (a) scale = 800 μm; (b) detail of muscle bundles; scale = 200 μm.

12 pairs of macrocnemes and a column divisible into capitulum and scapus [Zamponi, 1978]. Eltaninactis is distinguished from these by its single weak mesogleal sphincter, the division of its column into scapus (bearing tenaculi and cuticle) and scapulus, six pairs of macrocnemes, and broad base.

The conical shape of Eltaninactis infundibulum is similar to that of two other Antarctic coelenterates. One is the actinian Capnea georgiana, and the other is an alcyonacean. Both of the actinians have a broad basal end and narrow distal end, rather like that of Segonzactis platypus Riemann-Zürneck, 1979; Riemann-Zürneck analyzed the possible adaptiveness of this shape to deep water animals living in fine, unconsolidated sediments. Small specimens of Epiactis georgiana may also assume this form (see earlier). The alcyonacean presumably lives with the narrow end planted in the substratum, for the polyps emerge from the broad surface.

Eltaninactis infundibulum is known from two small areas: at 769-1230 m, among the islands off the Antarctic peninsula; and at 2610-2668 m northwest of Chatham Islands (Figure 14). Although the former region has been the subject of considerable study, the deep occurrence and rarity of this species explain how it has been overlooked previously.

Etymology. Infundibulum, Latin for 'funnel,' refers to the shape of this sea anemone.

Type Specimens

Holotype. USNM 60191 from Eltanin cruise 6, station 413, 62°07'-08'S, 55°58'-56°05'W, 1113-1153 m (x1)

Paratypes. USNM 60193 from Eltanin cruise 6, station 411, 62°04'-06'S, 56°52'-56°00'W, 1186-1230 m (x1); USNM 60192 (x18), CAS 005997 (x10) from Eltanin cruise 6, station 413, 62°07'-08'S, 55°58'-56°05'W, 1113-1153 m; CAS 009750 from Eltanin cruise 12, station 997, 61°44'-46'S, 55°56'-54'W, 769 m (x1)

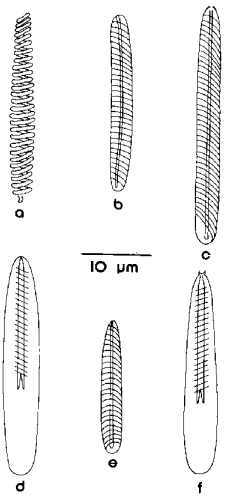

Fig. 69. Cnidae of Eltaninactis infundibulum; see text for explanation.

Other material examined

Eltanin Cruise 23

Sta. 1711, 41°45'-44'S, 178°05'-177°54'W, 2610-2668 m, USNM 60749 (x2)

Family LIPONEMATIDAE
Liponema multiporum Hertwig, 1882

Liponema multiporum: Hertwig, 1882a, p. 114; 1882b, p. 129; 1888, p. 17.
Bolocera multipora: Stephenson, 1922, p. 276.
Liponema brevicirrata: Carlgren, 1928a, p. 149; 1938, p. 42; 1945, p. 12; 1949, p. 55.
Liponema multipora: Carlgren, 1949, p. 54.

Description

Body form and size. Oral disc domed, margin extending proximally to or below level of pedal disc so animal is hemispherical (Figure 70); some individuals as much as 4 times as broad as tall, some less than half as wide as long; average width 65-80 mm. Column very short, strongly flared at oral end so that it is parallel to basal surface for most of its extent; no fosse. Texture firm; orange to rust red color.

Base. Pedal disc flat, circular, same color as column; with concentric circular furrows; generally half or less extent of oral disc (Figure 70).

Tentacles and oral disc. Tentacles same color as column and oral disc; longitudinally furrowed; proximal end narrow, may flare in center then taper to blunt end or be of constant width throughout; inner longer than outer; typical inner tentacle 15-20 mm long by 2 mm diameter at base. Tentacles deciduous (Figure 71) owing to strong endodermal tentacular sphincter muscle at base of each; cover entire oral disc nearly to mouth in intact state. Otherwise disc dotted with irregularly scattered pores (Figure 70); those near margin about 2 mm diameter, those near mouth usually larger; circular to ovoid, surrounded by raised rim; mesenterial filaments may protrude through them. No obvious pattern to tentacle/pore arrangement, but commonly several radially aligned over short distance, all communicating with one interseptal space; many hundred per animal. Mouth large, elongate, typically gaping in preserved material; prominent ribbed lips same color as oral disc.

Mesenteries and internal anatomy. Seven or eight cycles of mesenteries in average size animal; first two complete; all except directives and those of highest order may be fertile, but those of penultimate order commonly also sterile; dioecious; highest-order mesenteries may lack filaments, but all others have them. Two symmetrical directive pairs attach to siphonoglyphs, which extend nearly to base; actinopharynx sulcate, about half length of animal, same color as column and oral disc. Mesenteries with very small marginal stomata, no oral stomata detected; retractor muscles diffuse (Figure 72), not strongly developed; parietobasilar muscles hardly evident. One tentacle/tentacle pore communicates with each endocoel, at its oral end; multiple tentacles/pores communicate with each exocoel, in some cases being in staggered array or two abreast.

Endodermal marginal sphincter muscle diffuse (Figure 73), weak, only slightly better developed than general column circular musculature. Radial muscles of oral disc ectodermal, circular endodermal (Figure 73). Longitudinal tentacle musculature ectodermal, circular endodermal.

Distribution and size of cnidae (Fig. 74)

Tentacles
  Spirocysts(a), 32.0-65.6 x 2.5-4.9(6.6) µm, n = 48, N = 6/6
  basitrichs(b), 36.9-76.3(90.2) x 3.1-4.5 µm, n = 61, N = 6/6
  (cnidae of both types are larger at the tip than at the base of a tentacle)

Actinopharynx
  basitrichs(b), 38.5-59.9 x 3.3-4.3 µm, n = 101, N = 9/9

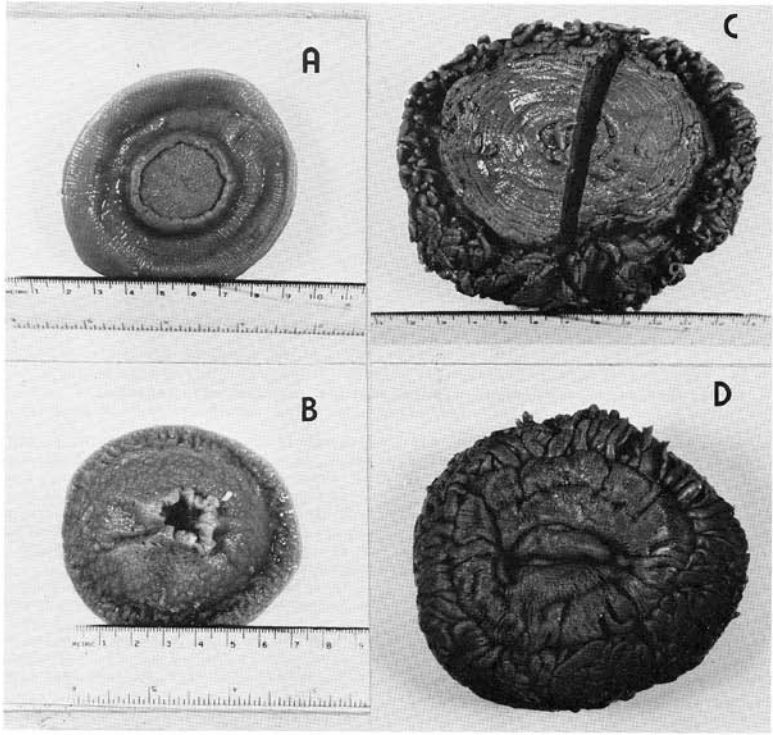

Fig. 70. Liponema multiporum; (a) and (b) USNM 60058, (c) and (d) from lot CAS 014141.

Mesenterial filaments
basitrichs(c), (18.9)20.5-27.9 x 2.3-3.3 μm, n = 61, N = 9/9
basitrichs(b), 31.2-56.6 x 3.1-4.9 μm, n = 74, N = 9/9
microbasic p-mastigophores(d), 24.6-31.2 x 3.7-5.3 μm, n = 37, N = 9/9

Column
basitrichs(e), 14.8-40.2 x 2.5-3.9 μm, n = 104, N = 9/9 (in some animals, these cnidae are separable into smaller and larger size classes, whereas in others, the range is continuous)

As seems typical of the genus [Dunn and Bakus, 1977], smaller individuals tend to have smaller cnidae.

This tabulation includes data from British Museum (Natural History) specimens 1889.11.25.35, holotype of Liponema multiporum from Challenger station 237, and 1889.11.25.72 from Challenger station 305A, both identified as L. multiporum by R. Hertwig.

Discussion

The hemispherical body form, and arrangement of deciduous tentacles (one communicating with each endocoel, many per exocoel), clearly mark the 28 USARP specimens listed below as belonging to the singular actinian genus Liponema. Two nominal species have been reported from southern seas, L. multiporum Hertwig, 1882a, b, type species of the genus by monotypy, and L. brevicirrata Carlgren, 1928a.

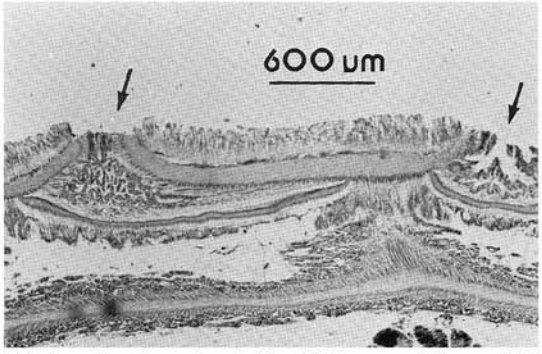

Fig. 71. Radial section through oral disc of Liponema multiporum (CAS 014140); arrows indicate pores that once communicated with now cast-off tentacles.

Contrary to my earlier statement [Dunn and Bakus, 1977], Hertwig did describe L. multiporum in 1882 [Hertwig, 1882a, p. 114, 1882b, p. 129]. The single, torn specimen that he had to examine was from Challenger station 237, at 34°N, 140°E, and 1875 fm. The description was very brief. The statement that 'more than one stomidium communicates with each radial chamber [Hertwig, 1882b, p. 129] does not seem to be borne out by the only figure of the animal, which shows a portion of the outer oral disc that appears to have an actiniid arrangement of tentacles. The holotype, BM(NH) 1889.11.25.35, exists, although it is, as Hertwig [1882b, p. 129] noted, in a condition '. . .most unfavourable for examination.' Nonetheless, study of a wedge representing about one-third of the type specimen, a female completely lacking tentacles, established that it is identical in gross anatomy and cnidae to the USARP specimens under consideration.

Hertwig's [1888] more detailed discussion of Liponema multiporum was based on examination of two additional specimens. I have studied the one from Challenger station 305A [illustrated in Plate I Figure 13, Hertwig, 1888], BM(NH) 1889.11.25.72, and have con-

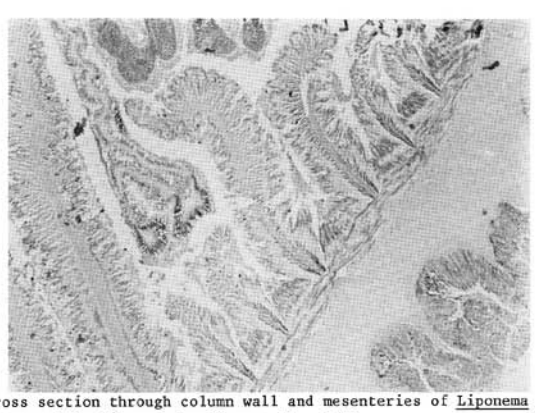

Fig. 72. Cross section through column wall and mesenteries of Liponema multiporum (USNM 60059); magnification as for Figures 71 and 73.

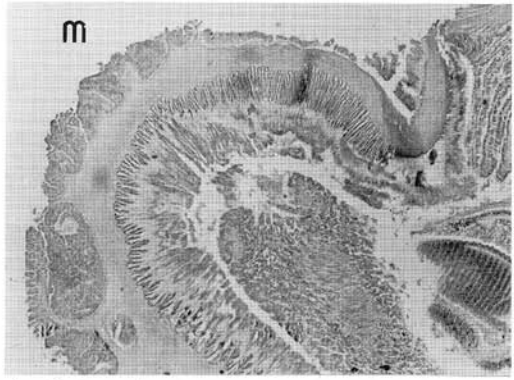

Fig. 73. Longitudinal section at margin (m) of Liponema multiporum (USNM 60059) showing diffuse endodermal sphincter; magnification as for Figures 71 and 72.

firmed that it, too, belongs to the same species as do the 28 USARP specimens.

Carlgren [1928a] described Liponema brevicirrata from off South Africa. His data on cnidae [Carlgren 1928a, 1938] fit mine from USARP specimens, although he found some slightly smaller capsules than I did in some classes of nematocysts. However, the actinopharynx cnidae listed by Carlgren in 1945 are very different and must be considered a lapsus; the animal on which measurements were made was from the type locality, German Deep-Sea Expedition station 103, where only two specimens were taken [Carlgren, 1928a], and other cnidae accord. His figure of the sphincter muscle [Carlgren, 1928a, text-Figure 11] is very much like my Figure 73. Carlgren [1928a] considered that sphincter form clearly separated L. brevicirrata from L. multiporum. The latter's sphincter muscle, according to the illustration by Hertwig [Plate II Figure 4, Hertwig, 1888] is much more circumscribed than any I have seen in Liponema, but clearly both of Hertwig's specimens that I examined were conspecific with the USARP specimens. Perhaps the specimen the sphincter of which is illustrated was abnormally strongly contracted.

The localities from which Hertwig's [1888] and Carlgren's [1928a] material came are compatible with the distribution of USARP specimens of Liponema brevicirrata. These 28 were taken as far north as 45°S, and around half of Antarctica, from 44°W west to 147°E. Based on these data, I strongly suspect that the provenance of Hertwig's original specimen was wrong. It is unfortunate that this constitutes the type locality.

Liponema brevicornis, which occurs in the northeast Pacific, is clearly separable from L. multiporum as a whole and from its holotype in particular [see Dunn and Bakus, 1977]. The limited data on cnidae of L. multicornis (Verrill, 1880) given by Carlgren [1921] do not differ significantly from those of L multiporum (although they do from those of L. brevicornis). Until more is known, it seems prudent to treat as distinct these two species that occur at opposite ends of the globe, despite their considerable similarity (indeed, all species of Liponema share a common morphology).

Six of the eight USARP lots were from depths around 3000 m, and the others were from 124-232 m. Hertwig's southern specimens were from 120 fm and 1600 fm. Thus a bathymetric discontinuity appears to be typical of the species. Carlgren [1949] opined that

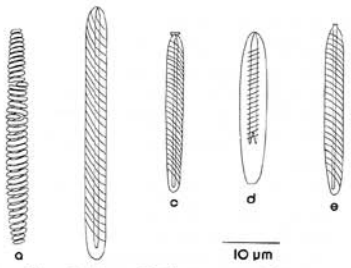

Fig. 74. Cnidae of Liponema multiporum; see text for explanation.

each of Hertwig's two specimens probably was a different species, but gave no reason for the speculation; perhaps it was because of the great difference in depth of capture (inexplicably, Carlgren [1949] cited the date of 'L. multipora' as 1882 but the localities of only the later two specimens). This is clearly a rare species, in contrast with the boreal L. brevicornis (McMurrich, 1893), which is the dominant benthic organism in the Gulf of Alaska [Dunn and Bakus, 1977].

Material examined (Fig. 19)

Eltanin Cruise 7

Sta. 514, 63°21'-28'S, 44°51'-57'W, 3587-3660 m, CAS 014140 (x3)

Eltanin Cruise 8

Sta. 610, 58°55'-54'S, 27°13'-06'W, 2553-2575 m, CAS 029633 (x2)

Eltanin Cruise 22

Sta. 1511, 59°01'-02'S, 52°00'-51°45'W, 3010-3510 m, USNM 60673 (x2)

Eltanin Cruise 23

Sta. 1711, 41°45'-44'S, 178°05'-177°54'W, 2610-2668 m, USNM 60689 (x2)

Eltanin Cruise 27

Sta. 1940, 67°24'S, 179°53'-54'W, 223-232 m, CAS 014141 (x6)
Sta. 1941, 67°24'-25'S, 179°54'W, 124-161 m, USNM 60672 (x8)
Sta. 1986, 45°33'-30'S, 147°18'-08'E, 2840-3001 m, USNM 60059 (x4)

Eltanin Cruise 32

Sta. 2113 73°19'S, 174°53'-52'W, 2897-2907 m, USNM 60058 (x1)

Previous records

Hertwig [1882a, b] Challenger station 237, 34°37'N, 140°32'E, 1875 fm (x1) (examined)
Hertwig [1888] Challenger station 305A, 47°47'00"-48'30"S, 74°47'-46'W, 120 fm (x1) (examined); Challenger station 147, 46°16'S, 48°27'E, 1600 fm (x1)
Carlgren [1928a, 1938] 33°10.5'S or 35°19.5'S (data in the two reports disagree), 23°02'E, 500 m (x2)

Acknowledgments. This work was supported by the Smithsonian Oceanographic Sorting Center's program 'Cooperative Systematics and Analyses of Polar Biological Materials' (National Science Foundation grant DPP 76-23979, B. J. Landrum, principal investigator) under contract PC-001394. I am indebted to Gordon Hendler and Betty J. Landrum of the Smithsonian Oceanographic Sorting Center for introducing me to the resources of the SOSC and making them available to me; Janet Pawlukiewcz of the SOSC has been a great help. Members of the Department of Invertebrate Zoology, California Academy of Sciences, without whose support this work have been impossible include Phoebe Grigg, cheerful secretary; Welton L. Lee, Chairman; Denise Ross, histologist. Special credit is due to Barbara Weitbrecht for illustrations of cnidae; my appreciation is also extended to Steve Sechovic for his artistry. Thanks, too, to More Downing of the Academy for photographic assistance, Nick Petrakis, University of California, San Francisco, for use of photomicrography equipment; and Paul Cornelius, British Museum (Natural History) and Gilbert L. Voss, University of Miami, for loan of type specimens. Comments by Cadet Hand and Karin Riemann-Zürneck greatly improved the manuscript.

References

Allen, R. H.
1963 Star names: Their lore and meaning. 563 pp. Dover, New York.
Andres, A.
1883 Le Attinie. 460 pp. Salviucci, Rome.
Belyaev, G. M.
1972 Hadal Bottom Fauna of the World Ocean. Engl. Transl. 199 pp., Israel Program for Scientific Translations, Jerusalem.
Belyaev, G. M., and A. N. Mironov.
1977 Bottom fauna of the west Pacific deep-sea trenches. Tr. Inst. Okeanol. AN SSSR, 108: 7-24.
Carlgren, O.
1891 Beiträge zur Kenntniss der Actinien-Gattung Bolocera Gosse. Ofv. K. Vetenskaps-Akad. Förh., 48(4): 241-250.
1893 Studien über nordische Actinien. K. Svenska Vetenskaps-Akad. Handl., 25(10): 1-148.
1911 Über Dactylanthus (Cystiactis) antarcticus (Clubb) zugleich ein Beitrag zur Phylogenie der Actiniarien. Wissen. Ergeb. Schwedischen Südpolar-Exp. 1901-1903, 6, Zool., 2(5): 1-31.
1914 On the genus Porponia and related genera, Scottish National Antarctic Expedition. Trans. R. Soc. Edinburgh, 50(1): 49-71.
1918 Die Mesenterienanordnung der Halcuriiden. Lunds Univ. Aarsskr., n.f. avd. 2, 14(29): 1-37.

1921 Actiniaria. I. Danish Ingolf-Exp., 5(9): 1-241.
1924 Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. XXI. Actiniaria from New Zealand and its subantarctic islands. Vidensk. Medd. Dansk. Naturh. Foren., 77: 179-261.
1927 Actiniaria and Zoantharia. Further Zool. Res. Swed. Ant. Exped. 1901-1903, 2(3): 1-102.
1928a Actiniaria der Deutschen Tiefsee-Expedition. Wissen. Ergeb. Deutschen Tiefsee-Exp. 1898-1899, 22(4): 123-266.
1928b Ceriantharier, Zoantharier och Actiniarier. Medd. Grön., 23(suppl.): 253-308.
1930 Antarctic and sub-Antarctic Actiniaria. Sci. Res. Norwegian Ant. Exp. 1927-1928 and 1928-1929, 7: 1-6.
1932 Die Ceriantharien, Zoantharien und Actiniarien des arktischen Gebietes. Fauna Arctica, 6(3): 255-266.
1933 The Godthaab Expedition 1928: Zoantharia and Actiniaria. Medd. Grön., 79(8): 1-55.
1938 South African Actiniaria and Zoantharia. K. Svenska Vetenskapsakad. Handl., ser. 3, 17(3): 1-148.
1939 Actiniaria and Zoantharia of the Scottish National Antarctic Expedition, 1902-1904. Trans. R. Soc. Edinburgh, 49(3): 791-800.
1940 A contribution to the knowledge of the structure and distribution of the cnidae in the Anthozoa. Lunds Univ. Aarssk., n.f. avd. 2, 36(3): 1-62.
1942 Actiniaria, II. Danish Ingolf-Exp., 5(12): 1-92.
1945 Further contributions to the knowledge of the cnidom in the Anthozoa especially in the Actiniaria. Lunds Univ. Aarsskr., n.f. avd. 2, 41(9): 1-24.
1949 A survey of the Ptychodactiaria, Corallimorpharia and Actiniaria. K. Svenska Vetenskapsakad. Handl., ser. 4, 1(1): 1-121.
1956 Actiniaria from depths exceeding 6000 meters. Galathea Rep., 2: 9-16.
1959 Corallimorpharia and Actiniaria with description of a new genus and species from Peru. Lunds Univ. Aarsskr., n.f. avd. 2, 56(6): 1-38.

Carlgren, O., and T. A. Stephenson.
1929 Actiniaria. Sci. Rep. Australasian Ant. Exp. 1911-14, ser. C (zool. and bot.), 9(2): 1-34.

Clubb, J. A.
1902 Actiniae, with an account of their peculiar brood chambers. Report. 'Southern Cross' Ant. Exp.: 294-309. Coll. of Nat. History, London.
1908 Coelentera. IV. Actiniae. Nat. Ant. Exp. 1901-1904, Nat. Hist., 4(zool.): 1-12.

Coughtrey, M.
1875 Description of a new species of Actinia. Trans. Proc. N. Z. Inst., 7: 280.

Dana, J. D.
1846 Zoophytes. U.S. Exploring Exp., 7: 1-740.
1849 Atlas. Zoophytes. U.S. Exploring Exp. Lea and Blanchard, Philadelphia.
1859 Synopsis of the Report on Zoophytes of the U.S. Exploring Expedition. 172 pp. New Haven.

Danielssen, D. C.
1890 Actinida. Norske Nordhavs-Exp. Zool., 19: 1-184.

Dayton, P.K., G. A. Robilliard, and R. T. Paine.
1970 Benthic faunal zonation as a result of anchor ice at McMurdo Sound, Antarctica. In M. W. Holdgate (Ed.) Antarctic Ecology, 1: 244-258. Academic, New York.

Dell, R. K.
1972 Antarctic benthos. Adv. Mar. Biol., 10: 1-216.

Dunn, D. F.
1975 Reproduction of the externally brooding sea anemone Epiactis prolifera Verrill, 1869. Biol. Bull., 148: 199-218.

Dunn, D. F., and G. J. Bakus.
1977 Redescription and ecology of Liponema brevicornis (McMurrich, 1893), with definition of the family Liponematidae (Coelenterata, Actiniaria). Astarte, 10: 77-85.

Dunn, D. F., F. S. Chia, and R. Levine.
1980 Nomenclature of Aulactinia (= Bunodactis), with description of Aulactinia incubans n. sp. (Coelenterata: Actiniaria), an internally brooding sea anemone from Puget Sound. Can. J. Zool., 58(11): 2071-2080.

Forbes, E.
1841 Contributions to British actinology. I. On Kapnea, a new helianthoid polype. Ann. Mag. Nat. Hist., 7: 81-85.

Gosse, P. H.
1860 A History of the British Sea-Anemones and Corals. 362 pp. Van Voorst, London.

Haddon, A. C.
1889 A revision of the British actiniae. I. Sci. Trans. R. Dublin Soc., ser. 2, 4: 297-361.

Hand, C.
1955 The sea anemones of central California, II. The endomyarian and mesomyarian anemones. Wasmann J. Biol., 13(1): 37-99.

Hargitt, C. W.
1914 The Anthozoa of the Woods Hole region. Bull. U.S. Bur. Fish., 32(for 1912): 225-254.
Heezen, B. C., and C. D. Hollister.
1971 The Face of the Deep. 659 pp. Oxford University Press, New York.
Hertwig, R.
1882a Die Actinien der Challengerexpedition. 119 pp. Gustav Fischer, Jena.
1882b Report on the Actiniaria dredged by H.M.S. Challenger during the years 1873-1876. Sci. Res. Voy. H.M.S. Challenger, Zoology, 6(1): 1-136.
1888 Report on the Actiniaria dredged by H.M.S. Challenger during the years 1873-1876, Supplement. Sci. Res. Voy. H.M.S. Challenger, Zoology, 26(3): 1-56.
Kwietniewski, C. R.
1896 Revision der Actinien, welche von Herrn Prof. Studer auf der Reise der Korvette Gazelle um die Erde gesammelt wurden. Jena. Zeit. Naturwiss., 30: 583-603.
Lemche, H., B. Hansen, F. J. Madsen, O. S. Tendall, and T. Wolff.
1976 Hadal life as analyzed from photographs. Vidensk. Medd. Dansk Naturh. Foren., 139: 263-336.
McMurrich, J. P.
1893 Report on the Actiniae collected by the United States Fish Commission Steamer Albatross during the winter of 1887-1888. Proc. U.S. Nat. Mus., 16(930): 119-216.
1904 The Actiniae of the Plate Collection. Zool. Jahrb., suppl., 6(2): 215-306.
Milne-Edwards, H.
1857 Ordre des zoanthaires. Histoire naturelle des coralliaires ou polypes proprement dits, 1: 221-310.
Neave, S. A.
1939a Nomenclator Zoologicus, vol. 1, A-C. 957 pp. Zoological Society, London.
1939b Nomenclator Zoologicus, vol. 2, D-L. 1025 pp. Zoological Society, London.
Pax, F.
1922 Diagnosen neuer Actiniarien aus der Ausbeute der Deutschen (1901-1903) und der Französischen (1908-1910) Südpolar-Expedition. Zool. Anz., 54(3/4): 74-92.
1923 Antarktische Aktinien aus der Ausbeute des 'Pourquoi pas.' Zool. Jahrb. Syst., 47(1/3): 1-28.
1926 Die aktinien der Deutschen Südpolar-Expedition 1901-1903. Deutsche Südpolar-Exp., 18(zool.10): 1-62.
Riemann-Zürneck, K.
1973 Actiniaria des Südwestatlantik, I. Hormathiidae. Helgo. Wissen. Meeres., 25: 273-325.
1979 Two disc-shaped deep sea Anthozoa from the Gulf of Biscay, with a survey of adaptation types in the Actiniaria. Zoomorphologie., 93: 227-243.
1980 Actiniaria des Südwestatlantik V. Bolocera, Isotealia, Isosicyonis (Actiniidae). Mitt. Hamb. Zool. Mus. Inst., 77: 19-33.
Roule, L.
1909 Hexactinides. Exp. Ant. Française (1903-1905), 19 pp.
Stephenson, T. A.
1918a Coelenterata, I. Actiniaria. Nat. Hist. Rep. Brit. Ant. ('Terra Nova') Exp. 1910, 5(1): 1-68.
1918b On certain Actiniaria collected off Ireland by the Irish Fisheries Department, during the years 1899-1913. Proc. R. Irish Acad., 34B(7): 106-164.
1920 On the classification of Actiniaria, I. Q. J. Microsc. Sci., n.s. 64(256): 425-574.
1922 On the classification of Actiniaria, III. Q. J. Microsc. Sci., n.s. 66(262): 247-319.
1928 The British Sea Anemones, vol. I. 148 pp. Ray Society, London.
Stuckey, F. G. A.
1909 On two anemones found in the neighbourhood of Wellington--Leiotealia thompsoni and Sagartia albocincta. Trans. N. Z. Inst., 41(for 1908): 370-374.
Studer, T.
1879 Zweite Abtheilung der Anthozoa polyactinia, welche während der Reise S. M. S. Corvette Gazelle um die Erde gesammelt wurden. Monatsb. Akad. Wissen. Berlin, 1879(for 1878): 524-550.
Thompson, W.
1853 Description of a new species of Corynactis. Proc. Zool. Soc. London, 21: 107-108.
Verrill, A. E.
1879 Notice of recent additions to the marine fauna of the eastern coast of North America, 5. Am. J. Sci., ser. 3, 17: 472-474.
1880 Notice of recent additions to the marine invertebrata of the northeastern coast of America, I. Proc. U.S. Nat. Mus., 2(for 1879): 165-205.
1882 Notice of the remarkable marine fauna occupying the outer banks off the southern coast of New England. Am. J. Sci., ser. 3, 23: 216-225.
1922 The Actinaria of the Canadian Arctic Expeditions, with notes on interesting species from Hudson Bay and other Canadian localities. Rep. Can. Arctic Exp. 1913-1918, 8(G): 89-164.

Widersten, B.
1976 Cerianthária, Zoanthidea, Corallimorpharia, and Actiniaria from the continental shelf and slope off the eastern coast of the United States. Fish. Bull., 74(4): 857-878.

Zamponi, M. O.
1978 La anemonofauna de Mar del Plata y localidades vecinas, II. La anemonas mesomyaria (Coelentherata[sic]: Actiniaria). Neotropica, 24(71): 21-26.

THE ANTARCTIC RESEARCH SERIES: STATEMENT OF OBJECTIVES

The Antarctic Research Series, an outgrowth of research done in the Antarctic during the International Geophysical Year, was begun early in 1963 with a grant from the National Science Foundation to AGU. It is a book series designed to serve scientists and graduate students actively engaged in Antarctic or closely related research and others versed in the biological or physical sciences. It provides a continuing, authoritative medium for the presentation of extensive and detailed scientific research results from Antarctica, particularly the results of the United States Antarctic Research Program.

Most Antarctic research results are, and will continue to be, published in the standard disciplinary journals. However, the difficulty and expense of conducting experiments in Antarctica make it prudent to publish as fully as possible the methods, data, and results of Antarctic research projects so that the scientific community has maximum opportunity to evaluate these projects and so that full information is permanently and readily available. Thus the coverage of the subjects is expected to be more extensive than is possible in the journal literature.

The series is designed to complement Antarctic field work, much of which is in cooperative, interdisciplinary projects. The Antarctic Research Series encourages the collection of papers on specific geographic areas (such as the East Antarctic Plateau or the Weddell Sea). On the other hand, many volumes focus on particular disciplines, including marine biology, oceanology, meteorology, upper atmosphere physics, terrestrial biology, snow and ice, human adaptability, and geology.

Priorities for publication are set by the Board of Associate Editors. Preference is given to research projects funded by U.S. agencies, long manuscripts, and manuscripts that are not readily publishable elsewhere in journals that reach a suitable reading audience. The series serves to emphasize the U.S. Antarctic Research Program, thus performing much the same function as the more formal expedition reports of most of the other countries with national Antarctic research programs.

The standards of scientific excellence expected for the series are maintained by the review criteria established for the AGU publications program. The Board of Associate Editors works with the individual editors of each volume to assure that the objectives of the series are met, that the best possible papers are presented, and that publication is achieved in a timely manner. Each paper is critically reviewed by two or more expert referees.

The format of the series, which breaks with the traditional hard-cover book design, provides for rapid publication as the results become available while still maintaining identification with specific topical volumes. Approved manuscripts are assigned to a volume according to the subject matter covered; the individual manuscript (or group of short manuscripts) is produced as a soft cover 'minibook' as soon as it is ready. Each minibook is numbered as part of a specific volume. When the last paper in a volume is released, the appropriate title pages, table of contents, and other prefatory matter are printed and sent to those who have standing orders to the series. The minibook series is more useful to researchers, and more satisfying to authors, than a volume that could be delayed for years waiting for all the papers to be assembled. The Board of Associate Editors can publish an entire volume at one time in hard cover when availability of all manuscripts within a short time can be guaranteed.

BOARD OF ASSOCIATE EDITORS
ANTARCTIC RESEARCH SERIES