

ON A COLLECTION OF HYDROIDS FROM SOUTH INDIA

III. FAMILY PLUMULARIIDAE¹

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Family PLUMULARIIDAE L. Agassiz

HYDROCAULUS is usually branched, rarely unbranched; hydrotheca sessile, arises on one side of the hydroclade, with an eccentric diaphragm; operculum absent; nematophores present; hydranth conical, with a single whorl of filiform tentacles; endoderm differentiated into non-digestive and digestive region; reproduction through sporosacs.

Stechow (1921) recognised 4 subfamilies under Plumulariidae (viz. Kirchenpaueriinae Stechow, Plumulariinae Kuhn, Acladiinae Stechow and Aglaopheniinae Kuhn). According to Stechow, single chambered nematophores characterise the subfamily Kirchenpaueriinae Stechow, but it would appear from the present study that the real character on which this subfamily should be based is the presence of a median unpaired supracalycine nematophore. It is therefore suggested that all Plumulariidae possessing this character may be transferred to Kirchenpaueriinae. On this basis *Plumella* Stechow and *Monothecella* Stechow will have to be included under Acladiinae. In *Ophionella* Stechow (*Ophionema* Hincks), the nematophore is represented by a naked sarcostyle. This condition may be regarded as the most primitive. The next stage is present in *Kirchenpaueria* Jickeli, where the mesial nematophore develops a theca. The presence of both mesial and supracalycine nematotheca evidently represents a further advancement and this condition is seen in *Ventromma* Stechow. Though *Pycnotheca* Stechow resembles *Kirchenpaueria*, in the nature of the nematophores, it represents the most specialised genus of the subfamily. Subfamily Plumulariinae Kuhn has supracalycine nematophores on either side of the hydrotheca and all nematophores are movable and bithalamic. Subfamily Acladiinae Stechow is characterised by the presence of movable lateral and immovable mesial nematophores while subfamily Aglaopheniinae Kuhn is characterised by the presence of a single chambered immovable nematophores.

One confusion in this subfamily is because the same generic name has been used for different genera, as for example *Halicornaria* Hincks and *Halicornaria* Allman, *Lytocarpia* Kirchenpauer and *Lytocarpus* Allman, *Azygoplou* Allman and *Azygoplou* Bale.

The genera of Plumulariidae represented in the Indian region may be identified by the following key :

- I. Supracalycine nematophore represented as median unpaired structure, nematotheca when present one chambered (monothalamic).

Subfamily KIRCHENPAUERIINAE

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1. Supracalycine nematophore represented by a naked sarcostyle, mesial nematophore with theca, hydrotheca with an abaxial intrathecal ridge.
Pycnotheca Stechow
 2. All nematophores provided with nematothecae.
Ventromma Stechow
- II. Supracalycine nematophores represented by two lateral structures. All nematophores provided with nematothecae.
1. All nematophores bithalamic and movable. Subfamily PLUMULARIINAE
 - (i) Hydrocaulus absent, hydrocladia arising directly from the hydro-rhiza.
Antennella Allman
 - (ii) Hydrocaulus present :
 - (A) Hydrotheca arising from hydrocaulus and hydroclade.
Schizotricha Allman
 - (B) Hydrotheca absent on hydrocaulus.
 - (A') Hydrocladia on both sides of hydrocaulus.
Plumularia Lamarck
 - (B') Hydrocladia on one side of hydrocaulus.
Monostaechas Allman
 2. Supracalycine nematophores bithalamic and movable, mesial nematophores monothalamic and immovable. Subfamily ACLADIINAE

Cladia simple, theca arising only from hydroclade. *Heteroplou* Stechow
 3. All nematophores monothalamic and immovable. Subfamily AGLAOPHENIIDAE
 - (i) Gonangium unprotected.

Hydrotheca simple, lateral nematophores present.
Gymnangium Hincks
 - (ii) Gonangium protected.
 - (A) Actual protective devices are modified hydroclade.
Macrorhynchia Kirchenpauer
 - (B) Actual protective devices are appendages of hydroclade.
 - (A') Protective devices do not enclose gonangia.
 - (a) Protective devices arising from one side of the modified hydroclade (half corbula). *Monoserius* Marktanner
 - (b) Protective devices arising all around the modified hydroclade.
Aglaria Stechow
 - (B') Protective devices enclosing gonangia in a basket-like structure (corbula). A stinging appendage absent at the extremity of the colony. The lateral nematophores represented by a pair.
Aglaophenia Lamouroux

Subfamily KIRCHENPAUERIINAE Stechow

Pycnotheca Stechow

Diplocheilus Allman 1883.

Azygoplou Bale 1888.

Kirchenpaueria Bale 1894 (in part).

Pycnotheca Stechow 1919.

Hydrocaulus is plumose, cauline internodes carrying one or two hydrocladia, cladial internodes homomerous, hydrotheca cup-shaped, margin entire, with abaxial and vertical intrathecal ridges; mesial nematophore with a nematotheca, with a single chamber and distal margin emarginated; supracalycine nematophore unpaired, without nematotheca; gonosome simple, without protective devices.

There is some difference of opinion regarding the validity of this genus. Allman (1883) instituted the genus *Diplocheilus* to accommodate *D. mirabilis* which he obtained from the Challenger collections. Later after examining Allman's material, Bale (1884) came to the conclusion that *Azygoplou* Bale was synonymous with *Diplocheilus* Allman and that both were synonyms of *Kirchenpaueria* Jickeli. This conclusion was generally accepted until Stechow (1913) upheld the distinctiveness of *Diplocheilus*. Since the name *Diplocheilus* was preoccupied, Stechow (1919) coined the generic name *Pycnotheca*. Though Stechow continued to recognise this genus in his subsequent contributions, most of the later workers disregarded it. The rejection of *Pycnotheca* was mainly because the genus was not sufficiently well described and partly because most of the subsequent authors avoided Stechow's classification altogether. However, Totton (1930) supported the independent status of *Pycnotheca* and pointed out that *Kirchenpaueria* Jickeli was only remotely related to *Pycnotheca* and its real affinity was to *Halicornopsis* Bale.

Naked sarcostyles, median supracalycine nematophores, single chambered movable nematophores, smooth perisarc, cauline internodes carrying a single hydroclade, heteromerous condition of the hydroclade, long intermediate internode and short cup-shaped hydrotheca, without thickening or intrathecal ridge are accepted primitive characters and therefore *Kirchenpaueria* Jickeli is a primitive genus. It is to this primitive genus that Bale and Bedot referred *Pycnotheca*. According to them the characters of the nematophore are enough to justify the inclusion of *Pycnotheca* Stechow in *Kirchenpaueria* Jickeli. The existence of unpaired sarcostyle representing the supracalycine nematophores is admittedly a primitive character, and this would justify the inclusion of *Pycnotheca* in the subfamily Kirchenpaueriinae, but the following characters will show that *Pycnotheca* is far more advanced than *Kirchenpaueria*.

In *Pycnotheca* the cauline internodes give rise to more than one hydroclade, foreshadowing the condition in *Gymnangium* Hincks and *Aglaophenia* Lamouroux, where the cauline internodes are nearly absent. The presence of an abcauline intrathecal ridge shows that the hydrotheca has undergone a double flexure.* The vertical ridge that ascends from the abaxial ridge is a character unknown to this family and is certainly not a primitive character. The highly emarginate mesial

* The eccentric diaphragm (adaxial intrathecal ridge) is not clear in some species, but *P. bisepitata* (Blackburn) and Warren's illustration of a longitudinal section of *P. mirabilis* clearly explains the true nature of these structures.

nematophore instead of bearing resemblance to the primitive *Kirchenpaueria*, suggests a more evolved state. In the occurrence of a tubular mamelon the genus shows affinity with *Halicornaria* Bale (Totton 1930 p. 124). Evidently *Pycnotheca* shows affinity with many of the higher genera of Plumulariidae and hence considered the most evolved genus under Kirchenpaueriinae.

***Pycnotheca mirabilis* (Allman) race *travancorensis* n. race**
(Figs. 90 & 91)

Totton (1930) has given a detailed account of *Pycnotheca mirabilis*. Stechow (1919, 1925) and Totton (1930) have created four geographical races based on

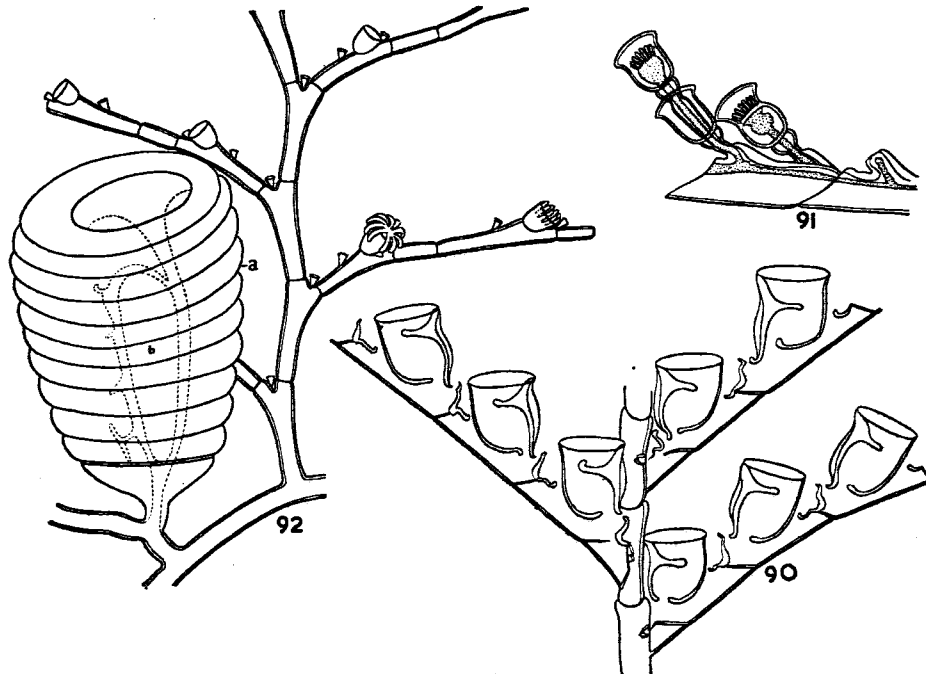


FIG. 90. *Pycnotheca mirabilis* race *travancorensis* front view; 91. *Pycnotheca mirabilis* race *travancorensis* side view; 92. *Ventromma halecioides* var. *minutus*.

variations met with in the materials collected from different places. The present collection differs from all the races so far described in the hydrotheca being more erect, placed close together, and the thecal margin and the vertical ridge more thickened. The present material is therefore described as a new race.

Height of colony	..	upto 5 mm.
Length of cauline internode	..	0.30-0.55 mm.
Breadth of cauline internode	..	0.10-0.18 mm.
Length of hydrocladial internode	..	0.28-0.34 mm.
Height of hydrotheca	..	0.19-0.20 mm.
Angle of hydrotheca with the hydroclade	..	50°-55°

Locality.—This is commonly found at Cape Comorin and occasionally at Kovilam and Thankassery. *Pycnotheca* has not been so far recorded from the Indian region.

Ventromma Stechow

Ventromma Stechow 1924a.

Hydrocaulus is branched or unbranched, monosiphonic or polysiphonic; hydrocladia pinnate, bearing more than one hydrotheca; hydrotheca small, insufficient to contain the retracted polyp, nematophores small, monothalamic, movable and unpaired; gonosome typical.

Ventromma halecioides (Alder)

var. *minutus* n.var.

(Fig. 92)

Plumularia halecioides Leloup 1932, p. 164

The hydrocaulus is short, delicate, monosiphonic, with regular nodes and arises from creeping hydrorhiza; hydrocladia arise from the apophysis of cauline internodes; hydrotheca cup-shaped, attached to the distal half of the internodes, supported on small basal expansions, adnate to half the adcauline side; thecal mouth simple, reaches the distal end of internode; hydranth with 12-16 tentacles, not fully retracting into the theca; nematophores short, simple and monothalamic, represented by a mesial and a median supracalycine. Gonosomes arise on short peduncles from the hydrorhiza; gonotheca large, barrel-shaped, with conical base, truncated apex and asymmetrical mouth, traversed by 10-12 transverse annulations, annulations becoming indistinct in older colonies, with an internal shelf at the base, an eccentric blastostyle bearing an internal marsupium and distally expanding to form a membranous lid for the eccentric mouth. Protoplasmic strands connect the blastostyle and internal marsupium to the gonothecal wall. These strands bear a strong resemblance to the 'gubernaculae' described in *Sertularia pumila* and might serve a nutritive function, or they might be mechanical devices for keeping the internal marsupium in position. The 'gubernacula', though not infrequent in Sertulariidae are unknown in Plumulariidae.

Height of colony	..	upto 8 mm.
Length of cauline internode	..	0.30-0.36 mm.
Length of hydroclade	..	1.20-2.00 mm.
Length of thecate internode of hydroclade	..	0.24-0.29 mm.
Length of athecate internode of hydroclade	..	0.10-0.15 mm.
Length of abcauline side of hydrotheca	..	0.08-0.09 mm.
Width of hydrotheca	..	0.07-0.08 mm.
Length of gonotheca	..	1.02-1.30 mm.
Breadth of gonotheca	..	0.55-0.75 mm.

Locality.—A few colonies of this delicate species were obtained from *Sargassum* weeds at Thankassery.

Remarks.—The nature of the nematophores clearly supports the inclusion of this species in *Ventromma* Stechow. This genus includes only 3 species [viz. *V. tenuis* (Schneider), *V. oligopyxis* (Kirchenpauer) and *V. halecioides* (Alder)]. According to Stechow the first two are synonyms. However, *V. halecioides* is distinguished from the other two by the characteristic gonotheca. The gonotheca and the nematotheca in the present specimens are exactly as in *V. halecioides*. Hincks (1868), Billard (1902, 1903, 1904), Stechow (1912, 1919, 1924a) described this species as a large colony measuring an inch in height with polysiphonic stem and irregular branching. The hydrocaulus of the present collection grows to a maximum height of 8 mm. only and even the mature specimens are unbranched and monosiphonic. The present material is therefore described as a new variety and named *minutus*. The material obtained from Pamban and identified as *V. halecioides* (Leloup 1932) is also similar to the present material. But Leloup refrained from separating his specimens from *V. halecioides* probably because he was not quite sure about its maturity as the gonosome was not present.

Subfamily PLUMULARIINAE Kuhn

Antennella Allman

Antennella Allman 1887.

A hydrocaulus is absent in this genus, the hydrothecae are borne on hydrocladia arising from the hydrorhiza. Ever since the creation of this genus there has been much doubt whether the species included under it are only immature stages of other genera of Plumulariidae. This doubt is to some extent substantiated by the discovery of *Antennella*-like forms arising from the hydrorhiza of branched adult colonies of *Plumularia filicaulis* Kirchenpauer, *Schizotricha liechensterni* (Marktanner), *S. campanula* (Busk) and *Heteroplou siliculata* n. sp. On the other hand *Antennella allmani* Armstrong, *A. balei* Billard, *A. campanulaformis* var. *dubia* Mulder et Trebilcock, *A. quadriaurita* Ritchie and *A. secundaria* Gmelin are known to possess mature gonosomes. The possible inference is that *Antennella* Allman is a distinct genus although some of the species now included may have to be transferred to other genera as more information becomes available. The species of *Antennella* recorded from the Indian region may be identified as follows:

- I. Lateral nematophores not reaching the mouth of the hydrotheca, a small median nematophore present in the axil of the hydrotheca. *A. secundaria* (Gmelin)
- II. Lateral nematophore exceeding the hydrotheca by its own height. Medial nematophore absent in the axil of hydrotheca. *A. allmani* Armstrong

Antennella secundaria (Gmelin)

(Fig. 93)

Sertularia secunda Gmelin 1781, p. 3854.

Plumularia secundaria Kirchenpauer 1876, p. 28, Pl. I, fig. 18.

Plumularia secundaria Marktanner 1890, p. 252, Pl. VII, fig. 1.

Plumularia secundaria Pictet 1893, p. 53, Pl. II, fig. 46.

- Plumularia secundaria* Jaderholm 1903, p. 292.
Antennella gracilis Thornely 1904, p. 108.
Antennella natalensis Warren 1908, p. 318.
Antennella secundaria Ritchie 1910, p. 14.
 Non *Antennella secundaria* Billard 1913, p. 8, fig. 1.
Antennella secundaria Stechow 1913a, p. 87.
Antennella secundaria Bedot 1921a, p. 5.
Antennella secundaria Broch 1933, p. 19.
Plumularia secundaria Blackburn 1938, p. 316.
Schizotricha secundaria Blackburn 1942, p. 108.

The hydroclade is divided into hydrothecate and athecate internodes, the former slightly the longer with a straight node above and an oblique node below and a notch opposite the oblique node; hydrothecae cup-shaped, set at an angle of 35° with the internode; perisarc of the abcauline side of the thecae and the thecate side of the hydrocladia distinctly thicker; nematophores consisting of a pair of supracalycine, mounted on elongated prominences on either side of the hydrotheca and not reaching as far as the mouth of the hydrotheca, a small axillary in the median line of the axil of the hydrotheca and two cauline on the athecate internodes; gonosome was not observed.

Length of hydroclade	..	..	..	upto 5 mm.
Length of thecate internode	..	..	..	0·24-0·28 mm.
Length of athecate internode	..	..	..	0·20-0·28 mm.
Breadth of hydroclade	..	..	..	0·06-0·08 mm.
Length of abcauline side of theca	..	..	..	0·16-0·18 mm.
Length of adcauline side of theca (free portion)	..	..	..	0·12-0·14 mm.
Breadth of hydrothecal mouth	..	..	..	0·16-0·22 mm.
Length of supracalycine nematophore	..	..	..	0·06-0·07 mm.
Length of mesial nematophore	..	..	..	0·04-0·05 mm.
Length of axial nematophore	..	..	..	0·02-0·03 mm.

Locality.—This species is represented in the present collection by a few colonies obtained from shore seines at Quilon beach. In the Indian region this species has been previously recorded from the Gulf of Manaar (Thornely 1904) and Interview Island near Andamans (Ritchie 1910).

Remarks.—The gonosome of this species was observed by Warren (1908) and Broch (1933). However, Blackburn (1942) considered *A. secundaria* (Gmelin) as synonymous with *Schizotricha liechensterni* (Marktanner), since he found branches exactly resembling those of the former arising from the hydrorhiza of the latter. Nevertheless the two species are quite distinct having only accidental resemblance. *A. secundaria* Billard (1913) does not appear to be the same as the present species and it is more like *A. allmani* Armstrong.

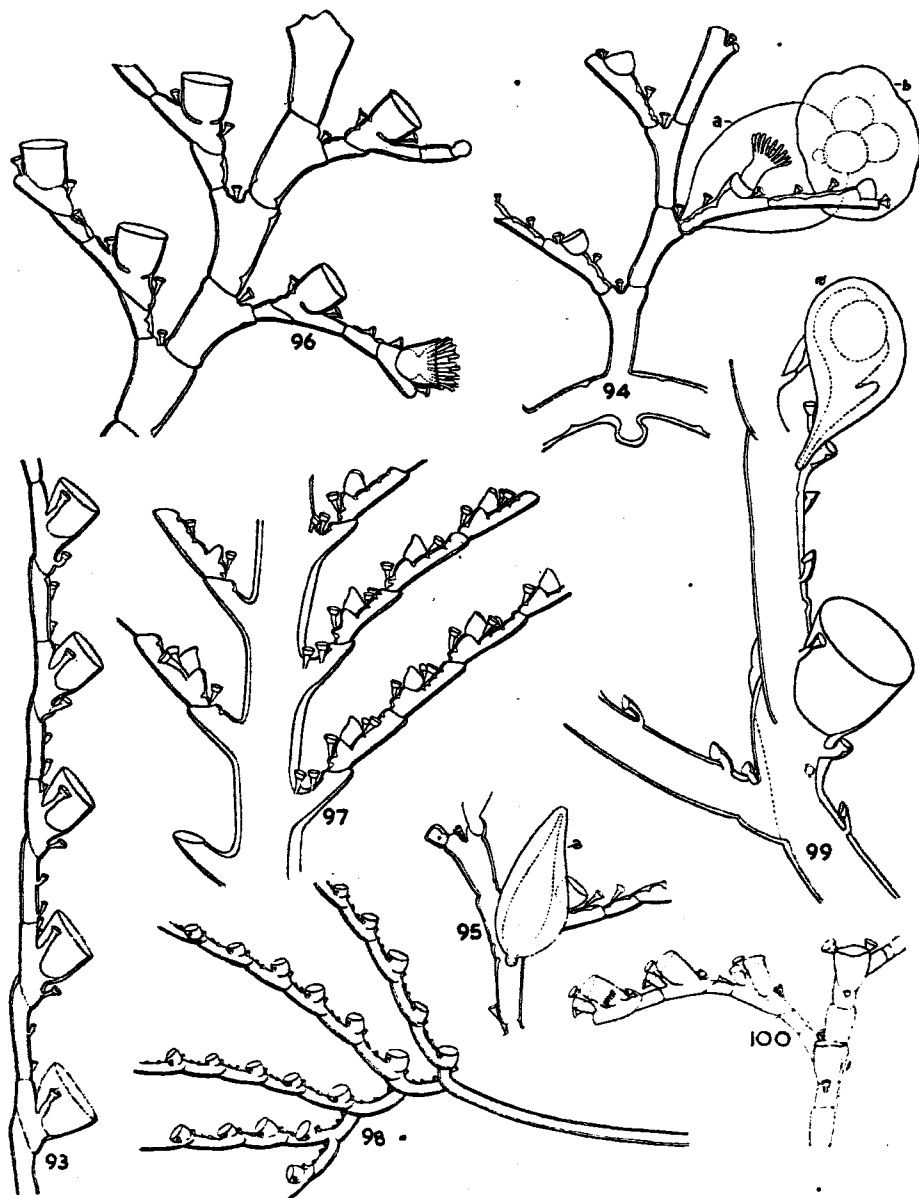


FIG. 93. *Antennella secundaria*; 94. *Plumularia warreni* (a) female gonotheca. (b) external marsupium; 95. *Plumularia warreni* (a) male gonotheca; 96. *Plumularia indica*; 97. *Plumularia polycladia*; 98. *Monostaechas quadridens*; 99. *Monostaechas quadridens*. A portion of the colony magnified; 100. *Schizotricha diaphana*.

Plumularia Lamarck*Plumularia* Lamarck 1816.

Hydrocaulus is athecate ; hydrocladia unbranched, pinnately arranged, with more than one hydrotheca, without a terminal spiny appendage ; nematophores movable and bithalamic ; gonosome simple and unprotected.

The species of *Plumularia* recorded from the Indian region may be identified as follows :

- I. A single hydroclade arising from each hydrocauline internode, excepting the basal.
 1. Abcauline and adcauline sides of the hydrotheca diverging. *P. warreni* (Warren)
 2. Abcauline and adcauline sides of the hydrotheca parallel. *P. indica* n. sp.
- II. Several hydrocladia arising from each cauline internode. *P. polycladia* n. sp.

Plumularia warreni (Warren)

(Figs. 94 & 95)

Plumularia tenuis Warren 1908, p. 318, fig. 13.

Non *Plumularia tenuis* Schneider 1897, p. 485.

Plumularia warreni Stechow 1919, p. 119.

Plumularia tenuis var. *pambanesis* Gravelly 1927, p. 16, Pl. II, fig. 11.

Plumularia warreni Millard 1958, p. 213.

Coenosarc is thick with regular internal ridges producing a septate appearance ; all the internodes with two ventrally incomplete internal annulations ; hydroclade divided into thecate and athecate internodes, internodes carry annulations one above the proximal and the other below the distal node ; thecate internode with an additional annulation mid-way between the proximal and distal annulations ; hydroclade divided into thecate and athecate internodes ; hydrotheca cup-shaped, shallow, sides diverging, with the adcauline side adnate to the hydroclade, nematophores bithalamic, typical with mesial and supracalycine on the thecate internode, cauline on the athecate internode and an axial in the axil of the hydroclade ; gonosome arising from the axil of the hydroclade ; male gonotheca elongated with a rounded base and a conical apex and female gonotheca oblong or subspherical, ova large, arranged around the blastostyle, passing into an external marsupium when mature.

Height of colony	..	..	..	upto 6.50 mm.
Breadth of hydrocaulus	..	..	..	0.07-0.09 mm.
Breadth of hydrorhiza	..	..	..	0.15-0.20 mm.
Length of cauline internode	..	..	..	0.35-0.40 mm.
Length of athecate cladial internode	..	..	..	0.15-0.18 mm.
Length of thecate cladial internode	..	..	..	0.24-0.26 mm.

Length of abcauline side of hydrotheca	..	0.05-0.07 mm.
Breadth of hydrothecal mouth	..	0.06-0.08 mm.
Length of female gonotheca (excl. marsupium)	..	0.51-0.54 mm.
Breadth of female gonotheca	..	0.37-0.44 mm.
Length of male gonotheca	..	0.40-0.44 mm.
Breadth of male gonotheca	..	0.22-0.24 mm.

Locality.—This is by far the most common species of Plumulariidae occurring at all stations of the present study. Mature specimens were collected from November to January. They generally grow on the base of *Saragassam* and occasionally on rocks and *Mytilus* shells. This species has been previously recorded by Gravely (1927) from Pamban in the Indian region. The male gonotheca is now described for the first time.

Remarks.—Apart from the two records of this species from the Natal waters by Warren (1908) and Millard (1958) this species was recorded only by Gravely (1927), who created a new variety based on the presence of ova on both sides of the blastostyle. Warren in describing this species did not give details of the arrangement of the ova on the blastostyles. His text figure shows three gonothecae, first with ova completely masking the blastostyle, the second with ova only in the marsupium and the third on one side of the blastostyle. The present collection includes some specimens from the locality where Gravely obtained his. In the entire collection only about half the number of specimens showed the condition described by Gravely. Actually the ova arise on all sides of the blastostyle, though in several cases the ova on one side may get partially or completely liberated resembling the condition described by Gravely. Therefore the variety *pambanensis* may be regarded as a synonym of *P. warreni*.

Plumularia indica n. sp.

(Fig. 96)

Hydrocaulus is plumose, demarcated into regular nodes and internodes bearing alternate hydrocladia; perisarc thin, smooth, except for a slight internal annulation on either side of each node; hydroclade divided into long thecate and short atehcate internodes, the latter with straight proximal nodes and oblique distal nodes; hydrotheca cup-shaped, large, set at an angle of 45°, the two sides of the theca more or less parallel and thecal margin entire; hydranth typical with 16 tentacles; nematophores alike, conical, bithalamic, represented by mesial and supracalycine nematophores on the thecate, cauline on the atehcate internode, axial in the axil of hydroclade and none on the hydrocaulus; gonosome not obtained.

Height of colony	..	..	upto 14.5 mm.
Length of basal internode	..	..	0.33-0.35 mm.
Breadth of hydrocaulus	..	..	0.14-0.20 mm.
Length of hydroclade	..	..	1.10-2.10 mm.
Length of abaxial side of cladial basal internode	..	..	0.07-0.08 mm.
Length of adaxial side of cladial basal internode	..	..	0.13-0.14 mm.

Length of thecate internode	.. ..	0.34-0.42 mm.
Length of atehcate internode	.. ..	0.13-0.15 mm.
Length of adcauline free side of hydrotheca	.. ..	0.11-0.12 mm.
Length of abcauline side of hydrotheca	.. ..	0.14-0.16 mm.
Breadth of hydrothecal mouth	.. ..	0.13-0.15 mm.

Locality.—This species is fairly common at Kovilam and Cape Comorin.

Remarks.—The present species is a typical *Plumularia* showing the simplest type of organization, in which respect it resembles *P. warreni*. However, it could be easily distinguished from the latter by the relatively stout internodes, parallel hydrothecal sides and less adnate and more erect nature of the hydrothecae. The shape of the hydrotheca in the present species is like that of *Schizotricha buskii* (Bale) and *S. campanulata* (Busk), but the absence of any cauline hydrotheca in the present species shows that the resemblance is only accidental. The present species is therefore treated as new under the name *Plumularia indica*.

***Plumularia polycladia* n. sp.**

(Fig. 97)

Hydrocaulus is monosiphonic, divided into long internodes carrying upto 12 hydrocladia; hydroclade arising on unusually long apophysis, divided into a number of internodes, each internode with a hydrotheca, a mesial nematophore, a pair of supracalycine and a minimum of five internal annulations arising on the thecate side and gradually fading towards the opposite side; of the five annulations, one each arises on either side of each internode, one each opposite the upper and lower ends of the hydrotheca and one above the origin of the mesial nematophores; hydrothecae borne on the expanded base of the internodes; abcauline side of hydrotheca is on line with the thecate side of the internode; projecting beyond the adcauline side; nematophores very large, bithalamic, conical, absent on the hydrocaulus except for two axials; supracalycine slightly the longer, arising from two prominences that slightly flange the adnate side of the hydrotheca; mesial nematophores originating between the lower internal ridges of the internode and reaching slightly below the base of the hydrotheca; gonosome not obtained.

Length of cauline internode	.. ..	1.0-2.1 mm.
Breadth of cauline internode	.. ..	0.25-0.39 mm.
Length of cladial internode	.. ..	0.21-0.25 mm.
Breadth of cladial internode	.. ..	0.05-0.06 mm.
Length of apophysis	.. ..	0.15-0.18 mm.
Length of abcauline side of hydrotheca	.. ..	0.07-0.08 mm.
Length of adcauline side of hydrotheca	.. ..	0.05-0.06 mm.
Breadth of hydrothecal mouth	.. ..	0.05-0.06 mm.
Length of supracalycine nematophore	.. ..	0.09 mm.

Locality.—This species is represented in the present collection by a few fragments dredged from a depth of 12 fathoms, 6 miles off Trivandrum.

Remarks.—Even though the gonosome is absent, other characters clearly support its inclusion in the genus *Plumularia*. *Plumularia brachiata* Totton is its nearest relative ; both agree in having variable lengths of cauline internodes, several hydrocladia arising from the hydrocaulus, long apophysis and in the general disposition of the hydrothecae and nematothecae. However, the present species differs from *P. brachiata* in the following characters. In *P. brachiata* there are only upto four hydrocladia on each cauline internode, while in the present species there are upto twelve, even though the internodes of both the species are of the same length. In other words the hydrocladia of the present species are closer. A polysiphonic stem with rows of nematophores is absent in the present species. These differences seem to be sufficient to justify the creation of a new species and the present species is named *Plumularia polycladia*, the specific name alluding to the very large number of hydrocladia on the cauline internode.

Monostaechas Allman

Monostaechas Allman 1877.

Hydrocladia arise from one side of the hydrocaulus ; hydroclade with more than one hydrotheca ; nematophores movable and bithalamic ; gonosome simple and unprotected. The two species of *Monostaechas* represented in the Indian region can be identified as follows :

- I. Hydroclade divided into thecate internodes only. *M. quadridens* McCrady
- II. Hydroclade divided into thecate and atehcate internode.
M. fischeri Nutting var. *simplex* Billard

Monostaechas quadridens (McCrady)

(Figs. 98 & 99)

Plumularia quadridens McCrady 1858, p. 97.

Monostaechas quadridens Nutting 1901a, p. 365, fig. 69.

Monostaechas quadridens Thornely 1904, p. 120.

Monostaechas quadridens Ritchie 1907a, p. 508.

Monostaechas quadridens Stechow 1909, p. 95.

Monostaechas quadridens Ritchie 1910, p. 14.

Monostaechas quadridens Deevey 1950, p. 347.

The hydrocaulus is divided into long basal and a number of distal internodes bearing hydrocladia ; hydroclade with thecate internodes ; hydrotheca cup-shaped, with even circular margin ; nematophores bithalamic ; mesial nematophore with a fairly broad base and the distal margin extending as far as the base of the hydrotheca ; supracalycine nematophores mounted on long peduncles and arise laterally to the hydrothecal mouth ; axial nematophore arises in the axil of hydrotheca, as large as cauline nematophore ; cauline nematophores two on each internode ; gonotheca arises from the side of the hydrothecal base ; blastostyle eccentric, distally curving around the ovum.

Height of colony	..	upto 9 mm.
Length of hydroclade	..	upto 5.8 mm.
Breadth of hydroclade	..	0.9-0.11 mm.
Length of cladial internode	..	0.58-0.65 mm.
Length of adcauline side of hydrotheca	..	0.18-0.19 mm.
Length of abcauline side of hydrotheca	..	0.27-0.29 mm.
Breadth of hydrothecal mouth	..	0.28-0.30 mm.
Length of typical nematophore	..	0.08 mm.
Length of female gonotheca	..	0.65-0.88 mm.
Maximum breadth of female gonotheca	..	0.33-0.35 mm.

Locality.—This species was dredged from a depth of 10 fathoms, off Neendakara. They were attached to Eunicid tubes.

Schizotricha Allman

Non *Diplopteran* Allman 1883.

Schizotricha Allman 1883.

Diplopteran Nutting 1900.

Schizotricha Bedot 1921a.

Hydrocaulus is plumose, hydrothecae arise from hydrocaulus and hydrocladia; hydrocladia originate outside the cauline hydrotheca; nematophore bithalamic; gonosome simple, without protective devices.

The Indian species of *Schizotricha* may be identified as follows:

- I. Hydrocaulus polysiphonic, cladial internodes long gonotheca ovate.
S. campanulata (Busk)
- II Hydrocaulus monosiphonic, cladial internodes short.
 - 1 A median nematophore present in the axil of hydrotheca, gonotheca with longitudinal raised ridges and flattened ventral side giving a triangular appearance.
S. buski (Bale)
 - 2 A median nematophore absent in the axil of hydrotheca, gonotheca curved and horn-shaped.
S. diaphana (Heller)

Schizotricha diaphana (Heller)

(Fig. 100)

Plumularia alternata Nutting 1900, p. 62, Pl. IV, figs. 1, 2.

Plumularia alternata Stechow 1912, p. 367, figs. 1, 2.

Plumularia diaphana Stechow 1919, p. 114.

Schizotricha diaphana Bedot 1921a, p. 12.

Thecocarpus diaphanus Stechow 1924a, p. 224

Plumularia nr. *alternata* Gravely 1927, p. 16, Pl. III, fig. 19.

Schizotricha diaphana Leloup 1932, p. 168

The species has a climbing hydrorhiza, hydrocaulus divided into identical internodes, each with a hydrotheca and a lateral hydroclade; hydrocladia of successive internodes alternating except for one or two athecate internodes at the base, alternate cladial internodes thecate, the nodes above the thecate internode nearly straight and the node below oblique; hydrothecae conical in front view and cup-shaped in profile, margin slightly wavy; supracalycine nematophore mounted on long tubular prominences on each side of the hydrotheca, funnel-shaped, exceeding the hydrothecal margin in height; mesial nematophore short and hardly extending to the base of the hydrotheca; cauline nematophore arising on the athecate internode and similar to the mesial nematophore in every respect; gonosome not observed.

Height of colony	..	upto 8·8 mm.
Breadth of hydrocaulus	..	0·09-0·12 mm.
Length of hydroclade	..	upto 1·8 mm.
Length of cauline internode	..	0·38-0·44 mm.
Length of thecate cladial internode	..	0·20-0·22 mm.
Length of athecate cladial internode	..	0·08-0·10 mm.
Breadth of hydroclade	..	0·06-0·07 mm.
Length of abcauline side of theca	..	0·14-0·16 mm.
Breadth of hydrothecal mouth	..	0·11-0·13 mm.
Length of lateral nematophore	..	0·08-0·09 mm.

Locality.—The material of this species belongs to Gravely's collection from the Shingle island.* From the Indian region *Schizotricha diaphana* was described by Leloup (1932) from the same locality.

Subfamily ACLADIINAE Stechow

Heteroplou Stechow

Heteroplou Allman 1883.

Plumularia Bedot 1921 (in part).

Hydrocaulus is plumose, hydroclade with a spur-like 'mamelon' at the axils, hydrothecate side thickened; supracalycine nematophore bithalamic, mesial nematophore monothalamic; gonosome simple and unprotected.

Heteropolou was created by Allman (1883) to include a species collected by the Challenger Expedition. Stechow (1912) recognized this genus and transferred

* I am thankful to the authorities of the Government Museum, Madras, for placing at my disposal for examination a small portion of Gravely's collection, identified as *Plumularia* nr. *alternata*.

a few of the then known species of *Plumularia* to this genus. This genus was maintained till 1925, when apparently accepting the arguments of Bedot (1921, 1921a), Stechow demoted it to the rank of a subgenus. This change seems to be unwarranted, for if the mesial nematophore is really monothalamic, then the genus should be retained, if not it should be merged with *Plumularia*. The question is one of interpretation of the homology of the mesial nematophores. A study of *Heteroplon siliculata* n.sp. has shown that the nematophore is really monothalamic and hence the genus *Heteroplon* is retained.

***Heteroplon siliculata* n. sp.**

(Fig. 101)

The colony is small, arises from creeping hydrorhiza ; cauline internodes 5-6 times as long as broad, each bearing hydroclade at the summit of lateral apophysis, hydrothecae borne on alternate cladiate internodes, base very thick, $1\frac{1}{2}$ times as

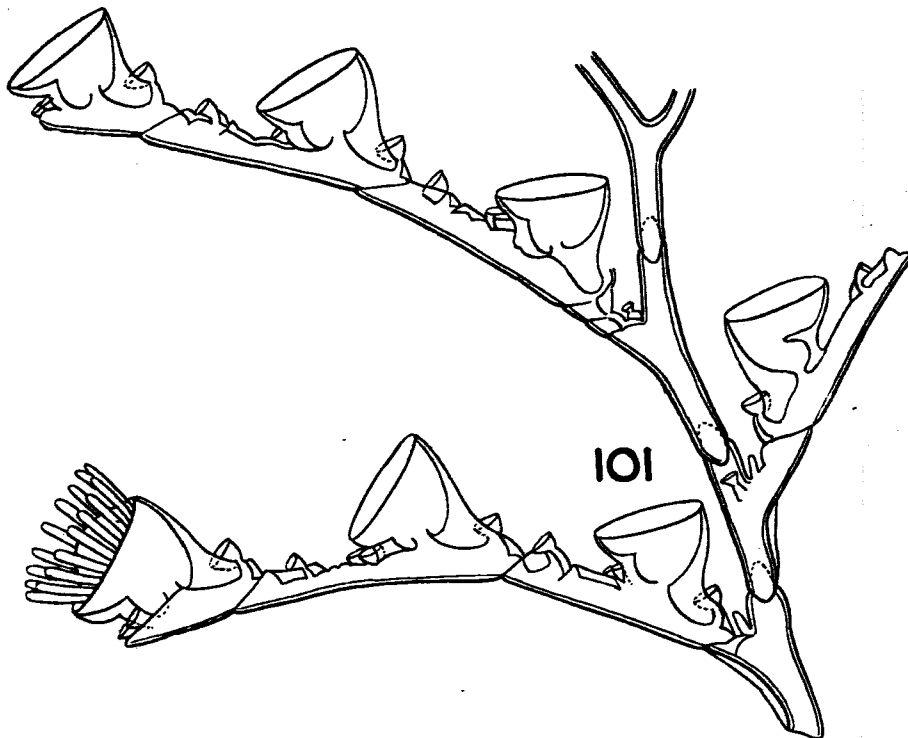


FIG. 101. *Heteroplon siliculata*.

broad as deep, externally cup-shaped, fore and aft margins slightly projecting, an adcauline intrathecal ridge present ; mesial nematophore large, conical and monothalamic, arising a little below the base of the hydrotheca, cavity in communication with the coenosarc through a deep excavation in the highly thickened perisarc, with a broad base, lying in a longitudinal furrow at the base of the hydrotheca and

appearing partially buried in the thickness of the perisarc, adcauline side of the nematotheca emarginated; supracalycine nematophore bithalamic and placed on short prominences on either side of the theca; cauline nematophores present on athecate internodes, similar to the mesial nematophores; and 'mamelon' present in the axils of hydrocladia; gonosome not obtained.

In the young colonies, hydrocladia-like hydracaulus arise directly from the hydrorhiza and hence are likely to be confused with *Antennella* species. Atheticate internodes are not developed in these young forms and even in slightly advanced colonies with plumose branching the nodes between the thecate and athecate internodes are indicated only by a dorsal constriction.

Locality.—This species is abundant at Cape Comorin and occasionally found at Kovilam and Thankassery.

Remarks.—The nature of the nematophores clearly shows that the present species belongs to *Heteroplou* Allman. It resembles *H. michaelsoni* Stechow and *H. filicaulis* Kirchenpauer to some extent. The distinctive characters of the present species are its delicate appearance, presence of intrathecal ridge and the cauline and mesial nematophores which are forwardly bent and partially accommodated in furrows. Table No. III shows the differences between the present species on one hand and *H. michaelsoni* and *H. filicaulis* on the other hand in morphometric measurements. It will be seen from the Table that the present species has longer cauline internode, hydrothecae placed more apart and has different proportion between the diameter and the depth of hydrotheca. This species is therefore described as new and the specific name *siliculata* refers to the adaxial thickening of the hydroclade.

TABLE III

	<i>H. michaelsoni</i> Stechow	<i>H. filicaulis</i> Kirchenpauer	<i>H. siliculata</i> n.sp.
Height of colony	.. ..	10 mm.	3.6 mm.
Length of cauline internode	.. .. 0.22 mm.	0.315 mm.	0.25 mm.
Diameter of hydrocaulus	.. .. 0.08 mm.	0.095 mm.	0.06 mm.
Length of hydrothecal internode	.. ..	0.11 mm.	0.29 mm.
Length of athecate internode	.. .. 0.08 mm.	0.09 mm.	0.09 mm.
Diameter of hydroclade	.. ..	0.08 mm.	0.06 mm.
Depth of hydrotheca	.. .. 0.18 mm.	0.125 mm.	0.12 mm.
Diameter of hydrotheca	.. .. 0.18 mm.	0.265 mm.	0.18 mm.
Ratio between length and diameter of cauline internode	2½ : 1	3½ : 1	4½ : 1
Ratio between the combined length of cladial (hydrothecate and intermediate) internode and their diameter	3¾ : 1	2½ : 1	6 : 1
Ratio between the diameter and depth of hydrotheca	1 : 1	1 : 2	1 : 1½
Distance between two consecutive theca expressed in diameter of theca	2	4	1½

The homology of the mesial nematophore is of utmost importance in deciding whether the genus *Heteroplou* should be recognised or not. The arguments in support of the bithalamic nature of the mesial nematophore is based on the assumption that a basal chamber is actually present, but that it is obscured by the extreme

thickening of the perisarc. If the thickened perisarc has a tendency to fuse with the nematotheca as assumed by Bedot, one should expect complete fusion of the nematotheca in the present species, where the perisarc thickening has proceeded to such an extent that the nematotheca is partially buried. But the nematotheca remaining free from the rest of the perisarc shows that the tendency of the nematotheca is not to get fused. If the tunnel through the perisarc really represents the basal chamber of a bithalamic nematophore, there should be some demarcation between the nematotheca and the rest of the perisarc. Since there is no such indication, the tunnel through the perisarc cannot be considered as the basal chamber and the nematotheca is therefore regarded as a monothalamic structure.

Subfamily AGLAOPHENIINAE Kuhn

• • • **Monoserius** Marktanner

Monoserius Marktanner 1890

Hemicarpus Billard 1913

Hydrocaulus and its branches are polysiphonic; hydroclade divided into internodes carrying hydrothecae; hydrotheca with an abcauline intrathecal ridge and dentate margin; nematophores monothalamic and immovable, cauline nematophores absent, mesial nematophore adnate to the hydrotheca; gonangia arising from alternate internodes of the nematoclade, with nematocladial leaves on one side only forming a 'semicorbula'.

Monoserius pennarius (Linnaeus)

(Figs. 108 & 109)

Sertularia pennaria Linnaeus 1758, p. 813

Aglaophenia (Lytocarpia) secunda Kirchenpauer 1872, p. 35, Pls. I, II, III, fig. 5

Lytocarpus secundus Allman 1883, p. 42, Pl. XIV, figs. 1-5

Lytocarpus fasciculatus Thornely 1904, p. 123, Pl. III, fig. 3, 3B

Lytocarpus hawaiiensis Nutting 1905, p. 954

Lytocarpus pennarius Ritchie 1910, p. 10, Pl. IV, fig. 11

Lytocarpus pennarius Billard 1910, p. 48

Lytocarpus pennarius Ritchie 1910a, p. 822

Hemicarpus fasciculatus Billard 1913, p. 83, figs. LXVII-LXIX, Pl. V, figs. 41-42

Monoserius fasciculatus Bedot 1925, p. 284

Monoserius fasciculatus Leloup 1932, p. 165, fig. 28

Monoserius fasciculatus Vervoort 1941, p. 331

Hydrocaulus long, attaining a height of 93 cms., somewhat zig-zag, branches arranged alternately to the right and left at a distance of 3-5 cms. from one another; hydrothecal mouth with a single sharp median spine and usually 5 wavy crenulations on either side of the median spine, crenulations diminishing in size towards the adcauline side. Gonangium is protected by a semicorbule, with a single hydro-

theca at the base of the nematoclade, the length of nematocladial leaves reaches upto 1.5 cms. and the number of nematotheca on it increases with maturity.

Height of colony	..	upto 93 cms.
Length of cauline branch	..	upto 50 mm.
Length of hydroclade	..	upto 14 mm.
Length of hydrotheca	..	0.28-0.30 mm.
Breadth of hydrothecal mouth	..	0.13-0.14 mm.
Length of adnate portion of mesial nematophore..		0.16-0.17 mm.
Length of free part of mesial nematophore	..	0.04-0.05 mm.
Length of nematoclade	..	upto 12 mm.
Length of gonotheca	..	0.62-0.82 mm.
Breadth of gonotheca	..	0.58-0.65 mm.

Locality.—A few specimens of this species were obtained from shore seines operated at Trivandrum and Vizhinjam. From the Indian region *M. pennarius* has been previously recorded from an unspecified locality by Jaderholm (1903), Gulf of Mannar by Thornely (1904), and from the mouth of Hoogly by Leloup (1932).

Remarks.—The genus *Monoserius* includes only two species, namely *M. pennarius* (Linn.) and *M. fasciculatus* (Thornely). According to Thornely (1904), *M. fasciculatus* closely resembles *M. pennarius*, but 'the branches are not so closely set on the stems and have not such one-sided mode of growth and are about half an inch longer, 6/10 of an inch instead of 2/10"—and the nematoclade in *M. pennarius* is not half as long as the hydroclade, whereas in *M. fasciculatus* it is of the same length, a hydrotheca is present at the base of the nematoclade in *M. fasciculatus* while this has not been reported in *M. pennarius*. Obviously Thornely has misinterpreted Allman's description and figures. In his figure Allman has shown a few of the lower branches as regularly pinnate, though others appear to lie on one side; a careful scrutiny of their points of origin will show that they really alternate (Allman 1883, Pl. XIV, figs. 1 & 4). Allman himself has recorded that 'though the branches are regularly disposed are all directed towards the same side of the stem'. The second difference which she pointed out is that the pinnae are closer in Allman's specimens. This appearance in Allman's sketches is evidently because of the accidental folding of the pinnae, whereby the two rows of pinnae appear on the same side, thus reducing the distance between successive pinnae. Allman's specimens measured 2½ feet and he had shown 32 branches in all, so that the average distance between the branches of the same side was about two inches. This appears to be the same in Thornely's specimens also. So also an examination of Allman's illustrations (Pl. XIV, fig. 1) shows that the actual length of the hydroclade is comparable to that of Thornely's specimens. As already mentioned, it has been observed in the present material that the length of the nematoclade and the nematocladial leaves are dependent on the maturity of the colony and so does not constitute a specific difference. Finally the fact that Allman has not mentioned the presence of a hydrotheca at the base of the nematoclade cannot be taken to mean that they are absent.

Leloup (1932a, p. 15) also distinguished *M. pennarius* from *M. fasciculatus*. According to him, the only difference between the two is the absence of a hydrotheca

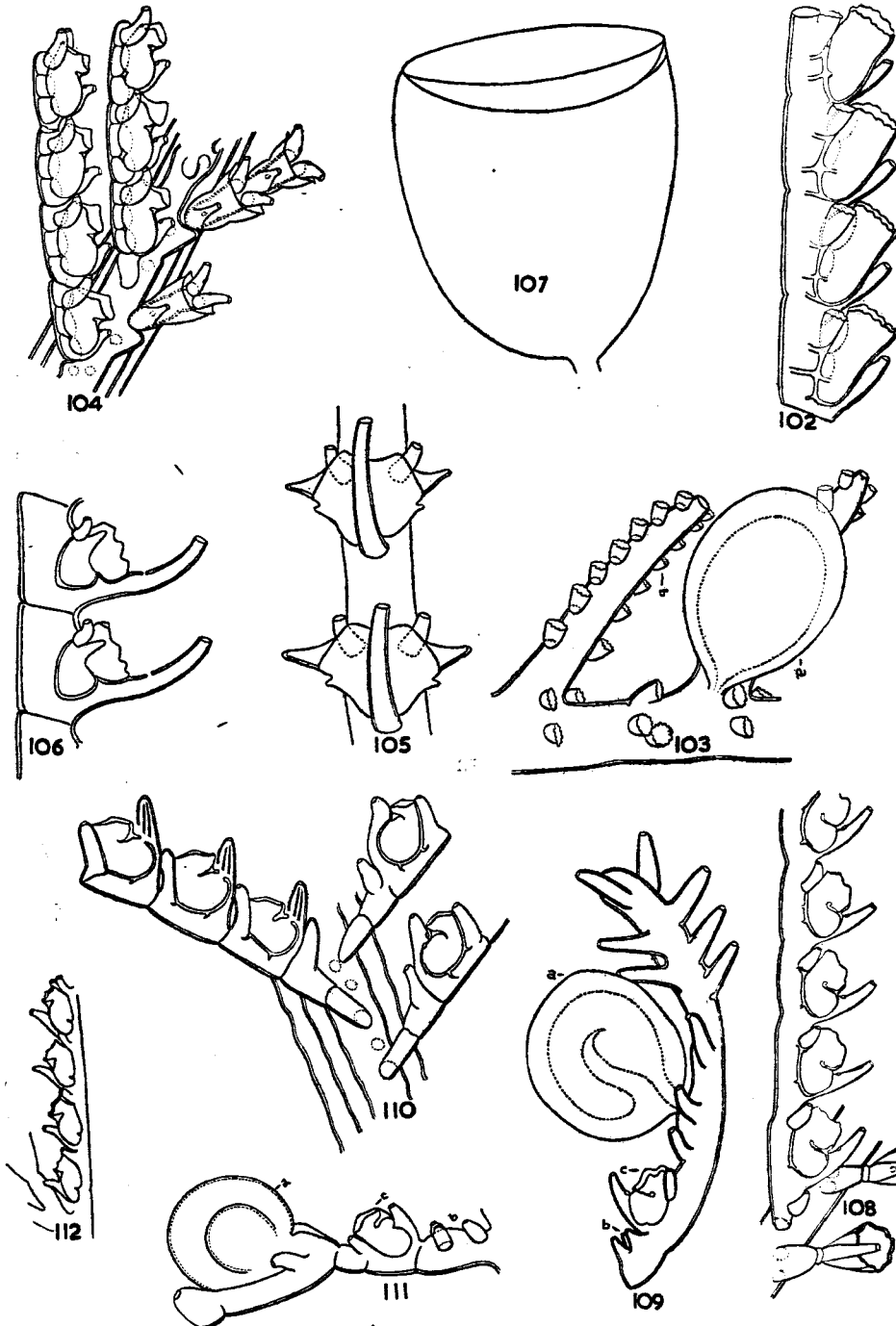


FIG. 102. *Monoserius pennarius*. A part of hydroclade; 103. *Monoserius pennarius*. A phylactocarp (a) gonotheca; 104. *Gymnangium eximium*; 105. *Gymnangium insigne*. Two hydrothecae, side view; 106. *Gymnangium insigne*, two hydrothecae, front view; 107. *Gymnangium insigne* Gonotheca; 108. *Macrorhynchia phoenicea*; 109. *Macrorhynchia phoenicea*. A phylactocarp (a) gonangium (b) basal athecate region (c) thecate region; 110. *Macrorhynchia philippina*, 111. *Macrorhynchia philippina*. Phylactocarp (a) gonangium (b) basal athecate internode (c) thecate internode; 112. *Macrorhynchia graveleyi*.

at the base of the nematoclaste in the former. But in the same paper (p. 7, footnote 18) he says that the hydrotheca is always absent in the male corbula and occasionally also in the female corbula of *Thecocarpus perarmatus* Billard. Pictet and Bedot (1900) have also observed the absence of hydrotheca at the base of *Thecocarpus myriophyllum* (Linnaeus). All these go to show that the presence or absence of the hydrotheca at the base of the nematoclaste cannot be taken as an important specific difference.

Examination of the specimens of *M. pennarius* kept in the Indian Museum* shows close similarity to the present collection. Unfortunately nematoclasts are absent in the Indian Museum specimens. Dr. W. J. Rees of the British Museum who examined the type specimens of *M. pennarius* for me, informed that he could not find any difference between *M. pennarius* and *M. fasciculatus*.* Taking all these facts into consideration it would appear that *M. pennarius* and *M. fasciculatus* are identical and that the latter should be included as a synonym of *M. pennarius*.

Gymnangium Hincks

Gymnangium Hincks 1874 (February)

Halicornaria Allman 1874 (April)

Taxella Allman 1874 (December)

Gymnangium Stechow 1924a

Hydrocaulus is pinnately branched; hydroclade homonomous; nematophores immovable; mesial nematophore adnate to hydrotheca; gonangia simple and unprotected.

The following key will facilitate the identification of the Indian species of *Gymnangium*.

I Hydrotheca with sharp long horns on either side. Mesial nematophores very long, horn-shaped and far exceeding the hydrothecal mouth. Intrathecal ridge arising from the middle of the hydrotheca; gonotheca cup-shaped.
G. insigne (Allman)

II Hydrotheca without lateral horns.

1 Hydrothecal margin slightly wavy.

Mesial nematophore extending slightly beyond the origin of the hydrotheca, intrathecal ridge high, gonotheca oval with transverse band of refringent corpuscles around the blastostyle. *G. saccarium* (Allman)

2 Hydrothecal margin deeply emarginate, forming broad wing like cheeks on either side, intrathecal ridge low, gonotheca cup-shaped.

G. eximium (Allman)

3 Hydrothecal margin toothed.

(i) Hydrotheca elongate, adnate to the mesial nematophore for the basal one-third and the hydrothecal mouth far in advance of the nematothecal mouth.

G. gracilicaule (Jaderholm)

*I am thankful to the authorities of the Indian Museum, Calcutta, for kindly passing on to me portions of Ritchie's material. I am also thankful to Dr. W. J. Rees for examining the type collections of the British Museum.

- (ii) Hydrotheca short, mesial nematophore short, nearly reaching the summit of the hydrotheca.
- (A) Gonangia short with distal conical and proximal rounded portion.
G. setosum (Armstrong)
- (B) Gonangia very large, funnel-like or bottle-like.
- (a) Hydrotheca set at some distance from one another, the interspace between thecae increasing towards cladial extremity.
G. hians (Busk)
- (b) Hydrothecae close to one another
- (a') Hydrocaulus stout. *G. hians* (Busk) var. *flava* Ritchie
- (b') Hydrocaulus slender. *G. hians* (Busk) var. *balei* Billard

Gymnangium eximium (Allman)

(Fig. 104)

Taxella eximia Allman 1874, p. 179.*Halicornaria bipinnata* Allman 1876, p. 276, Pl. XXII, fig. 5, Pl. XXIII, fig. 2.

Hydrocaulus and branches are polysiphonic, nodes obscure, with alternate hydrocladia; hydroclade relatively short, demarcated into 4-5 thecate internodes; each internode with two internal ridges dividing it into three subequal portions; hydrotheca nearly parallel to the internode excepting for the distal end, distal end sharply bent outwards at an angle of 45°; mouth slightly flared, emarginate, forming broad 'wing-like cheeks'; diaphragm well developed; abcauline intrathecal ridge feeble; axial and cauline nematophores absent; mesial nematophore flask-shaped, adnate to the hydrotheca for three quarters of its length, but not reaching the hydrothecal mouth; lateral nematophore arising from the proximal third of the internode, directed obliquely forwards and outwards, distally lying parallel to the internode flanging the posterior end of the next hydrotheca; gonosome not observed.

Length of hydroclade	..	..	upto 1.20 mm.
Length of cladial internode	..	..	0.23-0.25 mm.
Breadth of cladial internode	..	..	0.04-0.05 mm.
Length of hydrotheca	..	..	0.23-0.25 mm.
Breadth of hydrothecal mouth	..	..	0.12-0.15 mm.
Length of adnate part of mesial nematophore	..	..	0.14-0.15 mm.
Length of free part of mesial nematophore	..	..	0.05 mm.
Length of lateral nematophore	..	..	0.12-0.13 mm.

Locality.—This species is represented by a few fragments, probably belonging to the same colony, dredged at a depth of 15 fathoms off Trivandrum. It has been previously recorded from Ceylon.

Remarks.—Even though the identity of the present collection with Allman's species is beyond doubt, the hydrothecae show certain differences. In Pl. XXII, fig. 4, Allman has shown a median notch on the dorsal aspect of the hydrotheca, but this is absent in fig. 5 of the same plate. The latter is the condition in the present specimens. Allman has indicated the lateral and mesial nematophores as tubular

and lying parallel to the hydroclade. In the present specimens only the distal third of the laterals are parallel to the hydrotheca. The mesial nematophore has a broad base and is distally drawn out into a tube, with the free part distinctly turned outwards. Allman has overlooked the presence of the intrathecal fold, which is so characteristic of this species. Moreover he has not indicated the strong internal ridges of the cladial internode which give it a tripartite appearance. As Allman's descriptions were based on dry specimens, he might have mistaken the wrinkles as entirely due to bad preservation. He has in his illustrations endeavoured to give a smooth appearance to the hydroid, which has unfortunately obliterated many characters of taxonomic value.

Gymnangium insigne (Allman)

(Figs. 105-107)

Halicornaria insignis Allman 1876, p. 278, Pl. XXII, figs. 3, 4, Pl. XXIII, fig. 1.

Halicornaria insignis Thornely 1904, p. 121, fig. 4.

Gymnangium insigne Stechow 1924a, p. 234.

The present specimens closely agree with the descriptions given by Allman and Thornely. Allman did not get the gonosome and Thornely who got it, remarked that it resembled the gonosome of *H. bipinnata* (*G. eximium*). This is a correct appraisal of its appearance, for the gonosome in the present collection does not show any difference from those of *G. eximium* (Allman).

Length of hydroclade	..	..	..	upto 7 mm.
Breadth of hydroclade	..	..	..	0·12-0·14 mm.
Length of thecate internode	..	..	..	0·28-0·31 mm.
Length of hydrotheca	..	..	..	0·21-0·23 mm.
Breadth of hydrothecal mouth (dorso-ventral)	..	..	..	0·19-0·21 mm.
Breadth of hydrothecal mouth (side to side)	..	..	..	0·30-0·33 mm.
Length of adnate part of mesial nematophore	..	..	..	0·12-0·15 mm.
Length of free part of mesial nematophore	..	..	..	0·17-0·19 mm.
Length of lateral nematophore	..	..	..	0·08-0·09 mm.
Height of gonotheca	..	..	..	0·65-0·74 mm.
Diameter of gonothecal mouth	..	..	..	0·55-0·60 mm.

Locality.—Fragments of this plumose hydroid were obtained at a depth of 10 fathoms and complete specimens of 18 cms. in height were seen at the Marine Station, Thankassery.

Macrorhynchia Kirchenpauer

Macrorhynchia Kirchenpauer 1872.

Lytocarpus Allman 1883.

Hydrocaulus with pinnate hydrocladia; hydrotheca elongate and saccular, nematophores immovable, and monothalamic; gonangia protected by a phylactocarp, the latter being a modified hydroclade.

The Indian species of *Macrorhynchia* may be identified as follows :

- I. Tip of mesial nematophore extend beyond hydrothecal mouth ; phylactocarp not divided, but with a basal athecate, a thecate and one or two gonangial regions and several pairs of lateral nematophores. *M. phoenicea* (Busk)
- II. Tip of mesial nematophores slightly exceeding the hydrothecal mouth.
 1. Thecate internode septate.
 - (i) Phylactocarp branching. *M. thornely* (Thornely)
(*Lytocarpus plumosus* Thornely)
 - (ii) Phylactocarp not branching.
 - (A) Phylactocarp long, with a mesial and two lateral nematophores on all internodes ; hydrothecal margin even. *M. hornelli* (Thornely)
 - (B) Phylactocarp short, with an athecate, a thecate and distal gonangial internodes. *M. philippina* (Kirchenpauer)
 2. Thecate internodes non-septate ; phylactocarp similar to *M. phoenicea*.
M. gravelyi n. sp.

Macrorhynchia phoenicea (Busk)

(Figs. 108 & 109)

- Plumularia phoenicea* Busk 1852, p. 398.
Lytocarpus spectabilis Allman 1883, p. 43, fig. 2, Pl. XV, figs. 1-5.
Aglaophenia phoenicea Bale 1887, p. 87.
Lytocarpus phoeniceus Marktanner 1890, p. 276.
Lytocarpus phoeniceus Kirkpatrick 1890a, p. 604.
Aglaophenia phoenicea Thornely 1904, p. 121.
Aglaophenia phoenicea Borradaile 1905, p. 842.
Lytocarpus phoeniceus Ritchie 1910, p. 21.
Lytocarpus phoeniceus Billard 1913, p. 74.
Lytocarpus phoeniceus Stechow 1913a, p. 95, figs. 62-64.
Lytocarpus phoeniceus Jaderholm 1919, p. 25.
Macrorhynchia phoenicea Stechow 1921a, p. 232.
Lytocarpus phoenicea Nutting 1927, p. 233.
Lytocarpus spectabilis Nutting 1927, p. 237.
Lytocarpus spectabilis Gravely 1927, p. 17, Pl. III, fig. 16.
Lytocarpus phoeniceus Briggs et. Gardiner 1931, p. 194, fig. 5.

The trophosome in the present specimens generally agrees with the descriptions of earlier authors, the only difference is in the longer nature of the mesial nematophores. However in the phylactocarp, the region described as the basal part, by previous authors is not really the basal part. The phylactocarp arises from the hydrocaulus or its branches, nodes absent, but distinguishable into basal hydrothecate, gonangial and distal parts. The basal region has neither hydrotheca nor

gonotheca but with mesial and lateral nematophores; hydrothecal region similar to a typical internode of the vegetative region, gonangial region with one mesial and two lateral nematophores.

Height of colony (Incomplete)	.. ..	52 mm.
Length of cladial internode	.. ..	0.25-0.27 mm.
Width of cladial internode	.. ..	0.10-0.12 mm.
Length of adcauline side of hydrotheca	.. ..	0.20-0.22 mm.
Breadth of hydrothecal mouth	.. ..	0.13-0.15 mm.
Length of adnate part of mesial nematophore	.. ..	0.14-0.15 mm.
Length of phylactocarp	.. ..	1.20-1.55 mm.
Diameter of gonosome	.. ..	0.42-0.46 mm.

Locality.—This species is represented in the present collection by a part of a colony dredged from off Neendakara at a depth of 10 fathoms. *M. phoenicea* has been previously recorded from Ceylon (Thornely 1904), Pamban (Gravely 1927), off Andamans (Ritchie 1910), Laccadives (Borradaile 1905).

Remarks.—Even though *M. spectabilis* (Allman) is now accepted as a synonym of *M. phoenicea*, a few authors notably Nutting and Gravely have retained *M. spectabilis* and the former recognised *M. spectabilis* as distinct from *M. phoenicea*.

Macrorhynchia philippina (Kirchenpauer)

(Figs. 110 & 111)

- Aglaophenia philippina* Kirchenpauer 1872, p. 45, Pls. I, II, VII, fig. 2b.
Lytocarpus philippinus Bale 1888, p. 786, Pl. XXI, figs. 5-7.
Lytocarpus philippinus Marktanner 1890, p. 274, Pl. VI, fig. 16.
Lytocarpus philippinus Nutting 1900, p. 122.
Lytocarpus philippinus Thornely 1908, p. 84.
Lytocarpus philippinus Stechow 1909, p. 97.
Lytocarpus philippinus Ritchie 1910, p. 20.
Lytocarpus philippinus Ritchie 1910a, p. 822.
Lytocarpus philippinus Billard 1913, p. 78, fig. 63.
Lytocarpus philippinus Thornely 1916, p. 150.
Macrorhynchia philippina Stechow 1924a, p. 241.
Lytocarpus philippinus Gravely 1927, p. 18, Pl. III, fig. 18.
Lytocarpus philippinus Nutting 1927, p. 236.
Lytocarpus philippinus Briggs *et.* Gardiner 1931, p. 193, fig. 4.
Lytocarpus philippinus Leloup 1939, p. 13, fig. 9.
Lytocarpus philippinus Vervoort 1941, p. 225.
Lytocarpus philippinus Vervoort 1946, p. 329.
Lytocarpus philippinus Millard 1958, p. 220.

Height of colony	..	..	..	upto 20 cms.
Length of hydroclade	..	..	..	upto 21 mms.
Breadth of hydroclade	..	..	..	0·08-0·10 mm.
Length of cladial internode	..	..	..	0·23-0·25 mm.
Length of hydrotheca	..	..	..	0·19-0·21 mm.
Breadth of hydrothecal mouth	..	..	..	0·12-0·15 mm.
Length of free part of mesial nematophore	..	..	..	0·06-0·09 mm.
Length of phylactocarp	..	..	..	0·75-0·98 mm.
Diameter of mature gonangia	..	..	..	0·35-0·39 mm.

Locality.—The material of this species was collected in large quantities from under the Pamban bridge. Gravely's (1927) material was also obtained from the same locality. The other records of this species from the Indian region are that of Ritchie (1910) from the Andamans and of Thornely (1916) from Adatra (Kathiawar).

Remarks.—In the present specimens as well as specimens described earlier from the Indian region, the nematophores appear to be longer than those in specimens recorded from other parts of the world. This condition is also observed in *M. phoenicea* (Busk) and *Gymnangium insigne* (Allman) in the present collection. The structure of the phylactocarp also shows some difference from the previous observations. The phylactocarp usually arises from the hydrocaulus or its branches, many jointed, basal internode short, bulged on one side, with a pair of lateral nematophores and a mesial nematophore, all the three being thick and bottle-shaped, the second internode with a hydrotheca, similar to that of the vegetative region; the third internode carrying a lenticular gonangium with mesial nematophores completely adnate to the gonangial peduncle and lateral nematophores flanking its sides; the fourth internode short, carrying a pair of mesially adnate lateral nematophores only.

Macrorhynchia gravelyi n.sp.

(Fig. 112)

Lytocarpus sp. nr. *graeffei* (Kirchenpauer) Gravely 1927, p. 17, Pl. III, fig. 17.

Hydrocaulus is unbranched, divided into nodes, each cauline internode with hydroclade; hydroclade alternate, demarcated into short internodes each carrying a hydrotheca; hydrotheca similar to that of *M. philippina* (Kirchenpauer), two-thirds adnate to the internode, the free distal end directed upwards at an angle of 30° with the hydroclade; hydrothecal margin with median adcauline intrathecal septum extending to nearly half way across the width of hydrotheca; mesial nematophore adnate to the hydrotheca upto the level of the intrathecal ridge and then sharply bending outwards and slightly over-reaching the hydrothecal mouth; lateral nematophores arise on either side of the hydrotheca on the distal end of each internode and extending upto or slightly beyond the hydrothecal mouth. The gonosome was not observed. Gravely has given a brief description of the gonosome, which shows that it is similar to *M. phoenicea* (Busk).

Height of colony	..	..	..	upto 13.2 mm.
Breadth of hydrocaulus	..	..	..	0·10-0·19 mm.

Length of hydroclade	1.10-2.80 mm.
Breadth of hydroclade	0.07-0.08 mm.
Length of cladial internode	0.44-0.48 mm.
Length of hydrotheca	0.40-0.44 mm.
Breadth of hydrothecal mouth	0.14-0.16 mm.
Length of free part of mesial nematophore	0.09-0.13 mm.

Locality.—This species is represented by two collections, one from Shingle island and the other from a depth of 8 fathoms, off Neendakara. The specimens from Shingle island were attached to sand stones, while the Neendakara specimens were found growing on tubes of eunicid worms.

Remarks.—The most characteristic feature of the present species is its unusually small size. There is no doubt that this is the maximum size of the species, since the phylactocarp has been observed by Gravely. *M. crosslandica* (Ritchie) and *M. graeffei* (Kirchenpauer) are the other two species of *Macrorhynchia* showing some similarity with the present species. *M. crosslandica* differs in the possession of two internal ridges on the hydrothecate internode and a longer phylactocarp, which far exceeds the gonangia. *M. graeffei* has a long abcauline intrathecal septum which arises at a considerably higher level than in the present species. The present species is therefore reckoned as a distinct species and named after Dr. F. H. Gravely.

SUMMARY

Hydroids were collected from selected stations along the east and west coasts of south India. The collection includes 64 species belonging to 40 genera. Of these 27 species are new to the Indian region; 14 species, 1 variety and 1 race are new to science. The gonosome of 10 species are described here for the first time. Relevant discussions on affinities of specimens or homology of organs are given in respect of each species.

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REFERENCES

- AGASSIZ, A. 1865. North American Acalephae, *Ill. Cat. Mus. Comp. Zool. Harvard*; 1-234.
- *AGASSIZ, L. 1862. Contribution to the Natural History of the United States of America. *Monogr.*, II.
- ALDER, J. 1856. A notice on some new genera and species of British hydroid zoophytes. *Ann. Mag. Nat. Hist.*, (2) 18 : 353-362.
- *———. 1857. A catalogue of the zoophytes of Northumberland and Durham. *Trans. Tyneside Nat. Field Club*, 3 : 1-70.
- ALLMAN, G. J. 1864. On the construction and limitation of genera among hydroids. *Ann. Mag. Nat. Hist.* (3) 13 : 345-380.
- . 1871-2. A Monograph of the Gymnoblasic or Tubularian Hydroid. *Roy. Soc. London*, 1 & 2.
- . 1876. Diagnoses of new genera and species of hydroids. *J. Linn. Soc. London*, 12 : 251-284.
- . 1877. Report on the hydroida collected during the exploration of the Gulf-stream *Mem. Mus. Comp. Zool. Harvard Coll.* 5(2) : 1-66.
- . 1883. Report on the hydroida dredged by H.M.S. 'Challenger' (1) Plumulariidae. *Rep. Sci. Res. Voy. Challenger, Zool.*, 7 : 1-55.
- . 1888. Report on the hydroida dredged by H.M.S. 'Challenger' (2) *Ibid.*, 23 : 1-90.
- ANNANDALE, N. 1907. The fauna of brackish ponds at Port Canning, Lower Bengal (4) Hydrozoa. *Rec. Indian Mus., Calcutta*, 1 : 139-144.
- . 1915. The fauna of the Chilka Lake, Coelenterata, Hydrozoa. *Mem. Indian Mus., Calcutta*, 5 : 104-114.
- . 1916. On the hydrozoan *Campanulina ceylonensis* (Browne). 1. The systematic position and synonymy of the species. *Rec. Indian Mus., Calcutta*, 12 : 49-57.
- ARMSTRONG, J. 1879. A description of some new species of hydroid zoophytes from the Indian coasts and seas. *J. Asiat. Soc. Bengal*, 48 (2) : 98-103.
- BALE, W. M. 1882. On the hydroida of South Eastern Australia *J. Micr. Soc., Victoria* 2 : 15-48.
- . 1884. *Catalogue of the Australian Hydroid Zoophytes*. Australian Museum, Sydney. 198 pp.
- . 1887. The genera of Plumulariidae with observations on various Australian hydroids. *Trans. Proc. Roy. Soc. Victoria* 23 : 73-110.
- . 1888. On some new and rare hydroids in the Australian museum collection. *Proc. Linn. Soc. N.S. Wales* (2) 3 : 745-799.
- . 1913. Further Notes on Australian hydroids. *Trans. Proc. Roy. Soc. Victoria* (n.s.) 25 : 114-147.
- . 1924. Report on some hydroida from the New Zealand generally supplementing Farquhar's list. *Trans. Proc. N.Z. Inst.*, 55 : 225-268.
- BEDOT, M. 1901, 1905, 1910, 1912, 1916, 1918, 1925. Matériaux pour servir à l'Histoire des Hydroïdes, 1ère, 2e, 3e, 4e, 5e, 6e, et 7e Périodes. *Rev. suisse Zool.*, 10 : 379-515 ; 13 : 1-183 ; 18 : 189-490 ; 20 : 213-469 ; 24 : 1-349 ; 26 : (suppl.) 1-376 ; 27 : (suppl.) 1-567.

*Not referred to in original.

- BEDOT, M. 1914. Nouvelles Notes sur les Hydroides des Roscoff. *Arch. Zool. Exper.*, **54** : 79-98.
- . 1921. Notes systematiques sur les Plumularides I. *Rev. suisse Zool.*, **28** : 311-356.
- . 1921a. Notes systematiques sur les Plumularides II. *Ibid.*, **29** : 1-40.
- . 1921b. Hydroides provenant des Campagnes des yachts 'Hydronella' et 'Princesse Alice.' Plumularidae. *Res. Camp. Sci. Albert 1, Prince de Monaco*, **60** : 1-73.
- BERRIL, N. J. 1949. Growth and form in gymnoblastic hydroids. Polymorphic development in *Bougainvillia* and *Aseomaris*. *J. Morph., Philadelphia*. **82** : 1-30.
- . 1949a. The polymorphic transformation of *Obelia*. *Quart. J. Micro. Sci., London*, **10 c** : 235-264.
- BIGELOW, H. B. 1909. Reports on the scientific results of the expedition . . . U.S. Fish Commission Steamer Albatross-Medusae. *Mem. Mus. Comp. Zool., Harvard*, **37** : 1-243.
- BILLARD, A. 1901. Note sur l'*Antennularia antennina* Linn et sur l'*A. perrieri*. *Bull. Mus. Hist. Nat. Paris*, **7** : 69-75.
- . 1903. Notes sur les variations du *Plumularia halecioides* (Alder) **9** : 57-62.
- . 1905. Contribution l'etude des Hydroides. *Ann. Sci. Nat. Zool.*, (8) **20** : 1-251.
- . 1906. Expedition scientifiques du 'Travailleur' et du 'Talisman' Hydroides. *Paris Masson* **8** : 153-244.
- . 1907. Hydroides de la collection du Lamarck du Museum de Paris II Campanularidae et Sertularidae. *Ann. Sci. Nat. Zool.*, **5** : 215-218.
- . 1907a. Hydroides recoltés par M.Ch. Gravier a l'île de San Thome. *Bull. Mus. Hist. Nat. Paris*, **13** : 274-275.
- . 1907b. Hydroides de Madagascar et du Sud-Est de l' Afrique. *Arch. Zool. Exper.*, (4) **7** : 335-395.
- . 1909. Revision des especes types d'Hydroides de la collection Lamouroux conservee a l'Institut botanique de Caen. *Ann. Sci. Nat. Zool.*, (9) **9** : 307-336.
- . 1910. Revision d'une partie des Hydroides du British Museum. *Ibid.*, (9) **9** : 1-66.
- . 1913. Les Hydroides de l'Expedition du 'Siboga' I Plumularidae. *Res. Explor. Zool. Bot. du 'Siboga'*, **7a** : 1-114.
- . 1919. Note sur quelques especes d'*Sertularella* de l'Expedition du 'Siboga'. *Arch. Zool. Exper.*, **58** : Notes et Revue 14-16.
- . 1920. Note sur une especes nouvelles d'Hydroides du genera '*Diphasia*'. *Bull. Soc. Zool. France*, **45** : 144-147.
- . 1924. Note critique sur divers genres et especes d'Hydroides avec la description de trois especes nouvelles. *Revue suisse Zool.*, **31** : 53-74.
- . 1924a. Note sur quelques especes la plupart nouvelles de Synthecides et de Sertularides du 'Siboga'. *Bull. Soc. Zool. France*, **49** : 646-652.
- . 1925. Les Hydroides de l'Expedition du 'Siboga' Synthecidae et Sertularidae. *Res. Explor. Zool. Bot. du 'Siboga'* **7b** : 115-232.
- . 1925a. Note sur le *Sertularia distans* (Lamouroux). *Bull. Mus. Hist. Nat. Paris*, **31** : 197-202.
- . 1925b. Note sur quelques especes la plupart nouvelles de Synthecidae et de Sertularides du 'Siboga'. *Bull. Soc. Zool. France*, **49** : 646-652.

- . 1928. *Clytia johnstoni* Alder, *Campanularia varidentata* Alder et *Thaumantias inconspicua* Forbes. *Bull. Mus. Nat. Paris* (2) 1 : 456-477.
- BLACKBURN, A. 1938. Report on the McCoy Society for field investigation and Research. No. 2, Sir John Banks Islands. *Proc. Roy. Soc. Victoria* 1 : 312-328.
- . 1942. A systematic list of hydroids of South Australia with a summary of the distribution in other seas. *Trans. Roy. Soc. South Australia*, 66 : (1) 104-118.
- BORRADAILE, L. A. 1905. Hydroids. *Fauna and Geography of the Maldive and Laccadive Archipelagoes* 2 (4) : 836-845.
- BRIGGS, E. A. AND GARDINER, V. E. 1931. *Scientific Reports. Great Barrier Reef Expedition.* 4 : 181-196.
- BROCH, HJ. 1909. Hydroidenuntersuchungen II Zur kenntnis der Gattungen *Bonneviella* und *Licorella*. *Nyt. Mag. Naturw. Kristiania (Oslo)* 47 : 195-205.
- . 1912. Hydroidenuntersuchungen III Vergleichende Studien an adriatischen Hydroiden. *Kgl. Norske Vid. Selsk. Skr.* 1 : 65.
- . 1914. Hydrozoa benthonica. *Danish Ingolf Exped.*, 5(6) : 1-66.
- . 1918. Hydroida (2). *Ibid.*, 5(7) : 1-206.
- . 1933. Zur kenntnis der Adriatischen Hydroidfauna von Split—Arten und variations. *Skr. utgitt. D. norske Vid. naturw. klasse* (4) : 1-115.
- *BUSK, G. 1852. An account of the Polyzoa and Sertularian zoophytes. *J. narrat. Voy. H.M.S. Rattlesnake*, Appendix IV : 385-402.
- *———. 1857. Zoophytology. *Quart. J. Micr. Sci.*, 5 : 172-174.
- *———. 1858. Zoophytology. *Ibid.*, 6 : 124-136.
- *CAMPENHAUSEN, B. 1896. Hydroiden von Ternate. *Abh. seneckenberg Nat. Ges. Frankfurt*, 23 : 297-319.
- *CLARKE, S. F. 1876. Description of new and rare hydroids from the New England coast. *Trans. Acad. Sci. New-Haven*, 3 : 58-66.
- CONGDON, E. D. 1907. Hydroida of Burmuda. *Proc. Amer. Acad. Arts Sci.*, 42 : 463-485.
- DEEVEY, E. S. 1950. Hydroids of Louisiana and Texas *Ecology of Lancaster Pa* 31(3) : 334-367.
- *ELLIS, J. et SOLANDER, D. 1786. *Natural History of many curious and uncommon zoophytes collected from various parts of the globe.* London.
- FRASER, C. M. 1911. The hydroids of the west coast of North America. *Bull. State Univ. Iowa*, 6 : 1-91.
- . 1914. Some hydroids of the Vancouver region. *Trans. Roy. Soc. Canada*, (3) 8 : 99-216.
- . 1937. *Hydroids of the Pacific coast of Canada and the United States.* University Press, Toronto.
- . 1938. Hydroids of the 1934 Allan Hancock Pacific Expedition. *Res. Allen Hancock Pacific Exped.*, (4) : 107-127.
- *GEGENBAUR, C. 1856. Versuch eines Systemes der Medusen, mit Beshreibung neuer oder wenig gekannter Formen zugleich ein Beitrag zur Kenntnis der Fauna des Mittermeeres. *Z. wiss. Zool., Leipzig* 4(3&4) : 299-370.
- *GMELIN, J. F. 1788-93. *C. LINNE Systema Naturae.* Edit. 13, anato et reformata cura J. F. Gmelin.

- GRAVELY, F. H. 1919. A note on the marine invertebrate fauna of Chandipore, Orissa. *Rec. Indian Mus. Calcutta*, 16 : 396-402.
- . 1927. The littoral fauna of Krusadai island in the Gulf of Manaar. Hydrozoa. *Bull. Madras Govt. Mus. Nat. Hist. Sect. 1* : 7-20.
- GOTTE, A. 1916. Die Gattung *Podocoryne*, *Stylactis* und *Hydractinia*. *Zool. Jahrb. Syst.*, 39 : 443-510.
- HARGITT, C. W. 1924. Hydroids of the Philippine Islands. *Philippine J. Sci.*, 24 : 467-508.
- . 1927. Some hydroids of South China. *Bull. Mus. Comp. Zool. Harvard*, 24 : 491, 520.
- HARTLAUB, C. 1905. Die Hydroiden der Magalhaensischen Region und Chilienschen Kuste. *Zool. Jahrb. Suppl.*, (6) *Fauna Chilensis*, 3 : 497-718.
- . 1916. *Nordische Plankton* 6, (XII) Craspedote Medusen Pt., 1-3 : 237-363.
- HEATH, 1910. The association of fish with a hydroid. *Biol. Bull., Woods Hole, Mas s.* 19 : 73-78.
- HINCKS, T. 1861. On some new Australian hydrozoa. *Ann. Mag. Nat. Hist.*, (3) 7 : 279-281.
- . 1868. *A History of the British Hydroid Zoophytes*. London, 2 volumes.
- . 1874. On deep water hydroids from Iceland. *Ann. Mag. Nat. Hist.*, (4) 13 : 146-153.
- . 1887. On the polyzoa and hydroida of the Mergui Archipelago. *J. Linn. Soc. London (Zool.)*, 21 : 132-135.
- HODGSON, M. M. 1950. A revision of the tasmanian hydrozoa. *Pap. Proc. Roy. Soc. Tasmania* (1949) : 1-65.
- IWASA, M. 1934. Revision of *Stylactis* and its allied genera, with descriptions of *Stylactella (Stylactis) yerii* n.sp. *J. Fac. Sci. Hokkaido Imp. Univ.*, (6) 2 : 241-277.
- JADERHOLM, E. 1903. Aussereuropaische Hydroiden im Schwedischen Reichsmuseum. *Ark. f. Zool.*, 1 : 259-312.
- . 1909. Hydroiden, northern and arctic invertebrates in the collection of the Swedish state museum (Reichsmuseum). *Kugl. svensk Vet-Akad. Handl.*, 45(1) : 1-124.
- . 1920. Zur kenntnis der Hydroidenfauna Japans. *Ark. f. Zool.*, 12 : 1-34.
- JARVIS, F. E. 1922. The hydroids from Chagos Seychelles and other islands from the coasts of British East Africa and Zanzibar. *Trans. Linn. Soc. Zoology II*, 18(1) : 331-360.
- JOHNSTON, G. 1847. *A History of British Zoophytes*, London.
- KIRCHENPAUER, 1864. Neue Sertulariden ausverschieden Hamburgischen Summlungen, nebst allgemein Bemerkungen uber Lamouroux Gattung *Dynamena*. *Verh. k. Leopold Carol. deuts. Akad. Naturf. Dresden*, 31 (3) : 1-16.
- . 1876. Ueber die Hydroidenfamilie Plumularidae einsele Gruppen derselben und ihre Frechbehalter (II *Plumularia* und *Nemertesia*). *Abh. Naturw. Ver. Hamburg*, 6 : 1-59.
- . 1884. Nordische Gattungen und Arten von Sertulariden. *Abh. Ver. Hamburg.* 8 : 1-54.
- KIRKPATRICK, R. 1890. Report on the zoological collection made in Torres strait by Prof. A. C. Haddon, Hydroida and Polyzoa. *Sci. Proc. Roy. Dublin Soc.*, 6 : 603-626.
- KRAMP, P. L. 1932. Gotthaab Expedition 1928, Hydroids. *Medd. om Groenland*, 79(4) : 1-86.
- . 1949. Origin of the hydroid family Corymorphidae. *Vid. Medd. fra. Dansk naturh. Foren*, 111 : 183-215.

- KUHN, A. 1911. Über den Bau einer *Thyroscyphus*-Art und die systematische Stellung der Gattung *Thyroscyphus*. *Zool. Jahrb. Syst.*, 31 : 25-37.
- . 1914. Entwicklungsgeschichte und Verwandtschaftsbeziehungen der Hydrozoen. *Ergebn. Fort. Zool. Jena*, 4 : 1-284.
- KURIEN, G. K. 1950. Fowling organisms of the pearl oyster cages. *J. Bom. Nat. Hist. Soc.*, 49 : 90-92.
- *LAMARCK, J. B. P. A. 1816. *Histoire Naturelle des Animaux sans Vertebres* Paris 2.
- . 1836. *Histoire Naturelle des Animaux sans Vertebres* Paris 2.
- *LAMOUROUX, J. V. F. 1816. Histoire des polypiers coralligenes flexibles, vulgairement nommes zoophytes. *Caen Poisson*.
- *———. 1921. *Exposition methodique des genres de l'ordre des polypiers*, Paris.
- *———. 1924. Description des polypiers flexibles in Quoy et Gaimard. Voyage autour du monde execute sur les annees 1817, 1818, 1819, 1820, par M. L. de Freycinet Paris. *Pillet aline* : 603-643.
- LELOUP, E. 1931. Trois nouvelle especes d'hydropolypes. *Bull. Mus. Roy. Hist. Nat. Belgique*, 7 (25) : 1-6.
- . 1932. Une collection d'hydropolypes appartenant l'Indian Museum de Calcutta. *Rec. Indian Mus. Calcutta*, 24 : (2) 131-170.
- . 1935. Notes sur les Hydropolypes de la rade de Villefasche-sur-Mer (France). *Bull. Mus. Roy. Hist. Nat.*, 10 : (31) 1-18.
- . 1935a. Hydriaires calyptoblastique et Siphonophores recoltes au cours de la croisiere (1934-35) du naviere belge 'Mercator'. *Ibid.*, 11 : (34) 1-4.
- . 1935b. Hydriaires calyptoblastique des indes occidentale. *Ibid.*, 11 : 1-73.
- . 1937. Resultats Scientifique des croisiere du Navire ecole Belge 'Mercator'. *Ibid.*, (2) 1 (6) 91-127.
- . 1947. Les coelenterates de la fauna belge. Leur Bibliographic et leur distribution. *Mem. Mus. Hist. Nat. Belgique*, (107) : 1-73.
- LENDENFELD, R. VON. 1883. Über Coelenteraten der Sudsee IV. *Eucopella, Campanularia* n.g. *Z. wiss. Zool.*, 39 : 497-583.
- . 1884. Addenda to the Australian Hydromedusae. *Proc. Linn. Soc. N.S. Wales*, 9 : (4) 908-924.
- LEVINSEN, G. M. R. 1913. Systematic studies on Sertularidae. *Vid. Medd. Nat. Foren.*, 64 : 249-321.
- *LINNAEUS, C. 1758. *Systema Naturae, Holmia*. 10th Edition reformata 2.
- MARKTANNER TURNEREITSCHER, G. 1890. Die Hydroiden des k.k. naturhistorischen Hofmuseums. *Ann. naturf. Hofmus. Wien.*, 5 : 195-286.
- MAYER, A. G. 1910. *The Medusa of the World*, 3 volumes, Carnigie Institute, Washington.
- MENON, M. G. K. 1932. The hydromedusae of Madras. *Bull. Madras Govt. Mus. (N.S.) Nat. Hist. Sect.*, 3 : (2) : 1-32.
- MILLARD, N. A. H. 1955. New species of Hydrozoa from South Africa. *Ann. S.Afr. Mus.*, 41 : (5) 215-222.
- . 1957. Hydrozoa of False Bay, South Africa. *Ibid.*, 43 : (6) : 173-243.

- MILLARD, N. A. H. 1958. Hydrozoa of Natal and Portuguese East Africa. Part 1. Calyptoblastea. *Ibid.*, **44** (5) : 165-245.
- *MCCRADY, J. 1858. Gymnophthalamata of the Charleston Harbour. *Proc. Elliot Soc. Nat. Hist. Charleston*, **1** : (1) : 103-221.
- MOTZ-KOSSOWSKA, S. 1905. Contribution a la connaissance des Hydriaires de la Mediterranee occidentale. Hydriaires Gymnoblasiques. *Arch. Zool. Exper. Gen.*, (4) **13** : 39-98.
- NAIR, K. K. 1951. Medusae of the Trivandrum coast, (1) Systematics. *Bull. Centr. Res., Inst. Univ. Travancore, Trivandrum* **2** (1) : 47-75.
- NUTTING, C. C. 1900. American hydroids, Pt. 1. The Plumulariidae. *Smith. Inst. U.S. Nat. Mus. Spl. Bull., Washington*.
- . 1901. Hydroids of the Woods Hole region. *Bull. U.S. Fish. Comm.* 1899. **19** : 325-386.
- . 1904. American hydroids Pt. 2 The Sertulariidae. *Smith. Inst. U.S. Nat. Mus. Spl. Bull.*
- . 1905. Hydroids of the Hawaiian Islands collected by the steamer 'Albatross' in 1902. *Bull. U.S. Fish. Comm.* 1903. **23** : 931-959.
- . 1915. American hydroids, Pt. 3. The Campanulariidae and Bonnevelliidae. *Smith. Inst. U.S. Nat. Mus. Spl. Bull.*
- . 1927. Report on the hydroida collected by the U.S. Fisheries Steamer 'Albatross' in the Philippine region, 1907-1910. *Bull. U.S. Nat. Mus.*, **100** : 193-242.
- *OKEN. 1815. *Lehrbuch der Naturgeschichte* pt. (3) 2.
- PICARD, J. 1956. Les especes et formes mediterrannes du genre Sertularella. *Vie et Milieu* **7** : (2) 256-266.
- PICTET, C. 1893. Etude sur les Hydriaires de la baie d'Amboine. *Rev. suisse Zool.* **1** : 1-64.
- PICTET, C. & BEDOT, M. 1900. Hydriaires provenant des compagnes de l'Hirondelle (1886-1888). *Res. Com. Sci. Albert, Prince de Monaco*, **18** : 1-59.
- RANADE, M. R. 1954. Occurrence of Corymorpha (Hydrozoa) in Indian waters. *J. Bombay Nat. Hist. Soc.*, **52** : 119-120.
- REES, W. J. 1936. On a new species of hydroid *Staurocoryne filiformis*, with a revision of the genus *Staurocoryne* Rotch 1872. *J. Mar. Biol. Assoc. U.K.* **21** : 135-142.
- . 1938. Observations on British and Norwegian hydroids and their medusae. *Ibid.* **23** : 1-42.
- REES, W. J. & RUSSELL, F. S. 1937. On rearing of certain medusae with an account of the methods used. *Ibid.*, **23** : 1-42.
- RITCHIE, J. 1907. The Hydroids of the Scottish National Antarctic Expedition. *Trans. Roy. Soc., Edinburgh*, **45** : (2) 519-545.
- . 1907a. On collection of Cape Verde marine fauna made by Cyrill Crossland. The hydroids. *Proc. Zool. Soc., London*, **1** : 488-514.
- . 1909. New species and varieties of hydroida, Thecata, from the Andaman Islands. *Ann. Mag. Nat. Hist.*, (8) **3** : 524-528.
- . 1910. Hydroids of the Indian Museum. *Rec. Ind. Mus., Calcutta*, **5** : 1-30.
- . 1910a. The marine fauna of Mergui Archipelago, Lower Burma, collected by James Stimpson. . . . The Hydroids. *Proc. Zool. Soc. London* (2) : 778-825.
- . 1910b. Hydroids of the Christmas island, Indian Ocean. *Ibid.*, (2) : 826-836.

- RUSSELL, F. S. 1953. *Medusae of the British Isles*. Cambridge.
- , & REES. 1938. On rearing hydroid *Zanclaea implexa* (Alder) and its medusa *Zanclaea gemmosa* McCrady, with a review on the genus *Zanclaea*. *J. Mar. Biol. Assn. U.K.* 21 : 107-129.
- *SARS, G. O. 1874. Bidrag kundscaben om Norges Hydroider. *Forh. Vidensk. Selsk. Christiania* (1873) 91-150.
- *SARS, M. 1857. Bidrag til Kundskaben om Middlehavets—Littoralfauna. *Nyt. Mag. f. Natur.* 10.
- SPLITTSTOSSER, W. 1929. Beitrag zur Kenntnis der Sertulariden. *Zool. Jahrb. Syst.*, 58 : 1-134.
- STECHOW, E. 1909. Hydroidpolypen der Japanischen Ostküste. *Abh. Bayer Akad. wiss. Suppl.* 1 Abh. 6 : 1-111.
- . 1912. Hydroiden der Münchener Zoologischer Staatssammlung. *Zool. Jahrb. Syst.*, 32 : 333-378.
- . 1913. Neue Genera thecater Hydroiden aus der Familie der Lafoeiden und neue species von Thecaten aus Japan. *Zool. Anz. Leipzig*, 43 : 137-144.
- . 1913a. Hydroiden der Japanischen Ostküste II Teil Campanulariidae.... *Abh. Bayer Akad. wiss. Suppl.* 3 : (2) 1-162.
- . 1919. Zur Kenntnis der Hydroidenfauna des Mittelmeeres Amerikas und anderer Gebiete. *Zool. Jahrb. Syst.*, 42 : (2) 1-172.
- STECHOW, E. 1919a. Neue Ergebnisse auf dem Gebiete der Hydroidenforschung. *Stz. Ber. Ges. Morph. München*, 31 : 9-45.
- . 1921. Neue genera und species von Hydrozoen und anderen Evertibraten. *Arch. f. nat. Berlin*, 87 : 248-265.
- . 1921a. Über Hydroiden der Deutschen Tiefsee Expedition nebst Bemerkungen über einige andre Formen. *Zool. Anz. Leipzig*, 53 : 223-236.
- . 1922. Zur Systematik der Hydrozoen Stomatophoren, Anthozoen und Ctenophoren. *Arch. f. Nat. Berlin*, 88 : 141-155.
- . 1923. Neue Hydroiden der Deutschen Tiefsee Expedition nebst Bemerkungen über einige andere Formen II. *Zool. Anz. Leipzig*, 56 : 1-20.
- . 1923a. Über Hydroiden der Deutschen Tiefsee Expedition nebst Bemerkungen über einige andere Formen III. *Ibid.*, 56 : 97-119.
- . 1924. Diagnosen neuer Hydroiden aus Australien. *Ibid.*, 59 : 57-69.
- . 1924a. Zur Kenntnis der Hydroidenfauna des Mittenmeeres Amerikas und anderer Gebiete. *Zool. Jahrb. Syst.*, 47 : 29-270.
- . 1925. Über Hydroiden von West- und Südwestaustralien.... *Ibid.*, 50 : 191-269.
- . 1925a. Hydroiden der Deutschen Tiefsee Expedition. *Wiss. Ergebn. Deuts. Tiefsee Exped. 'Valdivia'*. 17 (3) : 287-546.
- STECHOW, E. & MULLER, H. C. 1923. Hydroiden von den Aru-Inseln. *Abh. senckenb. naturg. Ges.*, 35 : 459-478.
- THORNLEY, L. R. 1900. The Hydroid zoophytes collected by Dr. Willey in the south seas. *Willey Zool. Results*. 4 : 451-457.
- . 1904. Report on the Hydroida collected by Professor Herdman at Ceylon in 1902. *Rep. Ceylon Pearl Oyster Fish.*, 2 : 107-126.

- THORNLEY, L. R. 1908. Report on the Marine Biology of the Sudanese Red Sea. X. Hydroids collected by C. Crossland. *J. Linn. Soc. London*, 31 : 80-85.
- . 1916. Report on the hydroids collected by J. Hornell at Okhamandal in Kattiawar. *Rep. Govt. of Baroda on the Marine Zoology of Okhamandal in Kattiawar*. Williams and Norgate, London, Pt. 2 : 147-150.
- TORREY, H. B. 1902. The hydroids of the Pacific coast of North America, with special reference to the species of the collection of the University of California. *Univ. California Publ. Zool.*, 1 : 1-104.
- . 1904. Hydroids of the San Diego Region. *Ibid.*, 2 : 1-43.
- TOTTON, A. K. 1930. Hydroids, Natural History Reports. *British Antarctic (Terra Nova) Expedition*, 5 : 131-252.
- VANHOFFEN, E. 1910. Die Hydroiden der Deutschen Sud Polar Expedition 1901-1903. *Deuts. Sudpol. Exped.*, 11 : 269-340.
- VERSLUYS, J. 1899. Hydraires Calyptoblastes recueillis dans la mer des Antilles.... *Mem. Soc. Zool. France*, 12 : 29-58.
- VERVOORT, W. 1941. Biological Results of the Snellius Expedition XI Hydroid.... *Terminickia, Leiden*, 6 : 186-240.
- . 1946. Exotic hydroids in the collection in the Rijksmuseum. *Zool. Medd. Leiden*, 26 : 287-351.
- . 1946a. Hydrozoa. Hydropolyphen. *Fauna von Neiderlands. Leiden*, 14 : 1-336.
- . 1949. Small collection of Hydroids from Jersey (Channel Islands). *Zool. Medd. Leiden*, 30 : 133-162.
- YAMUDA, M. 1947. On two new species of athecate hydroid *Stylactis* from Hokkaido. *J. Fac. Sci. Hokkaido Univ.*, (6) *Zool.* 9 (4) : 383-387.
- . 1950. The fauna of Akkeshi Bay, XVII Hydroids. *Ibid.*, 10 (1) : 1-20.
- WARREN, E. 1908. On a collection of hydroids from the Natal coast. *Ann. Natal Mus.*, 1 : 269-355.
- *WRIGHT, T. S. 1857. Observations on British zoophytes. *Proc. Roy. Phy. Soc. Edin.*, 1 : 226-237.