HYDROIDS FROM THE JOHN MURRAY EXPEDTION TO THE INDIAN OCEAN, WITH REVISORY NOTES ON *HYDRODENDRON, ABIETINELLA, CRYPTOLARIA* AND *ZYGOPHYLAX* (CNIDARIA: HYDROZOA)

by

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and

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Rees, W. J. & W. Vervoort: Hydroids from the John Murray Expedition to the Indian Ocean, with revisory notes on *Hydrodendron, Abietinella, Cryptolaria* and *Zygophylax* (Cnidaria, Hydrozoa).

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Key words: Cnidaria; Hydrozoa; genera; relationships, new species; deep-water fauna Indian Ocean.

Fourty-four species and one variety of hydroids were identified in the John Murray hydroid collection, obtained from the Gulf of Aden, the Arabian Sea and the northern part of the Indian Ocean, largely from deep water localities. Of these 44 species 2 could be identified only to genus, 1 species is doubtfully mentioned and 5 are new to science. The 44 species we assigned to 2 families of athecate and 6 families of thecate hydroids. In many instances the species have been compared with the type material which, where necessary, was redescribed. A number of additional species, not represented in the John Murray collection has also been redescribed and/or figured. Practically all the John Murray hydroids are figured. Deposition of spirit-preserved type and other material (alc.), including microslide preparations (slds) in the collections of the British Museum (Natural History) (BMNH) and in the collections of the Rijksmuseum van Natuurlijke Historie (National Museum of Natural History), Leiden, Netherlands (RMNH), is indicated. Holotypes, and where necessary paratypes, have been indicated of *Zygophylax millardae* sp. nov., *Zygophylax tottoni* sp. nov., *Sertularella whitei* sp. nov., *Cladocarpus indicus* sp. nov., and *Cladocarpus sewelli* sp. nov. Holotype and paratype material of all these species has been deposited in the BMNH collections, Department of Zoology; schizoholotypes and some of the paratypes have been placed in the Coelenterate collection of the RMNH.

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INTRODUCTION

The John Murray hydroid collection had originally been entrusted to Dr W.J. Rees, at that time curator of the coelenterate collection, BMNH, for scientific study. At the beginning of 1966 Dr Rees suggested to the second author to prepare a joint paper on this important and interesting collection: the material had at that time been provisionally sorted by his assistant Mr E. White and a number of microslide preparations had been prepared. Dr Rees's untimely death in 1967 made it necessary to continue single handed with our joint venture. A large number of additional microslides preparations had been made and a voluminous bundle of notes on the various species, the majority of which had been identified, had been accumulated. Due to unforseen circumstances, involving a period of intensive administrative work, the project progressed very slowly and dragged on until the middle of 1982, when I could devote all my time and energy to the preparation of the final manuscript. In writing up the final report I borrowed freely from the massive files of notes left by Dr Rees; and I also profited largely from the many discussions on hydroid taxonomy I had with Dr Rees and later with his successor in the BMNH, Dr P.F.S. Cornelius.

William J. Rees, born July 2 1913, graduated from the University of Aberystwyth in 1933 and was awarded a DSc in 1942. Having worked on the helminth parasites of molluscs at Aberystwyth for some years he became a research student at the Plymouth Laboratory of the Marine Biological Association of the United Kingdom in 1936, where he started his research on the life cycles of Hydrozoa in cooperation with F.S. (later Sir Frederick) Russell. From 1940 to 1946 he served with the Royal Air Force Volunteer Reserve. He was appointed to the scientific staff of the British Museum (Natural History) in 1946. Here he was in charge of the Mollusc Section until 1954, when he transferred to be head of the Coelenterate Section. He resumed his research on hydroids and hydromedusae, becoming an acknowledged authority on both groups. He did not, however, lose his interest in Mollusca, serving as President of the Malacological Society from 1963 to 1966: his presidential address in 1966 was devoted to the symbiotic associations of Cnidaria with Mollusca. He died unexpectedly on October 12 1967, at the age of 54. (W. Vervoort)

LIST OF STATIONS AND SPECIES COLLECTED

Sta. 10. Red Sea, 13° 31′ 00″ N, 42° 31′ 00″ E, 17 Sep. 1933, Otter trawl, 55 m: *Gymnangium eximium* (Allman).

Sta. 24. Gulf of Aden, off Cape Guardafui, 11° 53′ 42″ N, 51° 13′ 12″ E, 9 Oct. 1933, Otter trawl, 73-200 m: *Hydrodendron dichotomum* (Allman), *Hebella scandens* (Bale) var. *contorta* Marktanner-Turneretscher, *Synthecium megathecum* Billard var. *parvulum* Billard, *Salacia tetracythara* Lamouroux, *Sertularella dubia* Billard, *Halopteris campanula* (Busk), *Cladocarpus alatus* Jarvis, *Gymnangium eximium* (Allman), *Lytocarpia flexuosa flexuosa* (Lamouroux).

Sta. 27. Gulf of Aden, off Bandar Alula, Somalia, 11° 57′ 12″ – 11° 56′ 42″ N, 50° 35′ 00″ – 50° 39′ 12″ E, 12 Oct. 1933, Otter trawl, 37-91 m: *Halecium labiatum* Billard, *Filellum serratum* (Clarke), *Synthecium patulum* (Busk), *Macrorhynchia philippina* (Kirchenpauer), unidentifiable hydroid.

Sta. 37. Gulf of Aden, 12° 47′ 30″ – 12° 50′ 00″ N, 45° 04′ 30″ – 45° 05′ 00″ E, 17 Oct. 1933, Otter trawl, 18-22 m: *Dynamena crisioides* Lamouroux.

Sta. 45. Off Oman, 18° 03′ 30″ N, 57° 02′ 30″ E, 29 Oct. 1933, triangular dredge, 4′, 38 m: *Solanderia procumbens* (Carter), *Sertularella dubia* Billard, *Sertularia turbinata* (Lamouroux), *Gymnangium eximium* (Allman), *Gymnangium ferlusi* (Billard), *Gymnangium hians* (Busk), *Lytocarpia flexuosa flexuosa* (Lamouroux), unidentifiable hydroid.

Sta. 53. Off Oman, 19° 22′ 36″ N, 57° 53′ 00″ E, 2 Nov. 1933, triangular dredge, 4′, 13.5 m: *Gymnangium eximium* (Allman).

Sta. 54. Off Oman, 21° 50′ 00″ N, 59° 52′ 00″ E, 3 Nov. 1933, Agassiz trawl, 1046 m: *Halecium delicatulum* Coughtrey, *Halisiphonia megalotheca* Allman, *Zygophylax tottoni* sp. nov., *Sertularella whitei* sp. nov., *Kirchenpaueria triangulata* (Totton), unidentifiable hydroid.

Sta. 80. Off Oman, 22° 13′ 30″ N, 59° 48′ 48″ E, 30 Nov. 1933, "Salpa" dredge, 4′, 16-22 m: *Clytia linearis* (Thornely).

Sta. 106. Off Zanzibar, 05° 38′ 54″ – 05° 40′ 18″ S, 39° 15′ 42″ – 39° 17′ 36″ E, 12 Jan. 1934, Agassiz trawl, 183-194 m: *Cladocarpus dolfeini* (Stechow), *Gymnangium gracilicaule* (Jäderholm).

Sta. 107. Zanzibar area, between Pemba and Tanganyika, 05° 15′ 30″ – 05° 17′ 14″ S, 39° 33′ 00″ – 39° 32′ 48″ E, 12 Jan. 1934, Agassiz trawl, 421-457 m: *Kirchenpaueria triangulata* (Totton), *Cladocarpus dofleini* (Stechow), *Gymnangium gracilicaule* (Jäderholm).

Sta. 111. Zanzibar area, off Tanganyika coast, opposite Pemba, 05° 04′ 18″ S, 39° 14′ 12″ E, 14 Jan. 1934, Agassiz trawl, 73-165 m: *Acryptolaria conferta australis* (Ritchie), *Hebella* sp., *Lafoea dumosa* (Fleming), *Zygophylax millardae* sp. nov., *Synthecium megathecum* Billard, *Antennella varians* (Billard), *Halopteris buskii* (Bale).

Sta. 112. Zanzibar area, off Tanganyika coast, opposite Pemba, 05° 04′ 57″ S, 39° 13′ 18″ E, 15 Jan. 1934, modified "Petersen" grab, 113 m: *Halecium* cf. *beanii* (Johnston), *Halecium delicatulum* Coughtrey, *Zygophylax cyathifera* (Allman), *Zygophylax millardae* sp. nov., *Zygophylax profunda* Quelch, *Synthecium patulum* (Busk), *Synthecium megathecum* Billard, *Antennella secundaria* (Gmelin), *Halopteris buskii* (Bale), unidentifiable hydroid.

Sta. 113. Zanzibar area, off Tanganyika coast, opposite Pemba, 05° 05′ 17″ S, 39° 13′ 39″ E, 15 Jan.

1934, grab, 220 m: *Plumularia antonbruuni* Millard, *Gymnangium gracilicaule* (Jäderholm), unidentifiable hydroid.

Sta. 118. Indian Ocean off Mombasa, Kenya, 04° 05′ 44″ – 04° 17′ 00″ S, 41° 10′ 12″ – 41° 11′ 48″ E, 17 Jan. 1934, Agassiz trawl, 1789 m: *Cladocarpus distomus* Clarke, *Gymnangium eximium* (Allman).

Sta. 120. Indian Ocean off Zanzibar, 05° 49′ 12″ – 05° 52′ 24″ S, 41° 28′ 12″ – 41° 40′ 12″ E, 20 Jan. 1934, Agassiz trawl, 2926 m: *Gymnangium eximium* (Allman)

Sta. 122. Zanzibar area, between Pemba and Tanganyika, 05° 21′ 24″ – 05° 22′ 36″ S, 39° 23′ 00″ – 39° 22′ 18″ E, 22 Jan. 1934, Otter trawl, 732 m: *Halecium* sp., *Lafoea dumosa* (Fleming), unidentifiable hydroid.

Sta. 124. Between Zanzibar and Pemba, 05° 39′ 00″ – 05° 39′ 12″ S, 39° 39′ 24″ – 39° 42′ 12″ E, 23 Jan. 1934, Monegasque trawl, 914 m: *Gymnangium expansum* (Jäderholm).

Sta. 146. Near Maldive Islands, 04° 50′ 18″ – 04° 53′ 00″ N, 72° 52′ 48″ – 72° 55′ 24″ E, 2 Apr. 1934, Otter trawl, 37 m: *Corydendrium parasiticum* (Linnaeus).

Sta. 157. Near Maldive Islands, 04° 43′ 48″ – 04° 44′ 00″ N, 72° 55′ 24″ – 72° 54′ 18″ E, 6 Apr. 1934, triangular dredge, 4′, 229 m: *Lafoea dumosa* (Fleming), *Nemertesia ramosa* Lamouroux, unidentifiable hydroid.

Sta. 159. Near Maldive Islands, 04° 47′ 30″ – 04° 48′ 00″ N, 72° 45′ 18″ – 72° 46′ 42″ E, 7 Apr. 1934, Monegasque trawl, 914-1463 m: *Cladocarpus indicus* sp. nov.

Sta. 178. Gulf of Aden, off Bandar Alula, Somalia, 12° 00′ 36″ N, 50° 40′ 06″ E, 2 May 1934, grab, 91 m: *Cladocarpus dofleini* (Stechow), *Cladocarpus sewelli* sp. nov.

Locality unkown: *Gymnangium eximium* (Allman).

LIST OF ABBREVIATIONS

AHM	Allan Hancock Museum, Allan Hancock Foundation, University of Southern California, Los Angeles, California, U.S.A.
AMS	Australian Museum, Sydney, Australia.
BCPM	British Columbia Provincial Museum, Victoria, B.C., Canada.
BMNH	British Museum (Natural History), London, U.K.
IMC	Indian Museum, Calcutta, India.
IRSN	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.
ITZ	Instituut voor Taxonomische Zoologie (Zoologisch Museum), University of Amsterdam, The Netherlands.
MCZ	Museum of Comparative Zoology (The Agassiz Museum), Harvard University, Cambridge, Massachusetts, U.S.A.
MNH	Muséum national d'Histoire Naturelle, Paris, France.
MOM	Musée Océanographique, Institut Océanographique, Monaco.
MVM	Museum of Victoria, Melbourne, Victoria, Australia.
NMNH	National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A.

NMW	Naturhistorisches Museum Wien, Vienna, Austria.
NRS	Naturhistoriska Riksmuseet, Stockholm, Sweden.
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands (now part of the Museums of Geology and Mineralogy & Natural History, Rijksmuseum van Geologie en Mineralogie & Natuurlijke Historie, Leiden, The Netherlands).
RSM	Royal Scottish Museum, Edinburgh, U.K.
SAM	South African Museum, Cape Town, South Africa.
YPM	Peabody Museum of Natural History, Yale University, New Haven, Connecticut, U.S.A.
ZMC	Zoologisk Museum, Universitet, København (Copenhagen), Denmark.
ZMO	Zoologisk Museum, Universitet, Oslo, Norway.
ZMU	Zoologiska Museet, Universitet, Uppsala, Sweden.
ZSI	Zoological Survey of India, Calcutta, India.
ZSM	Zoologische Staatssammlung München, Munich, F.R.G.

TAXONOMIC SECTION

Family Solanderiidae Marshall, 1892

Solanderia procumbens (Carter, 1873)

Ceratella procumbens Carter, 1873: 10-11.
Ceratella spinosa Carter, 1873: 12.
Solanderia atrorubens: Marshall, 1892: 12-13, pl. 5, pl. 7 figs. 2-4.
Solanderia procumbens: Vervoort, 1962: 535-536; Millard, 1966a: 444-448, text-fig. 4, pl. 1; Day, Field & Penrith, 1970: 12; Bouillon, 1974: 137; Millard, 1975: 59-61, fig. 22; Millard, 1978: 198.
Solanderia spinosa: Vervoort, 1962: 535.

Material examined. – Sta. 45. A single branch, 85 mm long, spread 35 mm. Dead on collection, lacking soft parts, partly covered by Foraminifera (BMNH 1984.1.1.1, alc.; RMNH 16501, sld.).

Description. – The present specimen tallies with Millard's description of form B (Millard, 1966a: 446), particularly in the arrangement of the hydrophores (predominantly in two opposite rows with the exception of irregularities on the thicker branches and the stem) and in their structure (usually of the double type described by Millard, that is, composed of two separate wings with smooth margins). The reticulate structure of stem and branches is also visible on the hydrophore but the raised ribs that form this structure do not continue beyond its rim. Spines are present but are restricted to some isolated areas only. The specimen was reddish brown. Soft parts lacking.

Distribution. – Considered by Millard (1975: 61) to be endemic to South Africa ("west coast of Cape Peninsula to Natal in 12-130 m"). The present record shows that the distribution of this species extends north to include the northern part of the Indian Ocean, off the southern Arabian coast.

Remarks. – We have re-inspected the BMNH syntype material of *Ceratella*

procumbens Carter, consisting of four dried colonies and five microslide preparations. The four dried colonies were all in one box with two labels:

"*Ceratella procumbens* Carter. C. of Good Hope and Algoa Bay, Natal, 1867.3.22.1 and 1872.8.1.1. Type", and

"*Ceratella procumbens* Carter, type, C. Good Hope, 1867.3.22.1. Miss Gatty (P.) & Natal, 1872.8.1.1. Col. Bolten (P.)".

The four specimens and the microslide preparations can be described as follows:

1. Marked 261 on base; 1867.3.22.1 on label. Height 165 mm, spread 85 mm. Basal part of stem flattened, 25 mm wide and 2.5-3.0 mm thick, dark brown. Tips of branches rounded. Major branches also flattened. Whole colony fan shaped. Apparently a heavily beach-worn specimen in which the hydrophores are only visible in protected areas. No spines found.

2. Marked 1872.8.1.1 on a white, glued on label. Height 265 mm, spread 105 mm. Two flattened main branches, one of which forks after 80 mm. Apparently quite fresh when collected, with hydrophores distinct on all younger branches but less distinct on older stems. No spines seen. Colony fan shaped. Designated lectotype by Millard (1966a: 446-448).

3. Specimen marked 1872.8.1.1, height 125 mm, spread 115 mm. Various branches rising from flattened basal portion. No spines observed. Beach-worn specimen with hydrophores visible only in protected areas.

4. Specimen marked 1872.8.1.1, height 95 mm, spread 50 mm. Similar in shape and structure to specimen no. 3.

Slide a. "*Ceratella procumbens* Carter, type, 1872.8.1.1, Natal, Col. Bolton". Fragment of strongly worn specimen.

Slide b. Identical markings. Very probably from lectotype since hydrophores are very conspicuous.

Slide c. "*Ceratella procumbens* Carter, Algoa Bay, 1877.5.21.209". Beach-worn specimen.

Slide d. Identical markings. Specimen with very distinct hydrophores.

Slide e. "*Ceratella procumbens* Carter. Part of specimen returned from Australian Museum labelled *Dehitella atrorubens*". (No BMNH registration number).

The holotype of *Ceratella spinosa* Carter, 1873, is also present in the BMNH under the number 1872.8.1.17. It is a dried specimen 105 mm high and 40 mm across. Distinct spines were visible only on the older, protected parts of the colony. The hydrophores are partly developed and have probably suffered from erosion.

We have followed Millard (1966a) in referring this species to *Ceratella* (= *Solanderia*) *procumbens*. Part of the material of *Solanderia atrorubens* descri-

bed and figured by Marshall (1892) also belongs to *S. procumbens* and not to *Dehitella* (= *Solanderia*) *atrorubens* Gray, 1868, a doubtful species that may be identical with *Solanderia fusca* (Gray, 1868) (see Vervoort, 1962; Millard, 1966a, 1975).

Family Clavidae McCrady, 1859

Corydendrium parasiticum (Linnaeus, 1767)

Sertularia parasitica Linnaeus, 1767: 1315-1316.
Soleniopsis dendriformis Ritchie, 1907a: 489, 495-498, text-figs. 142-143, pl. 26 fig. 1.
Corydendrium dendriforme: Gravely, 1927: 7, pl. 2 fig. 2; Kramp, 1935a: 11; Leloup, 1937b: 4, 10-11, fig. 3; Leloup, 1940b: 4; Dawydoff, 1952: 54; Rees & Thursfield, 1965: 50-51, 196; Smaldon, Heppell & Watt, 1976: 11.
Corydendrium parasiticum: Vervoort, 1941: 193; Vervoort, 1946a: 292-293; Millard, 1959a: 301-302; Rees & Thursfield, 1965: 49; Hirohito, 1969: 1-2, fig. 1; Glätzer, 1971: 213-280, figs. 1-28; Rossi, 1971: 20, figs 6L, 6L'; Schmidt, 1972a: 42, 44; Millard & Bouillon, 1973: 6, 27-28; Millard & Bouillon, 1974: 3; Millard, 1975: 72, fig. 24B-D; Wedler, 1975: 333, 339-340; Millard, 1978 : 191; Hirohito, 1983: 9.

Material examined. – Sta. 146. A single monosiphonic fragment; no gonophores (BMNH 1984.1.1.2, sld.).

Distribution. – Widely distributed throughout the tropics and subtropics, including the Mediterranean, Cape Verde Islands, South Africa, Seychelles, India, Indo-China, the Malay Archipelago and Japan (Vervoort, 1941; Millard, 1975). The present record, in the Maldive area, is from the presently known area of distribution.

Remarks. – In referring *Soleniopsis dendriformis* Ritchie [= *Corydendrium dendriforme* (Ritchie, 1907b)] to the present species we have followed Vervoort (1941), Hirohito (1969), Millard & Bouillon (1973), and Millard (1975). These authors concluded from the variation in a fairly extensive material that the two forms cannot be separated specifically, in spite of the arguments put by Ritchie (1910b: 803) and Rees & Thursfield (1965: 50-51). *Corydendrium sessile* Ritchie (1910a: 800, 802-803, pl. 76 figs. 1-2), based on material from the Mergui Archipelago, may also prove conspecific.

Family Haleciidae, Hincks, 1868

Genus **Hydrodendron** Hincks, 1874a.

In this genus we have united all species of Haleciidae with a combination of

a reduced gonophore (sporosac) and protective polyps in the form of nematophores with or without nematothecae. The genus *Hydrodendron* Hincks (1874a: 132), gender: neuter; type species, by monotypy, *Halecium gorgonoide* G.O. Sars, 1874, thus includes the genera *Diplocyathus* Allman (1888: 16-17), type species, by monotypy, *Diplocyathus dichotomus* Allman, 1888; *Phylactotheca* Stechow (1913b: 155), type species, by monotypy, *Phylactotheca pacifica* Stechow, 1913b; *Ophiodissa* Stechow [1919: 41-42, replacement name for *Ophiodes* Hincks (1866b: 421, preocc.)], type species, by monotypy, *Ophiodes mirabilis* Hincks, 1866b; *Ophinella* Stechow [1919: 107, replacement name for *Ophionema* Hincks (1874a: 131, preocc.)], type species, by monotypy, *Ophiodes parasitica* G.O. Sars, 1874; and *Scoresbia* Watson (1969: 111), type species, by monotypy, *Scoresbia daidala* Watson, 1969. The genus *Hydrodendron* thus defined shows the same range of colony structure and of development of hydrophore and hydrotheca as is seen in *Halecium* Oken, 1815 [type species: *Sertularia halecina* Linnaeus, 1758, see Cornelius (1975b: 390, footnote; 1976: 252-254) for the use of the generic name *Halecium* Oken, 1815, in spite of the fact that Oken, 1815, was placed on the list of rejected works; Cornelius's application has since been approved by the International Commission on Zoological Nomenclature (Anonymous, 1982)].

Hydrodendron, and also *Halecium*, include species with separate gonothecae as well as those that have gonothecae united to form a "glomulus" (term taken from Naumov, 1960: 40, see Millard, 1977a:11). There is only a single species, *Hydrodendron gorgonoide* (G.O. Sars), in which the nematotheca is almost fully reduced (Bonnevie, 1898: 11), leaving the nematophores nearly uncovered: in the remaining species the length of the nematotheca and its exact shape are distinctly varied, both inter- and intra-specifically. In our opinion it seems ill-advised to recognize genera among nematophorate Haleciidae based exclusively on differing nematothecal development while not paying attention to the great diversity in shape and arrangement of the gonothecae. A similar heterogeneity in gonothecal structure is observed in *Halecium*, which so far has escaped subdivision. If *Halecium* and *Hydrodendron* are subdivided in the future – and this seems quite likely to be useful sooner or later – the characters afforded by the gonosome would provide adequate grounds. The inclusion of *Ophiodissa* in *Hydrodendron* is contrary to opinions previously expressed by Vervoort (1959: 220; 1972a: 25) and Cornelius (1975b: 414). Cornelius recognized the somewhat arbitrary limits of the genera of nematophorate Haleciidae and quoted the necessity expressed by Watson (1969: 111-112) for a review of these genera.

Hydrodendron, in its present composition, shows affinities with *Halecium*, *Zygophylax* (Lafoeidae) and *Plumularia* (Plumulariidae). A single species, *H.*

dichotomum (Allman, 1888), occurs in the John Murray collection.

Hydrodendron dichotomum (Allman, 1888)
(figs. 1-3, tab. 1)

Diplocyathus dichotomus Allman, 1888: 17-18, pl. 17 figs. 1-3; Kirkpatrick, 1890b: 604; Billard, 1929a: 71, fig. 1b, c; Leloup, 1939: 5; Yamada, 1959: 35.
Ophiodes dichotomus: Billard, 1910: 4; Jäderholm, 1916: 4-5, fig. 1.
Hydrodendron dichotomus: Pennycuik, 1959: 155; Hirohito, 1983: 13.
non *Diplocyathus dichotomus*: Leloup, 1938: 5-6, text-fig. 2, pl. 1 fig. 2 (= *Hydrodendron leloupi* Hirohito, 1983, see: 22).

Material examined. – Sta. 24. Several fragments 50-70 mm high, representing a large colony consisting of a matting of irregularly intertwining and anastomosing hydrocauli and branches from which arise several irregular, plate-shaped or tubiform masses of hydrocauli. Basal matting dark ochre-brown; elevated portions yellowish brown. No gonothecae observed (BMNH 1984.1.1.3, alc. + sld.; RMNH 16506, alc. + 2 slds).

Description. – Large and fragmented colony comprising intertwining and anastomosing hydrocauli, composed largely of well demarcated internodes. Older parts of colony with hydrocauline internodes fairly thick, with strong, thick perisarc but without secondary tubules: consequently even here hydrocauli monosiphonic. Hydrocauline internodes slender, separated by straight to slightly oblique septa, terminally with two distinct apophyses pointing in opposing directions, lower and smaller being the hydrotheca-bearing hydrophore; upper and larger bearing next internode (fig. 1a, b). Hydrocauli strongly geniculate, except in younger parts; in oldest hydrocauli septa have disappeared; internodes still visible from persistent perisarcal constrictions. Non-hydrothecate, intermediate internodes common. Branches developing directly under hydrophore of large internode; branching distinctly dichotomous, frequent. Dichotomous branching brought about by divergence at obtuse angle of stem and branch, both originating from apophyses and originally enclosing hydrotheca with its nematotheca (fig. 1d); this process of branching may be repeated several times.

Hydrophores with their hydrothecae on apical portion of internodes. Axillary nematotheca between hydrophore and internodal apophysis. Primary hydrotheca vase-shaped, with almost smooth walls, gradually widening towards slightly everted margin; aperture circular (fig. 1c, e). Basal part of abcauline wall internally with perisarcal thickening from which thin, slightly oblique membrane originates (see Billard, 1929a: 71, fig. 1B); hydranth attached to upper third of hydrotheca: no desmocytes observed. Number of primary hydrothecae reduced. Usually internodes bear secondary hydrothe-

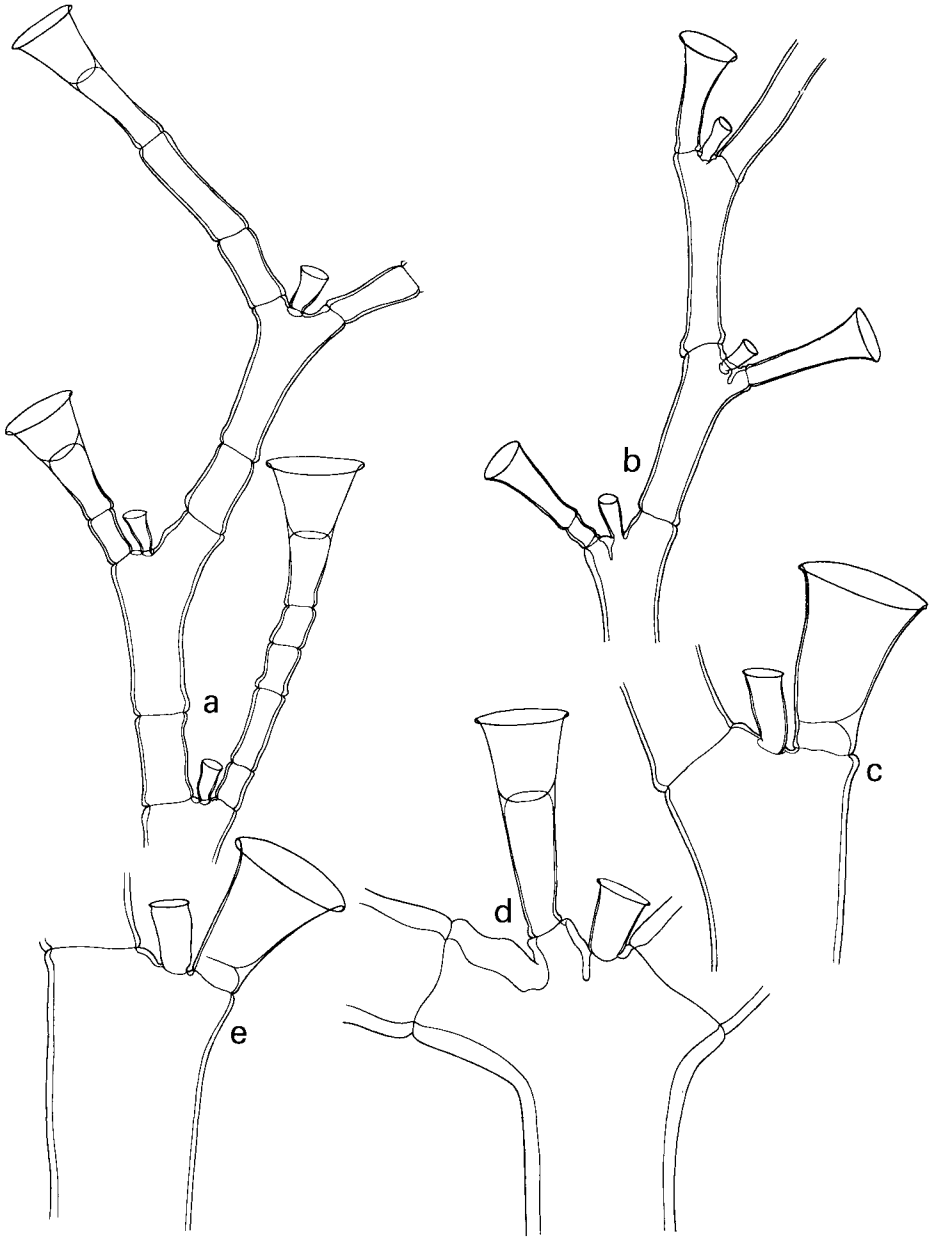


Fig. 1. *Hydrodendron dichotomum* (Allman), John Murray Exped., Sta. 24. a, terminal part of branch with renovated hydrothecae; b, internodes from side branch with primary hydrothecae and nematothecae; c, primary hydrotheca with axillary nematotheca; d, secondary (renovated) hydrotheca; e, primary hydrotheca with axillary nematotheca. a, b x 55; c-e x 85.

cae, differing from primaries in superior length and absence of perisarcal thickening. Moreover, secondary hydrothecae with distinct but fine internal membrane at about half their length, originating from thickened ring inside theca and apparently serving for attachment of base of hydranth (fig. 1a, d). No desmocytes seen on renovated hydrothecae. Hydrothecae with one to several intermediate "segments" common and probably indicating repeated renovation (fig. 1a). Some secondary hydrothecae greatly lengthened and almost trumpet-shaped. Sometimes distinct dilation at basal part of secondary hydrotheca, though never as strongly developed as figured by Billard (1929a, fig. 1C).

Nematophores restricted to hydrothecal axil and protected by a cup-shaped nematotheca with slightly everted margin, slightly inferior to half hydrothecal length. Both renovated hydrothecae and nematothecae greatly varied in length, being cup-shaped to trumpet-shaped, with or without swollen basal portion. Mode of eversion of hydro- and nematothecal margins varied; some thecae strongly flared (fig. 1a-e). Distinct perisarcal fold present between openings in internode leading to hydrotheca and nematothecae (fig. 1b).

No gonothecae were seen.

	John Murray Exped. Sta. 24
Stem internode	
length	460 – 710
maximum diameter	85 – 125
Primary hydrotheca	
total length	175 – 200
breadth at rim	135 – 155
Secondary hydrotheca	
total length, including intermediate segment	335 – 425
breadth at rim	140 – 175
Nematotheca	
total length	90 – 120
breadth at rim	50 – 60

Table 1. *Hydrodendron dichotomum*. Measurements in μm.

Distribution. – *Hydrodendron dichotomum* is known only from the Indo-West Pacific. The recorded localities are as follows: off Somerset, Cape York, Torres Strait, 15-22 m (Allman, 1888, type locality, as *Diplocyathus dichotomus*); Murray Island, Mabuiag Reef, Torres Strait, 27-37 m (Kirkpatrick, 1890b, as *Diplocyathus dichotomus*, specimen also mentioned below); Port Darwin, North Australia (no depth data, specimen mentioned below); 75 km WSW of Cape Jaubert, Western Australia, 18 m (Jäderholm, 1916, as *Ophiodes dichotomus*). Billard (1929a, as *Diplocyathus dichotomus*) mentioned speci-

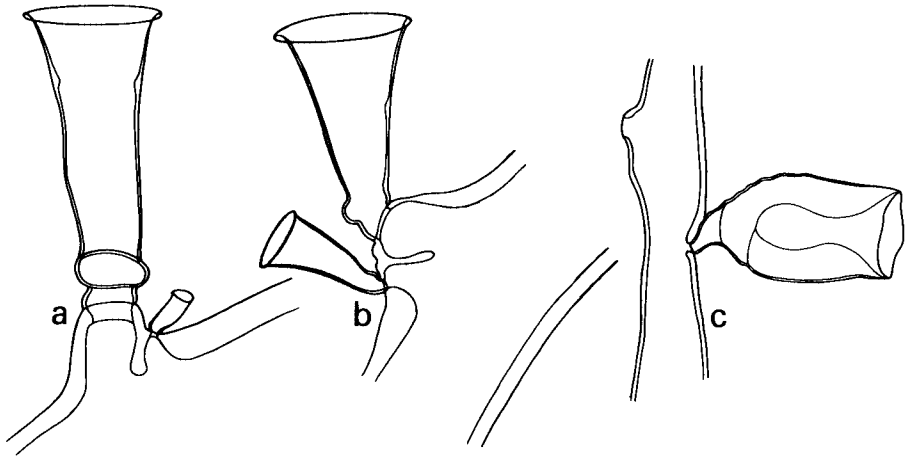


Fig. 2. *Hydrodendron dichotomum* (Allman), holotype of *Diplocyathus dichotomus* Allman, Torres Strait, BMNH 1888.11.13.11. a, b, secondary hydrothecae each with swollen basal portion; c, mature, partly spent gonotheca. a, b x 85; c x 55.

mens from the eastern part of the Malay Archipelago collected by the Siboga Expedition, but did not specify the localities. These specimens are now in the collections of the ITZ and originate from "Siboga" Stations 80 (Borneo Bank, 02° 25′ S, 117° 43′ E, 50-40 m), 99 (Anchorage off North Ubian, Sulu Archipelago, 06° 07.5′ N, 120° 26′ E, 16-23 m) and 144 [Anchorage north of Salomakiëe (= Damar) Island, near Halmaheira, 45 m]. Hirohito (1983) recorded specimens from two localities in the Indian Ocean (more correctly, the Timor Sea), viz., 12° 37′ S, 124° 34′ E, 78 m, and 12° 17′ S, 129° 40′ E, 49 m, these two localities being in the waters between Timor and northern Australia. The present record extends the known area of distribution to the Gulf of Aden, off Cape Guardafui.

Remarks. – The apparent absence of desmocytes is probably due to the use of permanent microslides with a mounting medium (Canada Balsam or Caedax) of almost the same refractive index as the structures themselves. Desmocytes are a conspicuous feature on the hydrothecal margin in some of the temporary preparations in water and glycerol.

The John Murray specimen has been compared with the holotype and other material in the BMNH collection. The holotype from the Challenger Expedition bears the number 1888.11.13.11 and the locality data: "off Somerset, Cape York, Torres Strait, depth 8-12 fms" (= 15-22 m) (figs. 2a-c, 3a-d). The specimen is strongly reticulate, about 30 x 55 mm, with a thickness of 10-15 mm. The hydrocauli are strongly branched dichotomously and frequently

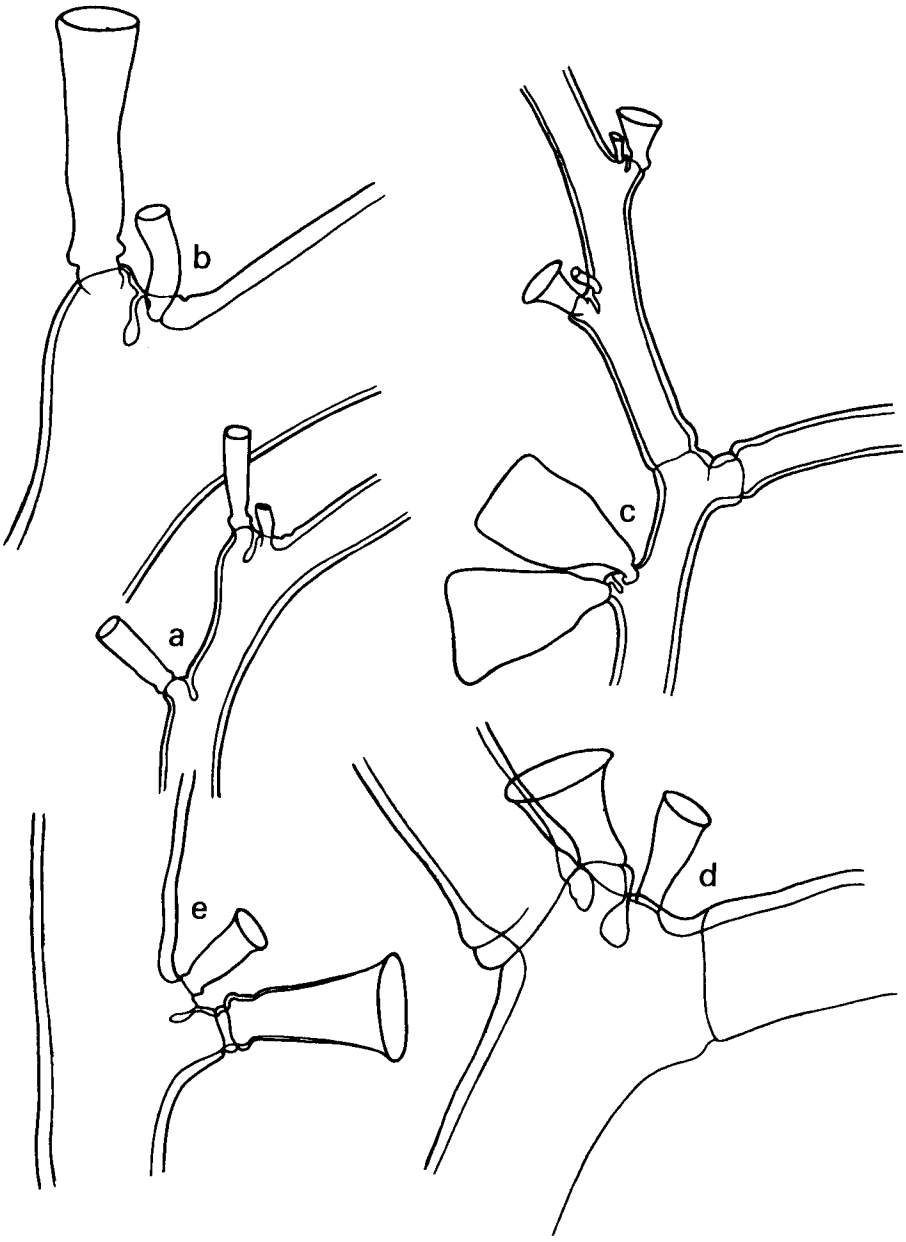


Fig. 3. *Hydrodendron dichotomum* (Allman). a-d, holotye of *Diplocyathus dichotomus* Allman, Torres Strait, BMNH 1888.11.13.11. a, b, stem internodes with renovated hydrothecae; c, stem internode with young gonothecae; d, stem internode at insertion of side branch, primary hydrotheca and nematotheca having become axillary. e, Murray Island, Torres Strait, BMNH 1890.3.24.11A, stem internode with renovated hydrotheca and nematotheca. a, c x 55; b, d, e x 110.

anastomose; the hydrothecae are in fair condition, but the hydranths are badly preserved. Gonothecae are present and are mostly attached to the basal parts of the branches (figs. 2c, 3c). Most are empty, but some young gonothecae contain tissue. In addition to this alcohol-preserved specimen there are three microslide preparations with the same number that have been used to study details. One of the slides includes gonothecae (fig. 2c). The primary and secondary hydrothecae largely resemble the descriptions given above; in the holotype, too, primary hydrothecae are scarce. The secondary hydrothecae usually have a better developed swelling at the base, and in some it attains the shape of a separate, more or less globular segment. No desmocytes were seen. Gonothecae occurred on the stem internodes at or near the hydrothecal apophysis. They were cylindrical with truncated apex and a faint indication of ribs on the narrowing basal part, and were attached by means of a short stalk. Young, developing gonothecae are obconical in outline (fig. 3c) but older, apparently spent gonothecae are distinctly barrel-shaped, the apical portions having four low cusps and the basal parts indistinctly ribbed. Some of the spent gonothecae had a central column of tissue, others were collapsed (fig. 2c). Occasionally two gonothecae were inserted together at a dichotomous branching of the stem (fig. 3c).

There are two more alcohol preserved specimens in the BMNH collection, viz., from Mabuiag Reef, Murray Island, Torres Strait, 27-37 m, coll. A.C. Haddon, Oct. 1888 (no. 1890.3.24.11A, with three slides) and Port Darwin, North Australia, coll. H.M.S. "Alert", 1926.2.7.1 (no slides). The Torres Strait specimen, mentioned by Kirkpatrick (1890b: 604), was about 10 mm high and attached to a fragment of sponge. It was strongly dichotomously branched and monosiphonic throughout. The specimen was sterile and it had apparently been collected alive since the hydrothecae have well preserved hydranths. The drawing (fig. 3e) has been made from one of the slides, stained with Ehrlich's haematoxylin; it shows the same details as the above-mentioned specimens and there are nematothecae in the axils of nearly all hydrothecae.

The Port Darwin specimen is a large, plate-shaped structure, 25 mm thick, attached to the stem of an antipatharian which traverses the length of the colony. In this specimen too the branching is strictly dichotomous. Though the state of preservation is not as good as in the Torres Strait specimen there are distinct hydrothecae and nematothecae, both including remnants of tissue. No gonothecae were seen.

A dried specimen labelled "Pearl Fisheries, W. Australia, J. Hayner Exped., [18]92.8.2.2", was not studied in detail.

All species of *Hydrodendron* so far described are listed below, along with

some notes on the gonothecae, if known.

Hydrodendron mirabile (Hincks, 1866b: 422-423, pl. 14, as *Ophiodes mirabilis*). Gonosome described by Hincks (1866b, 1868: 232): "gonothecae ovate, ringed transversely with wide tubular aperture, subpedicellate, borne on stolon".

Hydrodendron parasiticum (G.O. Sars, 1874: 109-111, pl. 4 figs. 5-8, as *Ophiodes parasitica*). Gonosome described by G.O. Sars: "gonothecae large, smooth, obconical or pyriform, with truncated apex, with fairly short pedicel singly attached to base of branches, never on stolon" (translation from latin diagnosis).

Hydrodendron gorgonoide (G.O.Sars, 1874: 112-114, pl. 4 figs. 9-15, as *Halecium gorgonoide*). Type species of genus. Gonosome unknown.

Hydrodendron arboreum [Allman, 1888: 10, pl. 14 figs. 1-3, as *Halecium robustum* (text) and *Halecium arboreum* (plate)]. Gonosome described by Hickson & Gravely (1907: 28). Gonothecae occurring together with nematophores in a glomulus on stems and branches. Glomulus "oval or spherical, densely branched and tangled clumps, 25 x 25 mm. to 60 x 30 mm. in size. The delicate dichotomously ramified branches of these masses bear dactylozooids [= nematophores] and nematophores [= nematothecae]... and numerous paired gonothecae, 1.0 x 0.7 mm. in size, which curve sharply backwards, terminating in a hook-like process at the extremity of which is the gonothecal mouth".

Hydrodendron dichotomum (Allman, 1888), see above.

Hydrodendron caciniforme (Ritchie, 1907a: 500-501, pl. 23 figs. 11-12, pl. 24 fig. 1, pl. 25 fig. 5, as *Ophiodes caciniformis*). Gonosome described by Millard (1966b: 490, fig. 1). Gonothecae "borne in numbers on hydrorhiza. Elongated barrel-shaped, with short pedicel and truncated distal end, lightly annulated. Reaching 1.35 mm in length and 0.58 mm in diameter. Male and female similar in appearance and distinguishable only under the microscope. Male generally slightly smaller than female. Blastostyle consisting of an elongated spadix bearing a single layer of rather flattened eggs in the female and a mass of spermatogenic cells in the male, the whole enveloped by a diffuse layer of tissue rich in large stenotele nematocysts. No hydranths present". Cornelius (1975b: 417) referred this species to *Hydrodendron mirabile* (Hincks, 1866b).

Hydrodendron pacificum (Stechow, 1913b: 155-156, fig. 135, as *Phylactotheca pacifica*). Gonosome unknown.

Hydrodendron gracile (Fraser, 1914a: 171, pl. 22 fig. 82, as *Ophiodes gracilis* = *Zygophylax enigmatica* Millard, 1964: 19-21, fig. 5A-F). Gonosome described by Millard (1964: 21; 1975: 164): "gonothecae borne on the hydro-

thecal apophyses; female flattened, flask-shaped in lateral view with slender neck and terminal aperture, containing about nine eggs which develop into planulae in situ; male unknown".

Hydrodendron carchesium (Fraser, 1914b: 220, pl. 1 fig. 1a-b, as *Ophiodes carchesium*). Gonosome unknown.

Hydrodendron australe (Bale, 1919: 336, pl. 16 fig. 1, as *Ophiodes australis* Bale , 1919). Gonosome described by Bale (l.c.) and by Watson (1973). Gonothecae "barrel-shaped or nearly cylindrical above, tapering below, summit broad or flat; borne on the hydrorhiza" (Bale, 1919, quoted by Ralph, 1958: 344). Watson (1973: 165, as *Ophiodissa australis*), redescribing part of Bale's material, referred to the gonothecae as being "smooth or very slightly annulated, with curved or straight pedicels, and several have a slight constriction just below the truncated distal end". Ralph (1958: 342-344) doubted whether or not the species could be separated from *H. caciniforme*; but Watson (1973: 165) recognized both species.

Hydrodendron gardineri (Jarvis, 1922: 334, pl. 24 fig. 1, as *Halecium gardineri* Jarvis, 1922). Gonosome described by Jarvis (1922): "the single male gonosome [= gonotheca] is carried on a short thick stalk [on the hydrorhiza], is cylindrical in shape, its distal end circular and concave".

Hydrodendron armatum (Stechow, 1924: 59-60, as *Phylactotheca armata* = *Ophiodissa fragilis* Blackburn, 1937a: 365, fig. 1). Gonosome described by Blackburn (l.c.) and by Watson (1975: 164-165, fig. 19, as *Phylactotheca armata*): "gonothecae subspherical, arising at the junction of stem and peduncles, as well as stem and hydrorhiza" (Blackburn), and: "colonies dioecious, gonophores borne thickly on hydrorhiza at base of stem, gonothecae large, flatly ovate, both sexes of the same size and shape, widest at middle or top, perisarc thick, slightly undulating, borne on a very short pedicel, length 1.14-1.56 mm (excluding pedicel), maximum width 0.90-1.16 mm" (Watson). Watson (1975: 164) doubts whether Blackburn realy studied gonothecae.

Hydrodendron sibogae (Billard, 1929a: 70, fig. 1A, as *Diplocyathus Sibogae*). Gonosome unknown.

Hydrodendron tottoni sp. nov. (= *Ophiodissa armatum*: Totton, 1930: 142-143, fig. 2b). Gonosome described by Ralph (1958: 341-342, as *H. armatum*): "the scaphus [glomulus] is a subspherical mass about 20 x 15 mm and the gonothecae are similar in size and shape to those described by Hickson and Gravely for "*Halecium arborea*" (Allman) from the Antarctic" (= gonothecae "curve sharply backwards, terminating in a hook-like process at the extremity of which is the gonothecal mouth", Hickson & Gravely, 1907: 28). The holotype (BMNH 1929.10.10.15) is a dried specimen comprising 2 stems 5 cm high growing from a common stock. The remaining 3 specimens described by

Totton are the spirit preserved paratypes (BMNH 1929.10.28.23, labelled: "*Halecium armatum* Totton, together with *Reticularia* (= *Filellum*) sp. (1929.10.28.271) and *Stegopoma fastigiatum* (Alder) (1929.10.28.52)". These colonies are up to 40 mm, but two are fragments. In addition there is a schizoparatype microslide preparation (1929.10.28.23), a stained branch 15 mm high with a spread of c. 15 mm. In this preparation a few nematothecae are visible, but holes in the periderm indicate that more were originally present. All the material is from the type locality, Terra Nova Sta. 91, off Three Kings Island, New Zealand, 549 m.

Hydrodendron corrugatum (Fraser, 1936: 504, fig. 2, as *Ophiodes corrugata*). Gonosome unknown.

Hydrodendron laxum (Fraser, 1938a: 45, pl. 10 fig. 50, as *Ophiodissa laxa*). Gonosome unknown.

Hydrodendron negligens (Fraser, 1938a: 46, pl. 11 fig. 51, as *Ophiodissa negligens*). Gonosome unknown.

Hydrodendron alternatum (Fraser, 1938c: 139-140, pl. 20 fig. 7, as *Ophiodissa alternata* Fraser). Gonosome described by Fraser (1938c): "gonangia [= gonothecae] appear almost sessile, attached to the hydrophore pedicels, to the internodes or to the stolon; obovate, with eight or nine strongly crested, transverse rugosities".

Hydrodendron expansum (Fraser, 1948: 227, pl. 25 fig. 12, as *Ophiodissa expansa*). Gonosome described by Fraser (1948): "The gonangium, 1.32 x 0.5 mm, arises from the fascicled portion of the stem, projecting at right angles to it; it resembles some of the *Sertularella* gonangia, e.g., those of *S. tricuspidata* (Alder). It is elongated oval, with short pedicel; very strongly crested rugosities appear throughout the whole length; the aperture is large, terminal".

Hydrodendron cornucopia (Millard, 1955: 219-221, fig. 3, as *Zygophylax cornucopia*). Gonosome described by Millard, 1955, 1975: "gonothecae borne on hydrothecal pedicels close to nematotheca, elongated, widening to truncated distal end. Male and female on separate hosts, female larger than male and containing numerous eggs" (Millard, 1975: 161-162).

Hydrodendron daidalum (Watson, 1969: 112-114, text-figs. 1-7, pl. 1, as *Scoresbia daidala*). Gonosome unknown.

Hydrodendron sympodiforme Millard & Bouillon, 1974: 25-26, fig. 5. Gonosome described by Millard & Bouillon (l.c.) and Millard (1975: 166): "gonothecae (only female known) borne on hydrorhiza, barrel-shaped with widest part below centre, with 6-7 deep, transverse annulations, reaching 0.8 mm in depth and 0.4 mm in maximum diameter" (Millard, 1975).

Hydrodendron leloupi Hirohito, 1973: 13-15, fig. 2 (= *Diplocyathus dichotomus* Leloup, 1938: 5-6, text-fig. 2, pl. 1 fig. 2). Gonosome described by

Hirohito: "Gonothecae are jar-shaped and arising from the hydrorhiza and the basal part of the stem. Gonophores are sporosacs. A monoecious colony is observed".

"*Diplocyathus minutus*" Leloup, 1930: 1-8, figs. 1-5, was later referred to the Plumulariidae by Leloup (1939: 5).

Halecium cf. **beanii** (Johnston, 1838)
(fig 4a, b)

Thoa Beanii Johnston, 1838: 120-121, pl. 7 figs. 1-2.

Halecium beani(i): Johnston, 1847: 59-60, pl. 9 figs. 1-2; Hincks, 1868:224-225, pl. 43 figs. 2, 2a-c; Leloup, 1940b: 6; Vervoort, 1946b: 161-163, figs. 29b, 65-66; Ralph, 1958: 332-334, fig. 10a-b, e-k; Vervoort, 1959: 224-225, fig. 6; Leloup, 1960: 230; Naumov, 1960: 447-449, fig. 336; Rees & Thursfield, 1965: 105-106; Teissier, 1965: 20; Millard, 1966a: 464, fig. 9A-F; Vervoort, 1966a: 103, fig. 3; Blanco, 1968: 201-202, pl. 1 figs. 11-13; Millard, 1968: 256; Patriti, 1970: 22, fig. 18; Rossi, 1971: 24, fig. 8D-F; Vervoort, 1972a: 30-33, figs. 6-7; Leloup, 1974: 10, fig. 7; Cornelius, 1975b: 391-393, fig. 5; Millard, 1975: 144-145, fig. 47A-E; Watson, 1975: 161, figs. 5-6; Blanco, 1976: 30-32, pl.1 figs. 4-7; Cooke, 1977: 87-88, fig. 15; Evans, 1978: 75; Stepan'yants, 1979: 108-109, pl. 16 fig. 6; Millard, 1980: 130.

Material examined. – Sta. 112. Two colonies, 30 and 35 mm high, with polysiphonic stems and main branches. No gonothecae (BMNH 1984.1.1.4, alc. + 2 slds; RMNH 16507, alc. + sld.).

Description. – Material comprising two polysiphonic stems with side branches arranged in roughly alternate fashion, ramifications more or less in one plane. Each branch originating from large apophysis directly under a stem hydrotheca. Polysiphony brought about by development of secondary tubules from stolon, growing along main stem and branches. Division into internodes distinct on both stems and branches, septa at nodes slightly oblique. Arrangement of hydrophores and (primary) hydrothecae as in fig. 4a: plane of hydrothecal aperture making angle of about 60° with long axis of internode. Perisarc on internodes firm and opaque, thinning out considerably below each hydrophore, leaving curved line beneath each hydrophore. Most primary hydrothecae with up to six renovations, lengths varied (fig. 4a, b). Renovated thecae with constricted basal portions and more symmetrical than initial ones; plane of hydrothecal aperture slightly inclined towards stem.

No gonothecae in the present material.

Distribution. – *Halecium beanii* is a nearly cosmopolitan species, found mostly in shallow to moderately deep waters (0-150 m depth). Undoubted specimens have been recorded in the Indian Ocean from the east coast of Cape Province, reaching as far north as the border of Moçambique, 26° S (Millard, 1975). The present record is from the Zanzibar area.

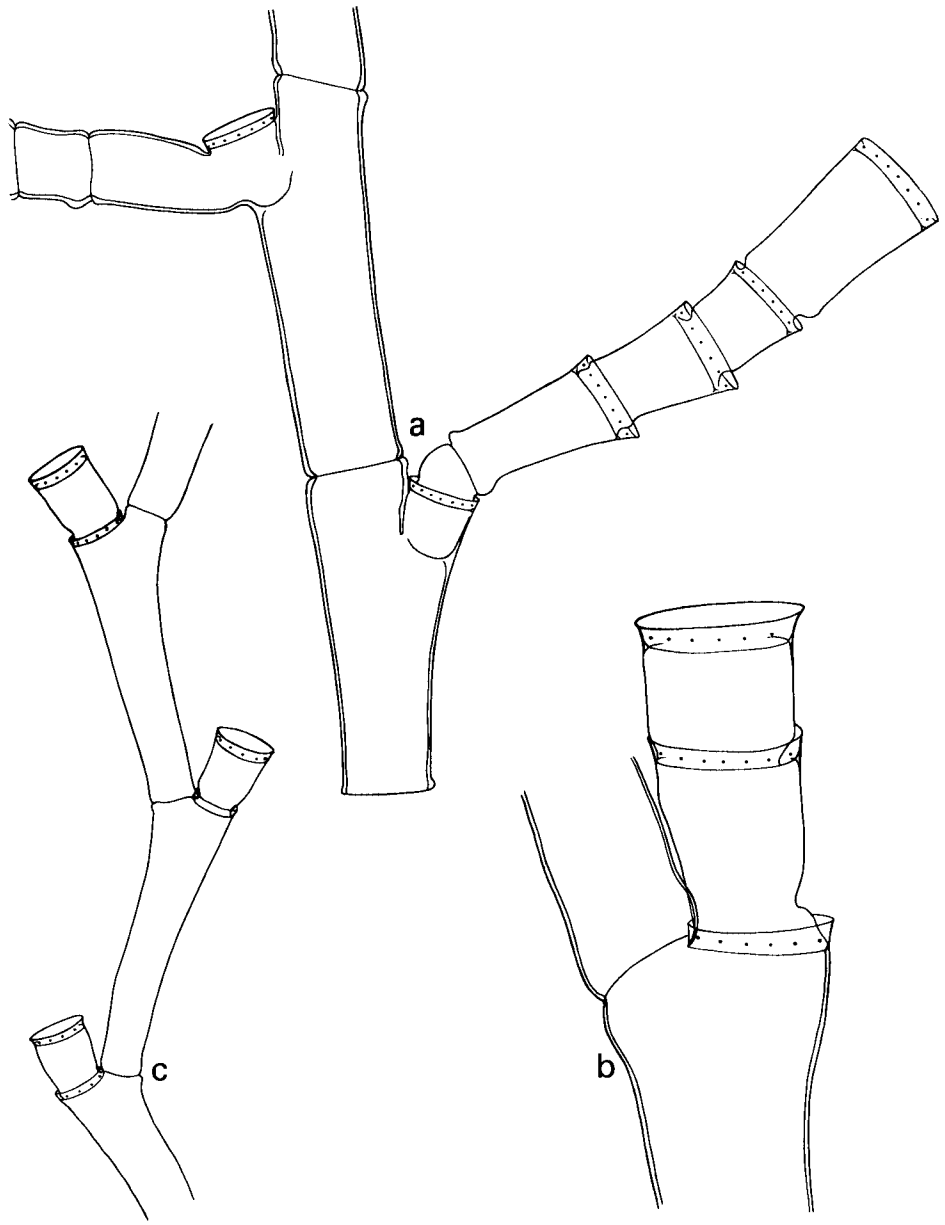


Fig. 4. a, b, *Halecium* cf. *beanii* (Johnston), John Murray Exped., Sta. 112. a, internodes from side branch; one of hydrothecae repeatedly renovated; b detail of a renovated hydrotheca. c, *Halecium labiatum* Billard, John Murray Exped., Sta. 27, stem internodes with renovated hydrothecae. a, c x 55; b x 150.

Remarks. – Though full-grown colonies of this species and of *Halecium halecinum* (Linnaeus, 1758) are of strikingly different appearance, it is sometimes impossible to separate infertile specimens. The John Murray material resembles closely specimens from the Magellan Strait described previously by Vervoort (1972) as *Halecium beanii*, but these specimens too were infertile.

Halecium delicatulum Coughtrey, 1876
(fig. 5, tab. 2)

Halecium delicatulum Coughtrey, 1876: 26, pl.3 figs. 4-5; Hartlaub, 1901: 368-369, pl. 21 figs. 13, 15; Hartlaub, 1905: 613-614, fig. L[3]; Stechow, 1913a: 144; Stechow, 1913b: 9, 79; Stechow, 1923b: 5; Bale, 1924: 235; Ralph, 1958: 334-338, figs. 11e, h-n, 12a-p; Pennycuik, 1959: 173; Yamada, 1959: 31; Leloup, 1960: 218-220, fig. 1; Rees & Thursfield, 1965: 106-107; Millard, 1966a: 464-466, fig. 10L; Ralph, 1966: 158; Blanco, 1968: 203-204, pl. 1 figs. 14-18, pl. 2 figs. 1-3; Millard, 1968: 256; Patriti, 1970: 23-24, fig. 20; Naumov & Stepan'yants, 1972: 34, 52; Vervoort, 1972a: 27-30, figs. 4-5; Vervoort, 1972b: 341-343, fig. 2a; Watson, 1973: 166; Leloup, 1974: 10; Millard, 1975: 145-147, fig. 47F-L; Watson, 1975: 159-160; Millard, 1977a: 7-8, fig. 1C-D; Millard, 1978: 193; Stepan'yants, 1979: 105, pl. 20 fig. 4; Hirohito, 1983: 11.

Halecium tenellum var. *mediterrranea* Weismann, 1883: 160, pl. 2 figs. 5-6; Neppi, 1917: 56-57, fig. 11. (= *Halecium mediterraneum* Weismann, 1883).

Halecium flexile Allman, 1888: 11, pl. 5 figs. 2, 2a; Hartlaub, 1905: 611-612, figs. J[3], K[3]; Jäderholm, 1905: 13; Stechow, 1913a: 144; Stechow, 1913b: 9, 81-83, figs. 45-49; Briggs, 1914: 286-288; Fraser, 1914a: 165, pl. 20 fig. 71; Bale, 1915: 246-247; Jäderholm, 1919: 6, pl. 1 figs. 4-5; Trebilcock, 1928: 6; Totton, 1930: 145; Fraser, 1937: 104, pl. 21 fig. 111; Leloup, 1937b: 15; Leloup, 1940b: 6; Fraser, 1948: 222; Hodgson, 1950: 16-17, figs. 28-30; Yamada, 1959: 32.

Halecium gracile Bale, 1888: 759-760, pl. 14 figs. 1-3; Motz-Kossowska, 1911: 335-366, text-figs. 7-8, pl. 18 fig. 2; Totton, 1930: 145.

Halecium parvulum Bale, 1888: 760-761, pl. 14 figs. 4-5; Fraser, 1914a: 167-168, pl. 21 fig. 75; Bale, 1924: 235; Fraser, 1937: 107, pl. 22 fig. 117; Fraser, 1938b: 110; Millard, 1957: 189-190, fig. 4A; Vervoort, 1959: 227-229, fig. 7.

Halecium flexile var. *japonica* Leloup, 1938: 4, fig. 1; Yamada, 1959: 32.

Halecium parvulum var. *magnum* Millard, 1957: 190-192, fig. 4B-O; Millard, 1979: 138.

Halecium delicatulum f. *macrothecum* Leloup, 1960: 218, fig. 1B.

Material examined. – Sta. 54. Two polysiphonic colonies about 40 mm high, and some fragments. One female gonotheca (BMNH 1984.1.1.5, alc. + sld.; RMNH 16508, alc. + sld.).

Sta. 112. Four small colonies on *Synthecium megathecum* Billard. No gonothecae (BMNH 1984.1.1.6, sld.; RMNH 16509, sld.).

Description. – The material from Sta. 112, which resembles previously known forms of this species, will be described first (fig. 5d, e). It comprises 4 hydrocauli with maximum height of 4 mm and composed of just a few internodes each, rising from short apophyses attached to a stolon creeping on *Synthecium megathecum* Billard. Internodes very slender and terminally with pedicellate hydrophore and apophysis for next internode; hydrophore slanted laterally and upwards. Hydrotheca separated from hydrophore by distinct

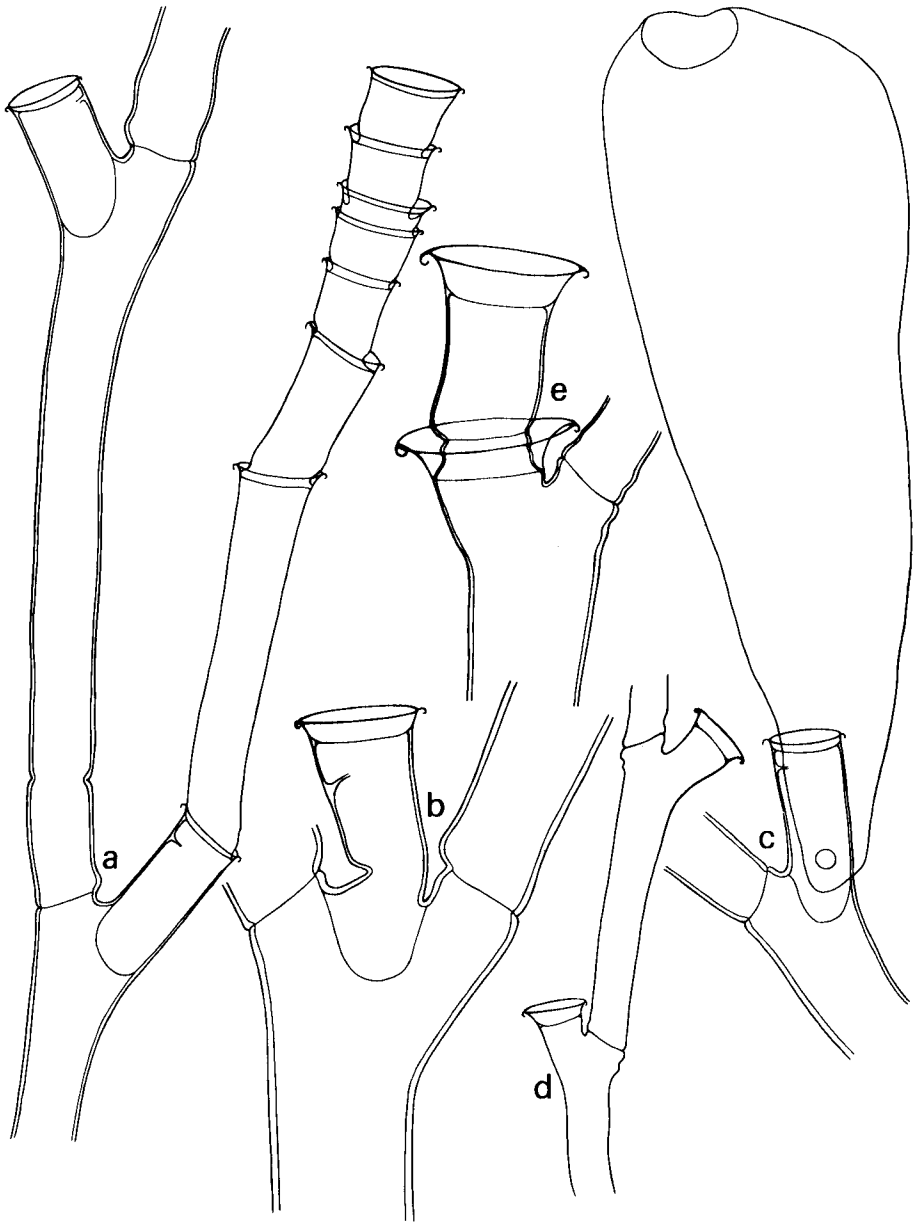


Fig. 5. *Halecium delicatulum* Coughtrey. a-c, John Murray Exped., Sta. 54. a, internodes from side branch with repeatedly renovated hydrotheca; b, axillary hydrotheca at origin of side branch; c, empty female gonotheca. d, e, John Murray Exped., Sta. 112. d, stem internodes; e, renovated hydrotheca. a x 85; b, e x 135; c, d x 55.

pseudodiaphragm, slightly thickened on both ad- and abcauline sides. Hydrotheca hyaline and rather deep; margin distinctly everted and transverse to long axis of theca or slightly tilted in adcauline direction (fig. 5d). Some basally constricted secondary hydrothecae with thin septum at constriction, attached to primary hydrotheca at level of pseudodiaphragm (fig. 5e). No desmocytes seen, but material rather dirty. Perisarc on hydrophore and internode thick and opaque. All colonies mounted on microslides. No gonothecae present.

The material from Sta. 54 is remarkable because of the hydrothecal renovations (fig. 5a-c). Colonies and some fragments polysiphonic and branched, and colonies moreover also with some hydrorhizal filaments. Polysiphony arising from development of secondary tubes from stolon. In lower parts of colony these secondary tubes having no constrictions, but becoming divided into internodes in upper parts and then indistinguishable from ramifications of main axis. Internodes extremely long and slender, making colonies flexible. Development of hydrophore and primary hydrotheca as in normal type. Perisarc on internodes fairly thick but considerably thinner along hydrophore, decreasing suddenly in thickness at its base. Septa at nodes distinct; internodes sometimes wrinkled. Hydrophores usually with distinct adcauline swelling, probably annular, thickest on adcauline side and scarcely visible on opposite wall. Occasionally an imperfect septum present. Primary hydrotheca shallow (fig. 5b). Throughout colony large numbers of additional hydrothecae occur on primary hydrothecae, in places as many as 10, some of which are up to three times length of hydrophore and primary hydrotheca, but shorter distally (fig. 5a). Branching of colony brought about by secondary tubules, by normal branching under a stem hydrophore or by combination of branching of both

	John Murray Exped. Sta. 54	John Murray Exped. Sta. 112
Stem internode		
length	1040 – 1360	565 – 600
diameter at node	105 – 130	85 – 105
Hydrophore		
length	235 – 270	55 – 125
breadth at rim	90 – 100	90 – 105
Primary hydrotheca		
length	20 – 35	35 – 40
breadth at rim	115 – 130	140 – 165
Secondary and subsequent hydrothecae		
length	60 – 605	145
breadth at rim	80 – 90	90
Female gonotheca		
length	1250	
diameter	300	

Table 2. *Halecium delicatulum*. Measurements in μm.

tubules and axis. Internodes bearing branch with additional apophysis just under hydrophore, usually slightly displacing that hydrophore (fig. 5b). Additional apophysis with internode of same shape and dimensions as apical stem internode.

One of the fragments carries a sac-shaped body that we think represents the (empty) female gonotheca, inserted on a hydrophore on a short stalk and communicating through a circular hole with the interior of the hydrophore (fig. 5c). The structure has a flattened apex with a circular opening from which a plug of tissue protrudes, possibly the remnants of a hydranth. Total length 1.25 mm.

Distribution. – This species is circumglobal in tropical and subtropical seas, in the Pacific penetrating north to Japan (Leloup, 1938, as *Halecium flexile* var. *japonica*) on the western side and the Queen Charlotte Islands, Canada, on the eastern side (Fraser, 1937, as *H. parvulum*). In the eastern Atlantic it reaches north to the coast of Morocco (Leloup, 1940b, as *H. flexile*; Patriti, 1970). The southward distribution seems to extend into the Antarctic (Stepan'yants, 1979).

Remarks. – For the synonymy of this species we particularly refer to Ralph (1958: 334-338), Millard (1975: 145-147) and Stepan'yants (1979: 105). All measurements of the John Murray material fall within the limits given by Millard (1975: 147) of the "small form".

The relation of *H. delicatulum* to *H. pallens* Jäderholm (1904: iv) is not clear. The species have been thought conspecific by Naumov & Stepan'yants (1962: 94-96) and Vervoort (1972b: 341-343), but have lately been separated by Stepan'yants (1979: 105-106); *H. pallens* being considered a purely Antarctic species. We prefer to leave the question open.

Halecium labiatum Billard, 1933
(fig. 4c, tab 3)

Halecium labiatum Billard, 1933: 21-22, fig. 8; Dollfus, 1933: 129; Vervoort, 1967: 30-31, fig. 4; Schmidt, 1972a: 41-42; Van Praët, 1979: 877-878, fig. 10.

Material examined. – Sta. 27. A few infertile colonies 5-8 mm high on the bases of other hydroids (BMNH 1984.1.1.7, sld.; RMNH 16510, sld.).

Description. – Material comprising four sterile, monosiphonic colonies 5-8 mm high, attached by short apophyses to creeping hydrorhiza. Stems divided into slender internodes, distinctly geniculate (fig. 4c). Internodes slightly to distinctly wrinkled basally, and apically bearing a hydrophore with short,

collar-shaped hydrotheca and slanting, laterally directed apophysis for attachment of next internode. No ramifications present. Length of terminal apophysis varied, in some places not reaching beyond hydrothecal rim but in others three to four times height of hydrotheca. Primary hydrothecae usually with secondary or both secondary and tertiary hydrothecae, with short, collar-shaped apical portion. Secondary and tertiary hydrothecae constricted at base, more or less cylindrical, and slightly widening towards hydrothecal margin which is not flared (fig. 4c). Hydrothecae with 10-12 conspicuous desmocytes; remnants of large hydranths present. No gonothecae seen.

	Gulf of Suez (Billard, 1933)	Dahlak Archipelago (Vervoort, 1967)	John Murray Exped. Sta. 27
Stem internode			
length	660 – 925	350 – 475	445 – 590
diameter at node	100 – 115	110 – 120	75 – 100
Primary hydrotheca			
height			25 – 35
breadth at rim	130 – 145	120 – 135	90 – 120
Secondary or tertiary hydrathecae			
length	180 – 330	160 – 230	125 – 225
breadth at rim		120 – 130	100 – 130
Female gonotheca			
length	775 – 900		
diameter	410 – 510		

Table 3. *Halecium labiatum.* Measurements in μm.

Distribution. – *Halecium labiatum* has so far been recorded only from the Gulf of Suez, at 29° 48′ – 29° 35′ N, 32° 32′ – 32° 30′ E, 36-55 m depth (Billard, 1933), and from the southern Red Sea (Umm Aabak, Dahlak Archipelago, no depth data; Vervoort, 1967). The present record extends the known distribution of the species towards the Gulf of Aden.

Remarks. – The present material resembles in detail both Billard's original description and material subsequently described from the southern Red Sea (Vervoort, 1967). One of us (Vervoort, 1967: 31) has already pointed out the general resemblance of this species to *Halecium lankesterii* (Bourne, 1890), a species widely distributed in the tropical, subtropical and north-eastern Atlantic and in the Indian Ocean (Vervoort, 1959; Cornelius, 1975b; Millard, 1975). Though the internodes of *H. labiatum* are generally longer and more slender than those of *H. lankesterii,* the measurements of *H. labiatum* fall entirely within the range of variation with respect to latitude now known to occur in *H. lankesterii*. Though *H. labiatum* is rarely so profusely ramified as *H. lankesterii*

and its stem internodes have a more geniculate arrangement, the principal recorded difference between the species is still the shape of the female gonotheca, the only sex known in *H. labiatum*. The female gonotheca in *H. labiatum* is broadly ovate when seen laterally and has the aperture of the pair of hydrothecae almost terminally. In *H. lankesterii* the female gonotheca is more or less kidney shaped in lateral view and the aperture of the paired hydrothecae is found at or near the middle of the convex side. The exact shape of the (female) gonotheca and particularly the place of the paired hydrothecae in *H. lankesterii* may be expected to vary as in other *Halecium* species with bean-shaped gonothecae. But gonothecae of the *Halecium labiatum* type have so far never been reported in the well known *H. lankesterii*. Principally for this reason the two species have been kept separate.

Halecium lankesterii (Bourne, 1890)

Halecium robustum Pieper, 1884: 166-167; Babić, 1913: 470-473, figs. 4-6; Bedot, 1914: 82, pl. 3 fig. 6; Stechow, 1919: 39-40; Teissier, 1965: 21; Fey, 1970: 397. (non *Halecium robustum* Verrill, 1873: 97 = *Zygophylax robusta* (Verrill, 1873)).

Haloikema lankesterii Bourne, 1890: 395-396, pl. 26.

Halecium lankesteri(i): Bedot, 1911: 213-217, pl. 11 figs. 1-5; Stechow, 1919: 157; Stechow, 1923d: 88; Prenant & Teissier, 1924: 25; Broch, 1933: 16-17, fig. 3; Leloup, 1934: 7; Philbert, 1935a: 26; Philbert, 1935b: 22; Vervoort, 1949: 145; Picard, 1950: 192; Picard, 1955: 188; Hamond, 1957: 295, 302-304, figs. 9-10; Marine Biological Association, 1957: 46; Picard, 1958: 192; Riedl, 1959: 626 (*H. lancesteri*, lapsus); Vervoort, 1959: 221-224, figs. 3-5; Bellan-Santini, 1961: 27; Bellan-Santini, 1962: 192; Millard, 1968: 257-258, fig. 1; Bellan-Santini, 1970: 340; Edwards, 1973: 587; Millard & Bouillon, 1974: 5; Cornelius, 1975b: 399-402, fig. 8; Millard, 1975: 153, fig. 50B-E; García Corrales, Aguirre Inchaurbe & González Mora, 1978: 13-14, fig. 3; Millard, 1978: 193; Boero, 1981: 182.

Remarks. – As stated above this species, closely allied to *Halecium labiatum* Billard, 1933, has a wide distribution in the tropical and subtropical eastern Atlantic and in the Mediterranean; it also occurs in the boreal East Atlantic, at least as far north as the North Sea. Along the Indian Ocean coast of South Africa it penetrates as far north as Santa Carolina, Moçambique. It does not occur in the John Murray collection but is mentioned here because of its close affinity to *H. labiatum*. The holotype and additional material were described by Cornelius (1975b) who also discussed its identity with *H. robustum* Pieper, 1884 [name preoccupied by *H. robustum* Verrill, 1873, a species of *Zygophylax* (see: 53, 54)].

Halecium sp.

Material examined. – Sta. 122. Mutilated colony about 70 mm high. No gonothecae (BMNH 1984.1.1.8, alc. + 2 slds).

Remarks. – Colony comprising a fragment of polysiphonic stem c. 70 mm long bearing a single, polysiphonic branch 30 mm long. Stem and branch with some finer side branches. The general appearance of the internodes is like those of the specimens of *Halecium* cf. *beanii* from the same area, but they are more slender and have thicker perisarc. Primary hydrophores and hydrothecae too are almost identical. Only a few secondary hydrothecae have been observed, those that are present having collapsed and become filled with débris.

The specimen, undoubtedly a species of *Halecium,* is particularly mentioned here because of its occurrence in deep water (732 m). The presence of remnants of hydranths suggests that it was alive when collected. Its bad condition is probably due to damage sustained in the trawl bag.

Family Lafoeidae Hincks, 1868

Subfamily Hebellinae Stechow, 1913b

Halisiphonia megalotheca Allman, 1888
(fig. 6a-c, tab.4)

Halisiphonia megalotheca Allman, 1888: 31, pl. 16 figs. 1, 1a; Hartlaub, 1905: 555; Stechow, 1925b: 452; Kramp, 1932b: 40; Kramp, 1951: 123; Vervoort, 1966a: 122-123, fig. 24; Vervoort, 1972a: 60, fig. 17a; Stepan'yants, 1979: 55-56, pl. 9 fig. 11.
Lafoëa (Halisiphonia) megalotheca: Levinsen, 1893: 165; Broch, 1917: 14.
Lafoëa megalotheca: Marktanner-Turneretscher, 1895: 404; Billard, 1910: 5-6.
Halisiphonia galatheae Kramp, 1956: 17-18, fig. 3; Vervoort, 1966a: 121-122, figs. 22-23; Belyaev, 1972: 48.

Material examined. – Sta. 54. Several small colonies comprising hydrothecae on long pedicels arising from a stolon growing over other hydroids or worm tubes. No gonothecae (BMNH 1984.1.1.10, alc. + sld.; RMNH 16514, sld.).

Description. – Stolon strongly intertwining, attached to another hydroid stem or covering a worm tube. From it arising fine pedicels of much varied lengths, each supporting a large hydrotheca. Pedicels springing directly from stolon or with a few basal constrictions (fig. 6c), 1.5-9.0 mm high; the longest on a worm tube. Pedicel widening fairly suddenly into large, cylindrical hydrotheca, demarcation marked by a fine "diaphragm" (fig. 6a, b). No accompanying thickening of hydrothecal perisarc observed. Perisarc quite firm throughout colony, thinning out gradually along hydrothecal wall, apical portion of which is fragile and easily collapsible. Hydrothecal margin not everted. Renovations of hydrothecae not seen, though some of pedicels

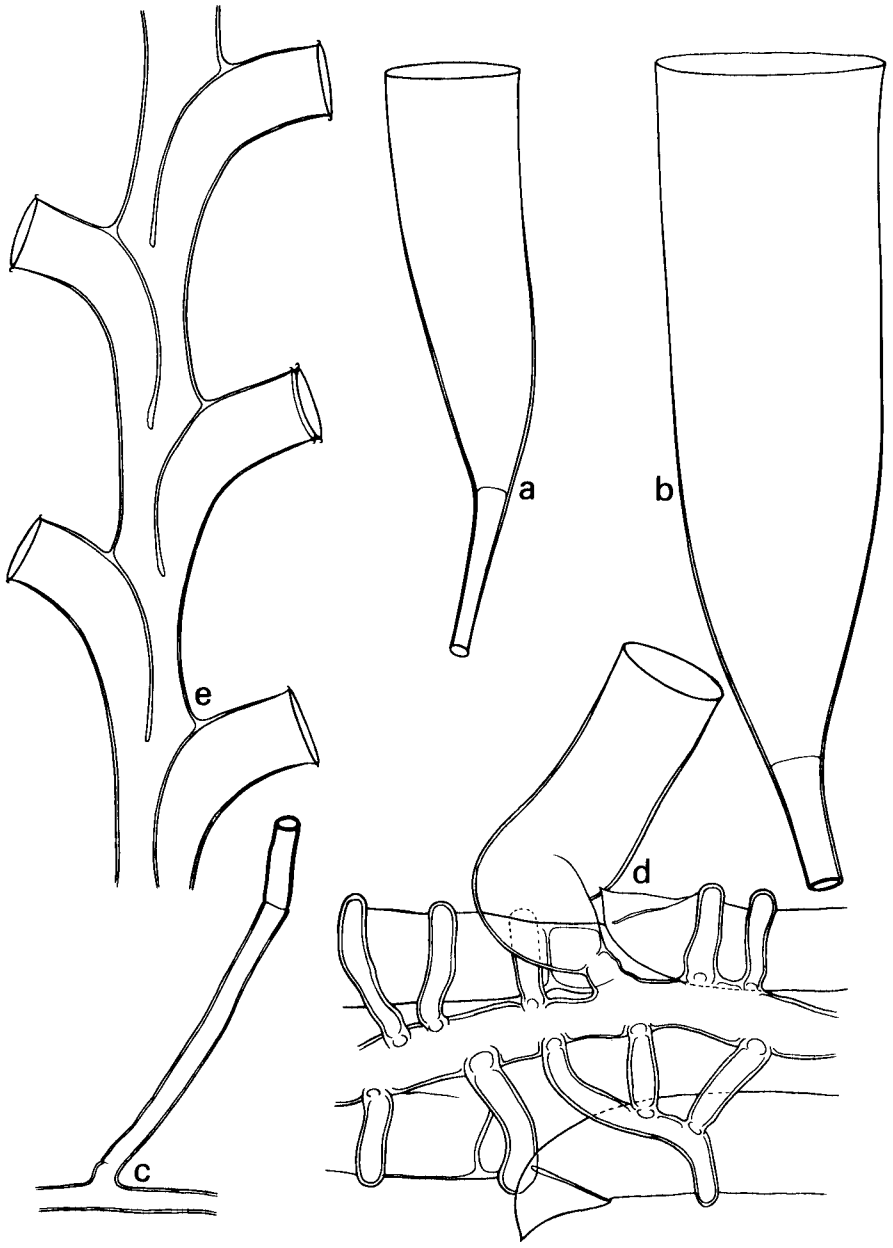


Fig. 6. a-c, *Halisiphonia megalotheca* Allman, John Murray Exped., Sta. 54. a, b, hydrothecae; c, insertion of hydrothecal pedicel, with constrictions, on stolon. d, *Hebella scandens* (Bale) var. *contorta* Marktanner-Turneretscher, John Murray Exped., Sta. 24, insertion of hydrotheca on stolon attached to *Salacia tetracythara* Lamouroux. e, *Acryptolaria conferta australis* (Ritchie), John Murray Exped., Sta. 111, part of stem near top. a-c x 30; d x 85; e x 55.

	Galathea Exped. Kermadec Trench (Kramp, 1956, as *H. galatheae*)	Galathea Exped. Celebes Sea (Vervoort, 1966a, as *H. galatheae*)	Challenger Exped. Sta. 160 S Australia (BMNH 1888, 11.13.20) (Vervoort, 1966a)	Valdivia Exped. S Indian Ocean (Stechow, 1925b)	Vema Exped. Sta. 14-29 S Atlantic (Vervoort, 1972a)	John Murray Exped. Sta. 54 Arabian Sea (present record)
Pedicel						
total length	20000 – 25000	8000 – 15000	1300 – 2010	740 – 1200	1320 – 2600	1500 – 9000
diameter	80	120 – 140	160 – 170	76 – 80	120 – 160	100 – 160
Hydrotheca						
length	1200	1200 – 1600	2100 – 2600	1000 – 1360	1900 – 2000	1700 – 2300
breadth at diaphragm		150 – 170	146 – 160	80 – 130	160 – 200	180 – 280
breadth at rim	400	320 – 370	640 – 660	200 – 330	480 – 650	480 – 880
Gonotheca						
total length		2800 – 3000	2200		1350	
maximum width		2200 – 2400	1160		1040	
thickness at base		300 – 350	610			

Table 4. *Halisiphonia megalotheca*. Measurements in μm.

showing signs of renovation. Size of hydrothecae considerably varied.

One well preserved hydranth found, attached deep inside hydrotheca, just above "diaphragm"; 14 tentacles.

Distribution. – The species has now been recorded from the following localities: SE Atlantic, SW of Cape of Good Hope, South Africa, 41° 03′ S, 07° 49′ E, 4961 m (Vervoort, 1972a); E of St Paul Is., southern Indian Ocean, 38° 40′ S, 77° 38.6′ E, 672 m (Stechow, 1925b); Celebes Sea, 01° 50′ N, 119° 20′ E, 4940-4970 m (Vervoort, 1966a, as *H. galatheae*); south of Australia, 42° 42′ S, 134° 10′ E, 3753 m (Allman, 1888, type locality of *H. megalotheca*), and Kermadec Trench, 35° 16′ S, 178° 40′ W, 8210-8300 m (Kramp, 1956, type locality of *H. galatheae*). The present record is from deep water of the Arabian Sea, off Oman.

Remarks. – The available evidence supports the suggestion that only one deep water species exists, the rather varied *Halisiphonia megalotheca*, especially since no distinct differences occur between the gonothecae of *H. megalotheca* and *H. galatheae*. The usually short stalked *H. megalotheca* and the long stalked *H. galatheae* are now linked by intermediate specimens and there are no consistent differences in the shape of the hydrothecae, bearing in mind that the development of the perisarc is greatly influenced by hydrothecal renovation. We thus recognize only one species, the name *H. megalotheca* having priority.

There are three more, poorly known, species in *Halisiphonia* and their synonymy is given below.

Halisiphonia spongicola Haeckel, 1889

Halisiphonia spongicola Haeckel, 1889: 77-78, pl. 4 fig. 9; Kramp, 1932b: 40-41; Kramp, 1951: 123.

Remarks. – This species has been recorded from "Challenger" Sta. 241, north-western Pacific, off Yokohama, 35° 41′ N, 157° 42′ E, 4206 m, and "Challenger" Sta. 272, ESE of Christmas Is., 03° 48′ S, 152° 56′ W, 4755 m, at both stations on keratose sponges.

Halisiphonia nana Stechow, 1921e

Halisiphonia nana Stechow, 1921e: 227-228; Stechow, 1925b: 452-453, fig. 22; Kramp, 1932b: 41; Stepan'yants, 1979: 56, pl. 9 fig. 10.
Halisiphonia ?nana Millard, 1977a: 14, fig. 3C.

Remarks. – This species was originally recorded from east of Bouvet Is., South Atlantic, 54° 28.7′ S, 03° 30′ E, 457 m (type locality; Stechow, 1925b). The record of Millard, 1977a, from Chenal des Orques, Crozet Is., 46° 24′ S, 51° 59′ E, 180 m, on *Sertularella picta*, is dubious.

Halisiphonia arctica Kramp, 1932b

Halisiphonia arctica Kramp, 1932b: 37-41, figs. 17-20.

Remarks. – Recorded only from Baffin Bay, 74° 41′ N, 70° 30′ W, 1200 m (Kramp, 1932b).

Hebella scandens (Bale, 1888) var. **contorta** Marktanner-Turneretscher, 1890 (fig. 6d, tab. 5)

Hebella contorta Marktanner-Turneretscher, 1890: 215, pl. 3 fig. 17; Von Campenhausen, 1896a: 104; Von Campenhausen, 1896b: 307; Levinsen, 1913: 285, pl. 5 figs. 16-17; Hargitt, 1924: 488; Nutting, 1927: 207; Rees & Thursfield, 1965: 73; Boero, 1980: 134.
Hebella calcarata var. *contorta:* Bale, 1915: 253-254; Briggs, 1918: 35-36; Leloup, 1937b: 4, 26-27, fig. 17; Vervoort, 1946a: 305; Hodgson, 1950: 13-14, fig. 24; Dawydoff, 1952: 55; Pennycuik, 1959: 188; Boero, 1980: 134.
?Hebellopsis contorta: Stechow & Müller, 1923: 464, pl. 27 fig. 5.
Phortis contorta: Stechow, 1923d: 139.
Hebella spiralis Nutting, 1927: 208, pl. 40 figs. 4-6.
Hebella scandens var. *contorta:* Vervoort, 1959: 239-240, fig. 14; Vervoort, 1968: 25-26, fig. 10; Gravier, 1970: 116; Rho & Chang, 1972: 100, pl. 2 figs. 6-9; Rho & Chang, 1974: 133, 138; Rho, 1977: 255, 415, pl. 73 fig. 6; Vervoort & Vasseur, 1977: 13-14, figs. 4, 12a.

Material examined. – Sta. 24. Many hydrothecae rising from a stolon creeping on *Salacia tetracythara* Lamouroux. No gonosome (BMNH 1984.1.1.12, alc. + 2 slds; RMNH 16516, 2 slds).

Description. – Present material differing from colonies previously described in curious condition of stolon. Stolon a fairly thick tube, epizoic and distinctly visible on surface of branches of *Salacia tetracythara* colony. Hydrothecae arising at regular intervals from stolon, which is firmly attached to host by means of completely encircling outgrowths of that stolon (fi. 6d). At certain places a number of ramifications uniting to form communal encircling holdfast. Ramifications and stolon with thick perisarc. Outgrowths communicating with stolon by means of circular openings. Hydrotheca with short, thick pedicel. Basal portion of hydrotheca not particularly swollen. Twist in hydrothecal wall usually in lower third of theca. A perisarcal ring marking demarcation between hydrotheca and pedicel. No hydranths seen. Hydrothecal peri-

sarc fairly thick in basal part, gradually thinning out along hydrothecal wall. Hydrothecal margin fragile, circular, not everted.

The host, judging from the presence of completely normal hydranths, was a living colony of *Salacia tetracythara* Lamouroux.

	Moorea, French Polynesia (Vervoort & Vasseur, 1977)	John Murray Exped. Sta. 24
Hydrotheca		
length (primary)	390 – 460	460 – 495
breadth at rim	140 – 160	140 – 170
maximum diameter	135 – 160	165 – 185
length of pedicel	40 – 95	40 – 55
diameter of pedicel	60 – 80	50 – 55

Table 5. *Hebella scandens* var. *contorta*. Measurements in μm.

Distribution. – This variety was originally described from Singapore (Marktanner-Turneretscher, 1890, as *Hebella contorta*) and has subsequently been recorded from various localities in the Malay Archipelago including the Philippines (Nutting, 1927, as *H. spiralis*; Leloup, 1937b; Vervoort, 1946a, both as *H. calcarata* var. *contorta*). Further Pacific localities are the Great Australian Bight (Bale, 1915, as *H. calcarata* var. *contorta*), Moorea, French Polynesia (Vervoort & Vasseur, 1977), and South Korea (Rho & Chang, 1972, 1974; Rho, 1977). Though this variety was recorded in Japanese waters by Rho & Chang, 1974), we have been unable to trace that record. The variety also occurs in subtropical and tropical Atlantic waters, having been recorded in the Gulf of Guinea, 10° 22′ N, 16° 22′ W (Vervoort, 1959) and St Thomas, Caribbean area (Vervoort, 1968).

Remarks. – Development of a stolon as described above is not a feature unique to the species of *Hebella* Allman, 1888. However, we have never observed this condition in *H. scandens* var. *contorta*, though it is not unlike that described in *H. spiralis* by Nutting (1927).

The taxonomic status of *Hebella scandens* var. *contorta* is problematic since "normal" and "contorted" hydrothecae are sometimes found along the same stolon.

Hebella sp.

Material examined. – Sta. 111. Two stalked hydrothecae arising from stolon on unidentifiable hydroid (BMNH 1984.1.1.13, sld.).

Remarks. – Two collapsed hydrothecae were observed in a microslide preparation made from material collected at Sta. 111. No positive identification was possible.

Subfamily Lafoeinae Hincks, 1868

Acryptolaria conferta australis (Ritchie, 1911b) (fig. 6e, tab. 6)

Cryptolaria conferta var. *australis* Ritchie, 1911b: 826-830, pl. 84 fig. 2, pl. 87 fig. 1; Jäderholm, 1919: 7-8, pl. 2 fig. 1.
Oswaldaria conferta var. *australis*: Stechow, 1923b: 11.
Acryptolaria conferta var. *australis*: Totton, 1930: 163-164, fig. 19c-e; Ralph, 1958: 315-317, fig. 4a-g; Yamada, 1959: 49; Ralph, 1961c: 236; Rees & Thursfield, 1965: 82, 194; Smaldon, Heppell & Watt, 1976: 14.
Acryptolaria conferta australis: Millard, 1964: 9-10, fig. 1D, F, G; Vervoort, 1966a: 115-116, fig. 15; Millard, 1967: 172.

Material examined. – Sta. 111. A 10 mm long stem fragment with 4 side branches, and some additional fragments. No gonosome (BMNH 1984.1.1.9, alc. + sld.; RMNH 16513, sld.).

Description. – Side branches pinnately arranged along polysiphonic stem 10 mm high. Hydrothecae on stem and branches; all except basalmost in plane of ramification. Hydrothecae gracefully curved and regularly arranged along stem and branches, pointing alternately left and right, 2/3 adnate, narrowing basally (fig. 6e). First hydrotheca on each hydrocladium pointing frontally, at right angles to remaining hydrothecae; and also slightly shorter. Hydrothecae fairly close, base of adnate adcauline wall reaching slightly below axil between adcauline wall and branch of previous hydrotheca. Hydrothecal aperture circular and perpendicular to long axis of theca. Margin very slightly, though distinctly, everted. Number of renovations few; some hydrothecae having only one. Perisarc of colony rather thick, thinning out considerably along free part of each hydrotheca.

The specimen was evidently taken alive since well preserved hydranths are present. Each is attached deep inside the hydrotheca, almost near its base, by a circle of tissue.

The gonosome, a coppinia, was not found in the collection.

Distribution. – *Acryptolaria conferta* is nearly cosmopolitan in water deeper than 100 m. The known distribution of *A. conferta australis* was summarized by Vervoort (1966a: 116) and includes localities off the South African coast between 34° – 35° S, 19° – 24° E, off New South Wales, off New Zealand and in

	South Africa (Millard, 1964)	Galathea Exped. Tasman Sea (Vervoort, 1966a)	Schizosyntype off New South Wales BMNH 1964.8.7.55	John Murray Exped. Sta. 111
Hydrotheca				
length adnate part adcauline wall	670 – 950	650 – 810	600 – 635	680 – 740
length free part adcauline wall, including renovations	200 – 550	450 – 540	215 – 295	
breadth at base	110 – 140	120 – 165	85 – 125	140 – 160
breadth at rim	190 – 260	175 – 210	125 – 135	260 – 300
ratio, rim/base	1.54 – 2.18	1.35 – 1.45	1.47 – 1.59	1.85 – 1.89

Table 6. *Acryptolaria conferta australis*. Measurements in μm.

the Tasman Sea (45° 51′ S, 164° 32′ E). The depths of these records ranged from 100 m down to 4400 m. The present record is from the Zanzibar area, at 73-165 m.

Remarks. – The two subspecies, *Acryptolaria conferta conferta* (Allman, 1877) and *Acryptolaria conferta australis* (Ritchie, 1911b), were referred to a single varied species, *Acryptolaria conferta* (Allman, 1877), by Millard (1975: 169), a point of view we have not immediately followed as in the material at our disposal, the two subspecies appear to be quite distinct. The John Murray specimens, because of the fairly close packing of the hydrothecae, resemble the subspecies described by Ritchie, though the diameter of the hydrotheca is considerably larger than that in a schizosyntype of this subspecies present in the BMNH (no. 1964.8.7.55, Thetis Expedition, Sta. 42, 6-8, 5 miles off Wata Mooli, New South Wales, Australia, 13 Mar. 1898, 128-143 m, see table 6).

Filellum serratum (Clarke, 1879)

Lafoea serrata Clarke, 1879: 242, pl. 4 fig. 25; Thornely, 1904: 116; Hartlaub, 1905: 595, fig. Q²; Billard, 1906b: 178-179; Billard, 1907c: 340; Ritchie, 1910a: 9; Ritchie, 1910b: 815; Ritchie, 1911b: 818-820; Rees & White, 1966: 274.

Filellum serratum: Stechow, 1913b: 30, 111-112, fig. 85; Jäderholm, 1919: 7; Stechow, 1923b: 11; Stechow, 1923d: 145; Hargitt, 1924: 488: Trebilcock, 1928: 4; Billard, 1933: 8; Leloup, 1937b: 5, 31; Leloup, 1938: 11; Leloup, 1940b: 15; Fraser, 1943: 90; Fraser, 1944a: 216, pl. 44 fig. 109; Deevey, 1954: 270; Picard, 1958: 193; Yamada, 1959: 51; Millard, 1967: 175, fig. 2D; Millard, 1968: 262; Hirohito, 1969: 14; Patriti, 1970: 29, fig. 32; Schmidt, 1972a: 42; Vervoort, 1972a: 51-53, fig. 14a-b; Millard & Bouillon, 1973: 8, 57; Leloup, 1974: 8, fig. 9; Rho & Chang, 1974: 133, 137-138, pl. 2 figs. 3-4; Millard, 1975: 178, fig. 59A-C; Blanco, 1976: 32-33, pl. 2 figs. 1-3; Millard, 1977b: 106; Rho, 1977: 254-255, 415, pl. 75 fig. 65; Millard, 1978: 192; Garcia Corrales, Buencuerpo Arcas & Peinado de Diego, 1979: 10-11, fig. 3; Gravier-Bonnet, 1979: 22-24, fig. 4D; Stepan'yants, 1979: 50, pl. 8 fig. 8; Millard, 1980: 131; Hirohito, 1983: 20.

Reticularia serrata: Ralph, 1958: 312, figs. 2j, 3a; Rees & Thursfield, 1965: 86-87.

Filellum ?antarcticum Millard, 1958: 175.

Filellum antarcticum p.p. Millard, 1964: 10.

Material examined. – Sta. 27. Hydrothecae arising from stolon epizoic on hydrocladia and stems of *Synthecium patulum* (Busk). No coppiniae (BMNH 1984.1.1.11, alc. + sld.; RMNH 16515, sld.).

Distribution. – *Filellum serratum* is nearly cosmopolitan, being well represented in deeper tropical and subtropical strata and much less common elsewhere. The present record is from the southern part of the entrance to the Gulf of Aden. From that area the species was previously recorded by Billard (1933, Gulf of Suez) and Millard (1975, Indian Ocean).

Remarks. – The present, infertile, material is not described in detail. The hydrothecae consist of a basal portion, adnate to the substratum, and a much

longer free part, sharply bending away from the fused part. The basal portion has a number of fine transverse ribs (striae), in some thecae hardly visible because of detritus. The apical part of the hydrotheca is tubular, with the margin very slightly everted or straight, and renovations are sometimes present. The identification is exclusively based on the presence of striae, since no coppinia was found.

Lafoea dumosa (Fleming, 1820)
(figs. 7-8, tab. 7)

Sertularia dumosa Fleming, 1820: 83-84.

Lafoea cornuta Lamouroux, 1821: 8, pl. 65 figs. 12-14.

Campanularia dumosa: Fleming, 1828: 548-549; Johnston, 1832: 254, pl. 11 fig. 11; Johnston, 1838: 157, pl. 23 figs. 2-5; Johnston, 1847: 113-115, figs. 20-21, pl. 27 figs. 2-5.

Capsularia dumosa: Gray, 1848: 88.

Campanularia fruticosa M. Sars, 1850: 138-139.

Campanularia gracillima Alder, 1856: 361, pl. 14 figs. 5-6.

Lafoea dumosa: Hincks, 1868: 200-201, text-fig. 23, pl. 41 figs. 1, 1a; Storm, 1882: 17, 27; Broch, 1905: 13-15; Hartlaub, 1905: 594-595; Broch, 1908: 34-35, fig. 3; Billard, 1909a: 311; Broch, 1909b: 156, fig. 16; Broch, 1910: 26, fig. 21; Linko, 1911: 91-98, fig. 16; Ritchie, 1911a: 33; Stechow, 1913b: 30; Hartlaub & Scheuring, 1916: 77; Broch, 1917: 3, 7, 13; Broch, 1918: 7-9; Stechow, 1919: 80, fig. A^1; Stechow, 1925b: 455, fig. 24; Billard, 1927: 331; Totton, 1930: 158, fig. 14; Broch, 1933: 62-63; Leloup, 1934: 8; Kramp, 1935b: 123-124, figs. 52a, 53; Leloup, 1940b: 14; Fraser, 1944a: 221-222, pls. 45-46, fig. 205; Vervoort, 1946b: 197-199, figs. 24d, 83a, 84; Teissier, 1950: 17; Picard, 1958: 193; Ralph, 1958: 310; Riedl, 1959: 646; Yamada, 1959: 50; Leloup, 1960: 221; Naumov, 1960: 276-277, text-figs. 21, 46V, 165, pl. 1 fig. 1; De Haro, 1965: 108, 109, fig. 2; Rees & Thursfield, 1965: 79-80; Teissier, 1965: 19; Vervoort, 1968: 100; Rees & Rowe, 1969: 14-15; Calder, 1970: 1524, pl. 5 fig. 3; Fey, 1970: 396; Patriti, 1970: 27, fig. 28; Von Salvini-Plawen, 1972: 391; Calder, 1975: 299, fig. 3D; Cornelius, 1975b: 385-390, fig. 4; Millard, 1975: 185; Millard, 1977a: 15; Millard, 1977b: 106, 114; Evans, 1978: 80-85; Millard, 1978: 195; García Corrales, Buercuerpo Arcas & Peinado de Diego, 1979: 18-20, fig. 8; Cornelius & Garfath, 1980: 281; Millard, 1980: 131; Gili i Sard à, 1982: 56, fig. 20B; Hirohito, 1983: 21-22.

Lafoea fruticosa: Hincks, 1868: 202-203, pl. 41 figs. 2, 2a-b; G.O. Sars, 1874: 114-115, pl. 4 figs. 16-18; Storm, 1882: 17, 27; Broch, 1908: 35-37, fig. 4; Broch, 1909b: 158-159, 208, fig. 19; Linko, 1911: 98-103, fig. 17; Stechow, 1913b: 30, 109-110, fig. 84; Hartlaub & Scheuring, 1916: 76; Broch, 1917: 3, 4; Broch, 1918: 12-15; Jäderholm, 1919: 6-7, pl. 1 fig. 7; Jarvis, 1922: 335; Stechow, 1925b: 456-457, fig. 24B; Totton, 1930: 157-158, fig. 13; Leloup, 1934: 8; Kramp: 1935b: 124-125, fig. 52C-D; Leloup, 1938: 10-11, fig. 7; Leloup, 1940b: 14; Fraser, 1944a: 223-224, pl. 46 fig. 206; Vervoort, 1946b: 201, fig. 83c-d; Hodgson, 1950: 11; Yamada, 1955: 123-124, fig. 1c; Yamada, 1959: 50; Naumov, 1960: 275-276, figs. 15G, 46B, 164; Naumov & Stepan'yants, 1962: 76; Millard, 1964: 13-15, fig. 3; Rees & Thursfield, 1965: 80; Millard, 1966b: 491; Rees & White, 1966: 274; Vervoort, 1966a: 126-127, fig. 29; Millard, 1967: 175-176, fig. 2C; Millard, 1968: 263; Calder, 1970: 1524-1525, pl. 5 fig. 4; Vervoort,1972a: 66-74, figs. 19-21; Vervoort, 1972b: 348, fig. 5; Millard, 1973: 28, fig. 4A; Rho & Chang, 1974: 138-139, pl. 3 figs. 1-2; Millard, 1975: 187, fig. 61A-F; Rho, 1977: 239, 256-257, 416, text-fig. 13, pl. 75 fig. 68; Stepan'yants, 1979: 47-48, pl. 8 fig. 6.

Lafoea pocillum Hincks, 1868: 204, pl. 40 fig. 2; Linko, 1911: 114-116, fig. 20; Naumov, 1960: 273-274, fig. 161.

Lafoea gracillima: G.O. Sars, 1874: 115, pl. 4 figs. 19-21; Storm, 1879: 26; Storm, 1882: 17; Grieg, 1887: 12; Bonnevie, 1901: 9; Hartlaub, 1901: 358-359, pl. 21 figs. 1-3; Jäderholm, 1903: 273-274; Hartlaub, 1904: 6; Hartlaub, 1905: 594, fig. P²; Jäderholm, 1905: 21-22, pl. 9 figs. 2-3; Ritchie, 1907b: 531; Broch, 1908: 37-38, fig. 5; Broch, 1909b: 156-157, 208-209, figs. 17-18; Ritchie, 1910a: 8-9; Linko, 1911: 103-110, fig. 18; Ritchie, 1911a: 33-34; Bale, 1915: 255-256; Broch, 1918: 9-11; Jäderholm, 1919: 7, pl. 1 fig. 8; Stechow, 1919: 81; Jäderholm, 1920: 3; Stechow, 1925b: 457-458, fig. 24C; Billard, 1927: 331; Totton, 1930: 158-159, fig. 15; Kramp, 1935b: 125, fig. 52B; Fraser, 1944a: 224-225, pl. 46 fig. 207; Vervoort, 1946b: 199-201, fig. 83c; Picard, 1958: 193; Ralph, 1958: 310, figs. 1y, 2a-c; Yamada, 1959: 50; Leloup, 1960: 231; Ralph, 1961c: 236; Rees & Thursfield, 1965: 80-81; Teissier, 1965: 20; Vervoort, 1966a: 125-126, fig. 28; Blanco, 1967: 246-248, pl. 1 figs. 1-4; Vervoort, 1968: 100-101; Rees & Rowe, 1969: 15-16; Calder, 1970: 1525, pl. 5 fig. 5; Fey, 1970: 396; Patriti, 1970: 27, fig. 26; Leloup, 1974: 10.
Lafoea capillaris G.O. Sars, 1874: 115, pl. 4 figs. 22-24; Storm, 1879: 26; Storm, 1882: 17, 27.
Calycella obliqua Hincks, 1874b: 149, pl. 6 figs. 4-5.
Toichopoma obliquum: Levinsen, 1893: 176, 178; Broch, 1909b: 159-160, 210, fig. 20.
Hebella pocillum: Ritchie, 1911a: 33; Yamada, 1955: 122, fig. 1B.
Lafoea intermedia Fraser, 1938a: 9, 47-48, pl. 11 fig. 53.

Material examined. – Sta. 111. Colony epizoic on *Synthecium megathecum* Billard, comprising stolon and five hydrothecae with hydranths. No coppiniae (BMNH 1984.1.1.14, sld.).

Sta. 122. Various colonies and fragments, probably all from a big, irregularly branched, polysiphonic colony about 70 mm high with a spread of about 50 mm. Stems and some branches covered by Alcyonacea. No coppiniae (BMNH 1984.1.1.15, alc. + sld.; RMNH 16517, alc. + sld.).

Sta. 157. One polysiphonic colony 50 mm high and a tangled mass of colonies 20-30 mm high on worm tubes, etc. No coppiniae (BMNH 1984.1.1.16, alc. + 3 slds; RMNH 16518, alc. + 2 slds).

Description. – The material from Sta. 111 will be described first (fig. 7). Stolon tubular, circular in cross section, creeping on branch fragment of *Synthecium megathecum*; almost straight, stretching along upper surface of branch. Hydrothecae arising directly from stolon, deep-campanulate, narrowed at base and there with indication only of slightly kinked pedicel, running into slightly expanding hydrotheca (fig. 7a, b). Upper half of hydrotheca nearly cylindrical, slightly but distinctly everted at margin. Some hydrothecae with one or two renovations. Hydrothecal margin in undamaged specimens perfectly circular. Perisarc firm on stolon and basal part of hydrotheca, rapidly thinning along hydrothecal wall. Apical portion of hydrotheca thin and easily collapsible.

All hydrothecae with well preserved hydranths completely retracted within them (fig. 7a). Basal portion of each hydranth attached to hydrothecal wall, apparently in the region where pedicel and hydrotheca meet; no desmocytes seen, nor traces of a diaphragm.

Though the various colonies from Stas 122 and 157 differed in height, they all had the same structure. Colonies shrubby in appearance, with about 1 mm thick polysiphonic stem and main branches; branching roughly in one plane and quite irregular, with many anastomosing side branches. Colonies flexuo-

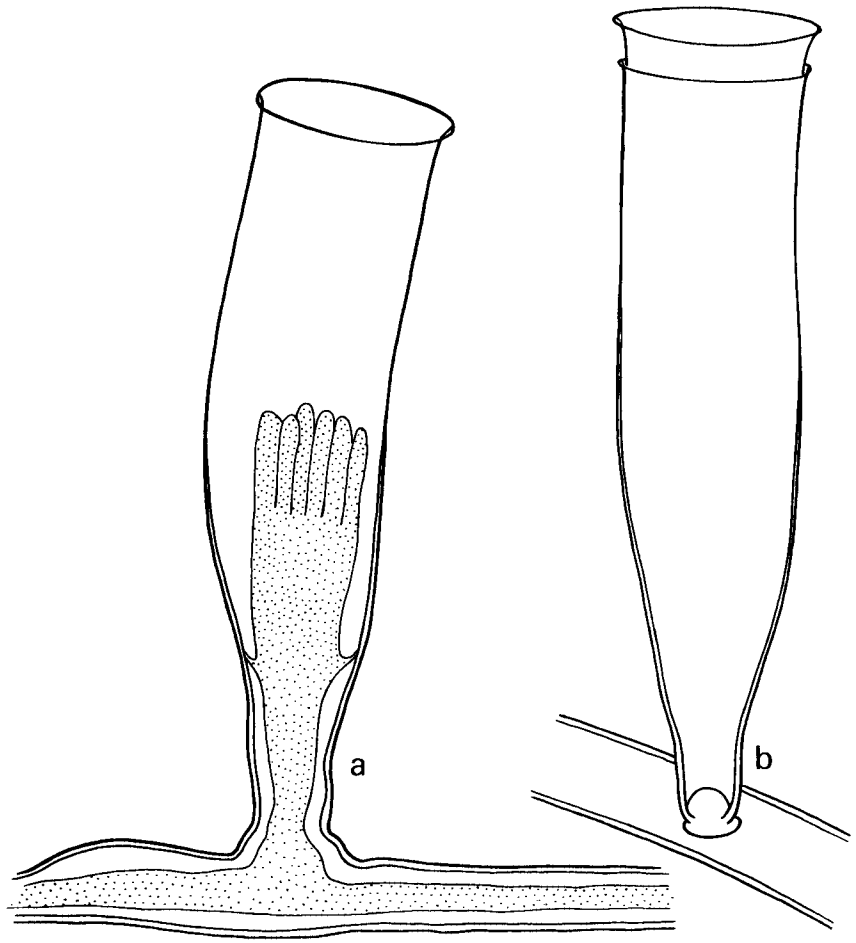


Fig. 7. *Lafoea dumosa* (Fleming), John Murray Exped., Sta. 111. a, b, hydrothecae from stolonal colony. a, b x 175.

se, not stiff, polysiphonic by development of secondary tubules from base of colony; these tubules forming the many side branches. Primary tube and secondary tubules bearing the hydrothecae, leaving axis at an angle of 40° – 45°.

Arrangement of hydrothecae irregular, particularly in polysiphonic parts of colony, pointing in several directions (fig. 8a, c). Hydrothecae with short pedicels with a more or less distinct twist, cylindrical in outline, narrowing towards pedicel and slightly bulging on adcauline side (fig. 8b, d). Hydrothecal margin slightly everted. Hydrothecal base with a row of desmocytes, marking

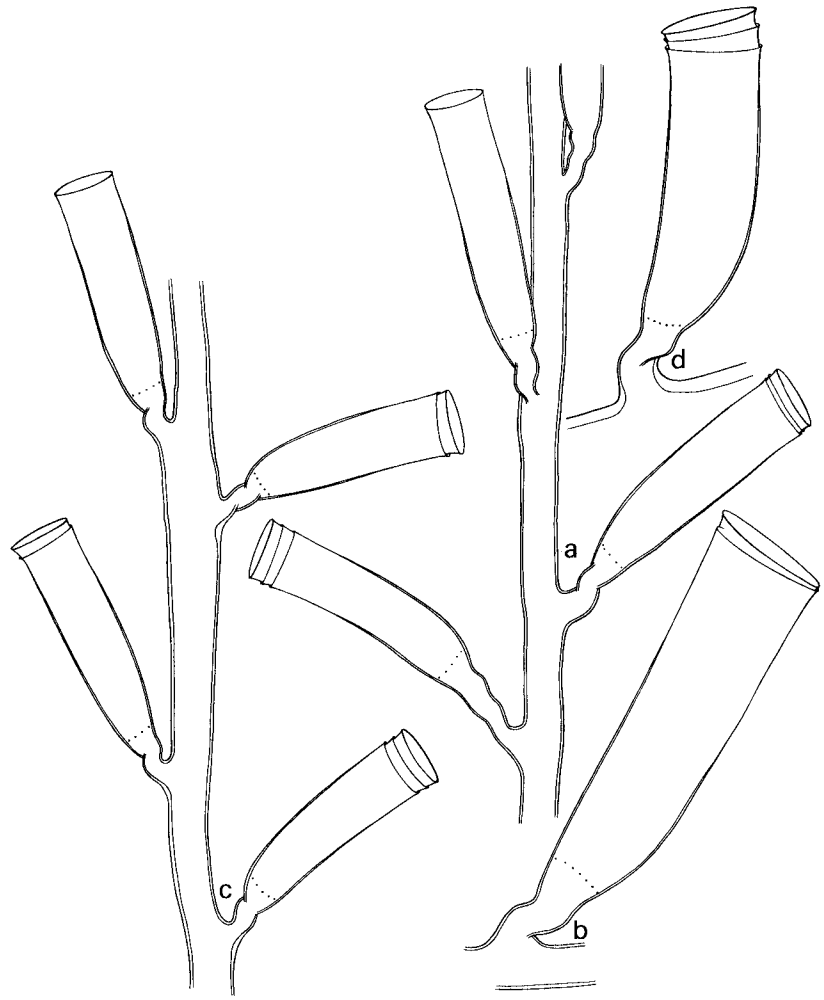


Fig. 8. *Lafoea dumosa* (Fleming). a, b, John Murray Exped., Sta. 122. a, monosiphonic part with hydrothecae; b, renovated hydrotheca. c, d. John Murray Exped., Sta. 157. c, monosiphonic part with hydrothecae; d, renovated hydrotheca. a, c x 55; b, d x 85.

level of attachment of hydranth. Desmocytes distinct in all specimens.

The material from Sta. 157 has well preserved hydranths and was alive when collected. The material from the two stations differed in hydrothecal size.

Distribution. – *Lafoea dumosa* is a nearly cosmopolitan species in shallow to deep water, extending from c. 10 m to at least 2078 m depth (Vervoort, 1972a). It occurs as stolonal colonies on various objects, including other hydroids, and as erect, polysiphonic colonies. Some colonies include both growth habits.

	John Murray Exped. Sta. 111	John Murray Exped. Sta. 122	John Murray Exped. Sta. 157
Hydrotheca			
total length (margin to desmocytes, including renovations)	490 – 535	530 – 695	460 – 500
breath at rim	115 – 135	170 – 205	150 – 190
Pedicel			
length stem to desmocytes		130 – 175	115 – 130
diameter		65 – 80	50 – 70
Stolon			
diameter	55 – 70		

Table 7. *Lafoea dumosa*. Measurements in μm.

Remarks. – We have followed Cornelius' concept of this species (Cornelius, 1975b: 385-390), uniting *Lafoea dumosa* (Fleming), *Lafoea fruticosa* (M. Sars), *Lafoea gracillima* (Alder) and *Lafoea pocillum* Hincks under the oldest available name: *Lafoea dumosa* (Fleming, 1820). It seems clear now that *Lafoea capillaris* G.O. Sars, *Calycella obliqua* Hincks and *Lafoea intermedia* Fraser also belong here. For a discussion of this synonymy we refer to the papers by Vervoort (1946b, 1972a), Naumov (1960) and particularly Cornelius (1975b). A form with unusually large hydrothecae (longer than 0.9 mm, including the pedicel) was described by Ritchie (1909a) as *Lafoea gracillima* var. *benthophila* and is now generally recognized as *Lafoea benthophila* Ritchie, 1909, a separate species. So far as the colony structure and the shape of the hydrothecae are concerned this "species" might very well fit in the present concept of *Lafoea dumosa* (Fleming). It is provisionally kept separate because the structure of the coppinia is imperfectly known and might furnish diagnostic characters to distinguish it from *L. dumosa*. The synonymy of *L. benthophila* is given below.

Lafoea benthophila Ritchie, 1909a

Lafoea gracillima var. *benthophila* Ritchie, 1909a: 76-77, fig. 2; Leloup, 1937b: 5, 31; Dawydoff, 1952: 55; Rees & Thursfield, 1965: 81-82, 198; Blanco, 1967: 249; Smaldon, Heppell & Watt, 1976: 15.

? *Lafoea gracillima* Vanhöffen, 1910: 312; Billard, 1914: 10.

Lafoea gracillima: Ritchie, 1910a: 8.

Lafoea benthophila: Stechow, 1923a: 7; Stechow, 1925b: 455-456, fig. 24D; Vervoort, 1946a: 303-304; Vervoort, 1966a: 124-125, fig. 27; Millard, 1975: 185, fig. 61G; Millard, 1978: 194.

Remarks. – The status of this nominal species is discussed under *L. dumosa*.

Subfamily Zygophylacinae Stechow, 1921d

Diagnosis. – Colony usually pinnate, composed of at times strongly forked primary axis bearing subalternate hydrocladia and two or four rows of alternate hydrothecae. Main stem and branches usually strongly polysiphonic by presence of secondary tubes, running parallel to primary axis and obscuring insertion of hydrothecae and hydrocladia; distal part of axis and branches monosiphonic. In exceptional cases pinnate structure of colony less distinct and colony apparently composed of polysiphonic, forked axis bearing irregularly arranged hydrothecae and hydrocladia (*Zygophylax flexilis* Pictet & Bedot, 1900). Subalternate hydrocladia usually at base of every third and fourth (stem) hydrotheca, with or without septa. Hydrothecae much varied, tubular to tumbler-shaped, usually on distinct apophyses from which hydrotheca is separated by distinct diaphragm. Mode of curvature of hydrotheca much varied. Secondary tubes on stem and principal branches may cover stem hydrothecae almost completely. Nematothecae present in practically all species of this subfamily, occurring on hydrothecal apophyses, on primary tube and on secondary tubes, deciduous, usually leaving circular depression on perisarc. Shape as varied as in hydrothecae: tubular to tumbler-shaped, symmetric, or asymmetric by development of one-sided bulge.

Reproduction by means of unisexual gonothecae, aggregated on main stem or branches to form coppinial masses. Gonothecae elongate oval to tubular, separated, touching or coalesced. Nematophorous tubules may be present. Colonies monoecious or dioecious; in monoecius colonies coppinia may be hermaphrodite.

Genera: *Abietinella* Levinsen, 1913, *Cryptolaria* Busk, 1857, and *Zygophylax* Quelch, 1885 (including *Lictorella* Allman, 1888).

Remarks. – There are several new species of the genus *Zygophylax* in the John Murray collection. This made it necessary to compare the descriptions of the various species of this genus and to reconsider the generic definitions within the subfamily Zygophylacinae Stechow, 1921d: 255. As a result of these comparisons it became necessary to merge the genera *Zygophylax* and *Lictorella*. In the subfamily Zygophylacinae we have furthermore included *Abietinella* and *Cryptolaria*.

Genus **Abietinella** Levinsen

Abietinella Levinsen, 1913: 294; type species, by monotypy, *Zygophylax operculata* Jäderholm, 1903.

Diagnosis. – Colony strongly pinnate, with much forked, polysiphonic stem; hydrocladia and hydrothecae rigorously in one plane. Hydrotheca scarcely pedicellate, flanked by two nematothecae, one on each side of apophysis. Hydrothecal rim circular, slightly flared, tilted so that plane of aperture is almost perpendicular to long axis of hydrocladium; terminal operculum circular, internally attached to adcauline wall close to rim.

Gonosome a coppinia (see *Abietinella operculata*).

Abietinella operculata (Jäderholm, 1903)

Zygophylax operculata Jäderholm, 1903: 262, 276-278, pl. 12 figs. 7-8; Billard, 1905a: 98; Jäderholm, 1905: 4, 22, 38; Billard, 1906b: 181; Clarke, 1907: 16, 17; Vanhöffen, 1910: 315, 317; Blanco, 1968: 198-200, pl. 1 figs. 8-10.
Abietinella operculata: Levinsen, 1913: 294, pl. 4 figs. 21, 22a; Naumov & Stepan'yants, 1962: 78-80, fig. 4; Vervoort, 1972a: 79-82, fig. 24; Blanco, 1976: 33-35, pl. 2 figs. 4-8, pl. 3 figs. 1-3; Stepan'yants, 1979: 59, pl. 10 fig. 2, pl. 25 fig. 4.
Cryptolaria operculata: Von Salvini-Plawen, 1972: 391.

Remarks. – Type species of the genus *Abietinella* Levinsen, 1913; gonosome unknown. Type locality: Cape Valentyn, Patagonia, 274 m. Holotype in main collection of NRS, registered under "Utländska Hydroider, no. 197". A schizoholotype is in BMNH (1960.8.29.41), labelled: "*Zygophylax operculata* Jäderholm. Fragment of holotype. Cape Valentyn, 150 fms, [= 274 m] 12.3.1896. Exch. Stockholm Mus. 1959". This material comprises 3 fragments, viz., a top part of a colony 9 mm long; a stem fragment with three hydrocladia 6 mm high, and a branched hydrocladium 8 mm long; the condition of these fragments is fair. The gonosome is still undescribed. [The gonosome of this species has recently been discovered in material collected by the French "Marion Dufresne" Relief Expeditions to the southern part of the Indian Ocean; it is a typical coppinia found on main stem and branches (W. Vervoort)].

Abietinella grandis (Vanhöffen, 1910).

Zygophylax grandis Vanhöffen, 1910: 273, 315-317, 327, 339, fig. 33a-e; Stepan'yants, 1979: 59.
Abietinella grandis: Vervoort, 1972a: 82.

Remarks. – Doubtful species, probably identical with *A. operculata* (see Vervoort, 1972a: 82). Gonosome unknown. Type locality: Gauss Station of German South Polar Expediton, 65° 21′ S, 86° 06′ E, 385 m. Whereabouts of holotype unknown, probably lost.

Genus **Cryptolaria** Busk, 1857

Cryptolaria Busk, 1857: 173; type species, by monotypy, *Cryptolaria prima* Busk, 1857.
Perisiphonia Allman, 1888: 43-44; type species, by subsequent designation (Totton, 1930: 166), *Perisiphonia pectinata* Allman, 1888.
Eucryptolaria Fraser, 1938c: 134; type species, by monotypy, *Eucryptolaria pinnata* Fraser 1938c.
Euperisiphonia Fraser, 1940: 578, type species, by monotypy, *Euperisiphonia rigida* Fraser, 1940.

Diagnosis. – Colony pinnate, main stem occasionally forked. Main axis with 2 or 4 longitudinal rows of sub-opposite hydrothecae. Hydrocladia sub-opposite, all in one plane. Hydrotheca, though basally delimited by distinct diaphragm, completely without pedicel, directly on apophysis, adcauline wall coalesced with axis or hydrocladium for some distance, usually curved outward, though degree of curvature varied. Nematothecae on apophyses deciduous or absent, number of nematothecae on secondary tubes usually increased.

Gonothecae aggregated to form coppiniae on main stem or branches; coppinia elongate oval, component gonothecae coalesced, apically with hooded structure (pyramidal "hood" or curved funnel) carrying the gonothecal aperture.

Cryptolaria prima Busk, 1857

Cryptolaria prima Busk, 1857: 173-174, pl. 16; Kirchenpauer, 1884: 106; Kirkpatrick, 1890a: 13; Totton, 1930: 161, 166; Ralph, 1958: 322-324, figs. 5a-c, 6a-f, 7a-b.
Perisiphonia quadriseriata Trebilcock, 1928: 4, pl. 2 figs. 2-2d.

Remarks. – The gonosome of this species is a coppinia with nematophorous ramules, described and figured by Ralph (1958): "Coppinia large, surrounding the branch for up to 3.0 cm and about 2.0 mm in diameter; gonothecae fused to one another on all sides, regularly arranged, arising from tubes of the peripheral fascicle, more or less pentagonal in shape, widest at the distal end, tapering towards the base; aperture carried on a small conical neck; aperture about 0.06 mm in diameter, protected by dome-shaped hood-like structure; tubes of the peripheral fascicle emergent beyond the gonothecae for up to 1.2 mm (giving the whole structure a prickly appearance), tubes branched at the distal region, and branches bearing nematothecae similar to those described for the main stem and branches".

Type species of the genus *Cryptolaria* Busk, 1857. Type locality: New Zealand, no depth data. The holotype (BMNH no. 1857.1.2.86) is a herbarium specimen c. 18 cm long, with sub-opposite branches and in good condi-

tion. It is labelled: "*Cryptolaria prima*, New Zealand, Dr Sinclair".

The holotype of *Perisiphonia quadriseriata* Trebilcock is in MVM (no. F52217).

Cryptolaria exserta Busk, 1858

Cryptolaria exserta Busk, 1858: 130, pl. 19 fig. 3; Stechow, 1923d: 146; Blackburn, 1942: 111; Ralph, 1958: 322, figs. 5d-f, 6k; Rees & Thursfield, 1965: 83-84, 199; Rees & White, 1966: 273; Yamada, 1959: 49; Hirohito, 1983: 19.

Perisiphonia filicula Allman, 1888: 44-45, pl. 22 figs. 1-4; Driesch, 1889: 202; Versluys, 1899: 35, 36; Pictet & Bedot, 1900: 19-21; Browne, 1907: 28; Vanhöffen, 1910: 316; Ritchie, 1911b: 835; Stechow, 1923d: 146; Smaldon, Heppell & Watt, 1976: 15.

Acryptolaria exserta: Marktanner-Turneretscher, 1895: 403; Stechow, 1923b: 10; Stechow, 1923d: 146.

Perisiphonia filicaulis Nutting, 1900: 28.

Perisiphonia exserta: Ritchie, 1911b: 834-837, pl. 87 fig. 3; Stechow, 1913a: 144; Stechow, 1913b: 12, 117; Briggs, 1914: 285, 286, 290, 291; Bale, 1915: 247; Jäderholm, 1919: 8; Jarvis, 1922: 335; Totton, 1930: 162; Kramp, 1947: 8; Hodgson, 1950: 12, figs. 20-21.

Zygophylax (Perisiphonia) filicula: Clarke, 1907: 16, 17.

non *Acryptolaria exserta*: Norman, 1875: 172-173, pl. 12 figs. 1-2 (= *Acryptolaria andersoni* Totton, 1930).

Remarks. – The gonosome of *Cryptolaria excerta*, a coppinia with nematophorous ramuli, was described by Ralph (1958): "Female coppinia surrounding the branch and sometimes the main stem for up to 2.0 cm and about 2.0 mm in diameter; gonothecae fused to one another on all sides, regularly arranged, arising from tubes of the peripheral fascicle, more or less pentagonal in shape, widest at the distal end, tapering towards the base; aperture carried on a small conical neck, aperture about 0.06 mm in diameter, protected by a large hood-like structure; tubes of the peripheral fascicle standing out more or less at right angles beyond the gonothecae for up to 0.70 mm (giving the whole structure a "prickly" appearance), tubes branched at the distal region, and branches bearing nematothecae very similar to those described for the main stem and branches". Type locality: Madeira, no depth data. Whereabouts of holotype unknown. Type locality of *Perisiphonia filicula* Allman, 1888: Twofold Bay, Australia, 274 m, also recorded from near Azores, 38° 38′ 00″ N, 28° 30′ 30″ W, "Challenger" Sta. 75. Holotype and schizoholotype microslide preparations in BMNH, no. 1888.11.13.33. There is also a schizoholotype microslide preparation in RSM (no. 1959.33.319).

The BMNH specimens are entered into the catalogue as follows:

"*Perisiphonia filicula* Allman, 1888.11.13.33, sp. & sl. Type. Stn 75, nr Azores. 38° 38′ N, 28° 28.5′ W, 450 fms. [= 823 m] Voy Challenger. Also Stn 163A, Twofold Bay, N.S.W., 150 fms. [= 274 m] 88.11.13.33*.

*It is not certain which locality the specimen comes from, whether Stn 75 or Stn 163A. R.K. [R. Kirkpatrick].

*N.B. Probaly from Twofold Bay because of presence of Cirripede *Ibla* sp. which is not known to occur in Atlantic. A.K.T. [A.K. Totton] 13.3/1926".

The vial contains at least 2 fragmented specimens, the larger with the cirripede *Ibla*. It is impossible to indicate the figured specimen, so we refrain from indicating a lectotype from the (syn)type series. The type locality, as deduced by Totton, is Twofold Bay, N.S.W.

In addition there are two microslide preparations: Allman's glycerine-mounted specimen labelled: "*Perisiphonia filicula* (Challenger)" (1888.11.13.33), and a second, stained preparation in balsam, labelled: "Challenger coll. St. ? (1888.11.13.33). *Perisiphonia filicula* Allman. Allman det." The condition of the first preparation is bad; the second is in better condition, though many hydrothecae are damaged.

Cryptolaria pectinata (Allman, 1888)

Perisiphonia pectinata Allman, 1888: 45-46, pl. 21 figs. 2-2b; Farquar, 1896: 461; Versluys, 1899: 35, 36; Pictet & Bedot, 1900: 4, 18-22, 53, 55, pls. 4-5; Lo Bianco, 1903: 243, 268, 277; Nutting, 1905: 947; Browne, 1907: 16, 18, 27, 28-29; Vanhöffen, 1910: 316; Ritchie, 1911b: 835, pl. 87 fig. 2; Totton, 1930: 166; Kramp, 1947: 8-9.

Cryptolaria pectinata: Ralph, 1958: 320-322, figs. 5g-j, 6g-j, 7c; Rees & Thursfield, 1965: 84-85, 196; Rees & White, 1966: 273-274; Millard, 1973: 28; Millard, 1975: 174-175, fig. 58A-F; Millard, 1978: 191; Smaldon, Heppell & Watt, 1978: 14; Millard, 1980: 131.

Acryptolaria pectinata: Stechow, 1921e: 229; Stechow, 1923d: 146; Stechow, 1925b: 448-451, figs. 20-21; Leloup, 1940b: 9.

Zygophylax pectinata: Jäderholm, 1903: 278; Clarke, 1907: 16, 17.

Zygophylax (Perisiphonia) pectinata: Clarke, 1907: 16; Broch, 1917: 13.

Remarks. – Type species of the genus *Perisiphonia* Allman, 1888. Gonosome a coppinia with nematophorous ramuli, described by Pictet & Bedot (1900), Stechow (1925b) and Ralph (1958): "Gonothecae fused together forming a coppinia; each gonotheca polygonal in shape with the distal end produced into a hood-like structure; slender tubes arise between the gonothecae and project beyond the general surface of the coppinia; the distal free end of these tubes is usually irregularly branched and each branch carries a nematotheca" (Ralph, 1958). Type locality: off New Zealand, "Challenger" Sta. 169, 37° 34′ S, 179° 22′ E, 1280 m. Holotype in BMNH (no. 1888.11.13.34). This is the specimen figured by Allman; it is now in three pieces (incidentally, there is also a fragment of *Stegolaria* sp. in the sample). There is also an additional vial, 1888.11.13.34 pt, "part of holotype after KOH" which appears to be empty. The main branch of the holotype has a

large coppinia, 15 mm long and 2.5 mm across, which has been used to make microslide preparations. Allman's schizoholotype microslide preparation bearing the same number, is an unstained, glycerol-mounted specimen in rather bad condition, though the nematothecae are distinct. There is an additional stained microslide preparation without registration number and another of sections through the coppinia. Part of the schizoholotype has been figured by Ralph (1958: fig. 6h, g). There is also a schizoholotype micropreparation in the RSM (no. 1959.33.320).

Cryptolaria chazaliei (Versluys, 1899)

Perisiphonia chazaliei Versluys, 1899: 32-36, figs. 2-4; Pictet & Bedot, 1900: 19, 20; Vanhöffen, 1910: 316; Nutting, 1919: 116; Leloup, 1940: 9; Van Soest, 1976: 81.
Zygophylax chazaliei: Clarke, 1907: 15, pls. 11-13; Fraser, 1944a: 232, pl. 43 fig. 196; Fraser, 1944b: 37; Fraser, 1946: 54, 187; Vervoort, 1968: 101.

Remarks. – Dubious species with unknown gonosome. Type locality: Los Testigos, Leeward Islands, West Indies, 80 m. Holotype in ITZ (ZMA COEL no. 4104, Van Soest, 1976).

Cryptolaria adhaerens (Fraser, 1938a)

Lictorella adhaerens Fraser, 1938a: 9, 48, pl. 11 fig. 54; Fraser, 1946: 187; Fraser, 1948: 232; Arai, 1977: 27; Ljubenkov, 1980: 48.
Zygophylax adhaerens: Fraser, 1944b: 37.

Remarks. – Species with unknown gonosome, provisionally referred to *Cryptolaria*. Type locality, as specified by Fraser (1938a): between Charles and Indefatigable Islands, Galápagos Archipelago, 219 m. Holotype in AHM, no. 79 [label: "R/V Velero III Sta. 192-34: Jan. 27, 1934; east of south end of Albemarle Island, Galápagos; 1° 04′ S, 90° 39′ W; 120 fms (= 219 m); rough rock"]. Material of this species also available in BCPM (no. 976-333-1, Arai, 1977).

Cryptolaria pinnata (Fraser, 1938c)

Eucryptolaria pinnata Fraser, 1938c: 134, 140-141, pl. 20 fig. 9; Fraser, 1943: 78-79, 90, pl. 17 fig. 6; Fraser, 1944a: 214, pl. 43 fig. 195; Fraser, 1944b: 37; Fraser, 1946: 53, 175; Deevey, 1954: 270; Vervoort, 1968: 100; Arai, 1977: 26.

Remarks. – Type species of *Eucryptolaria* Fraser, 1938c: 134 (monotypy); probably identical with *Cryptolaria pectinata* (Allman, 1888). Gonosome described by Fraser (1943, 1944), structure in principle as in *C. pectinata*, though described by Fraser as being placed on considerably modified secondary branch, terminating at end of coppinia. Type locality: Daphne Minor Island, Galápagos Islands, 128-146 m. Holotype in AHM, no. 76; paratype no. 213 [label: "R/V Velero III Sta. 792-39: Jan. 20, 1938; off Daphne Minor Island, Galápagos; 0° 24′ 30″ S, 90° 22′ 40″ W; 70-80 fms (= 128-146 m); mud". Jar empty; whereabouts of specimen not known]. Material also available in BCPM (no. 976-318-1, Arai, 1977).

Cryptolaria rigida (Fraser, 1940)

Euperisiphonia rigida Fraser, 1940: 579, pl. 33 fig. 7.
Zygophylax rigida: Fraser, 1944a: 232-233, pl. 44 fig. 197; Fraser, 1944b: 37; Fraser, 1946: 54, 188; Deevey, 1954: 270; Vervoort, 1968: 101.

Remarks. – Type species of *Euperisiphonia* Fraser, 1940: 579 (monotypy), referred by Fraser (1944a: 232) to *Zygophylax*. *Euperisiphonia rigida* is best referred to *Cryptolaria*, so that *Euperisiphonia* becomes a synonym of *Cryptolaria*. The gonosome is unknown. Type locality: Yucatan Channel, 20° 59′ 30″ N, 86° 23′ 45″ W, 238 m. Type series in NMNH (no. 43439).

Cryptolaria spinosa Millard, 1980

Cryptolaria spinosa Millard, 1980: 131, 140-142, fig. 3.

Remarks. – The gonosome, a coppinia, was described by Millard (1980: 140): coppinia "about 15 mm in diameter and covering up to 17 mm of branch, consisting of closely adpressed gonothecae and a few tubular protective structures. Gonothecae broadly flask-shaped, with a bulging basal part and a short, widely flared neck bearing a terminal aperture. Tubular structures about the same length as gonothecae, branching, bearing nematothecae". Type locality: off Transkei, 32° 14.8′ S, 29° 00.8′ E, 90 m. Holotype in SAM (no. H2986, Millard, 1979).

Genus **Zygophylax** Quelch, 1885

Zygopgylax Quelch, 1885: 4; type species, by monotypy, *Zygophylax profunda* Quelch, 1855.
Lictorella Allman, 1888: 35; type species, by subsequent designation (Totton, 1930: 166), *Lictorel-*

la halecioides Allman, 1888 = *Sertularia antipathes* Lamarck, 1816, non *Lictorella halecioides* (Allman, 1874) = *Lictorella* (= *Zygophylax*) *pinnata* (G.O. Sars, 1874).
Brucella Ritchie, 1907b: 533; type species, by monotypy, *Brucella armata* Ritchie, 1907b).

Diagnosis. – Colonies erect, pinnate or flabellate, stems usually rigid, occasionally forked. Branches, with hydrocladia, in most species in one plane, but in some (for example, *Zygophylax antipathes*) in various planes. Stem and branches strongly polysiphonic, with the exception of distal parts. Hydrotheca pedicellate, separated from pedicel by distinct diaphragm, occasionally reduced to mere annulus. Length of pedicel varied between the various species; hydrothecae tubular to tumbler-shaped, usually slightly asymmetric, occasionally touching hydrocladia or axis but never coalesced. Hydrothecal rim usually slightly everted, circular, no operculum.

Nematothecae usually present on hydrothecal apophysis, on main tube and on peripheral tubules. They are probably a constant feature but may be deciduous in certain species.

Gonosome a coppinia, formed by gonothecae arranged together on stem or on principal branches. Degree of approximation varied: in some species gonothecae separate, in others touching or coalesced. Apical part of gonotheca variously produced: aperture at end of short funnel or in hooded terminal portion. Funnel occasionally split up into two to four, often recurved, necks with terminal apertures. Male and female gonothecae may have different shape and may occur in separate coppiniae, at times placed on separate (male or female) colonies.

Remarks. – We abandon Totton's distinction between the genera *Zygophylax* and *Lictorella*, based on the shape of the gonothecae. Totton's conception of *Zygophylax* ("gonosome consisting of conjoined gonothecae of irregular shape and with a varying number of openings provided with flared mouths") and *Lictorella* (gonosome "a coppinia mass of closely packed and conjoined gonothecae having hooded apertures much as in *Perisiphonia* but without nematothecae bearing ramules") has been weakened by the discovery of many new species, in which the gonothecae differ widely from the types described above; while the presence or absence of nematophorous ramules may differ in the two sexes of a single species. We have therefore united the two genera under the oldest available name, *Zygophylax* Quelch, 1885. An inventory of the various species, with emphasis on the structure of the gonosome, where known, is given below.

Zygophylax antipathes (Lamarck, 1816)
(fig. 12d)

Sertularia antipathes Lamarck, 1816: 115-116; Milne Edwards, 1836a: 138; Milne Edwards, 1836b [-1849]: pl. 67 fig. 1; Van Praët, 1979: 884, fig. 26.

Laomedea antipathes: Lamouroux, 1816: 206, pl. 6 fig. 1a, B; Fleming, 1820: 88; Deslongchamps, 1827: 481; De Blainville, 1830: 439; De Blainville, 1834: 474; Duchassaing, 1850: 22; Busk, 1852: 402; Agassiz, 1865: 223; Von Lendenfeld, 1884: 403, 622; Von Lendenfeld, 1885b: 629; Von Lendenfeld, 1887: 17, errata: 6; Bale, 1894: 98, 99.

Campanularia antipathes: Bale, 1884: 52, 53, pl. 2 fig. 5.

Lictorella halecioides: Allman, 1888: 35-36, 37, pl. 17 figs. 1, 2; Driesch, 1889: 202; Kirkpatrick, 1890b: 604, 608-609; Borradaile, 1905: 836, 840, pl. 69 fig. 3; Nutting, 1905: 934, 935, 946, pl. 10 figs. 1-4; Billard, 1908: 1356; Billard, 1910: 6, 7.

Lictorella antipathes: Billard, 1907b: 215-216, fig. 1; Billard, 1908: 1356; Billard, 1909: 312; Billard, 1910: 6-7, fig. 1; Ritchie, 1911b: 821-823; Jäderholm, 1916: 5; Broch, 1918: 23; Stechow, 1926: 100; Leloup, 1937b: 4, 28-29, fig. 18; Pennycuik, 1959: 156, 189; Redier, 1964: 130; Vervoort & Vasseur, 1977: 22, fig. 9a.

Zygophylax antipathes: Rees & Thursfield, 1965: 76-77; Millard & Bouillon, 1973: 62-63, fig. 8H; Watson, 1973: 164-165, fig. 9; Hirohito, 1983: 24-26, fig. 7.

non *Lafoëa halecioides* Allman, 1874a: 471, 472, 477, pl. 66 figs. 1, 1a = *Zygophylax pinnata* G.O. Sars, 1874.

Remarks. – Type locality Australia, no depth data. Type series in MNH (Billard, 1907b; Redier, 1964; Van Praët, 1979: "Syntypes H.L. 305, 306 et échantillon à sec 52a, b, Z^2R, Collection Lamarck, Boîte 37"). Allman's figured specimen of *Lictorella halecioides* Allman, 1888, from the Challenger Expedition, off Somerset, Cape York, Torres Strait, 15-22 m, is still present in the BMNH (1888.11.13.23), but it is now in 3 pieces and some fragments. The condition is bad, and the specimen was apparently desiccated at some time. There is also a microslide preparation bearing the same number (see Vervoort & Vasseur, 1977, fig. 9a). The broken stem of the "Challenger" specimen carries several coppiniae, not figured by Allman; and a microslide preparation containing a section of the coppinia, made by R. Trebilcock, also bears the number 1888.11.13.23. The coppinia, 5 mm long and 3.5 mm across, is composed of closely aggregated, fused gonothecae, forming an oval mass around the stem. Each gonotheca is c. 1.6 mm long and has a maximum diameter of 0.4 mm, containing one large egg each. It is elongate, more or less flask-shaped, with a fairly broad base attached to the tubes of the axis and slightly widening apically. The top is narrowed into a cylindrical portion with rounded apex forming a hood-like structure with a large, oval, lateral opening (fig. 12d).

Zygophylax robusta (Verrill, 1873)

Halecium robustum Verrill, 1873: 9, note.

Zygophylax robustum: Cornelius, 1975b: 402, fig. 9.

Remarks. – Referred by Cornelius (1975b: 401, 402) to *Zygophylax*. Neotype, designated by Cornelius, 1975b, in YPM, no. 9137; holotype originally recorded from St. George's Bank, E Canada, 15 Sep. 1872, lost; neotype, on microslide, from off Cape Ann, Massachusetts, 17 Sep. 1878, no depth data. Gonosome unknown.

Zygophylax pinnata (G.O. Sars, 1874)

Lafoea pinnata G.O. Sars, 1874: 116-117, 133, 139, pl. 4 figs. 25-28; Storm, 1879: 26; Storm, 1882: 17, 27; Grieg, 1887: 12; Von Campenhausen, 1896a: 104; Von Campenhausen, 1986b: 308; Bonnevie, 1899: 10, 11, 59, 61, 62, 69, pl. 6 fig. 1; Broch, 1903, table; Hartlaub, 1905: 593-594, fig. O^2 no. a; Browne, 1907: 16, 18, 25-28, 29; Broch, 1909a: 195, 200; Billard, 1910: 7; Vanhöffen, 1910: 312.

Lafoëa halecioides Allman, 1872: 170 (nomen nudum).

Lafoëa halecioides Allman, 1874a: 471, 472, 477, pl. 66 figs. 1, 1a; Bale, 1887: 91.

Lafoea helicioides: Fewkes, 1881: 129 (lapsus).

Lictorella haleciodes: Clarke, 1894: 74 (lapsus).

Lictorella halecioides: Pictet & Bedot, 1900: 4, 16, 53, pl. 3 figs. 4-5; Browne, 1907: 25, 26; Billard, 1908: 1356; Broch, 1909: 203; Fraser, 1946: 181.

Lictorella pinnata: Broch, 1905: 10-11, fig. 3; Broch, 1909a: 202-205, figs. 4-6; Broch, 1909b: 211, 234, 239; Jäderholm, 1909: 20, 71; Kramp, 1913: 19; Stechow, 1913b: 30; Deryugin, 1915: 308; Broch, 1918: 22-24; Stechow, 1925b: 443-444, fig. 17; Kramp, 1932a: 11; Kramp, 1932b: 41, 69, fig. 33; Kramp, 1935b: 128, fig. 54B; Kramp, 1938: 67; Kramp, 1943: 43; Kramp, 1947: 9; Berezina, 1948: 56, pl. 15 fig. 14.

Zygophylax pinnata: Billard, 1910: 7; Billard, 1923: 15, fig. 1A; Vervoort, 1942: 289; Rees & Thursfield, 1965: 78-79; Cornelius, 1975b: 378, footnote, 402, footnote.

Remarks. – Gonosome described by Bonnevie (1899) and Broch (1909) as being a scapus (coppinia) composed of closely packed, but not coalesced, gonothecae without protective nematophorous ramuli. Gonothecae elongate, sac-shaped bodies, apically with 2-4 circular openings at end of a short funnel. Type locality: Hardanger Fjord, 165-183 m. Syntype series in ZMO, no. B 720.

Lafoëa halecioides Allman, 1874a, was originally collected from two localities, viz. 61° 10′ N, 02° 21′ W, 631 m, and 61° 21′ N, 03° 44′ W, 1170 m. No distinct holotype was indicated. The type series is probably lost, but a specimen came to the BMNH in the A.M. Norman collection from 61° 10′ N, 02° 21′ W, 631 m, "Porcupine", 1869, coll. A.M. Norman, 1912.12.21.248. This is a fragment 23 mm long, weakly polysiphonic basally, with 10 side branches (hydrocladia). No coppinia are present. Nematothecae are sparingly present; these have not been figured by Allman.

Zygophylax convallaria (Allman, 1877)

Lafoëa convallaria Allman, 1877: 12-13, pl. 9 figs. 1-2; Clarke, 1879: 239, 243, pl. 4 fig. 23; Goette, 1880: 355; Fewkes, 1881: 128, 129; Clarke, 1894: 71, 72, 74; Hartlaub, 1894: 176; Nutting, 1895:

88, fig. 4; Hartlaub, 1905: 593, fig. O² no. b.
Lictorella convallaria: Nutting, 1895, figs. 4-4c (on p. 88); Deevey, 1954: 270; Vervoort, 1968: 101.
Lictorella convallaria p.p. Fraser, 1943: 91; Fraser, 1944a: 229-230, pl. 47 fig. 213; Fraser, 1944b: 37; Fraser, 1946: 54, 182. Fraser, 1948: 232; Ljubenkov, 1980: 48.
Zygophylax convallaria: Nutting, 1927: 211; Totton, 1930: 165; Vervoort, 1972: 74-79, figs. 22-23.

Remarks. – The gonosome is described by Clarke (1879) and Vervoort (1972). Gonothecae attached in a dense cluster to the main stem and to the bases of 2 or 3 of the branches, sessile, anchor-shaped, apex with two downwardly directed flukes, at the end of which is an opening. Protective ramules with some nematothecae occasionally present. Type locality: Florida Reef, 278 m. Whereabouts of holotype unknown; not in MCZ or YPM.

Zygophylax elegans (Fewkes, 1881)

Lafoëa elegans Fewkes, 1881: 129.

Remarks. – Described by Fewkes as a species of *Lafoea*, but compared by him with *L. helicioides* (= *Zygophylax pinnata*): "Differs from *L. fruticosa* in having pinnately arranged ultimate branches. Resembles closely *L. helicioides*, All., but larger". Type locality: Barbados, 229 and 329 m. Type series in MCZ, with the following labelling: "No. 2163. Barbados, 180 fathoms [= 329 m]. "Blake" Ex. 1878-1879. A. Agassiz. *Lafoea elegans* Fewkes". Dr Ardis B. Johnston, MZC, kindly supplied the following information: "The original Blake Exp. label states the following: "U.S. Coast Survey. C.P. Patterson, Supt. Caribbean Islands Exploration. U.S.C.S., S. Blake, Alex. Agassiz, 1878-79. No. 295. Depth 180 fms. Barbadoes". No additional information has been entered into the MCZ Catalogue. Neither the catalogue nor any of the original labels found with the specimen designates the specimen as type. However, the data is correct, and the specimen had been placed in the type cabinets, with a modern (within 10 years) typewritten label stating that the specimen is a type. No specimens from 125 fathoms [= 229 m] were found in the collection". The species was never redescribed.

Zygophylax rufa (Bale, 1884)

Campanularia rufa Bale, 1884: 54, pl. 1 fig. 1; Bale, 1887: 91; Pictet, 1893: 36, 39; Bale, 1894: 98; Levinsen, 1913: 292.
Laomedea rufa: Von Lendenfeld, 1884: 404, 622; Von Lendenfeld, 1885b: 630; Von Lendenfeld, 1887: 18; Marktanner-Turneretscher, 1890: 206.
Zygophylax rufa: Bale, 1914b: 90-91; Nutting, 1927: 210; Rees & Thursfield, 1965: 79.
Lictorella rufa: Pennycuik, 1969: 151, 189; Vervoort & Vasseur, 1977: 15-23, figs. 5-8, 9b.

Remarks. – Gonosome described by Vervoort & Vasseur (1977): Coppinia at base of stem, unisexual but monoecious, male and female coppiniae placed one above the other. Gonothecae densely packed and contiguous, hexagonal in cross-section, cylindrical, slightly widening from base onward, near apex suddenly narrowed into hooded structure with rounded top, with lateral, oval to slit-like opening. Type locality: Holborn Island, Eastern Australia, 37 m. Type series in MVM (no. F52 216). There is also material from the type locality in AMS (no. G10811, no further data, "old collection", 2 fragments).

In the Busk collection, preserved in the BMNH, there is a bunch of 10 well preserved dried colonies up to 50 mm long (1899.7.1.6628) from the Rattlesnake Expedition, labelled "*Lictorella antipathes* (Lamarck), betweeen Cumberland Island "L" and Point Slade, 8-11 fms [= 15-20 m], co's and shells, 18.xii/47. Z25"; on the wrapper is written: "*L. antipathes* or *C. juncea*". Stems and main branches are coloured vividly red. From the same material there is a microslide preparation (1899.7.1.6255) of a 45 mm long stem and some fragments, still in good condition though rather dirty. In our opinion this material should be referred to *Zygophylax rufa*.

In the BMNH there are 2 additional slides (1964.8.7.48 & 1964.8.7.49) labelled: "54, Camb. Mus., Channel between Inex and Daves, Torres Strait, A.C. Haddon, Mar. 12, 1889"; these slides are entered in the catalogue as being schizoholotypes. They can not possible originate from the type series as Bale (1884) gives as the type locality Holborn Island and Mr Haswell as the collector. Also, they were collected after the species was described. They are probably *Z. antipathes* (Lamarck).

Zygophylax profunda Quelch, 1885
(figs. 9-10, tab. 8)

Zygophylax profunda Quelch, 1885: 4-5, pl. 1 fig. 4; Kirkpatrick, 1890a: 13; Jäderholm, 1903: 277; Billard, 1905: 98; Billard, 1906b: 181; Clarke, 1907: 16, 17; Ritchie, 1907a: 488; Vanhöffen, 1910: 315-317; Totton, 1930: 165; Millard, 1977b: 117, 119, fig. 6; Gravier-Bonnet, 1979: 29.
Zygophylax ?armata Gravier-Bonnet, 1979: 24-31, fig. 5.

Material examined. – Sta. 112. Various colonies and fragments, probably originating from two strongly polysiphonic, irregularly branched colonies 15-20 mm high, with three coppiniae on stem and major branches; partly overgrown by Bryozoa (BMNH 1984.1.1.20, alc. + 4 slds; RMNH 16522, 4 slds).

Description. – Stems polysiphonic, rigid and forked, as are some of the side branches. Structure can best be described starting with youngest, monosiphonic parts: here stems (and branches) slightly geniculate. No distinct arrange-

ment in internodes apparent, though constrictions of perisarc may occur just above apophyses. Side branches inserted on distal wall of hydrothecal apophyses, hydrothecae on such apophyses consequently becoming axillary. No anastomoses of branches seen.

Hydrothecae biseriate, with slight inclination to turn towards front of colony, on conspicuous apophyses (fig. 9a). In youngest parts of colonies demarcation between hydrothecal pedicel and apophysis indistinct, becoming distinct in older parts of colonies. Perisarc on stems and branches quite firm.

Hydrotheca asymmetrically tubiform, with abcauline wall almost straight and adcauline wall curved, convex. Exact shape of hydrotheca varied with occasional strongly curved hydrothecae; these about twice as long as wide. Basally hydrotheca narrows into short pedicel, separated from rest of theca by a diaphragm which is usually slightly oblique. High magnification shows diaphragm to be annular and fairly thick (fig. 9c). Renovations common, at times greatly lengthening hydrotheca. Hydrothecal rim distinctly everted, circular (fig. 9b).

Nematothecae on apophyses, usually one on each side of hydrotheca; occasionally one or three nematothecae present. Shape of nematotheca cylindrical with rounded base, attached by short pedicel to circular depression in apophysis. Rim circular and slightly everted; renovations common (fig. 9a, b).

Colony polysiphonic by development of secondary (accessory) tubules in basal parts, obscuring arrangement of hydrothecae some of which still protrude from covering of accessory tubules. Occasionally these tubules also bear nematothecae and an isolated hydrotheca. They also give rise to coppiniae, three of which occur in the John Murray material: two on stems, one on a side branch. Coppinia consists of strongly aggregated mass of globoid gonothecae, with their walls coalesced. Each gonotheca with short, tubular neck with strongly flared aperture; neck closed by perisarcal ring some distance from apex (fig. 9d, e). In addition each coppinia with numerous short ramuli pointing in all directions and bearing many nematothecae (fig. 9f). Occasionally such ramules topped by a reduced hydrotheca. In our opinion these "protective" ramules originating from underlying mass of accessory tubules and projecting outwards through openings in the reticulate mass of gonothecae. Perisarc of gonotheca thick and brittle; that of ramules thin. Both hydrothecae and gonothecae apparently empty.

Distribution. – Reliable records of *Zygophylax profunda* are from San Antonio, Cape Verde Islands, over 914 m depth; from Camera de Lobos, Madeira (BMNH 1919.8.15.2, also recorded by Millard, 1977b), depth unknown, and from off Tuléar, Madagascar, 23° 36′ 03″ S, 43° 32′ 05″ E, 250 m

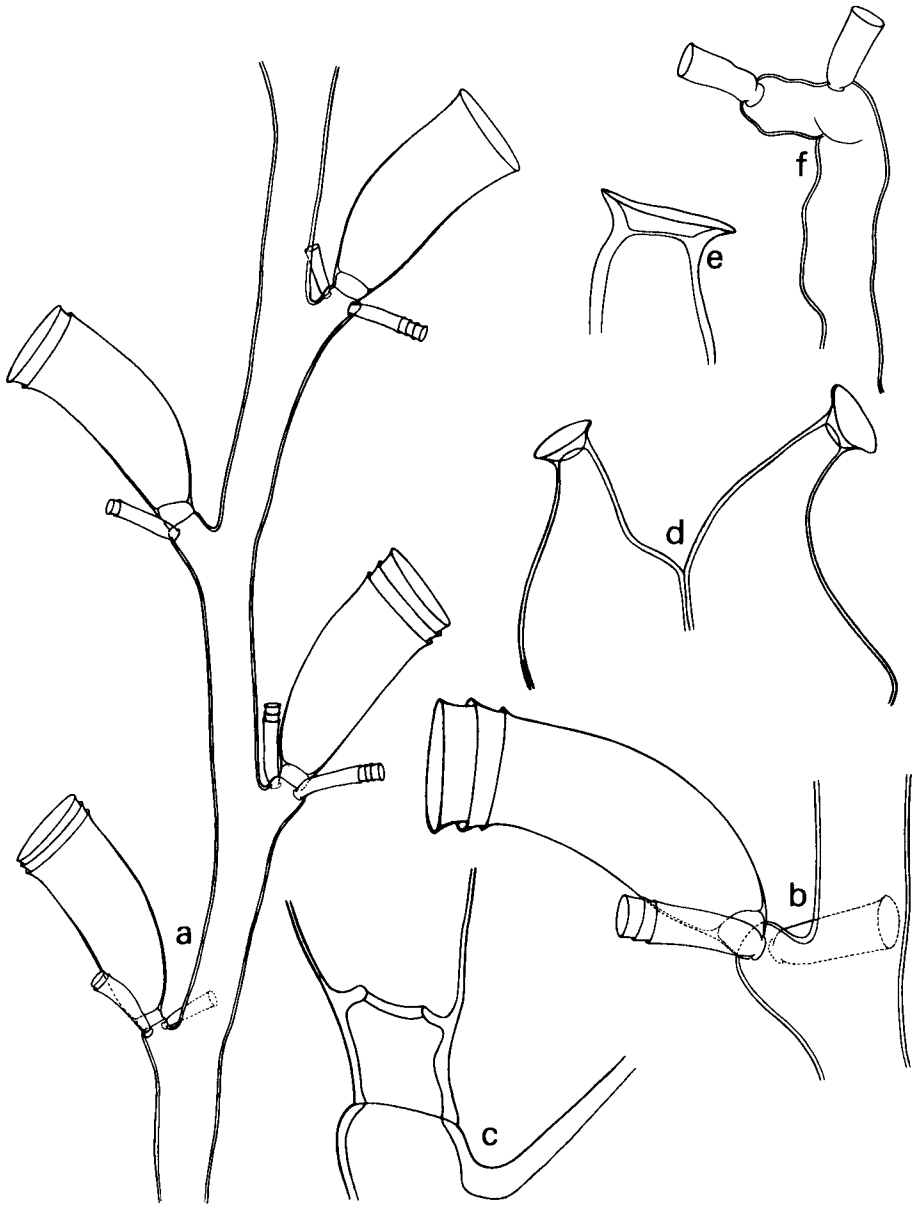


Fig. 9. *Zygophylax profunda* Quelch, John Murray Exped., Sta. 112. a, top part of branch with hydro- and nematothecae; b, insertion of renovated hydrotheca and nematothecae on hydrocladium; c, optical section through basal part of hydrotheca; d, top parts of two fused gonothecae from coppinia; e, gonothecal aperture; f, nematophorous ramule from coppinia. a x 85; b, e x 135; c x 240; d, f x 55.

	Off Madagascar (Gravier-Bonnet, 1979)	John Murray Exped. Sta. 112
Hydrotheca		
length along adcauline wall, without renovations	200 – 290	310 – 335
length along adcauline wall, with renovations	340	355 – 365
breadth at rim	100 – 130	105 – 120
Pedicel		
length along adcauline wall	40 – 60	20 – 35
Stem		
distance between two consecutive hydrothecae	260 – 440	320 – 390
diameter at "node"	60 – 80	65 – 80
Nematotheca		
length without renovations	70 – 100	80 – 85
length with renovations	130	105 – 120
breadth at rim	30 – 40	30 – 40
Coppinia		
breadth of gonotheca at apex of neck	180 – 240	105 – 130
breadth at diaphragm	90 – 120	85 – 90
diameter of ramules	50 – 70	55 – 60
length nematotheca	50 – 100	65 – 70
breadth of nematotheca at rim	30 – 50	30 – 35

Table 8. *Zygophylax profunda.* Measurements in μm.

(Gravier-Bonnet, 1979). The present record is from the Zanzibar area, 113 m.

Remarks. – The John Murray material resembles in detail the specimens described by Gravier-Bonnet (1979) as *Zygophylax ?armata* (Ritchie, 1907b) from off Tuléar, Madagascar, the only difference being that Gravier-Bonnet observed some or all of the ramules in the coppinia springing directly from ring shaped perisarcal thickenings of the gonothecal wall, while we think that here they originate from the underlying tissue of peripheral tubules.

We cannot corroborate Gravier-Bonnet's conclusion that her material was probably Ritchie's *Brucella armata* (Ritchie, 1907b: 533-534, pl. 2 fig. 2A-C), a species originally described from Gough Island, South Atlantic. Ritchie's description and figures indicated that the coppinia was composed of closely packed, usually hexagonal gonothecae ("numerous gonangia so closely packed that the sides become compressed and the whole assumes a honeycomb-like structure consisting of a dense mass of polygonal, usally hexagonal, cells, the majority of which communicates with the exterior by an exceedingly short tube", Ritchie, 1907b: 534). In our opinion the Tuléar and John Murray material can be identified with *Zygophylax profunda* Quelch, 1885, originally described from deep water ("over 500 fathoms") off San Antonio, Cape Verde Islands. Quelch's specimens were sterile, but fertile material was subsequently identified by A.K. Totton from Camera de Lobos, Madeira. Both Quelch's

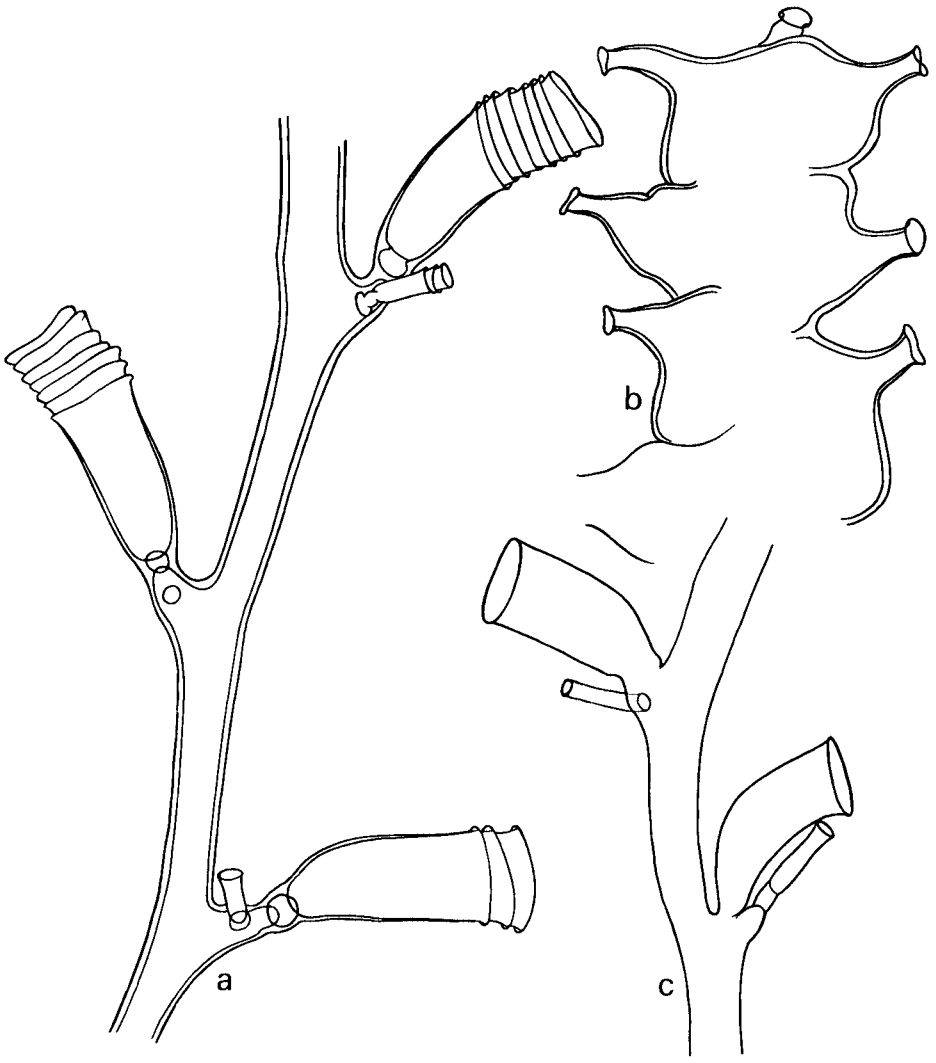


Fig. 10. *Zygophylax profunda* Quelch. a, b, Madeira, BMNH 1919.8.15.2. a, monosiphonic fragment with hydro- and nematothecae; b, part of coppinia with fused gonothecae. c, schizoholotype, Cape Verde Islands, BMNH 1885.7.21.1, outline drawing of two hydrothecae and two nematothecae. a-c x 55.

and Totton's material in the BMNH was studied by Millard (1977b: 117-119, fig. 6), and we have re-examined it.

Quelch's material comprises a dried specimen (holotype) and a microslide preparation of three fragments (schizoholotype). The dried specimen, labelled "*Zygophylax profunda* Quelch, C. Verde Is., 500 fms. [= 914 m], Mr.

Bishop, 1885.7.21.1", is an irregularly branched colony with polysiphonic main stem, 35 mm high, with a spread of about 20 mm. The stem rises from a small bunch of fibres. There is also an additional non-type fragment consisting of a piece of stem covered by a sponge. There are no coppiniae. The three mounted fragments (schizoholotype) are labelled "*Perisiphonia profunda*, part of 1885.7.21.1, C. de Verde Is., Mr. Bishop. Schizoholotype of Fig. d. Genotype of *Zygophylax*, A.K.T., 15.iii.1926" and are in poor condition. The microslide preparation was apparently made from the dried specimen and consists of stem fragments with hydro- and nematothecae. Only two of the hydrothecae are more or less undamaged (see fig. 10c; see also Millard, 1977b, fig. 6A): the nematothecae are fairly long. The microslide is labelled on the back: "Quelch 1885, Ann. Mag. nat. Hist. (5)16: 4-5 – also dry specimen".

The material from Madeira, Camera de Lobos, collected by R. Kirkpatrick, comprises an alcohol preserved specimen and 2 microslide preparations (BMNH 1919.8.15.2). The alcohol specimen, labelled "*Zygophylax biarmata* Billard, R. Kirkpatrick coll., Madeira, Camera de Lobos", comprises a number of irregularly branched specimens, the branching being mostly in one plane. The stems are thinner than in the holotype, the final branches being long, fine and monosiphonic. There are two small coppiniae. One fragmentary colony has a thicker main stem than the others and resembles the holotype in appearance.

There is one identically labelled microslide preparation bearing some fragments up to 22 mm long (fig. 10a). The second slide has the same markings but has also been relabelled: "= *Z. profunda* Quelch, vide Totton, 1930: 165". It bears parts of the gonosome (coppinia), which appears to consist of a number of contiguous gonothecae forming a mass around the stem. From this mass of fused gonothecae project a number of funnels with recurved openings (fig. 10b), exactly as figured by Millard (1977b, fig. 6C). The branched nematophorous ramules project through the mass. There are no noteworthy differences between the Tuléar material and that from the John Murray Expedition. The coppinia found in Totton's colonies and previously figured by Millard (1977b, fig. 6C) is exactly as observed in the Tuléar and John Murray colonies: a collar of contiguous gonothecae, each with a tubular opening with flared mouth. Many nematotheca-bearing ramules project between the gonothecae and curve over the coppinia.

Zygophylax inconstans Millard, 1977b: 117-119, fig. 5, a species from deeper water (360-450 m) off the coast of Natal, South Africa, is rather similar to the present species. The hydrothecae are less distinctly curved, usually almost radially symmetrical, the colony is slender and straggling and the coppinia, the principal diagnostic feature, lacks the nematotheca-bearing ramules. The

hydrothecae, of which the size falls within the limits observed in *Z. profunda*, apparently duplicate the diaphragm upon renovation. This has not been recorded so far in *Z. profunda*, but occurs in *Z. biarmata* Billard, 1905a. The last mentioned species in its vegetative parts closely resembles *Z. profunda, Z. armata* and *Z. inconstans*, but the coppinia is quite different (Broch, 1918: 24).

Zygophylax cyathifera (Allman, 1888)
(figs. 11, 12a-c, tab. 9)

Lictorella cyathifera Allman, 1888: 36-37, pl. 11 figs. 3, 3a; Driesch, 1889: 202; Clarke, 1894: 74; Pictet & Bedot, 1900: 16; Borradaile, 1905: 840; Billard, 1908: 1356; Billard, 1910: 7, fig. 2; Stechow, 1926: 100; Totton, 1930: 165.

Material examined. – Sta. 112. Five almost complete colonies 45-65 mm high, some with basal tuft of fibres, with several additional fragments; no coppiniae (BMNH 1984.1.1.17, alc. + sld.; RMNH 16519, alc. + 3 slds).

Description. – Colonies erect, pinnate; each with distinct, straight stem bearing two rows of branches (hydrocladia) in strictly opposite planes. Stem composed of axial tube and several parallel accessory tubules, which branch off from basal part of axial tube and/or basal tuft of fibres (hydrorhiza). Axial tube without septa. Two types of apophyses on axis, those bearing hydrocladia and others supporting axial hydrothecae (fig. 11a). Apophyses supporting hydrocladia fairly large and projecting beyond covering of peripheral tubules even in thick parts of stems. These apophyses supporting hydrocladia 10 to 15 mm long, bearing 25-30 hydrothecae; with axillary hydrotheca and two nematothecae. Hydrocladial apophyses sub-opposite and in strictly opposite planes; two axial hydrothecae between each pair of hydrocladial apophyses. Of the two nematothecae one placed on front part of colony near septum dividing apophysis from hydrocladium; other nematotheca on back of colony on part of apophysis that supports axillary hydrotheca (fig. 11b). Axial and hydrocladial hydrothecae placed on short but quite distinct apophyses, directed obliquely forward towards front of colony. Axial tube with a number of circular dots, representing thin spots in perisarc, probably later communicating with peripheral tubules; these future pores usually found near stem apophyses (fig. 11a).

Accessory (peripheral) tubules originally present as a pair on opposite sides of axis and still present as such in higher parts of colony (fig. 11a). Later on more tubules develop basally so that lower part of stem is composed of a central axial tube surrounded by several parallel peripheral tubules from which tips of hydrocladial apophyses still protrude. Only in biggest colonies

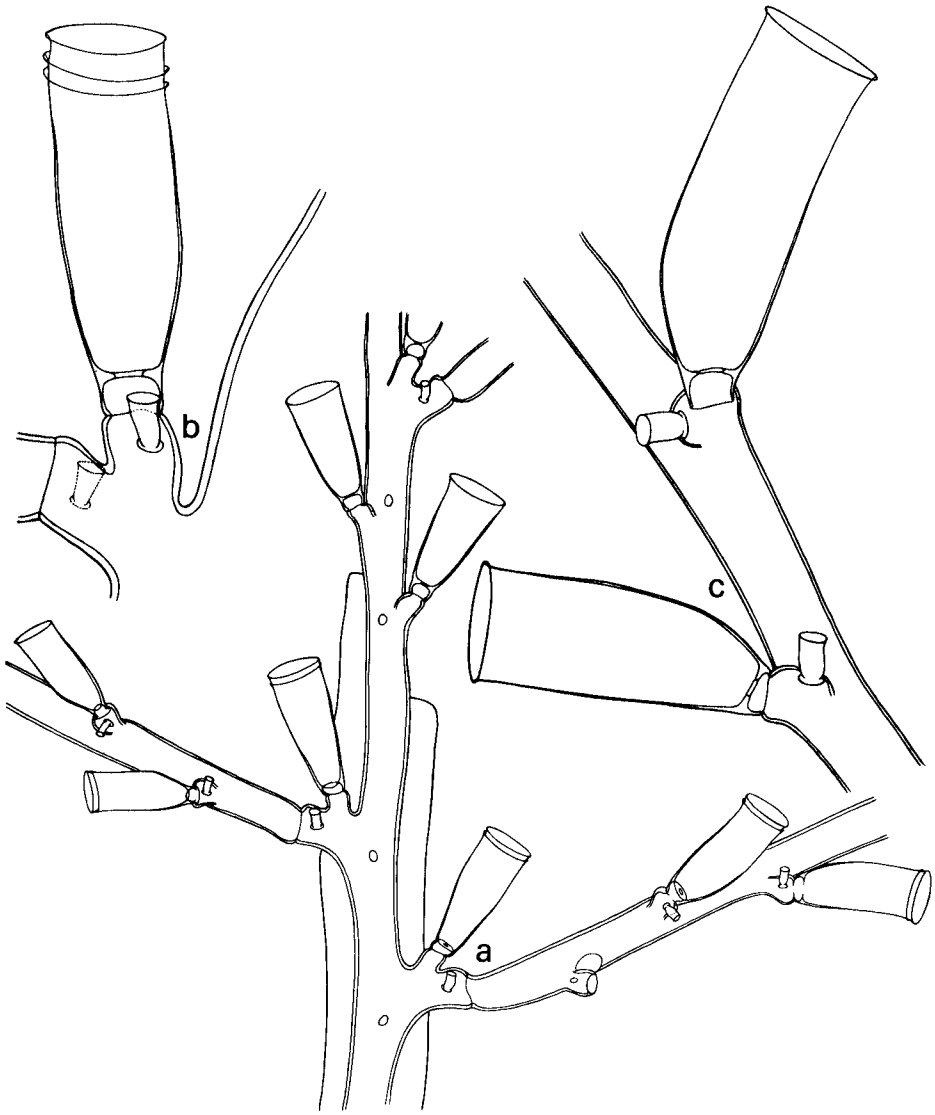


Fig. 11. *Zygophylax cyathifera* (Allman), John Murray Exped., Sta. 112. a, top part of stem with two side branches; b, insertion of stem hydrotheca; c, insertion of hydro- and nematothecae on hydrocladium. a x 30; b, c x 85.

some of lower hydrocladia with some accessory tubules. No proper ramifications of axial tube and consequently no side branches. Perisarc of axial tube thick and firm, horny brown in colour, that of peripheral tubules much thinner.

Axial and hydrocladial hydrothecae slightly different, the former conical with slightly bulging median part and more or less symmetrical (fig. 11b), the latter usually with adcauline swelling and slightly curved; degree of curvature varied (fig. 11c). Basal part of hydrotheca separated from apophysis by distinct node. Hydrothecal diaphragm perforated by large, circular opening. Perisarc of hydrotheca firm, gradually thinning out along hydrothecal wall. Hydrothecal aperture perfectly circular, slightly everted and usually with 2-3 renovations. No "stalked" hydrothecae, resulting from complete renovation of hydrothecae, were seen.

	John Murray Exped. Sta. 112
Hydrocaulus	
diameter at base	600 – 900
Axillary hydrotheca	
total length	500 – 555
breadth at rim	170 – 185
Normal hydrotheca	
total length	525 – 570
breadth at rim	155 – 185
Nematotheca	
total length	65 – 85
breadth at rim	40 – 55

Table 9. *Zygophylax cyathifera*. Measurements in μm.

Nematothecae present on front of hydrothecal apophyses of stem and hydrocladia, all directed towards front of colony. Arrangement of nematothecae on hydrocladial apophyses has been described above. Nematothecae small, cup-shaped, with circular, slightly everted rim and slightly bulging, almost parallel walls; perisarc very thin. Though nematothecae had disappeared from some apophyses they formed a very significant feature in all specimens; on disappearance leaving a small, circular hole in the apophyses.

No gonosome was seen.

Distribution. – *Z. cyathifera* is now known from three localities: New Hebrides, 16° 45′ S, 168° 07′ E, 115-238 m (Allman, 1888, type locality), Simon's Bay, Cape of Good Hope, shallow water ("Challenger" collection, BMNH, see below), and from the Zanzibar area (present record, 113 m depth).

Remarks. – The present specimens resemble closely Allman's (1888) description of the species, particularly in their rigid habit and in the arrangement and shape of the hydrothecae. The latter, while pinnately disposed and exactly alternating, have their axes slightly directed towards one side of the ramulus.

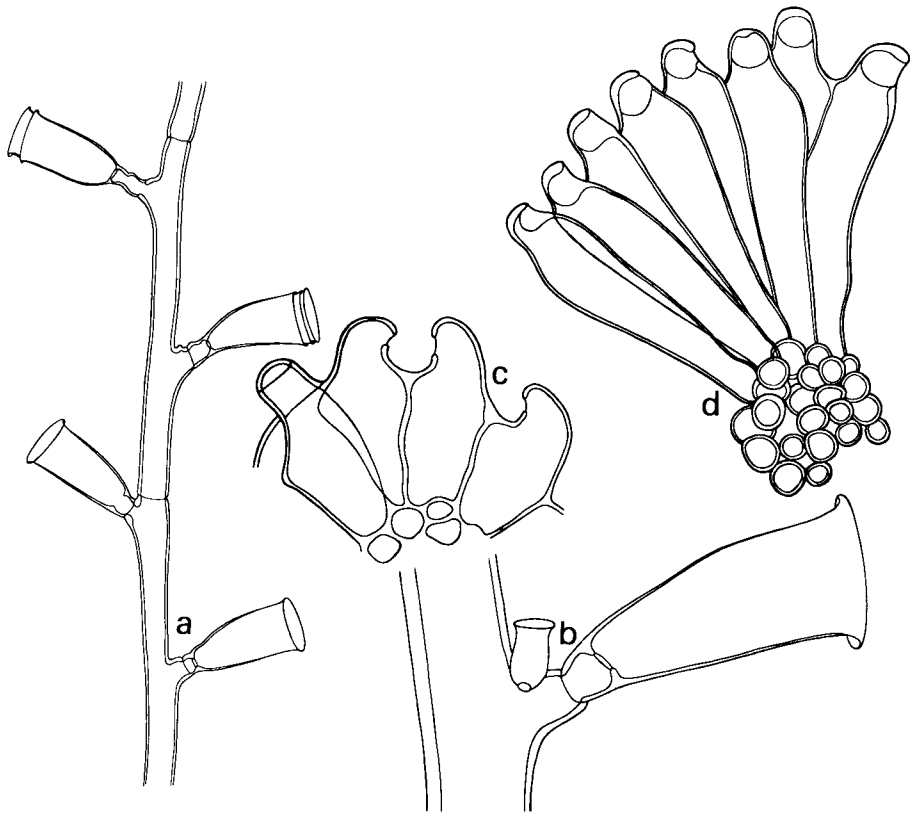


Fig. 12. a-c, *Zygophyllax cyathifera* (Allman), type series from "Challenger", Sta. 177, BMNH 1888.11.13.24. a, b, Allman's microslide preparation. a, monosiphonic fragment; b, hydro- and nematotheca. c, Trebilcock's section through one of the coppiniae. d, *Zygophylax antipathes* (Lamarck), Trebilcock's section through one of the coppiniae of Allman's "*Lictorella halecioides*" from Challenger Exped., Torres Strait, BMNH 1888.11.13.23. a, c, d x 30; b x 85.

The rim is perfectly circular, even, and slightly everted.

The type material was briefly redescribed by Billard (1910). A hydrotheca and its apophysis were figured. We think that Billard's measurements of the hydrothecae were incorrect. The type series (BMNH 1888.11.13.24) from "Challenger" Sta. 177, off New Hebrides, 16° 45′ S, 168° 07′ E, 115-238 m, has been re-inspected by us also. It comprises a number of colonies, some apparently fragments of larger ones. The biggest fragment is now 60 mm. In addition to hydrocladia there are a number of distinct branches of the axis at irregular intervals, but disposed in the same plane as the hydrocladia and subopposite. Some of the stem fragments are about 3 mm thick and dark brown. Coppiniae up to 10 mm long are present on some of the stem fragments. In

addition there is a microslide preparation from the type series, apparently made by Allman, bearing the same number and label (fig. 12a, b). A section through one of the coppiniae was made many years ago by Dr R.E. Trebilcock and bears the same number. This number is found also on three microslides made more recently by Mr E. White and stained with Ehrlich's haematoxylin, one after treatment with KOH. The colonies, as also appears from the slides, have few nematothecae, probably as a result of rough handling of the specimens. All are covered with dirt, visible also in the microslides. The nematothecae are best visible in the microslide preparations made by White.

The coppinia, not observed by Allman and Billard, consists of a mass of closely packed and fused gonothecae, each more or less pentagonal in section, broadest above but terminally narrowing suddenly into a hooded projection carrying the lateral opening of the gonotheca (fig. 12c). There are no nematothecae in the coppiniae.

In Allman's microslide preparation of the type there are septa in some of the finer branches, while some of the hydrothecae have a longer basal portion (pedicel) probably resulting from the renovation of complete thecae (fig. 12a).

In addition to the specimens mentioned above there are two microslide preparations labelled: "*Zygophylax cyathifera* (Allman), 1888.11.13.9A, from the Challenger collection, Simon's Bay, Cape of Good Hope, shallow water". The preparations are of fragments stained with Ehrlich's haematoxylin and were made by A.K. Totton. *Lictorella cyathifera* was referred to *Zygophylax antipathes* (Lamarck, 1816) by Millard (1975: 190), a point of view which we do not follow.

Zygophylax tizardensis Kirkpatrick, 1890a

Zygophylax tizardensis Kirkpatrick, 1890a: 12, pl. 3 fig. 3; Jäderholm, 1903: 277; Clarke, 1907: 16; Stechow, 1913a: 144; Stechow, 1913b: 11, 117; Jäderholm, 1919: 10; Stechow, 1923b: 10; Dawydoff, 1952: 56; Yamada, 1959: 48; Hirohito, 1983: 33-34, fig. 13.
Perisiphonia tizardensis: Vanhöffen, 1910: 316.

Remarks. – Female gonosome described by Hirohito (1983) as being an almost spherical coppinia, almost 5 cm (most certainly 5 mm) in diameter, developed on a branch. Separate gonothecae aggregated into cluster; gonothecae sac-like with 2 or 3 curved tubes with opening at end. Anastomosing protective tubules with nematothecae, covering the gonothecae like a canopy. Type locality: Tizard Reef, China Sea, 64 m. Type series in BMNH (1889.8.21.2), labelled: "*Acryptolaria tizardensis* (as *Perisiphonia tizardensis*, as *Zygophylax tizardensis*), Tizard Bank, 35 fms [= 64 m] HMS "Rambler",

coll. P.W. Bassett-Smith". The type series comprises 4 spirit-preserved colonies, 35 x 18, 28 x 17, 26 x 10 and 18 x 17 mm, the last having a side branch. The largest specimen is that figured by Kirkpatrick (1890a: pl. 3 fig. 3), and is here designated lectotype. The remaining 3 colonies become the paralectotypes.

In addition there are 4 microslide preparations:

a. Dry slide, 1889.8.21.2, labelled "*Zygophylax tizardensis* Kpk n. sp. Tizard Reef, 35 fms [= 64 m]". Also "*Perisiphonia tizardensis*" on separate label. Microslide preparation apparently made by Kirkpatrick, comprising a 10 mm long branch with 4 hydrocladia and many hydrothecae disposed in various planes.

b. Carmine stained and balsam mounted specimen, 1889.8.21.2, labelled "Bassett-Smith Coll. *Perisiphonia tizardensis* (Kirkpatrick). Tizard Bank, 35 fms., type"; it is initialled "B.C.E.W." This is a stem 14 mm long with 7 hydrocladia, apparently from the type series, now a paralectotype. Preparation made by E. White.

c. Unstained, glycerol mounted microslide preparation (1889.8.21.2) of hydrocladium 5 mm long, labelled: "*Perisiphonia tizardensis*, (*Zygophylax*) *tizardensis* n. sp. Kpk, part of type, Tizard Reef 35 fms", now a schizosyntype.

d. As b, 1889.8.21.2, a rather dirty colony 10 mm high with 5 side branches, labelled "Bassett-Smith Coll., *Perisiphonia tizardensis* (Kirkpatrick), Tizard Bank, type, 35 fms" ; initialled "B.C.E.W". This also is a paralectotype.

All this material closely resembles Hirohito's description.

Zygophylax thyroscyphiformis (Marktanner-Turneretscher, 1890)

Campanularia thyroscyphiformis Marktanner-Turneretscher, 1890: 206, pl. 3 fig. 4; Pictet, 1893: 38; Jäderholm, 1904a: vi; Jäderholm, 1905: 16; Vanhöffen, 1910: 296.
Lictorella thyroscyphiformis: Stechow, 1922: 146; Stechow, 1923d: 141.

Remarks. – Questionable species; may also be a species of *Cnidoscyphus* or *Thyroscyphus*. Type locality: Cebu, Philippines, no depth data. Holotype, an alcohol preserved specimen, in NMW (acquisition no. XIV 1596, Evertebrata varia collection no. 5626).

In the BMNH there is a spirit preserved stem 55 mm high with 6 side branches (1919.2.12.1) with the label "*Campanularia thyroscyphiformis* Marktanner, Philippine Isd., 10° 07′ N, 124° 06′ E, 154 fms [= 282 m], coll. cable ship Recorder". This is a specimen of *Thyroscyphus fruticosus* (Esper).

Zygophylax geniculata (Clarke, 1894)

Lictorella geniculata Clarke, 1894: 71, 72, 74, pl. 3 figs. 14-16; Pictet & Bedot, 1900: 16; Stechow, 1926: 100; Fraser, 1944b: 37; Fraser, 1946: 55, 183.
Zygophylax geniculata: Leloup, 1940b: 13-14, pl. 1 fig. 9; Rees & White, 1966: 274.
? *Zygophylax ?geniculata*: Millard, 1968: 264-266; fig. 3; Millard, 1975: 195-197, fig. 64.

Remarks. – Insufficiently described species with unknown gonosome. A critical redescription is badly needed. Type locality: Albatross, Sta. 3384, 07° 31′ 30″ N, 79° 14′ 00″ W, off West coast of South America, 838 m. Type series in MCZ with the following labelling: "MCZ No. 2283, off Panana, 1891, Albatross Sta. 3384. 458 fath. [= 837 m] *Lictorella geniculata* S.F. Clarke, Type!" (Pencil note on small label reads: "3384-8032").

The material recorded by Millard (1968, 1975) as *Zygophylax ?geniculata* (Clarke, 1894) from the Cape Peninsula, 287 m depth, was in our opinion not of that species; it shows affinities with *Z. bifurcata* Billard, 1942). *Z. geniculata* was originally described from the Gulf of Panama and has since been recorded from the Atlantic Ocean by Leloup (1940). It differs markedly from *Z. bifurcata* in shape and structure of the colony and shape and implantation of the hydrotheca, as comparison of Clarke's plate 3 and the present figures of *Z. bifurcata* (fig. 13) clearly shows. We should have been inclined to refer Millard's *Z. ?geniculata* directly to *Z. bifurcata* but the hydrothecal pedicel in the Cape material usually has a distinct "internode" and the size of the hydrotheca is larger than the type material (400-500 μm as compared with 320-390 μm). Millard may have included the basal chamber in her length measurements of the hydrothecae. We hesitate, therefore, to draw definite conclusions without proper inspection of Millard's material.

Zygophylax pinnata (G.O. Sars, 1874) var. **annellata** Pictet & Bedot, 1900

Lictorella halecioides var. *annellata* Pictet & Bedot, 1900: 17, 53, pl. 3 fig. 6.

Remarks. – Probably a specimen of *Z. pinnata* with a large number of renovations of the hydrothecae. Type locality: off north-west Spain, 43° 57′ N, 09° 27′ W, depth 300 m; holotype in MOM, no. 11 0053, 1 microslide preparation.

Zygophylax flexilis Pictet & Bedot, 1900

Lictorella flexilis Pictet & Bedot, 1900: 4, 15-16, 55, pl. 3 figs. 1-3; Rees & White, 1966: 274.

Remarks. – Gonosome unknown. Probably based on a species of *Lafoea*. Pictet & Bedot (1900) may have inspected a renovated hydrotheca (cf. pl. 3 fig. 3), though a diaphragm is figured in all hydrothecae (pl. 3 fig. 2). The species has many affinities with species of *Lafoea*, but is placed in *Zygophylax* because of the presence of a diaphragm. Type locality: off Pico, Azores, 38° 24′ N, 30° 21′ 40″ W, 318 m. Type series in MOM, no. 11 0094, three microslide preparations.

Zygophylax operculata Jäderholm, 1903

Zygophylax operculata Jäderholm, 1903: 262, 276-278, pl. 12 figs. 7, 8.

Remarks. – Type species of the genus *Abietinella* Levinsen, 1913, see above.

Zygophylax junceoides Borradaile, 1905

Campanularia junceoides Borradaile, 1905: 839-840, pl. 69 fig. 2.
Lictorella junceoides: Stechow, 1921d: 256; Stechow, 1923d: 140-141.

Remarks. – Insufficiently described species with unknown gonosome. Holotype probably lost.

Zygophylax cervicornis Nutting, 1905

Lictorella cervicornis Nutting, 1905: 934, 946, pl. 4 fig. 1, pl. 10 figs. 5-9; Stechow, 1913b: 30; Fraser, 1914a: 134, pl. 2 fig. 3; Fraser, 1937: 123, pl. 26 fig. 141; Fraser, 1938a: 9, 48; Fraser, 1938c: 134; Fraser, 1946: 54, 182; McCauley, 1972: 412.
Zygophylax cervicornis: Jäderholm, 1919: 10; Stechow, 1923a: 7; Stechow, 1923b: 10; Stechow, 1923c: 107; Totton, 1930: 165; Leloup, 1938: 10; Yamada, 1959: 48; Hirohito, 1983: 28-29, fig. 9.

Remarks. – Referred by Fraser (1944) to *Zygophylax convallaria* (Allman), but see Vervoort (1972: 78). Gonosome described by Nutting (1905: 946): "Gonangia forming a "coppinia" mass on the main stem, roughly triangular in outline, the distal ends being the broader on account of the opposite shoulders, which are quite conspicuous and end in round apertures. Midway between these shoulders there is a short neck ending in a third aperture. The individual gonangia are borne on short branchlets, which continue beyond them, arching over each gonangium so as to form a protecting network of such branches over the aggregated gonangia". Type locality: between islands Molokae and Maui, Hawaii, 252 m. Type in NMNH, no.22162.

Zygophylax biarmata Billard, 1905a

Zygophylax biarmata Billard, 1905a: 97-98, fig. 2; Billard, 1906a: 330; Billard, 1906b: 157, 180-181, fig. 8; Browne, 1907: 27; Clarke, 1907: 16, 17; Broch, 1909a: 201; Broch, 1909b: 155; Billard, 1910: 7; Vanhöffen, 1910: 315, 317; Broch, 1918: 24-25; Jäderholm, 1919: 8-9, pl. 2 fig. 3; Stechow, 1923b: 10; Stechow, 1925b: 447-448; Totton, 1930: 165; Leloup, 1938: 9-10, fig. 6; Kramp, 1938: 28; Leloup, 1940b: 11, pl. 1 fig. 6; Kramp, 1947: 10; Millard, 1958: 176-177, fig. 4A; Picard, 1958: 193; Yamada, 1959: 47; Rees & White, 1966: 274; Millard, 1968: 263; Patriti, 1970: 28, fig. 29; Rho & Chang, 1974: 135, 139, pl. 4 figs. 1-3; Millard, 1975: 193, fig. 63C; Rho, 1977: 255-256, 415-416, pl. 74 fig. 67; Gravier-Bonnet, 1979: 27; Van Praët, 1979: 883, fig. 2; Hirohito, 1983: 26-27, fig. 8.

Lictorella Levinseni Saemundsson, 1911: 86-88, fig. 2; Gravier-Bonnet, 1979: 29.

non *Zygophylax biarmata*: Stechow, 1913a: 144; Stechow, 1913b: 11, 14-15 (= *Zygophylax stechowi* Jäderholm, 1919).

non *Zygophylax biarmata*: Jarvis, 1922: 335 (= *Zygophylax millardae* sp. nov.).

Remarks. – The gonosome has been described by Broch (1918: 24-25): "The gonothecae are collected in a primitive, open coppinia (hermaphroditic ?) on the stem or main branches; the nematothecae are more richly developed in the gonotheca aggregate than elsewhere, and appear there in large numbers. The gonothecae are flattened ovate, with an outward and downward curving neck distally on either side of the transversal plane". Billard (1905a) recorded the species from a Bay of Biscay locality ("Travailleur" Sta. 8, 44° 04′ 30″ N, 09° 27′ 30″ W, 411 m) and from off Cape Spartel ("Travailleur" Stations 34 and 36, 35° 35′ – 35° 42′ N, 08° 40′ – 08° 42′ W, 112-150 m), no distinct type locality being indicated. Syntype series in MNH (Van Praët, 1979: "Syntypes H.L. 215, 216, H. 098. Localité-type: golfe de Gascogne, St. VIII du «Travailleur»").

The holotype of *Lictorella Levinseni* Saemundsson is from 9 km SSE of Vestmannö (Vestmanneyjar, south of Iceland), 510 m; it is supposed to be preserved in the ZMK, but could not be found there in March 1985.

Zygophylax armata (Ritchie, 1907b)

Brucella armata Ritchie, 1907b: 521, 522, 533-534, pl. 2 fig. 2a-c; Broch, 1909b: 155: Ritchie, 1909a: 67; Vanhöffen, 1910: 315, 317.

Zygophylax armata: Totton, 1930: 165; Millard, 1964: 18-19, fig. 4G; Rees & Thursfield, 1965: 77, 201; Millard, 1967: 176; Millard, 1968: 263; Millard, 1973: 28; Millard, 1975: 192-193, fig. 63A-B; Smaldon, Heppell & Watt, 1976: 16; Mergner & Wedler, 1977: 10, 16, pl. 2 fig. 17, pl. 7 fig. 46; Millard, 1978: 199; Stepan'yants, 1979: 58, pl. 10 fig. 1; Millard, 1980: 131, 142-143, fig. 4C.

Remarks. – The gonosome was described by Ritchie (1907b); the gonangia are placed in clusters, 5 x 3 and 5 x 2 mm, surrounding stem and bases of branches. Gonothecae closely packed, hexagonal in cross section, apically

with exceedingly short tube. Many nematophorous ramules between the gonothecae, overreaching those and curving over the gonothecae.

The type locality is in the South Atlantic off Gough Island, 40° 20′ S, 90° 56′ W. The holotype of this species is in the RSM, no. 1921.143.1349, as is also a schizoholotype microslide preparation (1959.33.304). Another schizoholotype slide is in the BMNH (1964.8.7.47). The latter is a stem fragment 7 mm long with 3 pairs of side-branches. It is labelled: "Scotia Coll., Gough Island, 40° 20′ S, 90° 56′ W, 100 fms [= 183 m], 22.4.04. *Brucella armata* n.g. et sp." The hydrothecae in the BMNH schizoholotype specimen are nearly all slightly constricted just below the rim and there at the abcauline side have a distinct internal perisarcal notch. Some of the side branches are polysiphonic.

Zygophylax grandis Vanhöffen, 1910

Zygophylax grandis Vanhöffen, 1910: 273, 315-317, 327, 339, fig. 33a-e.

Remarks. – A species of the genus *Abietinella* Levensen, 1913, probably identical with *Abietinella operculata* (Jäderholm, 1903). For synonymy see above.

Zygophylax carolina (Fraser, 1911)

Lictorella carolina Fraser, 1911: 53-54, pl. 4 figs. 3-5; Fraser, 1914a: 176-177, pl. 24 fig. 89; Fraser, 1914b: 218, 221, pl. 1 figs. 2a-b; Fraser, 1937: 122-123, pl. 26 fig. 140; Fraser, 1944b: 37; Fraser, 1946: 182; Arai, 1977: 27.

Remarks. – Insufficiently described N. Pacific species with unknown gonosome. Type locality San Juan Archipelago, Vancouver Is. region, no depth record (Fraser, 1911). Type material (probably the holotype) in NMNH (no. 70625, imperfectly preserved specimen labelled: "*Lictorella carolina* Fraser. San Juan. T. Kincaid" (no. 34084 on separate label). Material of this species is held also in BCPM, no. 976.334-1, Trinity Island, and no. 976.335-1, Gulf of Alaska, 91 m (Arai, 1977).

Zygophylax concinna (Ritchie, 1911b)

Lictorella concinna Ritchie, 1911b: 823-824, pl. 88 figs. 3-4; Briggs, 1922: 148-149, fig. 1; Stechow, 1926: 100.

Zygophylax concinna: Totton, 1930: 165; Rees & Thursfield, 1965: 77-78, 201; Smaldon, Heppell & Watt, 1976: 16.

Remarks. – Gonosome described by Briggs (1922) as a mass of loosely aggregated gonangia "ovate with undulated edges, truncated at the distal end, and tapering towards the proximal extremity". Peduncle short. "In frontal aspect each gonangium is a little narrowed in near the distal end and then widens outwards forming a conspicuous round projection or shoulder at each side of the top where the gonangium reaches its maximum width. These shoulders are produced slightly downwards into truncated processes, each of which ends in a small circular aperture directly facing towards the proximal extremity of the gonangium". The type locality is 5 to 6 miles off Coogee, New South Wales, 90-91 m. The lectotype is in the AMS, no. Y 287; there are also 3 schizoparatypes there (Y 372, Y 308 and Y 310). A paratype and a schizoparatype microslide are in RSM (no. 1912.68.5 and 1959.33.302, respectively); but there is no material of this species in the BMNH (Rees & Thursfield, 1965).

Zygophylax levinseni (Saemundsson, 1911)

Lictorella Levinseni Saemundsson, 1911: 86-88, fig. 2.

Remarks. – Considered by Broch (1918: 24-25) to be conspecific with *Zygophylax biarmata* Billard, 1905a (see above).

Zygophylax curvitheca (Stechow, 1913a)

Zygophylax curvitheca Stechow, 1913a: 139-140; Stechow, 1913b: 11, 116-117, fig. 89; Jäderholm, 1919: 9; Stechow, 1923b: 10; Nutting, 1927: 212-213, pl. 41 fig. 3; Yamada, 1959: 47-48; Rees & Thursfield, 1965: 78, 201; Smaldon, Heppell & Watt, 1976: 16.

Remarks. – The gonosome, a coppinia, is described by Nutting (1927) as being a loosely aggregated mass of sac-like, roughly globoid gonothecae, dispersed along proximal part of stem. Apex of gonotheca with 2 "flukes ending in apertures which open in opposite direction". Between gonothecae lie normal hydrothecae and "a few straggly, irregular, branched structures with neither hydrothecae nor nematophores". Type locality Haidaski Bank, Sagami Bay, Japan, 600 m. Holotype and 5 schizoholotype microslide preparations (no. 1604) in ZSM. Schizoholotype microslide preparation in RSM (no. 1959.33.305; Rees & Thursfield, 1965).

Zygophylax sibogae Billard, 1918

Zygophylax sibogae Billard, 1918: 21-22, fig. 1; Ralph, 1958: 311, fig. 2e-i; Millard, 1964: 21-22, fig. 5G-H; Millard, 1973: 32; Millard, 1975: 198-200, fig. 65A-C; Van Soest, 1976: 81; Millard,

1977b: 106; Millard, 1978: 200; Van Praët, 1979: 884, fig. 25; Millard, 1980: 131; Hirohito, 1983: 32-33, fig. 12.
Zygophylax sibogae p.p. Totton, 1930: 167-168, fig. 21.

Remarks. –The gonosome is described by Billard (1918) as follows: "gonosome du type Coppinia qui présente de nombreux tubes ramifiés, pourvus de dactylothèques et tourant les gonothèques sessiles, les unes simples, les autres composées. Les gonothèques simples sont globuleuses, pourvues de deux prolongements distaux recourbés et ouverts à leur extrémité à maturité; les gonothèques composées resultent de la soudure de deux ou plusieurs gonothèques simples; elles sont les formes les plus variées et les plus irrégulières".

Hirohito (1983) described the female gonothecae as being "aggregated into coppiniae, about 7 x 5 mm in size. Gonothecae not closely packed but separated, sack-like, not making a definite form, provided with one or two tubes directed to variable directions at upper end. Many protective tubes with nematothecae branching and anastomosing each other, making a canopy over cluster of gonothecae. Usually closely reticulated basket-like mass of tubes is enclosed in each coppinia. Its function cannot be known".

The syntype series is in the ITZ (ZMA Coel no. 5224, Van Soest, 1976). Another syntype is in MNH, no. H.L. 219 (Van Praët, 1979). The type locality is "Siboga" Sta. 254, Banda Sea, near the Kai Islands, 05° 40′ S, 132° 26′ E, 310 m.

Zygophylax brevitheca Jäderholm, 1919

Zygophylax brevitheca Jäderholm, 1919: 9, pl. 2 fig. 4; Stechow, 1923b: 10; Yamada, 1959: 48.

Remarks. – A species with unknown gonosome. The type locality is east of Chichijima, Bonin Is., 146 m. The holotype, a 2 cm long fragment, is in the type collection of ZMU (no. 34), labelled: "*Zygophylax brevitheca* Jäderholm, 1919. Bonin Islands (Ogasawara), east of Chichijima, 1/8 1914, depth: 80 fathoms [= 146 m]".

Zygophylax stechowi (Jäderholm, 1919)

Lictorella stechowi Jäderholm, 1919: 11-12, pl. 2 fig. 7; Stechow, 1923b: 10; Yamada, 1959: 47.

Remarks. – A species with unknown gonosome, near *Z. geniculata* (Clarke, 1907), sensu Millard and *Z. bifurcata* Billard, 1942. Type locality Jokuska (probably Yokusuka) Strait, Sagagun (= Sagami), Japan, 165 m. Syntypes in

type collection of ZMU, no. 36, three tubes with the following labels: "36a, Sagami, Jokuska Strait, 19/6 1914, depth 90 fathoms [= 165 m]; 36b, Sagami, Misaki, Okinose, 3/7 1914, depth 600 m; 36c, Goto Islands, 15/5 1919, depth 150 m". The material in the tube numbered 36a is here indicated as the lectotype.

Zygophylax pacifica Stechow, 1920a

Zygophylax biarmata Stechow, 1913a: 144; Stechow, 1913b: 114-115, fig. 88.
Zygophylax pacifica Stechow, 1920a: 19; Stechow, 1923b: 10; Stechow, 1923d: 141; Leloup, 1938: 10; Vervoort, 1941: 198-199; Yamada, 1959: 48; Hirohito, 1983: 29, fig. 10.

Remarks. – The gonosome was described by Hirohito (1983) as "gonothecae closely packed into coppinia, developed on stem and branch, not protected by tubes. Each gonotheca bottle-shaped, tapering proximally, with one distal opening. Distal end sometimes slightly curved. Only female gonothecae observed. Usually one planula developed in each gonotheca". Type locality Okinose Bank, Sagami Bay, Japan, 250 m (Stechow, 1913a, b, as *Z. biarmata*). Holotype and 4 schizoholotype microslide preparations (no. 772) in ZSM.

Zygophylax recta Jarvis, 1922

Zygophylax recta Jarvis, 1922: 335, pl. 24 fig. 2; Michel, 1974: 210; Gravier-Bonnet, 1979: 29.

Remarks. –A badly described species with unknown gonosome. Two localities (Saya de Malha Bank and Mauritius) are mentioned in Jarvis' description; no distinct type locality being indicated. In the BMNH there are two microslide preparations of Jarvis's material, labelled:

a. 1923.2.15.174. "*Zygophylax recta* Jarvis. Saya de Malha Bank, 150 fms [= 274 m]. Schizotype". Microslide preparation with 3 fragments, 2, 5, and 7 mm long, stained and mounted in balsam.

b. 1923.2.15.220. "*Zygophylax recta* Billard [!]. Mauritius, 1-200 f. [= 2-366 m]". This is a stained, balsam mounted microslide preparation of a colony 13 mm high with 3 side branches.

The material from Saya de Malha Bank is here indicated schizolectotype; the type locality thus becoming restricted to Saya de Malha Bank. The BMNH material is only part of the original material, including the lectotype, which is probably lost.

Z. recta is very similar to *Z. ?geniculata* as described by Millard (1975: 195-

197, fig. 64); no bifurcation of the hydrocladia has been observed in the BMNH material.

Zygophylax valdiviae Stechow, 1923a

Zygophylax valdiviae Stechow, 1923a: 6-7; Stechow, 1925b: 446-447, fig. 19.

Remarks. – A species with unknown gonosome. Type locality 7 km E of St Paul, southern Indian Ocean, 38° 40′ S, 77° 39′ E, 672 m ("Valdivia" Sta. 165). Material (possibly type series comprising 4 microslide preparations) in ZSM.

Zygophylax africana (Stechow, 1923c)

Zygophylax africana Stechow, 1923c: 106-107; Stechow, 1925b: 445-446, fig. 18; Millard, 1964: 15-18, fig. 4A-F; Millard, 1968: 263; Millard, 1973: 28, fig. 4B; Millard, 1975: 189-190, fig. 62A-E; Millard, 1977b: 106; Millard, 1978: 199; Gravier-Bonnet, 1979: 29; Millard, 1980: 131; Hirohito, 1983: 22-24, fig. 6.

Remarks. – A species with distinct affinities to *Cryptolaria*. Gonosome, a coppinia, described and figured by Millard (1964, 1975) and Hirohito (1983). Male and female gonothecae found on separate colonies; male and female coppiniae of same shape, present around stem and larger branches, about 10 mm long and 4 mm in diameter. Composed of densely packed (adpressed) gonothecae, penta- or hexagonal in surface view, each gonotheca laterally widening from base to apex, strongly contracted at top to form short, tubular neck surmounted by two divergent pointed horns, each with 2 apertures at opposite sides directly under horns. Many branching peripheral tubes between gonothecae, projecting beyond gonothecae and bearing nematothecae (Millard, 1964).

"Gonothecae aggregated into a coppinia, firmly adpressed to one another for about 3/4 length, then free. Each gonotheca widening from base to top of contiguous portion, with free part slender and bearing two lateral orifices and two distal, divergent horns. Coppinia provided with long, branching nematothecae, at least twice length of gonothecae; male and female similar" (Millard, 1975).

"Gonothecae aggregated into coppinia. Each gonotheca jar-shaped, widening distally; free distal end slender, diverged horn-like, provided with two lateral openings. Coppinia protected by branching tubes" (Hirohito, 1983).

Type locality off Cape Town, northern Agulhas Bank, 33° 41′ S, 18° 00′ E,

178 m ("Valdivia" Sta. 92). Material (possibly type series, including 2 microslide preparations) in ZSM.

Zygophylax brownei Billard, 1924

Lafoea pinnata Browne, 1907: 16, 18, 25-28, 29; Billard, 1923: 14-16, fig. 1A.
Zygophylax brownei Billard, 1924: 64; Billard, 1927: 331-332; Leloup, 1940b: 11, pl. 1 fig. 7; Patriti, 1970: 28-29, fig. 30; Millard, 1977b: 106, 114-116, fig. 4; Millard, 1978: 200; Van Praët, 1979: 883, fig. 23.

Remarks. – Originally recorded from the Bay of Biscay, 47° 20′ N, 06° 10′ W, 186 m (type locality, Billard, 1923, as *Lafoea pinnata*). Syntypes in MNH, no. H.L. 217 & 218 (Van Praët, 1979).

There are four slides from the E.T. Browne collection in BMNH:

a. 1959.9.17.115. "*Lafoea pinnata* Bay of Biscay, E.T.B., 07.2.27". Fragment of a colony, 18 mm long, 6 pairs of side branches.

b. 1959.9.17.116. "*Lafoea pinnata* G.O. Sars, Bay of Biscay, E.T.B., 07.2.27". Branched colony fragment, 25 mm high.

c. 1959.9.17.117. "*Lafoea pinnata* G.O. Sars, Bay of Biscay, 26 Aug. 06, 412 fms [= 753 m], 07.2.27, E.T.B.". Two fragments, 10 and 5 mm long.

d. 1959.9.17.118. "*Lafoea pinnata*, Bay of Biscay, 07.2.27, E.T.B.". Stem fragment 15 mm high, 4 pairs of side branches.

Nematothecae are visible in this material if looked for carefully.

Gonosome described by Millard (1977b): "Gonothecae. . . quite separate from one another, not conjoined in a coppinia, but clustered thickly round parts of the stem; deep oval, not compressed, with two apertures (rarely three) each on the end of a recurved tubular neck; containing planula larvae; with no special accumulations of nematothecae". Differs from *Z. pinnata* in the presence of nematothecae and in the structure of the coppinia.

Zygophylax abyssicola (Stechow, 1926)

Lictorella abyssicola Stechow, 1926: 99.

Remarks. – The species was not figured by the author, but compared with *Z. geniculata* (Clarke, 1907) and *Z. stechowi* (Jäderholm, 1919). Gonosome described (but not figured) by Stechow as "Ein Scapus an der Hauptachse eines der Stämme, 25 mm lang. Die einzelnen Gonotheken völlig frei, sich nicht berührend, so dass sie einzeln herausgelöst werden können. An Stelle

der Nematozooiden. . . ein eigentümliches Geflecht von langen maschenförmig verzweigten Tuben, offenbar die primitivste Form von Nematozooiden darstellend. Die Gonotheken (anscheinend weibliche) an kurzen ungeringelten Stielen, mit zwei bis drei breiten Ringelungen, oben breit abgestutzt(?) und mit zwei grossen, weiten Mündungen, die nach entgegengesetzten Richtungen auslaufen, mit zwei kurzen Mündungsrohren, die ganze Gonothek dadurch T-förmig aussehend; im Innern etwa sechs bis acht grosse Körper (Planulae ?) erkennbar. Länge der Gonotheken etwa 0,980 mm; grösste Breite in der Mitte 0,410-0,480 mm, Breite an der Mündung etwa 0,400-0,480 mm". Type locality: off East Africa, 01° 48.2′ N, 45° 42.5′ E, 1644 m ("Valdivia" Sta. 257). Holotype and paratypes, including 6 microslide preparations, in ZSM.

Zygophylax unilateralis Totton, 1930

Zygophylax unilateralis Totton, 1930: 167, text-fig. 20, pl. 1 figs. 1-2; Ralph, 1958: 311, fig. 2d.

Remarks. – The type series in BMNH, 1929.10.28.77, from Terra Nova Sta. 91, off Thee Kings Islands, New Zealand, 549 m (type locality), comprises 4 alcohol-preserved colonies, 3 attached to a mass of calcareous sand and 1 separate. The largest colony, 55 mm long, with a forked stem, is here designated lectotype; the remaining colonies are the paralectotypes. The branch off the main stem in the lectotype bears a coppinia about 10 mm from its origin on the main stem. The (female) coppinia is an oval mass, 6 mm long and 3 mm across, apparently overlooked by Totton. It closely resembles that of *Z. sibogae* Billard, 1918, as described by Hirohito (1983), but is smaller and less wide. It consists of a mass of (female) gonothecae placed together around the branch and springs from the peripheral tubules. Though the gonothecae touch they are not compressed but have open spaces in between, from which the abundant nematophorous ramules project. Each gonotheca sac-shaped, swollen and more or less oval to round in outline. Apex with 3 laterally projecting, short funnels, slightly flared at the rim, openings directed variously. Nematophorous ramules fine, anastomosing and strongly dichotomously branched, arching over the mass of gonothecae, only occasionally provided with a small, tubular nematotheca.

In addition there is a microslide preparation marked "schizoholotype" (a schizolectotype), 1929.10.10.4, with 4 stained fragments, and a larger colony fragment 6 mm long, with 2 pairs of side branches. There is also a jar (1929.10.28.78), containing 1 large and 3 smaller colonies attached to a mass of calcareous sand (paralectotypes).

Zygophylax arborescens (Leloup, 1931)

Lictorella arborescens Leloup, 1931: 3-4, figs. 6-7; Leloup, 1932: 148-150, text-figs. 6-7, pl. 16 figs. 4a-b.

Remarks. – The gonosome was described by Leloup (1931): "Coppinies avec gonothèques et tubes cylindriques. Gonothèques: sessiles, forme de carafe avec goulot étroit; 0,2-0,3 mm. de longueur, 0,12-0,2 mm. de largeur; un (très rarement deux) orifice. Tubes: cylindriques, sinueux; 1,4-1,8 mm. de hauteur, 0,08-0,1 mm. de diamètre; = hydrothèques transformées". Type series in ZSI collection of IMC (P3254/1, one colony; P3191/1 toP3197/1, seven microslide preparations) and in IRSN (P3198/1, one colony and one microslide preparation, registered under no. I.G. 9739). The colony in ZSI (P3254/1) is here indicated as the lectotype. Type locality off Travancore coast, India, 09° 14′ 10″N, 75° 45′ E, 475 m (Marine Survey India, "Investigator" Sta. 391).

Zygophylax bathyphila Leloup, 1940b

Zygophylax bathyphila Leloup, 1940b: 10-11, 33, pl. 1 fig. 5.

Remarks. – A species with unknown gonosome; type locality Atlantic Ocean, 47° 51′ 55″ N, 41° 51′ 50″ W, 4630 m. Holotype, a fragmented colony, in MOM, no. 11 0504; additional material (schizoholotype) in IRSN, registered under no. I.G. 12981 (microslide preparation).

Zygophylax elegantula Leloup, 1940b

Zygophylax elegantula Leloup, 1940b: 11-12, 29, pl. 1 fig. 8; Rees & White, 1966: 274.

Remarks. – Species with unknown gonosome. Leloup (1940b) mentioned two samples, one from the Atlantic near the Azores, 38° 35′ 30″ N, 28° 05′ 45″ W, 1250 m depth and a second from a broken telegraph cable in the Azores region (26 Feb., 1903, no depth data). No distinct holotype was indicated. There are syntypes in MOM, nos. 11 0434 and 11 0503, respectively. There is also material of the species, probably schizosyntype, in IRSN, registered under no. I.G. 12981 (microslide preparation).

Zygophylax crassitheca Fraser, 1941

Lictorella crassitheca Fraser, 1941: 85, pl. 18 fig. 12; Fraser, 1944a: 231, pl. 48 fig. 215; Fraser, 1944b: 37.

Remarks. –Species with unknown gonosome; type locality Gulf of Maine, 31 m. Type series in NMNH (no. 43456).

Zygophylax bifurcata Billard, 1942
(fig. 13, tab. 10)

Zygophylax bifurcata Billard, 1942: 34-35, figs. 1-3; Van Soest, 1976: 81.

Remarks. – We have inspected the type series of *Zygophylax bifurcata* Billard, 1942, in the collections of the Institute for Taxonomic Zoology (Zoological Museum), University of Amsterdam (ZMA Coel no. 5142; Van Soest, 1976). Billard (1942) gave a short description but did not mention the exact locality ("Siboga" Sta. 284, off N.E. point of Timor, Malay Archipelago, 08° 43.1′ S, 127° 16.7′ E (type locality), 18-i-1900, 828 m depth). There were 7 specimens in all, stored in two separate tubes, each labelled in Billard's hand. A large branched specimen, 55 mm high, with a separate coppinia, apparently removed from a side branch, was labelled: "*Zygophylax bifurcata* Billard fec. 17-xi-1941, type avec Coppinia, Siboga Exped., Stat. 284". We designate this specimen lectotype. The remaining 6 colonies were in a separate tube with the label: "*Zygophylax bifurcata* Billard fec. 17-xi-1941, type (une colonie avec Coppinia à la base)". These are the paralectotypes, one of which has been mounted by us on a microslide. The shortest is 30 and the tallest, having the coppinia, is 45 mm.

Redescription of *Zygophylax bifurcata* Billard. – Colonies with upright, fairly stiff, polysiphonic stems, forked only in one colony, monosiphonic distally; with hydrocladia arranged in two opposite rows along the stems, originally placed on apophyses at base of every third or fourth hydrotheca; axillary hydrothecae shifted onto hydrocladial apophyses (fig. 13a). Basal hydrocladia at times with some secondary tubules. All hydrocladia dichotomously branched some distance from origin on stems; one branch in plane of ramification, the other directed obliquely forward. Angle between stem and hydrocladia 80°-90°; some hydrocladia with additional ramifications further along their lengths. Internodes occasionally present, only visible in apical parts of stems and branches. Hydrothecae biseriate on stem and hydrocladia, on distinct apophyses, alternating but not in plane of ramification since apophyses and their hydrothecae are directed obliquely forward. Hydrothecal pedicels long, with wrinkled to indistinctly ringed portions, usually confluent with apophyses but occasionally separated from apophysis by distinct but thin septum, probably resulting from renovation (fig. 13a). Pedicels distally widen

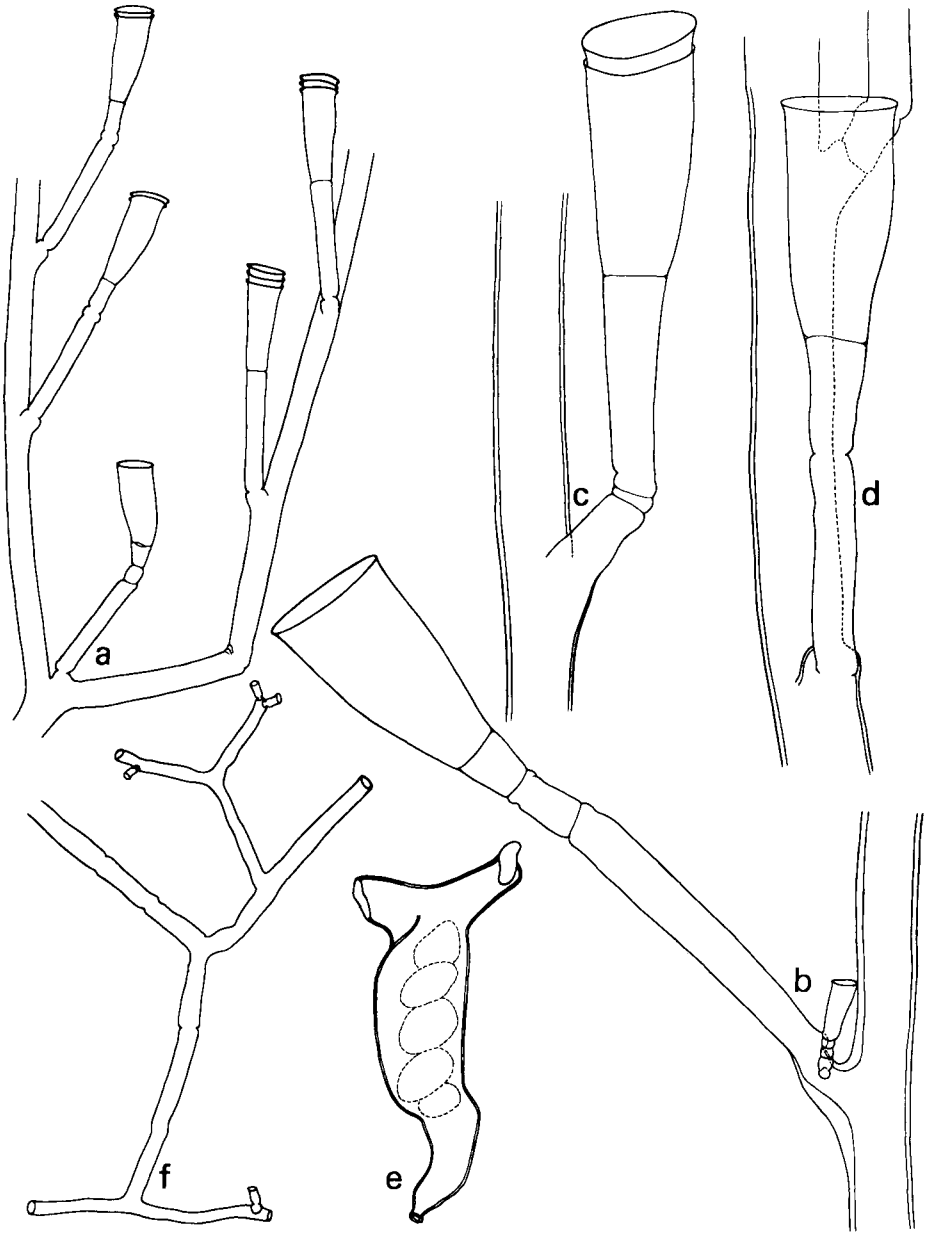


Fig. 13. *Zygophylax bifurcata* Billard. Lectotype, Siboga Exped., Sta. 284. a, monosiphonic stem fragment with side branch; b-d, hydrothecae; e, isolated gonotheca from a coppinia; f, nematophorous ramule from a coppinia. a, e, f x 30; b-d x 85.

gradually into more or less conical hydrothecae; diaphragm thin with large circular opening. Shape of hydrothecae slightly varied; some nearly symmetric, with slightly swollen middle region; others distinctly asymmetric, with almost straight abcauline and slightly bulging adcauline walls (fig. 13a-d). Rim slightly flared, circular, usually transverse, in some slightly tilted in adcauline direction. One to four renovations of hydrothecal margin quite common. Occasionally hydrothecae originating from secondary tubules. These, though generally of same shape as those on apophyses, supported by longer, wrinkled pedicels. Same phenomenon described in *Z. sagamiensis* by Hirohito (1983: 30, fig. 11a).

Nematothecae quite rare, only a few being present per colony; nor is their presence widely indicated by pores in apophyses, since they too are rare. Nematothecae, where present, invariably found on hydrothecal apophyses, slender tumbler-shaped, with only slightly diverging, almost straight walls and slightly flared aperture, usually placed on short, ringed pedicels (fig. 13b).

Perisarc firm and thick on stem, particularly just under each apophysis, but rapidly thinning out along apophysis and on hydrocladia, very thin on pedicels and hydrothecae, many of the latter collapsing.

	Siboga Exped. Sta. 284
Stem	
diameter at base	1000 – 1500
Internode	
diameter under apophysis	90 – 105
Hydrotheca	
length diaphragm to rim, excluding renovations	320 – 365
length diaphragm to rim, including renovations	355 – 390
breadth at rim	155 – 185
Hydrothecal pedicel	
length	460 – 570
Nematotheca	
length	140 – 155
breadth at rim	50 – 55
Gonotheca	
length, including apical funnels	1380
maximum diameter	340 – 360

Table 10. *Zygophylax bifurcata*. Measurements in μm.

Coppinia an aggregated mass of (female) gonothecae, contiguous but not fused, so that individual gonothecae can easily be separated. Many additional filaments between gonothecae, their dichotomous ramifications curving over coppinia and bearing small nematothecae (fig. 13f). Female gonotheca elongate-ovate, constricted basally, with short pedicel, apical portion with two

diverging funnels pointing in opposite directions, each with rather wide, slit-shaped opening (fig. 13e). Each gonotheca with 5 to 6 large ova.

The differences between *Z. bifurcata* and *Z. tottoni* are as follows:
1. Hydrocladia consistently dichotomously branched and leaving the stems almost at right angle in *Z. bifurcata*; hydrocladia only occasionally branched and leaving stems at an acute angle in *Z. tottoni*. 2. Arrangement of apophyses and consequently pedicels and hydrothecae in *Z. bifurcata* not strictly in one plane but shifted towards frontal part of colony; in *Z. tottoni* arrangement of apophyses and hydrothecae in plane of ramification. 3. In *Z. bifurcata* hydrotheca short, pedicel usually as long as or much longer than hydrotheca; in *Z. tottoni* hydrotheca longer, pedicel usually shorter than hydrotheca. 4. Very few nematothecae in *Z. bifurcata*; abundant nematothecae in *Z. tottoni*.

Zygophylax brevitheca (Jäderholm, 1919) var. **sibogae** Billard, 1942

Zygophylax brevitheca var. *sibogae* Billard, 1942: 35, fig. 4; Van Soest, 1976: 81.

Remarks. – Gonosome described by Billard (1942): "gonothèques, celles-ci sont groupées, mais néamoins distinctes; elles ne sont pas accompagnées de filaments ramifiés, leur forme est un tronc de cône cannelé, inséré par sa petite base; les côtes se continuent distalement par un mamelon, présentant à maturité un orifice tourné vers le dedans, avant la maturité cet orifice est fermé par une mince membrane d'occlusion. Le nombre des mamelons varie de 5 à 11". Type series in ITZ (ZMA Coel. no. 5145), 11 colonies from two "Siboga" Stations, viz. Sta. 220, anchorage off Pasir Pandjang, W of Binongka, 278 m, and Sta. 282, 08° 25.2′ S, 127° 18.4′ E, between Nusa Besi and the NE point of Timor, 27-54 m; no type locality has been indicated.

Zygophylax crassicaulis (Fraser, 1943)

Lictorella crassicaulis Fraser, 1943: 80, 91, pl. 18 fig. 9; Fraser, 1944a: 230, pl. 47 fig. 214; Fraser, 1944b: 37; Vervoort, 1968: 101.

Remarks. – Species with unknown gonosome. Type locality off Barbados, Blake Exped. Sta. 290, 13° 11′ 54″ N, 59° 38′ 45″ W, 134 m; type series in MCZ with the following labels: "M.C.Z. 9010, Type. *Lictorella crassicaulis* Fraser. Barbados. Mar. 9, 1879. 73 fms [= 134 m]", "Blake Exp. No. 290, Mar. 9, '79. 73 f." and "Type".

Zygophylax adhaerens (Fraser, 1938a)

Lictorella adhaerens Fraser, 1938a: 48, pl. 11 fig. 54.

Remarks. – A species of *Cryptolaria*, viz., *Cryptolaria adhaerens* (Fraser, 1938a).

Zygophylax reflexa (Fraser, 1948)

Lictorella reflexa Fraser, 1948: 233, pl. 26 fig. 14; Ljubenkov, 1980: 48.

Remarks. – Gonosome a coppinia, described by Fraser (1948), surrounding the main stem near the base, 6 x 2 mm; elliptical gonothecae closely packed, each broad at base and tapering into small opening; usually narrower portion slightly curved. Ramules not numerous, long and slender, forked at extremity, "somewhat like a phylactogonium of some of the species of *Cladocarpus*". The species is referred to *Zygophylax* and has affinities with *Z. tizardensis*. It was recorded by Fraser from many East Pacific localities off the SW coast of the U.S.A. No distinct type locality was indicated. Holotype in AHM, no. 80, with the following labelling: "*Lictorella reflexa*, R/V Velero III, Sta. 1246-41, Feb. 25, 1941, Ranger Bank, off Cedros Is., Mexico, 28° 33′ 44″ N, 115° 30′ 00″ W to 28° 32′ 14″ N, 115° 30′ 42″ W, 78-81 fms [= 143-148 m], coral, loose rock, pebbles, shell (dredge)"; the type locality thus being Ranger Bank, off Cedros Is., Mexico.

Zygophylax rigida Fraser, 1948

Lictorella rigida Fraser, 1948: 233-234, pl. 26 fig. 15, pl. 27 fig. 15; Ljubenkov, 1980: 48.

Remarks. – The gonosome, a coppinia, was described by Fraser (1948): "the coppinia is large, encircling the main stem for a distance of 4 cm or more. The gonangia are large, flask-shaped, and closely crowded. There are no modified hydrothecae to serve for protection". It is mentioned from two East Pacific localities, viz. north of Isla Partida, Gulf of California, 84-139 m and 1 mile south of Ben Weston Point, Santa Catalina Island, off western California, 82-90 m, no distinct type locality being indicated. The holotype is in AHM, no. 81, with the following labelling: "*Lictorella rigida*, R/V Velero III, Sta. 1081-40, Feb. 5, 1940, north of Isla Partida, Gulf of California (= Sea of Cortez),

Mexico, 28° 56′ 00″ N, 113° 02′ 45″ W to 28° 56′ 50″ W, 46-76 fms [= 84-139 m], coralline, rock (dredge)". The type locality is consequently restricted to the Gulf of California.

Zygophylax geminocarpa Millard, 1958

Zygophylax geminocarpa Millard, 1958: 177-178, fig. 4D-G; Millard, 1975: 195, fig. 63D-G; Millard, 1978: 200; Millard, 1979: 140.

Remarks. – Species with aberrant type of gonosome described by Millard (1958, 1975): "gonothecae not collected in coppiniae, but attached to one another in pairs and arranged in dense clusters around the main stem and principal branches. Each gonotheca very large [3.78-4.15 mm], elongated, round in section, tapering to the base, and, more rapidly, to the tip, fused to its twin for about 3/4 of length and then free. Scattered nematothecae borne on lower half. The gonothecae are not fully mature and have no opening to the exterior, nor can the sex be determined. It is probable that an opening will develop on the inner surface of the free distal part where a flattened area is present and where the end of the blastostyle is pressed against the perisarc. The gonothecae are borne by the peripheral tubes of the stem. Although most of them are arranged in pairs, there are occasional solitary individuals or groups of three" (Millard, 1958). Type locality off Port Shepstone, Natal, South Africa, 30° 53′ S, 30° 28′ E, 66 m (Sta. PF12308A), type series in SAM, no H59 (alc. + 2 slds).

Zygophylax infundibulum Millard, 1958

Zygophylax infundibulum Millard, 1958: 180-181, fig. 4B-C; Millard, 1968: 266; Millard, 1973: 32; Millard, 1975: 197-198, fig. 65D-E; Millard, 1978: 200; Millard, 1979: 140; Millard, 1980: 131, 143-144, fig. 4D.

Remarks. – Gonosome described by Millard (1980): "gonothecae not adpressed, narrow at base and widening distally, then divided into two outwardly curved necks bearing the terminal apertures. Protective tubular structures numerous, arising amongst the gonothecae and rising above them, completely obscuring them and forming a bristly coat to the coppinia; each branching irregularly and bearing many nematothecae similar to those of the trophosome. Each gonotheca apparently arising from the base of one of the tubular structures". Type locality off Cape Natal, South Africa, 29° 53′ S, 31° 11′ E, 155 m (PF10781B); type series in SAM, no H36 (alc. + 2 slds).

Zygophylax crozetensis Millard, 1977a

Zygophylax crozetensis Millard, 1977a: 3, 15-18, fig. 4; Millard, 1979: 140; Van Praët, 1979: 883-884, fig. 24.

Remarks. – Gonosome described and figured by Millard (1977a): "Coppiniae numerous and closing most of the larger branches completely to a width of 3-5 mm, so that it is not possible to distinguish one from another. Coppinia consisting of closely depressed gonothecae with between them irregular branching structures bearing nematothecae and rarely hydrothecae as well. Gonothecae slender, widening distally to top of adnate part, then narrowing to a free, pointed, and sometimes curved, hood or horn bearing aperture on one side. Sex not determinable". Type locality "Marion Dufresne" Sta. 26/64-B, Chenal des Orques, Crozet Is., 46° 24′ S, 51° 59′ E, 180 m; holotype and paratypes in MNH, no H.01577 (Van Praët, 1979), schizoholotype in SAM, no. H2779 (alc. + sld.).

Zygophylax inconstans Millard, 1977b

Zygophylax inconstans Millard, 1977b: 106, 117-119, fig. 5; Millard, 1978: 200; Millard, 1979: 140; Millard, 1980: 131, 143, fig. 4B.

Remarks. – Gonosome described by Millard (1977b, 1980): "coppiniae. . . surrounding thicker parts of stem, consisting of a mass of conjointed gonothecae, but without modified hydrothecae or nematothecae. Gonothecae saccular and of irregular shape, with a single aperture with a flared margin on the summit of a short tubular neck" (Millard, 1977b), and: "many coppiniae present, some completely unprotected as described by Millard (1977b), and some with tufts of branching tubular structures. The latter appear to be modified stems, since they bear a few hydrothecae and many nematothecae, but the branching is quite irregular" (Millard, 1980). Holotype in SAM, no. H1975 (Millard, 1979), type locality: off Natal, 27° 44.4′ S, 32° 42.8′ E, 400-450 m. Species near *Z. armata* (Ritchie) and *Z. profunda* Quelch.

Zygophylax sagamiensis Hirohito, 1983

Zygophylax sagamiensis Hirohito, 1983: 30, fig. 11.

Remarks. – Species compared by its author with *Zygophylax carolina* Fraser, 1911. With distinct nodes, especially in distal parts of hydrocladia. Gonosome described by Hirohito as follows: "Male gonosome observed.

Gonothecae bottle-shaped, tapering proximally, with distal aperture; one side of aperture prolonged upwards to a sharply pointed hook. Gonothecae closely packed each other, surrounding stem, aggregated into coppinia. Protecting tubes scarce, short, only slightly exceeding distal ends of gonothecae, rarely branched, bearing nematothecae". Type locality: Sagami Bay, Japan; syntype series in the Biological Laboratory of the Imperial Household, Tokyo. (Hydr. nos 3263 & 4195, 250-300 m; Hirohito, 1983).

Zygophylax millardae sp. nov.
(fig. 14, tab. 11)

? *Zygophylax biarmata*: Jarvis, 1922: 335
Zygophylax ?antipathes: Millard, 1975: 190-192, fig. 62F-G.

Material examined. – Sta. 111. One colony 30 mm high (holotype) and a fragmented colony about 25 mm high (sld., paratype). In addition there are some fragments (also paratypes). No coppiniae (BMNH 1984.1.1.18, holotype, alc. + sld.; RMNH 16520, paratype, sld.).

Sta. 112. A number of fragments, probably representing a single colony about 50 mm high. No coppiniae (BMNH 1984.1.1.19, alc. + 4 slds; RMNH 16521, sld.).

Description. – Erect, stiff colonies comprising fairly thick main stem with pinnately arranged side branches; hydrothecae strictly in one plane. Basal part of stem and major side branches polysiphonic, reddish-brown; monosiphonic parts brownish. Stem and side branches unsegmented. Side branches springing from stem at irregular intervals but alternately pointing left and right and leaving stem almost at right angles. Hydrothecae alternately arranged along stem and side branches (fig. 14a), stems and branches between successive hydrothecae weakly geniculate. Hydrothecae placed on strong apophyses with which hydrothecal pedicel is more or less contiguous: a perisarcal depression or perisarcal fold indicates demarcation (fig. 14b). Side branches inserted on stem under an apophysis which, with its hydrotheca, thus becomes axillary.

Hydrothecae deeply campanulate and only slightly asymmetric, adcauline wall usually being slightly more convex (fig. 14c-f). Axillary hydrothecae nearly symmetrical. Strong, annular diaphragm separating pedicel from hydrotheca proper. Pedicel well developed, of varied length. Hydrothecal rim slightly but distinctly everted, with repeated renovations, circular.

Nematothecae occurring very sparingly, but on close investigation nearly all apophyses with circular spot indicating that a nematotheca had originally been present on each apophysis. Nematothecae short, tumbler-shaped with rounded base, one to each apophysis, usually on frontal aspect of colony and with several renovations (fig. 14c). Nematothecae sometimes borne on hydrothecal pedicel (fig. 14d).

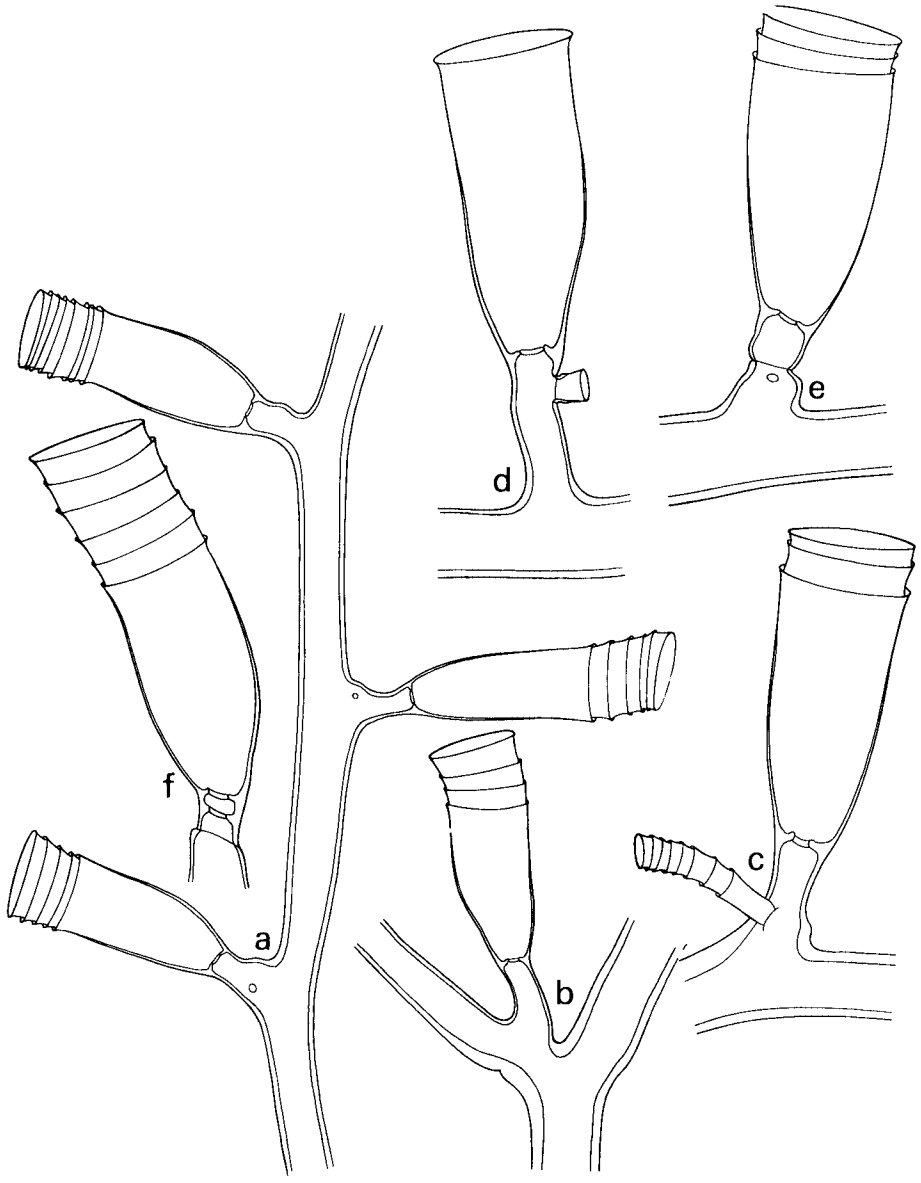


Fig. 14. *Zygophylax millardae* sp. nov., holotype, John Murray Exped., Sta. 111. a, monosiphonic top of branch with renovated hydrothecae; b, stem hydrotheca at insertion of side branch; c, renovated hydro- and nematotheca; d, hydrotheca with nematotheca on pedicel; e, renovated hydrotheca; f, renovated hydrotheca with double diaphragm. a, b x 55; c-f x 85.

A distinct septum demarcating apophysis from pedicel is present only where complete hydrothecae, with pedicels, have been renovated (fig. 14f). Occasionally such hydrothecae have two diaphragms.

Perisarc of hydrocaulus and branches quite firm, that of hydrothecal and nematothecal walls thinning out rapidly, the rim being very thin.

	Off Natal and Moçambique (Millard, 1975)	John Murray Exped. Sta. 111
Hydrocaulus		
diameter at base		300 – 500
Hydrotheca		
length, diaphragm to margin, without renovations		350 – 385
length, diaphragm to margin, including renovations	400 – 600	480 – 555
breadth at rim	170 – 200	165 – 180
Pedicel		
length		65 – 80
Branch		
diameter below apophysis		85 – 90
Nematotheca		
total length, including renovations		50 – 105
breadth at rim		40 – 50

Table 11. *Zygophylax millardae*. Measurements in μm.

Distribution. – *Zygophylax millardae* is known from a number of localities off Natal and Moçambique between 24° S and 31° S, depth 6-110 m. The present records extend its distribution to the Zanzibar area, at 5° S, between 73 and 165 m depth. Additional localities probably include Amirante Is., Providence Is., Chagos Archipelago, and the Seychelles, 37-183 m (Jarvis, 1922, as *Z. biarmata*).

Remarks. – The John Murray material has been identified with specimens described by Millard (1975) from off Natal and Moçambique as *Zygophylax ?antipathes*. We consider this material to be specifically different from *Zygophylax antipathes* (Lamarck, 1816), a species with a much stronger colony and in which the side branches leave the hydrocaulus in various directions, and with larger, wider, hydrothecae with shorter pedicels. Though *Z. antipathes* is known to be varied we have never seen it with the type of hydrothecae met with in the present specimen, which resembles in detail Millard's description. The coppinia of *Z. millardae* is still undescribed.

We have also inspected Jarvis's material of *Zygophylax biarmata* Billard, 1906, in the BMNH collection, comprising specimens from:

1. Amirante, 55-183 m, microslide preparation of stained, branched frag-

ment, 7 x 8 mm, with 3 side branches (1923.2.15.106);

2. Amirante, 71 m, microslide preparation of stained branch 9 mm long (1923.2.15.106);

3. Providence, 91-143 m, microslide preparation of two stained branches 7 and 10 mm long (1923.2.15.199);

4. Salomon, Chagos, 110-219 m, microslide preparation of stained fragment with 2 side branches, 8 x 8 mm (1923.2.15.118);

5. Seychelles, 68 m, microslide preparation of stained fragment with 2 side branches, 7 x 5 mm (1923.2.15.215);

6. Seychelles, 37 m, microslide preparation of stained branch 4.5 mm long (1923.2.15.219).

All this material resembles closely the colonies described here as *Zygophylax millardae*, to which species it must probably be referred. However, it represents only fragments of the original sterile colonies 5 to 6 cm high, that are probably lost. The microslide material is in bad shape, is very dirty, and has few nematothecae, though places of attachment are distinctly visible on the apophyses.

Etymology. – We dedicate this new species to Mrs (Dr) Naomi A. H. Millard, Cape Town, South Africa, in recognition of her fundamental contributions to hydroid taxonomy in general, and taxonomy and geographical distribution of South African hydroids in particular.

Zygophylax tottoni sp. nov.
(figs. 15-16, tabs. 12-13)

Zygophylax sibogae p.p. Totton, 1930: 167-168, fig. 21.

Material examined. – Sta. 54. Seven complete colonies from 28 to 50 mm high, and a number of fragments. A branched colony 30 mm high with a basal tuft of fibres, preserved as a microslide preparation, is designated holotype; the remaining colonies are the paratypes (BMNH 1984.1.1.21, holotype, sld.; 1984.1.1.22, paratypes, alc. + sld.; RMNH 16523, paratype, alc. + 3 slds).

Description. – The following is based on all the specimens, since they do not differ substantially in structure. It is not, therefore, a description of the holotype alone.

Colonies with erect, fairly stiff and sparingly branched stems; both they and branches polysiphonic basally and monosiphonic apically, both bearing alternate hydrocladia and hydrothecae placed on distinct apophyses, all in one plane. Hydrocladia usually subalternate and placed at base of third and fourth hydrothecae (consequently with two "free" hydrothecae between each pair of

hydrocladia, but this arrangement not followed consistently). Hydrocladia and branches leaving stem at angles of 60° to 90°. Many branches represent hydrocladia covered by secondary tubules and not ramifications of the primary axis. A few nodes, separating internodes, present in apical, monosiphonic parts of some colonies. Some hydrocladia branched, occasionally at first internode, but usually further along hydrocladium; branches always inserted on apophyses and with axillary hydrotheca. Some hydrocladia branched twice, one branch almost at origin and one more distal. Branches of hydrocladium directed frontally; hydrothecae on such branches in a plane perpendicular to main plane of branching. Hydrothecae biseriate, hydrocladium weakly geniculate to almost straight between the various hydrothecae (fig. 15a). Hydrothecae on distinct apophyses, in primary hydrotheca confluent with hydrothecal pedicel, curving gracefully away from hydrocladium (fig. 15b-d). Apophyses with their hydrothecae strictly in one plane. Renovation of hydrotheca apparently common; hydrothecal pedicel lengthening and sometimes developing one or a small number of internodes separated by distinct annuli representing, so far as we could make out, not complete septa but only strong constrictions of the perisarc (fig. 15b, e). Internodes so developed with contorted walls and with a number of "rings", or "rings" and short internodes, between hydrotheca and apophysis, hydrothecal pedicel then greatly lengthened. Pedicel gradually widening into slender, more or less conical hydrotheca. Demarcation between pedicel and hydrotheca proper marked by thin, ring shaped, frequently oblique diaphragm (fig. 15b-e). Hydrothecae usually slightly asymmetric, with convex adcauline and almost straight abcauline walls. Renovated hydrothecae slightly swollen at half their length and above that nearly symmetric (fig. 15b, c). Hydrothecal rims circular, slightly but distinctly flared. Two to four renovations, aperture perpendicular to hydrothecal long axis. Hydrothecae with strongly contracted hydranths.

Nematothecae mostly deciduous, pores in apophyses indicating positions; usually one (or a pore) on front of each apophysis; deep, tumbler-shaped, as a result of renovations sometimes on ringed or "segmented" pedicel of varied length (fig. 15b); occasionally on secondary tubules.

Perisarc firm on stems and branches, thinning out along hydrothecal pedicel and wall. Hydrotheca collapsing easily.

No coppiniae were seen.

Distribution. – Off Three Kings Islands, northern New Zealand, 549 m ("Terra Nova" Sta. 91, Totton, 1930, as *Zygophylax sibogae*, part, see below). The present record is from the Arabian Sea off Oman.

Remarks. – We have identified the John Murray material with two colonies

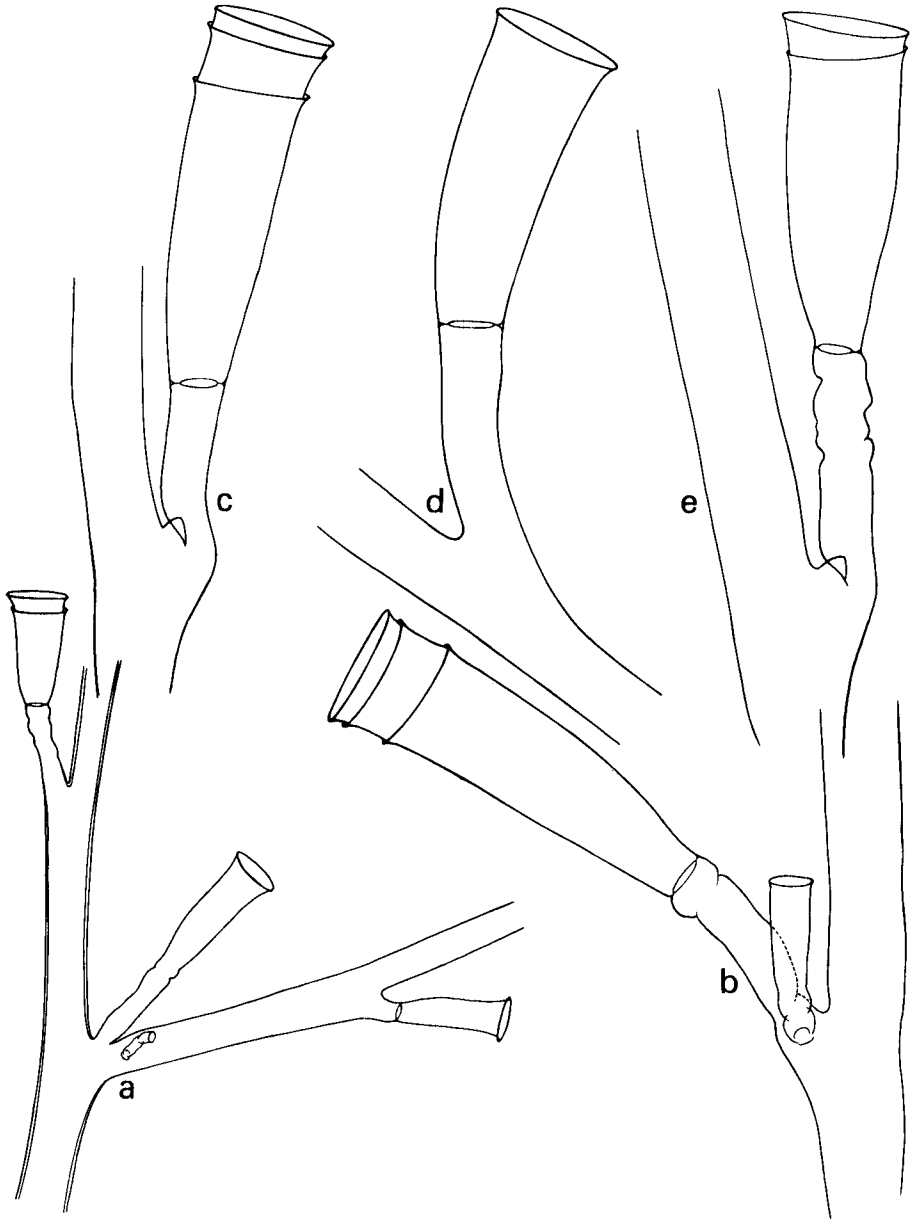


Fig . 15. *Zygophylax tottoni* sp. nov., holotype, John Murray Exped., Sta. 54. a, monosiphonic part of stem with side branch; b, hydro- and nematotheca. c-e, hydrothecae. a x 30; b-e x 85.

5 mm long recorded by Totton (1930: 168, fig. 21) from Three Kings Islands, off northern New Zealand (549 m) as *Zygophylax sibogae*. This is only part of the "Terra Nova" material mentioned by Totton under that name; the remainder of that material is really *Z. sibogae* Billard s. str. (see below).

The material on which Totton's (1930) figure of *Z. sibogae* was based has been re-examined (fig. 16). It comprised two microslide preparations, both labelled "BMNH 1929.10.28.79, Terra Nova Sta. 9l, N.Z.", bearing stained

	John Murray Exped. Sta. 54
Stem	
diameter at base	250
Internode	
diameter below apophysis	120 – 130
Hydrotheca	
length, diaphragm to margin, excluding renovations	355 – 435
length, diaphragm to margin, including renovations	450 – 535
breadth at rim	135 – 185
Nematotheca	
length	150 – 200
breadth at rim	55 – 65

Table 12. *Zygophylax tottoni*. Measurements in μm.

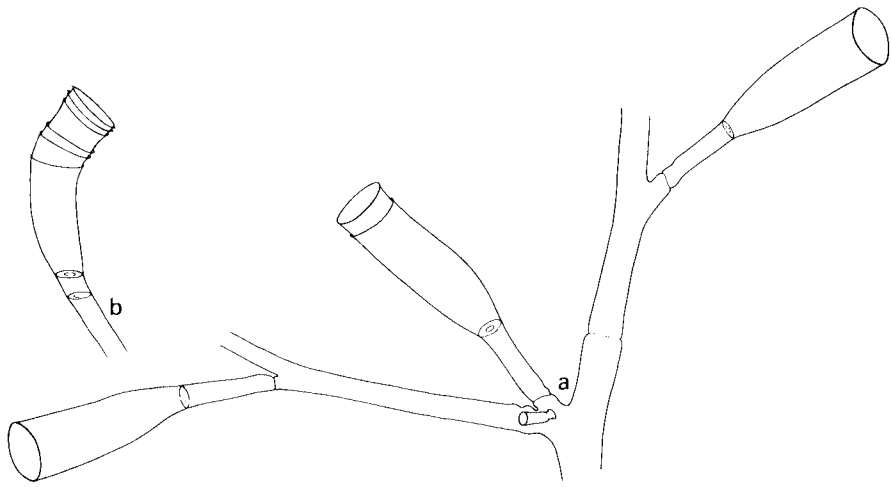


Fig. 16 *Zygophylax tottoni* sp. nov., part of Totton's (1930) "*Zygophylax sibogae*", Terra Nova Exped., Sta. 91, BMNH 1929.10.28.79, microslide preparations. a, branched stem with stem hydrotheca, axillary hydrotheca, and hydrocladial hydrotheca; b, strongly renovated hydrotheca with double diaphragm from unbranched stem. a, b x 60.

fragments mounted in Canada balsam:

a. Unbranched stem fragment of 5 mm long, with 2 hydrothecae and one (doubtful) nematotheca. One of the hydrothecae has at least 6 renovations, successively curving more and more outwards and also seemingly inducing a fairly strong curvature of the apical part of the hydrotheca (fig. 16b). This probably led Totton to record the specimens as *Zygophylax sibogae*, but he was clearly mistaken. The curved hydrotheca also has a double diaphragm. The second hydrotheca has a preserved hydranth with 8 tentacles, attached basally to the diaphragm; in addition a ligament attaches the hydranth to the abcauline hydrothecal wall at about half way along its length.

b. Stem 6 mm long, with one branch and 5 hydrothecae. The top part of this fragment was figured by Totton (1930, fig. 21). Two of the thecae have complete hydranths. The stem is monosiphonic and slightly geniculate, divided by transverse nodes into internodes bearing 1 or 2 apophyses. These point alternately left and right, supporting hydrothecal pedicels and, if present, side branches. Consequently the side branches each have an axillary hydrotheca. Each side branch is built as the stem, with some straight nodes and alternately placed apophyses. Hydrotheca on long pedicel, slightly wrinkled basally, widening gradually from diaphragm upwards to form cylindrical structure, slightly asymmetric since bulge of abcauline wall is slightly stronger than that of adcauline wall. Diaphragm distinct, annular with large, circular hole with slightly raised border. Hydrothecal rim smooth, circular and slightly everted, more so in renovated hydrothecae (fig. 16a). Nematothecae sparse, only two seen in position favourable for observation; on hydrothecal apophyses, tubular, attached by wrinkled basal portion. Apophysis with circular perisarcal depression. Perisarc thin, toughest in basal parts of fragment, thinning out gradually along stem and branch, particularly thin along pedicel and hydrotheca, the latter fragile and often collapsing.

	Terra Nova Exped. Sta. 91
Hydrothecal pedicel	
length base to diaphragm	240 – 265
Hydrotheca	
length diaphragm to margin	400 – 425
breadth at rim	145 – 150

Table 13. *Zygophylax tottoni*. Measurements in μm.

Remarks. – There is also an alcohol preserved colony, about 15 mm high, from "Terra Nova" Sta. 91, bearing three branches (BMNH 1929.10.28.79). This is an unmistakable specimen of *Zygophylax sibogae* Billard, 1918, with

highly characteristic hydrothecae.

Etymology. – We take great pleasure in naming this species in honour of Captain A. Knyvett Totton, M.C., in recognition of his fundamental contributions to hydroid taxonomy.

Family Campanulariidae Johnston, 1836

Subfamily Clytiinae Cornelius, 1982

Clytia linearis (Thornely, 1900)

Clytia sp. Inaba, 1890: 427, figs. 36-38.
Obelia linearis Thornely, 1900: 453, pl. 44 fig. 6.
Campanularia gravieri Billard, 1904: 482, fig. 1; Schmidt, 1972a: 33-34, 41-44; Schmidt, 1973: 285.
Clytia hendersoni Torrey, 1904: 18-19, figs. 10-11; Nutting, 1915: 62-63, pl. 15 figs. 2-3.
?*Clytia geniculata* Thornely, 1904: 112-113, pl. 3 figs. 4, 4a.
Campanularia (?) obliqua Clarke, 1907: 9, pl. 5 figs. 1-4.
Obelia striata Clarke, 1907: 9-10, pls. 6-7.
Clytia striata: Vanhöffen, 1910: 301, fig. 21; Stechow, 1925b: 429-431, fig. 8.
Clytia linearis: Stechow, 1913b: 8, 66-69, figs. 23-24; Jäderholm, 1919: 12; Hirohito, 1977: 14-20, fig. 4; Cornelius, 1982: 84-86, fig. 12; Hirohito, 1983: 16.
Laomedea striata: Kramp, 1921: 19; Vervoort, 1946a: 343.
Clytia hendersonae: Stechow, 1923d: 109; Mammen, 1965: 18-21, fig. 47.
Clytia alternata Hargitt, 1924: 483, pl. 2 fig. 7; Billard, 1938: 431.
?*Clytia (?)foxi* Billard, 1926: 93-94, figs. 9.
Laomedea bistriata Leloup, 1931: 4-6, figs. 8-11; Leloup, 1937b: 22, fig. 12.
Laomedea (Obelia) bistriata: Leloup, 1932: 153-155, text-figs. 20-23, pl. 17 figs. 5, 5a-b.
Laomedea gravieri: Billard, 1933: 9-10, fig. 3; Dollfus, 1933: 127.
Clytia gravieri: Billard, 1938: 429-432, figs. 1-3; Picard, 1955: 185-186; Bellan-Santini, 1962: 192; Bellan-Santini, 1970: 344; Gravier-Bonnet, 1972: 4, 5; Millard & Bouillon, 1973: 7, 51-53, fig. 7E-G; Millard & Bouillon, 1974: 5; Millard, 1975: 215-217, fig. 71F-H; Millard, 1977b: 107; García Corrales, Aguirre Inchaurbe & González Mora, 1978: 29-30, fig. 12; Millard, 1978: 190; Millard, 1980: 131.
Clytia serrata Millard, 1958: 173-174, fig. 3C, H.
Campanularia (Clytia) gravieri: Vervoort, 1967: 50-52, fig. 16; Mergner & Wedler, 1977: 12, pl. 2 fig. 8a-b.

Material examined. – Sta. 80. Numerous hydrocauli 10 to 15 mm high rising from a stolon epizoic on worm tube. Hydrothecae in bad shape; many gonothecae present (BMNH 1984.1.1.23, alc. + sld.; RMNH 16527, sld.).

Description. – The material of this species will not be described in detail. Hydrocauli composed of sympodially branched pedicels, reaching up to 15 mm high. Each pedicel ringed basally and under hydrotheca; next pedicel springing from previous one just under upper, ringed part. Occasionally two of such pedicels springing from preceding pedicel, one opposite the other; each may again branch sympodially. Hydrothecae 800-860 μm long and deep-campanu-

late, with base slightly swollen and with almost parallel sides up to hydrothecal margin. Maximum diameter 240-300 μm. Hydrothecal margin with 10-12 acute cusps, separated by shallow, rounded embayments. Internally hydrothecal margin with a number of longitudinal, thickened strips corresponding with marginal cusps and continuing downwards for about one third of hydrothecal wall. Cross section of hydrotheca just under margin distinctly polygonal. Basally hydrothecae with distinct though thin diaphragm, usually oblique but straight in some thecae (probably depending on angle of vision), separating off a spacious basal chamber.

Many gonothecae occur on hydrocauli in the axil of hydrothecae and are supported by short, ringed pedicels. They are elongate pear-shaped, truncated at the apex, with short distal collar. All gonothecae contain developing medusae.

Remarks. – For the synonymy of this morphologically varied species we refer also to Hirohito (1977) and Cornelius (1982). This species is widely distributed in tropical and subtropical parts of the Atlantic, Indian and Pacific Oceans (Vervoort, 1967; Millard, 1975; Hirohito, 1977; Cornelius, 1982), including the Mediterranean (García Corrales, et al., 1978; Vervoort, unpublished), usually in shallow water, but occasionally penetrating down to 110 m (Millard, 1977: 217). Pelagic colonies occur on the pteropod *Diacria trispinosa* (Lesueur) (Kramp, 1921; Vervoort, 1946a, as *Laomedea striata*). Here the pedicels are usually unbranched and the gonothecae occur on the stolon. Hirohito (1977) and Cornelius (1982) noted a facultative but regular association with pteropods.

Family Syntheciidae Marktanner-Turneretscher, 1890

Synthecium patulum (Busk, 1852)
(fig. 17, tab. 14)

Sertularia patula Busk, 1852: 390; Bale, 1884: 88, pl. 5 fig. 10.
Sertularia orthogonia Busk, 1852: 390; Bale, 1884: 88-89, pl. 9 fig. 11.
Synthecium campylocarpum Allman, 1888: 78, pl. 37 figs. 1, 1a-c; Marktanner- Turneretscher, 1890: 248; Von Campenhausen, 1896a: 104, 106; Von Campenhausen, 1896b: 310-311, pl. 25 fig. 6; Farquhar, 1896: 466; Billard, 1910:25, fig. 10; Stechow, 1913a: 144; Stechow, 1913b: 12, 127-128, figs. 96-97; Jäderholm, 1916: 6; Jäderholm, 1919: 14, pl. 3 fig. 6; Stechow, 1923b: 11; Totton, 1930: 169; Ralph, 1958: 347, fig. 15c-g; Yamada, 1959: 52-53.

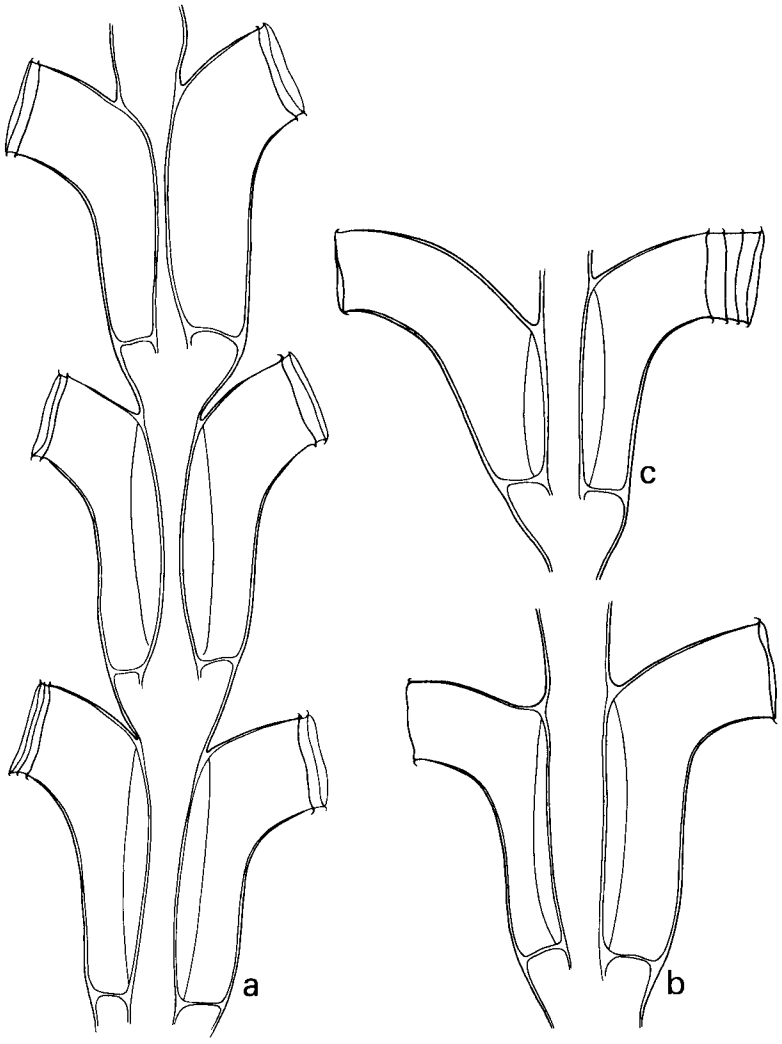


Fig. 17. *Synthecium patulum* (Busk). a, John Murray Exped., Sta. 112, pairs of hydrothecae on hydrocladium. b, c, John Murray Exped., Sta. 27, pairs of hydrothecae with long free portion from abnormal specimen. a-c x 55.

Synthecium orthogonium: Billard, 1910: 25; Ritchie, 1911b: 849-850; Stechow, 1913b: 12; Jäderholm, 1916: 6; Stechow, 1923b: 11; Stechow & Müller,1923: 465-466; Bale, 1924: 250; Totton, 1930: 169; Yamada,1959: 52.

Synthecium patulum: Jarvis, 1922: 345; Billard, 1925b: 125-128, figs. 2-3; Trebilcock, 1928: 9; Totton, 1930: 168, fig. 22c; Vervoort, 1941: 199-201, fig. 2; Hodgson, 1950: 18-19, figs. 32-33; Pennycuik, 1959: 190; Rees & Thursfield, 1965: 114-115; Redier, 1971b: 141; Millard & Bouillon, 1973: 8, 64-65, fig. 8J; Millard & Bouillon, 1975: 2, 12-13, fig. 3C-E; Watson, 1975: 165.

non *Synthecium orthogonium* Hirohito, 1969: 18 (= *S. elegans* Allman, 1876).
non *Synthecium campylocarpum* Hirohito, 1969: 18 (= *S. elegans* Allman, 1876).

Material examined. – Sta. 27. Three colonies c. 35 mm high, each comprising stem and opposite hydrocladia; a few gonothecae. In addition many tangled colonies, composed of stolons with many short, blackish stems bearing short hydrocladia; stems with epizoic *Filellum serratum* (Clarke). A few gonothecae are present (BMNH 1984.1.1.11, alc. + sld., with *Filellum serratum*; 1984.1.1.24, alc. + 2 slds; RMNH 16515, sld., with *Filellum serratum*; 16528, 2 slds).

Sta. 112. Large colony 35 mm high, comprising stem and many opposite hydrocladia. No gonothecae (BMNH 1984.1.1.25, alc. + sld.; RMNH 16529, sld.).

Description. – Stems arising from short apophyses on stolon and having fairly thick, occasionally blackish brown perisarc and widely spaced, opposite hydrothecae. Hydrocladia opposite, springing from two opposite rows of stem internodes, not separated by septa or nodes; stem hydrothecae, hydrocladia and hydrocladial hydrothecae all in one plane. Hydrothecae of hydrocladia opposite to sub-opposite; hydrocladia constricted beneath each pair, without nodes or septa.

Hydrothecae tubiform, with apical portion curving away from hydrocladium, adnate for most of their length; abcauline walls of opposite hydrothecae parallel for some distance. Hydrothecal aperture not perfectly circular, plane of opening not parallel to hydrocladium but slightly tilted in adcauline direction: margin distinctly everted. Renovations of thecal margin quite common, numbering up to 6 (fig. 17a).

Gonothecae arising directly from aperture of stem hydrothecae, resembling closely description and drawings by Millard & Bouillon (1973: 65, fig. 8J); number of annulations 9.

In a fragment from Sta. 27 free part of hydrothecae much longer than normal. This fact is enhanced by renovations that are more widely spaced than is usual in this species (fig. 17b, c). The fragment approaches Billard's *Synthecium patulum* var. *elongatum* (Billard, 1925b: 128-129, fig. 4), though here free portion of hydrothecae even longer. The fragment bears one gonotheca of the type mentioned above with 9 ribs.

Distribution. – *Synthecium patulum* (Busk), including *Synthecium orthogonium* (Busk) and *Synthecium campylocarpum* Allman, is distributed widely over the Indo-West Pacific, including localities in the Indian Ocean, the seas of the Malay Archipelago, Japan, Australia and New Zealand (cf. Vervoort, 1941: 201) and the Seychelles (Millard & Bouillon, 1973, 1975). The presence in the John Murray collection of specimens with gonothecae confirms the occurrence of the species in the Gulf of Aden, near Cape Guardafui. There were also sterile specimens, probably also of this species, from the Zanzibar area.

	John Murray Exped. Sta. 112	John Murray Exped. Sta. 27 (abnormal specimen)
Hydrotheca		
length adnate adcauline wall	510 – 535	560 – 575
length free adcauline wall	185 – 230	320 – 500
diameter at rim	200 – 230	200 – 215
distance across adnate part of pair	340 – 350	380 – 395
distance between hydrothecal pairs (from angle between adnate and free part adcauline wall to bottom of next above)	175 – 250	375 – 390
Gonotheca		
length	850	
diameter	745	

Table 14. *Synthecium patulum*. Measurements in μm.

Remarks. – We have provisionally accepted Billard's (1925b) synonymy of *Synthecium patulum* (Busk), bearing in mind the great variation in shape and size of the hydrothecae and in size and number of ribs of the gonothecae. Colonies of both sexes may also differ in the size of the hydrothecae.

Synthecium megathecum Billard, 1925a
(figs. 18a, 19a, tab. 15)

Sertularia tubitheca Pictet, 1893: 51-52, pl. 2 figs. 44-45; Von Campenhausen, 1896b: 309.
Synthecium megathecum Billard, 1925a: 648; Billard, 1925b: 130-132, text-fig. 6, pl. 7 fig. 2; Leloup, 1937b: 5, 32, fig. 21; Vervoort, 1946a: 306; Dawydoff, 1952: 55; Pennycuik, 1959: 189-190, pl. 6 fig. 1; Van Soest, 1976: 85; Gravier-Bonnet, 1979: 36-43, fig. 7.

Material examined. – Sta. 111. Five mutilated, unbranched colonies, 15-20 mm high, rising from creeping stolon. Damaged and empty hydrothecae, no gonothecae; one colony with epizoic *Lafoea dumosa* (Fleming) (BMNH 1984.1.1.14, sld., with *Lafoea dumosa*; 1984.1.1.18, sld., together with *Zygophylax millardae* sp. nov.; 1984.1.1.26, alc. + sld.).

Sta. 112. Numerous colonies 10-25 mm high, unbranched, rising from creeping stolon; hydranths present. No gonothecae (BMNH 1984.1.1.27, alc. + sld.; RMNH 16530, alc. + sld.).

Description. – Material comprises unbranched stems, rising from a creeping stolon. Stems short, split up into internodes bearing one to three pairs of opposite hydrothecae (fig. 18a). Basal internode slightly longer; stems without athecate segments. Nodes separating various segments straight and distinct. Hydrothecae in strictly opposite pairs, not touching and equally far removed from each other on both sides of hydrocaulus. Hydrothecae tubiform, gracefully curved, with adnate adcauline part slightly longer than free part. Hydrotheca curving away from internode; hydrothecal aperture perfectly circular and almost parallel with long axis of internode, in some hydrothecae slightly

tilted in adcauline direction; rim slightly but distinctly everted (fig. 19a). Usually one or two renovations visible. Perisarc of internodes quite firm, on hydrothecae thicker on abcauline than on adcauline side, but generally less thick than on internodes, as was inferred also from the fact that several hydrothecae had collapsed.

Distribution. – Widely distributed in the seas of the East Indies, being recorded by Pictet (1893, as *Sertularia tubitheca*), Von Campenhausen (1896b, as *S. tubitheca*), Billard (1925a, 1925b), and Vervoort (1946a). Leloup (1937b) recorded the species from the Bay of Nha Trang, Viet-Nam and Pennycuik (1959) gave as localities Wilson and Heron Islands of the Great Barrier Reef, Australia. Finally Gravier-Bonnet (1979) mentioned the species from Madagascar, where it was obtained between 185 and 250 m. Various authors recording *Synthecium tubithecum* (Allman, 1877) from the Pacific may have confused this mainly Atlantic species with the present one. It seems likely, therefore, that the distribution of *S. megathecum* in the Pacific is wider than appears from the present records.

Remarks. – Because of the absence of gonothecae the identification of the John Murray specimens is tentative, though the large hydrothecae strongly indicate *Synthecium megathecum*.

	Seas Malay Archipelago (Billard, 1925b)	Madagascar (Gravier-Bonnet, 1979)	John Murray Exped. Sta. 112
Hydrotheca			
length adnate adcauline wall	610 – 840	730 – 780	710 – 735
length free adcauline wall, including renovations	315 – 545	550 – 700	425 – 530
breadth at rim	230 – 330	330 – 420	250 – 305
distance between apertures of a pair			1200 – 1375
distance across adnate part of a pair			460 – 500
distance between hydrothecal pairs from angle between adnate and free part adcauline wall to bottom next above	280 – 860		390 – 570

Table 15. *Synthecium megathecum*. Measurements in μm.

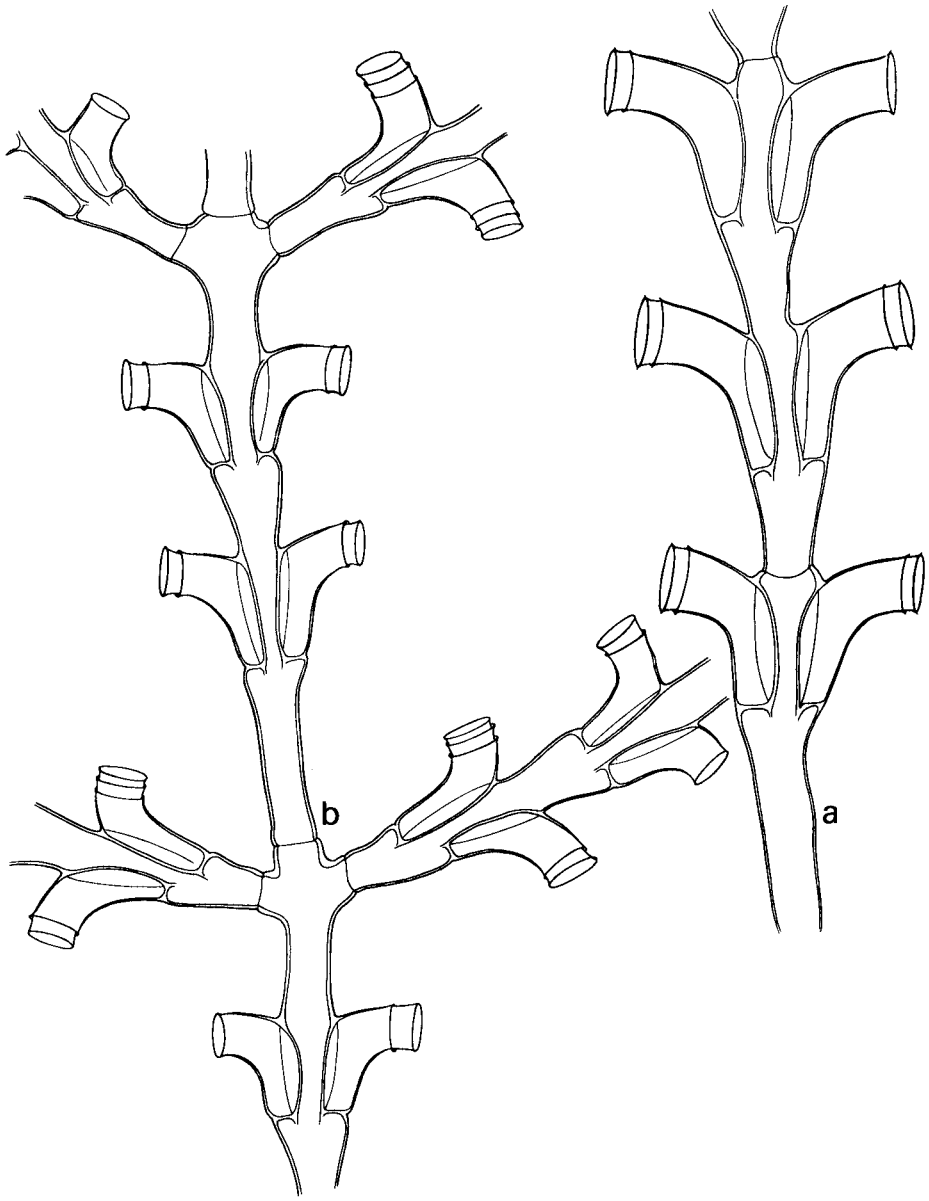


Fig. 18. a, *Synthecium megathecum* Billard, John Murray Exped., Sta. 112, basal part of unbranched stem bearing three pairs of hydrothecae. b, *Synthecium megathecum* Billard var. *parvulum* Billard, John Murray Exped., Sta. 24, part of stem with two pairs of hydrocladia. a, b x 70.

Synthecium megathecum Billard, 1925a var. **parvulum** Billard, 1925b (figs. 18b, 19b, tab. 16)

Synthecium megathecum var. *parvulum* Billard, 1925b: 132.

Material examined. – Sta. 24. Two colonies, 10 and 15 mm high, each composed of main stem and opposite hydrocladia; no gonothecae (BMNH 1984.1.1.28, alc. + sld. ; RMNH 16531, sld.).

Description. – The two colonies from Sta. 24 generally resemble *Synthecium megathecum* as described above (Stations 111 and 112). They differ in two respects: First, the hydrothecae, though identical in shape and structure, are smaller, as the measurements distinctly show. Second, the colonies from Sta. 24 apparently are slightly older, since the stems bear opposite pairs of hydrocladia (fig. 18b).

Stems detached from substratum, without basal internodes; rest of stem divided into internodes separated by transverse nodes, each bearing two pairs of opposite hydrothecae and an apical pair of apophyses, supporting hydrocladia. Hydrocladia also divided into internodes with one to three pairs of hydrothecae; nodes transverse and occasionally developed as hinge joint (fig. 19b). Hydrothecae on stems and hydrocladia identical. Hydrothecae of first pair on hydrocladia not strictly opposite, with upper (basal) hydrotheca at times slightly smaller than its opposite member. No gonothecae seen.

	Siboga Exped. Sta. 225, near Lucipara Islands (Billard, 1925b)	John Murray Exped. Sta. 24
Hydrotheca		
length adnate adcauline wall	510 – 610	460 – 505
length free adcauline wall, including renovations	365 – 430	320 – 405
breadth at rim	215 – 250	190 – 215
distance between apertures of a pair		815 – 995
distance across adnate part of a pair		320 – 375
distance between hydrothecal pairs from angle between adnate and free part adcauline wall to bottom next above	300 – 365	355 – 375

Table 16. *Synthecium megathecum* var. *parvulum*. Measurements in μm.

Distribution. – The only previous record, that from the Siboga Expedition, was in the vicinity of the Lucipara Islands (Kepulauan Lucipara), Malay Archipelago (Siboga Exped., Sta. 225), where this variety was obtained at 894 m. The present record is from 73 to 200 m in the Gulf of Aden.

Remarks. – The specimens resemble Billard's description of this variety,

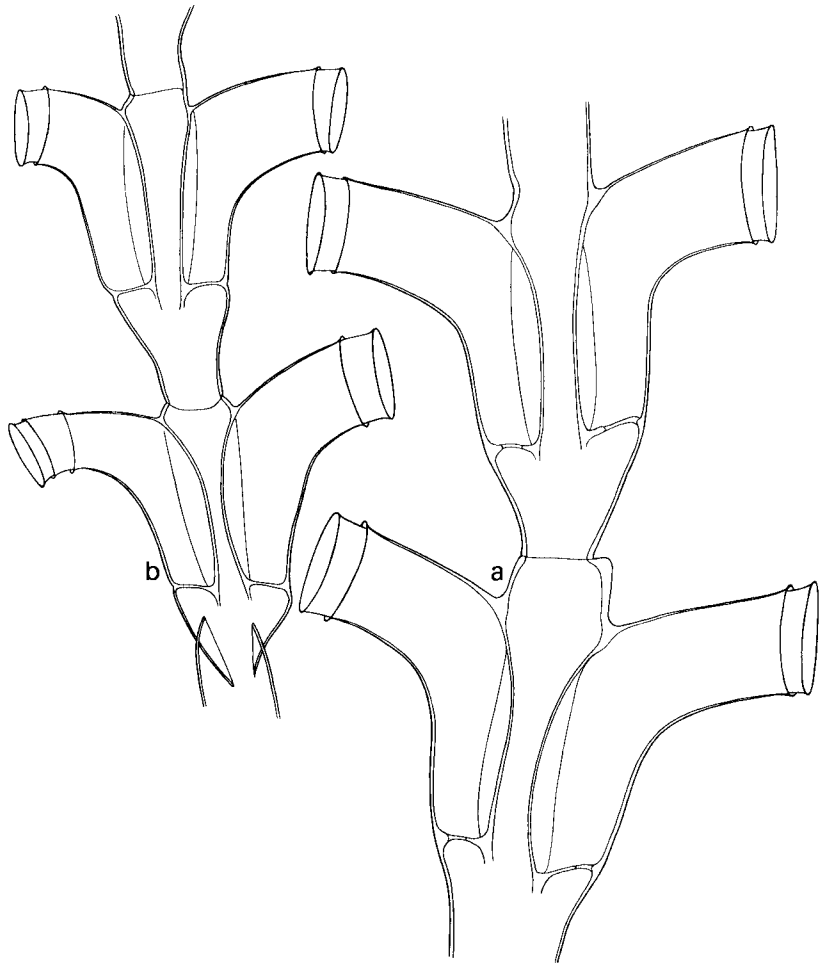


Fig. 19. a, *Synthecium megathecum* Billard, John Murray Exped., Sta. 112, two pairs of hydrothecae from unbranched stem. b, *Synthecium megathecum* Billard var. *parvulum* Billard, John Murray Exped., Sta. 24, two pairs of hydrothecae from hydrocladium. a, b x 50.

being slightly smaller even than those obtained by the Siboga Expedition. However, there is such complete conformity with the nominate form – except in size – that the identity of the present material can scarcely be doubted.

Family Sertulariidae Hincks, 1868

Dynamena crisioides Lamouroux, 1826

Dynamena crisioides Lamouroux, 1826: 613-614, pl. 90 figs. 11-12; Billard, 1925a: 651-652; Billard 1925b: 181-185, text-figs. 36-37, pl. 7 fig. 21; Briggs & Gardner, 1931: 190-191; Billard, 1933: 14; Dollfus, 1933: 128; Leloup, 1935a: 41-43; Blackburn, 1937b: 172-173; Leloup, 1937b: 36-37; Vervoort, 1941: 209-210; Yamada, 1958: 56-57, fig. 2; Leloup, 1960: 228; Van Gemerden-Hoogeveen, 1965: 21-24, fig. 6; Mammen, 1965: 51-52, figs. 84-85; Redier, 1966: 85-86; Vervoort, 1968: 38-41, 103, fig. 18; Millard & Bouillon, 1974: 32, fig. 6D; Rho & Chang, 1974: 135, 141; Millard, 1975: 263-265, fig. 87A-F; Cooke, 1976: 93, 95, fig. 20; Hirohito, 1977: 20-21, fig. 5; Rho, 1977: 271-272, 422, pl. 65, pl. 86 fig. 85; Vervoort & Vasseur, 1977: 35-36; Millard, 1978: 191, Millard, 1980: 131.

Dynamena tubuliformis Marktanner-Turneretscher, 1890: 238-239, pl. 4 fig. 10; Nutting, 1904: 70 pl. 11 figs. 1-8; Jäderholm, 1919: 15.

Dynamena crisioides crisioides Vervoort, 1967: 38-40, fig. 10.

Dynamena crisoides Van Praët, 1979: 888, fig. 33 (lapsus).

Material examined. – Sta. 37. A single fragment comprising a stem 3 mm long with a single hydrocladium of two internodes with 3 and 4 pairs of opposite hydrothecae, respectively (BMNH 1984.1.1.29, sld.).

Distribution. – This was discussed at some length by Billard (1925b), Leloup (1935) and Van Gemerden-Hoogeveen (1965). The species occurs over the whole of the tropical and subtropical Indian, Pacific, and Atlantic Oceans, usually in shallow waters.

Remarks. – The synonymy given above is incomplete. The fragmentary material, in a microslide preparation, will not be described in detail here. The considerable variation of this species has been discussed by Mammen (1965), Millard & Bouillon (1974) and particularly Millard (1975).

Salacia tetracythara Lamouroux, 1816
(fig. 6d)

Salacia tetracythara Lamouroux, 1816: 214, fig. 3a, B, C; Lamouroux, 1821: 15, pl. 67 figs. 7, 9 (*S. tetracyttara*, lapsus); Stechow, 1913b: 30; Stechow, 1922: 150; Stechow, 1923d: 214; Billard, 1924: 54, 55, 66; Billard, 1925b: 202-204, fig. 47, pl. 8 figs. 27-28; Dawydoff, 1952: 55; Pennycuik, 1959: 194; Mammen, 1965: 54, fig. 87; Redier, 1966: 81-82; Van Praët, 1979: 891-892, fig. 61.

Thuiaria fenestrata Bale, 1884: 116-119, pl. 7 fig. 7, pl. 9 fig. 14; Bale, 1888: 772, 773; Kirkpatrick, 1890b: 604; Bale, 1894: 103, pl. 4 fig. 2; Nutting, 1905: 934, 950; Thornely, 1916: 149.

Calyptothuiaria opposita Von Campenhausen, 1896b: 312-313, pl. 15 fig. 7.

Thuiaria tetracythara: Billard, 1909: 319-320; Leloup, 1937b: 5, 44.

Material examined. – Sta. 24. One stem 35 mm high, bearing hydrocladia with a spread of 20 mm. No gonothecae. Stem and hydrocladia overgrown by stolon of *Hebella scandens* var. *contorta*

Marktanner-Turneretscher. Some hydranths present (BMNH 1984.1.1.12, alc. + 3 slds; RMNH 16516, 3 slds).

Distribution. – This species is restricted to the tropical Indo-Pacific and parts of the subtropical regions. It was originally described from Australia (Lamouroux, 1816, 1821), where it was subsequently found near the Cumberland Islands, off Queensland (Busk, 1852, as *Thuiaria crisioides*, see Billard, 1925b: 204), in Albany Passage and near Port Curtis (Bale, 1884, as *T. fenestrata*; Pennycuik, 1959), in Moreton Bay and near Port Phillip (Bale, 1888, as *T. fenestrata*), and near the Murray Islands, Torres Strait (Kirkpatrick, 1890b, as *T. fenestrata*). Further records range from Hawaii (Nutting, 1905, as *T. fenestrata*) to Madagascar (Majunga, Billard, 1925b), including Ile les Pins, New Caledonia (Redier, 1966), various localities in the Malay Archipelago (Von Campenhausen, 1896b, as *Calyptothuiaria opposita*, and Billard, 1925b), Viet-Nam (Leloup, 1937b; Dawydoff, 1952), off Trivandrum, India (Mammen, 1965), and Okhamandal, Kathiawar, on the Arabian Sea coast (Thornely, 1916), this last locality being nearest to the John Murray record off Cape Guardafui in the Gulf of Aden. The depth records of this species range from c. 10 m down to at least 450 m (Billard, 1925b).

Remarks. – The fragmentary material will not be described in detail. It resembles closely Billard's description (1925b) of this distinctive species. Though the division of the stem into internodes is quite distinct there is only seldom such a division of the hydrocladia, some of which terminate in a tendril. The whole stem and its hydrocladia are covered by completely encircling stolonal fibres of *Hebella scandens* var. *contorta* Marktanner-Turneretscher, 1890 (fig. 6d).

Sertularella dubia Billard, 1907
(figs. 20, 21a-c, tab. 17)

Sertularella dubia Billard, 1907c: 344-346, text-fig. 3, pl. 25 fig. 1; Millard, 1975: 285, 287; Van Praët, 1979: 895, fig. 45.

Sertularella dubia var. *magna* Millard, 1958: 189-190, fig. 7A; Millard, 1979: 144.

Sertularella dubia magna: Millard, 1964: 41-42, fig. 14A-F; Millard, 1968: 269; Millard, 1975: 287, fig. 94A-F; Millard, 1978: 197; Gravier-Bonnet, 1979: 46-49, fig. 8B-D; Millard, 1980: 132.

Material examined. – Sta. 24. Two slightly polysiphonic colonies about 30 mm high and some smaller, monosiphonic colonies rising from stolon on shell fragment, together with *Stephanoscyphus* sp. (Scyphozoa). No gonothecae (BMNH 1984.1.1.30, alc. + sld.; RMNH 16532, sld.).

Sta. 45. Two hydrocauli about 15 mm long, one partly polysiphonic. No gonothecae (BMNH 1984.1.1.31, sld.).

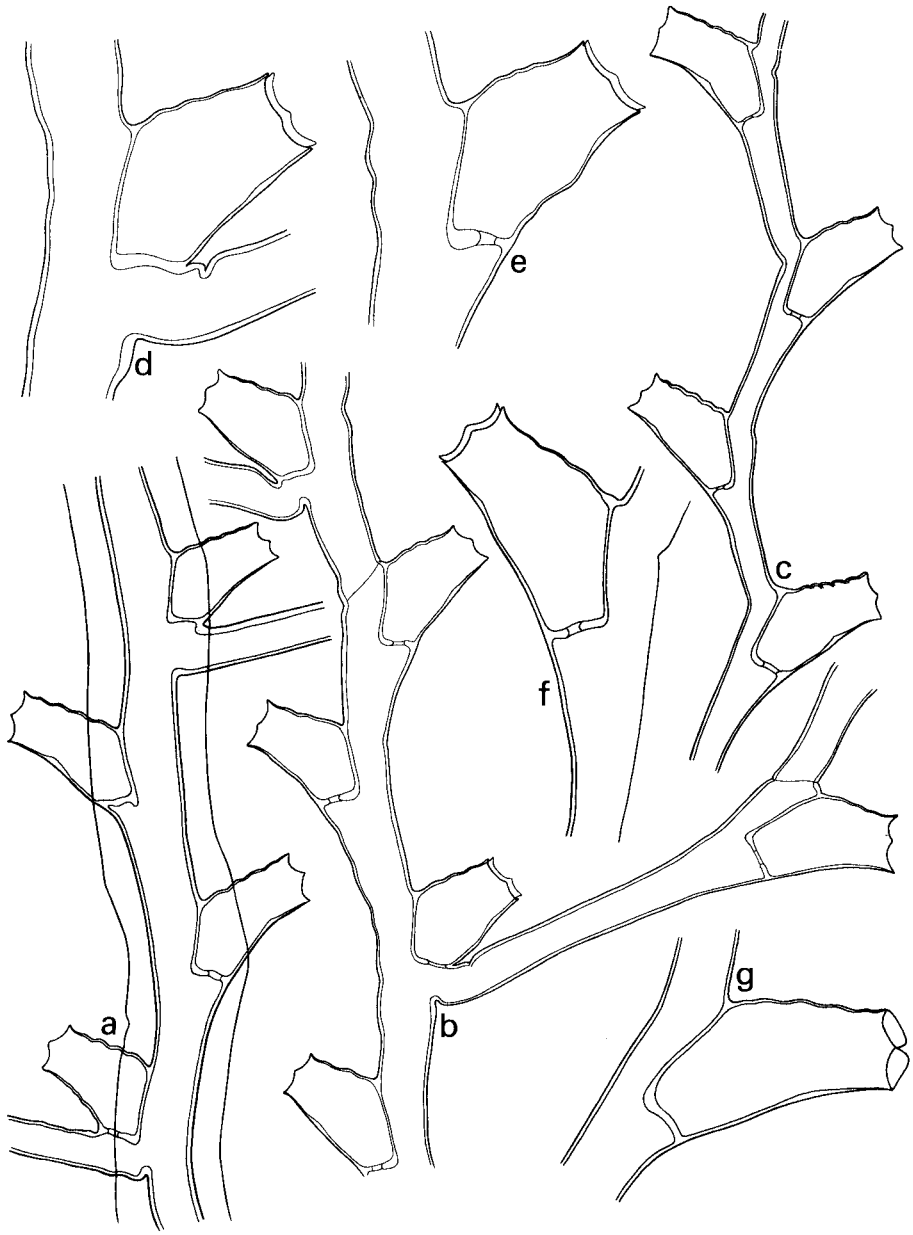


Fig. 20. *Sertularella dubia* Billard, John Murray Exped., Sta. 24. a, part of stem with insertion of two hydrocladia; b, monosiphonic part of stem with insertion of two hydrocladia; c, distal part of stem; d, axillary stem hydrotheca; e-g, hydrothecae. a-c x 30; d-f x 55.

	Madagascar (Billard, 1907c)	Off Natal, S. Africa, (holotype of *S. dubia magna*) (Millard, 1958)	Madagascar (Gravier-Bonnet, 1979, as *S. dubia magna*)	John Murray Exped. Sta. 24, large colony	John Murray Exped. Sta. 24, small colony	John Murray Exped. Sta. 45,
Internode						
length		580 – 720		600 – 800	700 – 800	500 – 600
diameter across node	160 – 210	220 – 380	190 – 230	600 – 800	700 – 800	500 – 600
Hydrotheca						
length abcauline wall	385 – 420	500 – 610	440 – 540	120 – 140	180 – 200	180 – 200
length free adcauline wall	230 – 280	400 – 490	270 – 330	300 – 340	280 – 300	250 – 265
length adnate adcauline wall	260 – 350	370 – 450	390 – 420	260 – 300	280 – 300	250 – 265
depth			520 – 600	500 – 600	480 – 520	490 – 510
diameter at rim	175 – 210	250 – 290	180 – 200			
maximum diameter		340 – 380	250 – 300	260 – 280	260 – 280	260 – 280

Table 17. *Sertularella dubia*. Measurements in μm.

Description. – The following is a general description of the material. Hydrocauli (stems) unbranched, moderately stiff, indistinctly divided into internodes each bearing one hydrotheca; nodes usually marked by perisarcal constrictions, occasionally by oblique septa. Hydrothecae alternate, usually in one plane, in some colonies turned slightly frontally. Hydrocladia springing from bases of stem hydrothecae thus becoming axillary; usually three hydrothecae between each pair of (alternate) hydrocladia (fig. 20a). Arrangement of hydrothecae along hydrocladia as in stems; septa only occasionally present in nodes. First internode of each hydrocladium 1.5-2 times longer than remaining internodes of that hydrocladium. Shape of hydrothecae can best be judged from figs. 20 and 21a-c. Hydrotheca of medium size, diverging from internode at angle of c. 60°, moderately swollen basally. Development of basal swelling and of corrugations of ad- and abcauline walls, and plane of aperture, all varied. Usually wall of internode continuing smoothly in almost straight abcauline hydrothecal wall, invariably curved slightly outwards just under rim of hydrotheca, forming lower marginal cusp (fig. 20f). Distinct internal thickening of abcauline wall at about two-thirds from base always present, but only just visible in young hydrothecae. Some hydrothecae with slightly concave abcauline wall. Adcauline wall usually distinctly convex because of hydrothecal swelling (fig. 20e); occasionally, however, almost smooth. Four to six undulations present, occasionally seen to continue on hydrothecal walls as distinct grooves, petering out towards abcauline wall (fig. 21a-c). Free adcauline wall usually slightly longer than adnate part. Hydrothecal rim produced into four distinct, slightly flared marginal cusps; rim not thickened, embayments between cusps rounded and shallow; renovations occasionally present (fig. 20f). Closing apparatus composed of four hyaline, more or less triangular, flaps, forming low roof when closed (fig. 20g). Hydrothecal aperture usually perpendicular to length axis of theca or, as a result of stronger development of adcauline marginal cusp, slightly tilted in adcauline direction.

Perisarc firm though not particularly thick; yellowish brown on stems.

Distribution. – *Sertularella dubia* was originally described from Macalonga, Madagascar, 22 m (type locality; Billard, 1907c). Additional specimens from the Madagascar area (off Fort Dauphin, 25° 13′ 01″ S, 47°17′ 08″ E, 105-115 m) were recorded by Gravier-Bonnet (1979, as *S. dubia magna*). Millard (1975, 1978) recorded *S. dubia magna* from the False Bay area to northern Natal with a depth distribution of 27 to 232 m, and suggested that this subspecies is endemic to South Africa. The present records extend the known distribution north to the Gulf of Aden and the northern Arabian Sea, indicating a wider range than South African waters.

Remarks. – We have tentatively identified the John Murray material with Billard's *Sertularella dubia* on account of its general resemblance in the structure of the colonies, the general shape of the hydrothecae, and the presence, in the John Murray material, of a distinct perisarcal thickening of the abcauline hydrothecal wall, proposed by Billard as one of the characteristics of the species. In the present material the hydrothecae generally have well developed undulations along the free part of the adcauline wall. Hydrothecae as figured by Billard (1907c, fig. 3B) are also present. Both Billard's material and the John Murray colonies are sterile. Millard (1958, 1964, 1975, as *Sertularella dubia* var. *magna*, later on raised to subspecific rank as *S. dubia magna*) described South African material which in colony structure and size of the hydrothecae was firmer and larger than Billard's original Madagascar colonies. The gonothecae of the material described by Millard differed from those of *Sertularella gayi* (Lamouroux, 1821) – which *S. dubia* resembles – by the presence of a number of well developed cusps around the gonothecal aperture, only two being present in *S. gayi*. Additional Madagascar colonies were described by Gravier-Bonnet (1979: 46, fig. 8B-D, as *Sertularella dubia magna*), this material being sterile.

The John Murray material resembles closely Gravier-Bonnet's specimens, but it is smaller in all respects. In measurements Gravier-Bonnet's material is intermediate between the John Murray colonies and those described by Millard as a separate subspecies. Since the gap in size between Billard's specimens and those recorded by Millard is now bridged by the John Murray material and that described by Gravier-Bonnet, we are inclined to refer Millard's subspecies to the nominate species (see table 17). The available figures of *Sertularella dubia* show it to be at least as varied as *Sertularella gayi* (Lamouroux) and the two might prove conspecific.

Sertularella whitei sp. nov.
(figs. 21d-e, tab. 18)

Material examined. – Sta. 54. Five straggling, monosiphonic stems and some fragments. A stem 25 mm high, preserved in a microslide preparation, is designated holotype. The remaining colonies are paratypes (BMNH 1984.1.1.32, holotype, sld.; 1984.1.1.33, paratypes, alc.; RMNH 16533, paratype, 2 slds).

Description. – The following is based mainly on the holotype. Colonies up to 40 mm (holotype 25 mm), monosiphonic, flexible. Stems geniculate, broken up into long, slender internodes, narrowed basally, increasing in diameter distally, separated by distinct nodes and thin septa (fig. 21d). Hydrothecae

almost at end of each internode, alternate ones directed left and right, in one plane, the following internode springing from scarcely indicated apophysis next to hydrotheca. Branching of colonies exclusively by hydrocladia springing from internode just under hydrotheca; where two successive but alternately directed hydrocladia are present there are three hydrothecae between that pair of hydrocladia, including axillary hydrotheca. First internode of hydrocladia of increased length; structure of remaining internodes as in stems.

Hydrotheca large and slender, almost tubular, slightly curving away from (following) internode, long axis making angle of c. 30° with that of internode (fig. 21e). Abcauline hydrothecal wall almost straight or very weakly concave; free adcauline wall fully four times as long as adnate part, distinctly convex in basal third. There hydrotheca reaches maximum diameter. Hydrothecal margin with four acute marginal cusps, separated by round embayments and supporting four triangular flaps that close to form low roof-shaped operculum.

	John Murray Exped. Sta. 54
Hydrocaulus	
greatest diameter at base	350
Stem internode	
length	1400 – 1500
diameter at node	160 – 170
Hydrotheca	
length abcauline wall	775 – 800
length free adcauline wall	760 – 820
length fused adcauline wall	220 – 245
depth	880 – 900
maximum diameter	320 – 345
diameter at rim	300 – 325

Table 18. *Sertularella whitei*. Measurements in μm.

Opercular flaps deciduous. Hydrothecal margin slightly thickened, rarely renovated.

Perisarc firm but not conspiciously thick on internodes, very thin on hydrotheca, which collapses easily.

No gonothecae have been observed and no perisarcal holes, where a gonotheca could have originated, were noticed.

Remnants of tissue present, but no well preserved hydranths seen.

Remarks. – We could not identify the present colonies with any of the described species of *Sertularella* (in restricted sense, i.e. including only those species with four marginal hydrothecal cusps). It has a certain similarity with Millard's specimens of *Symplectoscyphus paulensis* Stechow, 1923c (Millard,

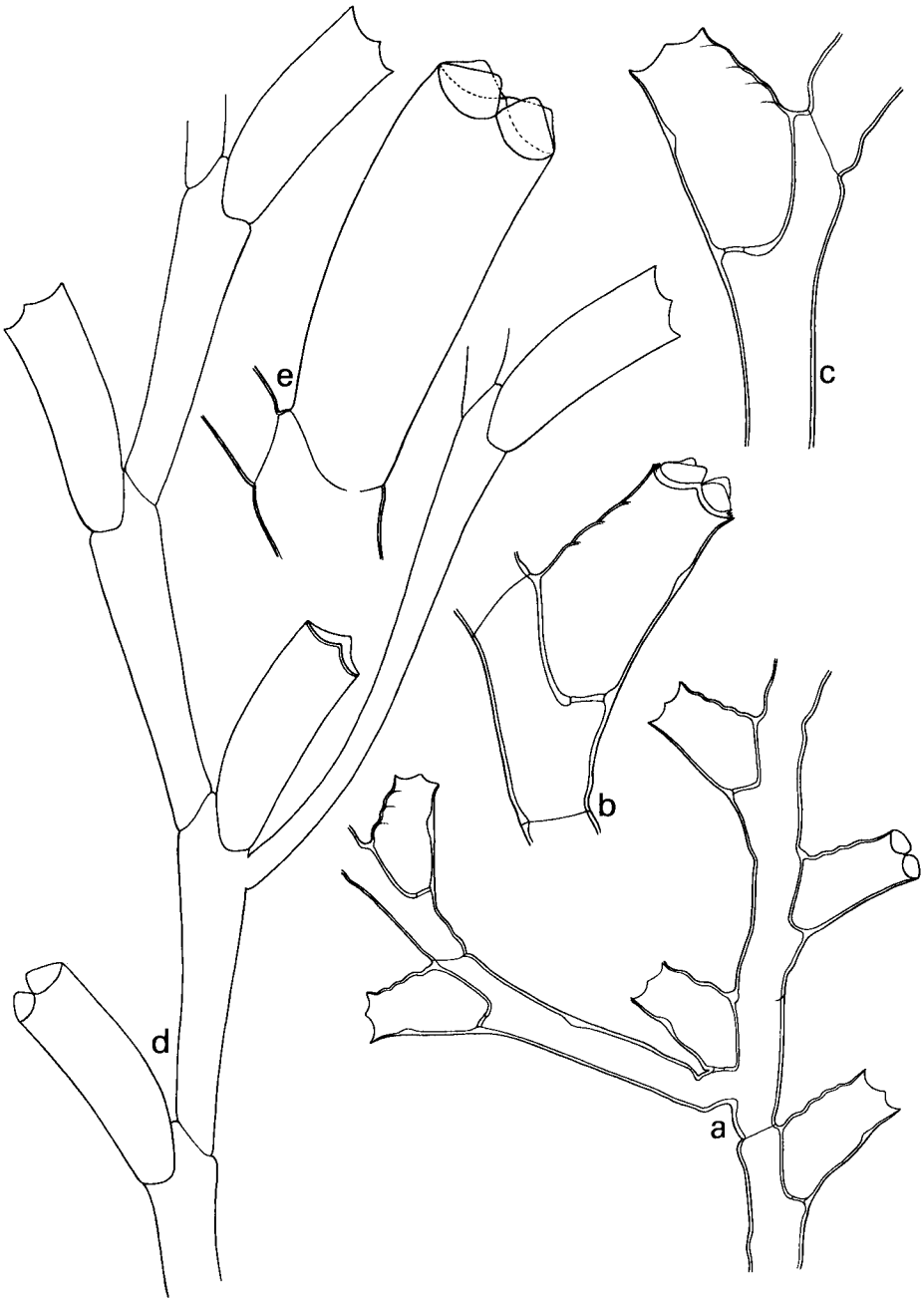


Fig. 21. a-c, *Sertularella dubia* Billard, John Murray Exped., Sta. 45. a, part of stem with hydrocladium; b, c, hydrothecae. d, e, *Sertularella whitei* sp. nov., holotype, John Murray Exped., Sta. 54. d, part of stem with hydrocladium; e, stem hydrotheca. a, d x 30; b, c, e x 55.

1975: 317-319, fig. 102A-C), though in this species of *Symplectoscyphus* the proportional lengths of adnate and free adcauline hydrothecal wall are 1: 2 (1: 4 in the present new species) and as in other species in that nominal genus there are three hydrothecal cusps. We believe the present material to have been young, basing this opinion mainly on the absence of holes in the internodes that usually mark the presence of gonothecae in *Sertularella* and *Symplectoscyphus*.

Etymology. – The specific name *whitei* is a tribute to Mr E. White, British Museum (Natural History), London. Mr White, born 1 March 1904, entered the BMNH on 1 January 1922 as a technical assistant in the Department of Zoology. In the period 10 May 1941 till 30 November 1945 he served with the Royal Air Force. He retired on 31 May 1964, having worked as a senior experimental officer in the Coelenterate Section for many years.

Sertularia turbinata (Lamouroux, 1816)
(fig. 22, tab. 19)

Dynamena turbinata Lamouroux, 1816: 180; Van Praët, 1979: 890, fig. 60d.
Sertularia loculosa Busk, 1852: 393-394; Bale, 1884: 91-92, pl. 4 figs. 5-6, pl. 9 fig. 12, pl. 19 fig. 9; Warren, 1908: 306-308, text-fig. 8, pl. 48 fig. 47; Bale, 1913: 121-124, pl. 12 figs. 7-8; Warren, 1919: 122, fig. 9; Jarvis, 1922: 340; Vannucci, 1946: 564-565, pl. 4 fig. 35; Hodgson, 1950: 25-26, figs. 43-44; Pennycuik, 1959: 197.
Desmoscyphus brevicyathus Versluys, 1899: 40-42, figs. 9-10.
Sertularia brevicyathus: Nutting, 1904: 60, pl. 6 figs. 1-2; Congdon, 1907: 481; Jarvis, 1922: 338, pl. 24 fig. 6.
Sertularia turbinata: Billard, 1909: 322; Bale, 1913: 124-125, pl. 12 fig. 6; Stechow, 1913b: 13, 145-146, figs. 119-120; Billard, 1925b: 177-178, fig. 34; Leloup, 1935a: 50-51; Leloup, 1937a: 106, 117; Vannucci, 1949: 244-245, pl. 2 figs. 38-41; Millard, 1958: 197-199, fig. 8B; Vervoort, 1959: 275-277, figs. 35-36; Yamada, 1959: 70; Millard, 1964: 49; Mammen, 1965: 46-47, figs. 78-81; Van Gemerden-Hoogeveen, 1965: 38-39; Vervoort, 1968: 52-54, 107, fig. 25; Millard & Bouillon, 1973: 76, fig. 9H; Millard & Bouillon, 1974: 8; Millard, 1975: 312-313, fig. 100B-C, E; Vervoort & Vasseur, 1977: 60-64, figs. 26-27; Millard, 1978: 198; Garcia Corrales, Aguirre Inchaurbe & Gonzáles Mora, 1980: 57-60, fig. 19; Hirohito, 1983: 50, fig. 22.
Tridentata acuta Stechow, 1921e: 231; Stechow, 1923d: 206-207.
Tridentata turbinata: Stechow, 1923b: 15; Stechow, 1923d: 205; Stechow, 1925a: 232-234, fig. L.
?Sertularia borneensis Billard, 1925a: 649, fig. 1D; Billard, 1925b: 171-173, fig. 31.
Sertularia restricta Totton, 1930: 205.
Sertularia acuta: Millard, 1958: 192-193, fig. 8A, F.

Material examined. – Sta. 45. Several unbranched stems, up to 7 mm high, rising from stolon. No gonothecae (BMNH 1984.1.1.34, alc. + sld.; RMNH 16534, sld.).

Description. – The present material is rather poor and will not be described in detail. The short stems rise directly from the stolon; basally there is a short apophysis separated from the rest of the stem by an oblique joint. Hydrocauli

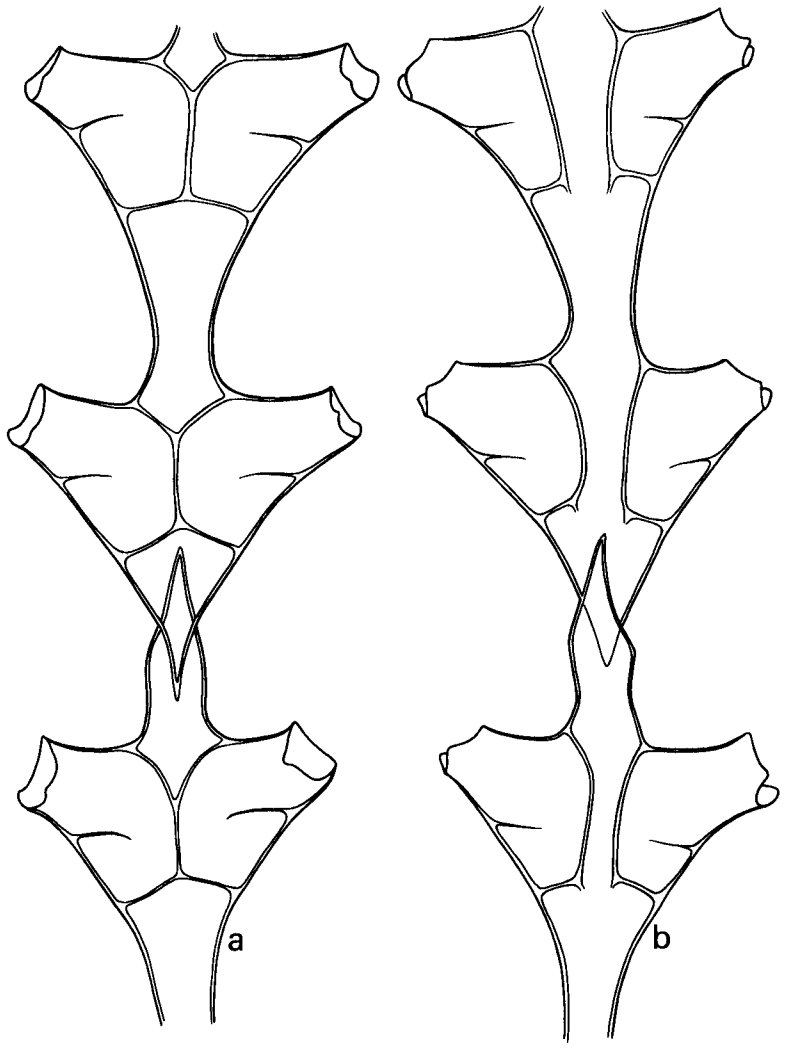


Fig. 22. *Sertularia turbinata* (Lamouroux), John Murray Exped., Sta. 45. a, part of stem, frontal view; b, part of stem, dorsal (rear) view. a, b x 75.

broken up into internodes separated either by weak, straight nodes or by oblique joints: the latter are prominent. Hydrothecae in opposite pairs, usually one pair per internode, though nodes sometimes hard to discriminate. Each pair placed on frontal part of each internode, touching frontally (fig. 22a) and on the reverse side separated (fig. 22b). Hydrothecae pointing laterally and obliquely upwards, free parts of the adcauline walls of each pair more or less in

one line. Each hydrotheca with distinct abcauline septum projecting into interior of theca; position of septum slightly oblique. Hydrothecal margin slightly thickened, with two prominent lateral cusps and a small adcauline cusp formed by upturned end of adcauline wall. No abcauline cusp or thickening. On back hydrothecal base produced into small peridermal notch or thickening (fig. 22b).

None of inspected hydrothecae with operculum complete, nor hydranths present.

	John Murray Exped. Sta. 45
Hydrotheca	
length abcauline wall	225 – 250
length adnate adcauline wall	250 – 255
length free adcauline wall	175 – 190
breadth at rim	115 – 125
maximum diameter	190 – 200
diameter across pair (including cusps)	600 – 645

Table 19. *Sertularia turbinata*. Measurements in μm.

Distribution. – *Sertularia turbinata* is widely distributed in tropical and subtropical parts of the Atlantic, Indian and Pacific Oceans. The variation of this species over this large area is considerable. The extremes, distinguished as *Sertularia turbinata* f. *turbinata* (Lamouroux, 1816) and *S. turbinata* f. *acuta* (Stechow, 1921e) are linked by intermediates.

Remarks. – The synonymy presented above is largely based on Millard (1975) and Vervoort & Vasseur (1977). We have also followed Millard's views concerning the variation of the present species. The John Murray material, though in poor shape, resembles most closely forma *acuta* (Stechow, 1921e), which Millard (1975: 313) held distinct.

Family Plumulariidae Hincks, 1868

Subfamily Halopterinae Millard, 1962

Antennella secundaria (Gmelin, 1789)
(fig. 23a, b, tab. 20)

Sertularia secundaria Gmelin, 1789: 3845.
Plumularia secundaria: Pictet, 1893: 53-54, pl. 2 fig. 26; Schneider, 1897: 487, 540; Blackburn, 1938: 316.

Antennella secundaria: Stechow, 1907: 199; Stechow, 1909: 84-85; Billard, 1913: 8, text-fig. 1, pl. 1 figs. 1-3; Stechow, 1913b: 9, 89; Bedot, 1917a: 124; Neppi, 1917: 54; Jäderholm, 1919: 20; Stechow, 1919: 111-112; Bedot, 1921b: 5; Stechow & Müller, 1923: 473; Billard, 1927: 342; Leloup, 1940b: 21; Deevey, 1954: 271; Millard, 1958: 199; Yamada, 1958: 59-60; Pennycuik, 1959: 176-177, pl. 3 figs. 4-5; Rees & Thursfield, 1965: 158; Van Gemerden Hoogeveen, 1965: 54-56, figs. 29-31; Von Schenck, 1965: 895, 926, fig. 2b; Rees & White, 1966: 279; Mammen, 1967: 296-298, fig. 93; Vervoort, 1967: 42-45, fig. 12; Millard, 1968: 273; Vervoort, 1968: 107; Fey, 1970: 402; Rho & Chang, 1972: 100-101; Millard & Bouillon, 1973: 77-78, fig. 10E; Hirohito, 1974: 28-29, fig. 12; Michel, 1974: 210; Millard & Bouillon, 1974: 8; Rho & Chang, 1974: 135, 146; Millard, 1975: 332-334, fig. 107F-L; Mergner & Wedler, 1977: 22, pl. 5 fig. 31a-b; Rho, 1977: 275-276, 423-424, pl. 90 fig. 89; Vervoort & Vasseur, 1977: 64-68, fig. 28; Millard, 1978: 188; Gravier-Bonnet, 1979: 56-58, fig. 11A-B; Millard, 1980: 132; Boero, 1981: 182; Hirohito, 1983: 58.

Antennella natalensis Warren, 1908: 318-320, fig. 14.

Antenella secundaria: Ritchie, 1910a: 14-15; Ritchie, 1910b: 802, 822; Jarvis, 1922: 349; Stechow, 1923d: 222; Stechow, 1925b: 493-494; Broch, 1933: 19-23, fig. 7; Leloup, 1934: 15; Leloup, 1935a: 53-54; Leloup, 1937b: 5, 45-46; Leloup, 1938: 18-20, fig. 13; Riedl, 1959: 653; Yamada, 1959: 9, 77; Hirohito, 1969: 24; Patriti, 1970: 57, fig. 81; Schmidt, 1973: 283; Gili i Sardà, 1982: 79, fig. 38A.

Plumularia dubiaformis Mulder & Trebilcock, 1911: 119, pl. 2 fig. 7.

Schizotricha secundaria: Blackburn, 1942: 108.

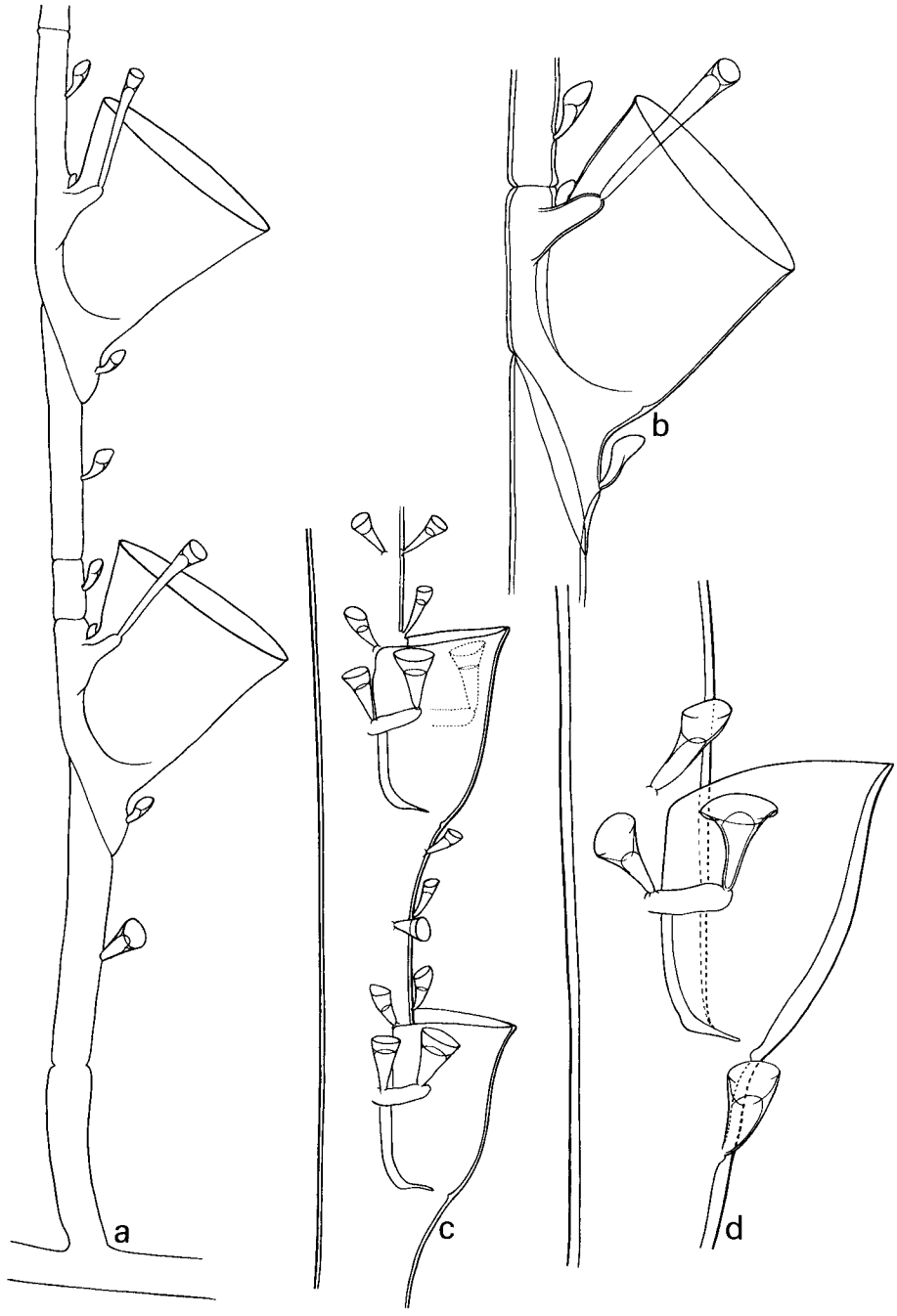
Polyplumaria secundaria: Picard, 1955: 189; Picard, 1958: 192.

Antennella secundaria dubiaformis: Watson, 1973: 183, figs. 45-46.

Material examined. – Sta. 112. Many stems 8-10 mm high rising from stolon epizoic on *Synthecium* sp. No gonothecae (BMNH 1984.1.1.35, alc. + sld.; RMNH 16535, alc. + sld.).

Description. – Stems rise from thin, creeping stolon by fairly long apophyses; first internode athecate, with one or two frontal nematothecae, straight basal node and oblique distal hinge joint with which it articulates with first hydrothecate internode (fig. 23a). Stems mainly heteromerously segmented, but division between hydrothecate internode and following intermediate segment at times indistinct or with extra straight node. Hydrothecate internodes basally with oblique, distally with straight, septum (if an intermediate internode is indeed present) or with distal oblique node if fusion between hydrothecate and following intermediate segment has taken place. Hydrothecate internode with large, distinctly flared hydrotheca, almost immobile infracalycine nematotheca, paired flanking nematothecae and reduced nematotheca behind free part of adcauline hydrothecal wall (fig. 23b). Infracalycine nematothecae slightly varied in size, two-chambered, adcauline wall deeply scooped out.

Fig. 23. a, b, *Antennella secundaria* (Gmelin), John Murray Exped., Sta. 112. a, basal part of stem at insertion on stolon; b, hydrotheca from (thecate) stem internode. c, d, *Antennella varians* (Billard), John Murray Exped., Sta. 111. c, portion of stem showing two hydrothecae; d, stem hydrotheca. a, c x 85; b, d x 135.


a
b
c
d

Flanking nematothecae placed on pair of conspicuous apophyses that curve dorsally around hydrotheca; nematothecae elongate, trumpet shaped, reaching beyond hydrothecal rim by about half their length, with small apical chamber and circular rim (fig. 23a, b). Nematotheca behind hydrotheca minute, scale shaped, apparently comprising single small chamber; nematophore large, obscuring structure of nematotheca. Hydrothecal rim circular or slightly scooped out.

Intermediate internode with two movable nematothecae, comparable in structure with infracalycine nematotheca, sometimes placed on two separate internodes.

Perisarc thin, firmest on basal parts of stem and on stolon.

	Malay Archipelago Siboga Exped. (Billard, 1913)	John Murray Exped. Sta. 112
Stem		
diameter at base		63 – 71
Intermediate internode length	365 – 945	190 – 425
Hydrothecate internode		
length	350 – 400	320 – 410
diameter	70 – 150	55 – 65
Hydrotheca		
depth		205 – 225
length abcauline wall	175 – 270	195 – 215
length free adcauline wall		125 – 140
breadth at rim	200 – 280	220 – 235
Lateral nematotheca		
length		125 – 250
breadth at rim		35 – 50

Table 20. *Antennella secundaria*. Measurements in μm.

Distribution. – *Antennella secundaria* is widespread in shallow parts of tropical, subtropical and temperate oceans throughout the world. It is known to occur at many localities along the shores of the Indian Ocean. Millard (1975) recorded it along the East African coast as far north as Moçambique. The occurrence of the species in the Zanzibar area fits into the general picture of its distribution.

Remarks. – The John Murray specimens have long lateral nematothecae, reaching beyond the hydrothecal border by about half their length. Specimens with such long nematothecae are mentioned by amongst others Billard (1913, eastern part Malay Archipelago, Siboga Exped., Sta. 71, off Makassar; Sta. 133, off Lirung, Salibabu Islands, and Sta. 213, environs of Saleyer) and by Millard (1975, east coast of South Africa). In the present specimen the lateral nematothecae are varied in length; they reach maximum length in the majority

of hydrothecate internodes, whilst in others they are of moderate length.

Antennella varians (Billard, 1911)
(fig. 23c, d, tab. 21)

Plumularia varians Billard, 1911: lxii, fig. 1; Van Praët, 1979: 930, fig. 72.
Antennella varians: Billard, 1913: 11-13, text-fig. 4, pl. 1 figs. 5, 8; Bedot, 1917a: 124; Bedot, 1921b: 5; Hirohito, 1983: 59.
Antenella varians: Ritchie, 1913: 7; Hirohito, 1969: 24-25, fig. 17.

Material examined. – Sta. 111. A small tuft, comprising several stems up to 30 mm high rising from stolonal fibres on a sponge. No gonothecae (BMNH 1984.1.1.36, alc. + 3 slds; RMNH 16536, 2 slds).

Description. – Unbranched hydrocauli arise directly from small, cylindrical apophyses on stolon, from which they are separated by straight nodes. Hydrocauli divided into internodes of greatly varied length, usually separated by straight nodes; septa thin, almost invisible. Division into internodes best seen in basal parts of hydrocauli, increasing in length apically and nodes eventually disappearing altogether (fig. 23c). Internodes in basal parts of colony with single or few hydrothecae; apically number of hydrothecae per internode increasing considerably. Oblique hinge joints only occasionally developed and, if present, between normally developed, straight, nodes in median part of colony.

Hydrotheca deep-campanulate, wholly adnate, abcauline wall distinctly convex and apically curving outwards in most hydrothecae: hydrothecal margin slightly but distinctly everted frontally (fig. 23d). Hydrothecal border straight, perpendicular to long axis of internode, in some thecae slightly convex or, by increased length of abcauline thecal wall, slightly oblique. Subsequent hydrothecae separated by distance equal to or longer than hydrothecal depth; distance between successive hydrothecae diminishing from base to apex. Hydrothecal depth, plane of margin and curvature of the abcauline wall all highly varied.

Nematothecae comprising two pairs of laterals, one pair of marginals, at least one pair of internodal nematothecae and (usually) a single mesial infracalycine. Laterals comprising one pair placed each at end of conspicuous apophysis confluent with hydrothecal wall at about half its height and reaching across half the hydrotheca; nematothecae at end of apophysis just reaching hydrothecal rim (fig. 23d). Base of each apophysis with additional nematotheca, slightly inferior to terminal one. Pair of marginals placed where hydrothecal rim is attached to internode; no apophyses. Distinct pair of internodal

nematothecae half way between two successive hydrothecae. Occasionally mesial nematotheca directly under each hydrotheca. Variations occurs in position of marginals; they may occur some distance from margin. Position of internodal pair also varied. Mesial nematotheca may occasionally be replaced by complete pair. All nematothecae basically tumbler shaped with circular rim, at times slightly flared. All nematothecae two-chambered; upper and lower chambers separated by fine, though quite distinct, diaphragm. Variation occurs in length of nematothecae, and in size of apical chamber. Marginal plane occasionally slightly oblique. Nematothecae at end of the apophyses best developed. Those at base slightly smaller, and those found on internodes smaller still.

Perisarc remarkably firm for such a graceful species, fairly thick along internodal walls and quite conspicuous along frontal wall of some hydrothecae. Here, nevertheless, development of perisarc varied, though most hydrothecae have perisarc about as thick as that of internodes or slightly thinner.

Distribution. – Originally recorded from 13 localities distributed over the eastern part of the Malay Archipelago, the depths records ranging between 16 and 141 m. Hirohito subsequently recorded specimens from various Japanese localities, viz. Tomioka, Amakusa Islands, Hachijojima Island and Sagami

	Malay Archipelago Siboga Exped. (Billard, 1913)	John Murray Exped. Sta. 111
Hydrotheca		
depth	175 – 500	200 – 270
breadth at rim	150 – 310	165 – 205
distance between successive hydrothecae	240 – 460	305 – 460
Nematothecae		
maximum length		85 – 100
breadth at rim		42 – 57

Table 21. *Antennella varians*. Measurements in μm

Bay (Hirohito, 1969, no depth data), and off the west coast of Niijima Island, off Sagami Bay, depth ranging between 50 and 80 m (Hirohito, 1983). The present records extend the known distribution westward towards Zanzibar.

Remarks. – The John Murray specimens resemble closely Billard's (1911, 1913) account of this varied species. Since these descriptions were published additional information has been supplied by Hirohito (1969). The species seems to be even more varied than appears from Billard's account, both in number and insertion of the nematothecae and in the length of nematothecae and hydrothecae. The John Murray specimens resemble the "Siboga" speci-

mens in the presence of a mesial nematotheca under each hydrotheca, allbeit that such a nematotheca is absent in some of the John Murray specimens. In Hirohito's specimens from the Amakusa Islands such mesial nematothecae seem to have been entirely absent. The John Murray specimens are further characterized by the strong development of apophyses for one pair of the lateral nematothecae. These apophyses reach half way across the hydrothecal diameter. The nematotheca placed at the end of each just reaches the hydrothecal border.

Billard seems to have attached particular importance to the presence of a pair of hinge joints in the internode bearing the first hydrotheca. None of our present specimens has such a first thecate internode: hydrothecae occur on basal internodes separated by straight septa and an oblique joint is only occasionally found, usually somewhere along the hydrocaulus.

In our opinion it seems questionable if Billard's *Antennella balei* (= *Plumularia balei* Billard, 1911: lxiii, fig. 3, not *P. balei* Bartlett, 1907: 65, pl. 1) can be held distinct from *Antennella varians*. Three points of difference between the species can be taken from Billard's (1913) detailed descriptions:

1. *A. balei* is said to lack the first hydrothecate internode separated by oblique joints, thought by Billard to be a character exclusive to *A. varians*. Such an internode is absent in the John Murray specimens, nor was it discussed by Hirohito;

2. Two pairs of lateral nematothecae accompanied by a conspicuous apophysis in *A. balei*, reaching almost the frontal part of the hydrotheca. The nematotheca at the end of the apophysis does not reach the hydrothecal border, in fact it is small and said to be less movable than in *A. varians*. The John Murray specimens are intermediate in this respect between the conditions described in *A. varians* and *A. balei*. The apophysis is much longer than is known to occur in *A. varians,* though not so long as in *A. balei*; while the apical pair of nematothecae on those apophyses in our specimens are intermediate in length between those of *A. varians* and *A. balei*;

3. The nematothecal margin in *A. balei* is said to be strongly scooped out. It is perfectly smooth in *A. varians*, in Billard's "Siboga" material, in Hirohito's Japanese colonies and also in the present specimens. Though this character is generally useful in plumularian systematics, it is notoriously varied in certain species.

Halopteris buskii (Bale, 1884)
(figs. 24, 25a, b, tabs. 22-23)

Plumularia buskii Bale, 1884: 125-126, pl. 10 fig. 3, pl. 19 figs. 34-35; Bale, 1887: 94; Thornely,

1904: 118, 120; Bartlett, 1907: 42; Ritchie, 1910c: 827, 830, 832-834; Billard, 1913: 21-23, text-fig. 11, pl. 1 fig. 15; Bale, 1914a: 28-29; Bale, 1915: 296; Thornely, 1916: 150; Briggs, 1918: 34, 42-43; Nutting, 1927: 221-222; Hodgson, 1950: 45-46, fig. 75; Redier, 1966: 90, pl. 2 figs. 1, 4, pl. 3 fig. 1.

Plumularia nuttingi Billard, 1911: lxvi-lxvii, fig. 8; Van Soest, 1976: 89.

Schizotricha buski: Bedot, 1921b: 12; Blackburn, 1942: 107; Mammen, 1967: 303.

Heterotheca buski: Stechow, 1921d: 260; Stechow, 1923a: 15; Hirohito, 1974: 30-32, fig. 14.

Halopteris buskii: Rees & Thursfield, 1965: 160; Watson, 1973: 184; Vervoort & Vasseur, 1977: 72-76, figs. 31c, 32; Hirohito, 1983: 61.

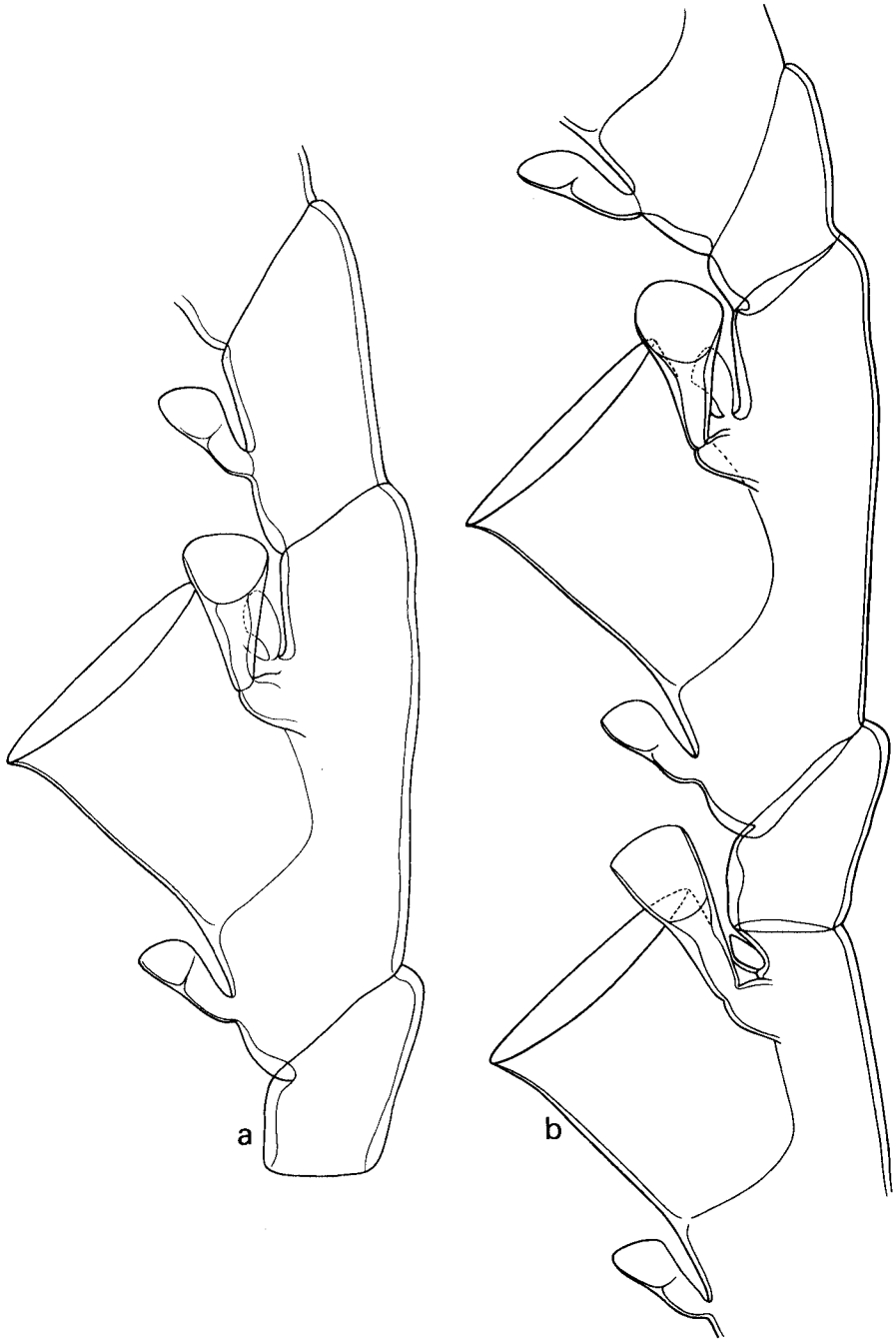
Thecocaulus buski: Von Schenck, 1965: 928.

Material examined. – Sta. 111. One hydrocladium about 30 mm high rising from a stolon. No gonothecae (BMNH 1984.1.1.37, alc. + sld.; RMNH 16537, sld.).

Sta. 112. One plume 40 mm high detached from stolon. No gonothecae (BMNH 1984.1.1.38, alc. + sld.; RMNH 16538, sld.).

Description. – The material from Sta. 112 will be described first (fig. 25a, b). It comprises one monosiphonic stem, about 40 mm high and 0.5 mm thick at the base, bearing hydrothecae and alternate apophyses on frontal aspect. Division of hydrocaulus into internodes only visible in higher parts of stem; here internodes separated by distinct though thin septa, sloping in frontal direction. No hydrothecae in basal part of stem, though here scattered nematothecae present. Stem internodes with a single hydrotheca frontally and apophysis besides hydrotheca; successive apophyses alternately pointing obliquely left and right (fig. 25a). No axillary hydrothecae seen. In addition stem internode with short, stubby nematotheca at base of hydrotheca, one pair of lateral nematothecae placed on distinct apophyses, and pair of nematothecae on free distal part of internode, all directed frontally. Reduced, scale-shaped nematotheca behind hydrotheca. Apophyses short, hydrocladia directed obliquely left and right and gracefully curving backwards. Hydrocladia segmented into hydrothecate internodes, delimited by oblique nodes. Basalmost 1-2 internodes ring shaped and followed by intermediate internode with straight basal and oblique distal nodes, separating it from first hydrothecate internode. One squat nematotheca on this intermediate internode. Hydrothecate internode with a squat, short, mesial nematotheca; cylindrical hydrotheca; pair of lateral nematothecae placed on distinct apophyses; reduced, scale shaped nematotheca in axil of hydrotheca and internode, and supracalycine, mesial nematotheca (fig. 25b). Part of internode on which last mentioned nematotheca occurs may be partly or completely separated from rest of internode by a transverse node.

Fig. 24. *Halopteris buskii* (Bale), John Murray Exped., Sta. 111. a, part of hydrocladium; infracalycine, unpaired nematotheca on separate internode as is occasional in this species; b, part of hydrocladium with athecate internodes. a, b x 165.


a
b

Hydrotheca large, cylindrical, adcauline wall separated from internode for part of its length; hydrothecal perisarc well developed. Hydrothecal rim perfectly circular, perpendicular to hydrothecal long axis, slightly flared (fig. 25b).

Lateral nematothecae tumbler shaped, border strongly scooped out medially or open on median side, movable, reaching hydrothecal border or slightly beyond. Remaining nematothecae, with exception of reduced axillary nematotheca, squat, curved, strongly scooped out medially, firmly attached to internode and probably immobile. Distal pair of nematothecae on axial inter-

	Malay Archipelago Siboga Exped. (Billard, 1913)	John Murray Exped. Sta. 112
Internode of hydrocaulus		
length		460 – 520
diameter		270 – 320
Hydrocladial internode		
length (including athecate internode)	570 – 610	495 – 580
diameter		115 – 120
Hydrotheca		
depth	135 – 150	175 – 200
breadth at rim	120 – 135	220 – 235
Lateral nematothecae		
length		95 – 140
breadth at rim		65 – 80

Table 22. *Halopteris buskii*. Measurements in μm.

nodes almost as large as laterals, in shape intermediate between lateral and mesial nematothecae. Reduced, axillary nematotheca scale shaped, varied in length.

Perisarc of whole colony firm, particularly on frontal side of hydrocladial internode. Hydrothecae with well preserved hydranths. No gonothecae seen.

The colony from Sta. 111 (fig. 24) differs in the following details:

1. Though the arrangement of hydrocladia along the stem is pinnate and mainly alternate, the first four pairs are opposite. Basal part of stem with some indistinct nodes and one damaged hydrotheca (without apophyses); not studied in detail;

2. The structure of the hydrocladia is more irregular than met with in the specimens from Sta. 112. There is a tendency for the distal part of the internode to split off as a separate, ahydrothecate internode, occasionally bearing a nematotheca, but no regularity in structure was observed (fig. 24a, b). The first two internodes of a hydrocladium are invariably a short ring

shaped internode and a "basal internode" (basal node straight, distal node oblique) bearing one nematotheca. The hydrothecate internodes have a mesial nematotheca under the hydrotheca, a pair of lateral nematothecae, a reduced axillary nematotheca and, occasionally, a more distally placed median nematotheca. Distal part of this internode may have a complete node or an imperfect, straight node. Resulting ahydrothecate internode, if present, may or may not carry the "distal" nematotheca occasionally observed in the hydrothecate internode;

3. Axillary, reduced nematotheca (behind the hydrotheca) small but distinctly visible. Lateral nematothecae long and slender, apical chamber open on the adcauline side. Lateral nematothecae placed on distinct apophyses and projecting beyond hydrothecal rim.

Distribution. – The known geographical distribution of *Halopteris buskii* was recently summarized by Vervoort & Vasseur (1977: 76) and includes many records from tropical and subtropical parts of the Indo-Pacific. The present records considerably extend the known distribution of this species in the tropical part of the Indian Ocean in a westerly direction. There seem to be no previous records from the East African coasts or from Madagascar. The presence of *H. buskii* is here recorded from the Zanzibar area, apparently a first record for African coasts.

Remarks. – The John Murray material from Sta. 112 resembles closely existing descriptions of this varied species. The specimen from Sta. 111 approaches Billard's *Plumularia buski* var. *peculiaris* (= *Halopteris buskii* var. *peculiaris* (Billard, 1913)) in several respects. Billard (1913: 23) listed four main points distinguishing the variety *peculiaris* from the nominate variety:

1. Two basal internodes of which one – the distal – bears a single nematotheca;

2. The fact that the distal chamber of the lateral nematothecae is less globular in var. *peculiaris* than in the typical form;

3. The great reduction of the axillary nematotheca;

4. The irregular condition of the distal mesial nematotheca, which may either be absent or be placed on a separate internode.

With the exception of the reduction of the axillary nematotheca all these characters also occur in the present specimens. The axillary nematotheca, however, is distinctly visible here. It is not improbable that Billard's var. *peculiaris* is linked with the typical form by intermediate specimens.

At a certain point in our study it became necessary to compare the John Murray material with Bale's *Thecocaulus heterogona* (= *Halopteris heterogona* (Bale, 1924)), a species of which descriptions are available by Bale (1924:

	Halopteris buskii var. *peculiaris* (Billard, 1913). Siboga Exped. Sta. 99, North of Ubian Islands	John Murray Exped. Sta. 111
Hydrocaulus		
diameter	340 – 390	305 – 355
Hydroclade		
length of basal internode (with nematotheca)	340 – 350	250 – 355
length hydrothecate internode (when no intermediate internode present)	470 – 540	520 – 745
length hydrothecate internode (followed by intermediate internode)	365 – 390	355 – 745
length intermediate internode	230 – 325	180 – 340
diameter	110 – 135	100 – 115
Hydrotheca		
length abcauline wall		155 – 190
length free adcauline wall		70 – 90
depth	205 – 215	190 – 215
breadth at rim	205 – 215	195 – 210

Table 23. *Halopteris buskii.* Measurements in μm.

255, fig. 13), Totton (1930: 217, fig. 56b-d), and Ralph (1961: 45, fig. 6h-i), the last apparently being based on the type material. Though this species resembles *H. buskii* in the structure of the colony and in the hydrothecate internodes of the hydrocladia, it turned out to be quite different in the arrangement of the internodes along the hydrocladia which in *H. heterogona* are consistently homomerous; and the hydrothecate internodes were never observed to have a distal mesial nematotheca. Additional figures of *H. heterogona*, made from microslide preparations from "Terra Nova", Sta. 144, off Cape Maria van Diemen, New Zealand, 64-73 m (BMNH 1929.10.28.187-9), are represented here (fig. 25c, d).

Halopteris campanula (Busk, 1852)
(fig. 26, tab. 24)

Plumularia campanula Busk, 1852: 400; Bale, 1884: 124-125, pl. 10 fig. 5; Bale, 1888: 776-777, pl. 20 figs. 1-6; Marktanner-Turneretscher, 1890: 255-256; Bale, 1894: 113-114; Farquhar, 1896: 466; Bartlett, 1907: 42; Billard, 1910: 31; Bale, 1913: 133-135; Billard, 1913: 17-18, pl. 1 figs. 11-13; Bale, 1915: 295-296; Jäderholm, 1919: 22, pl. 5 fig. 4; Hodgson, 1950: 40-41, fig. 69.
Plumularia indivisa Bale, 1882: 39, 46, pl. 15 fig. 1.
Plumularia laxa Allman, 1883: 19-20, pl. 1 figs. 5-6.
Plumularia rubra Von Lendenfeld, 1884: 476-477, pl. 13 figs. 11-12, pl. 14 fig. 15; Bale, 1888: 778, pl. 20 figs. 1-6.

Fig. 25. a, b, *Halopteris buskii* (Bale), John Murray Exped., Sta. 112. a, part of stem with alternate hydrocladia; b, hydrocladial hydrotheca. c, d, *Halopteris heterogona* (Bale), Terra Nova Exped., Sta. 144, BMNH 1929.10.28.187-9. c, part of stem with 2 hydrocladia; d, hydrocladial hydrotheca. a, c x 45; b, d x 110.

Plumularia torresia Von Lendenfeld, 1884: 477, pl. 13 figs. 13-14, pl. 14 fig. 16.
Schizotricha campanula: Bedot, 1921b: 12; Blackburn, 1942: 107.
Heterotheca campanula: Stechow, 1921d: 260; Stechow, 1923b: 18; Stechow, 1923d: 233; Leloup, 1938: 20-21, fig. 14; Yamada, 1959: 82; Hirohito, 1969: 25-26; Hirohito, 1974: 33-34, fig. 15.
Halopteris campanula var. *zelandica* Totton, 1930: 219-220, fig. 57; Ralph, 1961b: 46-47, fig. 6g; Ralph, 1961c: 236.

Thecocaulus campanula: Billard, 1933: 22-23; Dollfus, 1933: 129.
Halopteris campanula: Leloup, 1938: 20-21, fig. 14; Pennycuik, 1959: 156, 177; Schmidt, 1972a: 43; Hirohito, 1983: 61-62.
Halopteris campanula var. *campanula*: Ralph, 1961b: 47; Watson, 1973: 184; Watson, 1975: 170.
Schizotricha campanulata: Mammen, 1967: 303 (lapsus).

Material examined. – Sta. 24. A tuft of irregularly branched stems 25-30 mm high arising from branched stolon anchored in sponge. No gonothecae (BMNH 1984.1.1.39, alc. + 2 slds; RMNH 16539, alc. + 2 slds).

Description. – Numerous irregularly branched stems arise from yellowish brown stolon; basal part bearing few nematothecae frontally (fig. 26a). Stems divided into thecate internodes separated by oblique nodes; occasionally transverse nodes present, separating apical parts of stem internodes from thecate parts. Long hydrocladia, shaped like branches, originating from short apophyses on (hydrothecate) stem internodes and directed left and right without regular sequence. They are inserted on internode at level of hydrothecal axil and have no axillary nematotheca.

Oblique nodes divide hydrocladia into internodes. Occasionally apical part of thecate internode is separated from rest by straight node (or several straight nodes); division of hydrocladia consequently heteromerous locally (fig. 26b). First hydrocladial internode without hydrotheca, delimited by transverse node from apophysis and apically with oblique node. One or a few mesial nematothecae occasionally present. Complete stem and hydrocladial internodes with basal and mesial nematotheca; large, almost basal, hydrotheca; one pair of lateral (flanking) nematothecae; and mesial and apical nematotheca, which in heteromerous segmentation is placed on a separate internode.

Hydrothecae large, more or less cylindrical, diverging from internode at angle of c. 45°, slightly varied in exact shape since walls may slightly diverge. Abcauline wall distinctly thickened, rim slightly flared, circular (fig. 26b). Mesial nematotheca scoop shaped, with strongly sclerotized abcauline wall, open adcauline wall and strong septum. Laterally appearing rounded on abcauline side, with more or less truncate apex. Mesial nematotheca firmly attached to internode and apparently immovable. Lateral nematothecae short, squat, attached to short, rounded apophyses, one on each side of hydrotheca, slightly under axil. Nematothecal rim scarcely reaching hydrothecal axil. Each lateral nematotheca with cup shaped apical chamber; part of wall of apical chamber deeply scooped out or open, bottom of cup heavily sclerotized and attached to apophyses by short, scarcely visible, basal chamber. Position of cup oblique to long axis of nematotheca: resulting nematothecal outline largely depending upon angle of vision (fig. 26c-e). In lateral view nematotheca cut off straight at apex. When observed obliquely thin, deeply

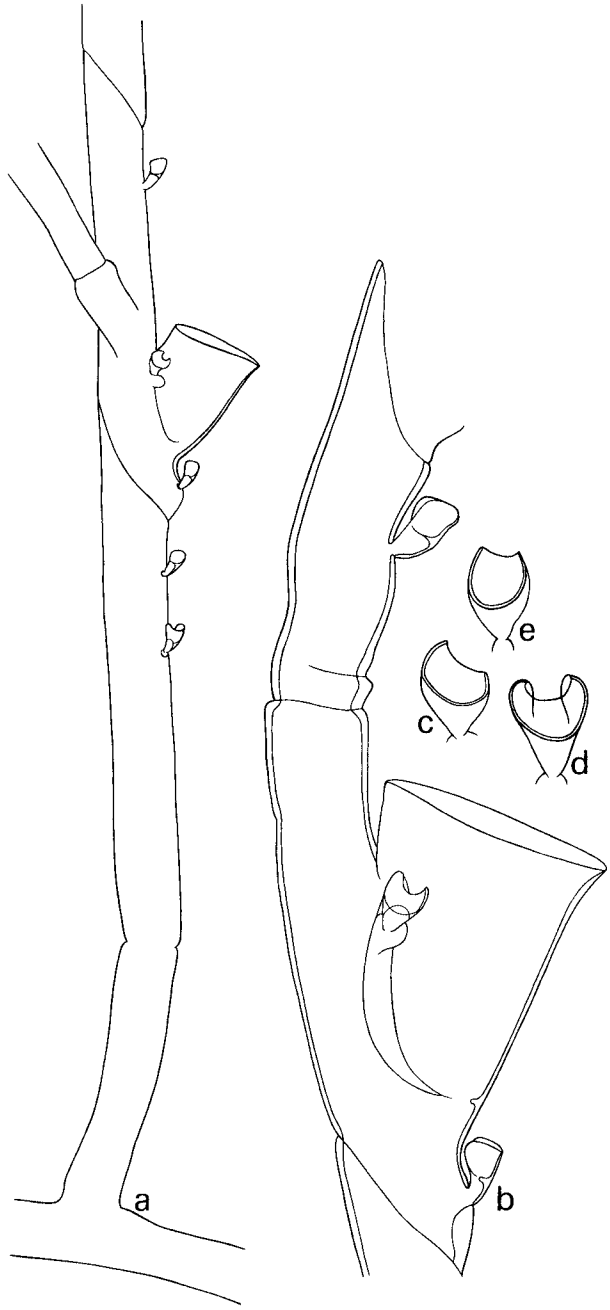


Fig. 26. *Halopteris campanula* (Busk), John Murray Exped., Sta. 24. a, basal part of stem at insertion on stolon; b, hydrocladial internodes with hydrotheca and nemetothecae; c-e, lateral (flanking) nematothecae; variation in appearance. a x 55; b x 135; c-e x 220.

	Malay Archipelago Siboga Exped. (Billard, 1913)	John Murray Exped. Sta. 24
Stem		
diameter at base		105 – 140
length of thecate internode		390 – 42
length of athecate internode		425 – 535
internodes, combined lengths	675 – 1000	
diameter of internode		80 – 95
Hydrotheca		
depth	255 – 280	250 – 270
length abcauline wall		240 – 255
length free adcauline wall		65 – 78
breadth at rim	215 – 255	190 – 255
Lateral nematotheca		
length		42 – 57
breadth at rim		36 – 43
Mesial nematotheca		
length		50 – 57
maximum breadth		28 – 36

Table 24. *Halopteris campanula*. Measurements in μm.

scooped out adcauline wall of nematotheca may be observed for some distance and may give impression of being slightly rolled inwards (fig. 26d). As nematothecae have various positions in our material we believe them to be movable.

Perisarc of internodes is firm on stems and thin on hydrocladia, particularly terminal ones.

Distribution. – Restricted to tropical and subtropical parts of the Indo-West Pacific, being recorded from off New Zealand (Totton, 1930; Ralph, 1961, as *H. campanula* var. *zelandica*); Australia (Busk, 1852; Bale, 1884, 1914, 1915; Watson, 1973, 1975; Allman, 1883, the last as *Plumularia laxa*), and Japan (Jäderholm, 1919; Leloup, 1938; Hirohito, 1969, 1974, 1983), from various localities in the eastern part of the Malay Archipelago (Billard, 1913), and from the Gulf of Suez, Red Sea (Billard, 1933). The present record from the Gulf of Aden is from within these limits. The recorded depth distribution is to at least 510 m (Billard, 1913).

Remarks. – The present material resembles existing descriptions of this well known species, particularly the monosiphonic material from the Bonin Islands described by Hirohito (1974). Totton (1930) described New Zealand material as *Halopteris campanula* var. *zelandica*, differing from Busk's Australian material in the following points:

a. The abcauline wall of the hydrotheca and its continuation down to the mesial nematotheca is distinctly thickened;

b. The free part of the adcauline wall of the hydrotheca is longer and diverges more strongly from the hydrocladium;

c. The distal ends of all nematothecae are rounded off, scoop shaped, and not truncate with inrolled sides as in the typical form.

It appears to us that each of these characters is based on rather varied features. The degree of thickening of the adcauline thecal wall varies within the same colony and in the present specimens is not noticeably thinner than as figured by Totton in var. *zelandica*. The length of the free portion of the adcauline hydrothecal wall appears to vary within one colony. Its degree of divergence from the hydrocladium is not only varied, but is also to a large degree influenced by the pressure of the cover glass in making slide preparations since the tubiform hydrotheca is usually slightly compressed in such specimens. Finally, the apical portion of the nematotheca varies much in outline even within a colony. Moreover, the impression is largely influenced by the angle of vision. This holds particularly for the lateral nematothecae, which are movable to some extent. They may at times appear to be cut off squarely at the apex, while in other specimens the inrolled tips of the lateral margins are distinctly visible. We do not consider the characters mentioned above sufficient to warrant the recognition of a distinct variety and, therefore, we have not followed Ralph (1961: 46, fig. 6g) in accepting it nor do we recognize it as distinct from the nominate variety.

Subfamily Kirchenpaueriinae Stechow, 1921

Kirchenpaueria triangulata (Totton, 1930)
(fig. 27, tab. 25)

?*Plumularia rubra* Bonnevie, 1899: 90, 91, 94, pl. 7 fig. 2. [non *Plumularia rubra* Von Lendenfeld, 1884 = *Halopteris campanula* (Busk, 1852)].

?*Plumularia elegantula* var. Pictet & Bedot, 1900: 4, 28, 53.

?*Plumularia bonnevieae* Billard, 1906a: 331; Billard, 1906b: 203-205, fig. 14; Jäderholm, 1909: 29, 107; Van Praët, 1979: 918, fig. 79.

?*Plumularia ventruosa* Billard, 1911: lxviii-lxix, fig. 11; Billard, 1913: 39, text-fig. 30, pl. 2 fig. 22; Bedot, 1916b: 646; Bedot, 1921b: 29; Bedot, 1923: 277-231; Van Soest, 1976: 90.

?*Plumularia bonneviae* Bedot, 1921b: 26; Bedot, 1923: 227, 230-231.

?*Kirchenpaueria bonneviae*: Billard, 1930: 79, 80.

?*Kirchenpaueria ventruosa*: Billard, 1930: 80.

?*Kirchenpaueria ventruosa simplex* Billard, 1930: 80.

Plumularia triangulata Totton, 1930: 225-227 fig. 61; Billard, 1930: 80; Ralph, 1961b: 41-42, fig. 5f-g.

Kirchenpaueria triangulata: Millard, 1962: 292-295, fig. 6E-J; Vervoort, 1966a: 136-138, figs. 38-39; Millard, 1967: 184-185; Millard, 1968: 277-278; Millard, 1975: 375-376, fig. 119E-H; Millard, 1977a: 39; Millard, 1977b: 107; Millard, 1978: 194.

Material examined. – Sta. 54. One fragmentary plume attached to stem of undeterminable hydroid and one basal fragment of second stem with two hydrocladia. No gonothecae (BMNH 1984.1.1.40, alc. + sld.).

Sta. 107. Two tufts of 3 and 7 hydrocauli rising from stolon epizoic on *Cladocarpus dofleini* (Stechow), one of the colonies with male (?) gonothecae (BMNH 1984.1.1.41, alc. + sld. (and sld. with only *C. dofleini*); RMNH 16540, 2 slds; 16547, sld. of *C. dofleini* with two small stems of *K. triangulata*).

Description. – Colonies from Sta. 107 (fig. 27) resemble in detail previously described material (Vervoort, 1966a) collected off Durban and Natal. There are no noticeable differences except that in the John Murray material some hydrothecae have slightly sloping hydrothecal apertures, the abcauline wall being slightly longer than the fused adcauline thecal wall. In such hydrothecae outline of hydrothecal rim with slight but decided curve (fig. 27a).

In stained microslide preparations a semicircular line is visible on the wall of the internode, curving between the distal ends of the fusion between hydrotheca and internode. This line probably marks a less thickened portion of the internode directly behind the hydrothecal aperture (fig. 27c). It is also visible in the microslide preparations from the "Galathea" material, though not explicitly mentioned in its description. The hydrothecae in the John Murray colonies point obliquely in frontal and upward directions.

The colonies from Sta. 107 bear developing and mature gonothecae that are probably male. The mature gonotheca is flattened, triangular and fan shaped with a truncate apex. There is a large central mass of developing spermatocytes; the gonothecal aperture is slit shaped and terminal (fig. 27d). All gonothecae are still fully closed and attached to the stem internodes directly under the "mamelon" on the apophysis by a one- or two-segmented pedicel. Holes in perisarc of apophyses indicate places where gonothecae have previously been attached.

The fragment from Sta. 54 differs from previously described material in the following details:

1. Nodes on hydrocaulus are indistinct, particularly in proximal part of colony; but are more visible in distal, pinnate part of colony;

2. Hydrocladia with short basal internode, 100-120 μm long, which attaches hydrocladium to apophysis. No nematothecae on basal internodes nor are such internodes consistently present;

3. Hydrocladial internodes long and slender, basalmost measuring 900-1000 μm, the following 1600-1800 μm.

Distribution. – *K. triangulata* occurs both in pinnate and in simple forms epizoic on other hydroids, usually in deeper water. It was originally described from off Three Kings Island, New Zealand, at 549 m, epizoic on *Plumularia*

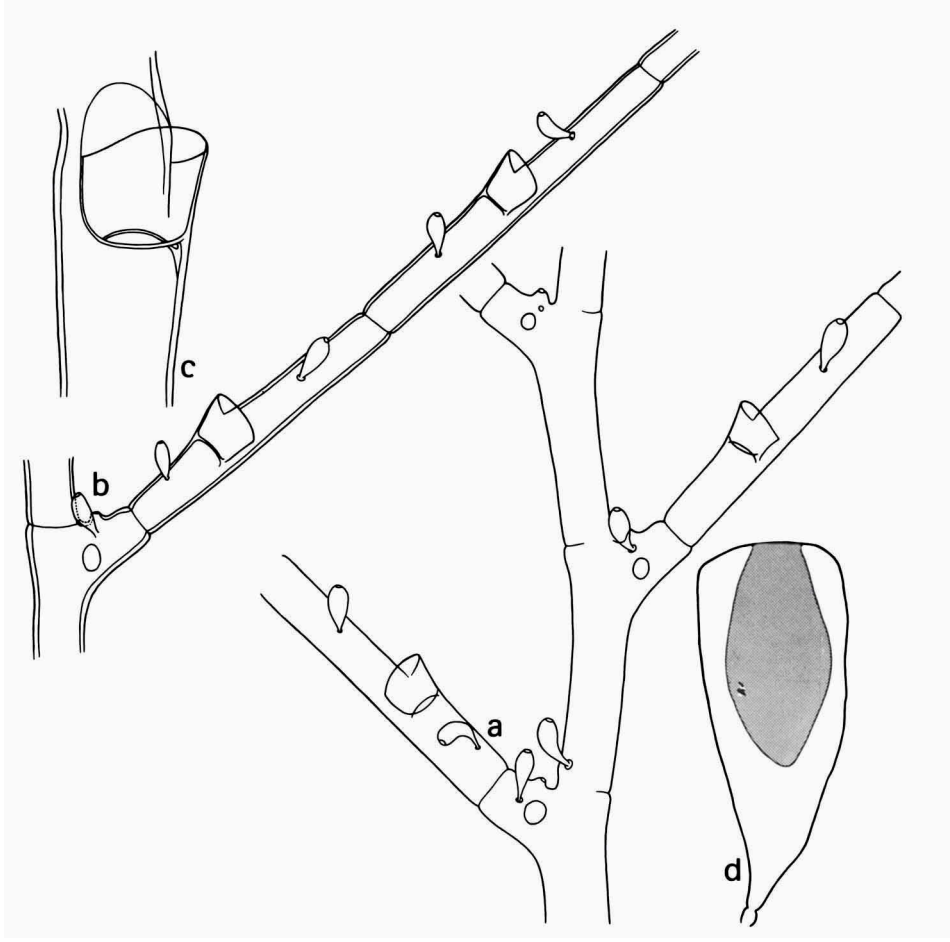


Fig. 27. *Kirchenpaueria triangulata* (Totton), John Murray Exped., Sta. 107. a, fragment of stem with insertions of three hydrocladia; b, hydrocladium at insertion on stem; c, hydrocladial hydrotheca, oblique view; d, male (?) gonotheca. a, b x 80; c x 130; d x 28.

tenuissima Totton, 1930 (Totton, 1930; Ralph, 1961b). Additional specimens were observed along the east coast of South Africa from the Cape Peninsula to Moçambique, the depths ranging between 111 and 1207 m [Vervoort, 1966; Millard, 1975; Vervoort's specimens, collected by the Galathea Expedition, were epizoic on *Cladocarpus inflatus* Vervoort, 1966, and *C. dofleini* (Stechow, 1911]. The present records extend the recorded geographical distribution north to the Zanzibar area at 421-457 m (on *C. dofleini*) and the coast of southern Oman at 1046 m, on undeterminable hydroid.

Remarks. – The material from Sta. 54 makes it clear that *Plumularia ventruosa* Billard, 1911, should probably be referred to the present species,

	Off southern Africa (Millard, 1962)	Off Natal, Galathea Exped. (Vervoort, 1966a)	John Murray Exped. Sta. 107
Internode of stem			
length	480 – 750	580 – 635	320 – 540
diameter	70 – 160	162 – 230	100 – 120
First hydrocladial internode			
length			540 – 720
Following hydrocladial internode			
length			620 – 720
Combined hydrocladial internodes			
length	660 – 885	785 – 835	
diameter at distal end	55 – 75	80 – 95	70 – 80
Hydrotheca			
length abcauline wall	70 – 95	68 – 85	70 – 85
length adnate adcauline wall		68 – 73	50 – 65
breadth at rim	100 – 120	100 – 110	85 – 100
Nematotheca			
length		68 – 85	55 – 70
maximum breadth		30 – 40	28 – 35
Male gonotheca			
length	1740 – 2460	850 – 1755	1200 – 1500
width	800 – 850	575 – 1015	500 – 600

Table 25. *Kirchenpaueria triangulata*. Measurements in μm.

contrary to the opinion expressed by Billard (1930: 80). The absence or presence of a basal internode in the hydrocladia is not a constant feature, and there are no differences in the shape of the nematotheca between *K. triangulata* and *K. ventruosa*. This last species has been recorded from a single locality in the eastern part of the Malay Archipelago, viz., "Siboga" Sta. 175, 02° 37.7′ S, 130° 33.4′ E, 1914 m depth. For a final conclusion inspection of the holotype in ITZ is imperative.

We wish here to draw attention to Billard's suggestion that *K. triangulata* (Totton) should be referred to *P. bonnevieae* Billard, 1906a (see Billard, 1930: 79-80). *Kirchenpaueria bonnevieae* (Billard, 1906b) (= *Plumularia rubra* Bonnevie, 1899 = *Plumularia elegantula* var. Pictet & Bedot, 1900) has so far been recorded exclusively from the Atlantic and always epizoic on *Diphasia alata* (Hincks, 1855) (= *Diphasia pinastrum* (Cuvier, 1830)). We hesitate to draw final conclusions concerning the conspecificity of the two species before having inspected Atlantic material.

Subfamily Plumulariinae Hincks, 1868

Nemertesia ramosa Lamouroux, 1816
(fig. 28a, b, tab. 26)

Nemertesia ramosa Lamouroux, 1816: 164; Billard, 1913: 58-60, fig. 49; Bedot, 1917b: 46; Stechow, 1919: 122-124, fig. V'b; Bedot, 1921b: 35; Bedot, 1921c: 18-20; Broch, 1933: 38-40; Leloup, 1934: 15; Leloup, 1937b: 47, fig. 32; Philbert, 1935a: 28; Philbert, 1935b: 34; Vervoort, 1941b: 182-185, figs. 74b, 76b, 77; Millard, 1957: 235; Picard, 1958: 192; Riedl, 1959: 657; Millard, 1961: 206; Millard, 1962: 299-300, fig. 7A-D; Rees & Thursfield, 1965: 167-168; Von Schenck, 1965: 928; Rees & White, 1966: 280; Vervoort, 1966a: 139-140, fig. 41; Millard, 1967: 185; Millard, 1968: 278; Fey, 1970: 404; Patriti, 1970: 45, fig. 60; Vervoort, 1972a: 234-236, fig. 83; Millard, 1975: 386-388, fig. 122D-H; Blanco, 1976: 57-59, pl. 8 figs. 1-6; Millard, 1977b: 107; Evans, 1978: 109; Millard, 1978:195; Van Praët, 1979: 915; Millard, 1980: 133; Gili y Sardà, 1982: 90-91, fig. 47.

Antennularia ramosa: Hincks, 1868: 282-283, pl. 62.

Antennularia ramosa var. *plumularioides* Billard, 1906b: 215-216.

Nemertesia ramosa var. *plumularioides*: Bedot, 1917b: 46; Bedot, 1921b: 35; Vervoort, 1959: 293-297, figs. 46b, 47; Patriti, 1970: 45, fig. 61; Mergner & Wedler, 1977: 22, pl. 5 fig. 34a-c, pl. 8 fig. 56.

Material examined. – Sta. 157. One branched colony 250 mm high and a fragment. Empty gonothecae present (BMNH 1984.1.1.42, alc. + sld.; RMNH 16541, 2 slds).

Description. – Colony with basally fascicled stem, forked about 60 mm from base, bearing whorls of four, apically three, apophyses, alternating with those above and below and bearing hydrocladia composed of 5 to 8 hydrothecate internodes. Ahydrothecate internodes only occasionally present and without nematothecae.

Hydrothecae on proximal half of internode, small, cup shaped, slightly wider than deep, plane of aperture perpendicular to internodal long axis or slightly tilted in abcauline direction (fig. 28a). Hydrothecal rim perfectly circular. Nematothecae on apophyses, stem and internodes, conical; with fine diaphragm separating apical chamber from basal portion. Nematothecal rim usually circular, some scooped out on adcauline side, such nematothecae usually slightly curved. Apophysis long, with distinct "mamelon", one pair of axillary nematothecae, one nematotheca directly behind "mamelon" and one farther along its length. Stem with nematotheca directly above insertion of apophysis (fig. 28a). Each hydrothecate internode with basal nematotheca, one pair of laterals placed at hydrothecal rim and one on distal portion of internode.

Septa occur in apophysis (one terminal only) and in internode (one basal and one terminal). No nodes visible on stem; hydrothecal internodes differ greatly in length.

Apparently female gonotheca on apophyses, inserted directly at base of "mamelon", ovate with large lateral opening (fig. 28b).

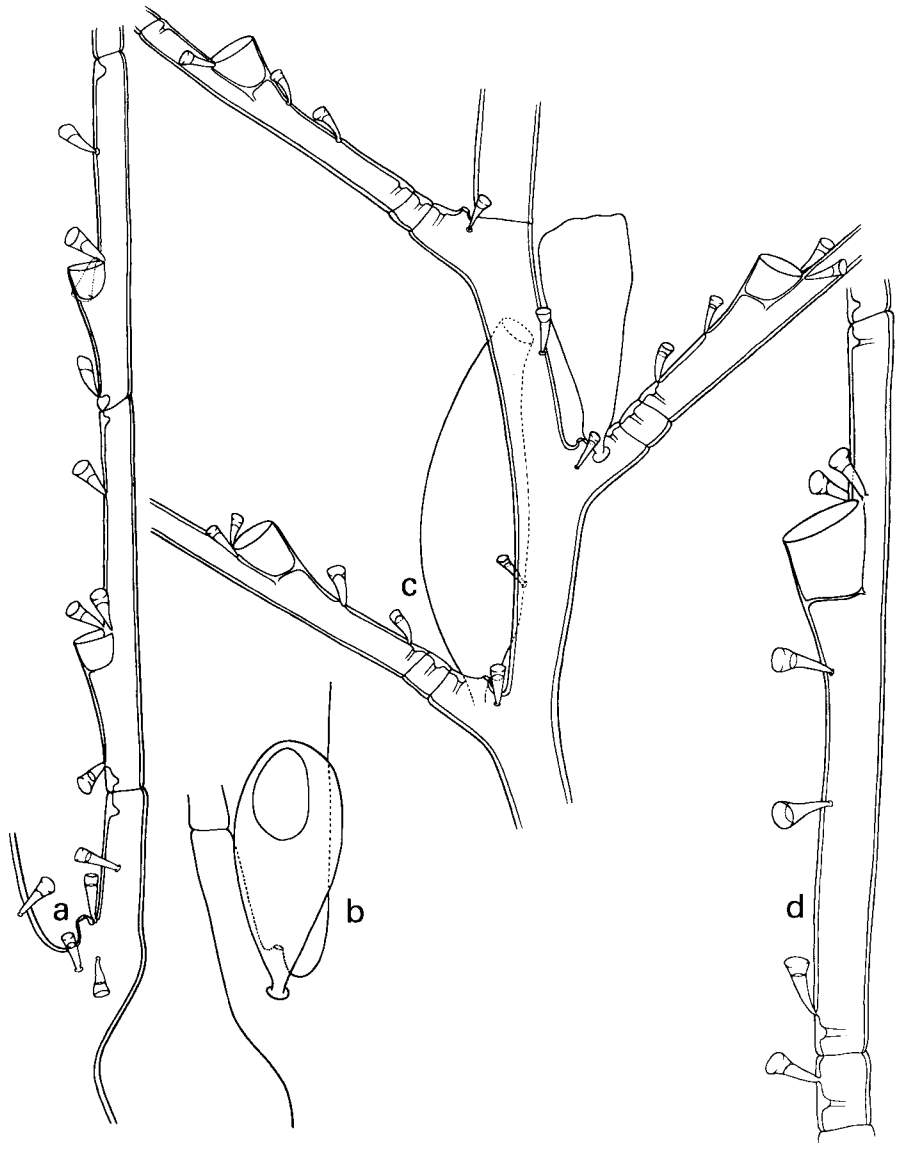


Fig. 28. a, b, *Nemertesia ramosa* Lamouroux, John Murray Exped., Sta. 157. a, hydrocladium at insertion on stem apophysis; b, gonotheca at insertion on stem apophysis. c, d, *Plumularia antonbruuni* Millard, John Murray Exped., Sta. 113. c, part of stem with insertion of three hydrocladia, male (lower) and female (upper) gonotheca; d, hydrothecate internode. a-c x 55; d x 85.

	John Murray Exped. Sta. 157
Hydrocaulus	
basal diameter	1500
distance between two successive apophyses in same plane	1100
Hydrocladial thecate internode	
length	560 – 800
diameter at node	60 – 80
Hydrotheca	
length abcauline wall	70 – 85
breadth at rim	90 – 110
Nematotheca	
length	100 – 110
breadth at rim	35 – 40
Female gonotheca	
length	500 – 600
diameter	250 – 280

Table 26. *Nemertesia ramosa*. Measurements in μm.

Distribution. – Cosmopolitan, especially in tropical, subtropical and temperate waters of medium depths. The species is widely distributed over the whole Atlantic Ocean, avoiding arctic and antarctic regions, but there are also many records from the Indo-Pacific. Along the south and east coasts of South Africa it occurs from Table Bay to the coast of Moçambique (Millard, 1975: 388). The species has been recorded from the eastern part of the Malay Archipelago by Billard (1913). We have been unable to trace previous records from the Maldives area, where the species has now been recorded from 229 m depth.

Plumularia antonbruuni Millard, 1967
(fig. 28c, d, tab. 27)

Plumularia antonbruuni Millard, 1967: 185-187, fig. 5; Millard, 1975: 389-390, fig. 123A-D; Millard, 1978: 196; Millard, 1979: 147.

Material examined. – Sta. 113. One plume 30 mm high, with male and female gonothecae; basal portion missing. Part of hydrocaulus preserved on microslides (BMNH 1984.1.1.43, alc. + sld.; RMNH 16542, sld.).

Description. – Hydrorhiza missing in present specimen. Stem stiff, thin, unfascicled; division into internodes, by means of straight septa, only visible in distal part. Each internode with single, nearly terminal, apophysis bearing hydrocladium. Stem weakly geniculate between nodes. Apophyses short, alternate ones pointing left and right and obliquely upwards, strictly in one plane, with distinct "mamelon", incomplete septum, and three nematothecae:

one on internode opposite apophysis and two axillary nematothecae flanking "mamelon" (fig. 28c). First internode of hydrocladium short, athecate, with single incomplete septum, and only occasionally with nematotheca. Rest of hydrocladium comprising 4-6 slender, hydrothecate internodes, separated by slightly oblique septa. Each hydrocladial internode with small hydrotheca placed on distal portion of internode, one pair of flanking nematothecae and 1-3 infracalycine nematothecae on proximal portion of internode. In addition each internode with two incomplete septa, one proximal, one distal (fig. 28d). Hydrotheca with straight or slightly everted adcauline wall; aperture circular and distinctly tilted in adcauline direction (fig. 28d). Hydrothecal depth slightly varied. Nematothecae all trumpet-shaped, two-chambered, with conical basal part, distinct though thin septum and slightly widening apical chamber. Rim not everted or scooped out. Some nematothecae slightly curved; all apparently movable. Pair of laterals (flanking nematothecae) inserted directly on internode; no apophyses noted.

Division of hydrocladia into internodes some of which are slightly irregular by occurrence of some intermediate athecate internodes, each bearing 1-2

	Off Natal (Millard, 1976)	John Murray Exped. Sta. 113
Stem		
diameter at base		150
Stem internode		
length	630 – 700	500 – 535
diameter	130 – 170	125 – 130
Basal internode of hydrocladium		
length	60 – 110	70 – 75
diameter		90 – 95
Hydrothecate internode		
length, including intermediate article, if present	850 – 950	675 – 960
diameter in middle	60 – 80	60 – 75
Hydrotheca		
depth		85 – 95
length adcauline wall	80 – 100	70 – 95
length abcauline wall		105 – 115
breadth at rim	110 – 120	105 – 115
Nematotheca		
length	70 – 90	70 – 85
breadth at rim		28 – 35
Female gonotheca		
total length		465 – 570
diameter at apex		215 – 320
Male gonotheca		
length	820 – 920	710 – 780
maximum diameter	200 – 270	225 – 250

Table 27. *Plumularia antonbruuni.* Measurements in μm.

nematothecae. Such internodes apparently cut off from proximal parts of internodes, since in thecate internode following such intermediate internodes hydrotheca occurs almost in middle of segment.

Perisarc of stem firm but on hydrocladia much thinner, particularly along hydrotheca, though damaged hydrothecae occur sporadically.

Present specimen bears numerous male and female gonothecae, all on same colony. Usually one male and one female gonotheca spring from same apophysis, one on each side of "mamelon". Male (?) gonotheca elongate, ovate; apically rounded and closed or open by means of short funnel. Female (?) gonotheca shorter, more or less conical with frayed apical margin, containing granular mass (fig. 28c).

The condition of the contents of the gonothecae is not optimal. Consequently we are not certain of the sex of the two types present in this single specimen. The elongate, ovate structures described above as male gonothecae diverge from the stem at an angle of c. 15°).

Distribution. – Originally collected off Natal, 29° 45′ S, 31° 40′ E, 440 m (type locality; Millard, 1967). The present record extends the distribution to the Zanzibar area, 05° 05′ 17″ S, 39° 13′ 39″ E, 220 m.

Remarks. – The present specimen resembles closely Millard's description of *P. antonbruuni*, based on four stems of maximally 51 mm height, collected off Natal. Millard did not mention or figure a septum in the apophysis. Such a septum, though incomplete, is distinctly visible in the John Murray material. The male gonotheca described by Millard was apparently not fully mature. Though in general outline it resembles the structure described above as the male gonotheca, the funnel-shaped aperture present here in some male gonothecae is absent from Millard's specimens. In our opinion there can be no reasonable doubt that the John Murray colony is conspecific with Millard's material.

In the course of the identification of the present material it became necessary to study *Plumularia diploptera* Totton (1930: 222, fig. 59a, b), with which *P. antonbruuni* has certain characters in common. *P. diploptera* so far as is known is endemic to New Zealand, being originally recorded from two New Zealand stations by Totton and later redescribed by Ralph (1961b: 32, fig. 3f-j) who recorded it from additional New Zealand localities. The material of this species in BMNH comprises specimens from "Terra Nova" Sta. 134, Spirits Bay, off North Cape, New Zealand, 20-36 m, and Sta. 144, 7 miles west by south from Cape Maria van Diemen, New Zealand, 64-73 m:

a. 1929.10.28.193, Sta. 134, five big, at least 50 mm high plumes without gonothecae;

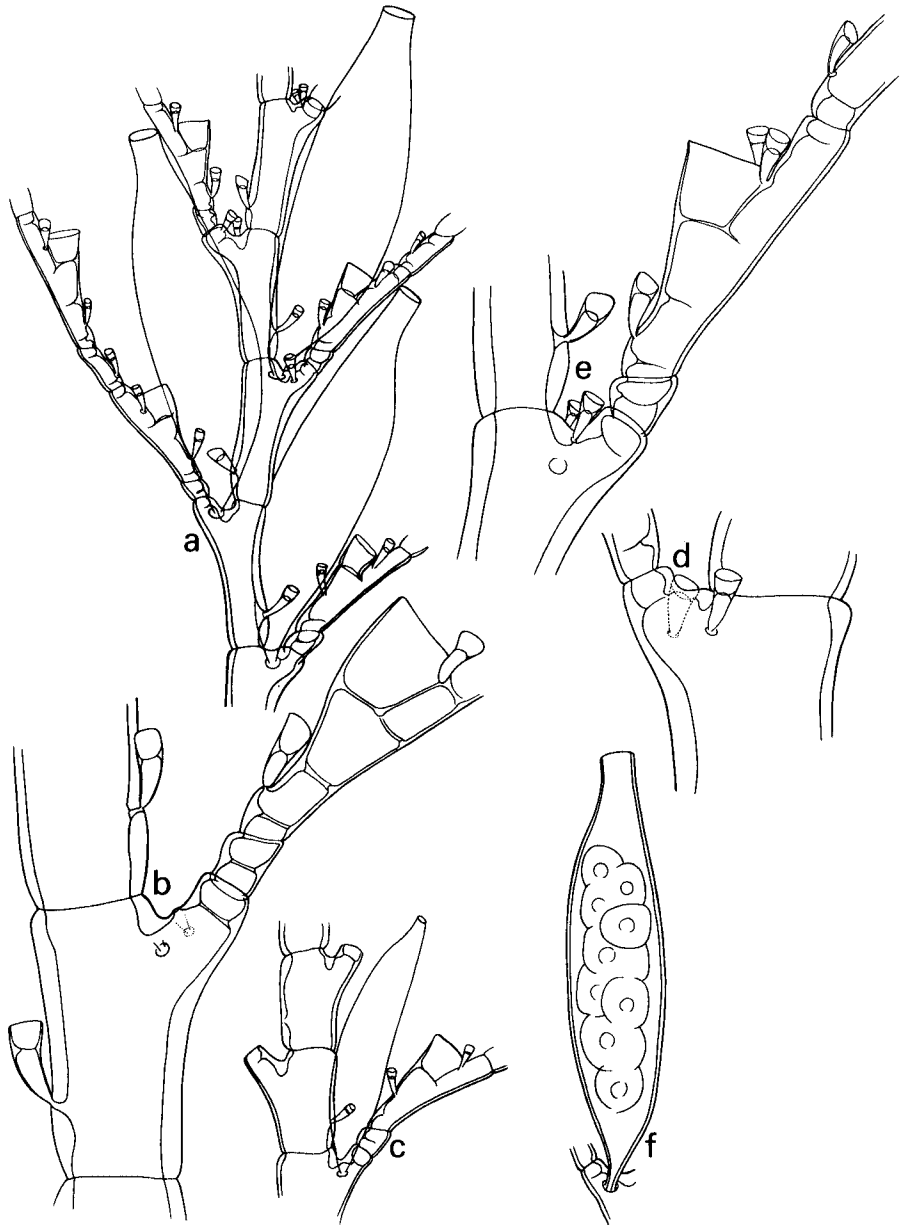


Fig. 29. *Plumularia diploptera* (Totton), Terra Nova Exped., Sta 134, BMNH 1929.10.28.196A. a, part of colony with hydrocladia and female gonothecae; b, stem internode with insertion of hydrocladium; c, part of colony with smaller (male ?) gonothecae; d, stem apophysis with pair of nematothecae; e, insertion of hydrocladium on stem internode; f, female gonotheca. a, c, f x 55; b, d, e x 135.

b. 1929.10.28.194, Sta. 134, many 15-30 mm high plumes, no gonothecae;

c. 1929.10.28.195, Sta. 134, a number of separate plumes, detached from substrate, up to 50 mm high, with male and female gonothecae.

In addition there are four slides from the same lot, numbered 1929.10.28.195 and 1929.10.28.195A. This material is here designated as the lectotype series.

There is other material as follows;

a. 1929.10.28.196, Sta. 134, a very large number of up to 30 mm high colonies on a shell; many, largely female, gonothecae are present;

b. 1929.10.28.197, Sta. 144, two plumes, one broken, no gonothecae;

c. 1929.10.28.198, Sta. 144, three plumes on a fragment of Bryozoa, one broken, no gonothecae.

The examination of the specimens has largely been confined to the slides. Drawings of the species (fig. 29), supplementing those already published by Totton and Ralph, are presented here to show the distinctive differences of *P. diploptera* from the John Murray specimen of *P. antonbruuni*. The differences between *P. diploptera* and *P. setacea* (Linnaeus, 1758) have been listed by Ralph (1961b: 33).

Subfamily Aglaopheniinae Broch, 1909b

Cladocarpus alatus Jarvis, 1922
(fig. 30a, tab. 28)

Cladocarpus alatus Jarvis, 1922: 351-352, text-fig. 2, pl. 26 fig. 25; Vervoort, 1966a: 149, 152-153, fig. 52.

Material examined. – Sta. 24. One colony about 80 mm high, basal portion missing but with many hydrocladia arranged along fairly thick stem. No gonosome (BMNH 1984.1.1.44, alc. + sld.; RMNH 16543, 2 slds).

Description. – Stem fairly thick, fascicled, bearing apophyses and cauline nematothecae on its front, almost in one longitudinal row. Apophyses pointing alternately left and right; cauline nematothecae in one strict row, five to six between two consecutive apophyses, one nematotheca being axillary. Cauline nematothecae two-chambered and with circular opening, deeply scooped out on cauline side. Hydrocladia 12-15 mm long, inserted directly on apophyses, with 22-25 hydrothecate internodes separated by oblique, thin nodes. Hydrothecae placed on front of each internode and consequently facing front of colony. Hydrotheca deep, with almost straight, slightly concave abcauline wall, produced into prominent median cusp (fig. 30a). No intrahy-

drothecal septum observed. Unpaired, median, infracalycine nematotheca short, conical, placed at hydrothecal base. Adcauline wall of nematotheca open and confluent with its circular rim. Lateral nematothecae greatly produced medially and apparently touching in medial plane, curving completely around hydrothecal rim. Proximal part of nematotheca lengthened, forming short funnel with circular, terminal aperture and large, medially directed opening. Extended part of nematotheca with slit-shaped opening resulting from fusion of a number of openings along margin. Extreme terminal part with distinctly visible, circular opening. Exact nature of hydrothecal rim obscured by great development of paired, lateral nematothecae (fig. 30a). All internodal septa incomplete. One oblique septum at base of internode, five behind hydrotheca, one at base of lateral nematothecae, and one at end of internode. Perisarc of internodes and hydrotheca normally developed, strong along internode and thin but quite firm on hydrotheca. The specimen was evidently collected live, since many of its hydrothecae have well preserved hydranths with 6-8 strongly contracted tentacles. Colour of colony light horn to yellowish-brown.

	Cargados Indian Ocean (Vervoort, 1966)	John Murray Exped. Sta. 24
Hydrocaulus		
diameter at base	170	625
Cauline nematotheca		
length	75 – 95	120
maximum diameter	60 – 70	50
Hydrocladial internode		
length	600 – 700	660 – 695
diameter at node	80 – 90	90 – 105
Hydrotheca		
depth (excluding median cusp)	400 – 410	440 – 455
breadth at rim	175 – 195	170 – 185
Unpaired nematotheca		
length free part	55 – 60	65 – 70
Lateral nematotheca		
height	95 – 105	120 – 130
spread	185 – 195	195 – 205

Table 28. *Cladocarpus alatus*. Measurements in μm.

Distribution. – This species is so far known from two areas, viz., Cargados Island, Indian Ocean (Jarvis, 1922), and off Cape Guardafui, Gulf of Aden, 11° 53′ 42″ N, 51° 13′ 12″ E. The depth of the Cargados specimen is stated by Jarvis to be 55 m, but the label of the schizoholotype gives the depth as being 82 m.

Remarks. – This species was originally based on a single colony 105 mm

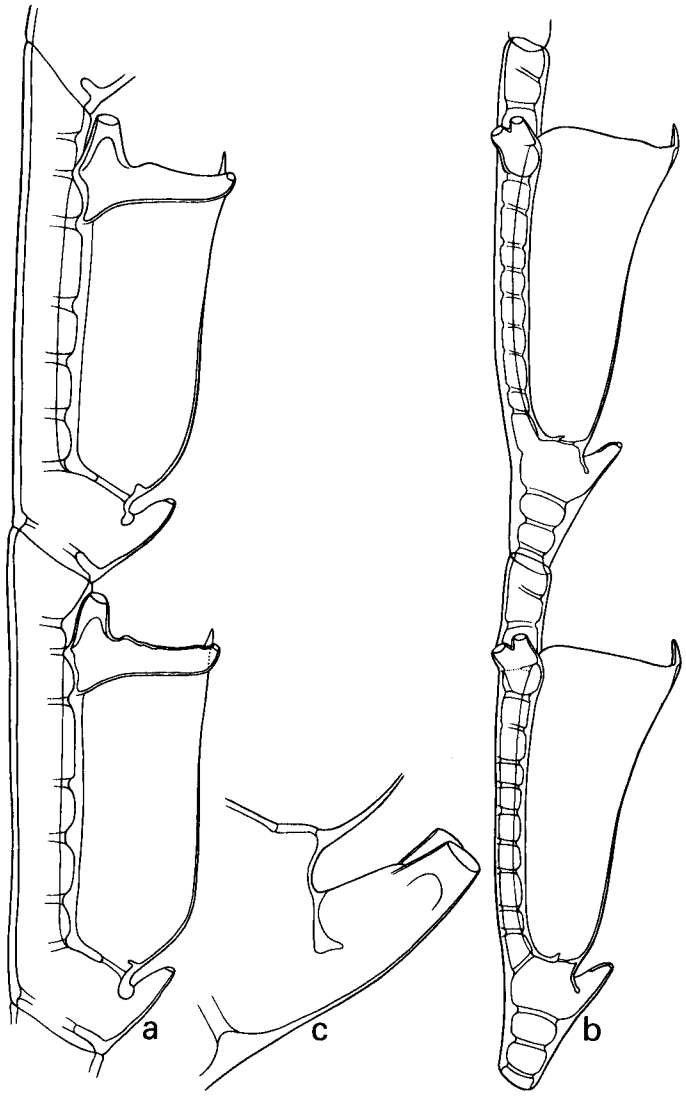


Fig. 30. a, *Cladocarpus alatus* Jarvis, John Murray Exped., Sta. 24, two hydrothecae on hydrocladial internodes, lateral view; b, c, *Cladocarpus distomus* Clarke, John Murray Exped., Sta. 118. b, two hydrothecae on hydrocladial internodes, lateral view; c, unpaired, infracalycine nematotheca with pair of apical funnels. a x 85; b x 55; c x 220.

high from Cargados Island, Indian Ocean, 55 m depth (Jarvis, 1922). The holotype colony has apparently been lost, but a schizoholotype microslide is preserved in BMNH (1923.2.15.169). The species was redescribed from this

material by Vervoort (1966). The John Murray material differs from the Cargados specimen only in that in the lateral nematothecae the medially produced part is here even longer: the two meet in the medial plane, while the openings (with the exception of the proximal, produced, funnel-shaped aperture) have apparently fused to form a more or less slit-shaped opening with undulating margin. The measurements of the two specimens are almost identical.

Cladocarpus alatus was regarded by Millard (1975: 418) as conspecific with the highly varied *Cladocarpus distomus* Clarke, 1907. Though recognizing the considerable variation of the latter species we are inclined to consider *C. alatus* [as well as *C. bathyzonatus* Ritchie (1911b: 861, pl. 89 figs 2, 6-11)] as distinct species, separable from *C. distomus* by a number of characters. Further assessment of the validity of the three species must, in our opinion, await the discovery of more, and preferably fertile, material of *C. alatus* and *C. bathyzonatus*.

Cladocarpus distomus Clarke, 1907
(fig. 30b, c, tab.29)

Cladocarpus distomus Clarke, 1907: 17-18, pl. 14; Ritchie, 1911b: 863; Bedot, 1921a: 326; Stechow, 1925b: 506-507, fig. 47; Vervoort, 1966a: 150-152, figs. 48-50; Vervoort, 1972a: 212-214, fig. 73a.

Cladocarpus sibogae Billard, 1911: lxx-lxxi, fig. 15; Billard, 1913: 71-73, text-figs. 57-58, pl. 4 fig. 39; Billard, 1918: 26-27, fig. 5; Bedot, 1921a: 322, 325; Pennycuik, 1959: 156, 185; Vervoort, 1966a: 152; Van Soest, 1976: 86.

Cladocarpella multiseptata Bale, 1915: 304, pl. 17 figs. 1-5; Bale, 1919: 356; Vervoort, 1966a: 152.

Cladocarpus plumularioides Jarvis, 1922: 352, fig. 3; Vervoort, 1966a: 152, fig. 51.

Cladocarpella (Cladocarpus) distomus Von Schenck, 1965: 942.

Cladocarpus distomus p.p. Millard, 1967: 188-191, fig. 6; Millard, 1968: 280; Millard, 1975: 418-421, fig. 130D-F; Millard, 1977b: 107; Millard, 1978: 189.

Material examined. – Sta. 118. One colony 45 mm high with basal tuft of fibres. No gonosome. One squid egg attached to stem (BMNH 1984.1.1.45, alc. + sld.; RMNH 16544, sld.).

Description. – Stem comprises primary tube, visible on front of colony along full length of stem, supported by many acccessory tubules, gradually diminishing in number in upward direction. Apical part of colony monosiphonic; remaining two thirds polysiphonic but always with primary tube visible on front. Primary tube frontally with row of apophyses and cauline nematothecae; apophyses alternately directed upwards and obliquely left and right, supporting gracefully curved hydrocladia; colony as a result plumose. Two cauline nematothecae between two successive apophyses, one of which is axillary. All cauline nematothecae two-chambered, basal chamber rounded

and separated from apical portion by distinct septum; apical portion composed of two separate funnels diverging left and right from communal connection with basal chamber. Hydrocladia about 10 mm long, composed of 9-10 internodes, delimited by slightly oblique nodes, each with hydrotheca, one cauline nematotheca and paired laterals.

Internodes slightly curved; unpaired infracalycine nematotheca free from hydrotheca, conical, with pair of slightly diverging apical funnels and unpaired median opening on adcauline side (fig. 30c). Hydrotheca long and slender, abcauline wall distinctly concave, curving outwards apically and there with conspicuous median cusp (fig. 30b). Inspection of hydrotheca in frontal aspect shows this cusp to be hollow; cavity directed frontally. Hydrothecal rim slightly sinuous and distinctly crenulate. Flanking nematothecae (laterals) projecting short distance above hydrothecal rim, curving backwards and provided with paired, funnel-shaped openings (fig. 30b). Septum in these nematothecae thin.

Septa in internodes form conspicuous feature, and though not complete are present as thickened perisarcal rings, leaving large, circular opening for passage of coenosarc. Each internode with 16 of such ring-shaped septa, 3 under hydrotheca, 11 behind hydrotheca (one almost hidden by lateral nematothecae) and 2 above hydrotheca. Distinct, inwardly projecting "lip" at base of median nematotheca (fig. 30c). No intrathecal septum; no hydranths seen.

	Galathea Exped. Sta. 188 off Durban (Vervoort, 1966)	John Murray Exped. Sta. 118
Hydrocaulus		
diameter at base		500
Cauline nematothecae		
length		140 – 155
maximum diameter		125 – 130
Hydrocladium		
length internode	950 – 1055	1065 – 1170
diameter at node	80 – 95	65 – 70
Hydrotheca		
depth (excluding median cusp)	565 – 660	700 – 750
breadth at rim	225 – 245	295 – 310
Unpaired nematotheca		
length free part	175 – 180	100 – 110
breadth at apex	13 – 25	28 – 35
Lateral nematotheca		
length	200 – 215	120 – 130
maximum diameter	35 – 40	85 – 95

Table 29. *Cladocarpus distomus*. Measurements in μm.

Distribution. – The geographical distribution of *C. distomus* has been summarized by Vervoort (1972: 214). The species occurs in deep water of tropical and subtropical parts of Atlantic, Indian and Pacific Oceans. From the southern coasts of Africa the species has been recorded by Millard (1975) from off Cape Town, Natal and Moçambique, at depths ranging between 292 and 2200 m. The present record is from the Indian Ocean north-east of Pemba, Zanzibar, 1789 m depth.

Remarks. – The John Murray specimen, in development and in number of internodal septa, resembles *Cladocarpella multiseptata* Bale, 1915, a species subsequently referred to the varied *Cladocarpus distomus* Clarke, 1907. For a discussion of the synonymy we refer to Vervoort (1966: 150-154, figs. 48-50) and for a discussion of the variation to Millard (1975: 418-421), though we have not followed the latter author in also referring *Cladocarpus alatus* Jarvis, 1922, to *C. distomus*.

The John Murray specimen is remarkable in the following features:

1. The large number (16) of internodal septa (perisarcal rings);
2. Duplication of the aperture of all nematothecae, cauline as well as internodal;
3. The absence of a frontal prolongation of the lateral nematothecae.

In duplication of the nematothecal aperture this specimen resembles *Cladocarpus bathyzonatus* Ritchie (1911b: 861, pl. 89 figs. 2, 6, 11) and *C. multiapertus* Billard (1911: lxxi, fig. 16).

Cladocarpus indicus sp. nov.
(figs. 31, 32, tab. 30)

Material examined. – Sta. 159. Two colonies, one 50 mm high (holotype), the other 40 mm high (paratype), both with basal tuft of fibres and a (paired) phylactocarp (BMNH 1984.1.1.46, alc. (holotype) + sld. (schizoholotype); RMNH 16545, sld. (schizoholotype), 16546, alc. (paratype) + sld. (schizoparatype)).

Description. – Colonies graceful and slender, composed of largely monosiphonic stems bearing alternate hydrocladia, turned alternately left and right. Basal part of stem made weakly polysiphonic by presence of some accessory tubules, springing from small tuft of hydrorhizal fibres, by which the colonies were anchored in sediment. Basal part of monosiphonic portion of stem with some indistinct, transverse septa. In higher parts of stem these only present as indistinct constrictions of perisarc. Stem frontally with one row of nematothecae and two rows of apophyses, the latter pointing alternately obliquely left and upwards and right and upwards. Five nematothecae between two successi-

ve apophyses, including axillary nematotheca which, compared with others, is slightly displaced and smaller. Cauline nematothecae pointing away from stem at angle of c. 45°, flattened, with compressed, cleft aperture, distinct septum and circular hole for communication with coenosarc of stem. So far as we have been able to see in microslide preparations part of flattened, adcauline portion of nematothecal wall absent. Circular hole present in distal chamber of cauline nematotheca and opening into interior of stem internode (fig. 31c). Under septum pair of strong, longitudinal internal ridges visible.

Hydrocladia long and gracefully curved, divided into 8 to 10 hydrothecate internodes, inserted on apophysis by means of slightly modified thecate internode (fig. 31a). Structure of normal internodes will be described first. Hydrocladial internodes delimited by straight to slightly oblique, weakly visible nodes, with exception of first, modified, internode which has two distinct, oblique nodes. Normal internode projecting small distance below and above each hydrotheca, and besides large, slender hydrotheca carrying basal, infracalycine, unpaired nematotheca and one pair of laterals (flanking nematothecae) near hydrothecal border (fig. 31b). Hydrotheca long and slender, without internal septum; abcauline wall almost straight to slightly concave, curving outwards near rim and there with a distinct, slightly inward-curved, furrowed cusp. Hydrothecal border slightly convex, more or less crenulate, fused with internal wall of laterals. Unpaired median, infracalycine nematotheca trans-

	John Murray Exped. Sta. 159
Hydrocaulus	
diameter at base	320 – 350
Cauline nematotheca	
length measured from base	78 – 105
diameter at rim	71 – 92
Hydrocladial internode	
length	1380 – 1790
diameter at node	125 – 135
Hydrotheca	
depth (excluding median cusp)	980 – 1180
length of median cusp	70 – 85
breadth at rim	390 – 460
Unpaired nematotheca	
length of free portion	170 – 185
Lateral nematotheca	
length, measured from insertion	280 – 295
breadth at rim	60 – 70
Gonotheca	
length	425
diameter	285 – 325

Table 30. *Cladocarpus indicus*. Measurements in μm.

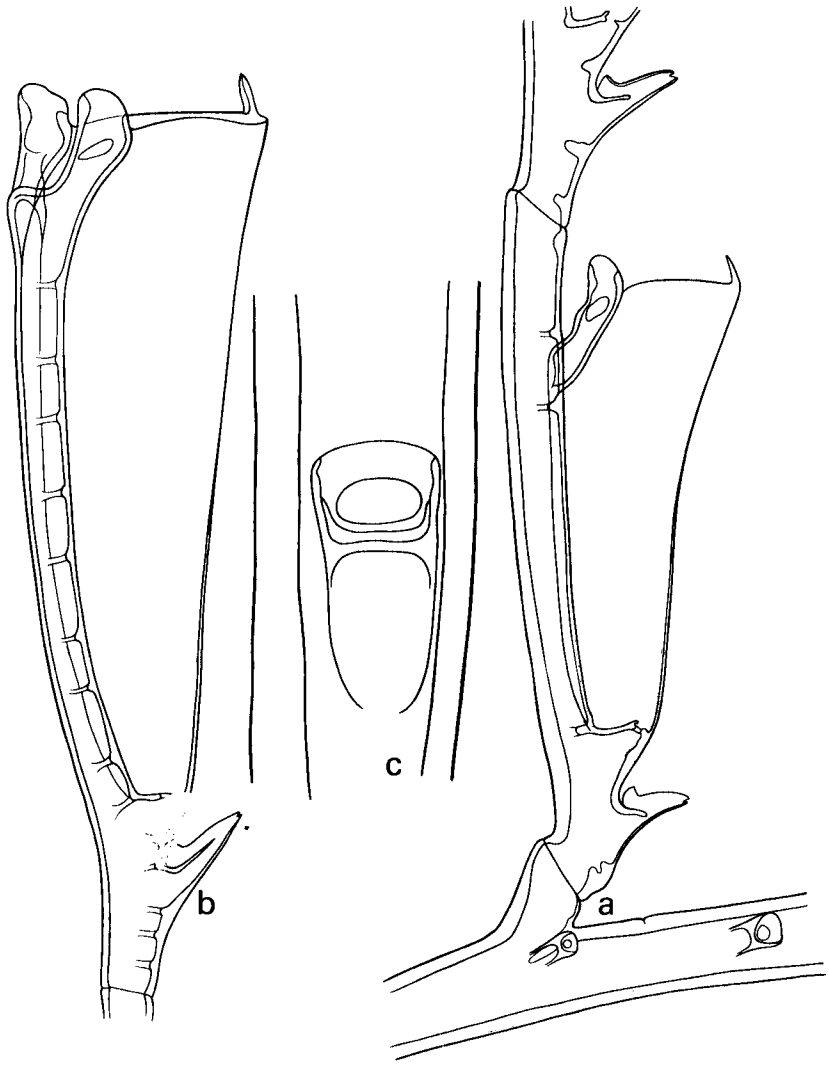


Fig. 31. *Cladocarpus indicus* sp. nov., holotype, John Murray Exped., Sta. 159. a, basal internode of hydrocladium at insertion on stem, lateral view of internode; b, hydrocladial internode with hydrotheca, lateral view; c, stem nematotheca, frontal view. a, b x 55; c x 220.

versely compressed, with slit-shaped terminal aperture and large, circular adcauline opening above septum dividing nematotheca into upper and basal portions. Lateral nematothecae also strongly laterally compressed, their adcauline walls fused with hydrotheca; the slit-shaped opening parallel with hydrothecal wall, communicating with internode by large, oval hole (fig. 31b).

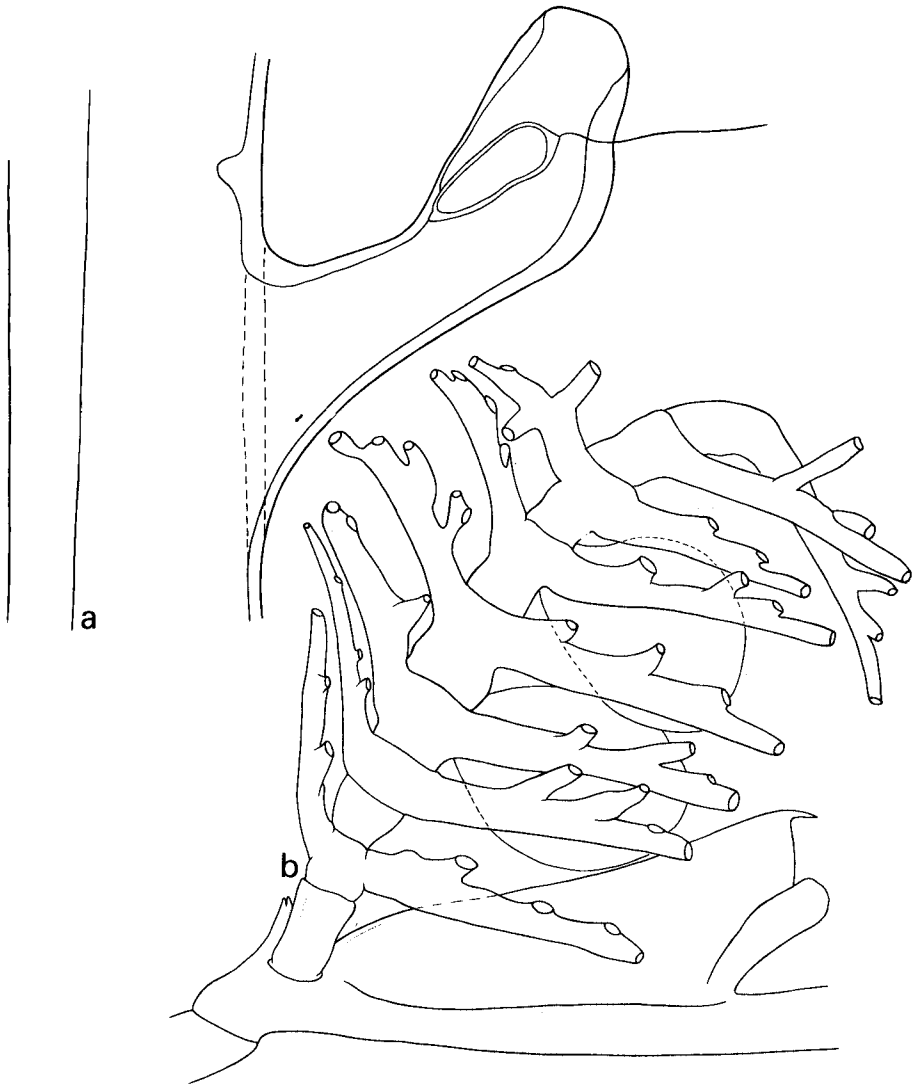


Fig. 32. *Cladocarpus indicus* sp. nov., holotype, John Murray Exped., Sta. 159. a, one of paired lateral nematothecae, showing large orifice opening into hydrothecal cavity; b, one of paired phylactocarps of a gonosome, oblique view from below. a x 220; b x 85.

In addition oval aperture in internodal wall of nematotheca, for communication with interior of hydrotheca (fig. 32a).

Number of septa in internode increasing from 4 to 15 along internodes of one hydrocladium: the basal, modified internode with four, best developed

internodes with maximum of 15, i.e., 3-4 in basal portion of internode (under unpaired nematotheca), 2 behind that nematotheca and 9-10 behind hydrotheca, 2 of which occur at base of paired nematothecae. Basal internode of each hydrocladium remarkable by reduction of number of septa. Basal septa, under unpaired nematotheca, absent and replaced by double perisarcal ridge. Septum in unpaired nematotheca short and thick. Only four septa behind hydrotheca, two of which occur at base of lateral nematothecae. Hydrotheca on this internode notably smaller than remaining hydrothecae (fig. 31a). All internodal septa incomplete and present as perisarcal rings, better developed on frontal than on back of internode.

Both holotype and paratype have a gonosome, each gonosome being composed of two rake-shaped phylactocarps, attached one on each side of unpaired nematotheca of basal hydrocladial internode (fig. 32b). Phylactocarps curved, as are also their composite nematothecae, and investing 8-10 egg-shaped gonothecae. Sex could not be determined. Each phylactocarp is composed of 8 uniform segments and slightly differing basal segment. These segments, except basal and terminal ones, with one pair of opposite arms, each set with three to four lateral and one terminal nematothecae; laterals all pointing forward. Sometimes these nematothecae are stalked or cup shaped, one may point backwards. Terminal segment with single branch with nematothecae: basal segment having none. The whole, ball-shaped gonosome has a diameter of about 2-3 mm.

Distribution. – Maldive Archipelago, Indian Ocean, 04° 47′30″– 04° 48′ 00″ N, 72° 45′ 18″ – 72° 46′ 41″ E, 914-1463 m.

Remarks. – This species is remarkable because of the condition of the nematothecae. They are strongly compressed, and as a result the aperture is a slightly curved slit supported by strongly sclerotized walls. The cauline nematothecae diverge strongly from the stem, as does the unpaired, median, infracalycine nematotheca. The paired laterals appear to be completely fused with the hydrothecal wall. The hydrothecae resemble those of *C. tenuis* Clarke, 1879, though in that species the hydrothecae are even more slender in relation to the length of the internode. The structure of the phylactocarp resembles the condition found in *C. tenuis* and *C. sinuosus* Vervoort, 1966a, though in the present previously undescribed species two branches are present, one on each side of the basal nematotheca, curving over the gonothecae and forming a rounded structure in which the gonothecae are almost completely covered by nematothecate structures. We could not identify this highly characteristic species with any previously described, though it has certain features in common with *C. moderatus* Fraser, 1948 (: 270, pl. 36 fig. 40). The latter is inadequately characterized and no measurements were given, but

internodes and hydrothecae appear to be smaller. However, points of agreement occur in the position of the nematothecae (cauline as well as hydrocladial), and in the shape of the hydrothecae. Fraser's species, the type of which is in AHM, is badly in need of a critical re-examination.

Etymology. – The specific name, *indicus,* refers to the Indian Ocean in which the species was collected.

Cladocarpus dofleini (Stechow, 1911)
(fig. 33, tab. 31)

Dinotheca dofleini Stechow, 1911: 194-197, fig. 1; Stechow, 1920b: 401-405, figs. 1, 2; Bedot, 1921a: 348; Stechow, 1923a: 17; Stechow, 1925b: 508-513, figs. 49-52; Von Schenck, 1965: 942; Rees, 1966: 204, fig. 5; Vervoort, 1966a: 162-164, figs. 63-64.
Cladocarpus dofleini: Millard, 1975: 421-422, fig. 130G; Millard, 1977b: 107, 125-127, figs. 9D-F; Millard, 1978: 189.

Material examined. – Sta. 106. One colony 50 mm high. No gonosome (BMNH 1984.1.1.47, alc. + sld.).

Sta. 107. Three colonies, 25, 40 and 60 mm high; one of the colonies with two tufts of stems of *Kirchenpaueria triangulata* (Totton). No gonosome (BMNH 1984.1.1.41, alc. + 2 slds; RMNH 16547, alc. + sld., the latter with 2 small stems of *K. triangulata*).

Sta. 178. One colony 25 mm high. No gonosome (BMNH 1984.1.1.48, alc. ; RMNH 16548, 2 slds).

Remarks. – This curious species has previously been described most fully by Stechow (1925b), Vervoort (1966a), and Millard (1975, 1977). The John Murray material resembles those descriptions and demonstrates the considerable variation in various details. Points of difference from existing descriptions and varied features are as follows:

1. No regular division of the stems into internodes was found. The John Murray colonies, all infertile, are largely monosiphonic, with the exception of some accessory tubules in the larger ones. There are some straight septa in the basal part of the stem and one of the colonies has an oblique "knee" joint between two successive apophyses. The number of cauline nematothecae between two successive apophyses varies between two and three, one always being axillary.

2. The hydrocladia are regularly divided into rather sigmoid internodes of slightly varied length, invariably thecate. In younger parts of the colonies they are completely without septa. In colonies with best developed hydrothecae three septa (perisarcal rings) are present, one below the medial nematotheca, one opposite the adcauline opening of that nematotheca, and one forming a

bridge between the back of the hydrotheca and the (internal) internodal wall (fig. 33b).

3. The hydrotheca is of the characteristic curved shape, with the proximal part projecting far above the hydrothecal aperture, usually bluntly pointed. The length of the "spur" varies considerably, from reaching to the middle of the internode (fig. 33a) to overlapping the distal extremity of the internode (fig. 33b). The hydrothecal margin is slightly to distinctly sinuous, and the median cusp is always distinct and thickened. In upper parts of the colonies there are no septa at all at the hydrothecal base, but in well developed hydrothecae there may be as many as 10 septa, including the above mentioned septum connecting with the internal wall of the internode. All septa except the last (here uppermost) are perisarcal rings. The uppermost septum is more or less complete but has a frayed opening for the passage of the hydranth.

4. The paired lateral nematothecae vary in length and curvature. In all the ends of the hydrothecal walls have fused with the nematothecae. They spring directly from the internode and may run obliquely upwards or present a distinct bend at the level of the septum in the nemaotheca. In many nematothecae the apical portion is almost closed, leaving a small, circular hole (fig. 33b). In addition there is internally a circular hole for communication with the hydrotheca.

All specimens were collected live since remnants of hydranths are present in the hydrothecae.

	Galathea Exped. Off Durban (Vervoort, 1966a)	John Murray Exped. Sta. 107
Hydrocaulus		
diameter	95 – 110	160 – 170
Cauline nematotheca		
length	105 – 120	65 – 105
maximum diameter	55 – 60	40 – 50
distance between two successive apophyses	740 – 1080	780 – 850
Hydrocladium		
length internode	875 – 985	850 – 995
diameter at node	65 – 80	55 – 65
Hydrotheca		
distance between node and apex theca	470 – 515	215 – 390
breadth at rim	190 – 215	165 – 175
length of "spur"		390 – 640
Median nematotheca		
length	150 – 160	90 – 95
Lateral nematotheca		
length base-apex	210 – 215	140 – 215
maximum diameter	35 – 40	28 – 50
breadth at rim		10 – 14

Table 31. *Cladocarpus dofleini*. Measurements in μm.

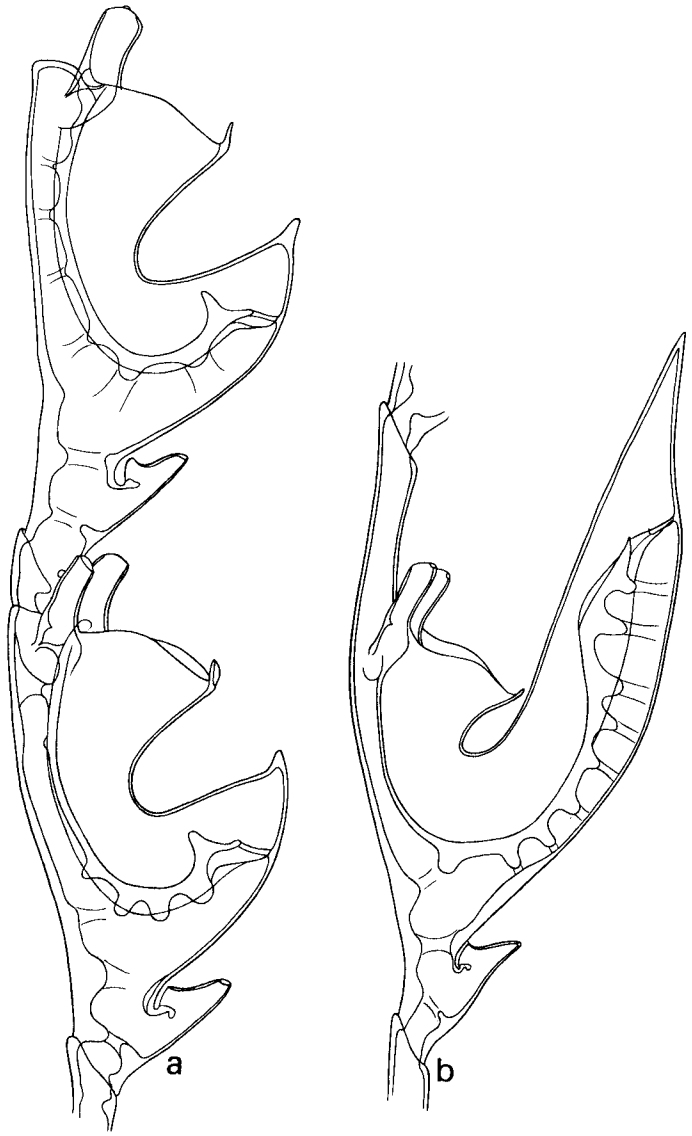


Fig. 33. *Cladocarpus dofleini* (Stechow), John Murray Exped., Sta. 107. a, two hydrocladial internodes with hydrothecae; "spur" short, lateral view; b, hydrocladial internode with hydrotheca; "spur" long, lateral view. a, b x 85.

Distribution. – Restricted to the Indian Ocean off the east coast of Africa, ranging from localities off Natal to the Gulf of Aden, at depths varying between 91 and 1019 m. The type locality of the species is off East Africa, 0°

24.5′ S, 42° 49.4′ E, 1019 m depth, in a soft bottom sediment. Millard's statement (1975: 422) that the type locality is "probably Agulhas Bank, South Africa, on a crab" must be due to a mistake. It was subsequently found at two localities off Durban (29° 55′ S, 31° 13′ E, 495 m depth, and 29° 55′ S, 31° 20′ E, 425-420 m depth, Vervoort, 1966) and off Natal (SM 86, 27° 59.5′ S, 32° 40.8′ E, 550 m depth, Millard, 1977b). The present records demonstrate its presence at two intermediate localities from the Zanzibar area, as well as extending the known distribution much farther to the north, viz., to the Gulf of Aden, where it occurred at a comparatively shallow depth (91 m).

Remarks. – We agree with Millard (1975: 421) that the species should be referred to *Cladocarpus* Allman, 1874a. There are at present no distinct differences held between this genus and *Dinotheca* Stechow, 1911. Phylactocarps such as occur in *C. dofleini* are found in several unmistakable representatives of *Cladocarpus*. The curious and extreme shape of hydrotheca in *C. dofleini* is connected by quite a number of intermediate forms with those species of *Cladocarpus* which have normally developed, elongate hydrothecae. We are also convinced, nevertheless, that the genus *Cladocarpus* as it is now understood comprises many heterogeneous species and is probably composite. An appropriate analysis of these species, using a large number of characters, may well lead towards a re-division.

Cladocarpus sewelli sp. nov.
(figs. 34-35, tab. 32)

Material examined. – Sta. 178. One colony 100 mm high (holotype) with basal tuft of hydrorhizal fibres; many phylactocarps present. In addition to the separately preserved holotype three microslide preparations (schizoholotypes) have been made in the course of the investigation (BMNH 1984.1.1.49, alc. (holotype) + sld. (schizoholotype); RMNH 16549, 2 slds (schizoholotypes)).

Description. – Colony comprising largely polysiphonic, stiff, slightly backwardly curved stem, springing from fairly large tuft of fine hydrorhizal fibres, anchoring colony in sediment. On hydrocaulus primary tube distinctly discernable frontally, carrying one frontal row of nematothecae along whole length, and two rows of alternately placed apophyses, almost in one plane but on close inspection slightly turned frontally. Three to four cauline nematothecae occur between two successive apophyses, one being axillary. Apophyses comparatively long, bearing hydrocladia c. 10 mm long, curving gracefully backwards, resulting in graceful, plumose colony.

Cauline nematothecae conical, terminal portion slightly rounded towards

the circular orifice, two-chambered, basal chamber separated by distinct, straight septum and communicating with interior of primary tube by well marked opening. Apical chamber, in addition to circular aperture, with circular hole in adcauline wall. Axillary nematotheca slightly larger than remaining nematothecae (fig. 34).

Hydrocladia composed of 8 to 10 hydrothecate internodes, each slightly sigmoidally curved, bearing large hydrotheca of characteristic appearance, one medial, infracalycine, unpaired nematotheca and paired supracalycine nematothecae projecting above hydrothecal rim. Abcauline hydrothecal wall with sharp, almost perpendicular, twist half way along its length; basal portion of hydrotheca turned forward, forming bluntly pointed "spur". Exact nature of hydrotheca can be seen in the drawing (fig. 34); there is only very little variation in shape and length of spur throughout colony except first hydrotheca of each hydrocladium, where spur is of distinctly reduced length and rounded at apex. Associated with internal wall of hydrotheca septa (perisarcal

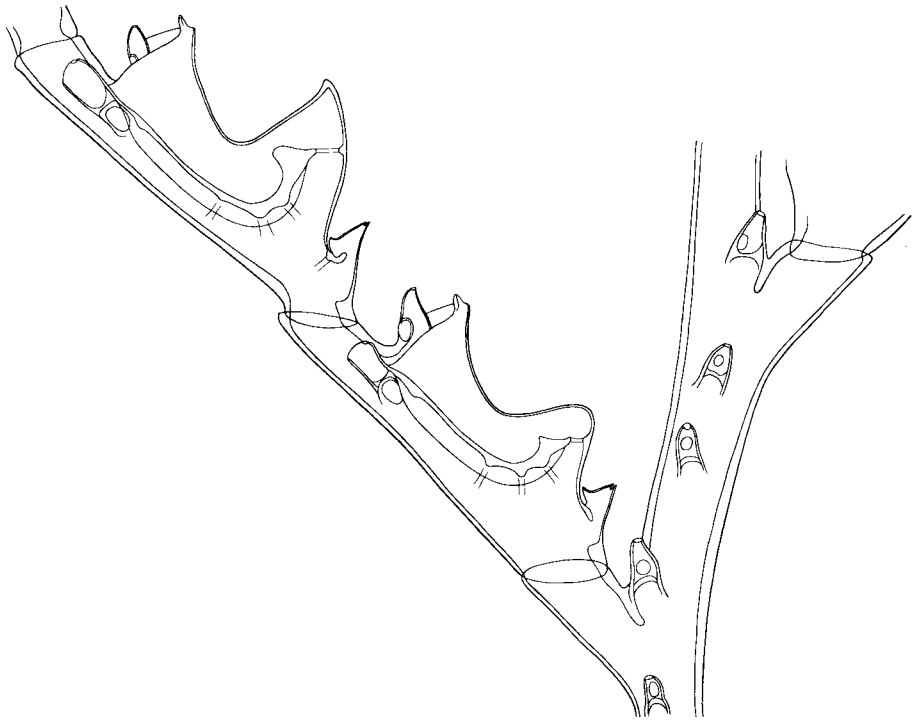


Fig. 34. *Cladocarpus sewelli* sp. nov., holotype, John Murray Exped., Sta. 178. Stem fragment in upper, monosiphonic part of colony, showing insertion of two hydrocladia, lateral view of hydrocladial internodes. x 70.

rings) occur, differing in number and in development. In older hydrothecae, found in basal parts of colony and at base of hydrocladia, maximally 7 such septal rings occur, four associated with curved hydrothecal base, one with base of lateral nematothecae, and 2 situated at upper portion of hydrothecal wall (one of which weakly developed). Interior of hydrotheca communicating with internode through ragged hole in plate connecting end of internal hydrothecal wall with middle of "spur". This plate may also be considered a perisarcal ring, bringing total number maximally found at hydrothecal base up to 5. Additional distinct ring at level of adcauline opening of median nematotheca and one at base of internode. Thickenings of frontal wall at end of internode indicate that rings may possibly develop there too. Number of rings may be fewer in younger hydrothecae than in old, though three rings associated with hydrothecal base invariably occurring, as well as one at base of lateral nematothecae. Hydrothecal margin medially produced into big cusp with thickened wall; hydrothecal margin distinctly convex, smooth to indistinctly crenulated (fig. 34).

Median, unpaired nematotheca conical, with slit-shaped terminal opening and one large circular aperture facing hydrothecal wall. Internally with thick-

Fig. 35. *Cladocarpus sewelli* sp. nov., holotype, John Murray Exped., Sta. 178. One of paired phylactocarps, lateral view. x 65.

ened lip projecting into its cavity.

Lateral, paired nematothecae beside hydrothecal aperture compressed laterally, two-chambered, cavities separated by thin septum. Nematothecae springing directly from internode; communication laterally visible as large, ear-shaped hole. Apical chamber funnel shaped, basally with circular hole just above hydrothecal rim. Apical portion largely closed, leaving small, circular aperture at distal corner. Upper portion of internode occasionally separated from hydrothecate part by straight septum.

Perisarc strongly developed on stem and internode; slightly less so on the hydrothecae, though comparatively thick along frontal hydrothecal wall and on "spur".

Basal part of colony with hydrocladia bearing phylactocarps over length of c. 10 mm. Phylactocarps arranged in opposite pairs, inserted on both sides of unpaired nematothecae of basal, slightly modified hydrocladial internode. Each pair forming open basket, surrounding gonothecae. Consecutive phylactocarps forming together heavily protected, almost closed, elongate oval in median plane of colony. Each phylactocarp forming inwardly curved, non-articulated structure bearing pairs of elongate nematothecae, whole structure shaped as a double rake (fig. 35). Six pairs of such nematothecae present; apical portion of axis of phylactocarp bearing two sessile nematothecae. Each elongate nematotheca with two openings, one terminal, one along frontal border. Gonothecae arranged along curved internal surface of axis of phylactocarp, usually two or three present on each phylactocarp. Male and female gonothecae occurring on same colony, though not found on same phylactocarp. Female gonotheca elongate oval with short tubular neck and circular opening. Male gonotheca truncate at apex and basally rounded. Their contents were spent, so that they became greatly compressed in the microslide preparation and could not be measured accurately. They are about half as long as the female ones.

Perisarc of phylactocarp is thick at its base, thinning out towards apex; terminal portion fragile.

Distribution. – *Cladocarpus sewelli* has been found in the Gulf of Aden, 12° 00′ 36″ N, 50° 40′ 06″ E (type locality), at 91 m.

Remarks. – This interesting species has features in common with both *Cladocarpus dofleini* (Stechow) and *C. natalensis* Millard (1977b: 127-129, fig. 10). From *C. dofleini* it is distinguished by the differing development of the hydrothecal "spur". In *C. dofleini* this spur is more strongly developed and is directed obliquely upwards. Moreover, the phylactocarp in *C. dofleini* is finer, with shorter, thinner nematothecae. From *C. natalensis*, in which the development of the "spur" varies a lot, it differs in that the internode is scarcely curved

	John Murray Exped. Sta. 178
Hydrocaulus	
diameter at base	500
distance between two successive apophyses	640 – 710
Cauline nematotheca	
length	70 – 120
maximum diameter	35 – 70
Hydrocladium	
length internode	625 – 695
diameter at node	86 – 95
Hydrotheca	
distance between node and apex theca	90 – 105
depth	320 – 370
breadth at rim	175 – 195
length of "spur"	175 – 200
Median nematotheca	
length free part	70 – 75
Lateral nematotheca	
length from insertion to apex	145 – 149
maximum diameter	50 – 57
breadth at rim	11 – 18

Table 32. *Cladocarpus sewelli*. Measurements in μm.

– it has a distinct bend in *C. natalensis* – and by the fewer and less developed perisarcal rings in the interior of the internode. The phylactocarp in *C. natalensis* is not a paired structure and its nematothecae are curved and more slender. We have been unable to identify this distinctive species with any other species of *Cladocarpus* and have consequently described it as unknown.

Etymology. – The specific name, *sewelli*, is a tribute to the late Lt.-Colonel R.B. Seymour-Sewell, C.I.E., F.R.S., leader of the John Murray Expedition.

Gymnangium eximium (Allman, 1874b)
(figs. 36-37, 38c, tab. 33)

Taxella eximia Allman, 1874b: 179.
Taxella eximis Kirchenpauer, 1876: 26.
Halicornaria saccaria Allman, 1876: 277-278, pl. 15 fig. 4, pl. 22 figs. 1-2.
Halicornaria bipinnata Allman, 1876: 279-280, pl. 22 fig. 5, pl. 23 fig. 2; Armstrong, 1879: 100; Schneider, 1897: 549; Bedot, 1921a: 346; Von Schenck, 1965: 942.
Halicornaria setosa Armstrong, 1879: 99-100, pl. 10; Thornely, 1904: 122; Bedot, 1921a: 347.
Lytocarpus longicornis Allman, 1883: 45-47, pl. 19 figs. 4-6 (non *Lytocarpus longicornis* (Busk, 1852)).
Halicornaria flabellata Marktanner-Turneretscher, 1890: 278-279, pl. 6 fig. 14; Schneider, 1897: 549; Bedot, 1921a: 346; Stechow, 1923d: 236.
Halicornaria gracilicaulis p.p. Billard, 1907c: 364, text-fig. 12, pl. 25 fig. 7; Billard, 1913: 63-65.
Halicornaria intermedia Billard, 1913: 65, text-fig. 53, pl. 4 fig. 37; Van Soest, 1976: 87.

Gymnangium (Halicetta) flabellata: Stechow, 1921e: 234.
Gymnangium (Halicetta) setosa: Stechow, 1921e: 234.
Halicornaria copiosa Jarvis, 1922: 356, text-fig. 6, pl. 26 fig. 28.
Gymnangium setosum: Stechow, 1923d: 236; Mammen, 1967: 311.
Gymnangium eximium: Stechow, 1923d: 236; Mammen, 1967: 311-312, fig. 104; Schmidt, 1972a: 39, 41, 43, text-fig. 2c, pl. 2 fig. C; Mergner & Wedler, 1977: 22, 24, pl. 6 fig. 40, pl. 9 figs. 62, 63; Vervoort & Vasseur, 1977: 81-84, fig. 34.
Halicornaria gracilicaulis Millard, 1958: 219, fig. 15I-J.
Halicornaria gracilicaulis lignosa Millard, 1968: 282.
Gymnangium gracilicaule lignosum: Millard, 1975: 443, fig. 136B-C, E.

Material examined. – Sta. 10. Two large, branched, plumose colonies and several fragments. Maximum height 220 mm, stem at base with diameter of 3.5 mm. No gonosome (BMNH 1984.1.1.50, alc. + 3 slds; RMNH 16550, alc. + sld.).

Sta. 24. Two colonies 150 and 90 mm high, and 50 mm long fragment. No gonosome (BMNH 1984.1.1.51, alc. + 4 slds; RMNH 16551, 5 slds).

Sta. 45. About 100 colonies and a large number of fragments. Largest colonies 110 mm high, spread 65 mm. All colonies and fragments more or less flabellate. No gonosome (BMNH 1984.1.1.52, alc. + 8 slds; RMNH 16552, alc. + 4 slds).

Sta. 53. Three colonies c. 90 mm high rising from communal mass of fibres. No gonosome (BMNH 1984.1.1.53, alc. + sld.; RMNH 16553, 2 slds).

Sta. 118. One colony c. 150 mm high, spread c. 100 mm, comprising irregularly branched hydrocaulus with a number of side branches and secondary side branches of uniform length. Hydrocladia of three to four internodes. No gonosome (BMNH 1984.1.1.54, alc. + 4 slds; RMNH 16554, 2 slds).

Sta. 120. Two branches of about 10 mm length preserved on a microslide (BMNH 1984.1.1.56, sld.).

Station unknown. Fine, branched, plumose colony 90 mm high, spread 96 mm; basal part invested by Bryozoa. No gonosome (BMNH 1984.1.1.55, alc. + sld.).

Description. – Flabellate, branched colonies, up to 150 mm in height and spread, comprising several plumose off-shoots, originating from forking of erect, polysiphonic hydrocaulus, basally 2-3 mm thick. It carries the primary tube, that may bear hydrocladia, or may branch again into secondary and tertiary ramifications. Side branches alternately arranged along shoots and hydrocaulus. Ramifications bearing hydrocladia monosiphonic only at their ends, where they are distinctly divided into internodes bearing hydrocladia. Internodes rapidly becoming covered by secondary tubules, leaving free apophyses bearing hydrocladia. Besides apophysis each internode with a basal and one axillary nematotheca; various apophyses obliquely directed towards front of colony. Basal nematotheca with 2 apertures. Axillary with single terminal aperture. No nematothecal septa (fig. 37a).

Hydrocladia borne on apophyses, alternate ones directed left and right, each divided into 2 to 5 hydrothecate internodes; various internodes of each hydrocladium distinct and completely separate. Hydrotheca large; shape best seen in fig 36. Hydrothecal rim with 2 distinct though blunt lateral cusps. Frontal curvature between lateral cusps without elevation, though in lateral

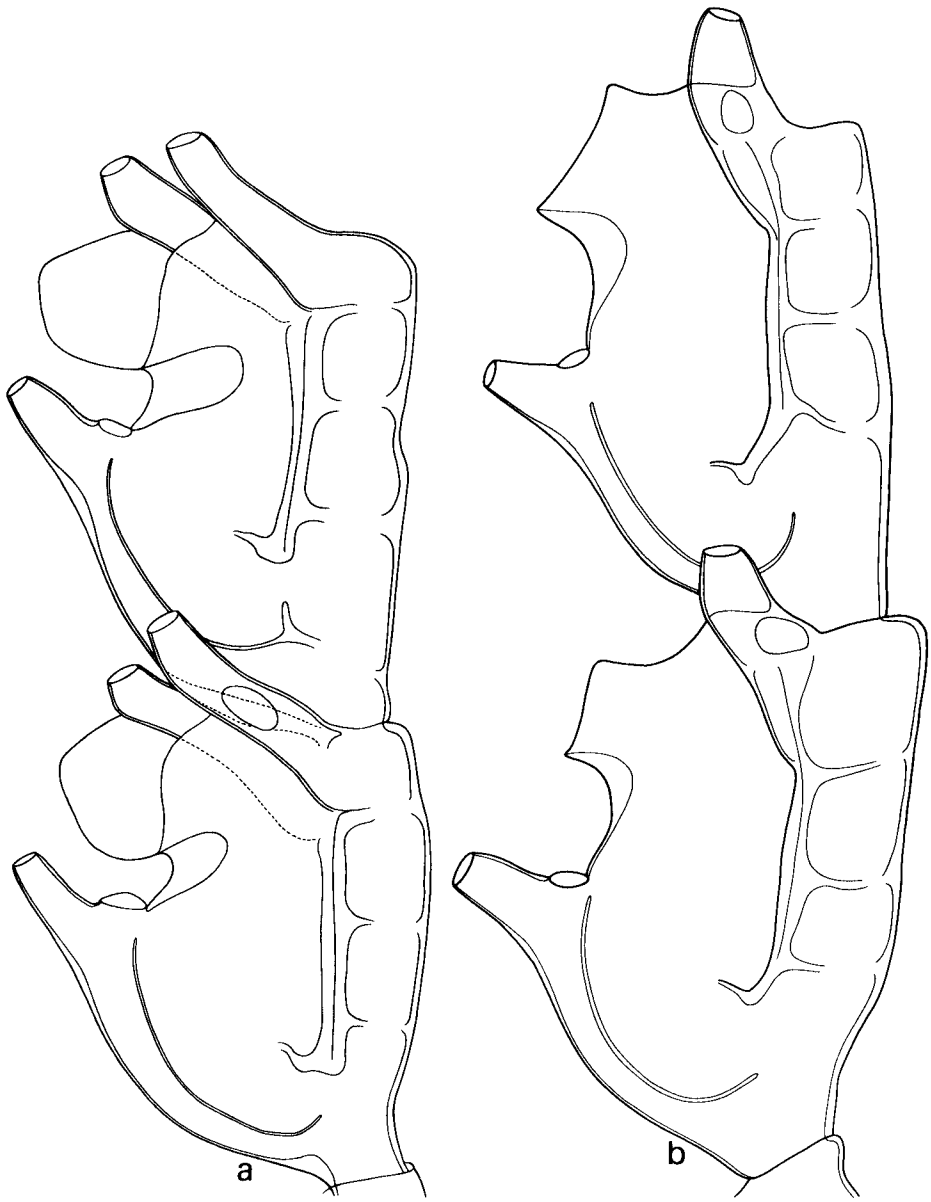


Fig. 36. *Gymnangium eximium* (Allman). a, John Murray Exped., Sta. 10, two hydrothecae from hydrocladium, slightly oblique lateral view. b, John Murray Exped., Sta. 24, two hydrothecae from hydrocladium, lateral view. a, b x 220.

aspect it may appear to have one. Plane of hydrothecal rim makes angle of 45° with long axis of hydrothecate internode. Nematothecae comprising one unpaired median and paired laterals. Median nematotheca covering about half median hydrothecal wall, though this varying a lot. Free part of median nematotheca varying in length, being either shorter (fig. 37f) or longer (fig. 36a, b) than free part of hydrothecal wall. Two openings present, a circular one at apex and a much larger oval one in axil between nematotheca and hydrothecal wall.

Lateral nematothecae in principal tubular structures, slightly swollen medially and narrowing apically, pointing obliquely forward (fig. 36a, b) though in some colonies curving upwards (fig. 37c). Apical aperture circular; lateral aperture oval, leading to interior of hydrotheca.

Hydrothecate internode with 4 internal rings, 2 of which are complete, viz., at base of lateral nematothecae and near end of dorsal hydrothecal wall. Of two incomplete rings one is situated between two complete rings and one just under basal ring.

The various colonies referred to this species differ considerably: 1. The number of hydrocladial internodes ranges between 2 and 5. Those colonies that have 5 hydrocladial internodes usually have these long and narrow, with a slender hydrotheca with the free part of the abcauline wall long and almost straight. Such colonies can be distinguished macroscopically by the long and fine hydrocladia(fig. 37a, b, c, f).

2. Colonies with a reduced number of hydrocladial internodes usually have these short, with compact hydrotheca with short, strongly curved free part of the abcauline hydrothecal wall. The plane of the hydrothecal aperture is directed downwards and makes an angle of 30° with the hydrocladial long axis. In side view the lateral marginal cusps are much more prominent than in the elongate type of hydrotheca, though actually they have about the same length. The free part of the median nematotheca is lengthened and is longer than the free part of the abcauline hydrothecal wall. The latter usually has a curved, oval, thickened shield which in lateral view may easily pass for a intrathecal septum or ridge (figs. 36a, 38c).

3. There is great variation in development of the rings in the hydrothecate internodes: there may be 4 rings (2 complete, 2 incomplete; fig. 36b), or only two complete rings (fig. 38c), with all possible transitional stages.

4. Though this variation is usually seen between colonies from various localities, much variation also occurs within a large colony, for example between hydrocladia from basal and upper parts.

Distribution. – Recorded from the Red Sea, the Indian Ocean and the

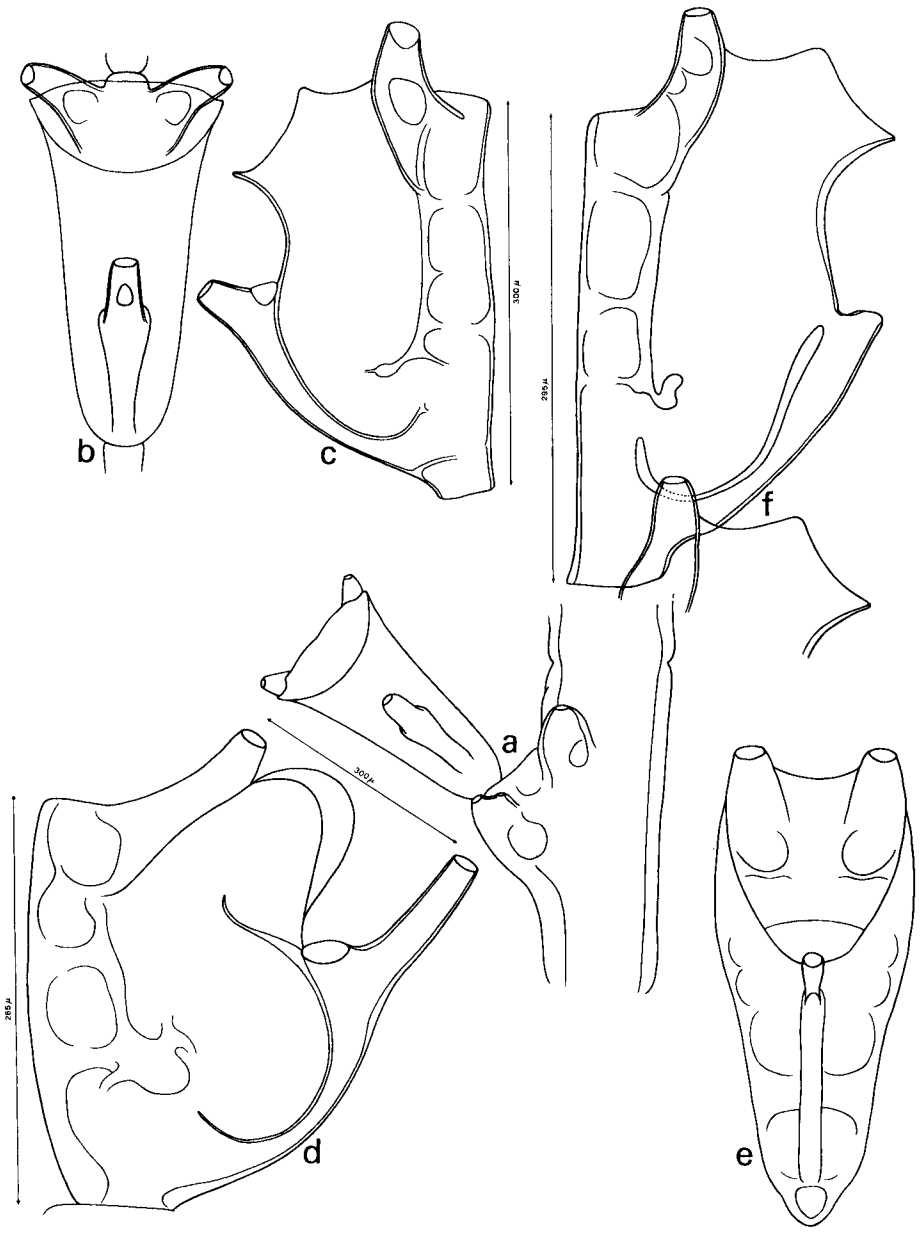


Fig. 37. *Gymnangium eximium* (Allman). a-c, John Murray Exped., Sta. 24. a, insertion of hydrocladium on internode, lateral view of internode; b, hydrotheca, frontal view; c, hydrotheca, lateral view. d, e, John Murray Exped., Sta. 27. d, hydrotheca, slightly oblique lateral view; e, hydrotheca, frontal view. f, John Murray Exped., Sta. 118, hydrotheca, lateral view. a, x 100; b, c x 165; d, e x 185; f x 220.

Pacific Ocean, viz., Gulf of Aqaba, 0-10 m (Schmidt, 1972a); Red Sea (Marktanner-Turneretscher, 1980, as *Halicornaria flabellata*, syntype in BMNH 1902.6.6.23; Mergner & Wedler, 1977, 1-220 m); Macalonga, Madagascar, 22 m (Billard, 1907c, as *Halicornaria gracilicaulis*); off eastern South Africa, 0-100 m (Millard, 1975, as *Gymnangium gracilicaule lignosum*); Amirante Islands, 37-155 m (Jarvis, 1922, as *Halicornaria copiosa*); Wasin, East Africa, 18 m (Jarvis, 1922, as *Halicornaria copiosa*); Karachi, India (Busk collection, BMNH 1899.7.1.6266); off Trivandrum, India, 27 m (Mammen, 1967); Sri Lanka (Allman, 1876, as *Halicornaria bipinnata* and *H. saccaria*); Zamboanga, Philippines, 18 m (Allman, 1883, as *Lytocarpus longicornis*); several localities in eastern part of Malay Archipelago, 18-36 m (Billard, 1913, as *Halicornaria intermedia*), and Moorea, French Polynesia, 0-15 m (Vervoort & Vasseur, 1977). The John Murray records are all within the known area of distribution. Their depth range, however, is considerable, extending down to 2926 m.

Remarks. – We have been able to compare the present specimens with a schizoholotype of *Gymnangium gracilicaule* (Jäderholm, 1903, as *Lytocarpus gracilicaulis*) (BMNH 1960.8.29.30). This species is more delicate in its mode of growth. There are distinct differences in the shape of the hydrothecae, those of *G. gracilicaule* being generally more slender and more sinuous than those of *G. eximium*, as also are the hydrocladial internodes. The lateral cusps of the hydrothecal rim are scarcely developed or absent, when the hydrothecal rim is even. The plane of the hydrothecal opening is tilted in an abcauline direction compared with that in *G. eximium*, so it is directed slightly upwards. The anterior, abcauline hydrothecal wall is slightly though distinctly thickened.

	Moorea Atoll (Vervoort & Vasseur, 1977)	John Murray Exped. Sta. 10	John Murray Exped. Sta. 27
Hydrocladial internode			
length	210 – 240	255 – 260	290 – 315
diameter	45 – 55	50 – 60	45 – 60
Hydrotheca			
depth	200 – 210	200 – 230	290 – 305
breadth at rim	95 – 100	100 – 130	110 – 120
Median nematotheca			
length free part	40 – 50	70 – 85	50 – 55
breadth at rim	15 – 20	17 – 20	18 – 20
Lateral nematotheca			
length measured from base	100 – 110	130 – 140	125 – 150
breadth at rim	10 – 15	17 – 23	23 – 29

Table 33. *Gymnangium eximium*. Measurements in μm.

The development of internal rings in *G. gracilicaule* is just as varied as in *G. eximium*. Though both species have a wide range of variation they are in our opinion quite distinct.

Part of the material of *Halicornaria copiosa* Jarvis, 1922, is in BMNH and has been re-examined. It is labelled "*Lytocarpus bipinnatus* (Allman, 1876) = *Halicornaria copiosa* Jarvis, 1922 = *Gymnangium eximium* (Allman, 1874)" and comprises:

a, 1923.2.15.43, Amirante, 40-155 m (E10). Three colonies, 100 x 60, 150 x 70, and 80 x 45 mm, marked "syntypes". In addition 3 microslide preparations with same number, all made up of stained branches. No gonosome.

b, 1923.2.15.45, Amirante, 66 m (39 fms on label) (E16). Three large, much forked colonies, up to 250 mm high. No gonosome. Here also belong 2 microslide preparations, 1923.2.15.209 (stained tip of colony) and 1923.2.15.99 (stained branch, on label "Amirante Bank, 36 fms"). Both without gonosome.

c, 1923.2.15.44, Amirante, 37-80 m (E25). Two colonies, one a very fine one, 130 mm high, spread c. 160 mm; second colony 110 x 75 mm; in addition a number of fragments. Here also belongs one microslide preparation: 1923.2.15.44, a stained top part of a colony.

d, 1923.2.15.42, Wasin, 18 m, C. Crossland coll. Several colonies up to 100 mm high and many fragments. No gonosome. Marked "holotype of *H. copiosa*", and "2nd bottle" by A.K. Totton.

e, 1923.2.15.41, Wasin, 18 m, C. Crossland coll. Two large colonies, 130 x 80 and 220 x 60 mm and some fragments. Marked "syntype" and "bottle 4" by A.K. Totton. In addition microslide preparation with same number, made up of stained top part of colony.

There are also 10 slides from the J.S. Gardiner collection, presented by Dr H.W.M. Tims, without locality data but probably from the series mentioned above, bearing the numbers: 1923.2.15.92, 93, 103, 104, 109, 111, 112, 113, 114, and 115.

In the Busk collection of BMNH there are five microslide preparations of *Halicornaria saccaria* Allman, 1876, from Ceylon (Sri Lanka), presented by Dr Holdsworth: 1899.7.1.5944, 5945, 5946, 5947, and 5954. All are glycerol preparations of top parts ("spikes") of colonies, much dried out, with the exception of 5947, which is a good microslide preparation. There are juvenile gonothecae on some of the branches.

Gymnangium expansum (Jäderholm, 1903)
(figs. 38a, b, tab. 34)

Halicornaria expansa Jäderholm, 1903: 303-304, pl. 14 figs. 5-7; Stechow, 1907: 200; Stechow, 1909: 5, 103-104, fig. 8; Stechow, 1913b: 10; Jäderholm, 1919: 26, pl. 26 fig. 7; Bedot, 1921a: 346; Von Schenck, 1965: 942.
Halicornaria sibogae Billard, 1918: 25-26, fig. 4; Van Soest, 1976: 87.
Gymnangium (Halicetta) expansum: Stechow, 1921e: 234.
Halicetta expansa: Stechow, 1923b: 19; Yamada, 1959: 83.
Gymnangium expansum: Stechow, 1923d: 236; Vervoort, 1966a: 165-166, figs. 65-66.

Material examined. – Sta. 124. One complete colony 160 mm high, and a few fragments. No gonothecae (BMNH 1984.1.1.57, alc. + sld.; RMNH 16555, 3 slds).

Description. – The John Murray specimen resembles in detail the "Galathea" material described by Vervoort (1966a), though it has no gonothecae. Sympodially built stem with helically arranged, unbranched plumes c. 5 cm long. Basal part of stem, detached from rest of colony, originating from bundle of fine fibres, evidently achoring colony in soft sediment. Plumes composed of rachis, divided into internodes delimited by slightly oblique nodes; apophyses on upper part of rachis, one to each internode; alternate ones pointing obliquely left and right. Hydrocladia slender, composed of 10-15 internodes, gracefully curving away from rachis. Hydrocladia white, rachis of plumes and stem light horn brown.

Each apophysis with three nematothecae: two axillary, one on each side of apophysis, and a third some distance under apophysis on internode. All cauline nematothecae with two openings, one terminal, one adaxial (fig. 38a).

Hydrocladia inserted immediately onto apophyses; no basal hydrocladial internodes of different appearance, first being just as following. Occasionally short, ring-shaped internode present between hydrothecate internodes, bearing no appendages. Hydrothecate internodes long and slender, scarcely curved, almost straight (fig. 38a).

Hydrotheca long and slender, as long as or slightly longer than internode, abcauline thecal wall gracefully curved in S shape, terminal portion running into fine, acute median spine or cusp. Adcauline hydrothecal wall free from internode for some distance (fig. 38b). Rim of hydrotheca making angle of 60° with long axis of internode and carrying three obtuse, low cusps on each side, separated by shallow, round embayments. Extreme basal part of hydrotheca with fine lip springing from bottom of abcauline wall. Mesial nematotheca short, covering small portion of abcauline hydrothecal wall; free part short, conical, with circular terminal aperture and additional circular aperture in axil with hydrothecal wall. Paired lateral nematothecae small, not reaching hydro-

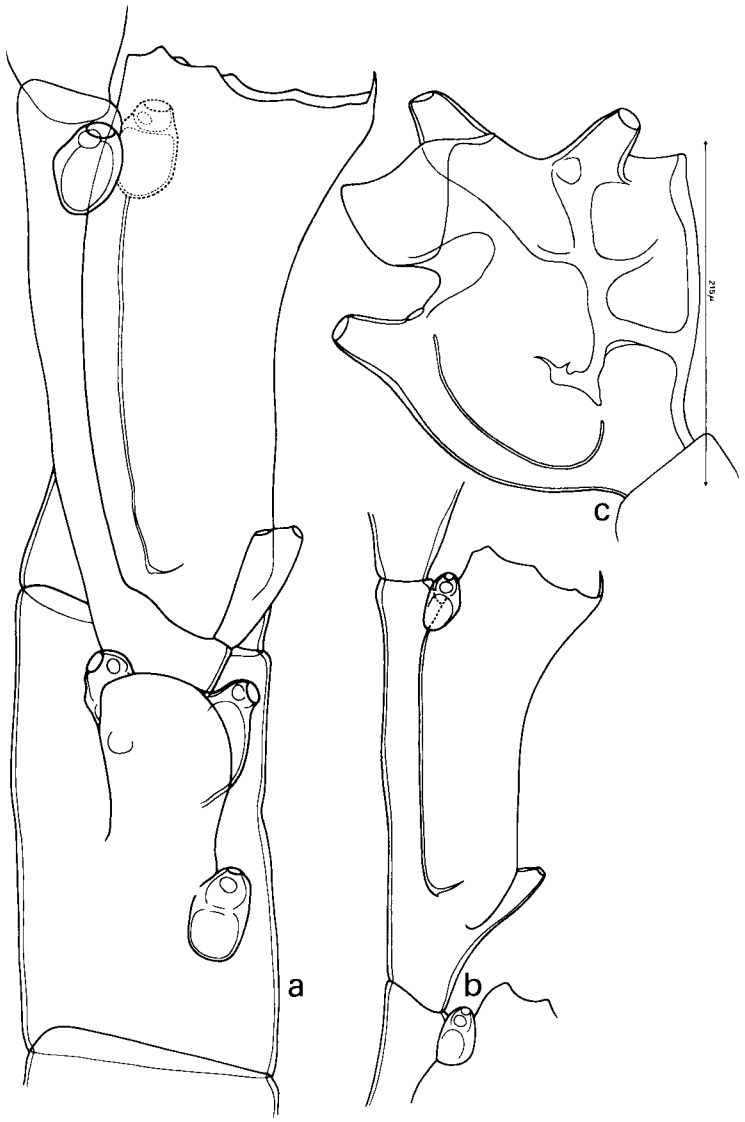


Fig. 38. a, b, *Gymnangium expansum* (Jäderholm), John Murray Exped., Sta. 124. a, insertion of hydrocladium on internode, oblique frontal view of internode; b, hydrotheca, lateral view. c, *Gymnangium eximium* (Allman), John Murray Exped., station unknown, hydrotheca, oblique lateral view. a x 85; b x 55; c x 200.

thecal border, composed of two chambers separated by distinct septum. Apical chamber with small, circular terminal opening and bigger, also circular, additional opening facing axil between nematotheca and internode.

	Vega Exped. Sta. 1107 (Vervoort, 1966a)	Galathea Exped. Sta. 490	John Murray Exped. Sta. 124
Internode of rachis			
length	495 – 510	580 – 675	725 – 780
diameter at node	255	245 – 260	340 – 390
distance between 2 successive apophyses	425	540 – 600	710 – 780
Cauline nematothecae			
length	100 – 110	135 – 150	120 – 140
maximum diameter	68 – 75	95 – 105	85 – 100
Hydrocladial internode			
length	595 – 680	865 – 950	815 – 885
diameter at node	85	135 – 148	125 – 140
Hydrotheca			
total length	690 – 725	865 – 890	815 – 850
breadth at rim	255	310 – 350	305 – 355
Unpaired nematotheca			
length free part	35 – 50	55 – 65	55 – 60
breadth at rim	17 – 35	40 – 48	28 – 36
Lateral nematotheca			
length	130	150 – 160	125 – 140
breadth at rim	68	35 – 40	20 – 28

Table 34. *Gymnangium expansum*. Measurements in μm.

Distribution. – Originally described from south of Japan (Vega Expedition, Sta. 1107, 29° 20′ N, 125° 40′ E, 104 m (Jäderholm, 1903, type locality; schizoholotype in BMNH 1960.8.29.39, figured by Vervoort, 1966a, fig. 65b). Additional Japanese material was described by Stechow (1907, 1909) and Jäderholm (1919) from Sagami Bay. Jäderholm's colonies come from depths of between 366 and 732 m. Billard's *Halicornaria sibogae* (Billard, 1918) is identical with *G. expansum* and was obtained at Sta. 284, Siboga Exped. (Van Soest, 1976), off the north-east point of Timor, 08° 43.1′ S, 127° 16.7′ E, 828 m. The "Galathea" specimens originate from the Bali Sea, Galathea Exped., Sta. 490, 05° 25′ S, 117° 03′ E, 545-570 m. The present record from the Zanzibar area, considerably extends the known geographical range of this rarely reported deep-water species.

Remarks. – Small though rather significant differences exist between the various specimens of *G. expansum* so far recorded. In Jäderholm's holotype each plume is bifurcated at the place of origin of the next branch. Stechow's specimens from the Bay of Sagami differ in having a completely different mode of ramification. They have a monopodial main axis with side branches directed in one direction only. Each side branch divides into three: two lateral branches that are strong and each divided into three smaller, secondary branches, and the original branch, not dividing again and much finer. Finally Billard's

material is characterized by the presence on each hydrocladium of a long basal internode ("une longue apophyse") without hydrothecae but with a nematotheca; the first hydrothecate internode is said to have two median, unpaired infracalycine nematothecae and is longer than the following internodes. Furthermore there is variation in the length of the free apical portion of the hydrotheca and the development of the lateral hydrothecal cusps.

We have not accepted Stechow's (sub)generic name *Halicetta*, type species *Halicornaria expansa* Jäderholm (Stechow, 1921e: 234; see also Stechow, 1923b: 19). Stechow repeatedly stressed the fact that in *Gymnangium* (= *Halicornaria*) the generic characters are vague, the genus being principally characterized by negative factors. Since Stechow's introduction of *Halicetta* more has become known about aglaopheniid hydroids and it is evident now that gonosomal characters are extremely important in defining genera. Since Stechow's subdivision of *Gymnangium* (= *Halicornaria*) was principally based on characters of the hydrotheca, and since the genus still contains so many species with unknown gonosome as to make a realistic subdivision at this stage impossible, we provisionally avoid employing *Haliaria* (type *Halicornaria vegae* Jäderholm, 1903: 301-303, pl. 14 figs. 1-4) and *Halicetta*, the two subgenera of *Gymnangium* proposed by Stechow.

Gymnnangium ferlusi (Billard, 1901)
(fig. 39, tab. 35)

Halicornaria ferlusi Billard, 1901: 121, figs. 3-4; Billard, 1907c: 370-371, text-fig. 14, pl. 25 fig, 8; Bedot, 1921a: 347; Millard, 1962: 312; Gravier-Bonnet, 1979: 62-67, figs. 12-13; Van Praët, 1979: 912, fig. 76.
Gymnangium (Haliaria) ferlusi: Stechow, 1921: 234.
Gymnangium ferlusi: Stechow, 1923d: 237; Millard, 1975: 440, fig. 137A-C; Millard, 1978: 192.

Material examined. – Sta. 45. A single plume 15 mm high attached to base of *Lytocarpia flexuosa flexuosa* (Lamouroux). No gonosome (BMNH 1984.1.1.58, sld.).

Description. – Rachis of plume attached to stem of *Lytocarpia f. flexuosa* by a few filaments (stolonal fibres), unbranched, unfascicled, top part divided into internodes by nodal constrictions, alternately slightly sloping left or right. Division into internodes obscure in basal part of rachis. Stem internodes without septa, each carrying one apophysis and three nematothecae. Alternate apophyses directed left and right, obliquely upwards. Hydrocladia borne on apophyses, gracefully curving left and right, forming oval plume. Two axillary nematothecae, one on front of colony, one on back. Third nematotheca placed on internode at base of apophysis. Each nematotheca, as also nematothecae

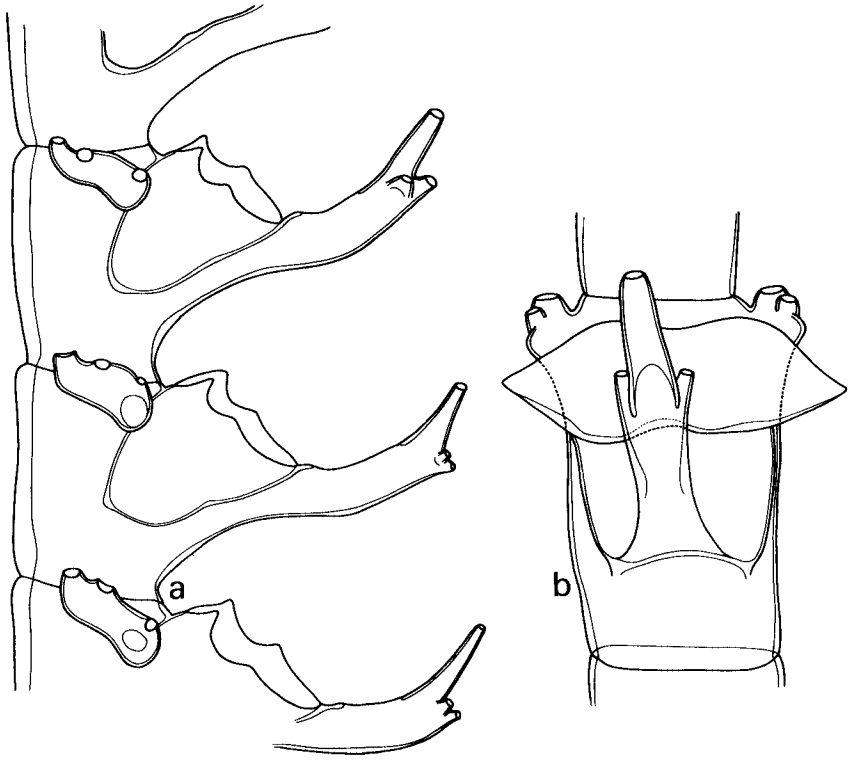


Fig. 39. *Gymnangium ferlusi* (Billard), John Murray Exped., Sta. 45. a, some hydrothecae from hydrocladium, lateral view; b, hydrotheca, frontal view. a x 85; b x 135.

flanking hydrotheca, with three circular openings. Upper surface of apophysis with scarcely visible "mamelon". Hydrocladia composed of 10-20 hydrothecate internodes without septa, delimited by slightly oblique nodes. Hydrothecae borne on front of internode. Hydrotheca not particularly large, cup-shaped, plane of aperture perpendicular to long axis of hydrotheca, making angle of 50°-60° with long axis of internode. Hydrothecal rim with two pairs of lateral cusps of which adcauline pair is best developed and acute; abcauline pair weakly developed and occasionally absent (fig. 39a). Hydrothecal aperture trapezoid in frontal view, with adcauline pair of marginal cusps widely separated (fig. 39b). Adcauline part of hydrothecal rim with deep, round embayment. Abcauline part of hydrothecal margin without median cusps but fused with thickened part of adcauline wall of mesial nematotheca. This mesial, unpaired nematotheca extending above hydrothecal border; free part as long as fused part, slightly curved upwards and with three circular openings the

configurations of which appear clearly from fig. 39a, b. Additional large, slit-shaped opening on adcauline wall of nematotheca. Paired lateral nematothecae directed backwards, with three circular apertures. First hydrothecate internode shorter; hydrotheca of normal size, mesial nematotheca not reduced.

Perisarc thick, especially in internodes; abcauline part of hydrothecal rim slightly thickened.

	John Murray Exped. Sta. 45
Cauline internode	
length	320 – 355
diameter at node	355 – 460
Hydrocladial internode	
length	250 – 340
diameter at node	125 – 155
Hydrotheca	
depth	235 – 255
breadth at rim	155 – 175
Mesial nematotheca	
length free part	215 – 285
diameter of terminal aperture	28 – 32
Lateral nematotheca	
greatest length	150 – 185
maximum diameter	70 – 90

Table 35. *Gymnangium ferlusi*. Measurements in μm.

Distribution. – This characteristic species has so far been recorded from Fort Dauphin, Madagascar (Billard, 1901, 1907c; Gravier-Bonnet, 1979) and the east coast of Cape Province and Natal (Millard, 1962, 1975). The depth distribution extends at least as far as 115 m (Gravier-Bonnet, 1979). A variety with reduced length of the mesial nematotheca (reaching just above the hydrothecal border) has been described by Jarvis (1922: 354, fig. 5, pl. 26 fig. 27) from Wasin, East Africa, as *Halicornaria* (= *Gymnangium*) *ferlusi* var. *brevis*. The present record from the southern Arabian coast considerably extends the known geographical range of this species.

Gymnangium gracilicaule (Jäderholm, 1903)
(fig. 40, tab. 36)

Lytocarpus gracilicaulis Jäderholm, 1903: 299-300, pl. 14 figs. 3-4; Stechow, 1913b: 10.
Halicornaria gracilicaulis: Ritchie, 1910a: 23-24; Stechow, 1912: 368-369; Billard, 1913: 63; Jäderholm, 1919: 26; Jäderholm, 1920: 9-10, pl. 2 fig. 9; Bedot, 1921a: 347; Billard, 1924: 67;

Billard, 1933: 25-26, pl. 1 fig. 5; Dollfus, 1933: 130; Millard, 1958: 219, fig. 15I-J; Von Schenck, 1965: 895, fig. 2d; Millard, 1967: 191-192; Vervoort, 1967: 47-50, figs. 14-15.

Gymnangium (Halicetta) gracilicaulis: Stechow, 1921e: 234.

Gymnangium gracilicaule: Rees & Thursfield, 1965: 170-171; Mammen, 1967: 310; Hirohito, 1983: 77.

Halicornaria gracilicaulis gracilicaulis: Millard, 1968: 282-283.

Gymnangium gracilicaulis: Schmidt, 1972a: 41, 43, 44; Schmidt, 1973: 285; Mergner & Wedler, 1977: 24, pl. 6 fig. 39, pl. 9 fig. 61.

Gymnangium gracilicaule gracilicaule: Millard & Bouillon, 1973: 8, 91-92; Millard & Bouillon, 1974: 10; Millard, 1975: 443, fig. 136A, D; Millard, 1978: 192.

Material examined. – Sta. 106. Two colonies 90 and 105 mm high. No gonothecae (BMNH 1984.1.1.59, alc. + sld.; RMNH 16556, alc. + sld.).

Sta. 107. One colony 90 mm high with 8 primary branches with hydrocladia. No gonothecae (BMNH 1984.1.1.60, alc. + sld.; RMNH 16557, sld.).

Sta. 113. One stem c. 14 mm high, monosiphonic, with about 10 partly damaged hydrocladia. No gonothecae (BMNH 1984.1.1.61, alc. + sld.; RMNH 16558, sld.).

Description. – Colony feather shaped, comprising polysiphonic though thin stem and pinnately arranged side branches. Basal part of stem devoid of branches. Bundle of fine fibres basally, anchoring colony in sediment. Stem composed of several parallel tubes. Primary tube visible on front of colony, carrying longitudinal row of nematothecae and in upper part apophyses supporting short hydrocladia. As on branches apophyses here have two nematothecae. Side branches originating from two accessory tubules running parallel to primary tube, bearing no neatothecae but with long, acutely pointed apophyses supporting side branches; the two rows of apophyses being opposite and individual apophyses alternating. Branches springing from apophyses, articulating by oblique hinge joints, c. 20 mm long, frontally with row of apophyses, alternately pointing obliquely left and right and supporting hydrocladia. Division of branches into internodes visible only in distal parts of branches, obscure in lower parts. Each apophysis with two large, two-chambered nematothecae, one above apophysis, almost in its axil and pointing in opposite direction from apophysis; second nematotheca partly on lower part of internode, partly on apophysis under insertion of hydrocladium. Several branches have a large, circular opening on apophyses next to basal nematotheca, probably originally places of insertion of gonothecae.

Hydrocladia gracefully curving away from branch, all in one plane, 2-3 mm long, composed of 5-8 hydrothecate internodes; basal internode and its hydrotheca as rest of internodes. Internodes slender, slightly to distinctly sigmoidally curved, with four distinct and one indistinct perisarcal rings, viz., at base of mesial nematotheca, at hydrothecal "lip", at bases of lateral nematothecae and at upper end of insertion of lateral nematothecae. Indistinct ring present half way between second and third rings (fig. 40a, b).

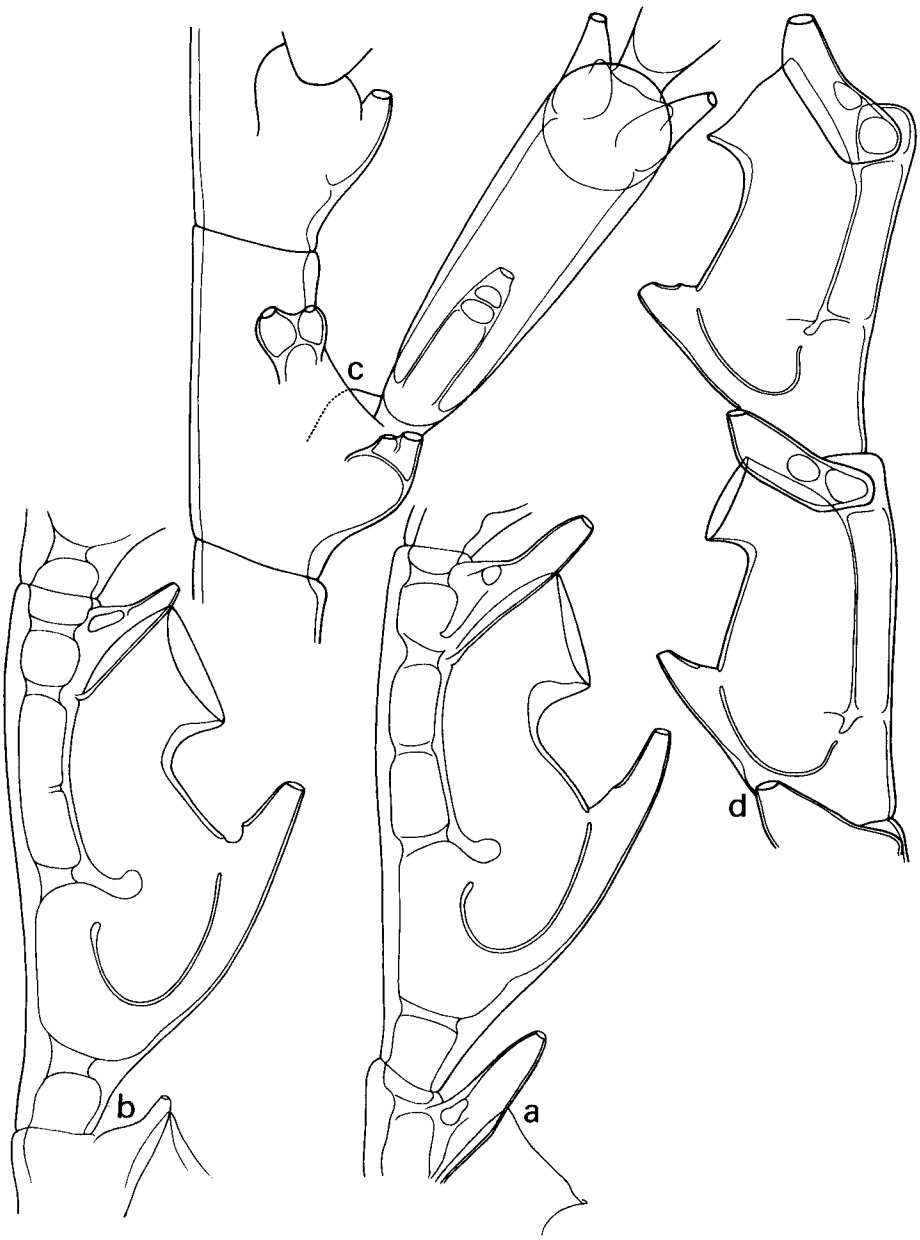


Fig. 40. *Gymnangium gracilicaule* (Jäderholm). a, John Murray Exped., Sta. 107, hydrotheca, lateral view. b, John Murray Exped., Sta. 113, hydrotheca, lateral view. c, d, Schizoholotype of *Lytocarpus gracilicaulis* Jäderholm, Vega Exped., Sta. 1112, BMNH 1960.8.29.40. c, insertion of hydrocladium on internode, slightly oblique lateral view of internode; d, hydrothecae, lateral view. a-d x 135.

Hydrotheca sigmoidally curved, mode of curvature varied, but abcauline hydrothecal wall always with perfectly flattened portion, curving sharply outwards near hydrothecal aperture. Flattened part of hydrothecal wall with distinct though varied thickening of perisarc (fig. 40a, b). Apical portion of hydrotheca sharply curving outwards; plane of aperture making angle of 30° (or slightly less) with internodal long axis. Rim usually perfectly circular, in some hydrothecae with indication of two rounded lateral cusps, one on each side; no indication whatsoever of median marginal cusp. Adcauline hydrothecal wall internally with inwardly projecting, thickened "lip".

Mesial nematotheca curving over ventral portion of hydrotheca; apical, free part varied in length, slightly curved. Terminal aperture circular, opening at axil with abcauline hydrothecal wall slit shaped; internal communication between nematotheca and hydrothecal cavity distinctly visible. Lateral, paired nematotheca more or less tubular, projecting obliquely upwards and forwards, apparently one-chambered, with narrowed, circular terminal aperture and a lateral aperture facing medial plane.

	Vega Exped. Sta. 1112 (schizoholotype, BMNH 1960.8.29.30)	John Murray Exped. Sta. 107	John Murray Exped. Sta. 113
Branch			
length of internode	285 – 320		
diameter	70 – 100	140 – 165	
distance between 2 successive apophyses	270 – 320	380 – 400	
Hydrocladium			
length internode	325 – 370	445 – 480	495 – 520
diameter at node	40 – 55	50 – 65	55 – 70
Hydrotheca			
total length	290 – 305	325 – 355	355 – 375
breadth at rim	100 – 120	105 – 120	100 – 115
length "flat" part	120 – 135	105 – 110	100 – 115
Median nematotheca			
length free part	50 – 60	80 – 85	85 – 100
breadth at rim	14 – 18	25 – 32	21 – 28
Lateral nematotheca			
length	105 – 115	165 – 175	145 – 150
breadth at rim	17 – 25	21 – 28	21 – 25
maximum diameter	35 – 43	49 – 64	50 – 65

Table 36. *Gymnangium gracilicaule*. Measurements in μm.

Distribution. – Widely distributed in tropical and subtropical parts of the Indian Ocean and the Indo-West Pacific, including Japanese waters where the species seems to be fairly common in suitable localities (e.g. Sagami Bay,

Hirohito, 1983). The species is known to occur from the Red Sea southwards along the Indian Ocean coast of Africa, almost reaching Cape Province. From Zanzibar there are no definite previous records and the species is newly recorded from that area.

Remarks. – As discussed above under *Gymnangium eximium*, we have not followed Millard (1968) in subdividing the nominal species *G. gracilicaule* into two subspecies, *G. gracilicaule gracilicaule* and *G. gracilicaule lignosum* (Millard, 1968). The two forms, in our opinion, must be separated at the specific rather than the subspecific level since they can be distinguished by a number of differences in colony structure, hydrocladia, hydrothecae and probably also gonothecae; moreover, they are largely sympatric. We do not, therefore, recognize a separation of *G. gracilicaule* into two subspecies and we have referred *G. gracilicaule lignosum* to *G. eximium*.

The John Murray specimens are much varied. The material from Stations 106 and 107 has longer median and lateral nematothecae. The curvature of the hydrotheca is considerable and the abcauline hydrothecal wall is strongly thickened. These characters, however, vary within a colony. We compared the John Murray specimens with a schizoholotype of *Lytocarpus gracilicaulis* Jäderholm, 1903, present in BMNH (1960.8.29.40, from Vega Expedition, Sta. 1112, 27° 35′ N, 123° 35′ E, East China Sea, N.E. of Taiwan, 91 m; fig. 40c, d). Though there is general similarity in the shape of the hydrothecae, the schizoholotype has only two septa (rings) per hydrocladial internode, viz., at the intrathecal "lip" and at the base of the lateral nematothecae (fig. 40d). The mesial nematotheca is short and the lateral nematothecae are distinctly swollen. Most of the hydrothecae have a perfectly circular rim, and some have weak lateral lobes. The "lip" is thin and represented by a perisarcal fold. Development of perisarcal rings in the hydrocladial internode, and the length of the nematothecae, are both notoriously varied in *Gymnangium*. Consequently no great importance should be attached to the differences between the schizoholotype and the John Murray material in these respects, especially since there is complete similarity in the shape and structure of the highly characteristic hydrothecae between the two series.

Gymnangium hians (Busk, 1852)
(fig. 41, tab. 37)

Plumularia hians Busk, 1852: 396; Kirchenpauer, 1876: 30.

Halicornaria hians: Bale, 1884: 179-180, pl. 13 fig. 6, pl. 16 fig. 7; Kirkpatrick, 1890b: 604; Stechow, 1909: 101, pl. 1 fig. 11, pl. 6 figs. 16-17; Billard, 1913: 68-69; Stechow, 1913b: 10, 94-95, fig. 61; Jäderholm, 1916: 8, fig. 5; Briggs, 1918: 47; Stechow, 1919: 125; Bedot, 1921a: 347;

Jarvis, 1922: 355; Nutting, 1927: 237; Vervoort, 1941: 222-225, figs. 7-8; Millard, 1958: 219-220, fig. 15G-H; Pennycuik, 1959: 186.

Aglaophenia balei Marktanner-Turneretscher, 1890: 272-273, pl. 7 figs. 19-20; Billard, 1905b: 334.

Halicornaria flava Nutting, 1905: 955, pl. 6 fig. 2, pl. 13 figs. 11-12.

Halicornaria hians var. *profunda* Ritchie, 1909b: 528; Ritchie, 1910a: 24, pl. 4 figs. 13-14; Jäderholm, 1919: 26, pl. 6 fig. 6.

Halicornaria balei: Ritchie, 1910a: 22-23, pl. 4 fig. 12.

Halicornaria balei var. *flava*: Ritchie, 1910a: 23.

Halicornaria hians var. *laxa* Ritchie, 1910c: 835-836, fig. 81; Rees & Thursfield, 1965: 197; Smaldon, Heppell & Watt, 1976: 23.

Halicornaria hians var. *balei*: Billard, 1913: 70, fig. 56; Bedot, 1921a: 347; Van Gemerden-Hoogeveen, 1965: 70-73, figs. 39-41.

Halicornaria hians var. *flava*: Bedot, 1921a: 347.

Gymnangium hians: Stechow, 1923b: 19; Stechow, 1923d: 236, 239; Stechow, 1924: 69; Stechow, 1925a: 254; Yamada, 1958: 51, 61-62; Yamada, 1959: 84; Ooishi, 1964: 191; Rees & Thursfield, 1965: 171; Mammen, 1967: 311; Rho, 1967: 346, fig. 6; Millard & Bouillon, 1973: 92-93; Rho & Chang, 1974: 147; Millard, 1975: 444-445, fig. 134G-H; Rho, 1977: 279, 425, pl. 93 fig. 93; Vervoort & Vasseur, 1977: 84-86, fig. 35; Millard, 1978: 193; Hirohito, 1983: 77.

Gymnangium hians var. *balei*: Mammen, 1967: 311; Vervoort, 1968: 114; Schmidt, 1972a: 41; Mergner & Wedler, 1977: 24, pl. 6 fig. 38, pl. 10 figs. 64-69.

Gymnangium hians var. *flava*: Mammen, 1967: 311.

Halicornaria hians balei Van Praët, 1979: 912.

Material examined. – Sta. 45. A single plume 30 mm long attached to base of *Lytocarpia flexuosa flexuosa* (Lamouroux). No gonosome (BMNH 1984.1.1.62, 2 slds; RMNH 16560, 2 slds).

Description. – Sole specimen comprises upright stem with some basal filaments, attaching colony to base of *Lytocarpia f. flexuosa*. Both sides of stem carry hydrocladial apophyses, alternately arranged and pointing sidewards and upwards. Division into internodes not visible, but perisarcal constrictions occur between each pair of apophyses. Each apophysis with three cup-shaped nematothecae, two axillary (one on each side of axil) and a third on "internode" directly under apophysis.

Hydrocladia 10-15 mm long, each composed of 20-30 hydrothecate internodes, first internode not differing from those following. Separation of internodes indistinct in proximal parts of hydrocladium; septa slightly oblique in distal parts. Hydrotheca cup shaped, rim slightly flared in frontal view, with three obtuse cusps on each side, no ad- or abcauline median cusps (fig. 41a-c). Plane of aperture at 70°-80° to long axis of internode. Abcauline hydrothecal wall with internal "lip" with slightly thickened margin. Mesial, unpaired nematotheca almost completely confluent with abcauline hydrothecal wall, apparently without communication with interior of hydrotheca, free apical portion of varied length, extending beyond hydrothecal rim by half its length in proximal parts of hydrocladia (fig. 41a) but only just projecting above the rim in distal parts (fig. 41b). Terminal aperture of mesial nematotheca circular, continuing as slit some distance along adcauline margin.

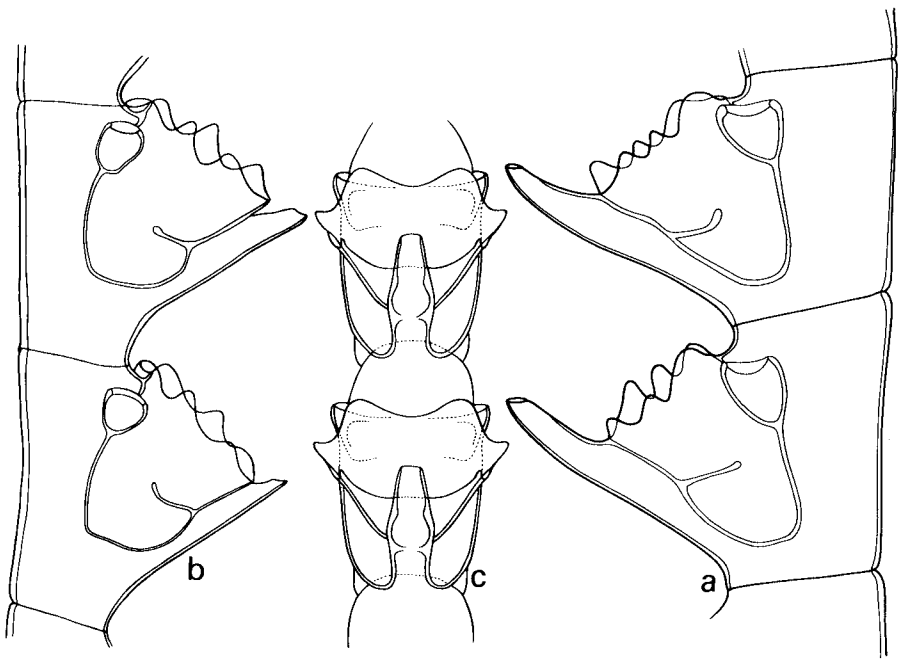


Fig. 41. *Gymnangium hians* (Busk), John Murray Exped., Sta. 45. a, hydrothecae from proximal part of hydrocladium, lateral view; b, hydrothecae from distal part of hydrocladium, lateral view; c, hydrothecae from distal part of hydrocladium, frontal view. a-c x 80.

Pair of lateral nematothecae small and cup shaped, not reaching hydrothecal border.

Distribution. – The species is widely distributed in tropical parts of the Indo-West Pacific, particularly the Malay Archipelago, and from there penetrates widely into subtropical regions of those oceans (Millard, 1975). In the western part of the Indian Ocean area it occurs from the Red Sea southwards along the east coast of Africa as far as Natal (Millard, 1975; Mergner & Wedler, 1977, as *Gymnangium hians* var. *balei*). The present record is from the waters off southern Arabia, where the species has not been recorded before but which locality is within the known distribution of the species. It has also been recorded from the Caribbean (Van Gemerden-Hoogeveen, 1965, as *Halicornaria hians* var. *balei*).

Remarks. – The hydrothecae of the present specimen have invariably three obtuse marginal cusps on each side, though the height of the cusps varies slightly within the colony. There is more variation in the length of the free portion of the mesial nematotheca, the longest free part being found in the

	John Murray Exped., Sta. 45
Stem	
distance between constrictions	815 – 850
diameter at constrictions	320 – 355
Hydrocladial internode	
length	305 – 390
diameter at node	125 – 200
Hydrotheca	
depth, including marginal cusps	240 – 255
maximum breadth	235 – 270
Mesial nematotheca	
length free part	55 – 125
breadth at rim	20 – 30
Lateral nematotheca	
depth	63 – 105
maximum diameter	50 – 65

Table 37. *Gymnangium hians*. Measurements in μm.

hydrothecae of proximal portions of hydrocladia in the basal parts of the colony (fig. 41a, b).

Lytocarpia flexuosa flexuosa (Lamouroux, 1816) (fig. 42)

Aglaophenia flexuosa Lamouroux, 1816: 167.
Aglaophenia (Aglaophenia) flexuosa: Kirchenpauer, 1872: 25.
Thecocarpus giardi Billard, 1907c: 381-385, text-fig. 21, pl. 25 fig. 9, pl. 26 figs. 11-16; Vervoort, 1946a: 335; Millard, 1957: 240-241; Millard, 1958: 221-222, fig. 16A; Van Praët, 1979: 933.
Thecocarpus flexuosus: Billard, 1909: 330; Bedot, 1921a: 333; Millard, 1961: 208; Redier, 1967: 406-407; Millard, 1973: 25; Gravier-Bonnet, 1979: 67-70, fig. 14.
Lytocarpia flexuosa: Stechow, 1922: 151; Stechow, 1923d: 245.
?*Aglaophenia (?) bifida* Stechow, 1923c: 117-118; Stechow, 1925b: 515-516, fig. 53.
Thecocarpus flexuosus flexuosus: Millard, 1962: 315, fig. 12A, J-L; Millard, 1975: 458-460, fig. 140A-C; Mergner & Wedler, 1977: 22, pl. 6 fig. 37, pl. 11 figs. 70-73; Millard, 1977b: 107; Millard, 1978: 199.

Material examined. – Sta. 24. Six fine colonies between 10 and 20 cm high. No gonosome (BMNH 1984.1.1.63, alc. + 3 slds; RMNH 16561, alc. + 3 slds).

Sta. 45. Twenty fine colonies up to 90 mm high, most attached to coral debris, one on small colony of *Gymnangium eximium* (Allman). One additional specimen in bad condition. No gonosome (BMNH 1984.1.1.64, alc. + 6 slds; RMNH 16562, alc. + 5 slds).

Distribution. – *Lytocarpia flexuosa* was originally recorded from the East Indies by Lamouroux (1816, type locality), but its occurrence there has not been reconfirmed and seems highly unlikely. Its occurrence in Australian

Fig. 42. *Lytocarpia flexuosa flexuosa* (Lamouroux). a, John Murray Exped., Sta. 24, hydrothecae, lateral view. b, John Murray Exped., Sta. 45, hydrothecae, lateral view. a, b x 115.

waters, based on Kirchenpauer's record from that area, must also be considered highly dubious (Kirchenpauer, 1872: 25, as *Aglaophenia flexuosa*): its occurrence there has never been reconfirmed. The species and its various subspecies and/or forms are widely distributed in the western Indian Ocean and in the Red Sea (Cape of Good Hope, Vervoort, 1946a, as *Thecocarpus giardi*; False Bay, Millard, 1957; south-east coast of South Africa, Millard, 1962; Algoa Bay, Millard, 1961, also Kirchenapuer, 1872, as *Aglaophenia plumifera*; Agulhas Bank, Stechow, 1925b, as *Aglaophenia (?) bifida*; Natal, Millard, 1958, 1961, 1977b; Madagascar, Billard, 1907c, as *Thecocarpus giardi*, and Red Sea, Mergner & Wedler, 1977). The John Murray records confirm its presence in the Gulf of Aden and along the southern Arabian coast. The

species has been recorded down to a depth of about 100 m.

Remarks. – For a discussion of the various forms of *Lytocarpia flexuosa* (Lamouroux, 1816) we refer to Millard (1975: 458-461, figs. 140-141). As in *Lytocarpia myriophyllum* (Linnaeus, 1758) there are slight differences between all the specimens and the various subspecies described in the two species can be bridged by intermediate specimens. The variation in *Lytocarpia flexuosa* is also evident from a comparison of the material from the two John Murray stations (fig. 42a, b) and Millard's subspecies may prove invalid. In structure of colony and of hydrotheca the John Murray specimens resemble the nominate subspecies described by Millard and have consequently been recorded under that name.

Aglaophenia (?) bifida Stechow, 1923c, should probably also be referred to *L. flexuosa*.

We have referred the species to the genus *Lytocarpia* Kirchenpauer, 1872, type species *Sertularia myriophyllum* Linnaeus, 1758, following Stechow's suggestion (1920a: 36; 1923d: 244), since his arguments are irrefutable. We do so, nevertheless, with considerable hesitation since it implies dropping the well known and widely used genus name *Thecocarpus* Nutting, 1900.

Macrorhynchia philippina (Kirchenpauer, 1872) (fig. 43)

Aglaophenia (Macrorhynchia) Philippina Kirchenpauer, 1872: 29, 45-46, pl. 1 fig. 26, pl. 2 fig. 26, pl. 7 fig. 26.

Lytocarpus philippinus: Kirkpatrick, 1890b: 604; Nutting, 1900: 122-123, pl. 31 figs. 4-7; Billard, 1907c: 377-378, fig. 18; Congdon, 1907: 484; Thornely, 1908: 84; Ritchie, 1910a: 20-21; Billard, 1913: 78-79, fig. 63; Jäderholm, 1916: 7-8; Thornely, 1916: 150; Jäderholm, 1917: 20; Bale, 1919: 351-352; Jäderholm, 1920: 9; Jarvis, 1922: 354; Jäderholm, 1923: 5; Hargitt, 1924: 503; Billard, 1926: 99-100; Gravely, 1927: 18, pl. 3 fig. 18; Nutting, 1927: 235-236; Briggs & Gardner, 1931: 193-194, fig. 4; Billard, 1933: 25-26; Dollfus, 1933: 130; Leloup, 1937b: 5, 48; Fraser, 1938a: 10, 61; Fraser, 1938c: 135; Leloup, 1939: 13-14, fig. 9; Vervoort, 1941: 225-226; Vervoort, 1946a: 329-330; Fraser, 1948: 188, 273-274; Millard, 1958: 220; Pennycuik, 1959: 186; Van Gemerden-Hoogeveen, 1965: 74-76, fig. 42; Rees & Thursfield, 1965: 176-177; Von Schenck, 1965: 942, 952, fig. 34a; Redier, 1966: 93; Redier, 1967: 405; Millard, 1968: 284; Vervoort, 1968: 88-90, 115, fig. 41; Schmidt, 1972a: 40, 41, 43, 45; Millard & Bouillon, 1973: 93-94; Schmidt, 1973: 284; Millard & Bouillon, 1974: 10; Rho & Chang, 1974: 135, 147; Millard, 1975: 449-451, fig. 138A-C; Wedler, 1975: 333, 340; Mergner & Wedler, 1977: 24, 26, pl. 6 fig. 43, pl. 12 figs. 80-81; Rho, 1977: 283-284, 427, pl. 97 fig. 78; Millard, 1978: 195.

Lytocarpia philippina: Stechow, 1919: 132-134, fig. Z[1].

Macrorhynchia philippina: Stechow, 1923d: 241; Stechow, 1924: 69; Stechow, 1925a: 258-259; Vannucci, 1946: 587-588, pl. 6 fig. 71, pl. 7 fig. 65; Vannucci, 1949: 256; Vannucci, 1954: 118; Mammen, 1967: 314, figs. 110-111; Gravier, 1970b: 253-256, fig. 1; Hirohito, 1983: 78-80, fig. 41.

Material examined. – Sta. 27. Single irregularly branched colony c. 100 mm high and some fragments. No gonosome (BMNH 1984.1.1.65, alc. + 2 slds; RMNH 16563, alc. + 3 slds).

Description. – A full description of this well known species is unnecessary. Stem branched, branches with pinnately arranged side branches; colony, therefore, composed of a number of plumes 50-80 mm long. Hydrocladia arranged in two nearly opposite series along side branches and fairly short, comprising 5-10 internodes. In distal parts of side branches division into short internodes still distinct, though secondary tubules are already present. These, and fusion of internodes, obscure exact structure of side branches. Internodes of side branches each with distinct, large apophysis, alternate ones directed left and right and in both slightly frontally. Hydrocladia inserted on these apophyses curving gracefully backwards. Each apophysis with three nematothecae: one reduced nematotheca ("mamelon") on the front, one almost axillary and one near its base on internode. First hydrocladial internode slightly shorter than remaining internodes; hydrotheca on this internode consequently slightly smaller. Basal internode of hydrocladium with three ring shaped septa, following internodes with four (fig. 43). Basal part of internode with perisarcal thickening on both sides, developing in some internodes into imperfect septum or ring. Hydrotheca at adcauline wall with strongly sclerotized fold, projecting into interior of hydrotheca. Abcauline hydrothecal wall above aperture in mesial nematotheca sclerotized, with strong, distinct, internally projecting lip. From this lip springs a thickened median abcauline hydrothecal cusp, the degree of development differing throughout the colony. In frontal aspect this abcauline, median cusp is visible as rounded, thickened lamella between lateral hydrothecal walls, height of lamella varying. Lateral hydrothecal margins developed as large, rounded lobes, in some hydrothecae shaped as blunt lateral cusps, one on each side. Mesial nematotheca usually large, directed upwards and forwards, narrowing towards apex and there with circular terminal aperture. In addition there is an opening in axil of hydrothecal wall. Lateral nematothecae usually projecting forwards, but in distal parts of hydrocladia projecting obliquely forwards and upwards, with circular terminal aperture and large median opening.

Distribution. – *Macrorhynchia philippina* is distributed circumglobally in the tropical and subtropical parts of all oceans, and in depth distribution extends from surface waters to at least 411 m (Billard, 1913). The present record, in the eastern extremity of the Gulf of Aden, is from an area where the species has previously been observed by Schmidt (1972a, 1973), Wedler (1975) and Mergner & Wedler (1977).

Remarks. – The present specimens closely resemble *Gymnangium eximium* (Allman) in external appearance. They can be readily distinguished from that species by the presence of a well marked abcauline ridge projecting into the lumen of the hydrotheca. The development of rings in the hydrocladial

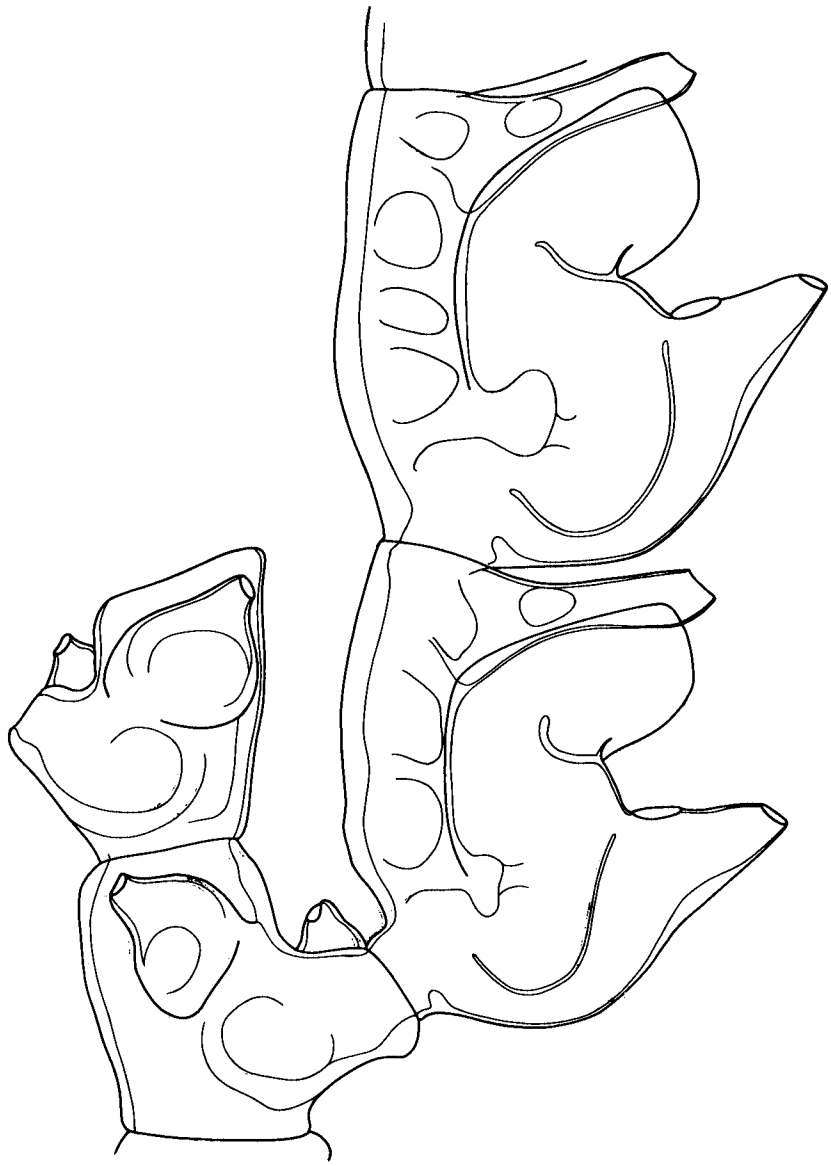


Fig. 43. *Macrorhynchia philippina* (Kirchenapuer), John Murray Exped., Sta. 27, insertion of hydrocladium on internode and hydrothecae in lateral view. x 220.

internodes is much stronger than we have so far observed in *Macrorhynchia philippina* and the number of such rings is much higher than seems usual in this species (2-3 rings being usually described). Nevertheless we have referred our specimens to this polymorphic species on account of the presence of the above

mentioned ridge, a distinctive character in *M. philippina*. The development of the lateral hydrothecal lobes is much greater here than is usually described in *M. philippina*, in which the hydrothecal border is described as having a blunt cusp on each side. Also the John Murray specimen is much more heavily sclerotized than is normal in *M. philippina*, which may account for some of the aberrant characters, as for example the number of rings in the internodes.

We have reluctantly referred this well known species to the genus *Macrorhynchia* Kirchenpauer, 1872, recognizing that Stechow's (1923d: 239-242) arguments in favour of the generic name *Macrorhynchia* are irrefutable. The widely used genus name *Lytocarpus* Allman, 1883, must consequently be dropped in favour of the less known genus name *Macrorhynchia* (type species *Plumularia filamentosa* Lamarck, 1816, by subsequent designation by Stechow, 1923d: 241).

UNIDENTIFIED MATERIAL

Unidentified hydroids were found at the following stations: Sta. 27. Unidentified tangled mass, 5 x 8 mm; Sta. 45. A tangled mass of stems and hydrorhizal fibres; Sta. 54. Fragmented colony, including polysiphonic stems and poly- and monosiphonic side branches, possibly *Eudendrium* sp.; Sta. 112. Tubiform structure and some fragments, possibly a bryozoan; Sta. 113. Basal part of hydrocaulus of 2 specimens, with hydrorhizal fibres; Sta. 122. A number of narrow tubes about 15 mm long, probably *Stephanoscyphus* sp. and *Tubularia* sp.; Sta. 157. Probably heavily overgrown athecate hydroid.

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Valid names are in Roman type, new names in **bold** and invalid names in *italics*. New combinations are indicated by an asterisk (*). Main page references are in **bold**.