

HYDROIDS FROM THE SOUTH-WEST INDIAN OCEAN

By

N. A. H. MILLARD

Zoology Department, University of Cape Town

(With 6 figures in the text)

CONTENTS

	PAGE
Introduction	169
Station list	171
List of species	171
Systematic account	172
Discussion	192
Summary	192
Acknowledgements	193
References	193

INTRODUCTION

This paper deals with an assortment of Indian Ocean hydroids from the area east of South Africa and south of Madagascar. With the exception of a small collection from Walter's Shoal all are from depths greater than 300 m. and are thus over the edge of the Continental Shelf, the margin of which is located at 150–300 m. Thus, although some of the stations are situated less than 30 nautical miles off the coast where it shelves steeply, the fauna cannot strictly be included in that of South Africa.

The material from Walter's Shoal is a shallow-water fauna dredged from 38 to 46 m., but, since Walter's Shoal is situated over 420 nautical miles from Madagascar and over 600 nautical miles from Africa, its fauna cannot be included in that of either country.

It was felt that the material from the whole of this area might conveniently be described together.

The material comes from two sources. Those samples bearing the prefixes ABD and WSS were collected by the R/V *Anton Bruun* during her seventh cruise in the International Indian Ocean Expedition in 1964. A final cruise report of the expedition was published by the U.S. Program in Biology, I.I.O.E., in 1965, to which body I am indebted for the opportunity of examining the material.

Material bearing the prefix AFR is part of a collection in the Zoology Department, University of Cape Town, and was collected in 1961 by the government research vessel *Africana II* belonging to the Division of Sea Fisheries, Department of Commerce and Industries.

The position of the collecting stations is roughly indicated on the accompanying sketch-map (fig. 1), and the complete data given in the station list which follows.

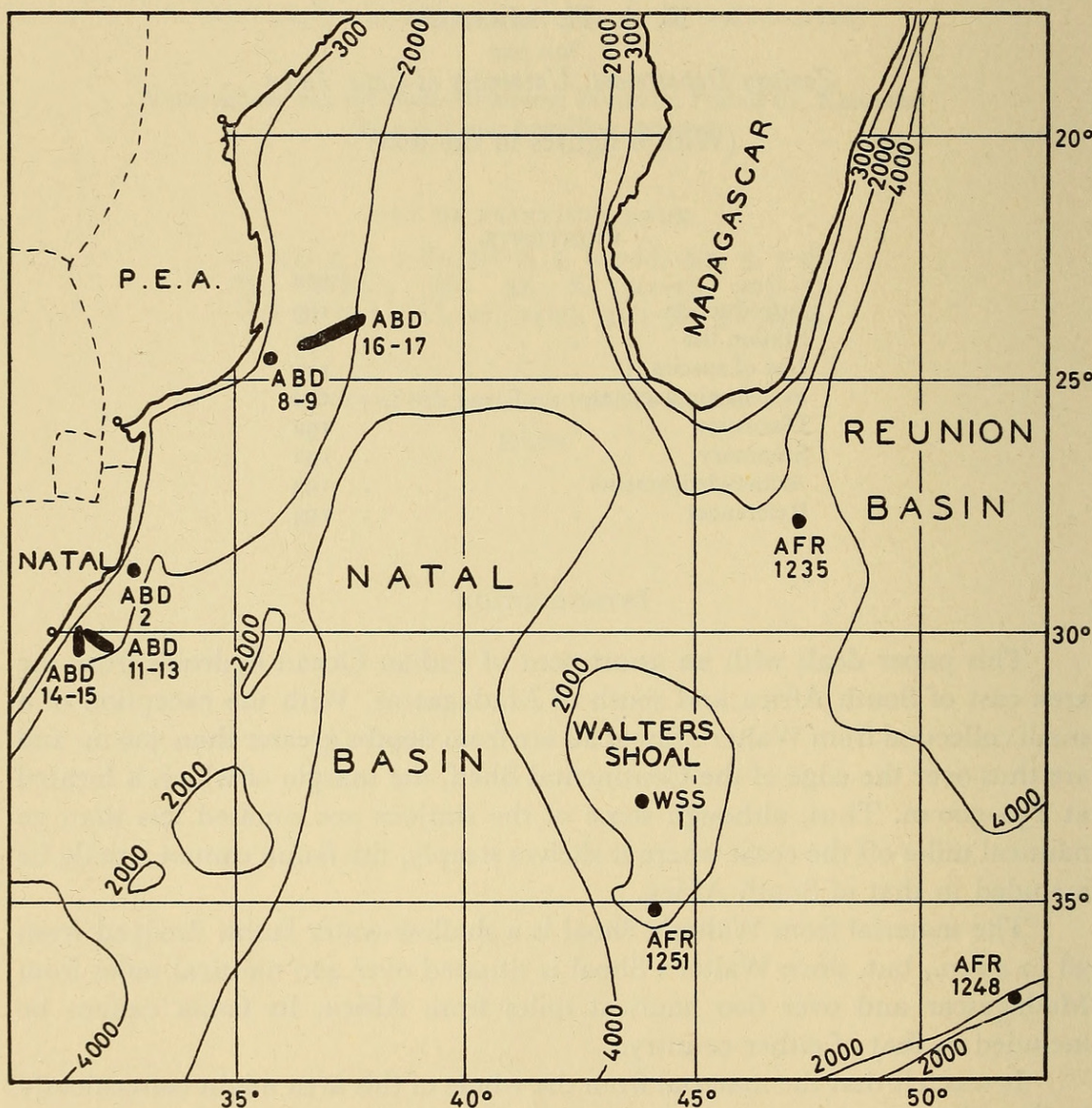


Fig. 1

Sketch-map of the area under consideration showing the approximate positions of the different collecting stations. The reference numbers are the same as those used in the station list. Depths in metres.

In the systematic section the full synonymy is not quoted in every case, but instead a number of references from which such can be obtained.

STATION LIST

U.C.T. cat. no.	Date	Position	Depth (m.)	Bottom	Anton Bruun stat. no.
ABD 2	31/7/64	28°43'S/32°38'E	1207	R	359C
ABD 8-9	18/8/64	24°40'S/35°28'E	347	sh. S.	370G
ABD 11	7/9/64	30°12'S/32°01'E	1360	Gl. Oz.	389C
ABD 12	7/9/64	30°09'S/31°37'E	930	s. M. Cl.	389E
ABD 13	8/9/64	29°57'S/31°31'E	700	Gl. Oz.	389G
ABD 14	8/9/64	29°45'S/31°40'E	440	h. S.	390C
ABD 15	8/9/64	29°42'S/31°38'E	350	s. M.	390E
ABD 16	17/8/64	23°48'S/37°45'E	2200	Gl. Oz.	369C
ABD 17	17/8/64	24°04'S/36°15'E	1610	Gl. Oz.	369F
WSS 1	30/8/64	33°13'S/43°51'E	38-46	Calc. Algae	381A-C
AFR 1235	22/6/61	27°48'S/47°19'E	875		
AFR 1248	9/7/61	36°48'S/52°08'E	400		
AFR 1251	11/7/61	35°03'S/44°12'E	600		

LIST OF SPECIES

Family **Campanulinidae***Stegopoma fastigiatum* (Alder)Family **Lafoeidae***Acryptolaria conferta australis* (Ritchie)*Acryptolaria crassicaulis* (Allman)*Acryptolaria rectangularis* (Jarvis)*Filellum serratum* (Clarke)*Lafoea fruticosa* (M. Sars)*Zygophylax armata* (Ritchie)Family **Syntheciidae***Hincksella echinocarpa* (Allman)*Hincksella indiana* n.sp.Family **Sertulariidae***Salacia ?desmoides* (Torrey)*Sertularella arbuscula* (Lamouroux)*Sertularella mediterranea* Hartlaub*Sertularella megista* Stechow*Sertularella polyzonias* (Linnaeus)*Sertularella xantha* Stechow*Symplectoscyphus ?amphoriferus* (Allman)*Symplectoscyphus paulensis* Stechow

Family **Plumulariidae***Kirchenpaueria triangulata* Totton*Nemertesia ramosa* Lamouroux*Plumularia antonbruuni* n.sp.*Plumularia setacea* (Linnaeus)*Gladocarpus distomus* Clarke*Halicornaria gracilicaulis* (Jäderholm)

SYSTEMATIC ACCOUNT

Family **Campanulinidae***Stegopoma fastigiatum* (Alder, 1860)*Stegopoma fastigiata*: Millard, 1958: 175.*Stegopoma fastigiatum*: Ralph, 1957: 850, fig. 8 n-o. Vervoort, 1959: 234, fig. 10.*Records*. ABD 9F (epizootic on *Zygophylax armata*).*Remarks*. This species has already been reported from the area, from 333 m. off the coast of Natal (Millard, 1958).Family **Lafoeidae***Acryptolaria conferta australis* (Ritchie, 1911)*Cryptolaria conferta* var. *australis* Ritchie, 1911: 826, pl. 84 (fig. 2), pl. 87 (fig. 1).*Acryptolaria conferta* var. *australis*: Totton, 1930: 163, fig. 19 c-e. Ralph, 1958: 315, fig. 4 a-g.*Acryptolaria conferta australis*: Millard, 1964: 9, fig. 1 D, F, G.*Records*. ABD 9G, 15B.*Description*. One colony (ABD 9G) reaching a height of 3.7 cm. and fairly regularly branched, a branch arising next to every third hydrotheca. Hydrothecae with a rather greater proportion of their height adnate than usual (0.59 to 0.88), especially on the thicker parts of the stem and branches. Margins practically parallel to axis of stem.

The other colony (ABD 15B) a single, little-branched stem 5.3 cm. high, with hydrothecae similar to those previously described (Millard, 1964).

Acryptolaria crassicaulis (Allman, 1888)

Fig. 2A

Cryptolaria crassicaulis Allman, 1888: 41, pl. 19 (figs. 3, 3a). Ritchie, 1911: 828-830, pl. 87 (fig. 4). Stechow, 1913: 113, figs. 86, 87.*Cryptolaria crassicaulis*, var. *dimorpha* Ritchie, 1911: 830, pl. 87 (figs. 5, 6). Jarvis, 1922: 335.*Records*. AFR 1248A.*Description*. A single fascicled stem 4.7 cm. in height, giving off a number of branches in a roughly alternate manner.

Hydrotheca adnate for about half height, with base very slightly above top of adnate part of preceding one, with diameter at margin approximately three times that at base. Margin very slightly everted.

Coppinae absent.

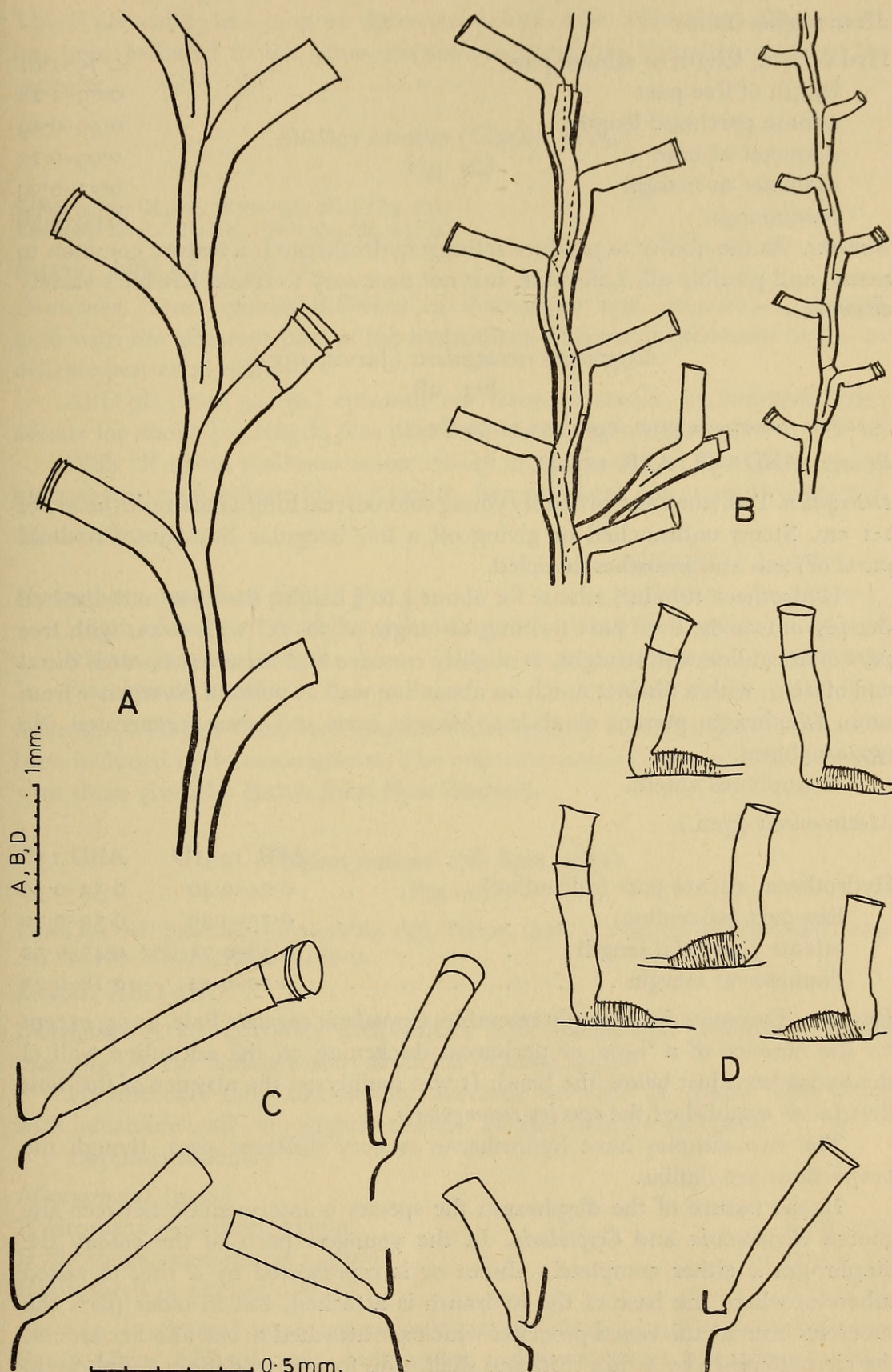


Fig. 2. Lafoeidae.

- A. *Acryptolaria crassicaulis* (Allman).
 B. *Acryptolaria rectangularis* (Jarvis) from ABD 15P (left) and AFR 1251D (right).
 C. Various hydrothecae of *Lafoea fruticosa* (M. Sars).
 D. *Filellum serratum* (Clarke) from ABD 9E.

Measurements (mm.)

Hydrotheca, length of adnate part	0.79-1.01
length of free part	0.69-1.18
adnate part/total length	0.40-0.59
diameter at base	0.09-0.13
diameter at margin	0.31-0.39
base/margin	0.29-0.38

Remarks. As the ability to produce solitary hydrothecae is a feature common to many, and possibly all, Lafoeidae, it is not necessary to retain Ritchie's variety *dimorpha*.

Acryptolaria rectangularis (Jarvis, 1922)

Fig. 2B

Cryptolaria rectangularis Jarvis, 1922: 335, pl. 24 (fig. 3).

Records. ABD 15P. AFR 1251D.

Description. Two small and probably young colonies reaching a maximum height of 1.1 cm. Stems unbranched or giving off a few irregular branches. Proximal parts of stem and branches fascicled.

Hydrotheca tubular, adnate for about $\frac{1}{2}$ to $\frac{2}{3}$ height, then free and directed sharply outwards. Free part forming an angle of $70-75^\circ$ with stem, with free part of adcauline wall straight, or slightly concave and recurved towards distal end of stem, with a distinct notch on abcauline wall at point of divergence from stem. Diaphragm present or absent. Margin even and often regenerated. No nematophores.

Gonophores absent.

Measurements (mm.)

	AFR 1251D	ABD 15P
Hydrotheca, adnate part (adcauline)	0.24-0.40	0.52-0.59
free part (adcauline)	0.15-0.29	0.52-0.72
adnate part/total length	0.48-0.71	0.43-0.52
diameter at margin	0.10-0.12	0.18-0.23

Remarks. This material strongly resembles *Cryptolaria angulata* Bale, 1914, except for the absence of a 'boss' or perisarcular thickening on the adcauline wall of the hydrotheca just below the bend. It was mainly on the absence of this boss that Jarvis established the species *rectangularis*.

The two samples have hydrothecae of very different sizes, though the proportions are similar.

In the nature of the diaphragm the species is intermediate between the genera *Acryptolaria* and *Cryptolaria*. In the youngest parts of the colony the diaphragm is either completely absent or is represented by a ring of raised tubercles where the base of the hydranth is attached, but in older parts the tubercles become thickened processes which are attached to one another around the circumference by a thin chitinous shelf, thus forming a definite diaphragm.

This is not visible as a joint on the outer surface of the hydrotheca. The species has been included in the genus *Acryptolaria* mainly on the absence of nematophores.

Filellum serratum (Clarke, 1879)

Fig. 2D

Lafoëa serrata Clarke, 1879: 242, pl. 4 (fig. 25).

Reticularia serrata: Ralph, 1958: 312, fig. 2j, 3a.

Records. ABD 9E. WSS 1R.

Description. Two colonies differing in dimensions and proportions, though both with the adherent part of the hydrotheca sculptured externally by 30–40 delicate perisarcial ridges.

ABD 9E (from 347 m.) epizootic on *Nemertesia ramosa*; hydrothecae large, adnate for about $\frac{1}{3}$ – $\frac{1}{2}$ length, free part bent out at right angles.

WSS 1R (from shallower water: 38–46 m.) epizootic on *Plumularia setacea*; hydrotheca small, adnate for $\frac{1}{2}$ – $\frac{3}{4}$ length, free part bent out at angle of 60–70°.

Measurements (mm.)

	ABD 9E	WSS 1R
Hydrotheca, length of adnate part	0.48–0.67	0.22–0.47
length of free part (without reduplications)	0.60–1.32	0.12–0.26
adnate part/total length	0.29–0.50	0.52–0.76
diameter at margin	0.22–0.30	0.11–0.14

Remarks. Although these two samples differ greatly in dimensions, they have been included in the same species. The measurements of the smaller form agree with those given by Ralph from New Zealand.

Lafoea fruticosa (M. Sars, 1851)

Fig. 2C

Lafoea fruticosa: Stechow, 1925: 456, fig. 24B. Totton, 1930: 157, fig. 13. Naumov, 1960: 275, fig. 164. Millard, 1964: 14, fig. 3.

Records. ABD 9H.

Description. A young colony with solitary hydrothecae and unbranched stems reaching 0.8 cm. Stems weakly fascicled in basal region.

Hydrothecae long and slender, forming an angle of 40–60° with stem, with adcauline wall very slightly convex. Pedicel with double twist.

Coppinia absent.

Measurements (mm.)

Hydrotheca + pedicel, height	0.52–0.91
Hydrotheca, diameter at margin	0.11–0.17
Hydrotheca + pedicel/diameter	3.71–6.07

Remarks. In general appearance this material differs from that recorded from South Africa (Millard, 1964) in its longer and more slender hydrothecae which

show no sign of a double curvature. In most cases the total length of the hydrotheca plus pedicel is over five times the diameter at the margin. Yet on the same stem are shorter hydrothecae resembling some of those figured in 1964.

The colony strongly resembles Alder's figure of *Lafoea gracillima* (1856, pl. 14, fig. 6), except that the pedicels are not quite so long. However, from the literature I can find no satisfactory means of distinguishing *L. gracillima* from *L. fruticosa*. Totton, who figures both, is himself in doubt and Naumov has united the two species.

Zygophylax armata (Ritchie, 1907)

Brucella armata Ritchie, 1907: 533, pl. 2 (fig. 2-2c).

Zygophylax armata: Millard, 1964: 18, fig. 4G.

Records. ABD 8D, 14V.

Description. Two rather straggling, sterile colonies reaching 4.2 and 3.1 cm. in height respectively.

Family **Syntheciidae**

Hincksella echinocarpa (Allman, 1888)

Fig. 3 A-C

Sertularia echinocarpa Allman, 1888: 57, pl. 28 (figs. 1, 1a).

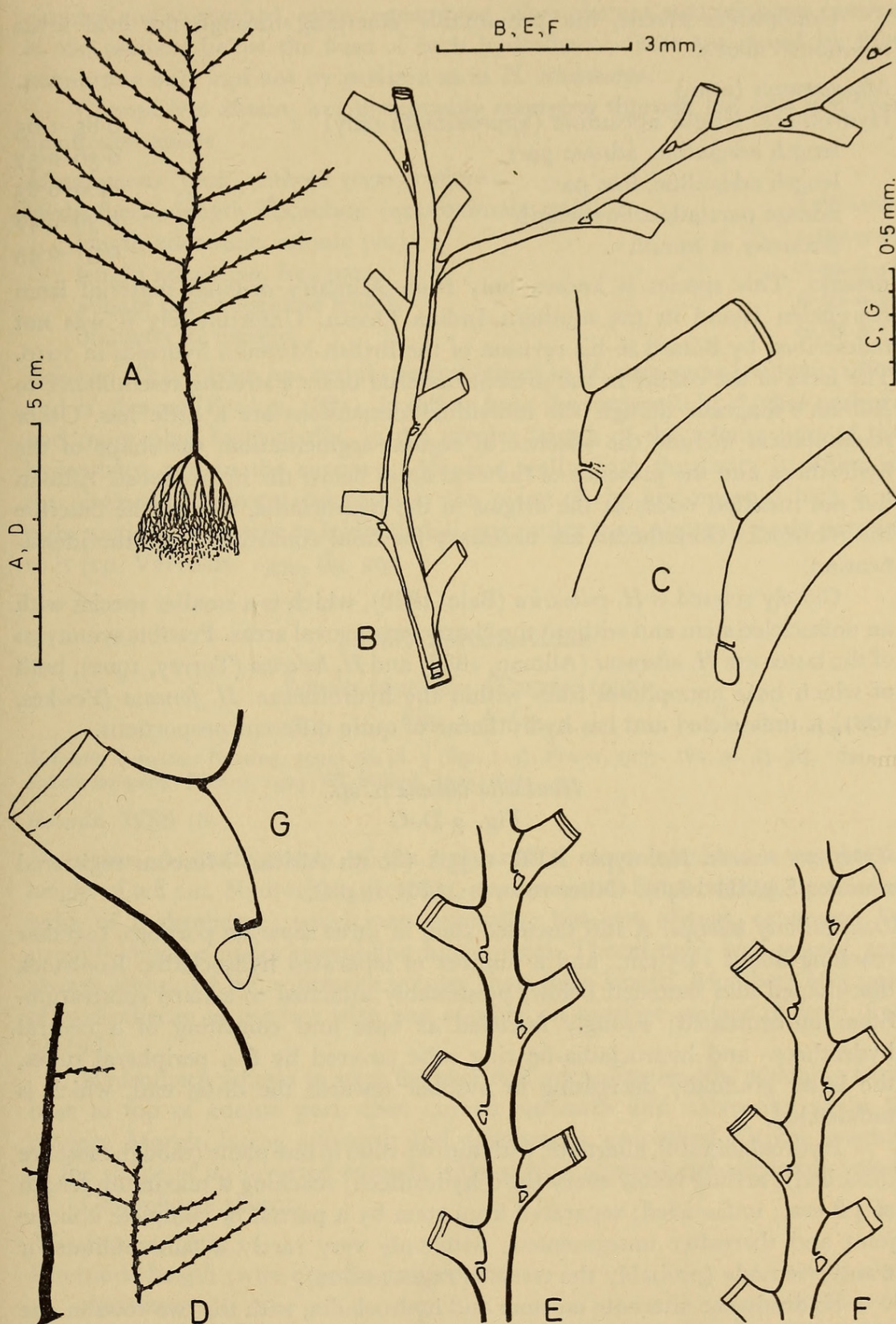
Records. ABD 16A, 17A.

Description. Altogether six rooted stems, of which the longest is 9.0 cm., and many incomplete stems and fragments.

Rootstock in the form of a branching system for penetration of a soft substratum; consisting of a number of fascicled 'roots' arising at the same level from the base of the stem, these subdividing a number of times and finally producing very delicate unfascicled 'rootlets'.

Stem comparatively flexuous and unable to support itself out of fluid; slightly geniculate; unsegmented; fascicled for most of its length but unfascicled in distal region; the central axial tube giving rise to alternate hydrothecae and alternate hydrocladia. Hydrocladia normally arising immediately below every third hydrotheca; long (reaching 4 cm.); flexuous; the two rows in one plane at origin, but due to flexibility producing an irregular effect; rarely rebranching. Each hydrocladium separated from stem by a distinct oblique joint and thereafter unsegmented except for an occasional transverse node immediately above a hydrotheca; bearing alternate hydrothecae.

Hydrotheca tubular, adnate for less than half adcauline height; then straight or curved very slightly outwards. Free part of adcauline wall straight or slightly convex. Margin untoothed, not everted, facing outwards and upwards, forming an angle of 30-40° with hydrocladium. Two distinct oval areas closed over by thin perisarc present in the perisarc immediately below the base of each hydrotheca.

Fig. 3. *Hincksella*.

A-C. *Hincksella echinocarpa* (Allman) from ABD 16A. A, a whole stem; B, a portion of a fascicled stem showing origin of hydrocladium; C, two hydrothecae from different stems.
 D-G. *Hincksella indiana*, n.sp., from the holotype. D, two portions of the stem; E and F, old and young portions of hydrocladia respectively; G, a hydrotheca.

Gonophores absent, but presumably emerging through the oval areas mentioned above.

Measurements (mm.)

Hydrotheca, length abcauline (approximate only)	0.85-1.05
length adcauline, adnate part	0.36-0.57
length adcauline, free part	0.60-0.83
adnate part/adcauline length	0.30-0.48
diameter at mouth	0.31-0.45

Remarks. This species is known only from Allman's original material from Kerguelen Island in the southern Indian Ocean. Unfortunately it was not redescribed by Billard in his revision of the British Museum hydroids in 1910. The form of the colony in the present material bears a striking resemblance to Allman's diagram though the individual dimensions are a little less. Other resemblances include the absence of regular segmentation, the shape of the hydrotheca and the presence of the oval areas below the hydrothecae. Allman did not mention nodes at the origins of the hydrocladia, nor did he describe the rootstock. Gonothecae are necessary for final confirmation of the identification.

Closely related is *H. cylindrica* (Bale, 1888), which is a smaller species with an unfascicled stem and without the characteristic oval areas. Possible synonyms of the latter are *H. alternans* (Allman, 1888) and *H. halecina* (Torrey, 1902), both of which bear gonophores from within the hydrothecae. *H. formosa* (Fewkes, 1881) is unfascicled and has hydrothecae of quite different proportions.

Hincksella indiana n. sp.

Fig. 3 D-G

Types and records. Holotype: AFR 1235A (South African Museum registered number SAMH 1646). Other records: AFR 1248C.

Description of holotype. A stiff fascicled stem in three separate portions, together reaching about 13.5 cm., and a number of separated hydrocladia. Rootstock disc-shaped and flattened below, presumably attached to a hard substratum. Stem unsegmented; strongly fascicled at base and consisting of a central hydrotheca- and hydrocladia-bearing tube covered by 8-9 peripheral tubes, the latter gradually decreasing in number towards the distal end, which is unfascicled.

Hydrocladia stiff, alternate, with the two rows in one plane (though most are detached); arising below every third hydrotheca; reaching a maximum length of 4.8 cm.; unfascicled; separated from stem by a partial or complete oblique joint and thereafter unsegmented; with only very rarely a faint oblique or transverse node (probably the result of regeneration).

Hydrothecae alternate on stem and hydrocladia, with the two rows in one plane; large; adnate for over half adcauline length; tubular, with the free part curved towards the adcauline side and with concave adcauline wall. Margin

circular and untoothed, often regenerated. Two distinct oval windows present in the perisarc below the base of each hydrotheca; these are closed by thin membrane only and not by perisarc as in *H. echinocarpa*.

Gonophores absent, but presumably emerging through the oval windows mentioned above.

Measurements (mm., without regenerations)

Hydrotheca, length abcauline (approximate only)	0.66-0.80
length adcauline, adnate part	0.60-0.73
length adcauline, free part	0.30-0.48
adnate part/adcauline length	0.56-0.70
diameter at margin	0.48-0.57

Remarks. This species has certain resemblances to *H. echinocarpa* (Allman, 1888) and *H. formosa* (Fewkes, 1881). It differs from the former in its thicker perisarc and more rigid hydrocladia, in the greater length of the adnate part of the hydrotheca and in the concave adcauline wall; from the latter it differs in the absence of segmentation and in the plane of the hydropore, which is at right angles to the stem or hydrocladial axis rather than approximately parallel to it (cp. Vervoort, 1959, fig. 29).

Family Sertulariidae

Salacia ?desmoides (Torrey, 1902)

Fig. 4 A-C

Sertularia desmoides: Nutting, 1904: 56, pl. 3 (figs. 1-3). Fraser, 1937: 161, pl. 37 (fig. 194).

Salacia desmoides: Billard, 1924: 66. Billard, 1925: 207.

Records. WSS 1S.

Description. A small colony of ten unbranched stems reaching a maximum height of 0.6 cm. Hydrorhiza creeping, unsegmented. Stem bearing up to nine pairs of hydrothecae, which are generally, but not always, separated by strongly oblique nodes resembling hinge-joints. Thecal pairs well spaced and always separated by a distance greater than their length. Members of a pair of hydrothecae in contact with one another on anterior surface of stem, free behind.

Hydrotheca adnate to stem for over half adcauline length, widening from base to top of adnate part, then curved outwards and narrowing again to margin. Margin facing outwards and downwards, untoothed. Orifice roughly in the shape of an inverted triangle. Operculum of one large abcauline valve.

Gonophores absent.

Measurements (mm.)

Internode length (where nodes are present)	0.55-0.75
diameter	0.06-0.08
Hydrotheca, length abcauline	0.17-0.21
length adcauline, contiguous part	0.14-0.18

length adcauline, adnate part	0.22-0.26
length adcauline, free part	0.13-0.18
adnate part/total length	0.56-0.65
diameter (vertical) at margin	0.10-0.12

Remarks. There is nothing in the published descriptions to exclude this material from being a young colony of *S. desmoides*, a species known from the Pacific coast of North America. Fraser's material, reported from a number of localities, appears to have somewhat larger dimensions. A greater variety of material and gonophores are necessary for final identification.

Sertularella arbuscula (Lamouroux, 1816)

Sertularella arbuscula: Millard, 1957: 208, fig. 10B, 11C. Millard, 1958: 188. Millard, 1964: 37.

Records. WSS 1N.

Description. A richly branched colony with a strongly fascicled stem 4.8 cm. in length. Hydrothecae closely set and smaller than is normal for the species (abcauline length 0.34-0.40 mm.), but typical in shape. Internal teeth five in number: one large abcauline, two slightly smaller latero-adcauline and two minute latero-abcauline.

Gonothecae abundant, male, smaller than normal (length, mature, 1.54-1.90 mm.), annulated in distal half.

Remarks. This material resembles the common form of *S. arbuscula*, as it is known from South Africa, in the form of the colony and shape of the hydrotheca, but differs in the smaller dimensions of the hydrotheca and gonotheca and in the annulations present on the latter. However, since annulated gonothecae are known to occur in the species (Millard, 1958 and 1964) it is not possible to differentiate the material on these grounds. The gonotheca is similar in appearance to that illustrated by Warren (1908, fig. 6B).

Sertularella mediterranea Hartlaub, 1901

Sertularella mediterranea: Millard, 1957: 215, figs. 10E, 11B.

Records. WSS 1Q.

Description. A small infertile colony reaching a maximum height of 1.6 cm.

Sertularella megista Stechow, 1923

Fig. 4D

Sertularella megista: Millard, 1957: 217, figs. 10L, 11J. Millard, 1964: 45 (synonymy).

Sertularella sp.: Millard, 1958: 192 (PF 12456E).

Records. ABD 8B.

Description. A single unfascicled, unbranched stem 9.8 cm. in height.

Hydrotheca similar to that previously described for this common species, except that the free part is much elongated and exceeds the adnate part in length. Free part of both adcauline and abcauline walls straight or nearly so.

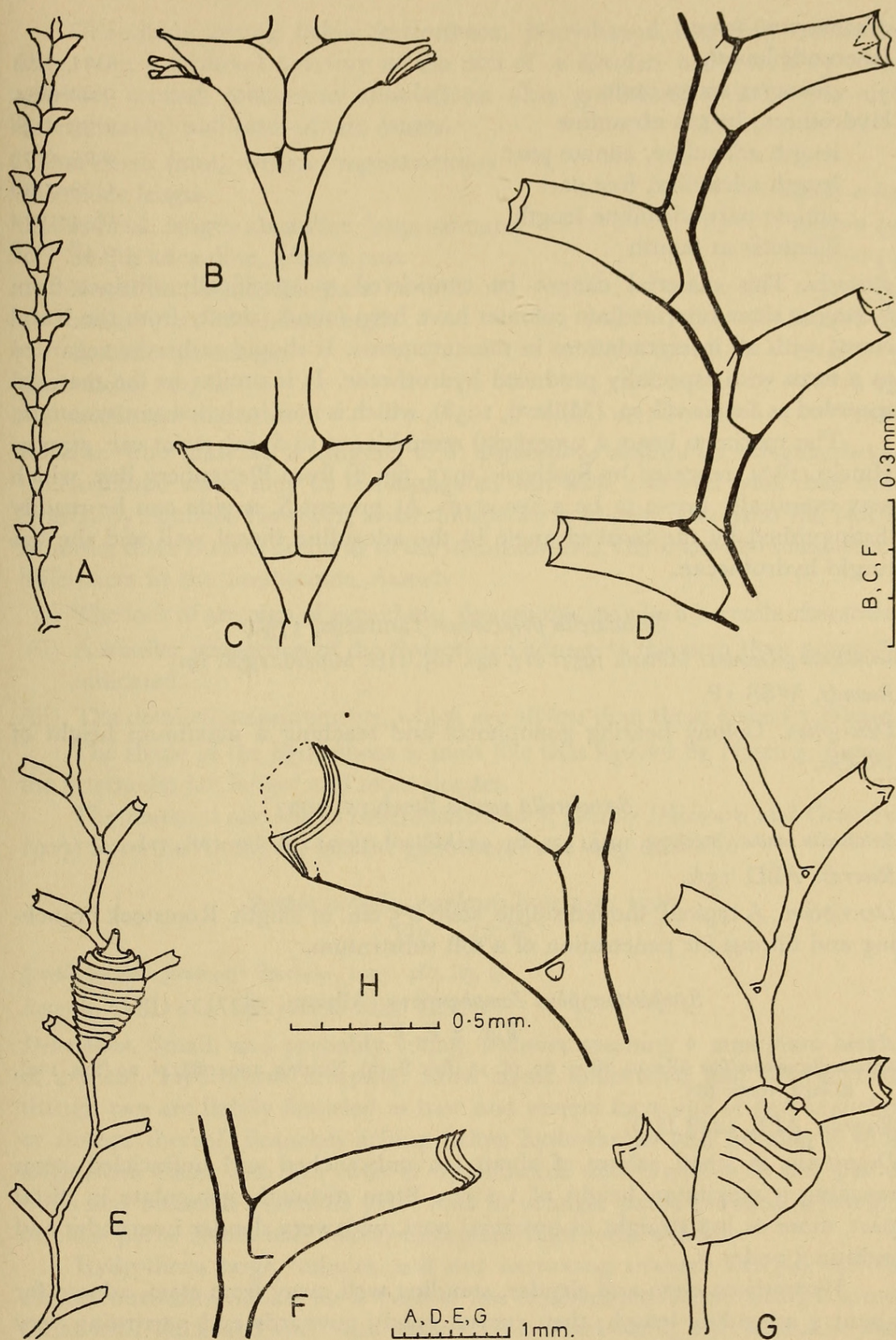


Fig. 4. Sertulariidae.

A-C. *Salacia ?desmoides* (Torrey).D. *Sertularella megista* Stechow.E-F. *Symplectoscyphus ?amphoriferus* (Allman).G-H. *Symplectoscyphus paulensis* Stechow, from ABD 8C.

Measurements (mm.)

Internode length	1.21-1.61
diameter across node	0.42-0.50
Hydrotheca, length abcauline	1.39-1.58
length adcauline, adnate part	0.65-0.75
length adcauline, free part	1.03-1.28
adnate part/adcauline length	0.34-0.42
diameter at mouth	0.48-0.56

Remarks. This material cannot be considered as specifically distinct from *S. megista* since intermediate colonies have been found (chiefly from the Natal coast) with all intergradations in measurements. It should rather be regarded as a form with especially produced hydrothecae. It is similar to the material recorded as *Sertularella* sp. (Millard, 1958), which is now included as a synonym.

The specimen bears a superficial resemblance to *S. polyzonias* var. *gigantea* Hincks, 1874, reported by Stechow (1925, fig. 6) from Plettenberg Bay, which may eventually prove to be a synonym. At present *S. megista* can be readily distinguished by the marked angle in the adcauline thecal wall and the less turgid hydrothecae.

Sertularella polyzonias (Linnaeus, 1758)

Sertularella polyzonias: Millard, 1957: 217, figs. 10J, 11H. Millard, 1958: 191.

Records. WSS 1P.

Description. Colony bearing gonophores and reaching a maximum height of 1.6 cm.

Sertularella xantha Stechow, 1923

Sertularella xantha: Stechow, 1925: 472, fig. 32. Millard, 1957: 218, figs. 10K, 11I.

Records. ABD 15A.

Description. A typical, though sterile, stem 8.5 cm. in length. Rootstock branching and fibrous for penetration of a soft substratum.

Symplectoscyphus ?amphoriferus (Allman, 1877)

Fig. 4 E, F

Sertularella amphorifera Allman, 1877: 22, pl. 15 (figs. 8-10). Nutting, 1904: 88, pl. 20 (figs. 1-2). Billard, 1906: 183.

Records. AFR 1248 IIQ.

Description. A small colony of about ten unbranched and unfascicled stems reaching a maximum height of 1.1 cm. Stem distinctly geniculate in distal part, more or less straight in proximal part, with very slender internodes and indistinct nodes.

Hydrotheca deep and slender, standing well away from stem, adnate for about $\frac{1}{4}$ adcauline length, then curved gently outwards and narrowing very slightly to margin. Margin with three teeth (one adcauline and two lateral), often regenerated.

Gonotheca arising below hydrotheca, pear-shaped, tapering evenly to base, with a terminal aperture at the end of a slender neck, with 13 well-marked, crested, transverse annulations. One gonotheca present (sex not determinable) and scars of two others.

Measurements (mm., without regenerations)

Internode length	0.60-0.84
Hydrotheca, length abcauline (approximate)	0.35-0.45
length adcauline, adnate part	0.12-0.14
length adcauline, free part	0.34-0.46
adnate part/adcauline length	0.21-0.28
diameter at margin	0.12-0.15
Gonotheca, length	1.19
maximum diameter	0.65

Remarks. This material is assigned to *S. amphoriferus* mainly on the gonotheca, which Billard states may be less elongated and with a shorter neck than that figured by Allman. However, since the species is known only from the North Atlantic, there is some doubt as to the identification. There are also some minor differences in the trophosome, namely

- (i) The lack of any sign of branching, though this may be a juvenile character.
- (ii) A smaller proportion of the hydrotheca adnate to the stem than generally indicated.
- (iii) The detailed measurements, which are all less than those given by Billard.

The shape of the hydrotheca is most like that figured by Nutting, though the internodes are longer and more slender.

The material also shows resemblances to *S. plectilis* (Hickson and Gravely, 1907) from the Antarctic, but the gonothecae are very different.

Symplectoscyphus paulensis Stechow, 1923

Fig. 4 G, H

Symplectoscyphus paulensis: Stechow, 1925: 467, fig. 28.

Records. ABD 8C, 14B. AFR 1248 IIN.

Description. Small, and probably young, colonies reaching a maximum height of 4.7 cm. Hydrorhiza creeping. Most stems unfascicled and unbranched, though two are lightly fascicled at base and several have one or two branches or stumps thereof. Branches arising below hydrothecae and forming a wide angle with stem. The two rows of hydrothecae and branches in one plane. Stem and branches markedly geniculate in younger parts, practically straight in older parts. Nodes only faintly indicated. Internodes slender.

Hydrotheca large, tubular and not narrowing towards margin, curved slightly outwards, adnate for a third or less of adcauline length. Margin sometimes with thickened rim, with three well-marked teeth, one adcauline and two lateral. Consecutive hydrothecae separated by a distance approximately equal to abcauline thecal length. Below each hydrotheca a pair of oval fenestrae

closed by thin perisarc, through which the gonophores emerge and through which the tubes of the fascicled stem communicate.

A single gonotheca present (on ABD 8C), with about five light corrugations around distal half, with a slender terminal neck which is slightly everted at margin.

Measurements (mm.)

	ABD 8C	AFR 1248 IIN
Internode length	0.96-1.48	1.16-1.36
Hydrotheca, length abcauline (approximate)	0.71-0.91	0.64-0.87
length adcauline, adnate part	0.34-0.39	0.22-0.28
length adcauline, free part	0.76-0.92	0.72-1.00
adnate part/adcauline length	0.27-0.34	0.19-0.27
diameter at margin	0.38-0.44	0.34-0.42
Gonotheca, length	1.47	
maximum diameter	1.05	

Remarks. *S. paulensis* has been reported only once, by Stechow from St. Paul in the southern Indian Ocean. His material was sterile.

Stechow states that the discovery of intermediate forms may prove that *S. paulensis* is a form of *S. columnarius* (Briggs, 1914). However, instead of bridging the gap, the present material emphasizes the differences between the two. *S. paulensis* differs from *S. columnarius* in the following features:

- (i) The well-separated hydrothecae.
- (ii) The narrower hydrothecae (diameter at margin in present material 0.34-0.44 mm., Stechow's material 0.46, *S. columnarius* (from Ralph, 1961a) 0.40-0.60 mm.).
- (iii) The smaller proportion of the adnate part of the adcauline thecal wall (adnate part/adcauline length 0.19-0.34 in present material, 0.34-0.40 in Stechow's material, 0.43-0.5+ in *S. columnarius*).
- (iv) The smaller gonotheca with less definite annulations.

This material is also very close to *S. tropica* (Hartlaub, 1900) from the Pacific.

S. paulensis differs from *S. amphoriferus* in the larger size, different appearance of the gonotheca and different shape of the hydrotheca.

Family Plumulariidae

Kirchenpaueria triangulata (Totton, 1930)

Plumularia triangulata Totton, 1930: 225, fig. 61. Ralph, 1961b: 41, fig. 5 f-g.

Kirchenpaueria triangulata: Millard, 1962: 292, fig. 6 E-J.

Records. ABD 2C, 15S.

Description. The first sample with pinnate stems without rootstock, reaching a maximum height of 1.6 cm. Male gonophores present.

The second sample epizootic on *Halicornaria gracilicaulis* and including

both simple and pinnate stems, the latter reaching a maximum height of 2.2 cm. No gonophores present.

Structural details as in previous descriptions. In the second sample (ABD 15S) stem nodes visible only in the extreme distal region and in many hydrocladia the node between the apophysis and the first thecate internode missing.

Nemertesia ramosa Lamouroux, 1816

Nemertesia ramosa: Millard, 1962: 299, fig. 7 A-D.

Records. ABD 8A, 13F, 15Q.

Description. Colonies provided with branching rootstock for penetration of a soft substratum. Stems reaching a maximum height of 21.7 cm., some with gonophores.

Plumularia antonbruuni n. sp.

Fig. 5

Holotype. ABD 14C (South African Museum registered number: SAMH 1647).

Description. Four stems, reaching a maximum height of 5.1 cm. Hydrorhiza of branching, filamentous rootlets for penetration of a soft substratum.

Stem unfascicled, unbranched, bearing alternate hydrocladia, the two rows in one plane. Segmentation not present in lower region, indistinct in upper region. Where demarcated each internode bears one hydrocladium from an apophysis at the distal end. No internodal septa. Apophysis with a distinct mamelon on upper surface. Cauline nematothecae: one on each internode, midway along its length, on opposite side to apophysis; two on each apophysis, one on each side of, and slightly proximal to, the mamelon.

Hydrocladium with one athecate internode, sometimes followed by long thecate internodes only, but often with intermediate athecate internodes present, especially towards the distal end. First internode very short, without nematotheca, with one internodal septum in central region. Thecate internode with two internodal septa, one near proximal end and one near distal end, with 0-3 median inferior nematothecae, one pair of laterals overtopping the thecal margin and sometimes one median superior. Athecate intermediate internode, when present, with two internodal septa, one proximal and one distal, and 0-2 median nematothecae. When no athecate internodes occur the hydrotheca is seated in the distal half of the thecate internode and there are generally two median inferior nematothecae. Athecate internodes, when they occur, appear to be formed by cutting off the proximal end of a thecate internode together with one or more of the median inferior nematothecae. The following thecate internode is shorter, with the hydrotheca seated more or less in the centre and and there is generally only one median inferior nematotheca. However, many variations occur.

Hydrotheca completely adnate, with more or less straight abcauline wall and distinctly convex adcauline wall. Width at margin slightly exceeding depth.

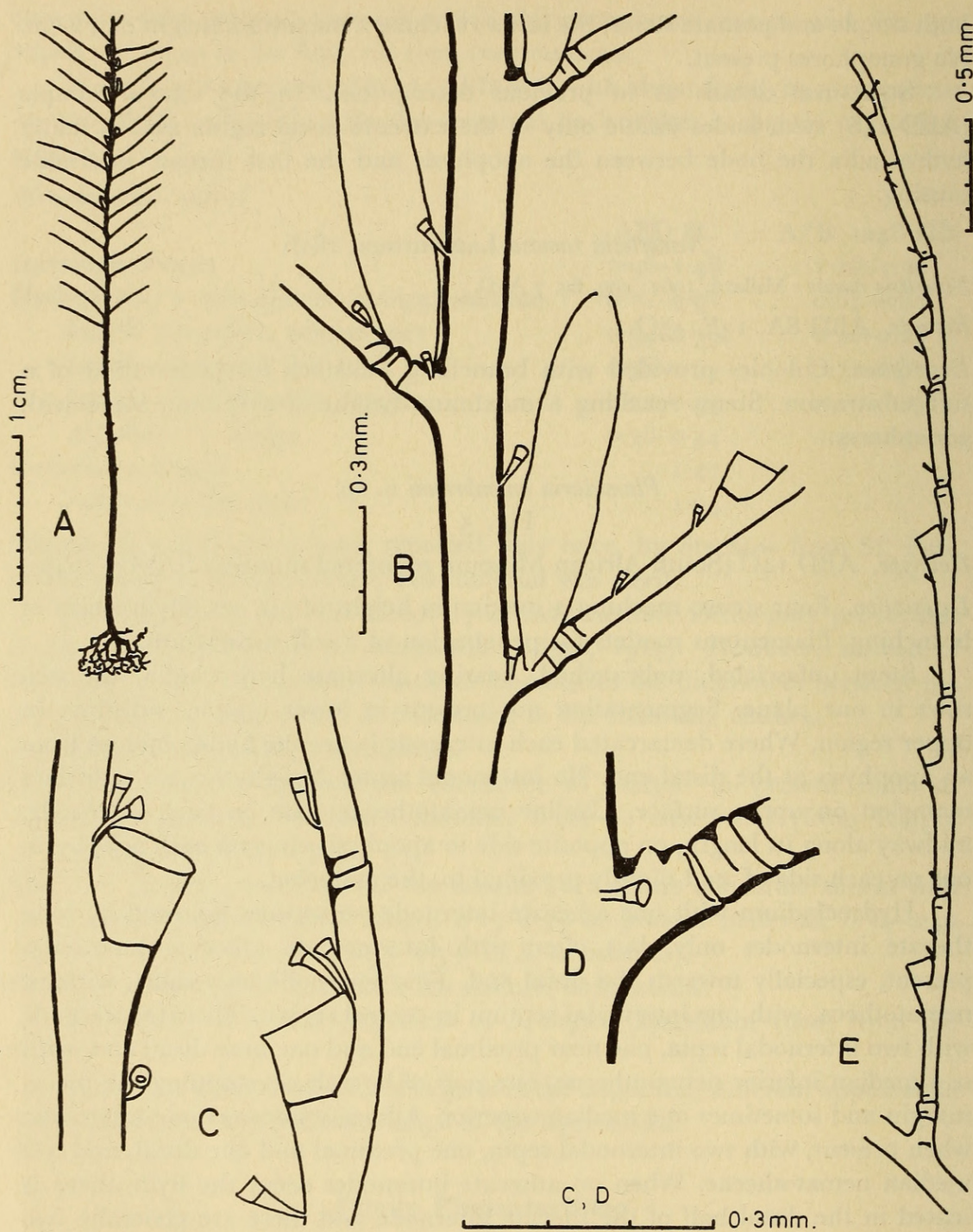


Fig. 5. *Plumularia antonbruuni* n.sp.

- A. A whole stem.
- B. A portion of the stem showing cauline nematothecae and gonothecae.
- C. Portions of hydrocladia with hydrothecae.
- D. The origin of a hydrocladium.
- E. A single complete hydrocladium.

Nematothecae all two-chambered and movable, laterals slightly shorter than hydrothecae.

Gonothecae (male) borne on hydrocladial apophyses, one or two to each, smooth, elongated, with terminal aperture, held at a small angle ($10-15^\circ$) to stem.

Measurements (mm.)

Stem internode, length	0.63-0.70
diameter at node	0.13-0.17
Hydrocladium, first athecate internode, length	0.06-0.11
normal thecate internode, length	0.85-0.95
diameter near centre	0.06-0.08
athecate internode, other than first, length	0.38-0.66
Hydrotheca, depth abcauline	0.08-0.10
diameter at margin	0.11-0.12
Gonotheca, length	0.82-0.92
maximum diameter	0.20-0.27
Lateral nematotheca, length	0.07-0.09

Remarks. Although I am reluctant to create a new species in a genus which is already so richly represented there is no other species with quite the same assortment of characters. *P. antonbruuni* is close to *P. diploptera* Totton, 1930, differing from it in the fact that athecate intermediate internodes are normally absent, in its much longer internodes and in the absence of a subthecal internodal septum.

It is also close to *P. ventriculiformis* Marktanner, 1890, differing from it in the presence of a short athecate internode at the base of the hydrocladium and in the presence of only one hydrocladium to a stem internode. It resembles it in the sporadic occurrence of athecate intermediate internodes in the distal parts of the hydrocladium, but in *P. ventriculiformis* these seem to be cut off from the distal ends of the internodes. The two species differ in the shape of the gonotheca.

It is closest of all to *P. orientalis* Billard, 1913, differing only in its larger size, in the usual absence of intermediate athecate internodes and in the presence of cauline nematothecae on the main axis of the stem. The hydrothecae are also a little deeper. The gonothecae of *P. orientalis* are unknown.

Closely related to *P. orientalis* are *P. delicata* Nutting, 1905, and *P. milleri* Nutting, 1905. In these the gonothecae of the former are relatively short and fat while those of the latter are held at right angles to the stem.

Plumularia setacea (Linnaeus, 1758)

Plumularia setacea: Hincks, 1868: 296, pl. 66 (fig. 1). Millard, 1962: 301.

Records. WSS 1L.

Description. A rich colony of numerous fertile stems reaching a maximum height of 6.8 cm.

Cladocarpus distomus Clarke, 1907

Fig. 6

- Cladocarpus distomus* Clarke, 1907: 17, pl. 14. Stechow, 1925: 506, fig. 47.
Cladocarpus sibogae: Billard, 1913: 71, fig. 57, 58, pl. 4 (fig. 39). Billard, 1918: 25.
Cladocarpella multiseptata Bale, 1915: 304, pl. 47 (figs. 1-5). Bale, 1919: 356.
 ?*Cladocarpus bathyzonatus* Ritchie, 1911: 861, pl. 89 (figs. 2, 6-11).
 ?*Cladocarpus multiapertus*: Billard, 1913: 73, fig. 59.
 ?*Cladocarpus alatus* Jarvis, 1922: 351, fig. 2, pl. 26 (fig. 25).
 ?*Cladocarpus plumularioides* Jarvis, 1922: 352, fig. 3.

Records. ABD 11A, 12F, 13E, 16B, 17B.

Description of typical form. Hydrorhiza forming a branching and filamentous rootstock penetrating up to 2.5 cm. into the bottom ooze. The first rootlets arise from the peripheral tubes of what would normally be considered stem and from here on the tubes continue to separate and subdivide until the final ramifications are only 0.15 mm. in diameter.

Stem reaching a maximum height of 9.7 cm., weakly fascicled in basal region; the principal tube always exposed on anterior surface and divided very irregularly by distinct oblique nodes, sometimes with a group of three or four of the latter close together below the level of the first hydrocladium and thereafter isolated ones at more distant, but irregular, intervals. Principal tube giving rise to alternate hydrocladia in its distal part and bearing a row of fairly regularly spaced cauline nematothecae on anterior surface. Of the latter there are 2-12 between the origins of two consecutive hydrocladia, of which one is always axillary.

Hydrocladium bearing up to 23 thecate internodes separated by oblique nodes. Internodal septa variable in number: one below level of median inferior nematotheca, 1-11 behind the hydrotheca and 0-7 above it. Each internode bearing, in addition to the hydrotheca, one median inferior nematotheca which is quite free from the hydrotheca, one pair of laterals and one to three (usually one) median superior nematothecae.

Hydrotheca deep, expanding towards margin, which is perpendicular to hydrocladium. Those hydrothecae at distal end of hydrocladium deeper than those at proximal end. A delicate shelf arising from adcauline side near base and overarching the hydropore. Margin with one median abcauline tooth.

Median nematotheca with a terminal aperture in the form of a narrow transverse slit, which may be subdivided into two parts, and a rounded opening on upper surface near base.

Lateral nematotheca applied to margin of hydrotheca and extending round it usually as far as the median tooth, though sometimes terminating before this; with numerous distal apertures, of which the first is generally raised slightly above the level of the others.

Phylactocarps arising from bases of thecate internodes, as many as six to a hydrocladium, each consisting of 3-6 internodes bearing two nematothecae each. Gonotheca borne on basal phylactocarpal internode, elongate, with a broad distal aperture.

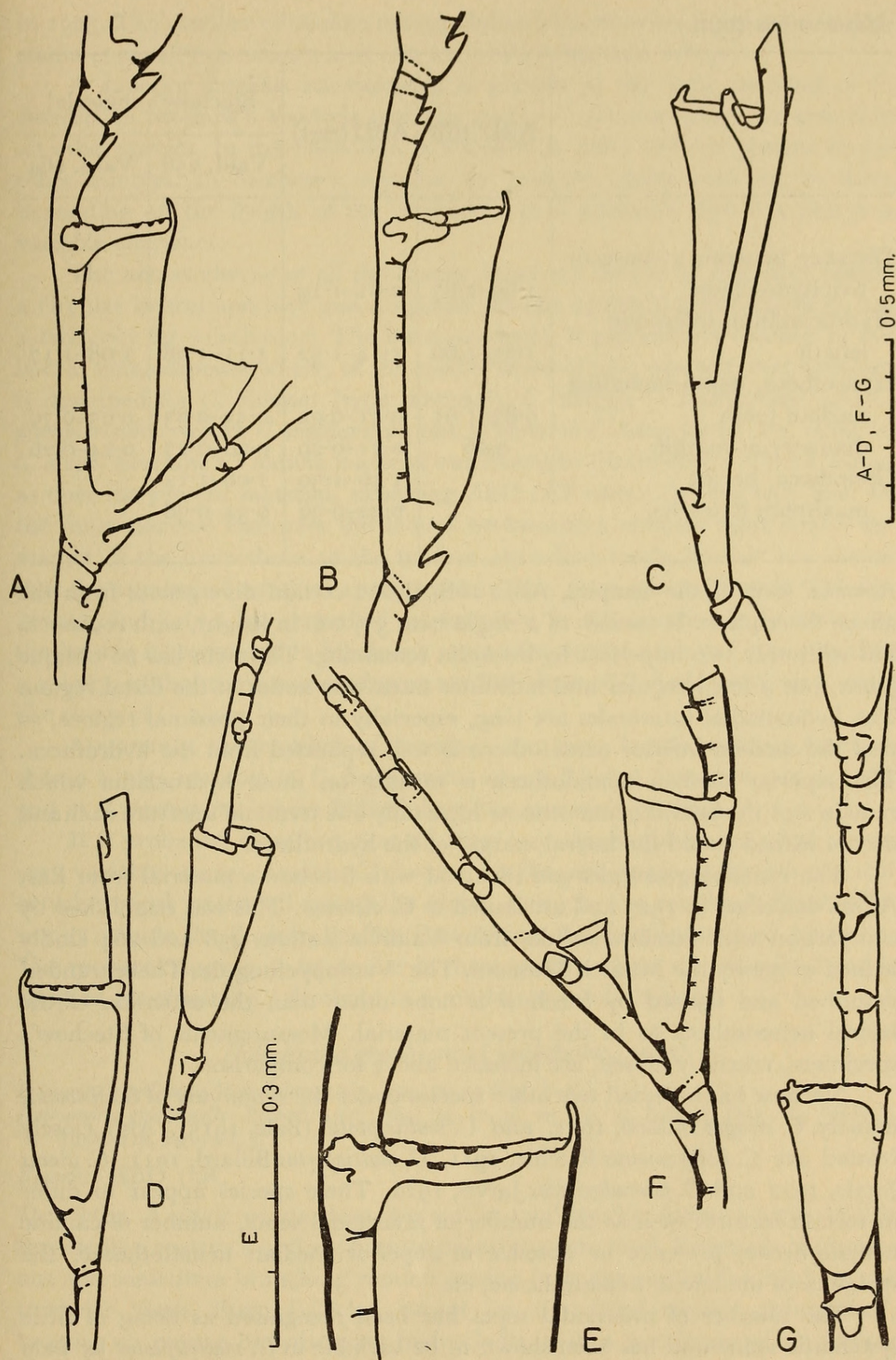


Fig. 6. *Cladocarpus distomus* Clarke.

A-D. Hydrothecae from different colonies. A and B from ABD 13E, C from ABD 16B, D from ABD 11A.

E. Part of a hydrotheca showing the lateral nematotheca from ABD 13E.

F-G. Diagrams from Stechow's slides from Valdivia stations 258 and 264 respectively. (A and F show portions of phylactocarps)

Measurements (mm.)

	ABD 16B	ABD (rest)	Stechow's material	
			Vald. 258	Vald. 264
Distance between 2 consecutive hydrocladia . . .	1.69-2.87	0.81-1.19		
Hydrocladium, internode length	1.55-1.60	1.14-1.52	1.11-1.38	1.08-1.17
Hydrotheca, depth including median tooth	0.83-1.01	0.51-0.92	0.53-0.83	0.65-0.79
diameter at margin . .	0.26	0.21-0.29	0.20-0.27	0.24-0.26
Gonotheca, height . . .		1.40-1.50	1.08-1.12	
maximum diameter . .		0.32-0.36	0.34-0.38	

Remarks. One of the samples, ABD 16B, shows certain divergences from the above description. It consists of a single stem 3.5 cm. in height, with rootstock, but with only two imperfect hydrocladia remaining. The stem has no oblique joints, but a few irregular and indistinct transverse nodes in the distal region. The hydrocladial internodes are long, especially in their proximal regions, so that the median inferior nematotheca is well separated from the hydrotheca. The superior median nematotheca is missing on those hydrocladia which remain and the lateral nematothecae have only one terminal aperture each and do not extend round the lateral margin of the hydrotheca.

The remaining samples are identical with Stechow's material from East Africa described in 1925 and attributed to *C. distomus*. This was established by comparison with Stechow's slides from Valdivia stations 258 and 264 kindly loaned to me by the Munich Museum. The 'Verdoppelung des Thekenrandes' described and figured by Stechow is none other than the extension of the lateral nematotheca as in the present material. Measurements of Stechow's specimens, taken by myself, are included above for comparison.

Stechow has included two other species under the synonymy of *C. distomus*, namely *C. sibogae* Billard, 1911, and *C. multiseptatus* (Bale, 1915). Also closely related are *C. bathyzonatus* Ritchie, 1911, *C. multiapertus* Billard, 1911, *C. alatus* Jarvis, 1922 and *C. plumularioides* Jarvis, 1922. These species appear to differ in certain features such as the number of internodal septa, number of cauline nematothecae, presence or absence of superior median nematothecae, the structure of the lateral nematothecae, etc.

The number of internodal septa has been recognised as being of little systematic value and has been shown to be variable in *C. multiseptatus* by Bale in 1919, in *C. sibogae* by Billard in 1913 and in the Valdivia material by Stechow

in 1925. The number of cauline nematothecae between two consecutive hydrocladia is equally unreliable as it can vary within a single colony.

A superior median nematotheca is present in the type material of *C. distomus*, in Stechow's Valdivia material and in *C. plumularioides*, but absent in all other species. In this collection it is absent in ABD 16B but present in the other samples. In Stechow's material the number varies from one to three depending on the length of the internode. It is probable that this also is a variable character.

The nematothecae of all the species listed are similar in that they possess a circular lateral aperture and a narrow slit-like terminal aperture which has a tendency for subdivision. The latter tendency is particularly marked in the lateral nematothecae where, of the species listed above, one terminal aperture is described for *C. distomus* (type material), *C. sibogae*, *C. multiseptatus* and *C. plumularioides*, two for *C. multiapertus*, one to three in *C. bathyzonatus* and many in *C. alatus*. Stechow's Valdivia material was shown by examination to have many, as does the present material, excepting ABD 16B where there is only one. In the most extreme examples the lateral nematotheca extends right round the margin of the hydrotheca to the median abcauline tooth. Ritchie has shown that the number of terminal apertures may vary from one to three in *C. bathyzonatus*, and Jarvis has remarked on variation in the number in *C. alatus*. In the present material and in Stechow's material a similar variation occurs within a colony, so that some nematothecae are like those of *C. bathyzonatus* and some like those of *C. alatus*.

Apparently the number of terminal apertures in the median nematothecae is also variable in *C. bathyzonatus* where Ritchie describes one or two, and in *C. multiapertus* where Billard describes one, two, or three.

It is probable, therefore, that all these records should be included in one very variable species, namely *C. distomus* Clarke, occurring in deepish tropical or subtropical waters all round the globe. As such, the recorded distribution would include the Eastern Pacific, East Africa, the East Indies and Australia. The rootstock appears to be similar in those records where it is described and is adapted for obtaining a foothold in a muddy or sandy bottom.

Halicornaria gracilicaulis (Jäderholm, 1903)

Lytocarpus gracilicaulis Jäderholm, 1903: 299, pl. 14 (figs. 3-4).

Halicornaria gracilicaulis: Billard, 1907: 364, fig. 12, pl. 25 (fig. 7). Billard, 1913: 63. Millard, 1958: 219, fig. 15 I, J.

Records. ABD 15R.

Description. A single young stem, 3.9 cm. in total height. About 1.5 cm. of this represents a rootstock and apparently penetrates into mud. It consists of numerous and sometimes branching rootlets arising from the central fascicled axis at irregular levels. Stem fascicled except for the distal region, unbranched, bearing no pinnae but alternate hydrocladia with a maximum of six hydrothecae each.

Hydrocladia with internodal septa poorly developed and internodes rather long and slender.

Hydrothecae very similar to those illustrated by Billard, 1907, and differing from those previously illustrated (Millard, 1958) in their greater length.

Gonophores absent.

DISCUSSION

The hydroid fauna of the deeper waters of the Indian Ocean is at present very poorly known. A total of 18 species is recorded here from depths of over 300 m., of which two are new: *Hincksella indiana* and *Plumularia antonbruuni*. Of the remainder, 6 are cosmopolitan (*Stegopoma fastigiatum*, *Acryptolaria conferta*, *A. crassicaulis*, *Filellum serratum*, *Lafoea fruticosa* and *Nemertesia ramosa*), 6 have affinities in the southern oceans (*Zygophylax armata*: Gough Island, South Africa; *Hincksella echinocarpa*: Kerguelen Island; *Sertularella megista*: South Africa, possibly Antarctic; *S. xantha*: South Africa; *Symplectoscyphus paulensis*: St. Paul; *Kirchenpaueria triangulata*: New Zealand, South Africa), 3 have tropical or subtropical affinities (*Acryptolaria rectangularis*: tropical East Africa; *Cladocarpus distomus*: Eastern Pacific, East Indies, North Australia, East Africa; *Halicornaria gracilicaulis*: Eastern Pacific, East Indies, Indian Ocean, Natal) and one is known only from the North Atlantic (*Symplectoscyphus amphoriferus*).

Seven species are recorded from the shallower water of Walter's Shoal, of which four are cosmopolitan (*Filellum serratum*, *Sertularella mediterranea*, *S. polyzonias* and *Plumularia setacea*), one occurs in South Africa (*Sertularella megista*), one in the southern oceans extending into the tropics (*Sertularella arbuscula*: Australia, tropical East Africa, South Africa, South Atlantic) and one is known only from the North Pacific (*Salacia desmoides*).

It is interesting that a number of species can adapt themselves to life in deeper waters by the development of a fibrous, branching rootstock suitable for penetrating and supporting the colony in the soft substratum which is normally encountered. Six species show this characteristic, namely *Hincksella echinocarpa*, *Sertularella xantha*, *Nemertesia ramosa*, *Plumularia antonbruuni*, *Cladocarpus distomus* and *Halicornaria gracilicaulis*. Some of these at least can also produce the normal flattened hydrorhiza on a hard substratum.

SUMMARY

A total of 23 species of hydroids is recorded from the Indian Ocean in the area east of South Africa and south of Madagascar. Some of these were collected by the R/V *Anton Bruun* during the International Indian Ocean Expedition in 1964 and some by the R/V *Africana II* in 1961. Descriptions and diagrams are included for the lesser known species. Two new species are described

and illustrated, namely *Hincksella indiana* and *Plumularia antonbruuni*. The geographical distribution of the species is briefly discussed.

ACKNOWLEDGEMENTS

The Author wishes to acknowledge with thanks the loan of Stechow's slides of *Cladocarpus distomus* from the Zoologische Sammlung des bayerischen Staates, Munich. Acknowledgements are also due to the Editorial Board of the University of Cape Town and to the Council for Scientific and Industrial Research for financial aid in publication. The holotypes of the new species will be deposited in the South African Museum.

REFERENCES

- ALDER, J. 1856. A notice of some new genera and species of British hydroid zoophytes. *Ann. Mag. nat. Hist.* (2) **18**: 353-362.
- ALLMAN, G. J. 1877. Report on the Hydroida collected during the exploration of the Gulf Stream by L. F. de Pourtalès, assistant United States Coast Survey. *Mem. Mus. comp. Zool. Harv.* **5**: 1-66.
- ALLMAN, G. J. 1888. Report on the Hydroida dredged by H.M.S. *Challenger* during the years 1873-76. Part II. The Tubularinae, Corymorphinae, Campanularinae, Sertularinae and Thalamophora. *Rep. Voy. Challenger 1873-76* **23** (70): 1-90.
- BALE, W. M. 1888. On some new and rare Hydroida in the Australian Museum collection. *Proc. Linn. Soc. N.S.W.* (2) **3**: 745-799.
- BALE, W. M. 1914. Report on the Hydroida collected in the Great Australian Bight and other localities. Part II. *Zool. Res. Fish. Exp. 'Endeavour'* **2**: 166-188.
- BALE, W. M. 1915. Report on the Hydroida collected in the Great Australian Bight and other localities. III. *Zool. Res. Fish. Exp. 'Endeavour'* **3**: 241-336.
- BALE, W. M. 1919. Further notes on Australian hydroids. IV. *Proc. roy. Soc. Vict.* **31**: 327-361.
- BILLARD, A. 1906. Hydroïdes. *Expéd. sci. 'Travailleur' et du 'Talisman'* **8**: 153-244.
- BILLARD, A. 1907. Hydroïdes de Madagascar et du Sud-Est de l'Afrique. *Arch. Zool. exp. gén.* (4) **7**: 335-396.
- BILLARD, A. 1910. Revision d'une partie de la collection des Hydroïdes du British Museum. *Ann. Sci. nat. zool.* (9) **11**: 1-67.
- BILLARD, A. 1913. Les Hydroïdes de l'expédition du Siboga. I. Plumulariidae. *Siboga Exped.*, no. VIIa: 1-115.
- BILLARD, A. 1918. Notes sur quelques espèces d'hydroïdes de l'expédition du 'Siboga'. *Arch. Zool. exp. gén.* **57**: 21-27.
- BILLARD, A. 1924. Note critique sur divers genres et espèces d'Hydroïdes avec la description de trois espèces nouvelles. *Rev. suisse Zool.*, **31**: 53-74.
- BILLARD, A. 1925. Les Hydroïdes de l'expédition du Siboga. II. Synthecidae et Sertularidae. *Siboga Exped.*, no. VIIb: 117-232.
- CLARKE, S. F. 1879. Report on the Hydroida collected during the exploration of the Gulf Stream and Gulf of Mexico by Alexander Agassiz, 1877-78. *Bull. Mus. comp. Zool. Harv.* **5**: 239-252.
- CLARKE, S. F. 1907. The Hydroids. In: Reports on the scientific results of the expedition to the Eastern Tropical Pacific, etc. *Mem. Mus. comp. Zool. Harv.* **35**: 1-18.
- FRASER, C. McL. 1937. *Hydroids of the Pacific coast of Canada and the United States*. Toronto.
- JÄDERHOLM, E. 1903. Aussereuropäische Hydroiden im schwedischen Reichsmuseum. *Ark. Zool.* **1**: 259-312.
- JARVIS, F. E. 1922. The hydroids from the Chagos, Seychelles and other islands and from the coasts of British East Africa and Zanzibar. *Trans. Linn. Soc. Lond. Zool.* **18**: 331-360.
- MARKTANNER-TURNERETSCHER, G. 1890. Die Hydroiden des k. k. naturhistorischen Hofmuseums. *Ann. naturh. Mus. Wien* **5**: 195-286.

- MILLARD, N. A. H. 1957. The Hydrozoa of False Bay, South Africa. *Ann. S. Afr. Mus.* **43**: 173-243.
- MILLARD, N. A. H. 1958. Hydrozoa from the coasts of Natal and Portuguese East Africa. Part I. Calyptoblastea. *Ann. S. Afr. Mus.* **44**: 165-226.
- MILLARD, N. A. H. 1962. The Hydrozoa of the south and west coasts of South Africa. Part I. The Plumulariidae. *Ann. S. Afr. Mus.* **46**: 261-319.
- MILLARD, N. A. H. 1964. The Hydrozoa of the south and west coasts of South Africa. Part II. The Lafoeidae, Syntheciidae and Sertulariidae. *Ann. S. Afr. Mus.* **48**: 1-56.
- NAUMOV, D. V. 1960. Hydroids and hydromedusae of the marine, brackish and freshwater basins of the U.S.S.R. (In Russian). *Opred. Faune SSSR* **70**: 1-585.
- NUTTING, C. C. 1904. American hydroids. Part II. The Sertularidae. *Spec. Bull. U.S. nat. Mus.* **4** (2): 1-151.
- NUTTING, C. C. 1905. Hydroids of the Hawaiian islands collected by the steamer 'Albatross' in 1902. *Bull. U.S. Fish Comm.* **23**: 931-959.
- RALPH, P. M. 1957. New Zealand thecate hydroids. Part I. Campanulariidae and Campanulinidae. *Trans. roy. Soc. N.Z.* **84**: 811-854.
- RALPH, P. M. 1958. New Zealand thecate hydroids. Part II. Families Lafoeidae, Lineolariidae, Haleciidae and Syntheciidae. *Trans. roy. Soc. N.Z.* **85**: 301-356.
- RALPH, P. M. 1961a. New Zealand thecate hydroids. Part III. Family Sertulariidae. *Trans. roy. Soc. N.Z.* **88**: 749-838.
- RALPH, P. M. 1961b. New Zealand thecate hydroids. Part IV. The family Plumulariidae. *Trans. roy. Soc. N.Z. Zool.* **1**: 19-74.
- RITCHIE, J. 1907. The hydroids of the Scottish National Antarctic Expedition. *Trans. roy. Soc. Edinb.* **45**: 519-545.
- RITCHIE, J. 1911. Hydrozoa (hydroid zoophytes and Stylasterina). In: Scientific results of the trawling expedition of H.M.C.S. 'Thetis'. *Mem. Aust. Mus.* (4) **2**: 807-869.
- STECHOW, E. 1913. Hydroidpolypen der japanischen Ostküste. II. Campanularidae, Haleciidae, Lafoeidae, Campanulinidae und Sertularidae, nebst Ergänzungen zu den Athecata und Plumularidae. *Abh. bayer. Akad. Wiss. math.-phys.* **3** (2): 1-162.
- STECHOW, E. 1925. Hydroiden der Deutschen Tiefsee-Expedition. *Wiss. Ergebn. 'Valdivia'* **17**: 383-546.
- TOTTON, A. K. 1930. Coelenterata. Part V. Hydroida. *Nat. Hist. Rep. Terra Nova Exped.* **5**: 131-252.
- U.S. Program in Biology, International Indian Ocean Expedition. 1965. Final Cruise Report, Anton Bruun Cruises 7, 8, 9, **1**: Woods Hole Oceanographic Inst.
- VERVOORT, W. 1959. The Hydroida of the tropical west coast of Africa. *Atlantide Rep.* **5**: 211-325.
- WARREN, E. 1908. On a collection of hydroids, mostly from the Natal coast. *Ann. Natal Mus.* **1**: 269-355.



Millard, N A H. 1967. "Hydroids from the south-west Indian Ocean." *Annals of the South African Museum. Annale van die Suid-Afrikaanse Museum* 50, 169–194.

View This Item Online: <https://www.biodiversitylibrary.org/item/127146>

Permalink: <https://www.biodiversitylibrary.org/partpdf/78187>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: In Copyright. Digitized with the permission of the rights holder.

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://www.biodiversitylibrary.org/permissions/>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.