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SIPHONOPHORA OF THE INDIAN OCEAN

By

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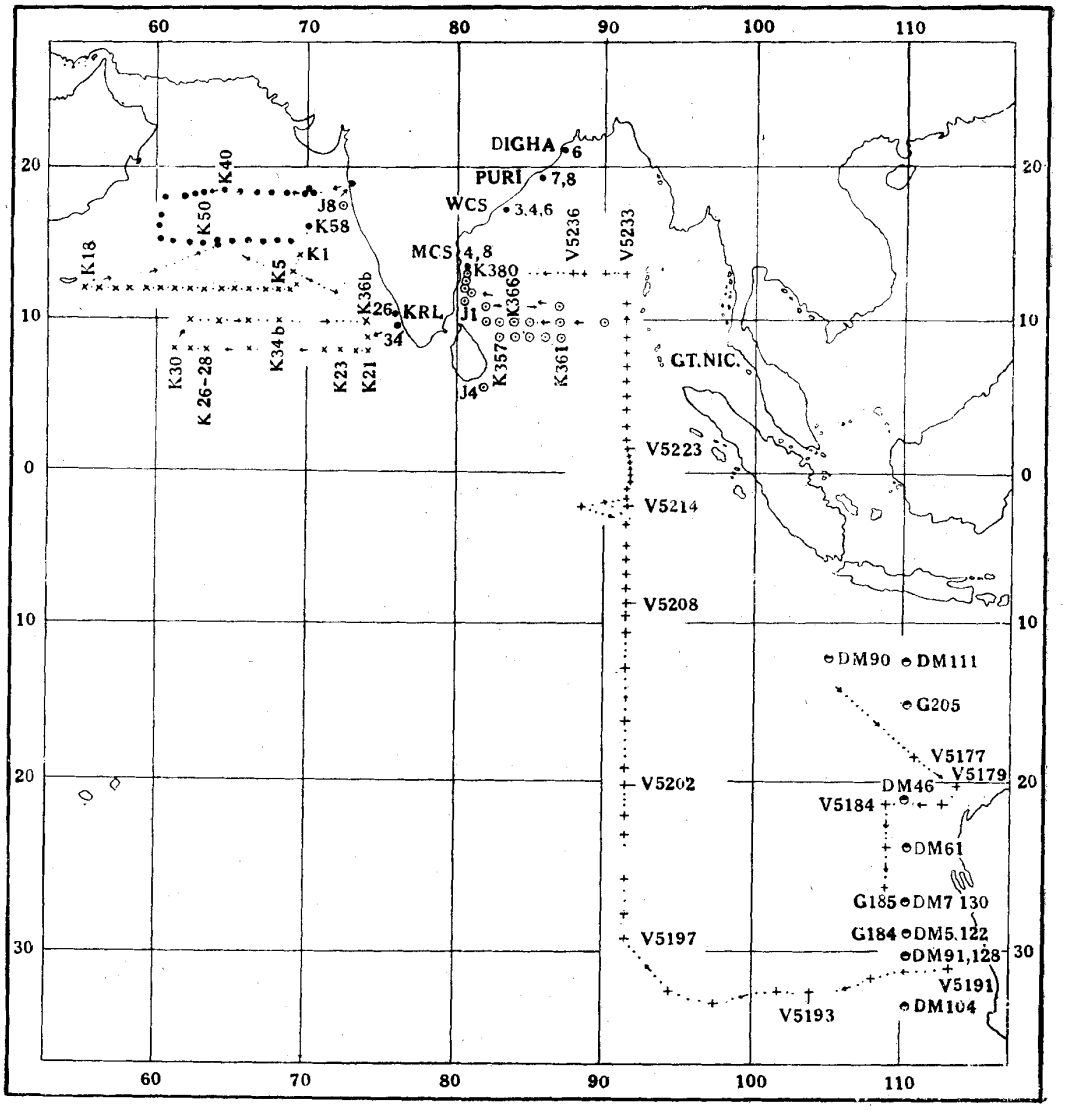


Map A. Map of collecting stations in different cruises in the Indian Ocean (c.f. text)

I—Introduction

The Siphonophora which constitute a stable part of the marine plankton has received attention of zoologists ever since Eschscholtz (1829) published 'System der Acalephen'. The chief works on this group are those of Huxley (1859), Haeckel (1888b), Lens & van Riemsdijk (1908), Bigelow (1911b), Moser (1925), Browne (1926), Bigelow & Sears (1937), Garstang (1946), Leloup (1954) and Totton (1954, 1965).

Bigelow's (1911b) report on the siphonophores collected by the RV ALBATROSS is the most useful, single, systematic account; it is a key work for checking synonymies and references to all works till that time and it contains reviews of past work under each suborder and family with a section on geographical distribution.

Totton's (1965) synopsis gives an excellent taxonomic account with descriptions and figures of the world valid species and short descriptions of the doubtful species (a grand total of 135 species) of the Siphonophora. This synopsis is of immense value to workers on this group but this must be read in conjunction with earlier works, especially with regard to synonymies and references. Furthermore, the known geographical and bathymetrical distribution of the species are not dealt with.

Scientists in India and many other bordering countries with limited library facilities are severely handicapped for want of literature. When I was attracted towards this group, my chief difficulty was the availability of literature. For eight years, between 1952 and 1960, when I studied the Siphonophora of the Madras coast as a research scholar in Madras University Zoological Research Laboratory, my efforts were terribly circumscribed for want of readily available literature.

The present report is therefore an outcome of my desire to bring together all available information on Siphonophora especially for the Indian Ocean forms, based not only from the literature but also from my personal experience. The Siphonophores are a difficult group to preserve and in many cases descriptions are based not on whole individuals, but on certain vital loose parts only. Such shortcomings are, however, inevitable till it is possible to collect and preserve entire individuals—a task not very easy, especially of the Bathyphysids and some of the Physonects, where the specimens are too long to be taken intact in the nets used in plankton-collecting.

In this paper, a list of the valid as well as the doubtful species (151 species) is given. The diagnostic features and previous history of the 3 suborders (CYSTONECTAE, PHYSONECTAE, and CALYCOPHORAE), 15 families and 56 genera, are discussed briefly. Keys for the genera and species are given which, it is hoped, would be of value to students of the Siphonophora. Since knowledge on actual specimens is needed, the 80 species present in the collections have been figured and described in detail. Synonymies for these have been brought uptodate. Data on latitudinal and bathymetrical distribution, depth, net used and the number of examples collected from each collecting station have been given so as to enable the preparation of an Atlas for the Siphonophora of the Indian Ocean when the entire material collected during the International Indian Ocean Expedition is studied.

Of the 81 species described in this report, one new genus and species, viz., *Frillagalma vityazi* was published earlier (Daniel, 1966). *Seven described here originally as new species belonging to the following genera *Amphicaryon* (1 species), *Lensia* (4 species), *Ceratocymba* (1 species) and *Enneagonum* (1 species) have since been published (See *Alvarino*, 1968 and Daniel, 1971), six are new records : *Rhizophysa filiformis* (Förskal, 1775), *?Halistemma amphytridis* (Lesueur & Petit, 1807), *Praya reticulata* (Bigelow, 1911), *Prayoides intermedia* Leloup, 1934; *Lensia challengeri* Totton, 1954 and *Lensia leloupi* Totton, 1954 and the remaining 67 species were known earlier from the Indian Ocean.

* Suitable changes have been made in the text.

In 1954, Totton had listed 74 species from the Indian Ocean which did not include 7 species listed by Haeckel (1888b), 3 by Browne (1926) and 5 by Sears (1953). Thus, upto 1954, 89 species of Siphonophora were known from the Indian Ocean. To this list, four species were added by Daniel & Daniel (1963), two species and one variety by Totton (1965a,b) and one species by Daniel (1966). The report of six new species in 1971 by the author and seven new records in this paper bring the total number of Indian Ocean forms to 109 species and one variety.

During the present study certain interesting aspects have come to notice :

The discovery of huge nectophores, probably belonging to *?Halistemma amphytridis* hitherto known only from the siphosome part of the colony is noteworthy. The record of two kinds of nectophores of *Nanomia bijuga* (Delle Chiaje, 1841)—those occurring in the Bay of Bengal being soft, with lesser musculature, and those from the Arabian Sea being large, hardy with well developed musculature is of interest. In *Athorybia rosacea* (Forskål, 1775) two kinds of colonies occur : one (smaller probably young) with linear arrangement of cormidia in a single median row; and the other (larger, older) bilaterally symmetrical with spirally and radially arranged cormidia. The occurrence of some examples of *Sulculeolaria turgida* (Gegenbaur, 1853) without somatocyst as figured by Gegenbaur, clearly shows that such nectophores do really exist although the somatocyst may have been lost when the stem and the posterior nectophore became detached. Some peculiar nectophores which possess characters of both *Diphyes dispar* Chamisso & Eysenhardt, 1821 and *D. bojani* (Eschscholtz, 1829) from the Arabian Sea and the Australian coast are of interest.

The genus *Lensia* including 30 species have been divided into four main groups, each group having close natural affinities which may have to be eventually recognized as distinct genera and a new subfamily may be erected for them.

The geographical and bathymetrical distribution of the world species of the Siphonophora (dealt with in detail elsewhere in the report) is a collation from the literature and present records, since no account on this aspect is available after Bigelow's (1911b) report. The adaptability of the Siphonophores to varying hydrographical factors may reveal that several species considered to be restricted to particular oceans may be more widely distributed.

Siphonophores have been shown to be an important constituent of the Sonic Scattering Layer (Barham, 1963; Totton, 1954, 1965). The siphonophore component of the Upper Sonic Scattering Layer (USSL) at seven stations established in the eastern sector of the Indian Ocean during 1962 by the RV VITYAZ, was studied along with other zoological constituents (Daniel, Nagabhushanam & Daniel, 1968). This study has revealed that the Siphonophores formed 36–44% of the total biological constituents of this Layer. In this connexion it is of interest to note that measurements of gasbubbles within the flotation structures of *N. bijuga* captured in a closing-net in an ascended Scattering Layer indicated that these are very close to the resonant size for soundwaves of 12 Kc.sec. (*vide* Totton, 1965). Further studies are required to throw more light on this subject.

II—Material and Methods

The present study is based on the following material :

(*i*) Biological samples collected by the Soviet Research Vessel VITYAZ in 1962; (*ii*) Plankton samples collected by the INS KISTNA in 1962, and in 1964; (*iii*) Plankton samples collected by the INS JAMUNA in 1961; (*iv*) Part of sorted-out Siphonophora samples, sent by the CSIRO, AUSTRALIA, collected by HMAS DIAMANTINA and HMAS GASCOYNE in 1962-63. (*v*) Plankton samples collected during coastal survey

of the littoral zone in Indian waters (Bay of Bengal, Great Nicobar Island, and Arabian Sea) during the years 1965 and 1966.

Fuller details of the above collections are given below :

(*i*) The RV VITYAZ on her 35th Cruise in 1962 collected 86 plankton samples from 48 Stations, and this material was deposited in the Zoological Survey of India and was available for study. These samples were collected by using the following gears : Juday Net, Indian Ocean Standard Net, Isaac-Kidd Mid-water trawl, Ring trawl, Pleistone Net and Ichthyological Net. The collections were mainly from a layer between 200 metres to surface; a few hauls were also taken from 1,000 metres, and also from a layer between 500 metres and 200 metres; a few stratified samples were also taken from 200 metres to surface (details of all these hauls are given under the different species which are described in the body of the text).

Details of the stations from which the RV VITYAZ took the samples (being studied in this work), are given in Table I. The samples were examined and the Siphonophora and Chondrophora were carefully sorted out : 1,847 examples of the former, and 213 of the latter were obtained. Of these, 1,806 examples of the Siphonophora were identified as belonging to 61 species (and 2 species *indet.*). The remaining 41 examples were too crushed or broken to be correctly identified.

The Order Chondrophora is not included in this report.

(*ii*) The INS KISTNA Cruises Nos. I, II, & III (in 1962), XV & XIX (in 1964), brought in 92 plankton samples for the Zoological Survey of India collections. The details of the stations from which these collections were made are given in Table II.

The gears used to collect these samples were : Organdie Net and Nansen's Net. The hauls were mainly in the layer between 200 metres to surface; a few hauls were made from 500 metres to 200 metres, 400 metres to 200 metres and from 500 metres to the surface.

The hauls yielded 3,014 examples of Siphonophora belonging to 52 species of which 11 species were not obtained in the RV VITYAZ collections.

(*iii*) Three plankton samples were taken from 3 stations during a Cruise of the INS JAMUNA in 1961 using a nylon net at the surface only. The location and other details of the stations established during this Cruise are given in Table III. The collections yielded 16 examples, belonging to 2 species.

(*iv*) Two hundred and twentyeight samples of siphonophores (sorted out) were received from the CSIRO, AUSTRALIA, being collections made by HMAS DIAMANTINA & HMAS GASCOYNE. The work on these collections is only partial and so far 54 examples have been identified as belonging to 5 species, and these have been dealt with in the present study; these species were not met with in the collections made by the other Research Vessels. Details of the Stations established by the HMAS DIAMANTINA & HMAS GASCOYNE are given in Table IV.

(*v*) Besides the plankton and marine samples obtained from the various research vessels, material was also taken in plankton hauls made at the surface by Zoological Survey of India parties which visited the following areas : Digha (West Bengal), Puri (Orissa), Waltair (Andhra Pradesh), Madras (Tamil Nadu), Cochin and Calicut (Kerala State) and the Great Nicobar Island (Andaman and Nicobar group of islands) during the years 1965–1966. Details of the Plankton Stations established by these survey teams, along with the number of examples and species taken, are given in Table V. A total of 4,131 examples belonging to 11 species were taken in these collections. One species taken in these collections did not occur in any of the other samples studied.

The chart (Text-fig. 19) gives a graphic representation of the various stations from which the plankton hauls were taken by the different Survey Teams of Research Vessels.

A total of 9,062 examples of siphonophores have been studied and included in this report for 81 species. All drawings of the animals have been made with the aid of a camera lucida.

These delicate siphonophores are best preserved by using 10% neutral formalin.

TABLE—I

Details of the U.S.S.R., RV 'VITYAZ's 35th Cruise with Dr. A. Daniel as participant from the Z.S.I. are given below :

V = Vityaz

Sl. No.	Stn. No.	Date	Time hrs.	Position Lat.	Long.E.
1.	V 5177	23-7-62	11.30–13.00	18°44′ S	110°33′
2.	V 5179	24-7-62	19.40–21.40	20°53′ S	113°08′
3.	V 5182	25-7-62	16.30–17.10	21°47′ S	112°51′
4.	V 5184	26/27-7-62	23.37–01.40	21°45′ S	108°25′
5.	V 5185	27-7-62	19.20–21.00	24°34′ S	108°20′
6.	V 5186	28-7-62	10.15–12.10	26°52′ S	108°20′
7.	V 5191	16-8-62	— -	31°07′ S	112°45′
8.	V 5192	16-8-62	15.15–16.40	31°59′ S	107°59′
9.	V 5193	17-8-62	14.00–16.20	32°48′ S	103°58′
10.	V 5194	18-8-62	17.45–18.10	32°39′ S	101°12′
11.	V 5195	19-8-62	20.00–20.45	33°02′ S	97°05′
12.	V 5196	20-8-62	13.45–15.15	32°34′ S	94°14′
13.	V 5197	22-8-62	04.55–05.20	29°50′ S	91°25′
14.	V 5198	22-8-62	17.00–20.00	28°01′ S	91°26′
15.	V 5199	23-8-62	10.15–10.50	26°02′ S	91°38′
16.	V 5200	24-8-62	17.45–20.10	23°58′ S	91°40′
17.	V 5201	25-8-62	10.05–12.55	22°29′ S	91°40′
18.	V 5202	26-8-62	4.30– —	20°57′ S	91°22′
19.	V 5203	26-8-62	15.55–16.30	19°31′ S	91°21′
20.	V 5204	27-8-62	08.30–10.00	16°55′ S	91°19′
21.	V 5205	28-8-62	15.30–17.40	13°10′ S	91°44′
22.	V 5207	29-8-62	17.42–18.40	9°57′ S	91°32′
23.	V 5208	30-8-62	06.00–08.00	9°16′ S	91°27′
24.	V 5209	31-8-62	18.35–20.30	8°10′ S	91°27′
25.	V 5211	2-9-62	02.00–06.15	6°04′ S	91°24′
26.	V 5212	2-9-62	23.10–01.10	5°11′ S	91°15′
27.	V 5213	3-9-62	23.35– —	3°59′ S	91°30′
28.	V 5214	4-9-62	07.50–08.30	2°59′ S	91°30′
29.	V 5216	5-9-62	12.05–12.45	2°03′ S	91°27′
30.	V 5217	7-9-62	14.00–14.15	1°27′ S	91°34′
31.	V 5218	7-9-62	17.50–19.25	0°58′ S	91°40′
32.	V 5219	8-9-62	01.20–03.00	0°30′ S	91°37′
33.	V 5220	8-9-62	12.50–01.00	0°08′ N	91°43′
34.	V 5221	9/10-9-62	23.05–00.22	0°28′ N	91°32′ E
35.	V 5222	10-9-62	04.00–06.10	01°00′ N	91°30′

TABLE—I (*Concluded*)

Sl. No.	Stn. No.	Date	Time hrs.	Position Lat.	Long. E
36.	V 5223	10-9-62	12.00–14.00	01°40′ N	91°45′
37.	V 5224	10/11-9-62	16.50–17.30	02°00′ N	91°33′
38.	V 5225	12-9-62	04.15–07.30	03°06′ N	91°34′
39.	V 5227	12/13-9-62	20.20–21.20	05°03′ N	91°32′
40.	V 5228	14-9-62	15.20–17.30	06°04′ N	91°32′
41.	V 5229	14-9-62	22:15–23.45	07°06′ N	91°34′
42.	V 5230	15-9-62	08.00–08.15	08°03′ N	91°32′
43.	V 5231	15-9-62	15.00–15.15	09°02′ N	91°32′
44.	V 5232	16-9-62	03.10–06.25	11°12′ N	91°32′
45.	V 5233	16-9-62	16.10–16.25	13°20′ N	91°32′
46.	V 5234	17-9-62	04.00–04.15	13°20′ N	90°00′
47.	V 5235	17-9-62	16.00–16.55	13°20′ N	88°57′
48.	V 5236	18-9-62	05.00–05.15	13°20′ N	87°00′

TABLE—II

Details of the INS Kistna' Cruises I, II, III, XV, XIX and XX(with Dr. K. K. Tiwari & Shri V. K. Prem Kumar in the Cruise I; Dr. A. G. K. Menon & Shri A. Ghosh in the Cruises II & III; Shri K. V. Rama Rao in the Cruise XV, and Dr. A. G. K. Menon in the Cruises XIX and XX as the participants from the Zoological Survey of India) are given below :

K—Kistna

Sl. No.	Stn. No.	Date	Time hrs.	Position Lat. N.	Long. E.
Cruise I					
1.	K 33	13-10-62	17.45	18°45′	71°45′
2.	K 34	14-10-62	00.16	18°46′	70°40′
3.	K 34	14-10-62	00.30	18°46′	70°40′
4.	K 35	14-10-62	06.00	18°45′	70°05′
5.	K 36	14-10-62	14.00	18°30′	68°57′
6.	K 37	14-10-62	21.00	18°35′	67°54′
7.	K 38	15-10-62	03.15	18°31′	66°52′
8.	K 39	15-10-62	09.30	18°27′	65°52′
9.	K 40	15-10-62	16.45	18°25′	64°47′
10.	K 41	15-10-62	23.30	18°31′	63°55′
11.	K 42	16-10-62	06.00	18°15′	62°52′
12.	K 43	16-10-62	13.15	18°12′	62°00′
13.	K 44	16-10-62	19.30	18°08′	60°56′
14.	K 46	17-10-62	09.00	16°35′	60°00′
15.	K 47	17-10-62	61.30	15°30′	60°00′
16.	K 48	18-10-62	01.30	15°30′	61°00′
17.	K 49	18-10-62	09.00	15°30′	62°00′
18.	K 50	18-10-62	14.30	15°30′	63°00′

TABLE—II (*Continued*)

Sl. No.	Stn. No.	Date	Time hrs.	Position Lat. N.	Long. E.
19.	K 51	18-10-62	21.00	15°30′	64°00′
20.	K 53	19-10-62	10.00	15°29′	66°00′
21.	K 53	19-10-62	10.30	15°29′	66°00′
22.	K 54	19-10-62	16.30	15°30′	67°00′
23.	K 56	20-10-62	07.30	15°30′	69°00′
24.	K 56	20-10-62	08.00	15°30′	69°60′
25.	K 58	20-10-62	19.45	16°16′	70°28′
26.	K 58	20-10-62	20.00	16°18	70°28′
Cruises II & III					
27.	K 1	4-11-62	22.30	14°32′	69°45′
28.	K 2	5-11-62	04.15	13°05′	69°00′
29.	K 3	5-11-62	09.15	12°50′	69°20′
30.	K 3	5-11-62	09.40	12°05′	69°20′
31.	K 4	5-11-62	17.00	12°00′	69°00′
32.	K 5	6-11-62	02.30	12°00′	68°00′
33.	K 6	6-11-62	08.50	12°00′	67°00′
34.	K 7	6-11-62	16.45	12°00′	66°00′
35.	K 7	6-11-62	03.25	12°00′	66°00′
36.	K 8	6-11-62	23.00	12°00′	65°00′
37.	K 9	7-11-62	06.15	12°00′	64°00′
38.	K 10	7-11-62	12.15	12°00′	63°00′
39.	K 11	7-11-62	20.50	12°00′	62°00′
40.	K 12	8-11-62	02.30	12°00′	61°00′
41.	K 13	8-11-62	10.45	12°00′	60°00′
42.	K 13	8-11-62	11.20	12°00′	60°00′
43.	K 14	8-11-62	17.20	12°00′	59°00′
44.	K 14	8-11-62	17.50	12°00′	59°00′
45.	K 15	8-11-62	23.00	12°00′	58°00′
46.	K 16	9-11-62	06.45	12°00′	57°00′
47.	K 17	9-11-62	14.45	12°00′	56°00′
48.	K 18	9-11-62	21.15	12°00′	55°00′
49.	K 19	12-11-62	08.00	15°00′	64°00′
Cruise III					
50.	K 20	27-11-62	04.40	09°00′	74°00′
51.	K 21	27-11-62	14.00	08°00′	74°00′
52.	K 22	28-11-62	06.05	08°00′	73°13′
53.	K 23	28-11-62	13.30	08°00′	72°80′
54.	K 24	28-11-62	20.00	08°00′	71°00′
55.	K 25	30-11-62	04.00	08°00′	66°00′
56.	K 26	30-11-62	16.45	08°00′	63°00′
57.	K 27	1-12-62	12.15	08°00′	63°10′
58.	K 28	1-12-62	07.15	08°00′	63°00′
59.	K 29	1-12-62	14.15	08°00′	62°00′

TABLE—II (*Concluded*)

Sl. No.	Stn. No.	Date	Time hrs.	Position Lat. N.	Long. E.
60.	K 30	1-12-62	08.45	08°00′	61°00′
61.	K 31	2-12-62	21.15	10°00′	62°00′
62.	K 32	3-12-62	10.15	10°00′	64°00′
63.	K 33b	3-12-62	—	10°00′	66°00′
64.	K 34b	4-12-62	—	10°00′	68°00′
65.	K 36b	5-12-62	—	10°00′	74°00′
Cruise XV					
66.	K 357	10-6-64	15.45	09°00′	83°00′
67.	K 358	11-6-64	05.45	09°00′	84°00′
68.	K 359	11-6-64	12.00	09°00′	85°00′
69.	K 359	11-6-64	12.30	09°00′	85′00′
70.	K 360	11-6-64	20.00	09°00′	86°00′
71.	K 360	11-6-64	20.30	09°00′	86°00′
72.	K 361	12-6-64	06.00	09°00′	87°20′
73.	K 363	13/14-6-64	23.40	10°00′	87°00′
74.	K 365	14-6-64	16.45	10°02′	85°00′
75.	K 366	15-6-64	02.45	10°00′	84°00′
76.	K 367	15-6-64	10.25	10°00′	83°00′
77.	K 369	16-6-64	03.00	11°00′	82°00′
78.	K 372	17-6-64	14.25	11°00′	87°00′
79.	K 377	19-6-64	18.40	12°00′	81°00′
80.	K 378	20-6-64	01.26	12°36′	80°40′
81.	K 378	20-6-64	04.30	12°36′	80°40
82.	K 379	20-6-64	05.00	12°59′	80°35′
83.	K 380	20-6-64	06.00	13°03′	80°30′
Cruises XIX, XX					
*84.	K 522	25-8-64	09.44	06°00′	99°29′
85.	K 525	3-9-64	07.28	02°30′	101°30′
86.	K 527	3-9-64	20.33	04°00′	99°49′
87.	K 529	4-9-64	12.52	06°00′	98°00′
88.	K 532	5-9-64	09.52	06°00′	95°00′
89.	K 533	5-9-64	17.22	06°00′	94°00′
90.	K 533	5-9-64	18.00	06°00′	94°00′
91.	K 535	6-9-64	18.18	06°00′	92°00′
92.	K 538	7-9-64	06.16	08°47′	92°16′

* Details such as date, time and position have been taken from "Oceanography in India", Publ. No. 4, Indian National Committee on Oceanic Research, New Delhi, 1967.

TABLE—III

Details of the INS 'Jamuna' cruise with Dr. A. Daniel as participant from the Zoological Survey of India.

J—Jamuna

Sl. No.	Stn. No.	Date	Position Lat.	Long.
1.	J 1	26-4-61	12°38′ N	80°25′ E
2.	J 4	28-4-61	05°58′ N	81°14′ E
3.	J 8	2-5-61	17°00′ N	73°00′ E

TABLE—IV

Cruise details of HMAS 'Diamantina' and HMAS 'Gascoyne'.

DM—Diamantina; G—Gascoyne

Cruise	Stn. No.	Sample No.	Position Lat. S	Long. E
DM/1/63	5	1267/E	29°00′	110°00′
DM/1/63	7	1274/E	27°30′	110°00′
DM/1/63	46	1437/E	21°30′	110°00′
DM/2/63	61	1639/E	24°30′	110°00′
DM/2/62	90	522/E	12°45′	105°03′
DM/3/63	91	1700/E	30°30′	110°00′
DM/3/62	104	846/E	33°24′	110°00′
DM/3/63	111	1803/E	12°30′	110°00′
DM/3/63	122	1868/E	29°00′	110°00′
DM/4/62	128	940/E	30°30′	110°00′
DM/4/62	130	952/E	27°30′	110°00′
G/4/62	184	653/E	29°00′	110°00′
G/4/62	185	658/E	27°30′	110°00′
G/4/62	205	770/E	15°30′	110°00′

TABLE—V

Details of the inshore coastal surveys.

WC-S—Waltair Coastal Survey; KRL—Kerala Coastal Survey;
MC-S—Madras Coastal Survey; Gt.Nic.—Great Nicobar Expedition.

Sl. No.	Place	Stn. No.	Date	Lat. N	Long. E	No. of Ex.	No. of species
1.	West Bengal (Digha)	Digha/6 1. colln.	12-3-66	21°60′	87°30′	1833	6
2.	Orissa (Puri)	Puri/7 Puri/8 2 colln.	18-12-66 19-12-66	19°60′	86°00′	331	6
3.	Andhra (Waltair)	WC-S/3 WC-S/4 WC-S/6 3 colln.	Nov. 1965	17°50′	83°20′	45	4

TABLE—Continued

Sl. No.	Place	Stn. No.	Date	Lat. N	Long. E	No. of Ex.	No. of species
4.	Madras	MC-S/4 MC-S/8 2 colln.	June 1966	13°00′	80°50′	13	2
5.	Kerala (Cochin & Kozhikode)	KRL/26 KRL 34 4 colln.	12-1-65 23-1-65	10°00′ 11°30′	76°00′	1808	6
6.	Great Nocober Island	Gt.Nic./1 Gt.Nic./2 Gt.Nic./5 Gt.Nic./6 4 colln.	March 1966	6°59′ 6°56′ 6°45′ 6°52′	93°38′ 93°42′ 93°53′ 93°58′	101	7

ABBREVIATIONS USED FOR NETS IN TEXT

J.N.	= Juday net
IOSN	= Indian Ocean Standard net
Pl.N.	= Pleistone net
I.K.T.	= Issac-Kidd trawl
Ring T, R.T.	= Ring trawl
Ich. N.	= Ichthyological net
NN	= Nansen's net
Ny N	= Nylon net
Org. N.	= Organde net
Bm.T.	= Beam trawl.

III—TERMINOLOGY FOR VARIOUS MORPHOLOGICAL STRUCTURES OF THE ORDER SIPHONOPHORA AND THEIR SYNONYMS FROM OLDER WORKS

The terminology used by Haeckel (1888b), Bigelow (1911b) and Totton (1954, 1960, 1965) is followed in the present study.

Terminology used in Sub-order Cystonectae :

Aboral.—the float end of the oozooid, *i.e.*, that end opposite to oral end.

Ampulla.—is the hypertrophied basigaster of a gastrozooid containing innumerable nematoblasts. It has no mouth-opening. The tentacle arises from its base.

Apical pore (air-hole, stigma).—is the opening situated at the tip of the pneumatophore or float.

Apical pigment (mitra ocellaris).—is the apically pigmented tip of the pneumatophore, varying from reddish-brown to black in colour.

Asexual nectophore (nectophore).—these are asexual medusoid nectophores developed in the gonodendra of *Physalia* and *Rhizophysa*. Previously regarded as female medusoids.

Basal internode.—term used by Haeckel to describe the gap between the oral and the main zone of cormidia in *Physalia.*

Basigaster (Vormagen).—is the base of the gastrozooid enlarged into a nematocyst producing area.

Beaked or bird-headed tentilla.—is the third type of tentilla occurring in *Rhizophysa filiformis*, possessing a bunch of long processes with central enlargements and a long beak-like, bent structure at the tip (Totton, 1965, pl. IV, fig. 4).

Cnidoblasts (nematoblasts).—are mother-cells, which produce nematocysts.

Cnidonodes (cnidocysts or nematocyst batteries, nematocyst head, or cnidospheres). —are the sessile reniform nematocyst heads occurring at regular intervals along the dorsal side of the tentacle of *Physalia* and in *Salacella* (= *Salacia*) possessing innumerable nematocysts.

Cormidium.—is a group of appendages—group(s) of gastrozooids, tentacles and gonodendra—occurring on the siphosome, which is highly reduced in *Physalia.*

Crest (sail).—is a polythalamous sail on the dorsal side of the large pneumatophore of *Physalia.* It is held firm by a set of triangularly shaped septa dividing the crest into many chambers.

Dendritic (or palmate) tentilla.—is the second type of tentilla, found in *R. filiformis.* An expanded tentillum is a highly branched structure. At one side of the distal end of the enlarged body between the bases of the branches is a hemispherical pigmented boss, reddish-brown in colour and covered with hair-like processes (resembling those that cover the ectoderm of the whole tentacle and the pedicels of all the tentilla). At the other side is an extensive opaque area of the ectoderm (Totton, 1965, p. 41, pl. IV, figs. 5 & 6).

Female medusoids (gynophore, female gonophore).—are the female gonophores possessing a thin single layer of germ-cells which form a continuous, narrow, sinuous band, running over the surface.

Gas gland.—is the spherical, opaque spot on the inner side near the main zone of cormidia in *Physalia.*

Gastrozooids (siphons, suctorial tubes, polypites, nutritive polyps, stomach sacs, gastral tubes, eating polyps, hydranths).—are the feeding polyps possessing the enlarged basal region, the basigaster, stomach proper (stomachus), long flexible proboscis a suctorial mouth and a tentacle at the base. They are either sessile or pedicellate.

Gonodendron (reproductive stalk, blastostyle, gonostyle).—is a diffusely branched structure arising from the base of the gastrozooid or palpon, possessing gonophores, gonopalpons and asexual nectophores.

Gonopalpon (gonozooid).—a reduced gastrozooid associated with the gonodendron, but does not possess a tentacle.

Gonophore (reproductive person, sexual medusoid).—is a small, ovoid male or female medusa, functional or reduced, without tentacles; codonid-like or styloid.

Gonozooids (gonopalpons).—are reduced gastrozooids without any tentacles, from the base of which the gonodendra are budded off.

Hypocystic villi.—are outgrowths containing giant ectodermal cells having a diameter of upto 2.0 mm, arising from the pneumadenia and often penetrating the septa that cross the pericystic cavity.

Jelly-polyps.—are vestigial nectophores, found only in *Physalia.*

Left-handed specimens.—The cormidia are borne on a bulge on the oral half of the animal, the tentacles streaming out on the windward side and acting as a drogue or sea-anchor; when the bulge is situated on the left-hand side of the float, the specimens are called left-handed specimens.

Main aboral zone.—the area or zone in which the highly developed cormidia occur. This zone is separated from the oral zone by the basal internode.

Male medusoids (androphores, male gonophores).— are very similar to the female gonophores in being ovoid and sessile, but the male ones possess a thick cap of germ-cells borne on a relatively less capacious endodermal spadix.

Nematoblasts.—are mother-cells which produce the nematocysts.

Nematocysts (stinging-cells, stinging-capsules, cnidocysts).—a nematocyst consists of a capsule with toxin, a whip-like thread coiled within the capsule, and a pointed minute trigger-spine or cnidocil. Depending on the structure of the capsule and armature on the whip-like thread, fourteen types of nematocyst are recognized.

Oozooid.—is the early larval stage in which two parts : (*i*) the abnormal invaginated pneumatophore or float, and (*ii*) the oral primary zooid, may be distinguished.

Oral end.—is the part in which the primary zooid is situated.

Oral zone.—area or zone in which the primary gastrozooid and a few cormidia are situated. This is separated from the main aboral zone of cormidia by the basal internode.

Palpons (feelers, tasters, arms, dactylozooids, hydrocysts, fluid receptacles).—occur as gonopalpons without tentacles (in this suborder), in the gonodendra of *Physalia*, *Rhizophysa* and *Bathyphysa*.

Pericystic cavity.—is the space between the pneumatocodon and the pneumatocyst, often traversed by septa.

Pneumadenia (gas-gland).—is the three-layered gas-gland of the invaginated pneumatocyst—a specialized part of the wall of the pneumatosaccus.

Pneumatocodon ('Luftschirm').—is the outer three-layered wall of the invaginated float.

Pneumatocone (air-funnel, 'Lufttrichte').—the basal cylindrical part of the chitinous lining of the pneumatosaccus, with the enclosed part of the pneumadenia.

Pneumatocyst (Pneumatosaccus, 'Luft-sac', 'Luftflasche').—is the three-layered, invaginated gas-containing part of the float, lined above by chitin and below by secondary ectoderm that grows up from the gas-gland and lies over the chitinous lining.

Pneumatophore (float, swimming-bladder, air-chamber, 'Luftkammer', 'Schwimmblase').—is the aboral invaginated portion of the oozooid possessing the above-mentioned associated parts—*viz.*, pneumadenia, pneumatocodon, pneumatocone, pneumatocyst.

Pore.—is the apical opening or stigma in the pneumatophore.

Protozooid (primary zooid, primary gastrozooid).—is the primary, terminal gastrozooid situated at the oral end of the juvenile siphonophore, and in the mature cystonects.

Right-handed specimens.—are specimens of *Physalia* in which the bulged region consisting of the cormidia is situated on the right hand side of the float.

Septa.—in *Physalia*, are the triangularly shaped partitions; the primary, secondary and tertiary septa divide the crest into many chambers.

Siphosome (nutritive body).—is either reduced or elongated, from which the gastrozooids, palpons, and gonodendra are borne.

Stem (trunk, coenosome, coenosarc, axial body).—is the central axial body on which the various 'persons' occur.

Tentacle (capturing filament, 'Senkfaden', stinging filament, nematozooid, tentacular filament).—is long, thin, tubular and arises from the base of the gastrozooid.

Tentilla.—are the lateral branches of the tentacle; these are either simple or end in tricornuate, dendritic or palmate or bird-headed sub-terminal battery of nematocysts.

Tricornuate.—when a tentillum ends in the form of three-branched structure, it is called a tricornuate tentillum.

Tripartite group.—consists of gastrozooid, tentacle and ampulla, and a gonodendron at the base of the gastrozooid; and further series of similar laterally placed tripartite groups grow from the base of its predecessor. This is the essential arrangement of budding in *Physalia*.

Terminology used in Suborder Physonectae.—(The terms given below are other than those common names referred to under the Suborder Cystonectae above) :

Angle-bands ('Elastische Bände').—these are extensile structureless filaments connecting the basal mesoglea of the cnidosac with the base of the terminal filament. On activation, they cause the folded cnidoband to straighten and slap itself with its larger flanking nematocysts on to its prey.

Aurophore (or air-bell).—lies below the pneumatophore; considered to be a gas-gland, and occurs only in the Family Rhodaliidae.

Blastostyle.—reproductive stalk or bud, from which the gonophores are produced.

Bracts (covering pieces, hydrophyllia, protecta, covering scales, "Deckblatter", phyllozooids).—are perhaps modified palpons with enlarged mesoglea, for protection and buoyancy. They are either thin and scale-like, or thick or facetted, and possess a thin thread-like canal—the bracteal canal which lies in the mid-region. They are attached to the siphosome by a peg-like structure or a large muscular sheath—the bracteal lamella.

Budding zone.—there are two budding zones along a physonect colony, *viz.*, the area just under the pneumatophore, which buds off nectophores; and an apical area of the siphosome, from which are budded the gastrozooids, palpons, bracts and gonophores.

Canal system.—occurs in nectophores and gonophores; *pedicular canal*—arises from the point of origin in the stem; *radial canals*—four meridionial canals run from the pedicular to the circular canals; *circular canal*—unites the distal ends of the radial canals.

Cnidoband (cnidotaenia, utricating band, 'Nesselband').—consists of rows of sabre-shaped nematocysts forming the chief part of most stinging organs. It is often flanked basally by two rows of larger, bean-shaped or sabre-shaped nematocysts. Usually the cnidoband occurs in the form of coils—the number of coils varies in different species.

Corm.—is the reduced vesicular stem region in the family Rhodaliidae.

Cormidium.—consists of a group of gastrozooids, tentacle, palpons, palpacle, bracts and gonodendra.

Gonostyle (reproductive stalks, blastostyle, gonoblastidia, gonodendra, klinozooid). —stalks from which the gonophores are produced.

Nectophores (nectocalyces, swimming bells, nectozooids, 'Schwimmglocken , 'Schwimmhohlenstucke').—are asexual medusoids used in locomotion. It consists of a *nectosac*—the sub-umbrellar cavity of a medusoid; *ostium*—the velar end or mouth opening of a nectophore. It possesses a canal system in which the lateral radial canals are either short and simple or very long, forming a number of loops before joining the circular canal.

Nectosome.—that portion of the stem in which the nectophores occur *i.e.*, from the zone of budding or proliferation of nectophores down to the region of least growth situated just above the budding zone of the siphosome.

Nectostyle.—is the area of attachment of larval type of bracts of Physonectae, *e.g.*, in *Athorybia* and subsequent budding zone of the siphosome.

Palpons (feelers, tasters, arms, fluid receptacles, hydrocysts, dactylozooids, cystons or anal vesicles).—are reduced gastrozooids with a simple tentacle, the palpacle (tasting filament).

Siphosome (nutritive body).—is that portion of the stem, from the budding zone down to the protosiphon, on which the gastrozooids, palpons, bracts and gonophores are borne.

Tentillum.—is a side branch of a tentacle, either simple or branched (as in Cystonectae). It consists of a pedicle and a thick cnidoband. When it is spirally twisted, it is often partly or fully covered over by a theca-like covering—the *involucrum*, or naked—

non-involucrate (without involucrum), with a single terminal filament—the unicornuate type—or tricornuate filaments, *i.e.*, a pair of *lateral horns* and a *median ampulla* or with many lateral horns (*e.g.*, *Lychnagalma*), or without a median terminal ampulla or vesicle. It also occurs as a closed sacculus containing elastic bands, cnidoband and other nematocysts together with a terminal filament often provided with a disc-shaped sinker.

Terminology used in Suborder Calycophorae. (in addition to those common ones given above) :

Central organ.—of uncertain origin. The central part of a larva of Hippopodiidae and Prayidae. Also the remains of a fragment of stem in an eudoxid, *e.g.*, Prayidae.

Cormidium.—in Calycophorae consists of a single gastrozooid, tentacle, a single bract, special nectophore and gonophores, but no palpons.

Cnidosac.—(Cnidobattery, sacculus, 'Nesselknopf', 'Bouton utricant').—pedicellate type of enclosed stinging organ formed by the tentilla.

Eudoxid phase (monogastric, sexual or second phase).—the oldest cormidia in the colony are set free as eudoxid-phases. The phase consists of a well-developed *bract, asexual or special nectophore* and a succession of *gonophores*, which are in turn set free as *medusae* (third phase). When a special nectophore is absent, the gonophore takes up the function of locomotion. The *manubrium* of the gonophore bears the germ-cells.

Hydroecium.—the hydroecial cavity (when present) in the nectophores of Calycophorae, is used for housing the retracted stem with its associated structures. It lies on the ventral side.

Mantle canal ('Mantelgefass').—is the upper and lower diverticula of the pedicular canal at the point of entry into a nectophore or gonophore (as in *Rosacea* spp.). The muscular pedicular lamella is attached to its proximal wall; very occasionally it lies embedded further within the mesoglea of an agalmid nectophore as in the young nectophore of *Forskalia leuckarti*.

Nectosome.—is very reduced in most of the Calycophorae (except in the Family Hippopodiidae). The colony lacks a pneumatophore or float.

Nectophore.—in Calycophorae is highly specialized, usually pyramidal in shape with well-marked ridges which are smooth or serrated, and facetted; or smooth, rounded and devoid of any ridges. It possesses a nectosac, hydroecium (may be absent) and somatocyst; *ostium* of nectosac often surrounded by *ostial teeth* and divided or undivided *mouth-plates* in Diphyidae.

Pallial canal.—sometimes used for mantle canal of a nectophore, sometimes for an apical part of it—thought to be homologous with the somatocyst.

Phyllocyst (Bracteal canal).—part of the common gastric cavity occluded in some mature bracts. It is either simple or branched.

Polygastric phase (asexual phase).—asexual phase—first phase—from which cormidia are set free as eudoxid (or second) phase. The colony consists of the nectophores and many developing gastrozooids.

Siphosome.—in Calycophorae lacks palpons, except in *Stephanophyes* where vestigeal ones are found.

Somatocyst.—a caecal part of the common gastric cavity found only in Calycophoran nectophores. It is now thought to be a vestige of an original actinuloid tentacle (or bract), which has united with the nectophore. It may branch as in *Praya* spp. It is often vacuolated and possesses oil-globules.

IV—Classification of Siphonophora

Eschscholtz (1829) divided the Siphonophora into three suborders : Chondrophorae (Chamisso, 1821); Physophorae (Eschscholtz, 1829, part), and Calycophorae (Leuckart, 1854).

Most of the earlier workers (Huxley, 1859; Chun, 1888, 1897b; Haeckel, 1888b; Lens & van Riemsdijk, 1908; Bigelow, 1911b; Browne, 1926; Garstang, 1946) retained Chondrophorae as one of the tripartite divisions of the Order Siphonophora, though always recognizing the former to be quite distinct in its morphology, relationships and development, *i.e.*, its radial symmetry, with an aboral whorl of simple tentacles, and developing from an 'Actinula' larva (*Conaria*), and showing close relationship with Tubularians (specially *Corymorpha*) in the dominance of a large axial polyp with plexiform aboral coelenteron, aboral wreath of tentacles, free Anthomedusan gonophores and an 'Actinula' larva (Garstang, 1946). The other two suborders, *viz.*, Physophorae and Calycophorae (= Siphonantha Haeckel, 1888; Garstang, 1946) are bilaterally symmetrical, with a separate basal tentacle to each polyp, and developed from a solid 'Planula' larva by unilateral precocious (ventral) budding (Garstang, 1946) and show "relationship with myriotheline in the resemblance of their lateral paddling bracts to the larval tentacles of the actinula of the hydroid *Myriothela*, which are aboral in position, locomotive in function and precociously developed" (*vide* Totton, 1954, p. 17).

Haeckel (1888) treated the group Siphonophora as a class, and his classification is as follows :—

Class SIPHONOPHORA

Subclass (?) *DISCONANTHAE*

Order 1 : DISCONECTAE

Subclass (?) *SIPHONANTHAE*

Order 2 : CALCYCONECTAE

Suborder I *CALYCONECTAE MONOGASTRICAE*

Suborder II *CALYCONECTAE POLYGASTRICAE*

Order 3 : PHYSONECTAE

Suborder I *PHYSONECTAE MONOGASTRICAE*

Suborder II *PHYSONECTAE POLYGASTRICAE*

A. *Macrostelia*

B. *Brachystelia*

Order 4 : AURONECTAE

Order 5 : CYSTONECTAE

Suborder I *CYSTONECTAE MONOGASTRICAE*

Suborder II *CYSTONECTAE POLYGASTRICAE*

A. *Macrostelia*

B. *Brachystelia*

Haeckel's Calyconectae Monogastricae is really the adult or sexual phase (Eudoxid phase) in the life-cycle of the Calyconectae Polygastricae. Similarly, his Physonectae Monogastricae and Cystonectae Monogastricae have been proved to be the larval stages in the life-history of the Physonectae Polygastricae and Cystonectae Polygastricae respectively. Therefore, these groups have not been recognized by any of the later workers.

Chun's (1897b) classification is as follows :—

Class SIPHONOPHORA

Order 1 : CALYCOPHORAE

Order 2 : PHYSOPHORAE

A. HAPLOPHYSAE
Suborder 1. *PHYSONECTAE*
Suborder 2. *RHIZOPHYSALIAE*

B. TRACHYOPHYSAE
Suborder 1. *CHONDROPHORAE*

While Bigelow (1911b), without designating the status of the group clearly (*viz.*, whether a class, or order), recognized four sub-divisions of the Siphonophorae, *i.e.*, Calycophorae, Physophorae, Rhizophysaliae and Chondrophorae.

The classification given in Kukenthal's "Handbuch", by Moser (1924b), is not correct since it almost completely obscures the natural relationships of the Siphonophora (Totton, 1954).

Libbie Hyman's (1940) classification is as follows :—

Order SIPHONOPHORA

Suborder *CALYCOPHORAE*
Suborder *PHYSOPHORIDA*
Group Physonectae
Group Rhizophysaliae
Group Chondrophorae

However, it was Garstang (1946) who, after studying the comparative morphology, phylogeny and relationships of Siphonophora, felt that the evolution of Siphonophora had progressed from a passive flotation, through various combinations of floatation with active modes of locomotion, to a climax of purely muscular methods of swimming and colonial simplification in Calycophorida. He, therefore, reversed the order in which Chun (1897b) and Haeckel (1888b) had arranged the principal groups. He recognized Haeckel's Disconanthae and Siphonanthae to mark the major gap between the Chondrophorae and the remaining groups. He agreed with Chun in recognizing only two divisions, *i.e.*, Physophorae and Calycophorae under the Siphonophora (= Siphonantha) and in classing Cystonectae and Physonectae (= Amphinecta) under Physophorae (= Physophorida). Garstang's classification is as follows :—

SIPHONOPHORA

I : DISCONANTHA
Order CHONDROPHORA

II : SIPHONANTHA
A. Physophorida
1. Cystonecta
a. Brachystelia
b. Macrostelia
2. Amphinecta
a. Brachystelia
b. Macrostelia
B. Calycophorida

Leloup (1954) after a study of embryology and comparative anatomy, divided the Siphonophora into four groups, *i.e.*, 'Chondrophorides', 'Cystonectides', 'Physonectides' and 'Calycophorides' and included the first three groups under 'Physophorides'. However, in 1955 (a,b) he recognized the older names, *viz.*, Calycophorae and Physophorae, and he classified the families Rhizophysidae, Physalidae, Velellidae and Porpitidae under the Physophorae.

However, Totton (1954), on grounds of priority, changed Garstang's new name Physophorida to Eschscholtz's old name Physophorae, Amphinecta to Haeckel's old name Physonectae and Calycophorida to Leuckart's Calycophorae. He further separated Chondrophora from Siphonophora and restricted the name Siphonophora to the Siphonantha of Haeckel and Garstang. His revised classification is as follows :—

Order CHONDROPHORA (Chamisso & Eysenhardt, 1821)
= DISCONANTHAE Haeckel, 1888
(includes the genera *Velella*, *Porpita* & *Porpema*)

Order SIPHONOPHORA (Eschscholtz, 1829, part)
= SIPHONANTHAE Haeckel, 1888

Suborder 1. *CYSTONECTAE* Haeckel, 1888
= '*PNEUMATOPHORIDEN*' Chun, 1882
= *RHIZOPHYSALIAE* Chun, 1897b

Suborder 2. *PHYSONECTAE* Haeckel, 1888
= *PHYSOPHORAE* Eschscholtz, 1829 (part)

Suborder 3. *CALYCOPHORAE* Leuckart, 1854.

This classification is followed in the present study.

The world-list of species of Siphonophora is presented :

V—Classified List of World Species of the Order Siphonophora

Order SIPHONOPHORA Eschscholtz, 1829

Sub-order *CYSTONECTAE* Haeckel, 1888

Family 1. Physaliidae Brandt, 1835

Genus **Physalia** Lamarck, 1801

1. **Physalia physalis* (Linnè, 1758)

Family 2. Rhizophysidae Brandt, 1835

Genus **Rhizophysa** Pèron & Lesueur, 1808

2. **Rhizophysa filiformis* (Forskål, 1775)
3. ***Rhizophysa eysenhardti* Gegenbaur, 1859
**Rhizophysa* sp.

Genus ? **Salacella** Delage & Herouard, 1901

4. *?Salacella polygastrica* (Haeckel, 1888)

Genus **Bathyphysa** Studer, 1878

5. *Bathyphysa conifera* (Studer, 1878)
6. *Bathyphysa sibogae* Lens & van Riemsdijk, 1908
7. *?Bathyphysa japonica* Kawamura, 1943

NOTE :— * Represented in the collections under report.
** Also known from the Indian Ocean, but not represented in the collections under report.
? Families, genera and species *inquirendae*.

Family ?EPIBULIIDAE Haeckel, 1888b

Genus ?**Epibulia** Eschscholtz, 1829

8. *?Epibulia chamissonis* (Eysenhardt, 1829)
9. ***?Epibulia ritteriana* Haeckel, 1888

Suborder *PHYSONECTAE* Haeckel, 1888

Family 3. APOLEMIIDAE Huxley, 1859

Genus **Apolemia** Eschscholtz, 1829

10. ***Apolemia uvaria* (Lesueur, ?1811)

Family 4. AGALMIDAE Brandt, 1835

Genus **Agalma** Eschscholtz, 1825

11. **Agalma okeni* Eschscholtz, 1825
12. ***Agalma haeckeli* Bigelow, 1911
13. *Agalma clausi* Bedot, 1888
14. **Agalma elegans* (Sars, 1846)

Genus **Halistemma** Huxley, 1859

15. **Halistemma rubrum* (Vogt, 1852)
16. *Halistemma cupulifera* Lens & van Riemsdijk, 1908
17. *Halistemma striata* Totton, 1965
18. **?Halistemma amphytridis* (Lesueur & Petit, 1807)

Genus **Cordagalma** Totton, 1932

19. **Cordagalma cordiformis* Totton, 1932

Genus **Nanomia** A. Agassiz, 1865

20. **Nanomia bijuga* (Delle Chiaje, 1841)
21. *Nanomia cara* A. Agassiz, 1865

Genus **Frillagalma** Daniel, 1966

22. **Frillagalma vityazi* Daniel, 1966

Genus **Marrus** Totton, 1954

23. *Marrus antarcticus* Totton, 1954
24. *Marrus orthocanna* (Kramp, 1942)
25. ***Marrus orthocannoides* Totton, 1954

Genus **Moseria** Totton, 1965

26. *Moseria convoluta* (Moser, 1925)

Genus **Lychnagalma** Haeckel, 1888

27. *Lychnagalma utricularia* (Claus, 1879)
28. ***?Lychnagalma vesicularia* Haeckel, 1888

Genus **Erenna** Bedot, 1904

29. *Erenna richardi* Bedot, 1904

Family 5. PYROSTEPHIDAE Moser 1925

Genus **Pyrostephos** Moser, 1925

30. *Pyrostephos vanhoeffeni* Moser, 1925

Genus **Bargmannia** Totton, 1954

31. **Bargmannia elongata* Totton, 1954

Family 6. PHYSOPHORIDAE Eschscholtz, 1829 (*pro parte*)

Genus **Physophora** Forskål, 1775

32. **Physophora hydrostatica* Forskål, 1775

Family 7. ATHORYBIIDAE Huxley, 1859

Genus **Athorybia** Eschscholtz, 1829

33. **Athorybia rosacea* (Forskål, 1775)

Genus **Melophysa** Haeckel, 1888

34. **Melophysa melo* (Quoy & Gaimard. 1827)

Family 8. RHODALIIDAE Haeckel, 1888

Genus **Angelopsis** Fewkes, 1886

35. *Angelopsis globosa* Fewkes, 1886
36. *Angelopsis dilata* Bigelow, 1911

Genus **Stephalia** Haeckel, 1888

37. *Stephalia corona* Haeckel, 1888

Genus **Rhodalia** Haeckel, 1888

38. *Rhodalia miranda* Haeckel, 1888b

Genus **Archangelopsis** Lens & van Riemsdijk, 1908

39. *Archangelopsis typica* Lens & van Riemsdijk, 1908

Genus **Dromalia** Bigelow, 1911

40. *Dromalia alexandri* Bigelow, 1911

Family 9. FORSKALIIDAE Haeckel, 1888

Genus **Forskalia** Kölliker, 1853

41. *Forskalia edwardsi* Kölliker, 1853
42. ***Forskalia leuckartii* Bedot, 1893
43. *Forskalia formosa* Kefferstein & Ehlers, 1860
44. *Forskalia tholoides* Haeckel, 1888
45. ***Forskalia cuneata* Chun, 1888
46. *?Forskalia misakiensis* Kawamura, 1954

Suborder *CALYCOPHORAE* Leuckart, 1854

Family 10. PRAYIDAE Kölliker, 1853

Sub-family (i) *Amphicaryoninae* Chun, 1888

Genus **Amphicaryon,** Chun 1888

47. **Amphicaryon acaule* Chun, 1888
48. ***Amphicaryon peltifera* (Haeckel, 1888)
49. ***Amphicaryon ernesti* Totton, 1954
50. **Amphicaryon intermedia* Daniel, 1971.

Genus **Maresearsia** Totton, 1954

51. **Maressearsia praeclara* Totton, 1954
**Maresearsia* sp.

Subfamily (ii) *Prayniae* Chun, 1897

Genus **Rosacea** Quoy & Gaimard, 1827

52. **Rosacea plicata* Quoy & Gaimard, 1827
53. **Rosacea cymbiformis* (Delle Chiaje, 1841)

Genus **Praya** Quoy & Gaimard (in Blainville, 1834)

54. **Praya dubia* (Quoy & Gaimard, 1883)
55. **Praya reticulata* (Bigelow, 1911)

Genus **Prayoides** Leloup, 1934

56. **Prayoides intermedia* Leloup, 1934

Genus **Lilyopsis** Chun, 1885

57. *Lilyopsis rosea* Chun, 1885
58. *Lilyopsis gracilis* Fewkes, 1883

Genus **Desmophyes** Haeckel, 1888

59. ***Desmophyes annectens* Haeckel, 1888

Genus **Stephanophyes** Chun, 1888

60. *Stephanophyes superba* Chun, 1888

Subfamily (iii) *Nectopyramidinae* Bigelow, 1911

Genus **Nectopyramis** Bigelow, 1911

61. ***Nectopyramis diomedeae* Bigelow, 1911
62. ***Nectopyramis thetis* Bigelow, 1911
63. ***Nectopyramis natans* (Bigelow, 1911)
64. **Nectopyramis spinosa* Sears, 1952

Family 11. HIPPOPODIIDAE Kölliker, 1853

Genus **Hippopodius** Quoy & Gaimard, 1827

65. **Hippopodius hippopus* (Forskål, 1776)

Genus **Vogtia** Kölliker, 1853

66. **Vogtia spinosa* Kefferstein & Ehlers, 1861
67. **Vogtia pentacantha* Kölliker, 1853
68. ***Vogtia serrata* (Moser, 1925)
69. **Vogtia glabra* Bigelow, 1918

Family 12. DIPHYIDAE Quoy & Gaimard, 1827

Subfamily (i) *Sulculeolariinae* Totton, 1954

Genus **Sulculeolaria** Blainville, 1834

70. **Sulculeolaria quadrivalvis* Blainville, 1834
71. **Sulculeolaria biloba* (Sars, 1846)
72. **Sulculeolaria turgida* (Gegenbaur, 1853)
73. **Sulculeolaria angusta* Totton, 1954
74. **Sulculeolaria chuni* (Lens & van Riemsdijk, 1908)
75. **Sulculeolaria monoica* (Chun, 1888)
76. *Sulculeolaria bigelowi* (Sears, 1950)

**Sulculeolaria* sp.

Subfamily (ii) *Diphyinae* Moser, 1925

Genus **Diphyes** Cuvier, 1817

77. **Diphyes dispar* Chamisso & Eysenhardt, 1821
78. **Diphyes bojani* (Eschscholtz, 1825)
79. **Diphyes chamissonis* Huxley, 1859
80. *Diphyes antarctica* Moser, 1925

Genus **Lensia** Totton, 1932

81. **Lensia subtiloides* Lens & van Riemsdijk, 1908
82. **Lensia conoidea* Kefferstein & Ehlers, 1860
83. **Lensia hotspur* Totton, 1941
84. ***Lensia gnanamuthui* Daniel & Daniel, 1963
85. **Lensia roonwali* Daniel, 1971
86. **Lensia hardy* Totton, 1941
87. **Lensia fowleri* (Bigelow, 1911)
88. **Lensia challengeri* Totton, 1954
89. ***Lensia achilles* Totton, 1941
90. *Lensia baryi* Totton, 1965
91. ***Lensia cordata* Totton, 1965
92. **Lensia leloupi* Totton, 1954
93. ***Lensia tottoni* Daniel & Daniel, 1963
94. **Lensia panikkari* Daniel, 1971.
95. **Lensia nagabhushanami* Daniel, 1971
96. **Lensia campanella* (Moser, 1925)
97. **Lensia cossack*, Totton, 1941
98. **Lensia subtilis* (Chun, 1886)
99. ***Lensia subtilis* var. *chuni* Totton, 1965
100. **Lensia meteori* (Leloup, 1934)
101. **Lensia tiwarii* Daniel, 1971.
102. **Lensia multicristata* (Moser, 1925)
103. **Lensia hunter* Totton, 1941

104. ***Lensia havock* Totton, 1941
105. ***Lensia leleouveteau* Totton, 1941
106. ***Lensia exeter* Totton, 1941
107. ***Lensia hostile* Totton, 1941
108. ***Lensia grimaldi* Leloup, 1933
109. **Lensia ajax* Totton, 1941
110. ***Lensia reticulata* Totton, 1954

Genus **Muggiaea** Busch, 1851

111. *Muggiaea kochi* (Will, 1844)
112. **Muggiaea atlantica* Cunningham, 1892
113. **Muggiaea delsmani* Totton, 1954
114. *Muggiaea bargmannae* Totton, 1954

Genus **Dimophyes** Moser, 1925

115. **Dimophyes arctica* (Chun, 1897)

Genus **Chelophyes** Totton, 1932

116. **Chelophyes appendiculata* (Eschscholtz, 1829)
117. **Chelophyes contorta* (Lens & van Riemsdijk, 1908)

Genus **Eudoxoides** Huxley, 1859

118. **Eudoxoides mitra* (Huxley, 1859)
119. **Eudoxoides spiralis* (Bigelow, 1911)

Genus **Eudoxia** Eschscholtz, 1825

120. **Eudoxia macra* Totton, 1954

Family 13. CLAUSOPHYIDAE Totton, 1965

Genus **Clausophyes** Lens & van Riemsdijk, 1908

121. ***Clausophyes ovata* (Kefferstein & Ehlers, 1860)
122. *Clausophyes galeata* Lens & van Riemsdijk, 1908

Genus **Chuniphyes** Lens & van Riemsdijk, 1908

123. **Chuniphyes multidentata* Lens & van Riemsdijk, 1908
124. **Chuniphyes moserae* Totton, 1954

Genus **Crystallophyes** Moser, 1925

125. ***Crystallophyes amygdalina* Moser, 1925

Genus **Heteropyramis** Moser, 1925

126. **Heteropyramis maculata* Moser, 1925

Genus **Thalassophyes** Moser, 1925

127. ***Thalassophyes crystallina* Moser, 1925

Family 14. SPHAERONECTIDAE Huxley, 1859

Genus **Sphaeronectes** Huxley, 1859

128. **Sphaeronectes gracilis* (Claus, 1873)
129. *Sphaeronectes irregularis* (Claus, 1873)
130. ***?Sphaeronectes princeps* Haeckel, 1888
131. *Sphaeronectes gamulini* Carre, 1966
132. *Sphaeronectes japonica* (Stepanyants, 1967)

Family 15. ABYLIDAE L. Agassiz, 1862

Subfamily (i) *Abylinae* L. Agassiz, 1862

Genus **Ceratocymba** Chun, 1888

133. **Ceratocymba leuckarti* Huxley, 1859
134. **Ceratocymba dentata* Bigelow, 1918
135. *Ceratocymba intermedia* Sears, 1953
136. **Ceratocymba sagittata* (Quoy & Gaimard, 1827)
137. **Ceratocymba indica* Daniel, 1971

Genus **Abyla** Quoy & Gaimard, 1827

138. **Abyla trigona* Quoy & Gaimard, 1827
139. ***Abyla carina* Haeckel, 1888
140. **Abyla schmidti* Sears, 1953
141. **Abyla haeckeli* Lens & van Riemsdijk, 1908
142. ***Abyla ingeborgae* Sears, 1953
143. **Abyla bicarinata* Moser, 1925
144. ***?Abyla brownia* Sears, 1953
145. *Abyla tottoni* Sears, 1953
146. *Abyla peruana* Sears, 1953
**Abyla* sp.

Subfamily (ii) *Abylopsinae* Totton, 1954

Genus **Abylopsis** Chun, 1888

147. **Abylopsis tetragona* (Otto, 1823)
148. **Abylopsis eschscholtzi* (Huxley, 1859)

Genus **Bassia** L. Agassiz, 1862

149. **Bassia bassensis* (Quoy & Gaimard, 1833)

Genus **Enneagonum** Quoy & Gaimard, 1827

150. **Enneagonum hyalinum* Quoy & Gaimard, 1827
151. **Enneagonum searsae*, Alvarino, 1968

VI—SYSTEMATIC ACCOUNT

Order SIPHONOPHORA Eschscholtz, 1829

Holoplanktonic Hydrozoa which form a sizeable part of the stable constituent of marine plankton, are essentially overgrown hydrozoan, oozoid polypes that remain juvenile and asexual but carry around with them large numbers of other asexual, juvenile polypes (gastrozooids and palpons) as well as sexual adults (medusoid gonophores) and asexual adults (medusoid nectophores), all budded either from the original and often very much elongated oozoid, or from other juveniles. The adults may separate and become independent, usually in association with one or more of the secondary juveniles and with protective buoyancy device (bracts).

Suborder *CYSTONECTAE* Haeckel, 1888
PNEUMATOPHORIDAE Chun, 1882
RHIZOPHYSALIAE Chun, 1897b; Bigelow, 1911b; 1931

Siphonophora with nectosome represented only by large pneumatophore and without nectophores. Siphosome without bracts; either reduced, with gastrozooids, tentacles and gonodendra crowding in great bunches under the float or greatly elongated with well spaced gastrozooids and gonodendra. Gonodendra highly branched possessing gonophores, gonopalpons and nectophores.

Haeckel (1888b) considered the Cystonectae to include five families, *i.e.*, Cystalidae Haeckel, 1888; Rhizophysidae Brandt, 1835; Salacidae Haeckel, 1888; Epibulidae Haeckel, 1888 and Physalidae Brandt, 1835. He included the bathyphysids in the family Forskalidae Haeckel, 1888 of the suborder Physonectae.

Chun (1897b) recognised the families Epibulidae, Rhizophysidae and Physalidae and included the former two families under the major group 'Rhizoidae' and the latter under 'Physaloidae'. (These two major groups were not considered necessary by the later workers). Further, he pointed out that the members of the family Cystalidae

were merely young stages of epibulids and that it certainly was not of more than generic rank. He treated Salacidae* as a sub-family of Rhizophysidae.

Schneider (1898) united all these families into one family Physalidae. Lens & van Riemsdijk (1908) recognized three families : Rhizophysidae, Bathyphysidae and Physalidae. However, Bigelow (1911b) felt that Schneider had gone too far in his reductions since the Epibulids, Rhizophysids and Bathyphysids were sharply demarcated from the Physalids by the possession of hypocystic villi in the pneumatophore. He regarded two families, Rhizophysidae and Physalidae as valid. Totton (1965a) also considered only these two families as distinctly valid and the family Epibulidae as problematic and doubtful, which consideration is followed in the present study.

Family 1 PHYSALIIDAE Brandt, 1835

Cystonectae with horizontal pneumatophore and bunches of cormidia under the float.

Includes the monotypic genus *Physalia* Lamarck. This family erected by Brandt (1835) for the genus *Physalia* has been recognized by all subsequent workers (Haeckel, 1888b; Chun, 1897; Lens & van Riemsdijk, 1908; Bigelow, 1911; Totton, 1954, 1965; and Daniel & Daniel, 1963).

Physalia Lamarck, 1801

1801. *Physalia* Lamarck, *Systeme des animaux sans vertebres.*, Paris, p. 356.

Colony with large bladder-like pneumatophore with polythalamus crest on the dorsal side and groups of gastrozooids, gonodendra and tentacles on the ventral side.

The history of *Physalia* has been discussed in detail by Totton (1960). Although Schneider (1898) considered this genus to include only one species with varieties, Bigelow (1911b) supporting Chun's (1897b) view maintained that there were two valid species, *i.e.*, *P. physalis* (Linné, 1758) of the Atlantic Ocean and *P. utriculus* (La Martiniéré, 1787) of the Indo-Pacific Ocean. The former was distinguished by many main tentacles and the latter with only a single main tentacle. Since later workers (*vide* Totton, 1960) have recorded intermediate forms, only one species *P. physalis* (L.) is considered as valid (*see* also Daniel & Daniel, 1963).

Physalia physails (Linne, 1758)

(Text-fig. 1, A–G)

1758. *Holothuria physalis* Linne, *Systema naturae* ed. 10(1), p. 657.

1776. *Medusa caravella* O.F. Müller, *Beschaft. Berlin Gesell. Naturf.* Freun de **2**, p.190, tag. 2, fig.2.

1787. *Medusa utriculus* La Martiniere, *Journ. de physique de Chemie et d' histoire naturelle*, **31**, p. 365, pl. 2, figs. 13, 14.

1789. *Physophora physalis :* Modeer, *Kongl. Vetenskaps. Akad. nya Handlingar.* **10**, p. 285, taf. 10, figs. 1, 2.

1790. *Holothuria physalis :* Gmelin, Linne *Systema naturae.* ed. 13(1), p. 3139.

1790. *Medusa utriculus :* Gmelin, Linne *Systema naturae.* ed. 13(1), p. 3155.

1790. *Medusa caravella :* Gmelin, Linne *Systema naturae.* ed. 13(1), p. 3156.

1801. *Physalia pelagica :* Lamarck, *Systeme des animaux sans vertibres.* Paris. p. 356.

1802. *Physalia pelagica :* Bosc, *Histoire naturelle des vers Suites a Buffon.* **2**, p. 159.

* Further historical details of the Salacinae which was not recognized by subsequent workers are dealt with under the family *Rhizophysidae.*

1804. *Physalis pelagica :* Bory de st. Vincent, *Voyage dans les quatres principales isles des Mers d' Afrique.* **1**, p. 288, pl. 54, fig. 1.

1804. *Physalia gigantea* Bory de st. Vincent, *Voyage dans les quatres principales isles der Mers d' Afrique.* **1**, p. 288.

1807. *Physalia megalista* Peron & Lesueur, *Voyage de decouvertes aux terres Australes execute.... Pendant* 1800–'04 *et redige par* M. F. Person. 2 tom (et *Atlas*), Paris. p. 42, pl. 29, fig. 1.

1810. *Physalia arethusa* Tilesius, *Ueber die Seeblasen.....In Reise um die welt....unter dem Commando des Capitains von der kaiserlichen Marine* .A. J. van Krusenstern. **3**, p. 91, *Atlas Zool.*

1810. *Physalia glauca* Tilesius, *Ueber die Seeblasen....In Reise um die welt....unter dem Commando des Capitains von der kaiserlichen Marine* A. J. von Krusenstern. *Atlas Zool.* **3**, p. 92.

1810. *Physalis pelagica :* Tilesius, *Ueber die Seeblasen....In Reise um die welt....unter dem Commando des Capitains von der kaiserlichen Marine* A. J. von Krusenstern. *Atlas Zool.* **3**, p. 94.

1810. *Physalis lamartinieri* Tilesius, *Ueber die Seeblasen....In Reise um die welt....Unter dem Commando des Capitains von der kaiserlichen Marine* A. J. von Krusenstern. *Atlas Zool.* **3**, p. 99.

1810. *Physalis cornuta 'foresbecku' afer* Tilesius, *Uber die Seeblasen....In Reise um die welt.... Unter dem Commando des capitains von der kaiserlichen Marine* A. J. von Krusenstern. *Atlas Zool.* **3**, p. 104.

1816. *Physalis pelagica :* Lamarck, *Histoire naturelle des animaux sans vertebres.* Paris. **2**, p. 480.

1816. *Physalia megalista :* Lamarck, *Histoire naturelle des animaux sans vertebres.* Paris. **2**, p. 481 (Non Brandt, 1835; Bigelow, 1904).

1816. *Physalia elongata* Lamarsk, *Histoire naturelle des animaux sans vertebres.* Paris. **2**, p. 481.

1816. *Physalia tuberculosa* Lamarck, *Histoire naturelle des animaux sans vertebres.* Paris. **2**, p. 481.

1821. *Physalis pelagica :* Eysenhardt, *Nova Acta Caes. Leop. Carol.* **10**, p. 45, taf. 35, fig. 2.

1821. *Physalia arethusa :* Eysenhardt, *Nova Acta Caes Leop. Carol.* **10**, p. 240, taf. 35, fig. 1.

1821. *Physalis lamartinieri :* Eysenhardt, *Nova Acta Caes. Leop. Carol.* **10**, p. 421.

1826. *Physalia atlantica* Lesson, *Voyage autour du Monde....Sur la Corvette de sa Majeste, La Coquille, pendant les annees* 1822–'25....*Atlas, Zoophytes.* p. 4, figs. 3, 4.

1826. *Physalia australis* Lesson, *Voyage autour du Monde....Sur la Corvette de sa Majeste, La Coquille, pendant les anees* 1822–'25....*Atlas Zoophytes.* pl. 5, figs. 1, 2.

1826. *Physalia antarctica :* Lesson, *Voyage autour du Monde sur la Corvette de sa Majeste, La Coquille, pendant les anees* 1822–'25....*Atlas, Zoophytes.* p. 5, fig. 3.

1826. *Physalia azoricum :* Lesson, *Voyage autour du Monde....Sur la Corvette de sa Majesta, 'La Coquille', pendant les anees* 1822–'25....*Atlas, Zoophytes.* p. 5, fig. 4.

1829. *Physalia caravella :* Eschscholtz, *System der Acalephen.* Berlin. p. 160, taf, 4, fig. 1.

1829. *Physalis pelagica :* Eschscholtz, *System der Acalephen.* Berlin. p. 162.

1829. *Physalia utriculus :* Eschscholtz, *System der Acalephen.* Berlin. p. 163, taf. 14, fig. 2.

1830. *Physalia atlantica :* Lesson, *Zoologie.* **2**, p. 36.

1830. *Physalia antarctica :* Lesson, *Zoologie.* **2**, p. 36.

1830. *Physalia australis :* Lesson, *Zoologie.* **2**, p. 38.

1830. *Physalia azoricum :* Lesson, *Zoologie,* **2**, p. 42.

1830. *Physalis lamartinieri :* Blainville, *Dict. Sci. nat.* Paris. **60**, p. 103.

1832. *Physalis pelagica :* Olfers, *Abh. K. Akad. Wiss.* Berlin. 1831, p. 38.

1832. *Physalia arethusa :* Olfers, *Abh. K. Akad. Wiss.* Berlin. 1831, p. 155, taf. 1–2.

1834. *Physalis glauca :* Blainville, *Manuel d'actinologie ou de Zoophytologie,* Paris. p. 113.

1834. *Physalus arethusa :* Blainville, *Manuel d'actinologie our de Zoophytologie,* Paris. p. 113.

1834. *Physalia utriculus :* Blainville, *Manuel d'actinologie ou de Zoophytologie,* Paris, p. 113.

1835. *Physalis (Alophota) olfersii* Brandt, *Polypus. Acalephas Discophoras et Siphonophoras, nec non Echinodermata continens Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatum.* St. Petersburg. **1**, p. 37.

1835. *Physalia megalista :* Brandt, *Polypus. Acalephas Discophoras et Siphonophoras, nec non Echinodermata continens Prodromus descriptionis animalium ab H. Mertensionin orbis terrarum circum navigatione observatum.* St. Petersburg. **1**, p. 37.

1841. *Physalia arethusa :* Delle Chiaje, *Memorie Sulla storia e notomia degli Animali senza vertebre del Regno di Napoli.* **4**, Atlas 1823–31. taf. 33, fig. 1.

1843. *Physalis pelagica :* Lesson, *Acalephs Histoire naturelle des Zoophytes.* p. 545.

1843. *Physalia azoricum :* Lesson, *Acalephs Histoire naturelle des Zoophytes.* p. 555.

1843. *Physalia utriculus :* Lesson, *Acalephs Histoire naturelle des Zoophytes.* p. 557.

1851. *Physalia utriculus :* Leuckart, *Z. Wiss. Zool.* **3**, p. 190, taf, 6, figs. 1–6 (Non Eschscholtz, 1829; Chun, 1897b; Lens & van Riemsdijk, 1908).

1854. *Physalia olfersii :* Quatrefages, *Ann. Sci. nat.* Ser. 4, *Zool.* **2**, p. 109, pls. 3, 4.

1857. *Physalia aurigera :* McCrady, *Proc. Elliott Soc.*, **1**, p. 74.

1859. *Physalis pelagica :* Huxley, *The Oceanic Hydrozoa.* Ray. Soc. London, p. 100.

1859. *Physalia utriculus :* Huxley, *The Oceanic Hydrozoa.* Ray. Soc. London, p. 101, pls. **10**, **12**, fig. 12.

1862. *Physalia arethusa :* L. Agassiz *Contr. Nat. Hist.* U.S.A. Boston, **4**, p. 35.

1885. *Physalia caravella :* Carus, *Prodromus faunae Medit.* Stuttgart, **1**, p. 49.

1888. *Physalia caravella :* Chun, *S.B. preuss Akad. Wiss* for 1888, p. 1173.

1888. *Alophota olfersii :* Haeckel, *Jena Z. naturw.* **22**, p. 46.

1888. *Alophota giltschiana* Haeckel, *Jena Z. naturw.* **22**, p. 46.

1888. *Arethusa challengeri* Haeckel, *Jena. Z. naturw.* **22**, p. 46.

1888. *Alophota giltschiana :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 348, **pl. 26**, figs. 1–3.

1888. *Alophota mertensii* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 348.

1888. *Arethusa challengeri :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 349, **pl. 26**, figs. 4–8.

1888. *Arethusa thalia* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 349.

1888. *Physalis pelagica :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 351.

1888. *Caravella maxima* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 352.

1888. *Caravella gigantea :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 352.

1897. *Physalia utriculus :* Chun, *Ergebn Plankton Exped.* **2**, K.b., p. 86.

1897. *Physalia arethusa :* Chun, *Ergebn Plankton Exped.* **2**, K.b., p. 89.

1897. *Physalia maxima :* Goto, *J. Coll. Sci.* Tokyo, **10**, p. 175, taf. 15.

1898. *Physalia physalis :* Schneider, *Zool. Anz.*, **21**, p. 190.

1898. *Physalia physalia :* Schneider, *Zool. Anz.* **21**, p. 190.

1900. *Physalis pelagica :* Mayer, *Bull. Mus. Comp. Zool. Harv.*, **37**, p. 73.

1902. *Physalia utriculus :* Agassiz & Mayer, *Mem. Mus. Comp. Zool. Harv.* **26**, p. 169.

1902. *Physalia utriculus :* Agassiz & Mayer, *Mem. Mus. Comp. Zool. Harv.* **26**, p. 169.

1904. *Physalia utriculus :* Browne, *Fauna and Geography of the Maldive and Laccadive archipelagoes.* **2**, p. 744.

1904. *Physalia megalista :* Bigelow, *Bull. Mus. Comp. Zool. Harv.* **39**, p. 265 (Non Peron & Lesueur, 1807).

1907. *Physalia physalis :* Richter, *Z. Wiss. Zool.* **86**, p. 571.

1908. *Physalia utriculus :* Lens & van Riemsdijk, *Siboga Exped.* **9**, p. 118, pl. 24, figs. **174**, **175**.

1911b. *Physalia utriculus :* Bigelow, *Mem. Mus. Comp. Zool. Harv.* **38**, p. 321.

1926. *Physalia utriculus :* Browne, *Trans. Linn. Soc.* London *Zool.* Ser. 2, **19**(1), p. 84.

1934. *Physalia physalis :* Leloup, *Bull. Mus. Hist. nat. Belg.* **10**(6), p. 2.

1954. *Physalia physalis :* Totton, *Disc. Rep.* **27**, p. 15.

1954. *Physalia utriculus :* Kawamura, *J. Shiga Prefect Junior College, Ser.* A, **2**, p. 120.

1955. *Physalia physalis :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.* 1910. *Siphonophores.* **5**(11), p. 17.

1955. *Physalia physalis :* Leoup, *Inst. Roy. Sci. nat. Belg.* **3**(4), p. 15.

1960. *Physalia physalis :* Totton, *Disc. Rep.* **30**, p. 301, pls. VII–XXV; text-figs. 1–31.
1960. *Physalia physalis :* Mackie, *Disc. Rep.* **30**, p. 369, pls. XXVI–XXVIII, text-figs. 1–6.
1963. *Physalia physalis :* Daniel & Daniel, *J. Mar. biol. Assoc.* India, **5**(2), p. 189, fig. I, 11–13.
1965. *Physalia physalis :* Totton, *A synopsis of the Siphonophora. Brit. Mus.* (*Nat. Hist.*) London, p. 39, pl. 1, fig. 1.

Material examined.—All examples were collected from the surface by Pleistone net.

Station no.	*Material*	*Z.S.I. Reg. no.*
V 5179	4 ex.— all left-handed	P 1630/1
V 5185	7 ex.— ,,	P 1664/1
V 5191	1 ex.— ,,	P 1744/1
V 5198	1 ex.— ,,	P 1759/1
V 5214	3 ex.—one left-handed; two without crest	P 1714/1
V 5218	24 ex.—four left-handed; 20 without crest	P 1781/1
V 5220	1 ex.—left-handed	P 1684/1
V 5223	4 ex.—all left-handed	P 1694/1
V 5225	3 ex.— ,,	P 1645/1
V 5227	6 ex.—2 right-handed; 4 without crest	P 1709/1
V 5230	3 ex.—all without crest	P 1741/1
V 5231	10 ex.—2 right- & 8 left-handed	P 1770/1
V 5235	14 ex.—2 right- & 11 left-handed 1 without crest	P 1771/1
K 359	1 ex.—right-handed	general collection
K 378	1 ex.—larval stage	,,
K 380	1 ex.—right-handed	,,

Type-locality.—Coast of Santa Catharina, Brazil.

Distribution.—Pelagic; extremely common in all tropical seas. Details of localities from which the species have been recorded are given in Table 1.

Description.—Colour : In the living specimens the pneumatophore, gastrozooids, palpons and tentacles are of various shades of blue ranging from light sky-blue to deep blue. In formalin the blue colour entirely fades leaving a pink colour in the cormidia and gonodendra. Later the whole specimen becomes brownish. *Size :* Of the eighty-four examples present in the collection, 31 are young forms in which the crest had not yet developed. In those with crests, 45 are left-handed and 8 are right-handed. The larval forms measure from 1.5 mm to 5.0 mm in float length, while others measure 8.0 mm to 85.0 mm in float length.

Pneumatophore : (Text-fig. 1, A & B).—The pneumatophore is transparent, bladder-like with a prominent crest on the dorsal side. The crest occurs either on the left or right-hand side of the float. Its one end is tapering, and the pore is situated at the aboral end. The opposite broader end is the oral end. The outer muscular coat, *i.e.*, the pneumatocodon, is distinctly clear only in big specimens. When this coat is freed, the pneumatocyst or air-sac is revealed as a thin, transparent air-sac with branching digitiform processes on the dorsal side. These processes fit into pockets of the crest.

The largest example studied is left-handed, with the float length of 85.0 mm and gas-gland of 15.0 mm diameter. The crest has 6 primary, 8 secondary and 10 tertiary septae. The primary septa measures 15.0 mm, the secondary septa 11.0 mm, and the tertiary septa 7.0 mm at the central region. The major pockets are sub-divided three

times and rudiments of a fourth series are visible at the crest margin. There are depressions where the lower edges of the septa meet the sides of the float. In the smaller specimens, the numbers of septa in the crest are relatively fewer.

In all the specimens examined, the gas-gland occurs as an opaque, circular spot in the otherwise transparent float on the inner surface, at the base near the main zone (Text-fig. 1 B,gg).

The float length and gas-gland diameter are given below.

Float-length (mm)	*Gas-gland diameter* (mm)
8.0	1.8
20.0	3.0
27.0	5.0
33.0	7.0
85.0	15.0

These diamensions more or less correspond with those given by Totton (1960) for specimens from Canary Islands (Atlantic Ocean).

Cormidia : The cormidia are budded on the under and windward side of the float in two zones, *i.e.*, a main aboral zone and an oral zone. These two zones are separated by a gap—Haeckel's "basal internode". This basal internode is well marked in young stages. In the largest specimen in the present collection the basal internode measures 18.0 mm in length. This specimen is described below :

Main aboral zone : (Text-fig. 1B,mz)—there are 9 cormidia in the main aboral zone. A single main tentacle which occurs between the sixth and seventh cormidia is very thick and measures 20.0 cm in length. The other tentacles are small and thin. The cormidia occur in bunches, consisting of numerous gastrozooids, few gonodendra, ampulla and a single main tentacle. In young specimens, the branching is tripartite in each cormidium. Further branching occurs in a series of similar lateral tripartite groups, each arising from the base of its predecessor. *Oral zone :* (Text-fig. 1B,oz)—The oral end of the float carries the protozooid and about seven small cormidia arranged towards the basal internode. The youngest cormidium lies nearest the protozooid. Tentacles are present but they are very small and usually inconspicuous. *Tentacle :* (Text-fig. 1A,t)—All the examples examined possess only one main tentacle and many short and thin tentacles. These have thick muscular suspensoria on one side and numerous sessile, equidistant kidney-shaped cnidospheres. These cnidospheres possess numerous round nematocysts. *Gonodendron :* (Text-fig. 1C,D,E)—It is a diffuse, highly branched structure. Often loose bunches of gonodendra are seen in the collection. It has been studied in detail by Totton (1960, page 347) who states that "the egg-shaped gonophores hitherto supposed to be all male were in any single gonodendron either all male or all female, and that the stalked medusoids generally supposed to be female gonophores were asexual nectophores and not gonophores at all, thus confirming Steche's view (1907)".

The gonodendron is budded off from the base of gastrozooids and has a long peduncle with many branches. Each branchlet consists of small palpons, gonophores, jelly-polyps and nectophores (Text-fig. 1D). Some of the gonodendra clusters measure from 5.0 to 10.0 mm in diameter. *Gonophores :* The androphores and the gynophores are borne by different individuals. The *androphores* (Text-fig. 1D, an) are oval or egg-shaped, sessile structures in which two regions are clearly visible. Each has a thick cap of germ cells borne by a spadix, with a homogenous outer covering. The *gynophores*

are similar to the androphores in shape and size. In stained preparations, the germcells are seen as a continuous narrow and sinuous band running over the surface. *Jelly-polyps :* (Text-fig. 1D,jp) They occur at the base of each palpon. In structure they resemble both the medusoids and polyps. These are shown as reduced nectophores (*vide* Totton, 1960, p. 351). A canal is seen in the centre of each jelly-polyp. *Nectophore :* (Text-fig. 1D,n) It occurs at the tip of the branchlet and has no manubrium. It has a long stalk and an enlarged distal part. This enlarged portion is distinctly medusoid, possessing a pedicular canal, radial canals, a ring-canal and subumbrella. *Gonopalpons :* (Text-fig. 1D,p) These occur close to the jelly-polyps. They are slender and smaller than those occurring at the base of main branch. They do not possess palpacles. The gonopalpons are armed with pads of nematocysts (Text-fig. 1,G). *Ampulla :* (Text-fig. 1A,amp.) According to Totton (1960) an ampulla is the hypertrophied basigaster of a gastrozooid from the base of which the tentacle arises. It contains numerous nematoblasts.

Some larval stages

The earliest larval stage present in the collection measures 1.5 mm in float length. The primary zooid or protozooid and its tentacle are well developed. Besides the primary zooid, there are three buds on the ventral side towards the aboral end. The bud nearest the primary zooid is very small and is the youngest; the bud towards the aboral end is the largest and bears a tentacle (Text-fig. 1F). The later stages measure 2.0–5.0 mm in float length. In these, the crest has not yet developed, and no buds are seen on the main zone, *i.e.*, zones and the basal internodes are not yet differentiated. The faint trace of a crest is seen in specimens measuring more than 8.0 mm in float length.

Family 2 RHIZOPHYSIDAE Brandt, 1835
RHIZOPHYSIADAE Huxley, 1859

Cystonectae with apical, vertical pneumatophore usually possessing hypocystic villi; siphosome fine and long.

Bigelow (1911b, p. 317) included three subfamilies : Rhizophysinae Chun (1897b), Bathyphysinae Chun (1897b) and Epibuliinae Bigelow (1911b) under the family Rhizophysidae (*see* also Daniel & Daniel, 1963, p. 190).

The subfamilies Rhizophysinae and Bathyphysinae are so closely related that Totton (1965) failed to consider the validity of these subfamilies and included genera *Rhizophysa* Peron & Lesueur (1807) and *Bathyphysa* Studer (1878) directly under the family Rhizophysidae. The subfamily Epibuliinae is referred to as a problematic and doubtful family by Totton (1965, p 44).

Chun (1897b) treated the family Salacidae Haeckel, as a subfamily Salacinae of Rhizophysidae but, Bigelow (1911b) failed to recognize the subfamily and included the genus *Salacia* Haeckel (1888) directly under Rhizophysinae. As early as 1901 it had been pointed out by Delage & Herouard that the name *Salacia* was pre-occupied and renamed it as *Salacella* (*vide* Totton, 1960, p. 346). *Salacella polygastrica* (Haeckel, 1888) characterized by the possession of polygastric cormidia, typical physalid-like tentacle, hypocystic villi in the pneumatophore and a long stem has not been recorded since 1888. Therefore Totton (1960) doubted the validity of this genus and later he omitted it from the list of valid species of Siphonophora in his Synopsis (1965). The validity of *Salacella* will remain problematic and doubtful until fresh material is obtained.

Key to the Genera of *Rhizophysidae*

1. Cormidia monogastric; tentacle without sessile cnidospheres 2
   Cormidia polygastric; tentacle with sessile cnidospheres . . . . . *Salacella*
2. With ptera on walls of young gastrozooids . . . . . *Bathyphysa*
   Without ptera on walls of young gastrozooids . . . . . *Rhizophysa*

Rhizophysa Peron & Lesueur, 1807

1807. *Rhizophysa* Peron & Lesueur, *Voyage aux terres australes., Mollusques et Zoophytes.*, pl. 29.
1888. *Aurophysa* Haeckel, *Rep. Sci. res. H.M.S. Challenger Zool.*, **28**, p. 323.
1888. *Cannophysa* Haeckel, *Rep. Sci. res. H.M.S. Challenger Zool.*, **28**, p. 324.
1888. *Nectophysa* Haeckel, *Rep. Sci. res. H.M.S. Challenger Zool.*, **28**, p. 326.
1888. *Pneumophysa* Haeckel, *Rep. Sci. res. H.M.S. Challenger Zool.*, **28**, p. 328.

Cystonectae with long, fine stem, whose gastrozooids have no lateral wings or ptera in all growth stages. Pneumatophore with hypocystic villi. Tentilla either simple or tri-cornuate and dendritic.

The genus *Linophysa* Haeckel 1888b, was included in the synonymy of *Rhizophysa* by Chun (1897b, p. 77) and Lens & Van Riemsdijk (1908, p. 100), but it is not valid since the species *Rhizophysa conifera* Studer (1878) for which it was instituted, belongs to *Pterophysa* (= *Bathyphysa*)—*vide* Bigelow, 1911b, p. 318.

Chun (1897b, p. 104) recognised five species of *Rhizophysa* :

1. *Rhizophysa filiformis* (Forskål, 1775);
2. *R. eysenhardti* Gegenbaur, 1859b;
3. *R. clavigera* Chun, 1888 (= *Cannophysa filiformis* Mayer, 1894);
4. *R. gracilis* Fewkes 1882; and
5. *R. murrayana* (Haeckel, 1888).

The accounts given for *R. gracilis* and *R. murrayana* agree so well with *R. filiformis* especially in the form of the tentilla that these were united with the latter (Schneider, 1898; Lens & Van Riemsdijk, 1908; Bigelow, 1911b). *R. clavigera* drawn from a multilated specimen and its account and figures of the twisted siphons and tentacles given by Mayer (1894) were so unsatisfactory that Bigelow made it a synonym of *R. filiformis*.

For this reason recent workers (Lens & van Riemsdijk, 1908; Bigelow, 1911b; Totton, 1954, 1965; Leloup, 1955b; Daniel & Daniel, 1963) considered only two species : *R. filiformis* and *R. eysenhardti* as valid.

Key to the Species of *Rhizophysa*

1. Tentilla simple and filiform . . . . . *Rhizophysa eysenhardti*
2. Tentilla branched, tricornuate, dendritic or bird-headed . . . . . *R. filiformis*

Only *R. filiformis* (Forskål, 1775) is represented in the present collection.

Rhizophysa filiformis (Forskål, 1775)

(Text-fig. 1, H-N)

1775. *Physsophora filiformis* Forskål, *Descriptiones animalium..quae in itinere orientali observavit, post mortem edidit cartem Niebuhr.* Hauniae.

1776. *Physsophora filiformis :* Forskål, *Icones rerum naturalium...post mortem auctoris editi carsten Niebuhr.* Hauniae.

1789. *Physsophora filiformis :* Modeer, *Kongl. Vetenskaps. Acad. nya Handlinger,* **10**, p. 282.

1790. *Physsophora filiformis :* Gmelin, Linne *Systema naturae* ed. 13(1), p. 3159.

1807. *Phizophysa planestoma* Peron & Lesueur, *Voyage de decouvertes aux terres Australes, execute... Pendant* 1800–'04, *et redige par M. F. Peron.* 2 tom, (et *atlas*), Paris, pl. 39, fig. 3.

1816. *Rhizophysa filiformis :* Lamarck, *Histoire naturelle des animaux sans vertebres.* Paris, **2**, p. 477.

1829. *Rhizophysa planestoma :* Eschscholtz, *System der Acalephen.* Berlin, p. 148.

1829. *Epibulia filiformis :* Eschscholtz, *System der Acalephen.* Berlin, p. 148.

1834. *Rhizophysa planestoma :* Blainville, *Manuel d'actinologie ou de Zoophytologie.* Paris, p. 118.

1834. *Rhizophysa filiformis :* Blainville, *Manuel d'actinologie où de Zoophytologie.* Paris, p. 118.

1835? *Epibulia (Macrosoma) mertensii* Brandt, *Polypus. Acalephas Discophoras et Siphonophoras, nec non Echinodermata continens. Prodromus descriptionis animalium at H. Mertensio in orbis terrarum circumnavigatione observatum.* St. Petersburg. **1**, p. 32.

1843. *Rhizophysa filiformis :* Lesson, *Acalephs Histoire naturelle des Zoophytas.* p. 490.

1843. *Rhizophysa planestoma :* Lesson, *Acalephs Histoire naturelle des Zoophytes.* p. 491.

1843. *Rhizophysa mertensi :* Lesson, *Acalephs Histoire naturelle des Zoophytes.* p. 492.

1853. *Rhizophysa filiformis :* Gegenbaur, *Z. Wiss. Zool.* **5**, p. 324, pl. 18, figs. 5–11.

1882. *Rhizophysa gracilis :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **9**, p. 269, pl. 6, figs. 1–6.

1888. *Cannophysa gracilis :* Haeckel, *Jena Z. naturw.* **22**, p. 44.

1888. *Cannophysa murrayana* Haeckel, *Jena Z. naturw.* **22**, p. 44.

1888? *Pneumophysa mertensi :* Haeckel, *Jena Z. naturw.* **22**, p. 45.

1888. *Cannophysa murrayana :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 324, pl. 24.

1888. *Pneumophysa gegenbaur* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 328.

1888. *Rhizophysa filiformis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 329.

1888? *Rhizophysa mertensi :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.* **28**, p. 329.

1894. *Cannophysa eysenhardti* Mayer, *Bull. Mus. Comp. Zool.* Harv. **25**, p. 239, pl. 3, figs. 1, 2, 4.

1894? *Cannophysa filiformis :* Mayer, *Bull. Mus. Comp. Zool.* Harv. **25**, p. 241, pl. 3, fig. 3.

1897. *Rhizophysa murrayana :* Chun, *Ergebu. Plankton Exped.* **2**, K.b., p. 84.

1897. *Rizophysa filiformis :* Chun, *Ergebu Plankton Exped.* **2**, K.b., p. 104.

1897? *Rhizophysa clavigera* Chun, *Ergebu Plankton Exped.* **2**, K.b., p. 104.

1898. *Rhizophysa filiformis :* Schneider, *Zool. Anz.* **21**, p. 170.

1900. *Rhizophysa, murrayana :* Mayer, *Bull. Mus. Comp. Zool.* Harv. **37**, p. 72.

1907. *Rhizophysa filiformis :* Richter, *Z. Wiss. Zool.* **86**, p. 559, taf. 27, figs. 1–13.

1908. *Rhizophysa filiformis :* Lens & van Riemsdijk, *Siboga Exped.* **9**, p. 100, pl. 18, figs. 141–145.

1911. *Rhizophysa filiformis :* Bigelow, *Mem. Mus. Comp. Zool.* Harv. **38**, p. 319.

1937. *Rhizophysa filiformis :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit. II Biology.* H, **2**, pp. 65, 124, figs. 50, 78 (Bibl.).

1965. *Rhizophysa filiformis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 41, pl. I, fig. 2, pls. II, III & IV.

Material examined.—One complete example from cruise no. D/m3/63 of HMAS DIAMANTINA of CSIRO, Australia, Station no. 122, Sample no. 1868 E; from Lat. 29°S, Long. 110°E.

Type-locality.—Mediterranean Sea.

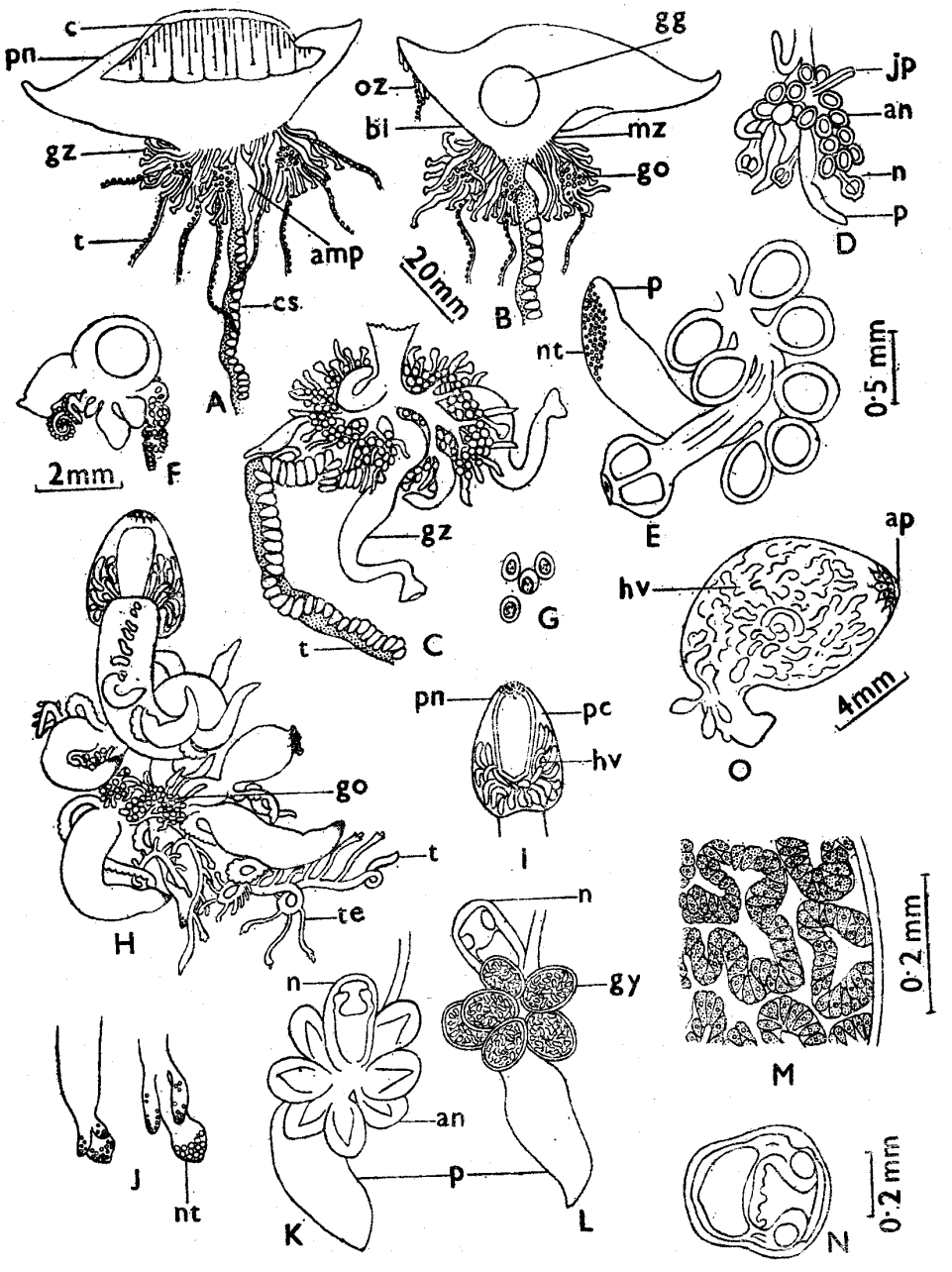
Distribution.—This species has been recorded many times from the tropical regions of the Pacific and Atlantic Oceans. For details of localities from the different oceans *see* Table 1

This species has been recorded as *Pneumophysa gegenbauri* Haeckel in 1888 from the Indian Ocean without giving the exact locality. Although Haeckel did not give any description or figures in his account, Bigelow (1911b) considered this as a record for *R. filiformis* depending on Haeckel's report of the presence of trifid tentilla. Therefore, this is considered the first authentic record for this species from the Indian Ocean.

Description.—The single example present in the collection is highly contracted and measures 22.0 mm in length.

Pneumatophore.—(Text-fig. 1H & I,pn): The egg-shaped pneumatophore measures 4.7 mm in length and 3.13 mm in width. The thick-walled pneumatocodon (outer wall) is separated by a wide cavity from the pneumatosac (inner wall). This cavity (pericystic chamber) is closed above but opens below into the axial canal of the stem. The base of this cavity is filled with clusters of finger-shaped villi—hypocystic villi—which arise from the hypocystic funnel. The apex of the pneumatocyst has an apical pore controlled by circular muscle fibres. The pore is surrounded by red polygonal pigment cells.

Gastrozooid.—There are about 20–25 sessile gastrozooids in this colony. The progressive stages in the development of the gastrozooids and the tentacles are clearly seen. The buds of the developing gastrozooids occur on the ventral side. The youngest bud is situated close to the base of the pneumatophore. Due to the contracted state of the stem, the first gastrozooid with the mouth-opening is not discernible. In many of the gastrozooids, the tentacles show only simple bud-like tentilla. In the older gastrozooids the tentilla are bud-like in the proximal half and slightly elongated in the distal half. The tentilla in the distal half of the still older tentacles are very much longer and terminate in the characteristic trifid structure (Text-fig. 1J). Each trifid tentillum is composed of an odd median lobe and two small lateral branches. This lobe bears round cnidocysts in the centre and smaller ones at the tip. The cnidocysts in the lateral branches are small resembling those occurring at the tip of the median lobe. In this specimen, only this type of trifid tentilla are noted. The dendritic or palmate and the bird-headed type of tentilla are not observed. *Gonodendra.*—These occur between two gastrozooids. The largest gonodendron was removed, stained and studied. It possesses about 20 gonopalpons protruding out from the bunch. The same number of branchlets are observed in the gonodendron. Each branchlet consists of 5–7 gonophores, one asexual nectophore and a gonopalpon. In this gonodendron, all the gonophores appear to be male (androphores). Another gonodendron removed from the interior of the contracted stem showed the presence of only female gonophores (gynophores). Whether the male and female gonodendra alternate along the stem is not clear as the colony is inextricably coiled and contracted. Both the androphores and gynophores occur in the same colony. *Androphore.*—(Text-fig. 1K) Each androphore is oval, sessile and measures 400μ in length. In the stained preparations the distal outer wall is thick, "Λ"-shaped and darkly staining. Its interior is filled with a homogenous substance. *Gynophore.*—(Text-fig. 1L & M) Each gynophore is similar to the androphore in shape, size and in being sessile. It is easily distinguished from the androphore as it lacks the thick "Λ"-shaped distal end. The entire surface is occupied by a continuous, thick and sinuous band. This band contains large polygonal cells 50–100μ in length with prominent nuclei. *Gonopalpon.*—(Text-fig. 1K & L,p) Each branchlet is seen to end in a single gonopalpon. It is thin, slender and reaches 2.0 mm in length. In the oldest gonodendron observed in the colony the palpons are without an apical opening. *Nectophore.*—(Text-fig. 1K & L,n;N) Each branchlet of the gonodendron bears a single nectophore which is always situated opposite the palpon. It measures 0.5 mm in length. It is not fully developed but the distal end is slightly larger and well-differentiated into the radial and circular canals.



TEXT-FIGURE 1

Physalia physalis : A—G

A—colony : showing the crest. B—colony : showing position of gas-gland. C—Gonodendra. D—Gonodendra : two branches enlarged. E—Gonodendra : single branchlet enlarged. F—young *Physalia*. G—Nematocysts from palpon.

Rhizophysa filiformis : H—N

H—entire colony. I—pneumatophore. J—young tentilla. K—branchlet of male gonodendron. L—branchlet of female gonodendron. M—Gynophore enlarged. N—Asexual nectophore.

Rhizophysa sp. : O

O—pneumatophore.

Abbreviations used :

an—androphore. amp—ampulla. ap—apical pore. bi—basal internode. c—crest. cs—cnidosphere. gg—gas-gland. go—gonodendron. gy—gynophore. gz—gastrozooid. hv—hypocystic villi. jp—jelly-polyp. mz—main zone. n—asexual nectophore. nt—nematocyst. oz—oral zone. p—palpon. pc—pericystic cavity. pn—pneumatophore. t—tentacle. te—tentillum.

Rhizophysa sp.

(Text-fig. 1,O)

One large pneumatophore of *Rhizophysa* was sorted from the collection taken at RV VITYAZ Station No. 5199 (Z.S.I. Registered No. P 1716/1). It measures 8 mm in length and 5 mm in breadth. In the absence of a siphosome it is not possible to make a satisfactory determination of the species.

? **Salacella** Delage & Herouard, 1901

1888. *Salacia* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 330.
1901. *Salacella* Delage & Herouard, *Traite de zoologie cencretes*, Paris, **2**(2), p.

This genus, which is doubtful and problematic, is not represented in the collection.

Bathyphysa Studer, 1878

1878. *Bathyphysa* Studer, —*Zeit. f. wiss. Zool.*, **31**, p. 1.
1884. *Pterophysa* Fewkes, *Bull. Mus. Comp. Zool. Harv.*, **11**, p. 1–79.
1888. *Linophysa* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 326.

Cystonectae with extremely long, fine stem whose gastrozooids possess wings or 'ptera' at their sides in the early growth stages.

Lens & van Riemsdijk (1908) recognized two genera : *Bathyphysa* Studer (1878) in which the siphons are borne on long pedicels, and *Pterophysa* Fewkes, 1884 in which the siphons are sessile. They reviewed the history of these two genera, and considered two species of *Bathyphysa* as valid, *viz.*, *Bathyphysa abyssorum* Studer, 1878 and, *Bathyphysa sibogae* Lens & van Riemsdijk, 1908. Among *Pterophysa*, they recognized two species, *viz.*,

1. *Pterophysa* (*Rhizophysa*) *conifera* Studer, 1878
   syn. *P.* (*Bathyphysa*) *grimaldii* Bedot, 1893b
   P. grandis Fewkes, 1884
2. *Pterophysa* (*Bathyphysa*) *studeri* Lens & van Riemsdijk, 1908.

Leloup (1936) after examination of type material of the different species, merged *Pterophysa* with the older name *Bathyphysa* and recognized only two species of *Bathyphysa* as valid. Totton (1965) is in complete agreement with the conclusions of Leloup (*loc.cit.*). The valid species are :—

1. *Bathyphysa conifera* (Studer, 1878)
   syn. *B. abyssorum* Studer, 1878
   P. grandis Fewkes, 1884; Lens & van Riemsdijk, 1908
   P. grimaldii Bedot, 1893a; Kawamura, 1954
   P. (*B.*) *studeri* Lens & van Riemsdijk, 1908

with simple and unbranched tentacle; and,

2. *Bathyphysa sibogae* Lens & van Riemsdijk, 1908

with tentilla ending in a trifid structure, as in *R. filiformis* (Forskål). The hypocystic villi are absent in *B. conifera* but present in *B. sibogae.*

Bathyphysa japonica Kawamura, (1943, from great depths is regarded as a *species inquirenda;* and *B. grimaldii* Bedot, recorded by Kawamura (1954) is a synonym of *B. conifera* (as shown above).

Key to species of *Bathyphysa*

1. Tentacle without tentilla . . . . . *B. conifera*
2. Tentacle with tentilla . . . . . *B. sibogae*

These two species are not represented in the present collection, and have not so far been recorded from the Indian Ocean.

Family ? EPIBULIIDAE Haeckel, 1888

? EPIBULINAE Bigelow, 1911

Cystonectae with large apical vertical pneumatophore and hypocystic villi; siphosome highly reduced with gastrozooids, a ring of palpons (?) and gonodendra underneath float.

The family Epibuliidae Haeckel, 1888 (reduced to the status of a subfamily Epibulinae by Bigelow 1911b) was established to accommodate the genus *Epibulia* Eschscholtz, 1829. Totton (1965) did not consider the validity of either *Epibulia chamissonis* Eysenhardt 1821 (which was imperfectly known) or *Epibulia ritteriana* Haeckel 1888, which was probably based on an incompletely examined specimen of *Athorybia rosacea* (Forskål, 1775). Totton (*loc. cit.*), however, states that "on account of the presence of a ring of what looked like palpons underneath the float it seems best to regard the animals, if they exist, as forming a quite separate family Epibuliidae Haeckel" (page 44, of Totton's Synopsis).

As pointed out by Totton (*op. cit.*) the species of the family Epibuliidae will have to be treated as *species inquirendae*. The alleged presence of 'palpons' below the float may be really young gastrozooids, for if it were really palpons this family may have to be removed from the Suborder Cystonectae and placed before the Suborder Physonectae.

Suborder *PHYSONECTAE* Haeckel, 1888

PHYSOPHORAE Eschscholtz, 1829 (part)

Siphonophora with nectosome represented by apical vertical pneumatophore and nectophores (except in *Athorybia*); siphosome either well elongated or reduced; gastrozooids with simple or branched tentilla, palpons with palpacles, bracts and gonodendra.

Bigelow (1911b) recognized six families when he reviewed the suborder. These are : Apolemiidae Huxley, 1859; Agalmidae Brandt, 1835, Physophoridae Eschscholtz, 1829; Athorybiidae Huxley, 1859 (—Anthophysidae Brandt, 1835); Forskaliidae Haeckel, 1888 and Rhodaliidae Haeckel, 1888. The first five families were recognized without doubt even by the earlier workers (*vide* Chun, 1897b). The sixth family, Rhodaliidae, was revived by Bigelow to include the genera belonging to the order Auronectae Haeckel, 1888 (treated as family Auronectidae by Chun, 1897b). Since the name Auronectidae was not derived from the generic name, Schneider (1898) and Lens & van Riemsdijk (1908) avoided this difficulty by using the older name, Angelidae Fewkes, 1886. But the genus *Angela* Fewkes (= *Athorybia*) from which Angelidae was derived belonged to a different family, *viz.*, Anthophysidae (= Athorybiidae). For this reason the family name Rhodaliidae, based on *Rhodalia* Haeckel, 1888, was considered valid.

The family Nectalidae Haeckel, 1888b, including the monotypic genus *Nectalia* Haeckel, 1888b, was retained as a separate family by Chun (1897b). Schneider (1898) included the genus *Nectalia* under the family Agalmidae, and Bigelow (1911b) regarded Nectalidae as a subfamily Nectalinae under the family Agalmidae. Subsequently,

Leloup (1955a) retained the Family Nectaliidae. Totton (1954, 1965), showed that the species of the genus *Nectalia* is a young stage of one of the enormous Physonectae and hence he did not recognize it.

Two other families: Circalidae Haeckel, 1888 (for *Circalia stephanoma* Haeckel, 1888b), and Athoriidae Haeckel, 1888 (for *Athoria larvalis* Haeckel, 1888) were also regarded as larval forms due to the monogastric condition. *Circalia* was associated by Schneider (1898) and Vanhoeffen (1906, page 34) provisionally with Rhodaliidae as the young stage of *Stephalia* Haeckel, 1888. *Athoria* was proved to be a larval stage in the development of some of the Agalmidae by Totton (1956). Hence these two families were invalidated.

Only one more family Pyrostephidae Moser, 1925, was added since 1911. This suborder Physonectae thus includes seven valid families (*vide* Totton, 1965a, page 45).

The families Agalmidae, Pyrostephidae, Physophoridae and Athorybiidae are represented in the present collection. The other three families Apolemiidae, Rhodaliidae and Forskaliidae (although not represented in the collection) are briefly discussed to complete the account of the suborder Physonectae.

Family 3. Apolemiidae Huxley, 1859

Physonectae with a single monotypic genus *Apolemia;* with unique kind of tentacle (probably larval) in small tufts below each muscular attachment of nectophores. Gastrozooid bears filiform tentacle.

Detailed historical account has been given by Bigelow (1911b). The latest detailed description is by Totton (1965).

Apolemia Eschscholtz, 1829

1829. *Apolemia* Eschscholtz, *System der Acalephen*, p. 143.
1835. *Apolemopsis* Brandt, Prodromus....observatum, p. 36.
1888. *Dicymba* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 209.

Monotypic genus for *A. uvaria* (Lesueur, ?1811). For synonymy see Bigelow (1911b).

Not represented in the present collection.

This species has been recorded from the Indian Ocean by Huxley (1859) and by Haeckel (1888b).

Family 4. Agalmidae Brandt, 1835

Physonectae with elongated nectosome bearing biserially arranged nectophores; siphosome bearing many bracts, palpons with palpacles, gastrozooids with tentacles possessing unicornuate or tri-cornuate tentilla and gonodendra; protosiphon with larval type of tentacle.

Bedot (1896), in his classical revision of this family, recognized the following eight genera taking the structure of the tentilla as the most important taxonomic character.

1. *Agalmopsis* Sars, 1846 (= *Agalma* Eschscholtz, 1825)
   (= *Nanomia* A. Agassiz, 1865)
2. *Agalma* Eschscholtz, 1825
3. *Crystallomia* Dana, 1858 (= *Agalma*)

4. *Stephanopsis* Bedot, 1896 (preocc. Cambridge, 1869 *vide*, Totton, 1965; = *Agalma*)
5. *Halistemma* Huxley, 1859 (= *Stephanomia* Lesueur & Petit, 1807)
6. *Cupulita* Haeckel, 1888 (= *Nanomia*)
7. *Anthemodes* Haeckel, 1888 (= *Nanomia*)
8. *Lychnagalma* Haeckel, 1888.

Later, Schneider (1898) considered the general 'habitus', such as long and contractile or short and stiff nature of the colony, and thin or thick form of bracts, and distinguished only 4 genera, *viz.*, *Anthemodes*, *Stephanomia*, *Agalmopsis* and *Cupulita*. He treated the genera *Agalma*, *Crystallomia* and *Stephanopsis* (recognized by Bedot) under *Agalmopsis;* and retained *Anthemodes* and *Cupulita*. He did not recognize *Lychnagalma* as a valid genus.

Bigelow (1911b) followed Bedot's method of distinguishing the genera of the Agalmidae on the basis of the structure of the tentilla, but recognized only four genera. He agreed with Schneider (*loc. cit.*) in retaining the genera *Anthemodes* and *Stephanomia*, but synonymised *Cupulita* under *Stephanomia*. He regarded the older name *Agalma* as valid and included *Agalmopsis* and *Crystallomia* as its synonyms. Following Bedot, he recognized the validity of *Lychnagalma*.

Totton (1965a) retained the validity of *Agalma*, *Lychnagalma* recognized by Bigelow, but changed *Stephanomia* into *Halistemma* and partly into *Nanomia*. *Anthemodes* was synonymised under *Nanomia;* and three new genera : *Marrus*, *Moseria* and *Cordagalma*, were erected. Further, he transferred *Erenna* from the Family Forskaliidae to this family.

Only one more genus, *Frillagalma* Daniel, 1966, was added to the list of valid genera given by Totton (1965a).

The valid genera of this family are, therefore, the following :—

1. *Agalma* Eschscholtz, 1825
2. *Halistemma* Huxley, 1859
3. *Cordagalma* Totton, 1932
4. *Marrus* Totton, 1954
5. *Moseria* Totton, 1965
6. *Nanomia* A. Agassiz, 1865
7. *Lychnagalma* Haeckel, 1888
8. *Erenna* Bedot, 1904
9. *Frillagalma* Daniel, 1966

Key to the Genera of *Agalmidae* (Modified after Totton, 1965a)

1.	Tentilla not known	8
	Tentilla unicornuate or with more than one terminal appendage	2
2.	Tentilla unicornuate	4
	Tentilla with more than one terminal appendage	3
3.	Tentilla multicornuate	*Lychnagalma*
	Tentilla tricornuate	*Agalma*

4.	Cnidoband very large, not spirally coiled	*Erenna*
	Cnidoband small, spirally coiled	5
5.	Cnidoband without basal involucrum	*Marrus*
	Cnidoband with basal involucrum	6
6.	Nectophores very flat, Antarctic species	*Moseria*
	Nectophores thick, not Antarctic species	7
7.	Mature specimens small, gonodendra in pairs at bases of palpons, sexes alternating from side to side	*Nanomia*
	Mature specimens large, one female gonodendron in each cormidium	*Halistemma*
	Minute heart-shaped nectophores with unlooped lateral, radial canals	*Cordagalma*
	Frilled ridges in nectophores with unlooped lateral, radial canals	*Frillagalma*

Five genera: *Agalma, Nanomia, Halistemma, Cordagalma* and *Frillagalma* are represented in the collection.

Agalma Eschscholtz, 1825

1825. *Agalma* Eschscholtz, *Okens Isis*, p. 743.
1829. *Agalma :* Eschscholtz, *System der Acalephen*, p. 150.
1846. *Agalmopsis* Sars, *Fauna littoralis Norvegiae*, p. 31.
1853. *Agalmopsis :* Kolliker, *Die schwimmpolypen order Siphonophoren von Messina*, p. 10.
1858. *Crystallomia* Dana, *Mem. Amer. Acad. Arts Sci. (N.S.)*, **61**, p. 459.
1869. *Crystallodes* Haeckel, *Nat. Verh. Prov. Utrechtsch Genoots*, **1**, 6, p. 43.
1888. *Crystallodes :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 221.
1896. *Stephanopsis* Bedot, *Rev. Suisse Zool.*, **3**, p. 367.
1911. *Crystallomia :* Kawamura, *Zool. Mag. Tokyo*, **23**, p. 1–10.
1921. *Stephia* Stechow, *Arch. Naturgesch.*, A.**87**, (3), p. 248–265.

Agalmidae with tricornuate tentilla, consisting of involucrate coiled cnidoband, terminal ampulla and paired lateral horns.

Four species of *Agalma* are considered as valid by Bigelow (1911b) and Totton (1965): *A. okeni* Eschscholtz, 1825; *A. elegans* (Sars, 1846); *A. haeckeli* Bigelow, 1911b; *A. clausi* Bedot, 1888. The last two species have not been recorded since the first authors described them.

Key to Species of *Agalma*
(after Totton, 1965)

1.	Distal border of bract very thick, obliquely truncated. Nectosac 'Y'-shaped, when viewed from above	*A. okeni*
	Distal border of bract thin, not truncated	2
2.	Bracts with three unarmed, longitudinal ridges; nectosac triangular, when viewed from above	*A. elegans*
	Bracts with from three to five armed longitudinal ridges and red pigment spots	*A. haeckeli*
3.	Thick, oval foliaceous bracts with red spots, two teeth on each side. Nectophores resembling those of *okeni*	*A. clausi*

Of these, *A. okeni* Eschscholtz, 1825 and *A. elegans* (Sars, 1846), are represented in the collection.

Agalma okeni Eschscholtz, 1825
(Text-fig. 2, A–M)

1821? *Stephanomia amphtritis* Chamisso & Eysenhardt, *Nova Acta Caes Leop. Carol.* **10**, 'p. 367, taf. 33, figs. 5 a-f.

1821? *Cuneolaria incisa* Eysenhardt, *Nova Acta Caes. Leop. Carol.* **10**, p. 369.

1825. *Agalma okeni* Eschscholtz, *Okens Isis*, **16**, p. 744, taf. 5, fig. 17.

1829. *Agalma okeni :* Eschscholtz, *System der Acalephen*, Berlin. p. 151, pl. 13, figs. 1 a-d.

1834. *Stephanomia triangularis—alveolata—heptacantha* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'...de M. J. Dumont D'Urville. Zool. et Atlas, Zoophytes*, **4**, p. 71, pl. **3**, figs. 1–7, 16–18, 19–23.

1835? *Agalma mertensii :* Brandt, *Polypus. Acalephas Discophoras et Siphonophoras, nec non Echinodermata continens Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatum.* St. Petersburg, **1**, p. 34.

1843. *Agalma okeni :* Lesson, *Acalephs Histoire naturelle des Zoophytes*, p. 510.

1858. *Crystallomia polygonata* Dana, *Mem. Amer. Acad. Arts Sci.* (N.S.), **6**, p. 459, pl. 1.

1859. *Agalma breve* Huxley, *The Oceanic Hydrozoa.* Ray. Soc. London, p. 75, pl. 7.

1859. *Agalma okeni :* Gegenbaur, *Nova. Acta Leop. Carol.*, **27**, p. 403, taf. 32, figs. 45, 50–52.

1869. *Crystallodes rigidum* Haeckel, *Natuurk. Verh. Prov. Utrechtsch. Genoots.*, **1**(6), p. 49, pl. 10, figs. 65–71.

1884. *Agalma okeni :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **11**, p. 81.

1886. *Agalma okeni :* Fewkes, *Rep. U.S. Comm. Fish.* for 1884, p. 964.

1888. *Crystallodes rigida* Haeckel, *Jena Z. naturw.* **22**, p, 40

1888. *Crystallodes vitraea* Haeckel, *Jena Z. naturw.*, **22**, p. 40.

1888? *Crystallodea mertensii :* Haeckel, *Jena Z. naturw.*, **22**, p. 40.

1888. *Crystallodes vitraea :* Haeckel, *Rep. Sci. res. H.M.S. Challenger Zool.*, **28**, p. 222, pl. **17**.

1888? *Crystallodea mertensii :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 222.

1888. *Agalma polygonata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger Zool.*, **28**, p. 366.

1888. *Crystallodes rigidum :* Chun, *S.B. preuss Akad. Wiss* for 1888, p. 1170.

1888. *Agalma rigidum :* Bedot, *Recucil Zool. Suisse.*, **5**, p. 78.

1896. *Agalma okeni :* Bedot, *Rev. Suisse Zool.*, **3**, p. 405.

1896. *Crystallomia polygonata :* Bedot, *Rev. Suisse Zool.*, **3**, p. 406.

1897. *Crystallomia polygonata :* Chun, *Verh. Dtsch. Zool. Ges.*, **7**, p. 84, fig. 18.

1897. *Crystallomia polygonata :* Chun, *Ergebn. Plankton Exped.*, **2**, K.b., p. 103.

1898. *Stephanomia incisa :* Schneider, *Zool. Anz.*, **21**, p. 120.

1899. *Agalma pourtalesii* Agassiz & Mayer, *Bull. Mus. Comp. Zool.* Harv., **32**, p. 180.

1900. *Agalma pourtalesii :* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 79, pl. 31, figs. 106, 107; pls. 32, 33.

1908. *Crystallomia polygonata :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 70.

1911. *Agalma okeni :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 277, pl. 17.

1926. *Agalma okeni :* Browne, *Trans. Linn. Soc. Lond. Zool.* Ser. 2, **19**(1), p. 87.

1932. *Agalma okeni :* Totton, *Sci. Rep. Gr. Barrier Reef Expec.*, **4**, p. 321.

1935. *Agalma okeni :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **7**(11), p. 257.

1936. *Agalma okeni :* Totton, *Zoologica*, N.Y., **21**(4), p. 236.

1936. *Agalma okeni :* Leloup *Bull. Inst. Ocean.*, Monaco. No. 703, p. 12, pl. 2.

1938. *Agalma okeni :* Boone, *Bull. Vanderbilt Mar. Mus.*, **7**, p. 42.

1949. *Agalma okeni :* Moore, *Bull. Bingham Oceanogr. Coll.*, **12**(2), p. 23.

1954. *Agalma okeni :* Totton, *Disc. Rep.*, **27**, p. 64, figs. 25–27.

1955. *Agalma okeni :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 13.

1963. *Agalma okeni :* Daniel & Daniel, *J. Mar. biol. Assoc. India.*, **5**(2), p. 191, fig. II, 3–6.

1965. *Agalma okeni :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 53, pl. 9, figs. 1–14; pl. 11, fig. 3.

Material examined.—The material consists of 7 mature colonies, 112 loose nectophores, 159 loose bracts, 1 young stage and 5 broken siphosomes. Details of this material are given below :—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI regd. no.*
V 5177	I-KT	200—90	6 loose nectophores	Gen. coll.
V 5201	PL	Surface	9 loose nectophores	Gen. coll.
V 5207	I-KT	150—100	1 col.; 3 nectophores	P 1651/1
V 5209	IOSN	200—0	1 col.; without nectophores	P 1619/1
V 5212	,,	,,	2 necto.; 11 bracts	P 1600/1
V 5217	,,	,,	1 col.; 2 loose cormidia	P 1531/1
V 5217	JN	,,	38 necto.; 73 bracts; 3 loose cormidia	P 1574/1
V 5220	PL/I-KT	Surface/70-120	2 full colonies	P 1682/1
V 5227	I-KT	70—120	4 necto.; 2 bracts	P 1701/1
K 7	N N	200—0	1 col.; 10 necto.; 18 bracts	Gen. coll.
K 28	,,	,,	4 necto.; 1 bract	,,
K 31	,,	,,	4 bracts	,,
K 34	,,	75—0	1 colony	,,
K 35	,,	200—0	2 necto.; 4 bracts	,,
K 36	,,	,,	1 necto.	,,
K 37	,,	,,	11 necto.; 20 bracts	,,
K 40	,,	,,	1 necto.	,,
K 42	,,	,,	1 young stage	,,
K 48	,,	,,	2 necto.	,,
K 359	Org.N	Surface	1 bract	,,
K 379	,,	,,	6 necto.; 6 bracts	,,
K 533	,,	,,	3 necto.; 4 bracts	,,
Gt.Nie-5	,,	,,	10 necto.; 15 bracts	,,

Type-locality.—St. Peter & Paul Islands.

Distribution.—Extremely common in the warm regions of all the oceans. Details of localities from these oceans are given in Table 1.

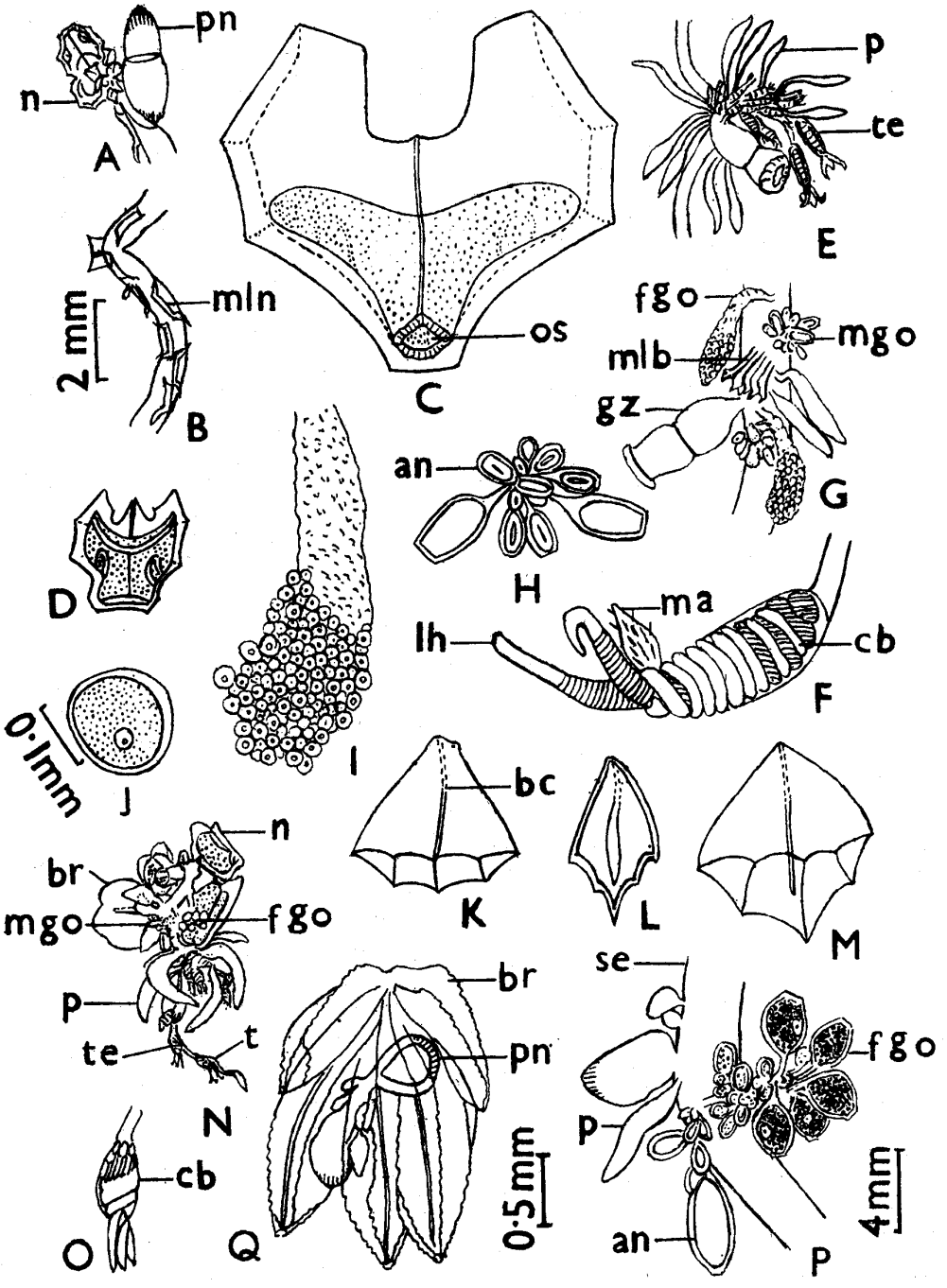
Description.—The nectosome and the siphosome are rigid and nearly equal in length.

Pneumatophore.—(Text-fig. 2A, pn) : The pneumatophore is elongated with its apex pigmented and measures 2.0 mm in length.

Nectosome.—(Text-fig. 2, A & B) : It measures 30 mm in length in a colony obtained from RV VITYAZ Station no. 5207. It has five minute buds, eight immature nectophores and ten pairs of muscular lamellae of mature nectophores. These occur on the ventral side alternately as shown in figure.

Nectophores.—(Text-fig. 2A,n; C & D) : The dimensions of the mature and young nectophores are as follows : Young nectophores (immature) : length—1.27 mm; breadth—1.27 mm. Mature nectophores : length—6.67 mm; breadth—7.0 mm.

The mature nectophore (Text-fig. 2,C) is flattened dorsoventrally and is prismatic and transparent. The lateral corners of the nectophore are prolonged into prominent wings or wedges. The dorso-lateral ridges occur almost at the lateral edges of the nectophore. Similarly the ventral ridges occur near the edges and these two ridges (*i.e.*, dorsal and ventral) are connected by two vertical ridges. The nectosac is 'Y'-shaped when viewed from above. The lateral corners of the nectosac are also winged. The



TEXT-FIGURE 2

Agalma okeni : A—M

A—pneumatophore and part of stem showing budding zone.
B—arrangement of nectophores—only their muscular lamellae are seen. C—mature nectophore.
D—immature nectophore. E—Cormidium. F—Tentillum.
G—part of stem showing arrangement of gonodendra and bracts. H—male gonodendron.
I—female gonodendron. J—single ovume enlarged. K, L, M—bracts.

Agalma elegans : N—Q

N—Colony. O—Tentillum. P—part of stem showing male and female gonodendra.
Q—larval stage.

Abbreviations used :

an—androphore. bc—bracteal canal. br—bract. cb—cnidoband. f.go—female gonodendron.
gz—gastrozooid. lh—lateral horns. ma—median ampulla. m.go—male gonodendron.
m.l.b.—muscular lamellae of bracts. m.l.n.—muscular lamellae of nectophore. n—nectophore.
o—ostium. p—palpon. pn—pneumatophore. se—siphosome. t—tentacle. te—tentillum.

lateral radial canals are looped. The broad nectosac narrows towards the mouth opening.

The shape and structure of the immature nectophores differ from the mature ones (Text-fig. 2,A,n; D). The two vertical ridges are present as in the mature nectophores. The lateral corners of the nectosac extend well into the lateral wings of the nectophore. The lateral radial canals are thick and looped at the basal conrers of the nectosac.

In a slightly larger nectophore, the nectosac is abruptly prolonged into two narrow blunt canal or caecum at the upper lateral corners. The loop of the lateral radial canals occupies the entire lateral surface of the nectophore.

There is a single immature nectophore from INS KISTNA Station no. K 42 which measures 2.2 mm in length and 1.75 mm in breadth. The lateral wings are well developed and occur close together without much space between them. The dorsolateral ridges are present and there is only one vertical ridge on each side. The nectosac is slightly extended into the wings.

Siphosome.—(Text-fig. 2,E & G) : The siphosome measures 20.0 mm in length and possesses five groups of cormidia. Each cormidium consists of a single gastrozooid, 8–10 palpons, tentacles, gonodendron and bracts; they are separated from one another by a free space "the internode" occupied only by the bracts. The arrangement of the gastrozooids, palpons, bracts and the gonodendra is regular and characteristic for the species.

Gastrozooids.—The gastrozooids are long with prominent basigaster, and possess a long tentacle. There are about 12–15 tentilla which end in a highly coiled (6–10 coils) cnidoband and trifid filaments at the tip. The coils are often partly or entirely covered with the involucrum. Of the three trifid terminal filaments, the middle one is large and spindle-shaped with vibratile cilia and the two lateral arms are thinner and longer (Text-fig. 2F).

In one of the detached cormidia present in the collection, the gastrozooid, probably the primary gastrozooid, possesses a tentacle in which the tentillium is not coiled. The cnidoband is somewhat straight, thick, dark in colour, and ends in a short, small trifid structure.

Palpons.—(Text-fig. 2E,p) : There are 8–10 palpons in each cormidium surrounding the gastrozooids. They are long and thin. The palpacles are thin, thread-like, simple and have a beaded appearance.

Bracts.—(Text-fig. 2,K,L & M) : The bracts measuring 6.0–15.0 mm in length are firm, rigid, prismatic, roughly triangular in shape and gradually thicken at the distal ends. The thick distal end is divided into four vertical concave (occasionally 5) facets by three vertical ridges. The bracteal canal which lies in the centre is thin and thread-like and sometimes only faintly seen. Some bracts are not distally faceted, but slope gradually towards the distal end. The distal edge of these bracts is thin and ends in teeth-like structures. In these, the bracteal canals are broad. In a young specimen, the bract has only two facets divided by a single vertical ridge.

The arrangement of the bracts are precise and regular, and the numerous closely packed bracts give the appearance of a carapace. The bracts occur only on the ventral side of the siphosome between the gastrozooids in groups of four to five. The bracts possess large triangularly shaped muscular lamellae, which remain on the stem even after the bracts fall off.

Gonodendra.—(Text-fig. 2G,H & I, fgo, mgo) : Both the male and the female gonodendra occur at the bases of some of the palpons in an alternating manner. A group of bracts occur in between two pairs of gonodendra, as shown in figure 2-G.

The male gonophores (androphores).—Text-fig. 2,H—are 10–12 in number and occur in the form of bunches directly from the stem. They range from 0.3 to 1.25 mm in length. They possess long pedicels and end in distinctly medusoid structures with mouth openings. The interior is filled with homogenous substance.

The female gonophores (gynophores)—Text-fig. 2,I & J—occur on club-shaped reproductive stalks. The gynophores are round, measure 0.1–0.25 mm in diameter, and occur at the distal end of the stalk. The scars of the released gynophores are seen at the proximal half of the stalk. Each gynophore consists of a single ovum with prominent nucleus and nucleolus. There are about 200–350 gynophores on the entire gonodendron.

Agalma elegans (Sars, 1846)

(Text-fig. 2, N–Q; 3, A–D)

1846. *Agalmopsis elegans* Sars, *Fauna littoralis Norwegiae* Christiana, **1**, p. 32, tab. 5, 6 (in part).
1853. *Agalmopsis sarsii* Kolliker, *Die Schwimmpolypen oder Siphonophoren von Messina*, Leipzig, p. 10, taf. 3.
1853. *Agalma punctata* Leuckart, *Zoologische Unterchechungen I Die Siphonophoren*, p. 3, taf. 1, figs. 1, 19, 20; taf. 2, figs. 1, 2, 5, 7, 23 (Non Vogt, 1854, p. 83, tab 12 = *Apolemia uvaria*).
1853. *Agalma clavata* Leuckart, *Zoologische Untersuchungen I Die Siphonophoren*, p. 3, taf. 2, fig. 3.
1854. *Agalmopsis sarsii :* Leuckart, *Arch. Naturgesch. Jahrg.*, **22**, p. 331, taf. 12, figs. 21–27; taf. 13, fig. 1.
1854. *Agalma clavata :* Leuckart, *Arch. Naturgesch. Jahrg.*, **22**, p. 337, taf. 13, figs. 2–12.
1862. *Agalmopsis clavatum :* L. Agassiz, *Contr. Nat. Hist. U.S.A.* Boston, **4**, p. 369.
1880. *Agalma elegans :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **6**, p. 141.
1880. *Agalma clegans :* Fewkes, *Amer. nat.*, **14**, p. 618, fig. 1.
1881. *Agalma elegans :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **8**, p. 163, pls. 9, 10.
1882. *Agalma elegans :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **9**, p. 301.
1888. *Cuneolaria elegans :* Haeckel, *Jena Z. naturw.*, **22**, p. 40.
1888. *Agalmopsis sarsii :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 234.
1888. *Agalmopsis catena* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 234.
1888. *Agalmopsis elegans :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 234.
1896. *Agalmopsis sarsii :* Bedot, *Rev. Suisse Zool.*, **3**, p. 409.
1897. *Agalmopsis elegans :* Chun, *Ergebn. Plankton Exped.*, **2**, kb., p. 104.
1898. *Agalma elegans :* Schneider, *Zool. Anz.*, **21**, p. 122.
1898. *Agalmopsis elegans :* Schneider, *Zool. Anz.*, **21**, p. 122.
1902. *Agalma elegans :* Romer, *Die Siphonophoren : In Fauna Arctica*, **2**, p. 178.
1902. *Agalmopsis elegans :* Romer, *Die Siphonophoren : In Fauna Arctica*, **2**, p. 178.
1906. *Agalmopsis elegans :* Vanhoeffen, *Siphonophoren: Nordisches plankton*, **5**(11), p. 24, figs. 31–36.
1909? *Cupulita sarsii :* Damas, *Rep. Norwegian Fishery and Marine Investigations*, **2**(1), p. 107.
1911. *Agalma elegans :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 281, pl. 18, figs. 9–13; pl. 19, figs. 1–4.
1926. *Agalma elegans :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), ser. 2, **19**(1), p. 83.
1932. *Agalma elegans :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 322.
1935. *Agalma elegans :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 257.
1936. *Agalma elegans :* Totton, *Zoologica*, N.Y. **21**(4), p. 236.
1936. *Agalma elegans :* Leloup, *Bull. Inst. Ocean.* Monaco No. 703, p. 2, pl. 12.
1939. *Agalma elegans :* Bigelow & Sears, *Mem. Mus. Comp. Zool.* Harv., **54**(4), p. 367.
1949. *Agalma elegans :* Moore, *Bull. Bingham Oceanogr. Coll.*, **12**(2), p. 23.
1954. *Agalma elegans :* Totton, *Disc. Rep.*, **27**, p. 61, fig. 24.

1955. *Agalma elegans :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 13.

1963. *Agalma elegans :* Daniel & Daniel, *J. Mar. biol. Assoc.* India, **5**(2), p. 192, fig. II, 7.

1965. *Agalma elegans :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 54, pl. 10, figs. 11–17; pl. 11, figs. 1, 2; text-figs. 7, 18–20.

Material examined.—The material consists of four young colonies, 22 loose nectophores, 8 loose bracts and three larval stages. Details of this material are given below :

Station No.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5220	PL	Surface	3 necto.; 2 bracts	P 1681/1
K 7	NN	200—0	2 necto.	Gen. coll.
K 8	,,	,,	1 colony; 4 necto.	,,
K 9	,,	,,	2 necto.	,,
K 10	,,	,,	6 necto.; 1 bract	,,
K 11	,,	,,	1 colony; 3 necto.; 3 bracts	,,
K 25	,,	,,	1 necto.	,,
K 41	,,	,,	1 larval stage	,,
K 43	,,	,,	1 larval stage	,,
K 44	,,	,,	1 bract	,,
K 49	,,	,,	1 larval stage	,,
K 361	Org.n.	Surface	2 complete colonies	,,
K 533	,,	200—0	1 necto.; 1 bract	,,

Type-locality.—North Sea.

Distribution.—This species is world-wide in distribution, occurring in the tropical, temperate and sub-arctic waters (*see* also Table 1 for details).

Description.—The colony is soft and contractile, unlike the stiff colony of *A. okeni*. It measures 5.33 mm in length.

Pneumatophore.—(Text-fig. 2,N) : It is small, measuring 0.57 mm in length and 0.27 mm in breadth. It is oval in shape and pigmented at the tip.

Nectosome.—The nectosome measures about 1/3rd of the length of the colony. In a colony from INS KISTNA Station no. 8, there are three mature and few buds of the nectophores.

Nectophores.—(Text-fig. 2N,n; 3C) : The mature nectophores from the INS KISTNA stations measure 2.17 mm in length and 2.0 mm in breadth. Loose nectophores from RV VITYAZ Station no. 5220 measure 6.50 mm in length and 6.0 mm in breadth. The nectophores are not flat as in *A. okeni* and their sides are rounded, smooth and not distinctly faceted as in *A. okeni*. The lateral wings are long. The dorsolateral ridges are present and each lateral facet is divided into two by a single vertical or oblique ridge. When viewed from above, the nectosac appears triangular in shape and not 'Y'-shaped as in *A. okeni*. The lateral corners of the nectosac do not extend into the lateral wings. The lateral radial canals run on the proximal surface of the nectosac and do not dip down as in the species of *Halistemma*. These canals form a semi-circle on the lateral sides before they descend and join the ring-canal. The pedicular canal does not project far downwards.

The immature nectophores (Text-fig. 3,A & B) are very minute buds of nectophores in which the canals are not distinctly differentiated. These nectophores possess two horn-like extensions at their distal ends.

Siphosome.—(Text-fig. 2,N & P, se) : The siphosome measures 2/3rd of the total length of the colony. There are only two groups of cormidia, each possessing a single gastrozooid and several palpons. A young gastrozooid without any palpon is seen just below the nectosome, in a colony measuring 5.3 mm in length.

Gastrozooids.—(Text-fig. 2,N,t,te; O) : In the young colony mentioned above there are only three gastrozooids. The two older ones possess well-developed tentacles. The tentacles are long, thick and possess involucrate and tricornuate tentilla which are reddish in colour. The involucrum covers the entire or nearly 3/4th of the cnidoband. There are about 3–4 coils in the cnidoband. Each tentillum bears 5–7 pairs of long slender nematocysts and 4–6 rounded ones at the proximal end. The median ampulla or horn is thick and spindle-shaped. The two lateral horns are thin and long. The protosiphon and its tentacle is not present in the specimen (Text-fig. 2,N,te;O).

Palpons.—(Text-fig. 2,N,p) : Four to six palpons form a ring round the gastrozooids. The palpons are slender and longer than the gastrozooids. The palpacles are simple and have a beaded appearance.

Bracts.—(Text-figs. 2,N,br; 3,D) : A single bract is found attached to one of the colonies. It is broad, trident and thin at the distal edge. It measures 1.33 mm in length and 1.17 mm in breadth. The larger bracts found loose in the collection, are long and measure 15.0–18.0 mm in length; they are trident and possess three—crested ribs on the dorsal side. They are thick in the middle region and thin at the sides folding inwards to form cavities. They are not faceted as in *A. okeni*. The bracteal canal is thin and threadlike and extends almost to the tip of the bract.

Gonodendra.—(Text-fig. 2,P) : Both the male and female gonodendra occur in-between the first two gastrozooids. The female gonodendron occurs near the base of a small palpon. The male gonodendron lies just below the female gonodendron.

The female gonodendron (Text-fig. 2,P,fgo) : consists of a long stalk on which the gynophores are borne. The small gynophores appear to be sessile while larger ones are distinctly pedicellate. There are six mature gynophores which occur mixed among the many small immature ones. They are round in shape, whitish in colour and possess a single ovum. The ovum occurs within a distinct medusoid structure; and the cytoplasm of the egg is granular (? yolk). The nucleus and the nucleoli are seen clearly in some of the ova.

The male gonodendra (Text-fig. 2,P,an) : are fewer in number, consisting of three mature and few buds of the androphores. The androphores are larger than the gynophores, oval in shape and possess large pedicels. These are also medusoid in structure, possessing a definite mouth opening at the distal ends. The interior is filled with a homogenous substance.

Larval stage

(Text-fig. 2,Q)

The three examples present in the collection are all of the same stage, *i.e.*, the "Athorybia" stage. The pneumatophore is rounded, large and surrounded by a corona of bracts. There are about 6–8 bracts. They possess 3–4 finely serrated ribs on the dorsal surfaces. The bracteal canals extend to the tips of the bracts. Four of them are three-sided in structure, while the others are thin and leaf-like. They appear to meet at the apex above the pneumatophore. There is a single gastrozooid, two palpons and a contracted tentacle and two buds of nectophores. The nectosome is slightly elongated.

Halistemma Huxley, 1859

1807. *Stephanomia* Lesueur & Petit, *Voyage aux terres australes Mollusque et. zoophytes.*, pl. 29.
1859. *Halistemma* Huxley, *The Oceanic Hydiozoa, Ray Soc. London*, p. 70.
1862. *Phyllophysa* L. Agassiz, *Contr. nat. Hist. U.S.A. Pt. IV*, Hydroidea, **4**, p. 369.
1888. *Stephanomia :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 221.
1888. *Phyllophysa :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 225.
1911. *Stephanomia :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 348 (part).
1954. *Stephanomia* : Totton, *Disc. Rep.*, **27**, p. 46.
1955. *Stephanomia :* Leloup, *Rep. Sci. res. "Michael Sars" north Atlantic deep sea Exped.*, **5**(11), p. 13.

Agalmidae with long stem; nectophores rigid, prismatic, not laterally winged, possessing a median lappet, dorso-lateral ridges and 1–3 vertical ridges; gastrozooids with unicornuate tentilla whose cnidoband lacks a marked basal involucrum; bracts thin, foliaceous and trident.

Bigelow (1911b) included all the long stemmed agalmids with unicornuate tentilla under the genus *Stephanomia* Lesueur & Petit, 1807; (i.e., *S. amphytridis* Lesueur & Petit, 1807; *S. bijuga* Delle Chiaje, 1841; *S. rubrum* Vogt, 1852; *S. cara* Agassiz, 1865; and *S. cupulifera* Lens & van Riemsdijk, 1908). Later, an Antarctic species *S. convoluta* Moser, 1925 and an Arctic species *S. orthocanna* Kramp, 1942, were added to this list.

Totton (1954, 1965) while revising the family Agalmidae realized the necessity for the separation of the above-mentioned species of *Stephanomia* into four genera, viz., *Halistemma* Huxley, 1859; *Nanomia* Agassiz, 1865; *Marrus* Totton, 1954; and *Moseria* Totton, 1965.

Further, he pointed out that *Stephanomia* is the name of a monotypic genus, the identity of whose only species *S. amphytridis* is exceedingly doubtful since only the siphosome is known. *Cupulita* (Quoy & Gaimard, 1824) is also monotypic and the identity of its only species *C. bowditchii* Quoy & Gaimard, is doubtful. *Agalmopsis* (Sars, 1846) was erected to include two species, *A. elegans* (Sars) and *A. cara* (Agassiz) but restricted by Kölliker (1853) and by Haeckel (1888b) for the species with tricornuate tentilla (*elegans*). Therefore, the next available name *Halistemma* Huxley, 1859 was revived by Totton, (1965). On the basis of the structure of the nectophore (except in *amphytridis*), bract and lack of marked basal involucrum in the cnidoband, the following species viz., *H. rubrum* (Vogt, 1852); *H. cupulifera* Lens & van Riemsdijk, 1908; *H. striata*, Totton, 1965; and (?) *H. amphytridis* are recognized.

The next available name *Nanomia* Agassiz, 1865, was selected for the two closely allied species, *cara* and *bijuga*, on the basis of the shape and structure of the nectophore and involucrate tentilla.

The Arctic species *Stephanomia orthocanna* Kramp and two new species : *orthocannoides* and *antarcticus* were put under the genus *Marrus* Totton, 1954 as their nectophores bear the characteristic dorsolateral ridges, simple unlooped lateral radial canals, and lack the usual vertical ridges. The only remaining species *Stephanomia convoluta* Moser, though bearing non-involucrate and unicornuate tentilla has an entirely different kind of nectophore for which reason the genus *Moseria* was created by Totton (1965).

Key to species of *Halistemma*

1. Tentilla not known 4
   Tentilla with terminal filament either simple or with appendage 2
2. Tentilla simple possessing distinct basal involucrum . . . . . *amphytridis*
   Tentilla with terminal filament ending in appendage 3

3. Tentilla with terminal filament ending in cone-shaped coil of ten turns; basal involucrum inconspicuous . . . . . *rubrum*

   Tentilla with terminal filament ending in acorn-shaped appendage; without basal involucrum . . . . . *cupulifera*

4. Nectophores with four vertical ridges descending from upper lateral ridge at an angle of about 30° . . . . . *striata*

Of these four species, *Halistemma rubrum* (Vogt) and (?) *H. amphytridis* (Lesueur & Petit) are present in the collections.

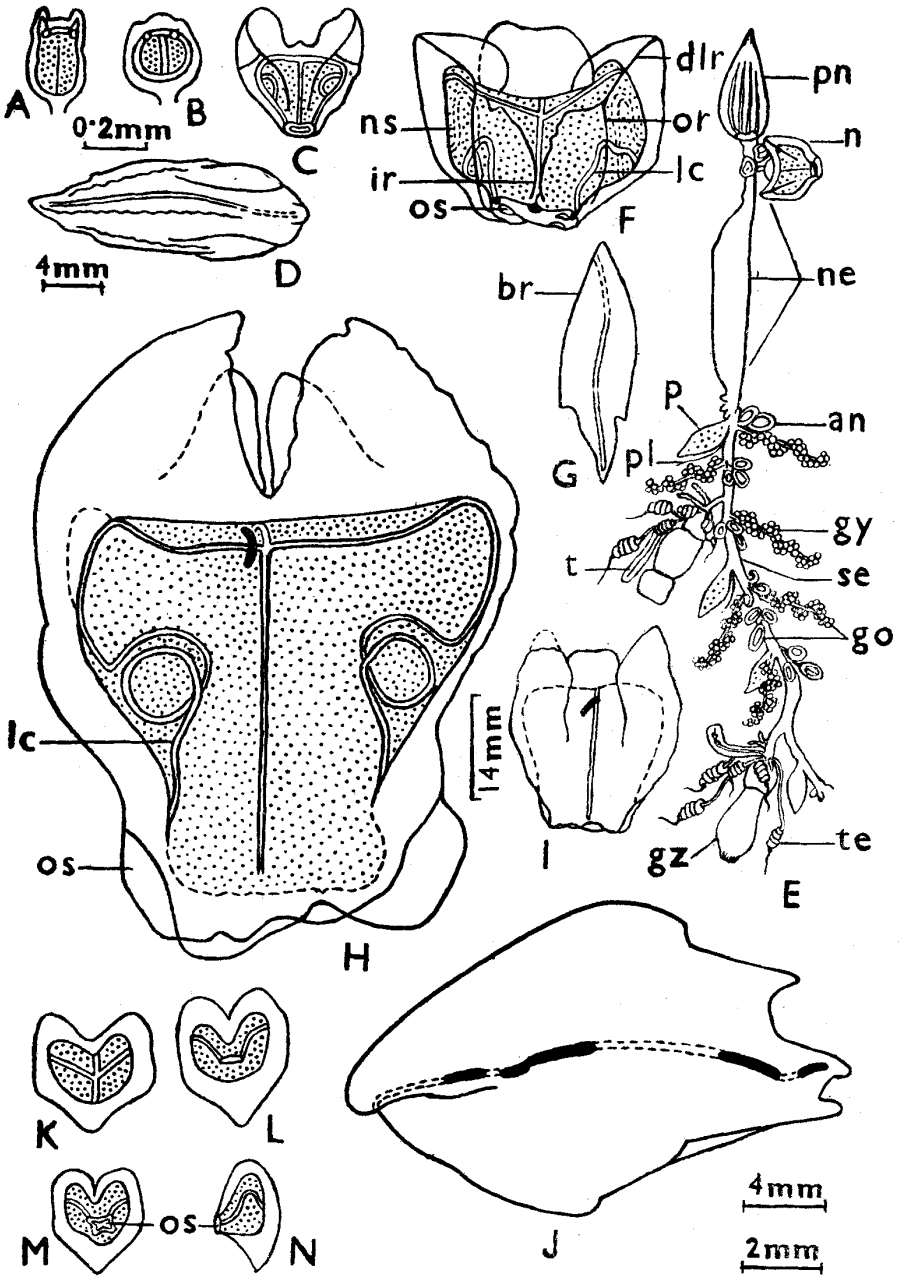
Halistemma rubrum (Vogt, 1852)

(Text-fig. 3, E–G)

1852. *Agalma rubra* Vogt, *Z. Wiss. Zool.*, **3**, p. 522.
1853. *Agalmopsis punctata* Kolliker, *Die Schwimmpolypen der Siphonophoren von Messina*, Leipzig, p. 15, taf. 4.
1853. *Agalmopsis rubra :* Leuckart, *Zoologische Untersuchungen I Die Siphonophoren*, p. 3.
1854. *Agalma rubra :* Vogt, *Mem. Inst. Nat.* Genèv., **1**, p. 62, taf. 7–11.
1854. *Agalma rubrum :* Leuckart, *Arch. Naturgesch. Jahrg.*, **22**, p. 321, taf. 12, figs. 12–20.
1859. *Halistemma rubrum :* Huxley, *The Oceanic Hydrozoa* Ray Soc. London, p. 70.
1860. *Agalma minimum* Graeffe, *Denkschr. Schweiz. naturf. Ges.*, **17**, p. 15, taf. 2, 3.
1888. *Halistemma rubrum :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 367.
1896. *Halistemma rubrum :* Bedot, *Rev. Suisse Zool.*, **3**, p. 407.
1898. *Agalmopsis rubra :* Schneider, *Zool. Anz.*, **21**, p. 123.
1899. *Agalmopsis rubra :* Schneider, *Arh. Zool. Inst. Wein.*, **11**(2), p. 27, taf. 4, figs. **34–42**.
1905. *Halistemma rubrum :* Wolterech, *Z. Wiss Zool.*, **82**, p. 612.
1911. *Stephanomia rubra :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 348.
1936. *Stephanomia rubra :* Leloup, *Bull. Inst. Ocean.* Monaco. No. **703**, pp. 3, 12.
1937. *Stephanomia rubra :* Dawydoff, *Bull. Soc. Zool.* France., **61**, p. 470.
1937. *Halistemma rubra :* Dawydoff, *Bull. Soc. Zool.* France, **61**, p. 470.
1954. *Stephanomia rubra :* Totton, *Disc. Rep.*, **27**, p. 46, fig. 12–18.
1955. *Stephanomia rubra :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped*, **1910**. *Siphonophores*, **5**(11), p. 13.
1963. *Stephanomia rubra :* Daniel & Daniel, *J. Mar. biol. Assoc. India*, **5**(2), p. 194, fig. **11**, **9**.
1965. *Halistemma rubrum :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 56, pl. XII, text-fig. 21–23.

Material examined.—The material consists of one complete colony (without bracts and many of the nectophores), 34 loose nectophores and 7 bracts. Details of this material are as follows :

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5179	I-K T	450—150	Two necto.; 3 bracts	Gen. coll.
K 7	N N	200—0	Two necto.	,,
K 8	,,	,,	Four necto.	,,
K 15	,,	,,	Two ,,	,,
K 16	,,	,,	11 ,,	,,
K 24	,,	,,	One ,,	,,
K 26	,,	,,	One ,,	,,
K 40	N N	200—0	4 necto.	,,
K 49	,,	,,	1 ,,	,,
K 361	Org. n.	Surface	6 ,, ; 2 bracts	,,
K 529	,,	200—0	One complete colony	,,
K 538	,,	,,	2 bracts	,,



TEXT-FIGURE 3

Agalma elegans : A—D

A—immature nectophore. B—immature nectophore (slightly older bud). C—young nectophore. D—bract.

Halistemma rubrum : E—G

E—Colony (after Daniel & Daniel, 1963). F—Mature nectophore. G—Bract.

? Halistemma amphytridis : H—J

H—nectophore with median lappert divided. I—nectophore with median lappert undivided—diagmatic. J—Bract.

Cordagalma cordiformis : K—4

K—nectophore, ventral view. L, M—nectophore, ostial view. N—nectophore, side view.

Abbreviations used :

an—androphore. br—bract. dlr—dorsolateral ridge. go—gonodendron. gy—gynophore. gz—gastrozooid. ir—inner lateral ridge. lc—lateral radial canal. n—nectophore. ne—nectosome. ns—nectosac. or—outer;lateral ridge. os—ostlum. p—palpon. pl—palpacle. × pn—pneumatophoer. se—siphosome. t—tentacle. te—tentillum.

Type-locality.—Mediterranean Sea, off Nice (France).

Distribution.—Warm regions of all the oceans and in the Mediterranean. For details *see* Table 1.

Description.—The complete colony measures 90 mm. in length.

Pneumatophore.—(Text-fig. 3,E,pn.) : The pneumatophore is large, measures 2.5 mm. in length and tapers towards the pigmented apex. There are eight incomplete(?) radial septae.

Nectosome.—(Text-fig. 3,E,ne.) : The nectosome measures about 10 mm. in length, and possesses 3 very young nectophores, of which one is fairly well developed. All the mature nectophores have become detached.

Nectophores.—(Text-fig. 3,E,n;F) : The mature nectophore measures 3.5 mm. in length and 4.33 mm. in breadth. The paired lateral wedges are not so prolonged as in *Agalma* but short and separated by an undivided broad median lappet or "thrust-block".

The dorsolateral ridges bifurcate in the mid-region of the nectophore. The inner branches occur together near the mouth of the nectosac. The outer branches diverge and occur on either side of the mouth opening. The vertical ridges are not prominent, but are faintly marked and oblique. The lateral corners of the nectosac are slightly extended into the lateral wedges. The nectosac narrows down at the mouth region. Musculature is well developed. The lateral radial canal dips down as it runs on to the lateral face of the nectosac, before ascending, and falls into loops on the dorsolateral and on the ventrolateral surfaces of the nectosac, before it descends to the ring-canal. Enlarged *rete* occur at places where the radial canals and the ring-canal meet.

Siphosome.—(Text-fig. 3,E,se) : It measures about 80 mm. in length. Few gastrozooids and palpons are still found attached to the stem. The gastrozooid has a thick stalk, each tentacle bearing unicornuate, non-involucrate tentilla. It is much contracted and 8–10 tentilla occur in a bunch at the base of the gastrozooid. About 6–8 coils occur in the cnidoband which is not covered by a marked involucrum. A single terminal filament is present. The palpons and the palpacles are small.

Bracts.—(Text-fig. 3,G) : They are thin, and leaf-like with three distally pointed teeth. The bracteal canal is threadlike and lies in the middle. The pads of nematocysts observed in the bracteal canal by Totton could not be noticed in the present material.

Gonodendra.—(Text-fig. 3,E,an & gy.) : These occur in-between the gastrozooids, *i.e.*, on the internode. The female gonodendron has the appearance of a bunch of grapes with a median stem around which the gynophores are grouped, giving a coiled appearance. Each gynophore bears a single ovum. The male gonodendra are situated at bases of palpons occurring below the female gonodendra. There are about 3 androphores occurring in a row, the middle one being the largest and well developed. Each androphore bears a long and thin stalk, a medusoid androphore with a central spadix and a terminal mouth opening.

? **Halistemma amphytridis** (Lesueur & Petit, 1807)

(Text-fig. 3, H–J)

1807. *Stephanomia amphytridis* Lesueur & Petit, *Voyage decouvertes aux terres Australes. et Atlas*, pl. 29, fig. 5.

1834? *Stephanomia foliacea* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'...de M. J. Dumont D' Urville. Zool. et. Atlas. Zoophytes*, **4**, p. 74, pl. 13, fig. 8–12.

1859? *Stephanomia amphytridis :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 72, pl. 6.

1862? *Stephanomia amphytridis :* L. Agassiz, *Contr. Nat. Hist. U.S.A.*, Boston, **4**, p. 368.

1888? *Stephanomia nereidum* Haeckel, *Jena Z. naturw.*, **22**, p. 40.

1888? *Phyllophysa squamacea* Haeckel, *Jena Z. naturw.*, **22**, p. 40.

1888? *Stephanomia nereidum :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 221.

1888? *Phyllophysa squamacea :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 225.

1896. *Cupulita amphitridis :* Bedot, *Rev. Suisse Zool.*, **3**, p. 409.

1898? *Stephanomia amphytridis :* Schneider, *Zool. Anz.*, **21**, p. 118.

1908. *Stephanomia* sp. Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 84, pl. 15, figs. 113, 114.

1911? *Stephanomia amphytridis :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 287, pl. 18, figs. 1–8.

1936? *Stephanomia amphytridis :* Totton, *Zoologica*, N.Y., **21**(4), p. 236.

1954? *Stephanomia amphytridis :* Totton, *Disc. Rep.*, **27**, p. 46.

1955? *Stephanomia amphytridis :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 13.

1965. *Halistemma amphytridis :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.), London, p. 60.

Material examined.—Two nectophores and one bract were taken from RV VITYAZ Station no. V5208, by ichthyological net in a haul made from 1,000 metres to the surface; these specimens are in the general collections of the Zoological Survey of India.

Type-locality.—Between Le Havre and Mauritius (Peron, 1807–16), *vide* Totton, 1954.

Distribution.—East coast of Australia; eastern tropical Pacific; Indo-Pacific; Atlantic; Pacific; off Ceylon; New Guinea; Malayasia (*see* Table 1).

Description.—Nectophores (Text-fig. 3,H & I) : The sizes of the two nectophores in the collection are given below :

length—28.0 mm to 33.0 mm

breadth—25.0 mm to 25.0 mm

The nectophores are dorso-ventrally crushed so that they are almost flat, but have retained their shape. The number and the course of the ridges are therefore not discernible. The smaller nectophore has a typical "Halistemma" type of nectophore with the slight lateral wings or wedges and the median lappet or "thrust-block". The musculature observed in the larger nectophore is entirely lacking in the smaller one. A thick pedicular canal and faintly marked dorsal and ventral radial canals are seen (Text-fig. 3,I).

In the larger nectophore (Text-fig. 3,H) the lateral wings are prominent and the median lappet occurs as two lobes. The nectosac has a broad proximal half which gradually narrows towards the mouth opening. The musculature is highly developed. The radial canals are clearly seen as thick, clear canals. The dorsal and ventral radial canals are straight without any sigmoid curves or loops. The lateral radial canals dip down at the base or proximal surfaces of the nectosac and ascend upwards at the lateral corners and descend along the lateral surfaces. Here they take nearly two circular courses, once on the dorsal and then on the ventral surfaces of the nectosac, before they run down and join the ring-canal (not clearly discernible due to the crumpled appearance of the musculature). The mouth of the nectophore is very broad and flap-like as shown in Text-figure 3, H, os. The pedicular canal is short, thick and is situated in the centre, slightly below the proximal surface of the nectosac.

Bract.—(Text-fig. 3,J) : It is 29.0 mm in length, 15.0 mm in breadth and 1.2 mm in thickness. It is uniformly thick, except at the proximal middle region which is thicker and ridge-like. It is leaf-like but asymmetrical in shape. There are three blunt teeth at the distal end and two smaller ones on the lateral edges of the bract. The bracteal canal is thick and lies in the middle. Four pads of some opaque material—nematocysts (?)—are seen within the canal.

Remarks.—Provisionally, these nectophores are assigned to this species *H. amphytridis*, because of its occurrence along with the bract which resembles the bracts described by Huxley (1859) and Bigelow (1911b), from the siphosomes of *S. amphytridis*, in being thick, stiff, foliaceous and trident or with more teeth. The above mentioned authors have given detailed descriptions of the siphosomes. So far, the nectosome of this species has never been described. But Haeckel (1888b, page 221) stated that he had seen the complete specimen off Ceylon, but gave no description or figures. Totton (1965, page 61) stated that nectosomes and siphosomes collected off Bermuda by Beebe and by ships of the National Institute of Oceanography are known to exist. but no descriptions are available.

Nectophores measuring 33.0 mm in length have so far never been described or recorded. Such huge nectophores with heavy musculature are essential to move a large colony. The siphosomes described by Huxley and by Bigelow show that they belong to enormous colonies. Further, these nectophores were collected from RV VITYAZ Station no. V 5208 which is situated at Latitude 9°16′ S and Longitude 91°27′ E. The original record of this species is from the east coast of Australia and areas near-by (Peron & Lesueur, 1807–16; Huxley, 1859).

The identity of this species will remain uncertain till the nectosome or siphosome is found intact, *i.e.*, till a complete specimen is collected, which corresponds with Huxley's and Bigelow's material. Only then, the species *Stephanomia amphytridis* could be firmly established.

Cordagalma Totton, 1932

1888. *Anthemodes* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 229.
1932. *Cordagalma* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 325.

Agalmidae with minute characteristic heart-shaped nectophores whose lateral canals do not form sigmoid curves.

The genus *Cordagalma* was established by Totton (1932) for a very obscure, and the smallest, of all the physonects. This is known only from its nectophores and the complete colony is still unknown.

Monotypic genus for *C. cordiformis* Totton, 1932.

Cordagalma cordiformis Totton, 1932

(Text-fig. 3, K–N)

1932. *Cordagalma cordiformis* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 325, text-fig. 8, 9.
1954. *Cordagalma cordiformis* : Totton, *Disc. Rep.*, **27**, p. 69.
1965. *Cordagalma cordiformis* : Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.), London, p. 61, text-fig. 25.

Material examined.—The material consists of 20 nectophores, details of which are given below :

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5232	J N	200—0	4 nectophores	Gen. coll.
K 44	N N	,,	2 ,,	,,
K 46	,,	,,	12 ,,	,,
K 49	,,	,,	1 ,,	,,
K 522	Org.n.	,,	1 ,,	,,

Type-locality.—Great Barrier Reef, Australia. Type specimens located at British Museum, London.

Distribution.—Great Barrier Reef, Australia; off St. Vincent; West Indies; Ville Franche-sur-Mer, A.M. France; Gulf of Aqaba; East African coast; Red Sea; Eastern Indian Ocean (*see* also Table 1).

Description.—(Text-fig. 3,K-N) : Only nectophores are present in the collections. The colony is still unknown. The nectophore measures 2.4 mm in length and 1.93 mm in breadth. It is minute and heart-shaped. The lateral lobes of the nectophore are divided from one another by a sharp cleft, and the base narrows down to a smooth blunt tip resembling the heart. It is deeply grooved on the ventral side. The nectosac is also heart-shaped, but its mouth opening or ostium is placed almost in the centre on the dorsal side (L & M). The pedicular canal is found directly opposite the ostium and towards the base of the nectophore. The lateral radial canals are simple and sweep upwards to form a semicircle on the inner surface of the nectosac without forming any sigmoid curves before joining the ring-canal. The upper curvature of these canals lies somewhat below the proximal surfaces of the nectosac. The point of attachment is unusually low down the nectophore, the upper end not reaching the level of the upper median wall of the nectosac and the lower end extending well down to the pointed base below. These are characteristic features of this species. The junction of the pedicular and radial canals is nearly on a level with the base of the nectosac.

Nanomia Agassiz, 1865

1824. *Cupulita* Quoy & Gaimard, *Voyage...Sur l'uranie et al 'Physicienne'... Zool.*, pt. 2 & atlas, p. 580.

1846. *Agalmopsis* Sars, *Fauna littoralis Norwegiae.*, p. 31.

1865. *Nanomia* Agassiz, *Proc. Boston. Soc. nat. Hist.*, **9**, p. 180.

Agalmidae with highly contractile stem; nectosome with biserially arranged soft and less prismatic nectophores, flattened in a plane parallel or at right angles to long axis of whole animal; male and female gonodendra alternating on siphosome; tentilla involucrate and unicornuate; bracts very small, stiff, thin, foliaceous and trident.

Although Bigelow (1911b) included all known species with unicornuate tentilla under the genus *Stephanomia*, Totton (1954) showed that the generic names of *Stephanomia* and *Cupulita* were not valid. The reasons for not using these names have been dealt with under the genus *Halistemma* (*see* page 44).

The genus *Nanomia* Agassiz was revived to accommodate *bijuga* Delle Chiaje, 1841 and *cara* Agassiz, 1865.

Key to species of *Nanomia*

Nectophores flattened from stem-side to ostial side . . . . . *bijuga*

Nectophores flattened in the horizontal plane . . . . . *cara*

Type species.—Nanomia cara A. Agassiz, 1865.

Only *Nanomia bijuga* Delle Chiaje, 1841 is represented in the material examined..

Nanomia bijuga (Delle Chiaje, 1841)

(Text-fig. 4, A–G)

1841. *Physsophora bijuga* Delle Chiaje, *Descrizione e notomia degli Animali Invertebrati della Scicilia citeriore Osservati vivi negli anni* 1822–'30. et *Atlas*. Napoli, 6–7, pl. 181, figs. **3–6.**

1846. *Agalompsis elegans* Sars, *Fauna littoralis Norwegiae*, Christiana, p. 32, tab. 5, 6 (in part).

1869. *Anthemodes canariensis* Haeckel, *Natuurk. Verh. Prov. Utrechtsch*, Genoots, **1**(6), p. 36, taf. 1.

1870. *Halistemma pictum* Metschnikoff, *Mem. Soc. Amis Sci. nat.* Moscou, **8**, p. 305, tab. 2.

1874. *Stephanomia* (*Anthemodes*) *canariensis :* Metschnikoff, *Z. Wiss. Zool.*, **24**, p. 36.

1874. *Stephenomia pictum :* Metschnikoff, *Z. Wiss. Zool.*, **24**, p. 36.

1878. *Halistemma tergestinum* Claus, *Arb. Zool. Inst. Univ. Wein.*, **1**, p. 1, taf. 1, 2.

1878. *Agalmopsis elegans :* Claus, *Arb. Zool. Inst. Zool.*, **24**, p. 38 (in part).

1882. *Agalmopsis fragile* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **9**, p. 267, pl. 5, fig. 2; pl. 6, figs. 16, 17, 23–25.

1888. *Halistemma pictum :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1167.

1888. *Anthemodes canariensis :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1170.

1888. *Anthemodes picta :* Haeckel, *Jena Z. naturw.*, **22**, p. 40.

1888. *Halistemma fragile :* Haeckel, *Jena Z. naturw.*, **22**, p. 40.

1888. *Anthemodes canariensis :* Haeckel, *Jena Z. naturw.*, **22**, p. 40.

1888. *Cupulita picta :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 367.

1888. *Cupulita tergestina :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 367.

1888. *Cupulita fragilis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 367.

1888. *Cupulita canariensis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 367.

1888. *Anthemodes ordinata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 229, pls. XIV, XV.

1896. *Cupulita picta :* Bedot, *Rev. Suisse Zool.*, **3**, p. 407.

1896. *Cupulita canariensis :* Bedot, *Rev. Suisse Zool.*, **3**, p. 408.

1897. *Cupulita* (*Halistemma*) *picta :* Chun, *Verh. Dtsch. Zool. Ges.*, **7**, p. 86, fig. 19.

1898. *Cupulita bijuga :* Schneider, *Zool. Anz.*, **21**, p. 123.

1902. *Anthemodes moseri :* Agassiz & Mayer, *Mem. Mus. Comp. Zool.* Harv., **26**, p. 167, pl. 12.

1911. *Stephanomia bijuga :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 284, pl. 19, fig. 5–11; pl. 20, figs. 1–3.

1932. *Stephanomia bijuga :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 324, text-figs. 6, 7.

1954. *Nanomia bijuga :* Totton, *Disc. Rep.*, **27**, p. 52, text-fig. 19D.

1963. *Nanomia bijuga :* Daniel & Daniel, *J. Mar. biol. Assocn.* India, **5**(2), p. 195, fig. III, 2–6.

1965. *Nanomia bijuga :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 68, text-figs. **32–36**; pl. X, figs. 1–10; pl. XIV, fig. 9.

Material examined—

Station no.	*Net used*	*Depth* (*m*)	*Material*	*Z.S.I. Regd. no.*
V 5232	J N	200—0	6 nectophores	Gen. coll.
K 3	N N	,,	12 ,,	,,
K 6	,,	,,	1 colony	,,
K 7	,,	,,	2 nectophores	,,
K 8	,,	,,	1 ,,	,,
K 15	,,	,,	5 ,,	,,
K 16	,,	,,	6 ,,	,,
K 38	,,	,,	4 ,,	,,

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
K 41	N N	200—0	1 nectophores	Gen coll.
K 43	,,	,,	1 ,,	,,
K 48	,,	,,	4 coln.; 25 loose necto.	,,
K 49	,,	,,	4 nectophores; 1 colony	,,
K 51	,,	,,	3 nectophores	,,
K 54	,,	,,	2 ,,	,,
K 56	,,	,,	1 ,,	,,
K 358	Org.N.	Surface	2 ,,	,,
K 361	,,	,,	4 ,,	,,
K 378	,,	,,	2 ,,	,,
K 379	,,	,,	2 ,,	,,
K 522	,,	200—0	4 ,,	,,
K 533	,,	,,	1 ,,	,,
J 1	Ny.N.	Surface	6 ,,	,,
WC-S 4	Org.N.	,,	2 ,,	,,
MC-S 8	,,	,,	2 colonies; 10 nectophores	,,

Type-locality.—Mediterranean Sea (off Sicily).

Distribution.—It occurs in the tropical regions of all the oceans. For details of localities of distribution *see* Table 1.

Description.—In general, the colony is pinkish in colour in the living condition. It is very contractile. The entire colony measures from a few millimetres to 20.0 mm in length.

Pneumatophore.—(Text-fig. 4,A,pn): The oval shaped pneumatophore is small, measuring 0.6 mm to 1.0 mm in length and 0.23–0.5 mm in breadth. It has no radial septa. Its tip is pigmented and surrounded by polygonal cells which are reddish-brown in colour.

Nectosome.—(Text-fig. 4,A,ne): The nectosome is 1/5th the length of the colony. There are 1–5 pairs of well-developed nectophores and few reserve buds. On the nectosome, there are two to three dark-red pigmented spots near the point of attachment of the nectophores.

Nectophores.—(Text-fig. 4,B,C,F & G): The nectophores are arranged biserially and alternately. These are soft, almost round in shape, the length and breadth being nearly equal, and less prismatic than in *H. rubrum*. They are highly transparent in the living condition. Each nectophore has two lateral extensions or lobes, but the nectosac does not extend into these. The nectosac has a bulged rounded appearance and its mouth-opening or ostium is directed dorsally. The lateral radial canals are looped on the lateral surfaces of the nectosac and these loops occur higher up than in other species of Agalmidae. The mouth-plates are small and clefted.

The two dorsolateral ridges run down almost from the apices of the lateral wings of the nectophore to the ostium. The vertical ridges are present but very faintly marked. The nectophores are flattened in a plane parallel to the long axis of the whole animal by which they can easily be identified. In the living condition the nectophores measure from 1.33 mm to 1.5 mm in length, and from 1.5 mm to 1.75 mm in breadth.

In the preserved condition, the nectophores are opaque, not rounded and the two lateral sides are bent towards the ventral side. In the collections there are two kinds

of nectophores based on their sizes. The nectophores from the Bay of Bengal are very much smaller than those occurring in the Arabian Sea (*see* table below) :

	Nectophores from the Bay of Bengal	*Nectophores from the Arabian Sea*
Length :	1.33 mm	3.67 mm
Breadth :	1.17 mm	3.17 mm

The nectophores from the Arabian Sea are three times larger than those from the Bay of Bengal. Except for their size, they resemble each other greatly in possessing lateral horns, in the lateral sides being bent towards the ventral side, and in the nectosac being rounded and not extending into the lateral horns.

Siphosome.—(Text-fig. 4,A,se) : The siphosome is about 4/5th the total length of the colony. It is slender, long, highly contractile and possesses numerous buds of developing siphons—gastrozooids, tentacles, palpons, bracts and gonodendra. In a colony measuring 15.0 mm in length there are about 6–8 well developed gastrozooids, and 10–12 palpons. The gastrozooids and palpons have a net-work of red pigment at their bases.

Gastrozooids.—(Text-fig. 4, A, gz) : The primary gastrozooid possesses the larval type of tentacle, while the other gastrozooids possesses the adult type of tentacles. However, in a few colonies, the larval type of tentacles persist in all the gastrozooids. In most of the colonies only the adult type of tentacles are seen.

The larval tentacle possesses many tentilla which end in round tentacular knobs. The proximal half contains 6–8 large rounded nematocysts. The distal half bears smaller but elongated nematocysts which have long pointed cnidocils. These tentacular knobs do not have terminal filaments (Text-fig. 4,D).

The adult tentacle possesses tentilla which are involucrate and unicornuate. There are $2\frac{1}{2}$ to 3 coils in the cnidoband, and the involucrum covers only half the cnidoband. The single terminal filament is long and has a beaded appearance (Text-fig. 4,E).

Palpons.—(Text-fig, 4, A, p) : About 2–3 palpons occur between two gastrozooids. These are smaller than the gastrozooids, but similarly coloured with a network of pigment. Sometimes an oil globule is present as in *N. cara.* The palpacles are simple and short.

Bracts.—(Text-fig. 4,A,br) : These are numerous, and stand at right angles to the stem. There are two kinds of bracts. The first type is small, thin, stiff and tetragonal in shape, with three distal pointed tips or teeth. At the proximal pointed corner of the bract there is a small peg-like structure for the attachment to the stem. These are numerous in the colony. The other kind of bract is large, rounded with three distal teeth and slightly thicker edge. These occur only near the gastrozooids and are fewer in number. Sometimes these larger bracts are folded forming a cavity for the gastrozooid and its tentacle to be retracted inside.

Gonodendra.—(Text-fig. 4,A) : The gonodendra are not fully developed and occur at the bases of palpons, the male and female ones alternating. These occur in small groups. The female gonodendra possess about 10–15 sessile gynophores. Each gynophore is small, round in shape, and possesses a single ovum which occurs at one end. The surface has a reticulated appearance. The male gonodendra possess two to three stalked androphores. These occur near the base of the palpons. They are oval in shape and two regions can be distinguished.

Remarks.—Nectophores obtained from the Indian Ocean are of two types. Those occurring in the Bay of Bengal are small, soft with lesser musculature. Full colonies

range in size from 5.0–20.0 mm in length, possessing a maximum number of 5 pairs of nectophores.

Nectophores from the Arabian Sea are large, hardy with well developed musculature. Full colonies of these specimens are not available for comparison. A juvenile nectophore from the Arabian Sea material (of the same size as the Bay of Bengal nectophore) shows the same adult hardiness and well-developed musculature. When sufficient living material is available, it can be decided whether in the Indian Ocean there exists a species of *Nanomia* other than *bijuga* and *cara*.*

In an earlier investigation on the seasonal variations of the Siphonophora of the inshore waters of Madras coast during 1952–54, it was observed that the large-sized nectophores occurring in the West coast of India (Arabian Sea) were never encountered along the Madras coast. Further, swarming of juvenile forms occurred during the month of April. It is possible that these are juvenile forms which occur in great abundance in the neritic region in the Bay of Bengal and this region is probably its breeding ground.

Genus **Frillagalma** Daniel, 1966

1966. *Frillagalma* Daniel, *Ann. Mag. nat. Hist. London*, (13), **9** p. 689.

Nectophores with well flared out and frilled edges. Includes the single species: *Frillagalma vityazi* Daniel, 1966.

Frillagalma vityazi Daniel, 1966

(Text-fig. 4, H–L)

1966. *Frillagalma vityazi* Daniel, *Ann. Mag. nat. Hist.* Lond., (13)**9**, p. 690, figs. 1–5.

Material examined.—Three mature and one juvenile nectophores from RV VITYAZ Station number V 5212, taken with IOSN hauled from 200 m to surface.

Type-locality.—Latitude 05°11′S and Longitude 91°15′E. Holotype and paratypes deposited in the Zoological Survey of India, bearing registered numbers: P 1807/1 and P 1808/1.

Distribution.—Eastern Indian Ocean.

Description.—Nectophore.—(Text-fig. 4,H–L): The nectophores measure 3.7 mm to 4.8 mm in length, and 3.5 mm to 4.5 mm in breadth. The nectophores are small, delicate and transparent. All the ridges are prominent, flared out and frilled or fluted in appearance. There are two dorsolateral ridges on either side of a longitudinal median groove.

In the young nectophore the longitudinal median groove is very narrow and the dorsolateral ridges occur close together with their broad frilled edges overlapping (Text-fig. 4,H,dlr.). These ridges form facets on the dorsal side itself and do not extend on to the ventral side as in the mature nectophores.

In the mature nectophores, the central groove is broader and the frilled dorsolateral ridges are separated. These ridges run from a point just below the lateral upper corners of the nectophore down to the mouth of the nectosac where they bifurcate into an inner and an outer branch (Text-fig. 4,J,ir,or.). These branches form the dorsolateral corners of the mouth of the nectosac. The inner branch from each dorsolateral ridge does not meet its fellow on the dorsal side but both terminate close together, as shown in figure

* Totton is of the view that there may be in the Indian Ocean, a species of *Nanomia* other than *bijuga* and *cara* (personal communication).

4-J. The course of these branches is clearly seen by viewing the nectophore with the oral end uppermost.

Besides these ridges, there are four very short ridges—Text-fig. 4,I,ar,pr—(also frilled in appearance) which arise from the dorsolateral ridges. These are directed towards the central groove. The anterior pair of ridges are hidden between the frills and the frilled edges have to be flattened with a brush to see them clearly.

The dorsolateral ridges continue on the ventral side and terminate at the mouth of the nectosac, forming two irregularly shaped dorsolateral facets. Each facet is divided into two by a lateral vertical ridge. The ventral side of the nectophore is also grooved as on the dorsal side, but it is much shallower.

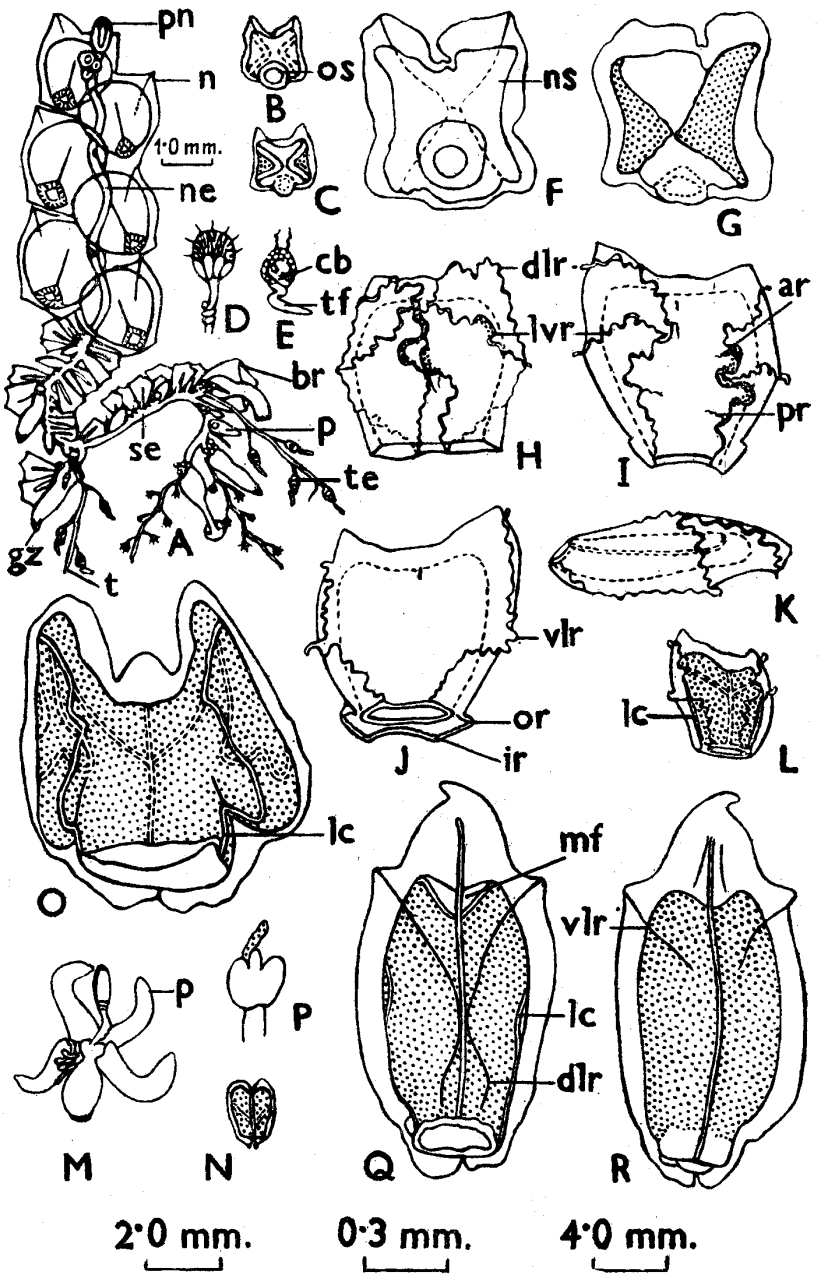
The nectosac is large and rounded. The mouth of the nectosac which is broad, oval or quadrangular in shape, is directed slightly towards the ventral side. The musculature and the lateral radial canals are clearly seen in only one nectophore after staining with diluted borax carmine. The lateral radial canals are simple, straight and unlooped. The curvature of these canals lies below the apex of the nectosac (Text-fig. 4,L,lc.).

Remarks.—Of the seven families included in the suborder Physonectae Haeckel, 1888 (Agalmidae Brandt, 1835; Athorybiidae, Huxley, 1859; Apolemiidae Huxley, 1859; Physophoridae Eschscholtz, 1829; Pyrostephidae Moser, 1925; Forskaliidae Haeckel, 1888 and Rhodaliidae Haeckel, 1888) the present species resembles the nectophores of Agalmidae to a certain extent. The nectophores of Agalmidae possess ridges and the lateral radial canals are either straight or looped. A comparison of these nectophores with those of the valid species included in the family Agalmidae (? *Halistemma amphytridis* Lesueur & Petit, 1807; *H. cupulifera* Lens & van Riemsdijk, 1908; *H. rubrum* Vogt, 1852; *H. striata* Totton, 1965a; *Agalma okeni* Eschscholtz, 1825; *A. elegans* Sars, 1846; *A. haeckeli* Bigelow, 1911b; *A. clausi* Bedot, 1888; *Nanomia bijuga* Delle Chiaje, 1841; *N. cara* Agassiz, 1865; *Lychnagalma utricularia* Claus, 1879; *Cordagalma cordiformis* Totton, 1932; *Marrus antarcticus* Totton, 1954; *M. orthocannoides* Totton, 1954; *M. orthocanna* Kramp, 1942; *Moseria convoluta* Moser, 1925 and *Erenna richardi* Bedot, 1904) and the valid species of the family Pyrostephidae (*Pyrostephos vanhoeffeni* Moser, 1925 and *Bargmannia elongata* Totton, 1954) shows that in the presence of the dorsolateral ridges and the lateral vertical ridges, these resemble *Halistemma*, *Nanomia* and *Agalma* but in these the lateral radial canals, are looped. In the bifurcated nature of the dorso-lateral ridges these resemble *Marrus* but the position of the bifurcation and the courses of the branches are different. Further, the lateral vertical ridges are lacking in *Marrus*.

Cordagalma and *Bargmannia* are known only from their nectophores (and some fragments of the siphosome in *Bargmnnia*) like the present species, and the entire colony is still unknown. Their exact systematic position is not clear though these have been assigned to the family Agalmidae (Totton, 1954; Leloup, 1955). Later in 1965, Totton assigned the genus *Bargmannia* to the Family Pyrostephidae because of the peculiar inpushing of the wall of the nectosac and the absence of musculature from that part of its wall.

The present nectophores by the possession of simple, unlooped lateral radial canals resemble *Cordagalma*, *Bargamannia* and *Marrus*. As in *Cordagalma*, the curvature of the lateral radial canals lies below the apex of the nectosac.

This species, *Frillagalma vityazi* Daniel 1966, is unique in possessing flared out and frilled ridges.



TEXT-FIGURE 4

Nanomia bijuga : A—G

A—entire colony (after Daniel & Daniel, 1963). B—nectophore : dorsal view.
C—nectophore : ventral view. D—larval tentillum. E—adult tentillum.
F—Nectophore from Arabian Sea : dorsal view. G—Nectophore from Arabian Sea : ventral view.

Frillagalma vityazi : H—L

H—young nectophore. I—Mature nectophore : dorsal view.TJ—Mature nectophore : ventral vieT.
K—Mature nectophore : side vieT. L—Mauture nectophore : showing lateral radial canals.

Physophora hydrostatica : M—P

M—young colony. N—young nectopho· O—Mature nectophore. P—Young tentillum.

Bargamannia elongate : Q & R

Q—mature nectophore, dorsal view. R—mature nectophore, ventral view.

Abbreviations used :

ar—anterior ridge. br—bract. cb—cnidoband. dlr—dorsolateral ridge. gz—gastrozooid.
ir—inner ridge. lc—lateral radial canal. lvr—lateral venrtical ridge. mf—muscle-free area.
n—nectophore. ne—nectosome. ns—nectosac. or—outer r/dge. os—ostium. p—palpon.
pn—pneumatophore. pr—posterior ridge. se—siphosome. × t—tentacle. te—tentillum.
tf—terminal filament. vlr—ventrolateral ridge.

Marrus Totton, 1954

1954. *Marrus* Totton, *Disc. Rep.*, **27**, p 55.

Agalmidae from cold waters; known only from fragments. Nectophore large with dorsolateral ridges bifurcating into two at their distal ends and without vertical ridges; lateral radial canals straight (unlooped); tentilla unicornuate, without involucrum.

Type-species.—Marrus antarcticus Totton, 1954.

The three valid species of *Marrus* are :

1. *M. antarcticus* Totton, 1954
2. *M. orthocanna* Kramp, 1942
3. *M. orthocannoides* Totton, 1954.

Key to species of *Marrus*

1.	Nectosac without musculature on its broad ad-axial face	2
	Nectosac with musculature on its broad ad-axial face	*orthocannoides*
2.	Bracts flattened, cone-shaped, truncated distally; with bracteal canal terminating on papilla	*antarcticus*
	Bract quadrangular, distal and lateral angles almost rectangular, without protruding points or ridges	*orthocanna*

These species are not represented in the collection.

Distribution.—M. antarcticus is restricted to the Antarctic Ocean and in waters that have just left the zone. *M. orthocanna* is restricted to the Arctic Ocean (Baffin Bay) and has penetrated south, west of the Faroes. *M. orthocannoides* is known from the Indian Ocean only.

Moseria Totton, 1965

1965. *Moseria* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 66.

Agalmidae with pneumatophore consisting of two chambers besides pneumatosaccus; nectophores exceptionally thin in comparison with length and breadth. Tentilla involucrate and unicornuate.

Monotypic genus for *Moseria convoluta* (Moser, 1925).

This species has been recorded from the Antarctic Ocean by Moser, 1925. For description and figures see Totton, 1965, p. 47, text-fig. 31; pl. XIII, figs. 4–10.

This species is not represented in the present collection.

Lychnagalma Haeckel, 1888

1888. *Lychnagalma* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 234.

Agalmidae with multicornuate tentilla consisting of involucrate cnidoband, terminal ampulla and a corona of eight radial horns or filaments.

Type-species.—Lychnagalma utricularia (Claus, 1879).
Agalmopsis utricularia Claus, 1879

This species from the Mediterranean Sea has been described in great detail by Claus (1879) and by Totton (1965, p. 73, pl. XVI, figs. 1–7).

? Lychnagalma vesicularia Haeckel, 1888, recorded from the Indian Ocean (off Ceylon) is considered a doubtful species by Totton (1965).

The genus *Lychnagalma* is not represented in the collections.

Erenna Bedot, 1904

1904. *Erenna* Bedot, *Res. Camp. Sci. Monaco*, **27**, p. 1–27.

Agalmidae known from fragments only. Nectophores with muscle-free strip of nectosac above and below proximal, adcauline part of unlooped pigmented lateral radial canals; with short caecum-like or long, fine horn canals at lateral corners of nectosac. Nectosome and siphosome with black pigments in endoderm. Tentacle with characteristic tentilla—divided into a pedicle, a middle part with upper half crested, and an apex.

Monotypic genus for *Erenna richardi* Bedot, 1904 (—*Erenna bedoti* Lens & van Riemsdijk, 1908).

Type-locality.—Between Portugal and the Azores.

Types are in the Institut Oceanographique, Monaco.

Distribution.—It occurs in the tropical regions of the three oceans—the Atlantic, Pacific & Indian—from great depths (*see* Table 1).

The genus *Erenna* is not represented in the collections.

Family 5 PYROSTEPHIDAE Moser, 1925

Physonectae with long nectosome, biserially arranged nectophores with lateral radial canals arising separately from ventral and dorsal canals, having three loops each; ventral canal nearly straight and dorsal canal having three or four marked bends; adaxial side of nectosac lacking musculature; deeply embayed towards ostium, with embayment occupied by mesoglea. Adult tentillum with proximal part of axial canal appearing as a fine tube on one side of the widened diverticular canal, which becomes the cavity of the saccus; outer wall of diverticular canal becoming cnidoband. Bracts large, three-pointed, thick, flat below and conical above. The gonophores budded one from another forming small gonodendra. Dioecious.

Two genera *Pyrostephos* Moser, 1925, and *Bargmannia* Totton, 1954, are included in this family.

Key to the Genera of *Pyrostephidae*

1. Nectosac lacks musculature on adaxial side; deeply embayed, embayment occupied by mesoglsea 2

2. Nectophore with breath greater or equal to length . . . . . *Pyrostephos*
   Nectophore twice as long as broad . . . . . *Bargmannia*

Pyrostephos Moser, 1925

1925. *Pyrostephos* Moser, *Dtsch. Siidpol Exped.*, **18**, p.

This is a monotypic genus for *P. vanhoeffeni* Moser, 1925. The diagnostic features of this genus are given under the family characters. This species is confined to the Antarctic Ocean and is not represented in the present collections.

Bargmannia Totton, 1954

1954. *Bargmannia* Totton, *Disc. Rep.*, **27**, p. 69.

Pyrostephidae known only from its nectophores and fragments of stem and detached gastrozooids. With large elongated nectophores lacking in musculature on adaxial side of nectosac, with deep embayment occupied by mesogloea; all radial canals straight without any sigmoid bends.

It is a monotypic genus for *B. elongata* Totton, 1954, which is represented in the present collection by the nectophores only.

Bargmannia elongata Totton, 1954

(Text-fig. 4, Q & R)

1954. *Bargmannia elongata* Totton, *Disc. Rep.*, **27**, p. 69, text-fig. 28.

1955. *Bargmannia elongata :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 13.

1965. *Bargmannia elongata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 82, text-fig. 45.

Material examined.—The material consists of 5 mature and one juvenile nectophores from INS KISTNA Station no. K 46, from a depth of 200-0 metres.

Type-locality.—Cape Verde Islands—in North Atlantic (Lat. 14°27¼′ N; Long. 30°02¼′ W) from a depth of 370-0 metres.

Holotype.—Deposited in British Museum (Natural History) bearing Reg. no. 1952.11.19.7-25.

Distribution.—Western Indian Ocean, off South & East coasts of Africa; North Atlantic (Lat. 37°37′ N; Long. 29°25′ W). Present record : from the Arabian Sea.

Description : Nectophore.—(Text-fig. 4, Q & R) The size of the nectophores ranges from 4.0 to 11.0 mm in length, and 2.2 mm to 5.53 mm in breadth. The nectophore is twice as long as broad. It is almost cylindrical in shape from the level of the base of the nectosac to the ostium. The cylindrical part is ¾th the total length. The proximal end is flat and triangular. The pallial canal lies in the mid-region of this extension and reaches nearly up to the tip of the nectophore. The long muscular lamella is discernible on the ventral side, along the entire length of the triangular extension of the nectophore.

The dorsolateral ridges are prominent and extend from the two corners of the cylindrical portion. These curve toward the median line and diverge again terminating near the mouth of the nectosac (Text-fig. 4, Q,dlr.).

Similarly two more ridges, the ventrolaterals, occur on the ventral side of the nectophore. The dorsolaterals and the ventrolaterals are connected by very gradually sloping (oblique) ridges on the lateral sides of the nectophore. These oblique ridges are long, extending from the two upper corners of the nectophore to the base of the ventrolateral ridges forming narrow, elongated, triangular facets on the lateral sides. From the ventrolateral ridges two thin ridges, run almost to the tip of the nectophore (Text-fig. 4,R,vlr).

The nectosac is cylindrical or tubular in shape. It is not produced into wings. Its apex has a slight notch or embayment directed toward the ostium. In this region, there is no musculature while the other portion shows well developed musculature. The lateral radial canals are simple, slightly bent, without forming any loops on its

way to the ring-canal. The dorsal and ventral radial canals are also simple and straight. The mouth of the nectosac is large and is directed upwards. The nectophore extends below the mouth of the nectosac and it is slightly bilobed.

Remarks.—The present material was collected from the Arabian Sea from a depth of 200-0 metres, while those of the DISCOVERY material came from a depth of 370-0 metres; 1,000–750 metres (Totton, 1954), and those from the North Atlantic from a depth of 1,000–0 metres (Leloup, 1955a). As in previous records, only the nectophores have been collected. No fragments of an orange-coloured stem or large detached gastrozooids (30.0 mm×7.0 mm) similar to those noted by Totton (1965) are found in the same plankton sample as the nectophores.

The entire colony of this species is still unknown.

On the basis of lack of musculature on the adaxial wall of the nectosac and its deep embayment occupied by mesogloea, this species has been included in this family. Only a study of the complete colony, particularly its tentillum would confirm its place in this family.

Family 6 PHYSOPHORIDAE Eschscholtz, 1829

Physophoriadae Huxley, 1859

Discolabidae Haeckel, 1888

Physonectae with elongated nectosome and biserially arranged nectophores; siphosome, instead of elongating, expands laterally into a spiral sac, with cormidia occurring on outer rim of faceted sides; each cormidium possessing a single very long palpon with nematocysts at tip, forming a ring of active feelers capable of co-ordinated action around gastrozooids.

One genus *Physophora* Forskål, 1775, is considered as valid.

Genus **Physophora** Forskål, 1775

1775. *Physophora* Forskål, *Descriptiones....edidit carstem Niebuhr.*, p. 119.

1829. *Discolabe* Eschscholtz, *System der Acalephen*, p. 155.

1888. *Discolabe* : Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 263.

The diagnostic characters of this genus are dealt with under the family.

The various Atlantic and Mediterranean species of *Physophora* were united by Chun (1897b). Subsequent workers also (Lens & van Riemsdijk, 1908; Bigelow, 1911b) who studied material from the Indo-Pacific and eastern tropical Pacific, came to the same conclusion that only one species of *Physophora*, i.e., *P. hydrostatica* Forskål, as valid. The structure of *P. hydrostatica* was studied in detail by Gegenbaur (1859b), Claus (1860, 1878), Sars (1877), Lens & van Riemsdijk (1908) and Totton (1954, 1965a).

The species of *Discolabe* i.e., *D. tetrasticha* Philippi, 1843 and *D. quadrigata* Haeckel, 1888b were not recognized as valid, since the quadriserial nectosome is due to the spirally twisted stem as explained by Gegenbaur (1853). The evidence published by Haeckel for the latter species was considered unsatisfactory by Totton (1965). Thus, the genus includes only one valid species, i.e., *P. hydrostatica* Forskål, which is present in the collection.

Physophora hydrostatica Forskål, 1775

(Text-fig. 4, M–P)

1775. *Physophora hydrostatica* Forskål, *Descriptiones animalium....quae in itinere orientali observavit, post mortem editi carstem Niebuhr.* Hauniae, p. 114.

1776. *Physophora hydrostatica :* Forskål, *Icones rerum naturalium....post mortem auctoris editi Carsten Nicbuhr,* Hauniae, tab. 33, fig. 3.

1789. *Physophora hydrostatica :* Modeer, *Kongl. Vetenskaps Acad. nya Handlinger,* **10**, p. 280.

1790. *Physophora hydrostatica :* Gmelin, Linne *Systema naturae.* ed. **13**(1), p. 3159.

1807. *Physophora muzonema* Peron & Lesueur, *Voyage de decouvertes aux terres executi Pendant* 1800–'04 *et redige par M. F. Peron.* 2 tom (*et Atlas*), Paris, p. 43, taf. 29, fig. 4.

1824. *Physophora forskal* Quoy & Gaimard, *Voyage de decouvertes sur l' Uranie et la 'Physicienne'... Zool.*, pt. 2 & *Atlas,* Paris, p. 583, pl. 87, fig. 6.

1826. *Physophora disticha* Lesson, *Voyage autour du Monde Sur la Corvette de saMajeste 'La Coquille' Pendant les annees* 1822–'25, & *Atlas, Zoophytes,* p. 16, fig. 3.

1827. *Rhizophysa discoidea* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 179, pl. 5, B, figs. 1–3.

1829. *Physophora hydrostatica :* Eschscholtz, *System der Acalephen,* Berlin, p. 145.

1829. *Discolabe mediterranea* Eschscholtz, *System der Acalephen,* Berlin, p. 156.

1830. *Physophora disticha :* Lesson, *Voyage autom du Monde,* etc. *Zoologie.*, **2**, p. 49.

1830. *Rhodophysa discoidea :* Blainville, *Dict. Sci. nat.* Paris, **60**, p. 112.

1834. *Rhodophysa discoidea :* Blainville, *Manuel d'actinologie ou de Zoophytologie,* Paris, p. 123.

1834. *Physophora discoidea :* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'....de M. J. Dumont D'Urville. Zool. & Atlas, Zoophytes,* **4**, p. 59, pl. 1, figs. 22–24.

1835. *Physophora ambigua* Brandt, *Polypus. Acalephas Discophoras et Siphonophoras nec non Echinodermata continens Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatum.* St. Petersburg, **1**, p. 32.

1836. *Physophora muzonema* Costa, *Fauna degli Regno di Napoli, Medusari,* p. 7, taf. 3.

1841. *Physophora rosacea* Delle Chiaje, *Descrizione e notomia degli Animali Invertebrati della Scicilia Citeriore osservati vivi negli anni* 1822–'30 *et Atlas,* Napoli, 6–7, tab. 33, fig. 2.

1843. *Physophora tetrasticha* Philippi, *Arch. f. Anat. u. Physiol.*, p. 58, taf. 5.

1850. *Physophora glandifera* Sars, *Nyt. Mag. Naturvidenskabeme,* Christiana, **6**, p. 158.

1850. *Physophora vesiculosa* Sars, *Nyt. Mag. Naturvidenskabeme,* Christiana, **6**, p. 159.

1853. *Physophora phillippi* Kölliker, *Die Schwimmpolypen oder Siphonophoren von Messina.* Leipzig, p. 19, taf. 5.

1859. *Stephanospira insignis* Gegenbaur, *Nova Acta Leop. Carol.*, **27**, p. 67, taf. 33, figs. 53–56.

1859. *Physophora hydrostatica :* Gegenbaur, *Nova. Acta Leop. Carol.*, **27**, p. 382, taf. 30.

1860. *Physophora hydrostatica :* Claus, *Z. Wiss. Zool.*, **10**, p. 295, tab. 25–27.

1869. *Physophora magnifica* Haeckel, *Natuurk. Verh. Prov. Utrechtsch. Genoots,* **1**(6), p. 36, taf. 3.

1877. *Physophora borealis* Sars, *Fauna littoralis Norwegiae,* **3**, p. 32, taf. 5, 6, figs. 1–8.

1888. *Physophora magnifica :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1172.

1888. *Discolabe mediterranea* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 263 (Non Eschscholtz).

1888? *Discolabe quadrigata* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 263, pls. 19–20.

1897. *Physophora hydrostatica :* Chun, *Ergebu. plankton Exped.*, **2**, k.b., p. 39, taf. 2, 3, figs. 3–6.

1898. *Physophora hydrostatica :* Schneider, *Zool. Anz.*, **21**, p. 126.

1908. *Physophora hydrostatica :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 86, pl. 16, figs. 120–122.

1941. *Physophora hydrostatica :* Leloup, *Bull. Mus. Hist. nat.* Belg., **17**(31), p. 1.

1954. *Physophora hydrostatica :* Totton, *Disc. Rep.*, **27**, p. 42.

1955. *Physophora hydrostatica :* Leloup, *Rep. Sci. res. 'Michael Sars' north Atlantic deep Sea Exped.*, 1910. *Siphonophores,* **5**(11), p. 14.

1965. *Physophora hydrostatica :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 83, pl. XV, figs. 1–10.

Material examined.—The material consists of a single young colony and five mature nectophores. Details of these are given below :

Station no.	*Depth(m)*	*Net used*	*Material*	*Z.S.I. Regd. no.*
K 8	75—0	N N	1 young colony; 3 loose nectophores	Gen. coll.
K 21	200—0	,,	5 mature nectophores	,,

Type locality.—North Mediterranean.

Distribution.—This species has been recorded frequently from the tropical regions of the three oceans. Details of localities are given in Table 1.

Description.—The young colony measures :

length of pneumatophore	.. 0.9 mm
length of nectosome (incl. pn.)	.. 1.5 mm
breadth of siphosome	.. 0.5 mm
length of primary gastrozooid	.. 1.1 mm
length of palpon	.. 2.0 mm
length of young nectophore	.. 1.3 mm
breadth of young nectophore	.. 0.9 mm

The young colony (Text-fig. 4,M) carries two immature and few minute buds of nectophores, 5 palpons, 2 gastrozooids and an immature tentacle. The pneumatophore is plum-coloured at the apex and has a narrow stalk. The nectosome is elongated and bears nectophores.

Nectophore.—(Text-fig. 4,N) The apex of the immature nectophore has two small blunt or rounded lateral extensions. The nectosac is almost of the same diameter throughout its length and does not extend into the lateral wings. The lateral radial canals originate lower down, *i.e.*, nearer the ostium. At the base of the ostium there is a pair of lobes. The canals are not so highly sinuous as in the matured nectophores.

The matured nectophore (Text-fig. 4,O) measures 6.13 mm in length, 5.43 mm in breadth and the ostium of diameter 2.77 mm. The nectophore has lateral subangular expansions or wings and the apex of the nectosac extend into them. The nectosac is broad at the base and narrows into a tubular portion at the ostium. This tubular portion has the same diameter (2.77 mm) as the ostium. The nectophore extends into two small lobes below the ostium. The origin of the lateral radial canals is higher up than in the immature nectophores. They are very long and pass through a complex sinuous course, entering the lateral wings of the nectosac twice, *i.e.*, once ventrally and then dorsally before reaching the ring-canal. Siphosome of the young specimen : The pentagonally expanded siphosome measures 0.5 mm in breadth. Originally there were five palpons, all attached on the upper margin of the siphosome. These are almost sessile, long, broad and curved upwards towards the pneumatophore. The tips of these palpons are differently coloured in the preserved material showing the presence of nematocysts.

There are two gastrozooids of which the larger one measuring 1.1 mm in length is the primary gastrozooid. The other one is smaller. The tentillum ends in a rounded trilobed structure (Text-fig. 4,P). The denuded siphosome has a faceted appearance.

No gonodendra are present in this colony.

Family 7 ATHORYBIIDAE Huxley, 1859

Anthophysidae Brandt, 1835

Ploeophysidae Fewkes, 1888b

Physonectae with nectosome reduced or absent; siphosome reduced, vesicular, bearing bracts, gastrozooids with involucrate and tricornuate tentilla, palpons with palpacles and gonodendra; bracts occurring on siphosome forming corona around pneumatophore.

The best known Athorybiidae is the Mediterranean *Physophora rosacea* Forskål, 1775. Two closely related species : *Rhizophysa heliantha* Quoy & Gaimard, 1827 and *R. melo* Quoy & Gaimard, 1827, were described from the Straits of Gibralter. These species were included in the genus *Athorybia* by Eschscholtz, 1829. But Brandt (1835) included these three species and a fourth species from the North Pacific, *Anthophysa rosea* (based on unpublished and only a manuscript description by Mertens) in the Family Anthophysidae. Haeckel (1888b) recognised four genera : *Athorybia* Eschscholtz, 1829; *Anthophysa* Brandt, 1835; *Rhodophysa* Haeckel, 1888b and *Melophysa* Haeckel 1888b, under Anthophysidae. Bigelow (1911b, p. 294; 1931) however considered only *Athorybia* and *Anthophysa* as valid. The genera *Rhodophysa* and *Melophysa* were treated as problematic and doubtful since these were neither described in detail nor figured, and each was based on a single specimen which was soon lost. He felt that the descriptions of *Athorybia rosacea* given by Forskål could apply equally to any *Athorybia*. Therefore, Bigelow (1911b; 1931) assigned a species with distinctly thick, ribbed, tuberculated bracts (*Athorybia melo* Quoy & Gaimard) as *A. rosacea*. The species with thin, striated bracts was assigned to *Anthophysa rosea* Brandt, 1835.

However, Totton (1954, p. 57) considered *Athorybia rosacea* Forskål as valid; and synonymised *Anthophysa rosea* with *Athorybia rosacea*. He felt that *Rhizophysa melo* Quoy & Gaimard was distinct, due to the presence of a short nectosome, and included it under *Melophysa* Haeckel. He considered only *Athorybia* and *Melophysa* as valid.

Key to genera of *Athorybiidae*

1. Nectosome absent or reduced, possessing nectophore 2
2. Nectosome absent; bracts thin distally, with seven inconspicuous longitudinal rows of nematocysts on dorsal surface . . . . . *Athorybia*

   Nectosome reduced, possessing nectophore; bracts thick, with 8–9 longitudinal rows of strong tubercles or papillae on dorsal surface . . . . . *Melophysa*

Both the genera are represented in the collection.

Genus **Athorybia** Eschscholtz, 1829

1829. *Athorybia* Eschscholtz, *System der Acalephen*, p. 153.
1835. *Anthophysa* Brandt, Polypus, *Acalephas....observatum.*, **1**, p. 35.
1843. *Angela* Lesson, Acalephs, *Hist. nat. Zoophytes*, p. 496.
1853. *Athorybia :* Kölliker, *Die Schwimmpolypen Oder Siphonophoren von Messina*, p. 24.
1859. *Athorybia :* Huxley, *The Oceanic Hydrozoa., Ray Soc. London*, p. 86.
1859. *Athorybia :* Gegenbaur, *Nova Acta Leop. Carol.*, **27**, p. 412.
1882. *Athorybia :* Fewkes, *Bull. Mus. Comp. Zool. Harv.*, **9**, p. 271.
1888. *Ploeophysa* Fewkes, *Ann. Mag. Nat. Hist.*, (6) **1**, p. 317.
1888. *Diplorybia* Fewkes, *Ann. Mag. Nat. Hist.*, (6) **1**, p. 320 (foot-note).
1888. *Athorybia :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 275.
1888. *Anthophysa :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 278.

1897. *Anthophysa :* Chun, *Ergeb. Plankton Exped.*, 2 k, b : p. 61.
1904. *Anthophysa :* Bedot, *Res. Camp. Sci. Monaco.*, **27**, p. 5.
1911. *Anthophysa :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 296.
1936. *Anthophysa :* Totton, *Zoologica* N.Y., **21**(4), p. 237.
1941. *Anthophysa :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **17** (47), p. 1.
1946. *Anthophysa :* Garstang, *Quart. J. Micros. Sci.*, **87**, p. 167 .
1955. *Anthophysa :* Leloup, *Rep. Sci. res. "Michael Sars" north Atlantic deep sea Exped.*, **5**(11), p. 14.
1965. *Athorybia :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 87

Athorybiidae without nectosome; siphosome with thin striated bracts; involucrate tentilla with 2–3 coils in cnidoband and tricornuate or dendritic terminal filaments.

Monotypic genus for *A. rosacea* (Forskål, 1775.)

This species is represented in the collection.

Athorybia rosacea (Forskål, 1775)

(Text-fig. 5, A–H)

1775. *Physophora rosacea* Forskål, *Descriptiones animalium....quae in itinere orientali observavit, post mortem editi Carstem Nelbuhr*, Hauniae, p. 120.
1776. *Physophysa rosacea :* Forskål : *Icones rerum naturalium....post mortem auctoris editi Carten Niebuhr*, Hauniae, taf. 43, fig. B.
1789. *Physophora rosacea :* Modeer : *Kogl. Vetenskaps. Akad. nya Handlinger*, **10**, p. 283.
1816. *Rhizophysa rosacea :* Lamarck : *Histoire naturelle des animaux sans vertebres*, Paris, **2**, p. 478.
1827. *Rhizophysa heliantha* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 177, pl. 5a, figs. 1–8.
1830. *Rhodophysa helianthus :* Blainville, *Dict. Sci. Nat.*, Paris, **60**, p. 112.
1830. *Rhodophysa rosacea :* Blainville, *Dict. Sci. Nat.*, Paris, **60**, p. 112.
1834. *Rhodophysa helianthus :* Blainville, *Manuel d'actinologie ou de Zoophytologie*, Paris, p. 123.
1834. *Rhodophysa rosacea :* Blainville, *Manuel d'actonilogie ou de Zoophytologie*, Paris, p. 123.
1835. *Anthophysa rosea :* Brandt, *Polypus Acalephas Discophoras et Siphonophoras nec non Echinodermata continens Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatum.* St. Petersburg, **1**, p. 35.
1843. *Angela cytherea :* Lesson, *Acalephs Histoire haturelle des Zoophytes*, p. 496, pl. 9, fig. 1 (*Anga* nom. nov. Stechow, 1921; *Angela* preoccupied-Orthoptera).
1853. *Athorybia rosacea :* Kölliker, *Die Schwimmpolypen oder Siphonophoren von Messina.* Leipzig, p. 24, taf. 7.
1859. *Athorybia rosacea :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 86, pl. 9.
1859. *Athorybia heliantha :* Gegenbaur, *Nova Acta Leop. Carol.*, **27**, p. 412, taf. 32, figs. 43, 44.
1882. *Athorybia formosa* Fewkes, *Bull. Mus. Comp. Zool. Harv.*, **9**, p. 271, pl. 5, figs. 3, 4; pl. **6**, figs. 7–14.
1888. *Ploeophysa agassizii* Fewkes, *Ann. Mag. nat. Hist.*, Lond., **6**(1), p. 317, pl. 17, figs. 1, 2.
1888. *Diplorybia formosa :* Fewkes, *Ann. Mag. nat. Hist.*, Lond., **6**(1), p. 320 (foot note).
1888. *Athorybia californica* Fewkes, *Ann. Mag. nat. Hist.*, Lond., **6**(3), pl. 207, pl. 1.
1888. *Athorybia ocellata* Haeckel, *Jena Z. naturw.*, **22**, p. 42.
1888. *Anthophysa darwinii* Haeckel, *Jena Z. naturw.*, **22**, p. 43.
1888. *Athorybia indica* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 275.
1888. *Athorybia ocellata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 276, pl. 11, figs. 10–18.
1888. *Athorybia formosa :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 278.
1888. *Anthophysa darwinii :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 278, pl. **12**, fig. 7–9.

1897. *Athorybia rosacea :* Chun, *Ergebn. plankton Exped.*, **2**, k.b., p. 49.
1897. *Athophysa formosa :* Chun, *Ergebn. plankton Exped.*, **2**, k.b. p. 61, pl. 3, figs. 7,8.
1898. *Athorybia rosacea :* Schneider, *Zool. Anz.*, **21**, p. 162.
1904. *Anthophysa formosa :* Bedot, *Res. Camp. Sci.* Monaco., **27**, p. 5, pl. 1, figs. 4–15.
1908. *Anthophysa formosa :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 88, pl. 16, fig. 123a,b.
1911. *Anthophysa rosea :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 296, pl. 20, figs. 7–13; pl. 21, figs. 1–5; pl. 23, figs. 1–5.
1925. *Anthophysa rosea :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, 9, p. 441.
1926. *Anthophysa rosea :* Browne, *Trans. Linn. Soc.*, Lond., *Zool.*, ser. 2, **19**(2), p. 83.
1931. *Anthophysa rosea :* Bigelow, *Zoologica*, N.Y, **8**(11), p. 577.
1936. *Anthophysa rosea :* Totton, *Zoologica*, N.Y., **21**(4), p. 237.
1937. *Anthophysa rosea :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II *Biology*, H. **2**, pp. 64, 124, fig. 78.
1941. *Anthophysa rosea :* Leloup, *Bull. Mus. Hist. nat.* Belg. **17**(47), p. 1.
1954. *Athorybia rosacea :* Totton, *Disc. Rep.*, **27**, p. 38, pls. 1–3.
1954. *Athorybia longifolia :* Kawamura, *J. Shiga Prefect Junior College*, Ser. A, **2**, p. 205.
1955. *Anthophysa rosea :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 14.
1955. *Anthophysa rosea :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 16.
1965. *Athorybia rosacea :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 87, text-fig. 48; pl. XVII, figs. 1–16.

Material examined.—The material consists of 5 colonies and 10 loose palpons.

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5220	Pl. N.	Surface	One young col.	Gen. coll.
DM 128 DM/4/62* Sample no. 940/E	IOSN	200—0	One col.; 10 palp.	,,
DM 130 DM/4/62* Sample no. 952/E	,,	,,	One col.	,,
DM 46 DM/1/63* Sample no. 1437/E	,,	,,	One col.	,,
DM 5 DM/1/63* Sample no. 1267/E	,,	,,	One col.	,,

(* For details of these cruises, *see* MATERIAL & METHODS).

Type locality.—From Straits of Gibralter.

Distribution.—It occurs in the tropical and temperate regions of the three oceans (*see* Table 1).

Description.—The colonies represented in the present collection are of two kinds. Of the five colonies; four are young, showing linear arrangement of the gastrozooids in a straight row and fewer groups of bracts on either side of pneumatophore. The fifth colony, from DM/1/63, Station no. 46, shows a distinct bilateral arrangement of the different appendages which are spirally and radially directed on the oval shaped shortened stem or "corm" (Text-fig. 5,G,H).

A medium-sized young colony (from DM/4/62 Station no. 128) measures 7.0 mm in length and possesses 6 gastrozooids (two very young), few palpons—many loose palpons were obtained from the same plankton sample—attached, two well extended tentacles,

a single small attached bract, and remnants of the muscular lamellae of the bracts which occur in four groups of four each.

Pneumatophore.—(Text-fig. 5,A,pn.) The pneumatophore is large, measuring 2.25 mm to 3.0 mm in diameter, and is pigmented apically. Dark brown or red coloured pigments occur as granules or flecks arranged in clusters radially. This pigmented area is very thin and transparent, while the area below is thicker, opaque and possesses white coloured giant cells similar to those described by Bigelow (1911b). These giant cells separate the pneumatocodon from the pneumatosaccus. There is no apical pore at the apex of the pneumatophore, but it is open below by a round opening. It is large, and measures 0.67 mm in diameter. This is seen clearly when the whole colony is examined with its undersurface uppermost (Text-fig. 5,D).

In one of the young colonies (from DM/4/62 Station no. 130) there is a peculiar round structure which is firm, disc-shaped with a funnel-like central opening; whether this forms the base of a pneumatophore is not clear because one end of it is free and appears to hang from the other end (as shown in Text-fig. 5, F,uds). This needs further study.

The septa, their number, nature and occurrence are not clearly seen in unsectioned material, but Bigelow (1911b) has given full details of these septa.

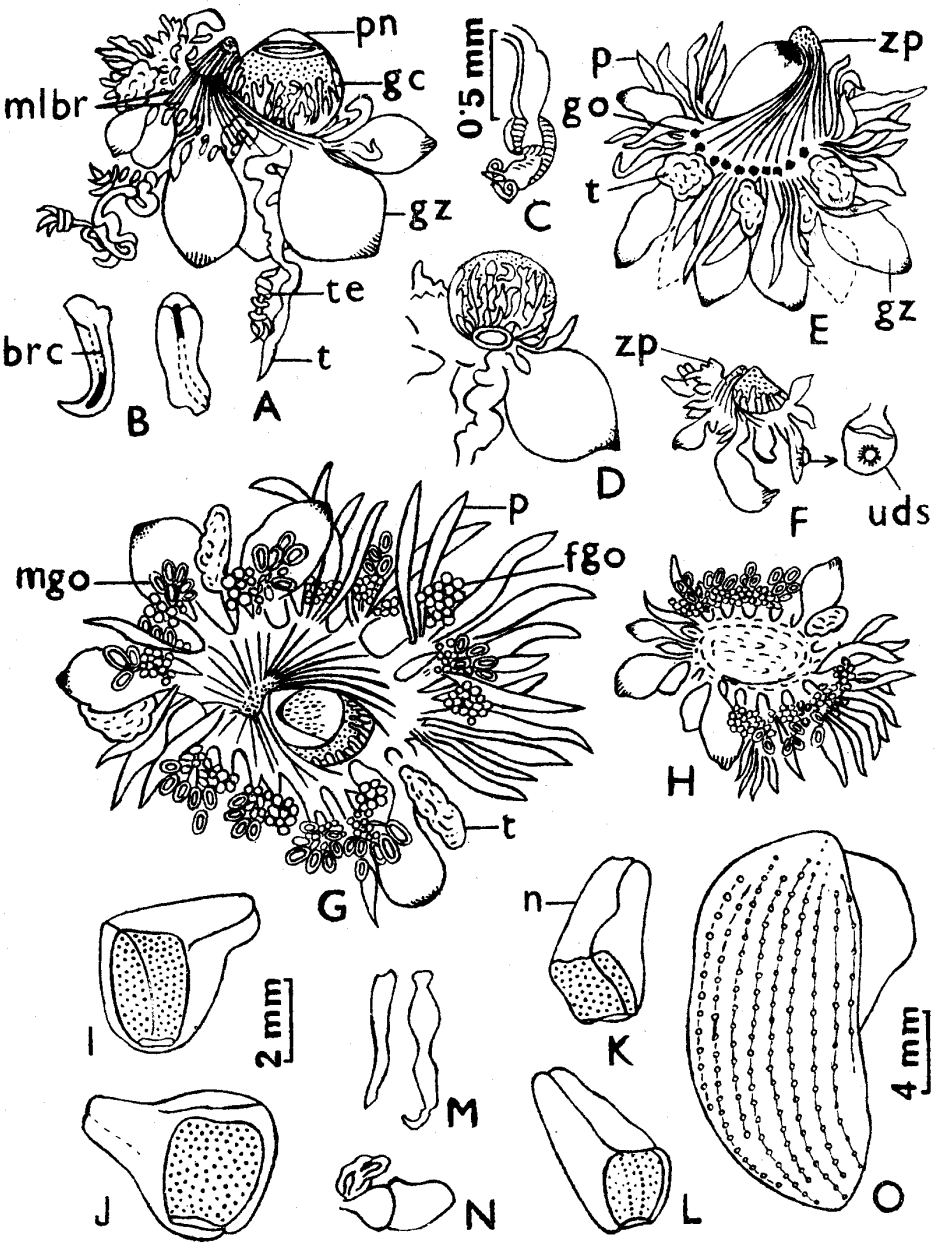
Zone of proliferation.—There are two zones of proliferation, *i.e.*, one for the bracts and the other (just below it) for the gastrozooids. In the contracted specimens, the zone of proliferation of the bracts is seen as a raised hood-like structure, and occurs close to the pneumatophore on the ventral side. Minute buds are seen on its surface as papillae.

Cormidia.—(Text-fig. 5,A & E,gz.) The cormidia are arranged in a single median row, the youngest occurring near the ventral end and the oldest occurring at the opposite (dorsal) end. The budding of new gastrozooids is seen at the ventral end just behind the proliferation of the bracts. As mentioned above, there are six gastrozooids of which two are very young : the rest are larger but contracted, possess stalks, well developed basigaster and eight striae of hepatic (?) ridges radiating from the mouth opening. Of the four well-developed tentacles, two are extended and show the presence of tricornuate tentilla.

Tentilla.—(Text-fig. 5,A,te.) In the present collection only the tricornuate tentilla are observed. The dendritic type, similar to those noted by Fewkes (1882a), Haeckel (1888b), and Bigelow (1911b) are not present. The tentilla are covered over by involucra. There are only 2 to $2\frac{1}{2}$ coils in each cnidoband. In the young tentillum the cnidoband is straight or curved and when coiled, the coiling, is loose. The two lateral filaments or horns are long and thin while the median ampulla is short and thick.

Palpons.—(Text-fig. 5,E,p.) These are arranged in a circlet above the gastrozooids, but many of them, the larger ones, have come off. They are long, thin and bear nematocysts at their tips.

Bracts.—(Text-fig. 5,B.) There is a single, immature small bract present which measures 3.0 mm in length. It is characteristically shaped, like the adult bract (described by previous workers). It is three times as long as broad, with a keel for attachment—this keel is flattened laterally in its proximal part and flattened dorsoventrally at the distal part. It is convex on the upper side but it is smooth and does not bear the seven inconspicuous longitudinal rows of nematocysts observed for the adult bract. As stated above, the remnants of the muscular lamellae of the bracts are seen to arise from the "ex-centric" zone of proliferation or nectostyle. Further, these muscular lamellae or pedicels are observed to embrace the pneumatophore in the contracted specimens. In this specimen, there are four groups of muscular lamellae separated by free spaces in-between. Each group consists of 3–4 muscular lamellae. In the living state, the bracts form a complete corona around the pneumatophore.



TEXT-FIGURE 5

Athorybia rosacea : A—H

A—young colony with linear arrangement of gastrozooids. B—young bracts. C—young tentillum. D—under surface of pneumatophore. E—slightly older colony in which gastrozooids alternate. F—young colony, with undefinable structure (uds). G—mature colony, showing distinct bilateral syns metry : upper aspects. H—mature colony, showing district bilateral symmetry : underside view.

Melophysa melo : I—O

I—mature nectophore : dorsal view. J—mature nectophore : ventral view. K—young nectophore : dorsal view L—young nectophore : ventral view. M—palpon. N—gastrozooid. O—bract.

Abbreviations used :

br.c—bracteal canal. f.go—female gonophore. go—gonophore. gc—giant cells. gz—gastrozooid. m.go—male gonophore. mlbr—muscular lamellae of bracts. n—nectophore. p—palpon. pn—pneumatophore. t—tentacle. te—tentillum. uds—undefinable structure. zp—zone of proliferation.

Gonodendra.—(Text-fig. 5,E,go.) There are two very small structures with undeveloped gonophores occurring in between the gastrozooids just below the group of muscular lamellae of the bracts.

Description.—(Text-fig. 5, G & H.) The largest colony measures 13.0 mm in length. There are nine groups of muscular lamellae—each made up of 5–6 lamellae—on either side of the pneumatophore. These groups are crowded at the zone of proliferation, but towards the distal end they are separated by well-marked spaces.

Just below the groups of bracts of this large colony, are the thick, short stalks of the gonodendra (Text-fig. 5, G,fgo,mgo.). These stalks are arranged, six on each side, of the oval-shaped vesicular corm. About 6–8 palpons occur on the upper side of the stalks of the gonodendra. Distally, each stalk of the gonodendra divides into two, one branch bearing male gonophores, and the other, female ones. The sexes alternate in each stalk. The male gonophores are borne on long thin pedicels, and show two distinct regions. The female ones have short stalks, each bearing a single ovum.

Gastrozooids.—(Text-fig. 5,G & H.) There are about four gastrozooids found attached between the stalks of the gonodendra. It is deduced that there are about 16 gastrozooids in the colony, based on the assumption that one gastrozooid occurs between two stalks—many of the gastrozooids get easily detached and hence very few are found actually attached in captured colonies. The tentilla are exactly like those described for the specimens in which the cormidia are arranged in a linear manner.

As in the other forms, this example lacks a nectosome and no trace of a muscular lamella of the pedicel of a nectophore is seen near the pneumatophore. The pneumatophore is similar to that described above for the young colony.

Remarks.—As stated above there are two kinds of examples found in the present series. The one with the linear arrangement of the cormidia in a single median row resemble Bigelow's (1911) specimens described as *Anthophysa rosea* Brandt, while the other example with the bilaterally symmetrical, spirally and radially arranged cormidia resemble the example described by Haeckel (1888b). Except in the arrangement of the cormidia, these two examples resemble *Athorybia rosacea* in every respect. The specimens examined by Bigelow (1911b) possessed a maximum number of eight gastrozooids which are arranged in a single row. It is felt that the younger specimens (with less than probably 8 gastrozooids) may exhibit a linear median row of cormidia while the arrangement becomes spiral and radial in the older specimens; the beginning of such an arrangement is seen in the case of the specimen from Station no. DM 5, which possesses 10 gastrozooids.

Genus **Melophysa** Haeckel, 1869

1869. *Melophysa* Haeckel, *System der Siphonophoren*, p. 42.
1888. *Melophysa :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 274.
1954. *Melophysa :* Totton, *Disc. Rep.*, **27**, p. 40.

Athorybiidae with reduced nectosome and 1–2 functional nectophores; siphosome with large, thick, tuberculated and ribbed bracts; tentilla with 6–8 coils in cnidoband, involucrate and tricorniate.

Monotypic genus for *Melophysa melo* (Quoy & Gaimard, 1827).

Melophysa melo (Quoy & Gaimard, 1827)

(Text-fig. 5, I–O)

1827. *Rhizophysa melo* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 180, pl. 5C, figs. 1–9.
1830. *Rhodophysa melo :* Blainville, *Dict. Sci. Nat.* Paris, **60**, p. 112.

1834. *Rhodophysa melo :* Blainville, *Manuel d'actinologie ou de Zoophytologie*, Paris, p. 123.

1834. *Stephanomia melo :* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'....de M. J. Dumont D'Urville*, Paris, **4**, *et Atlas, Zoophytes*, p. II, figs. 7–12.

1888. *Athorybia melo :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1172.

1888. *Melophysa melo :* Haeckel, *Jena Z. naturw.*, **22**, p. 42.

1888. *Melophysa melo :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 274.

1897. *Athorybia melo :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 49, taf. 4.

1931. *Athorybia rosacea :* Bigelow, *Zoologica* N.Y., **8**(11), p. 578, text-figs. 217–220.

1954. *Melophysa melo :* Totton, *Disc. Rep.*, **27**, p. 40, text-figs. 7–9.

1965. *Melophysa melo :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 89, text-figs. 49, 50.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
DM 7 DM/1/63* Sample no. 1274/E Tube *One*	IOSN	200—0	9 mature bracts; 2 immature bracts; 2 necto.; 8 palp. & 1 gastrozooid	P2004/1 P2122/1
DM 7 DM/1/63* Sample no. 1274/E Tube *Two*	,,	,,	2 mature bracts; 6 palpons	P2211/1
DM 61 DM/2/63* Sample no. 1639/E	,,	,,	1 immature bract	P2322/1

(* For details of these cruises, *see* MATERIAL & METHODS)

Type locality.—Straits of Gibralter.

Distribution.—Mediterranean, North Central Atlantic (Lat. 32°–34° N; Long. 30° W); Eastern tropical Pacific between Galapagos and Panama; Indian Ocean (off south and east coasts of Africa).

Description.—The description is based on loose parts—nectophores, bracts, palpons and gastrozooids. The entire colony is not represented in the collection.

Nectophores.—(Text-fig. 5,I–L.) There are two nectophores—one with a long pedicel and small nectosac; the other with a short pedicel and large nectosac. The smaller nectophore (the one with a long pedicel) measures 14.0 mm in length (including the pedicel) and 6.0 mm in breadth. The long pedicel is oblique and the pedicular canal lies in the mid-region. The edges of the pedicel are folded to form a deep groove or furrow, as described by Bigelow (1931, p. 581). The nectosac lies at the broad end, *i.e.*, opposite to the pedicel. Two lateral and one median ridges are faintly marked. The courses of the radial canals are not discernible even after staining in diluted borax-carmine.

The larger, *i.e.*, the older nectophore, measures 10.0 mm in length and 8.0 mm in breadth. The pedicel is short, *viz.* $\frac{1}{3}$rd the length of the pedicel of the younger nectophore. The lateral ridges are clearly marked while the median ridge is not discernible. The courses of the radial canals could not be traced.

Bracts.—(Text-fig. 5,O.) Of the 14 bracts present in the collection, three are without the characteristic tuberculated ridges. Of these three bracts, two are very small, thin, measure 12.0 mm in length, and possess well-thickened proximal keel for attachment. The dorsal surface is smooth, devoid of the conical tubercles or papillae. The

other bract is large and is nearly the size of the mature bracts, but still without the tuberculated ridges. It is probable that the tuberculation develops only in the mature bracts.

The other 11 bracts are large and one of the largest measures 20.0 mm in length. The thickened proximal keel is 11.0 mm in thickness. The distal half is dorsoventrally flattened and is 5.0 mm thick. These bracts bear from 8–9 strong tuberculated longitudinal rows of papillae in the dorsal surface. The number of tubercles on the ridges vary from 7–25, the greatest number occurring always in the middle ridge. The tubercles are in the form of conical papillae and in some parts they form continuous crests.

Palpons.—(Text-fig. 5,M.) The palpons are long, narrow and sessile. The longest measures 12.0 mm in length. The distal ends of these palpons are very narrow and vermiform, possessing large nematocysts at their tips.

Gastrozooid.—(Text-fig. 5,N.) It is the usual type met with in physonects, with a stalk well-developed basigaster, long stomach region and a broad mouth opening. From the mouth opening eight radiating ridges, probably hepatic ridges are seen. The tentacle is very much contracted and no tentilla are observed. It measures 7.0 mm in length.

Remarks.—Previous workers have shown that there may be up to five nectophore buds present in the nectosome, but that only one functional nectophore is developed at a time (Chun, 1897b; Bigelow, 1911b; Totton, 1954, 1965). The present collection shows the presence of two functional nectophores, though one has a smaller nectosac.

Very few examples of this species has been studied in detail so far, though Bigelow (1931) has given a detailed account of this species, the arrangement and the occurrence of the different appendages on the stem are still not known.

Family 8 RHODALIIDAE Haeckel, 1888b

Sub-order Auronectae Haeckel, 1888b

Family Auronectae Chun, 1897b

Family Angelidae Lens & van Riemsdijk, 1908.

Physonectae in which enlarged homologue of the pneumatochone (or basal, gas secreting area of the pneumatosaccus) protrudes on one side at the junction between pneumatophore and corm to form a characteristic structure—the aurophore. Nectosome and siphosome forming globular corm below large pneumatophore. Both nectophores and bracts develop, the simple sac-like nectophores forming a corona of one or more rows. Cormidia borne on prominences. Zone of proliferation of cormidia lies opposite the aurophore.

Bigelow reviewed the family in his ALBATROSS report (1911b). Since then, very little additional material has been found. Bigelow (1911b) and Totton (1965) recognised the following genera :—

1. *Angelopsis* Fewkes, 1886
2. *Stephalia* Haeckel, 1888b
3. *Rhodalia* Haeckel, 1888b
4. *Archangelopsis* Lens & van Riemsdijk, 1908
5. *Dromalia* Bigelow, 1911b.

Key to Genera of *Rhodaliidae*

1.	Corm a spongy mass, or bulbous; when latter, either solid or with a cavity	2
	Corm a voluminous thin-walled sac; aurophore with numerous papilliform appendages on surface	*Archangelopsis*
2.	Corm in the form of a spongy mass without a central cavity; aurophore smooth-walled; nectosome with shallow hypocystic cavity of great breadth and siphosome traversed by a network of innumerable small canals	*Rhodalia*
	Corm bulbous, either solid or with a central cavity	3
3.	Corm bulbous and solid; aurophore either smooth-walled or with papilliform appendages .	4
	Corm bulbous with a central cavity; siphosome solid but traversed by a network of canals	*Angelopsis*
4.	Aurophore smooth-walled; cormidia with trefoil-headed, nail-like bracts	*Stepalia*
	Aurophore with numerous papilliform appendages; pneumatophore flattened at apex, with gelatinous prominences on its outer rim; nectosome without hypocystic cavity .	*Dromalia*

The taxonomy of the family Rhodaliidae is still imperfectly known due to paucity of good study-material. The above key drawn out on the basis of published literature, is provisional. It is likely that more researches on intensive and perfect material may reveal that *Rhodalia*, *Stephalia* and *Angelopsis* are all congeneric (*cf.* Totton, 1965, pp. 91–96).

Genus **Angelopsis** Fewkes, 1886

1886. *Angelopsis* Fewkes, *Rep. U.S. Comm. Fish. for 1884*, p. 972.

Rhodaliidae with bulbous corm, the nectosome containing a hypocystic cavity, the siphosome solid but traversed by a network of canals. General ground substance cartilaginous in consistency. Aurophore smooth-walled.

Includes two species : *A. globosa* Fewkes, 1886 and *A. dilata* Bigelow, 1911b.

Genus **Stephalia** Haeckel, 1888

1888. *Stephalia* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 297.

Rhodaliidae with bulbous and solid corm. Aurophore smooth-walled. Trefoil-headed nail-like bracts present on cormidia.

Monotypic genus for *S. corona* Haeckel, 1888b.

Genus **Rhodalia** Haeckel, 1888

1888. *Rhodalia* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 302.

Rhodaliidae with corm in the form of a spongy mass and lacking a central cavity. Aurophore smooth-walled. Nectosome with a shallow hypocystic cavity of great breadth. Siphosome traversed by a network of innumerable canals. General ground substance cartilaginous in consistency as in *Angelopsis*.

Monotypic genus for *R. miranda* Haeckel, 1888b.

Genus **Archangelopsis** Lens & van Riemsdijk, 1908

1908. *Archangelopsis* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 91.

Rhodaliidae with voluminous thin-walled sac-like corm; aurophore bears numerous papilliform appendages on its surface.

Monotypic genus for *A. typica* Lens & van Riemsdijk, 1908.

Genus **Dromalia** Bigelow, 1911

1911. *Dromalia* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 303.

Rhodaliidae with bulbous corm. Nectosome of considerable length, lacking hypocystic cavity. Pneumatophore flattened apically bearing gelatinous prominences on its outer rim. Aurophore bears papilliform appendages.

Monotypic genus for *D. alexandri* Bigelow, 1911b.

None of the Rhodalids are represented in the present collections.

Family 9 FORSKALIIDAE Haeckel, 1888b

Genus **Forskalia** Kölliker, 1853

1853. *Forskalia* Kölliker, *Die Schwimmpolypen oder Siphonophoren von Messina*, p. 2.
1888. *Strobila* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 242.
1888. *Forskaliopsis* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 247.

Physonectae with nectosome cone-shaped or cylindrical, bearing numerous, multiserial nectophores all arising from one meridian of the coiled stem. Gastrozooids borne on long peduncles which are covered with numerous bracts.

Only one genus, *Forskalia* Kölliker, 1853, is recognized by Bigelow (1911b) and by Totton (1965). For the early history of this family and discussions on the validity of the different species of *Forskalia*, the works of Bigelow (1911b) and Totton (1965) may be consulted.

The valid species of *Forskalia* are :

1. *Forskalia edwardsi* Kölliker, 1853
2. *F. leuckarti* Bedot, 1893
3. *F. formosa* Kefferstein & Ehlers, 1860
4. *F. tholoides* Haeckel, 1888b
5. *F. cuneata* Chun, 1888
6. *? F. misakiensis* Kawamura, 1954, *Species inquirenda.*

Type species.—Forskalia edwardsi Kölliker, 1853.

Key to species of *Forskalia*

1.	Nectophores with pigmented *rete* or spots, or bands	2
	Nectophores without any pigment spots	4
2.	Nectophores with disc-shaped pigmented *rete* in pedicular canal; wider than deep, concave above; incision on both sides close to lateral horns of nectosac	*leuckarti*
	Nectophores with pigmented spots or bands	3
3.	Nectophores with yellow pigment spot at junction of upper radial and circular canals; incision on right-hand side only, proximal portion elongate and flattened from above	*edwardsi*
	Nectophores with 4–6 red bands on each side of subumbrella; truncated bracts with bracteal canals bent at right angles	*cuneata*
4.	Stem-side incision creating two unequal lobes; gastrozooids small with short stalks . . .	*formosa*
	Stem-side not incised, forming long and tapering peduncles twice the length of nectosac . .	*tholoides*

F. misakiensis Kawamura, 1954, based on a single specimen from Misaki, Japan, with quadrangular nectophores (when seen from above) is considered by Totton (1965) as a *species inquirenda.*

None of the species of *Forskalia* are represented in the collection.

Suborder *CALYCOPHORAE* Leuckart, 1854

Siphonophora without apical gas-filled pneumatophore; nectosome reduced with one to several pairs of similar, or dissimilar, nectophores, with somatocyst. Siphosome elongated, contractile, bearing many ordinate cormidia with free internodes (polygastric phase); each cormidium consisting of a bract (except in the family Hippopodiidae), gastrozooid, its tentacle and a succession of gonophores, and without palpons (except in the genus *Stephanophyes*, which possesses vestigeal ones). Older cormidia break off as free-swimming eudoxids (second phase), producing sexual gonophores (third phase) of which one may be asexual (special nectophore) and specialized for propulsion.

Chun (1897b), Schneider (1898), Bigelow (1911b), Leloup (1954) and Totton (1954, 1965) have revised this suborder. Chun considered the number of nectophores as the most important character and as a result divided the suborder into three families :

1. Monophyidae Claus, 1874; with one nectophore
2. Diphyidae Quoy & Gaimard, 1827, with two nectophores
3. Polyphyidae Chun, 1882, with several nectophores.

However, Schneider maintained that the number of nectophores is not an important character and that on the basis of the structure of the nectophore, the Calycophorae are divisible into two families :

1. Prayidae Kölliker, 1853, with structurally similar nectophores
2. Diphyidae, with structurally dissimilar nectophores.

Bigelow combined both Chun's and Schneider's criteria in recognizing the following four families :

1. Sphaeronectidae Huxley, 1859, with one nectophore
2. Diphyidae Quoy & Gaimard, 1827, with 2 (or 3) structurally dissimilar nectophores
3. Prayidae Kölliker, 1853, with 2 (3 or 4) nectophores all structurally alike, and
4. Hippopodiidae Kölliker, 1853, with many nectophores all structurally alike, groups of appendages sessile and without bracts.

Leloup (1954a) in his "Propos des Siphonophores" after a study of comparative morphology and phylogeny recognized nine families; by raising many subfamilies considered by Bigelow (*loc. cit.*) to family level. These are :

1. Hippopodiidae
2. Desmophyidae Haeckel, 1888b
3. Stephanophyidae
4. Prayidae
5. Sphaeronectidae
6. Amphicaryonidae
7. Mitrophyidae
8. Nectopyramidae
9. Diphyidae.

The last revisor of this suborder, Totton (1954, 1965a) after a detailed morphological and some developmental studies (on the members of the families Prayidae, Hippopodiidae and Sphaeronectidae) recognized only six families and rearranged them as follows :

1. Prayidae Kölliker, 1853
2. Hippopodiidae Kölliker, 1853
3. Diphyidae Quoy & Gaimard, 1827
4. Clausophyidae Totton, 1965
5. Sphaeronectidae Huxley, 1859
6. Abylidae L. Agassiz, 1862.

The families Clausophyidae and Abylidae were treated as subfamilies by most of the previous workers. The family Sphaeronectidae, which was considered as a simple group, was shifted near to the highly organized Abylidae due to the larval nectophore, which instead of being caducous develops into the definitive one as in the case of the Abylidae, and the somatocyst curving over towards the dorsal side. Totton was inclined to regard the second character to be analogous with an early evolutionary stage of the condition found in most Abylids and *Ceratocymba* (though not in *Bassia*), *i.e.*, the main part of the somatocyst lies entirely on the dorsal side of the hydroecium. He felt that the commencement of development of such an arrangement could be seen in Sphaeronectidae, and that the Sphaeronectids may possibly be a proto-Abylid, or a neotenic form (*cf.* Totton, 1965, p. 201 & 204).

This arrangement of the six families of the Calycophorae is being followed in the present study. All these families are represented in the collections being reported on in this work.

Family 10 Prayidae Kölliker, 1853

Calycophorae with large, rounded, opposed (except in *Stephanophyes*, where they form a ring of several nectophores) and nearly alike nectophores; one to several pairs in number; usually devoid of ridges (except in *Nectopyramis natans* and *N. spinosa*), possessing great amount of mesoglea for flotation of large and heavy stem; larval nectophore caducous, and replaced by a short succession of larger heteromorph ones. Somatocyst typically small or thin canal-like or branching profusely. Cormidia set free as eudoxids; bracts with characteristically branched canals and large gonophores or asexual nectophores.

This family is divided into three subfamilies :

I. Amphicaryoninae Chun, 1888a
II. Prayinae Chun, 1897b, and
III. Nectopyramidinae Bigelow, 1911b.

Provisionally, nine genera and fourteen species of Prayids are recognized.

Subfamily I. *Amphicaryoninae* Chun, 1888a

Prayidae with two nectophores of unequal sizes; larval one appearing to be retained, and first heteromorph one either reduced or vestigeal. Bracts (eudoxid stages, when known), with reduced canal system to a pair of lateral hydroecial canals, dorsal and ventral branches being absent.

This subfamily is treated first of the Prayidae because of the failure to develop more than two, nectophores or even additional reserve buds. This according to Bigelow

(1911b) is a primitive character being related to "Monophyidae". Whereas in the more highly specialized members of the family Prayidae, the older nectophores are successfully dropped off as new ones develop, the numbers thus remaining approximately constant.

This subfamily is based on the genus *Amphicaryon* by Chun (1888a) though the genus *Mitrophyes* Haeckel, 1888b was described a few months earlier. He recognized the validity of the latter, but Schneider (1898) made it a synonym of *Amphicaryon*. Moser (1925) and Leloup (1955a) recognized *Mitrophyes* to be a distinct genus and included it under a separate subfamily : *Mitrophyinae* Moser, 1925. They also recognized the subfamily Amphicaryoninae including the monotypic genus *Amphicaryon*. However, Totton (1954) agreed with Schneider in merging the two genera under *Amphicaryon*. Further, he added a new giant-sized Amphicaryoninae, *Maresearsia* with two functional nectophores of unequal size.

These two genera, *Amphicaryon* Chun and *Maresearsia* Totton are recognized as valid in the present study.

Key to genera of *Amphicaryoninae*

1.	Two nectophores of unequal size	2
2.	Young definitive nectophore shield-like or reduced, with vestigeal nectosac	*Amphicaryon*
	Young definitive nectophore comparatively large, with functional nectosac	*Maresearsia*

Both the genera are represented in the present collection.

Genus **Amphicaryon** Chun, 1888

1888. *Amphicaryon* Chun, *S. B. preuss. Akad. Wiss.* for 1888, p. 1141.

Amphicaryoninae with young definitive nectophore reduced or vestigeal; nectosac obsolescent or absent.

Though the generic name *Mitrophyes* Haeckel, 1888b, has priority over *Amphicaryon* Chun, 1888a by a few months, on the basis of *nomina conservanda* the latter name has been retained.

This genus includes three valid species : *A. acaule* Chun, 1888a; *A. peltifera* Haeckel, 1888b; and *A. ernesti* Totton, 1954. In addition, a species is hereby added to this list of valid species, viz. *A. intermedia*.

Type species.—Amphicaryon acaule Chun, 1888a.

Key to species of *Amphicaryon*

1.	Vestigeal nectophore embraced by the larger nectophore; radial canals simple and straight	2
	Vestigeal nectophore not embraced by the larger nectophores; radial canals either simple or branched in the proximal half	3
2.	Vestigeal nectophore with reduced nectosac, which does not open to the exterior, but with 4 distinct radial canals	*acaule*
	Vestigeal nectophore without nectosac, but only 3 highly reduced radial canals present	*peltifera*
3.	Vestigeal nectophore with functional nectosac with 4 simple radial canals in both nectophores	*intermedia*
	Vestigeal nectophore with highly reduced nectosac; dorsal canal simple, lateral canals absent, ventral canal reticulated on ventral wall. Larger nectophore with proximal half of radial canals branched	*ernesti*

Of these, *A. acaule* and a species of this genus, viz. *A. intermedia* are present in the collection.

Amphicaryon acaule Chun, 1888a

(Text-fig. 6, A–E)

1888. *Amphicaryon acaule* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1162.
1911. *Amphicaryon acaule :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 195, pl. 4, figs. 1–8.
1912. *Amphicaryon acaule :* Moser, *Sitz. Ges. Nat.* Berlin, **10**, p. 529.
1913. *Amphicaryon acaule :* Moser, *Zool. Anz.*, **41**(4), p. 146.
1919. *Amphicaryon acaule :* Bigelow, *Bull. U.S. nat. Mus.*, **100**(i)(5), p. 403.
1925. *Amphicaryon acaule :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 399.
1926. *Amphicaryon acaule :* Browne, *Trans. Linn. Soc.* Lond., *Zool., ser.* 2, (2)**19**, p. 60.
1931. *Aphicaryon acaule :* Bigelow, *Zoologica,* N.Y., **8**(11), p. 531.
1932. *Amphicaryon acaule :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 330.
1933. *Amphicaryon acaule :* Boone, *Bull. Vanderbilt Mar. Mus.*, **4**, p. 39.
1934. *Amphicaryon acaule :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 13, fig. 5.
1935. *Amphicaryon acaule :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 258.
1936. *Amphicaryon acaule :* Totton, *Zoologica,* N.Y., **21**(4), p. 231.
1937. *Amphicaryon acaule :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II *Biology,* H. **2**, pp. 7, 73.
1949. *Amphicaryon acaule :* Moore, *Bull. Bingham. Oceanogr. Coll.*, **12**(2), p. 11.
1954. *Amphicaryon acaule :* Totton, *Disc. Rep.*, **27**, p. 92.
1955. *Amphicaryon acaule :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.,* 1910. *Siphonophores,* **5**(11), p. 5.
1965. *Amphicaryon acaule :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 112, pl. XXI, fig. 6.

Material examined.—Details of the material examined are given below :

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5183	Ich. N.	1000—0	One colony	P 1662/1
V 5209	J. N.	200—0	One eudoxid	P 1612/1
V 5223	,,	,,	Two colonies	P 1697/1
K 6	N N	,,	1 large, loose nectophore	Gen. coll.
K 7	,,	,,	One colony	,,
K 10	,,	,,	Two colonies	,,
K 20	,,	,,	2 loose nectophores	,,
K 39	,,	,,	One eudoxid	,,
K 43	,,	,,	One ,,	,,
K 48	,,	,,	One colony	,,
K 51	,,	,,	One colony; 2 loose nectophores	,,
K 358	Org. n.	Surface	One colony	,,

Type locality.—Canary Island.

Distribution.—Tropical Atlantic Ocean (Canary Isles, west coast of Africa, West Indies); eastern tropical Pacific; Indian Ocean (off south and east coast of Africa, Seychelles Archipelago, south-eastern Indian Ocean and Arabian Sea); Red Sea (*see* also Table 1).

Description.—Polygastric phase : (Text-fig. 6, A,B & C). The polygastric phase consists of two dissimilar nectophores differing in size and shape. No reserve bud of a future nectophore is observed. The young smaller nectophore is vestigeal, small, shield-like and is partly embraced by the larger, older nectophore. Large nectophore : (Text-fig. 6, C). The large nectophores have the following dimensions :

Length of nectophore :	2.5 mm	— 3.5 mm	
Breadth of nectophore :	3.4 ,,	— 4.3 ,,	
Length of nectosac :	0.67 ,,	— 1.6 ,,	
Breadth of nectosac :	0.93 ,,	— 1.4 ,,	
Diameter of ostium :	0.55 ,,	— 1.4 ,,	
Length of somatocyst :	0.65 ,,	— 1.0 ,,	

The nectophore is smooth, devoid of ridges and rounded in shape. The somatocyst is small, distinct and slightly curved. The hydroecium is large, circular in shape, not very deep and occurs on the upper lateral side of the nectophore. The concave inner surface of the smaller vestigeal nectophore fits like a shield in the hydroecium, thus forming a cavity in which the contracted stem with its gastrozooids and the tentacles are found. The nectosac is well developed, and has a broad ostium. All the radial canals are simple, straight and unbranched and join the circular canal at the ostium. The ostium of the nectosac lies slightly below the surface of the nectophore.

Vestigeal nectophore.—(Text-fig. 6, A,vn.;B). The following are the measurements of the vestigeal nectophore—

Length of the nectophore :	2.23 mm	— 3.45 mm	
Breadth of the nectophore :	2.16 ,,	— 3.25 ,,	
Length of canals :	0.73 ,,	— 1.00 ,,	

The highly reduced vestigeal nectophore is almost flat, firm and shield-like in appearance. The somatocyst occurs as a thin, short canal on the inner concave surface. The nectosac is highly reduced, without a mouth-opening to the exterior. The four radial canals are simple and straight, and join at their distal ends.

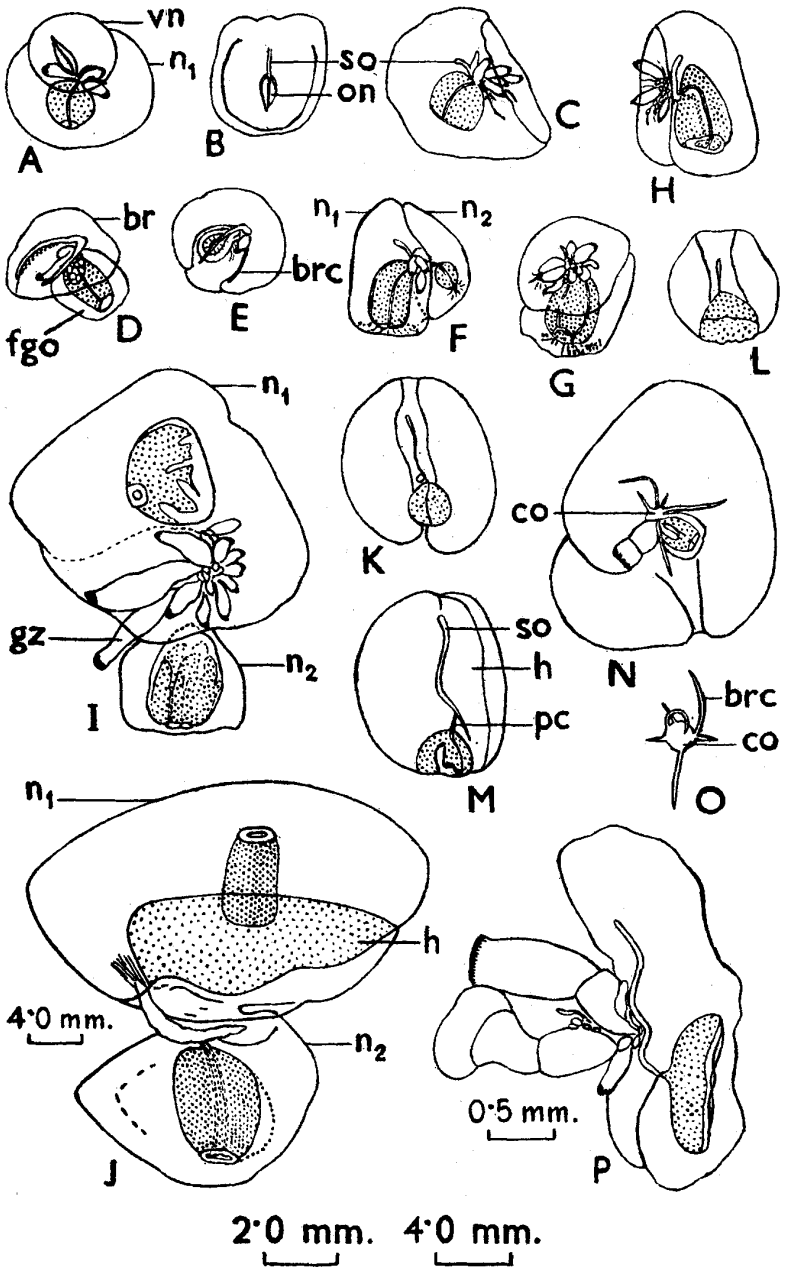
Eudoxid phase.—(Text-fig. 6, D & E). The dome-shaped bract measures 2.0 mm in length and is 1.6 mm in breadth. The hydroecial or bracteal cavity is deep and conical. The phyllocyst (or bracteal canals) occur in the form of two lateral canals on either side of the hydroecium. These lateral canals meet proximally where there is a slight enlargement (? central body). The dorsal and ventral branches usually found in Prayinae are not developed. The gonophore is smooth, devoid of ridges and rounded in appearance. It measures 1.4 mm in length and is 1.2 mm in breadth. The nectosac is well developed. The radial canals are simple and unbranched. The mouth-opening is large and is surrounded by extensions of the gonophore. The female manubrium bears four ova.

Remarks.—The present material was obtained from hauls made from 200 metres to the surface, and in one instance from a haul made from 1,000 metres to the surface, by an open net; whereas examples from the eastern tropical Pacific, GAUSS and MICHAEL SARS Atlantic Deep-sea Expedition collections showed that the species is bathypelagic or mesoplanktonic in habit (Bigelow, 1911b; 1931; Leloup, 1955a).

Amphicaryon intermedia sp. n.

(Text-fig. 6, F–H)

Among the Siphonophores sorted from the plankton samples collected from the Arabian Sea by INS KISTNA, there are three examples of the polygastric phase of an



TEXT-FIGURE 6

Amphicaryon acaule : A—E
A, B & C—polygastric phase. D & E—eudoxid phase.
Amphicaryon intermedia n.sp. : F—H
F & G—polygastric phase. H—polygastric phase, larger nectophore.
Maresearia praeclare : I
I—polygastric phase.
Maresearsia sp. : J
J—polygastric phase.
Rosacea plicata : M—O
M—polygastric phase. N & O—eudoxid phase.
Rosaeea cymbiformis : K, L & P
K, L & P—polygastric phase.
Abbreviations used :
br—bract. br.c—bracteal canal. co—central organ. f.go—female gonophore. gz—gastrazooid. h—hydroecium. n_1—larger nectophore. n_2—smaller nectophore. on—reduced nectosac. pc—pedicular canal. so—somatocyst. vn—vestigeal nectophore.

Amphicaryoninae which fall intermediate between *Amphicaryon* Chun (they possess a similar shape, are of same size and general appearance as this genus) and *Maresearsia* Totton (this genus they resemble in possessing two functional nectophores); these three examples are therefore treated as belonging to a species of *Amphicaryon*, which is hereby named *Amphicaryon intermedia.*

Material examined.—One polygastric phase from INS KISTNA Station no. K 20; two examples of polygastric phase from INS KISTNA Station no. K 44. All the specimens were taken by Nansen's net in hauls made from 200 metres to the surface.

Type locality.—Arabian Sea.

Description.—Polygastric phase.—(Text-fig. 6, F & G). The polygastric phase consists of two functional nectophores. The smaller one of the two is the younger nectophore, but it is not flat and shield-like as in *A. acaule;* it is not embraced by the larger nectophore. *Larger nectophore.*—(Text-fig. 6, F, n_1; & H): The dimensions of the larger nectophore are as follows:

Length of the nectophore :	3.85 mm
Breadth of the nectophore :	2.25 ,,
Length of the nectosac :	2.10 ,,
Length of the somatocyst :	1.30 ,,

It is longer than broad, smooth and lacks ridges. It is rounded on the dorsal side and flat with a shallow hydroecium on the ventral side. The somatocyst is small, thick and curved towards the dorsal side of the nectophore. The nectosac is large, elongated and the ostium is situated slightly below the surface of the nectophore. This gives a funnel-like slope towards the mouth-opening. The radial canals are simple and unbranched.

Smaller nectophore.—(Text-fig. 6, F, n_2). The measurements of the smaller nectophore are as follows:

Length of the nectophore :	3.25 mm
Breadth of the nectophore :	2.75 ,,
Length of the nectosac :	1.00 ,,
Diameter of ostium :	0.25 ,,

The nectophore has a smooth exterior, rounded on the dorsal side, and flat with a shallow hydroecium in the middle region of the ventral side. The hydroecium lies in contact with the hydroecium of the larger nectophore. The contracted stem with six gastrozooids are found within this common hydroecium. The nectosac is small, being about $\frac{1}{3}$rd the length of the nectosac of the larger nectophore. It has a bulged, rounded appearance. The ostium of the nectosac is very small, measuring 0.25 mm in diameter, and it is open and round in shape. It is situated well below the level of the outer surface of the nectophore which slopes downwards towards the ostium as in the larger nectophore. The four radial canals are distinct, simple and unbranched. This reduced nectophore is not embraced by the larger nectophore.

Eudoxid phase.—Unknown.

Remarks.—The genera *Amphicaryon* and *Maresearsia* are included in this subfamily, because they possess nectophores of unequal sizes. The present species, viz. *A. intermedia* n. sp., differs from *A. acaule* and *A. peltifera* in the presence of a functional nectophore, while both *A. acaule* and *A. peltifera* possess a highly reduced

nectophore which is shield-like in shape. *A. intermedia* resembles *A. ernesti* in possessing a smaller nectophore which is not embraced by the larger one. However, in *A. ernesti* the proximal half of the four radial canals of the larger nectophore is branched while in the smaller nectophore the dorsal canal is normal, the ventral canal forms reticulations on the ventral wall of the nectosac and the lateral canals are absent. The radial canals of the vestigeal nectophore are simple without branches in *A. acaule* but occur in the form of a three-pronged structure in *A. peltifera*. In general appearance and in size, the present species resembles the valid species of the genus *Amphicaryon*.

In possessing two functional nectophores, the species resembles *Maresearsia*, but the latter species is known to grow to a very large size (20.0 mm in diameter) and the proximal parts of the radial canals are hypertrophied.

A study of a large series of specimens of this species is necessary to prove the steadfastness of its character. It would be worthwhile to check up different growth stages to show that the nectosac of the smaller nectophore remains functional throughout its life-history.

Genus **Maresearsia** Totton, 1954

1954. *Maresearsia* Totton, *Disc. Rep.*, **27**, p. 97.

Giant Amphicaryoninae in which the nectosac of both the nectophores are large and functional. The basal part of the lateral radial canals of the nectosac are hypertrophied.

Monotypic genus for *M. praeclara* Totton, 1954.

Maresearsia praeclara Totton, 1954

(Text-fig. 6,I)

1954. *Maresearsia praeclara* Totton, *Disc. Rep.*, **27**, p. 97, text-figs. 46–48; pl. VII.

1965. *Maresearsia praeclara* : Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.), London, p. 113, text-fig. 64; pl. XX; figs. 2–5.

Material examined.—Two polygastric phases, taken at RV VITYAZ Station nos. V 5208 and V 5223, by Ichthyological net, in hauls made from 1,000 metres to surface.

Type of locality.—Bermuda (Western Atlantic Ocean).

Distribution.—Bermuda, from a depth of 1645 to 1828 metres in the Western Atlantic Ocean. Also taken at RV DISCOVERY Station nos. 695 and 1580 in the Indian Ocean (off south and east coasts of Africa). The present records extend its distribution to the eastern Indian Ocean. (*see* also Table 1).

Holotype bears Brit. Mus. (Nat. Hist.) Registered no. 1952.11.19.6.

Description.—Polygastric phase consists of two large nectophores of unequal sizes, both with functional nectosac.

Larger nectophore.—(Text-fig. 6, I, n_1). The larger nectophore has the following measurements—

Diameter of the nectophore :	12.2	mm
Length „ „ nectosac :	3.3	„
Breadth „ „ „ :	4.0	„

The nectophore is almost globular in shape. The hydroecium is deep and has a broad opening. The somatocyst is oval in shape and borne on a thin short stalk. The nectosac is not shaped as in the holotype figured by Totton, but it is short and broad at the base (*i.e.*, its breadth is greater than its length). The base of the lateral radial canals are hypertrophied.

Smaller nectophore.—(Text-fig. 6, I, n_2). Measures as follows :

Diameter of the nectophore :	5.00 mm
Length of nectosac :	4.00 ,,
Breadth ,, ,, :	2.67 ,,

The smaller nectophore possesses a nectosac which is longer than that of the larger nectophore. The hydroecium and the somatocyst are not clearly seen. The proximal end fits into the hydroecium of the larger nectophore. The base of the lateral radial canals possess short blind diverticula.

The stem with many gastrozooids is found within the hydroecium. The biggest gastrozooid measures 4.6 mm in length.

Remarks.—Due to the presence of the hypertrophied nature of the proximal part of the lateral radial canals in the nectosac, these specimens are assigned to this species.

Maresearsia sp.

(Text-fig. 6, J)

Material.—One polygastric phase from RV VITYAZ—Station no. V 5227, taken by the Pleistone net from the surface.

Description.—Polygastric phase. Due to the absence of specific characters such as the hypertrophied lateral radial canals and the stalked oval-shaped somatocyst, the identity of the specimen is uncertain; but it resembles *M. praeclara* in the large size of its nectophores with their functional nectosacs.

Large nectophore.—(Text-fig. 6, J, n_1). The large nectophore has the following measurements :

Breadth of the nectophore :	23.0 mm
Length ,, ,, nectosac :	5.7 ,,

The nectophore is very broad. The nectosac is long, narrow and has a round mouth-opening which lies at the surface of the nectophore. It lacks musculature, hence the courses of the radial canals are not discernible. The hydroecium is very deep and nearly triangular in shape, extending on the ventral side (Text-fig. 6,J,h). The stem connecting the nectophores is short, and no gastrozooids are present in the hydroecium. The somatocyst has probably burst.

Smaller nectophore.—(Text-fig. 6, J, n_2). The smaller nectophore measures as follows :

Diameter of the nectophore :	12.0 mm
Length of nectosac	5.0 ,,

The proximal end of the smaller nectophore fits well into the large triangular hydroecium in the larger nectophore. The nectosac is large and lacks musculature. The courses of the radial canals are not clear, but it is apparent that they are simple, straight and without diverticula as far as present material is concerned.

Remarks.—Specific diagnosis was not possible since both the nectophores lack musculature. The structure of the radial canals was therefore not clearly discernible.

Subfamily II. *Prayinae* Chun, 1897

Prayidae possessing one to several pairs of smooth structurally similar nectophores with simple or branched somatocysts; nectosac with subumbral radial canals simple with laterals meandering or straight or with multiform radial canals. Eudoxids with bracts possessing branched bracteal canal-system with or without special nectophores and central organ.

Totton (1965a) revised this sub-family and recognized six genera as valid, viz., *Rosacea* Quoy & Gaimard, *Praya* Quoy & Gaimard, *Prayoides* Leloup, *Lilyopsis* Chun, *Desmophyes* Haeckel and *Stephanophyes* Chun.

The history of this subfamily is summarized below:

Previous workers up to Bigelow's time used the generic names of *Rosacea*, *Praya* and *Lilyopsis* indiscriminately since the earlier descriptions and figures were unsatisfactory and inadequate. Bigelow (1911b) considered the presence or absence of a special nectophore in the eudoxid phase to be of generic importance. He, therefore, restricted the use of the genus *Rosacea* to a species with simple somatocyst, the lateral radial canals meandering, and a special nectophore in the eudoxid stage, viz. *R. plicata* Quoy & Gaimard. He synonymised *Lilyopsis* with *Rosacea* on the basis of the presence of a special nectophore.

The genus *Praya* was proposed in 1834 by Blainville for a species which he called *P. dubia* and considered it to be equal to *Diphyes dubia* Quoy & Gaimard. But Blainville's account of *P. dubia* and *D. dubia* were different, since as pointed out by Bigelow, the former resembled *P. cymbiformis* (Delle Chiaje). Therefore, Bigelow made *cymbiformis* the type for the genus *Praya*. This necessitated the creation of a new genus *Nectodroma* Bigelow for Quoy & Gaimard's *D. dubia* and his new species *N. reticulata* Bigelow 1911.

Bigelow recognised *Desmophyes* Haeckel as a valid genus and provisionally retained *Desmalia* Haeckel*, since it differed from the former only in the number of nectophores. He accepted the monotypic genus *Stephanophyes* Chun to be distinct and recognized a separate sub-family Stephanophyinae. He recognized four genera including six species of Prayinae, viz., *Praya cymbiformis*, Delle Chiaje; *Rosasea plicata* Quoy & Gaimard *sensu* Bigelow; *R. medusa* Metschnikoff; *Nectodroma dubia* Quoy & Gaimard; *N. reticulata* Bigelow and *Desmophyes annectens* Haeckel.

Leloup (1933, p. 8; 1934, p. 10) included *Praya cymbiformis* under the genus *Rosacea*. Later workers (Leloup & Hentschel, 1935; Hardy & Gunther, 1935; Totton, 1936, 1954, 1965; Bigelow & Sears, 1937; and Leloup, 1955a) followed this arrangement since the somatocyst is simple, lies on the dorsal surface of hydroecium and the lateral radial canals are meandering, as in *R. plicata*.

Totton (1954, 1965a) following the current code of nomenclature revived *Praya* for *Nectodroma*. He also revived the generic name *Lilyopsis* Chun for species with somatocyst prolonged into mesoglea and eudoxids with asexual nectophore and no central organ. He regarded *Rosacea* (*Prayoides*) *intermedia* Leloup to be too much unlike *Rosacea* in the presence of branched radial canals, to be included in the same genus and therefore raised the sub-genus *Prayoides* Leloup to generic rank. Further, he retained the monotypic genera *Desmophyes* (with simple somatocyst prolonged into mesogloea, and eudoxids with central organ) and *Stephanophyes* (with nectophores forming a corona and the presence of palpons in the cormidae).

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* This genus was not recognized by later workers.

Key to genera of *Prayinae*
(after Totton, 1965, p. 115)

1.	Nectophores biserial. Reserve bells may be present	2
	Nectophores in corona. Palpons present	*Stephanophyes*
2.	Nectophores biserial, somatocyst simple	3
	Nectophores biserial, somatocyst branched	*Praya*
3.	Nectophores biserial, somatocyst simple, at surface of hydroecium	4
	Nectophores biserial, somatocyst simple, prolonged into mesogloea	5
4.	Nectophores biserial, somatocyst simple, at surface, radial canals simple	*Rosacea*
	Nectophores biserial, somatocyst simple, at surface, radial canals branched . . .	*Prayoides*
5.	Nectophores biserial, somatocyst simple, in mesogloea	
	A. eudoxids with central organ	*Desmophyes*
	B. eudoxids with asexual nectophore, but no central organ	*Lilyopsis*

Of these six genera, *Rosacea* Quoy & Gaimard *sensu* Bigelow 1911b *Praya* Quoy & Gaimard (in Blainville, 1834); and *Prayoides* Leloup 1934, are represented in the present collection.

Genus **Rosacea** Quoy & Gaimard, 1827
Sensu Bigelow, 1911b

1827. *Rosacea* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 177.
1853. *Praya :* Kölliker, *Die Schwimmpolypen order Siphonophoren von Messina*, p. 33.
1854. *Praya :* Vogt, *Mem. Inst. Nat. Genev.*, **1**, p. 99. (non *Praya* Quoy & Gaimard, 1833).
1888. *Eudoxella* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 108.
1899. *Huxleya* Gravier, *Bull. Mus. Inst. nat. Paris*, **5**, p. 87.
1911. *Rosacea :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 201.

Prayinae with a pair of large smooth rounded nectophores, often replaced by reserve bells of slightly different shape; somatocyst simple lying on dorsal surface of hydroecium; nectosac with meandering lateral radial canals. Eudoxids with four main bracteal canals in bracts, large gonophores and no asexual nectophores.

Bigelow (1911b) included two species : *R. plicata* Quoy & Gaimard *sensu* Bigelow, 1911b and *R. medusa* (Metschnikoff, 1870) under this genus. But Totton (1954) considered *R. medusa* as a doubtful synonym of *Lilyopsis rosea* Chun, 1885. As mentioned earlier, *P. cymbiformis* was included in this genus. Thus, only two species : *R. plicata* and *R. cymbiformis* are recognized as valid.

Type species : *Rosacea plicata* Quoy & Gaimard *sensu* Bigelow, 1911b.

Key to species of *Rosacea*

1.	Nectophore with hydroecium extending as shallow groove along entire length of nectophore	*cymbiformis*
2.	Nectophore with hydroecium extending as deep conical depression mainly at centre of nectophore	*plicata*

Both the species are represented in the present collections.

Rosacea plicata Quoy & Gaimard, 1827

Sensu, Bigelow, 1911b

(Text-fig. 6, M–O)

1827. ?*Rosacea ceutensis* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 176, pl. 4B, figs. 2, 3.

1827. *Rosacea plicata* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**. p. 177, pl. 4B, fig. 4.

1830. ?*Rhizophysa filiformis* Delle Chiaje, *Mem. Sulla Storia e notomia degli Animali sanza vertebrae del Regno di Napoli, et Atlas.*, tav. 50, fig. 3.

1834. *Rosacea ceutensis :* Blainville, *Manuel d'actinologie ou de Zoophytologie*, Paris, p. 140 (in part), pl. 6.

1841. ?*Rhizophysa filiformis :* Delle Chiaje, *Descrizione e notomia degli Animali Invertebrati della Sicilia citeriore ossarvati vivi negli anni* 1822–'30. 6–7 *et Atlas*, p. 135, pl. 149, fig. 3.

1851. *Diphyes bragae* Vogt, *Zool. Brief.* Frankfurt, p. 140.

1853. *Praya diphyes* Kölliker, *Die Schwimmpolypen oder Siphonophoren von Messina*, Leipzig, p. 33, taf. 9.

1854. *Praya diphyes :* Vogt, *Mem. Inst. Nat.* Genev., **1**, p. 99, pls. 16, 17.

1861. *Praya filiformis :* Kefferstein & Ehlers, *Zool. Beitrage gesammelt im Winter* 1859–'60 *in Neapel und Messina.* I *Beobachtungen uber die Siphonophoren*, Leipzig, p. 20, taf, 5, figs. 8–11.

1882. *Praya diphyes :* Bedot, *S. B. preuss Akad. Wiss.* for 1882, p. 122 (Non Lesson. 1843, p. **144**).

1885. *Lilyopsis diphyes :* Chun, *S. B. preuss. Akad. Wiss.* for 1885, p. 280.

1888. *Lilyopsis diphyes :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 150.

1897. *Lilyopsis diphyes :* Chun, *Egebn. Plankton Exped.*, **2**, k.b., p. 102.

1898. *Rosacea plicata :* Schneider, *Zool. Anz.*, **21**, p. 78.

1911. *Rosacea plicata :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 201, pl. 2, figs. 7–9.

1932. *Rosacea plicata :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 329.

1933. *Rosacea plicata :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 8.

1934. *Rosacea plicata :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 11.

1935. *Rosacea plicata :* Leloup, *Bull. Mus. Hist. nat.* Belg., **11**(31), p. 7.

1935. *Rosacea plicata :* Leloup & Hentschel, *Wiss. Ergbn. dtsch. atlant. Exped.*, *'Meteor'*, **12(2)**, p. 7, Carte 4.

1935. *Rosacea plicata :* Hardy & Günther, *Disc. Rep.*, **11**, p. 106.

1935. *Rosacea plicata :* Russel & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 258.

1937. *Rosacea plicata :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology* H. **2**, pp. 11, 76, figs. 9–14.

1950. *Rosacea plicata :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Rosacea plicata :* Totton, *Disc. Rep.*, **27**, p. 89.

1955. *Rosacea plicata :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 6.

1965. *Rosacea plicata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 165, text-figs. 65–67.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5193	Ich. N.	1000 0	One eudoxid	P 1734/1
V 5216	,,	,,	One nectophore	P 1591/1
V 5220	J. N.	200—0	One ,,	P 1685/1
V 5232	,,	,,	One ,,	P 1728/1
K 31	N. N.	,,	One ,,	Gen. coll.
K 54	,,	,,	One ,,	,,
K 532	,,	,,	One ,,	,,

Type locality.—Off Gibralter.

Distribution.—It occurs in the tropical and temperate regions extending between 60°N and 53°S of the Atlantic and Pacific Oceans and in the Indian Ocean (for details of localities, *see* Table 1).

Description.—Polygastric phase.—(Text-fig. 6,M). The nectophores measures 10.0–17.0 mm in length and do not possess the characteristic circumscribed, slit-like orifice of the larval caducous nectophores. They resemble the definitive nectophore No. 1 described by Totton (1954, 1965). The hydroecium is conical in shape and gradually tapers on either side along the entire ventral region. In the smaller nectophores the somatocyst is thin, thread-like, varies in length and does not extend below the origin of the pedicular canal. In the larger nectophores, it extends below the level of the origin of the pedicular canal and the anterior arm is slightly thicker as described by Bigelow (1911b). The radial canals of the nectosac are simple, the laterals in the smaller nectophores take a slightly sigmoid course, while in the larger ones, they take a meandering course.

The stem and the gastrozooids are not present.

Eudoxid phase.—(Text-fig. 6,N). The single eudoxid phase measures 11.0 mm in diameter. It is globular and trilobed. The lobes are bent inwards, leaving a slightly conical shallow hydroecium or bracteal cavity. The phyllocyst has five branches and a prominent central organ (Text-fig. 6,O,co.) The right and left hydroecial canals are longer than the others. The shorter lateral canals are distal to the small spur canal. The odd dorsal canal is very thin, threadlike and reaches the outer surface of the bract. The male gonophore measures 2.0 mm in length. It is smooth, elongated and the mouth of the nectosac is surrounded by the slight extension of the mesogloea. The radial canals are simple and straight. The tentacle is much contracted.

Rosacea cymbiformis (Delle Chiaje, 1841)

(Text-fig. 6, K, L & P)

1834. *Praya dubio* Blainville, *Manuel d'actinologie ou de Zoophytologie*, Paris, p. 137, pl. 6, fig. 4. (Non *Diphyes dubia* Quoy & Gaimard, 1834).

1834. *Diphyes prayensis* Quoy & Gaimard, *Voyage de decouvertes de 'l' 'Astiolabe'....de M. J. Dumont D'Urville. Zool.*, **4**, *et Atlas, Zoolphytes*, p. 106, pl. 3, figs. 37, 38.

1841. *Physalia cymbiformis* Delle Chiaje, *Descrizione enotomia degli Animali Invertebrati della Sicilia citeriore osservati, vivi negli anni*, 1822–'30, 6–7, *Atlas*, tab. 33, fig. 1.

1843. *Prava diphyes* Lesson, *Acalephs Histoire naturelle des Zoophytes*, p. 144 (Non Kölliker, 1853).

1853. *Prava cymbiformis :* Leuckart, *Zool. untershchungen.* I *Die Siphonophoren*, p. 2, taf. 1, fig. 4.

1853. *Praya maxima* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 301, pl. 17, figs. 1–6.

1854. *Praya cymbiformis :* Leuckart, *Arch. Natur. Jahrg.*, **22**, p. 286, pl. 11, figs. 18–24.

1859. *Praya cymbiformis :* Huxley, *The Oceanic Hydrozo*, Ray Soc. London, p. 30.

1859. ?*Praya diphyes :* Huxley, *The Oceanic Hydrozoa*, Ray Soc. London, p. 52, pl. 3.

1861. *Praya cymbiformis :* Kefferstein & Ehler, *Zoologische Beitrage gesammelt im Winter*, 1859–'60 *in Neapel und Messina.* I *Beobachtungen uber die Siphonophoren*, Leipzig, p. 20, pl. 1, fig. 28.

1888. *Praya galea* Haeckel, *Jena Z. naturw.*, **22**, p. 35.

1888. *Eudoxella galea :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 108, pl. 2, (Eudoxid).

1888. *Praya cymbiformis :* Haeckel, *Reip. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 146.

1888. *Praya maxima :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 146.

1888. *Praya galea :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 146, pls. 31, 32.

1897. *Praya cymbiformis :* Chun, *Verh. Dtsch. Zool. Ges.*, **7**, p. 66, fig. 8.

1897. *Praya cymbiformis :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 102.

1899. *Praya (Huxleya) californica :* Gravier, *Bull. Mus. Inst. nat.* Paris, **5**, p. 87, figs. 1–4.

1908. *Praya maxima :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 17.

1911. *Praya cymbiformis :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 200, pl. 2, figs. 1–5.

1933. *Rosacea cymbiformis :* Leloup, *Res. Camp. Sci.* Monaco, **87**, p. 8.

1934. *Rosacea symbiformis :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 10.

1935. *Rosacea cymbiformis :* Leloup, *Bull. Mus. Hist nat.* Belg., **11**(3)1, p. 5.

1935. *Rosacea cymbiformis :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlantic Exped. 'Meteor'*, **12**(2), p. 5, carte 4.

1935. *Rosacea cymbiformis :* Hardy & Gunther, *Disc. Rep.* **11**, p. 106.

1936. *Rosacea cymbiformis :* Leloup, *Bull. Inst. Ocean No.* **703**, p. 6.

1936. *Rosacea cymbiformis :* Totton, *Zoologica*, N.Y., **21**(4), p. 232.

1937. *Rosacea cymbiformis :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II *Biology* H. **2**, pp. 10, 75, figs. 6–7, 56.

1954. *Rosacea cymbiformis :* Totton, *Disc. Rep.*, **27**, pp. 15, 88.

1955. *Rosacea cymbiformis :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 5.

1955. *Rosacea cymbiformis :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 11.

1965. *Rosacea cymbiformis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 118, pl. XXI, fig. 1; pl. XXII, figs. 1–3; text-figs. 68, 69.

Material examined.—The material consists of three loose nectophores taken from INS KISTNA Station nos. K31, K33 and K35 by Nansen Net in hauls from 200–0 metres; these specimens are in the general collections of the Zoological Survey of India.

Type locality.—Mediterranean Sea.

Distribution.—This species has been recorded in the tropical and temperate regions extending between 60°N and 40°S of the three Oceans (for details of localities, *see* Table 1).

Description.—Polygastric phase.—(Text-fig. 6, K, L & P). The nectophores range in size from 6.0–15.0 mm in length and resemble those of *R. plicata* in their shape but the hydroecium is in the form of a shallow groove occurring along the entire length on the ventral surface. The two edges on this side are often folded inwards thus forming a narrow cylindrical tube. The ostium of the nectosac is small and directed outwards. The velum of the ostium is very narrow. The lateral radial canals take a meandering course in the larger nectophores, while they are much simpler in the smaller ones. The somatocyst is long, thin and extends only anteriorly in the smaller nectophores, while in the larger ones the descending branch extends to almost as far as the level of the nectosac.

Two gastrozooids and their contracted tentacles are found attached to one of the smaller nectophores (Text-fig. 6,P).

Eudoxid phase.—Not present in the collection.

Genus **Praya** Quoy & Gaimard, 1833-34

1833. *Praya* Quoy & Gaimard, *Voyage....de M. J. Dumont D'Urville. Zool.*, **4**, p. 104.

1911. *Nectodroma* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 204.

1965. *Praya :* Totton, *Synopsis of the Siphonophora*, p. 122.

Prayinae with a pair of huge smooth elongated and opposed nectophores; nectosac with multi-form (branched) radial, subumbral canals; and branched somatocyst. Eudoxid with flattened semicircular bract having four main bracteal canals and flattened gonophores with branched pedicular canals.

There are two valid species : *P. dubia* (Quoy & Gaimard, 1833-34) and *P. reticulata* Bigelow, 1911b.

Type species.—*P. dubia* (Quoy & Gaimard, 1833-34).

Key to species of *Praya*

1. Nectosac with multi-form radial, subumbral canals which anastamose; dorsal and right hydroecial bracteal canals with recurved tips . . . . . *reticulata*
2. Nectosac with multi-form radial, subumbral canals which do not anastomose; dorsal and right hydroecial canals without recurved tips . . . . . *dubia*

P. dubia and a single gonophore belonging to *P. reticulata* are present in the collections.

Praya dubia (Quoy & Gaimard, 1833-34)

(Text-fig. 7, A & B)

1833-44. *Diphyes dubia* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe....de M. J. Dumont D'Urville. Zool.*, **4**, *Atlas, Zoophytes*, p. 104, pl. 5, figs. 34–36.

1843. *Praya dubia :* Lesson, *Acalephs Histoire naturella des Zoophytes*, p. 143 (Non Blainville, 1834, p. 137).

1898. *Rosacea dubia :* Schneider, *Zool. Anz.*, **21**, p. 79. (in part).

1911. *Nectodroma dubia :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 204, pl. 3, figs. 8, 9.

1925. *Nectodroma dubia :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 381.

1931. *Praya dubia :* Bigelow, *Zoologica*, N. Y., **8**(11), p. 531.

1931. *Praya reticulata :* Bigelow, *Zoologica*, N.Y., **8**(11), text-fig. 185- bract.

1954. *Praya dubia :* Totton, *Disc. Rep.*, **27**, p. 15.

1965. *Praya dubia :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 122, pl. XXIII, figs. 6, 7; text-figs. 70, 74E.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5182	Pl. N.	Surface	One necto.; 1 stem	P 1739/1
V 5193	Ich. N.	1000—0	One necto.	P 1735/1

Type locality.—Neighbourhood of Kangaroo Island, off Adelaide (South Australia).

Distribution.—Eastern tropical Pacific, Indian Ocean and Atlantic Ocean (*see* also Table 1).

Description.—Polygastric phase.—(Text-fig. 7,A). One nectophore measures 40.0 mm in length and is 17.2 mm in breadth; the other specimen has the following dimensions : length—45.0 mm, breadth—20.0 mm. The nectophore, in both cases, is flattened dorsoventrally, smooth, elongated, possessing great amount of mesogloea, for the flotation of a large and heavy stem. The hydroecium is in the form of an elongated depression extending along the entire length of the nectophore on the ventral side.

The somatocyst is divided into three main branches. The median branch lies in the mid-region of the nectophore, and is uniformly thick. It is white in colour, clearly seen against the transparent mesogloea and appears as though two similar cord-like canals are bound together. It runs anteriorly almost upto the edge of the nectophore. In this region the somatocyst separates into two lateral branches which run nearly to the lateral edges of the nectophore, then curve and run downwards (*i.e.*, posteriorly) and terminate on either side at the level of the apex of the nectosac. On their course these canals give off short, blind diverticula which are directed outwards. Posteriorly,

the median branch extends down as far as the level of the ostium of the nectosac. The pedicular canal leading to the nectosac is thin and threadlike.

The nectosac is large and occurs at the posterior end at one side of the nectophore. It is about $\frac{1}{4}$th the length of the nectophore. The ostium is large. The nectosac possesses well-developed musculature. In both the specimens, a portion of this musculature is torn and missing and therefore, the exact number of the subumbral radial canals is not known. Eight canals are distinctly seen at the apex of the nectosac and the rest are missing. Each canal is seen to divide once and then twice in the middle and distal regions of the nectosac so that there are about 24 canals at the ostium of the nectosac.

A full description of these radial canals is given by Bigelow (1911b; 1931). According to him there are 12 radial subumbral canals which subdivide in the above pattern near the base of the mouth of the nectosac so that their number is nearly 30–50 at the distal end.

Stem.—(Text-fig. 7,B). In the plankton sample from RV VITYAZ Station no. V 5182, there is a long, thick stem which measures 115.0 mm in length. One end of the stem is thick (2.5 mm), while the other end is thin and tapering. At the thicker end there is a bunch of gastrozooids. A thick, stiff collar-like structure occurs in the midst of the gastrozooids, probably by which it is attached to the nectophore. This stem appears as though it is segmented. No bracts are observed.

Praya reticulata (Bigelow, 1911)

(Text-fig. 7, C)

1911. *Nectodroma reticulata* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 208, pl. 1, figs. 7, 8, pl. 3, figs. 1–7.

1925. *Nectodroma reticulata :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 383.

1930. *Nectodroma reticulata :* Bigelow & Leslie, *Bull. Mus. Comp. Zool.* Harv., **70**, pp. 546, 551.

1931. *Praya reticulata :* Bigelow, *Zoologica*, N.Y. **8**(11), p. 532, text-figs. 186–189 (Non text-fig. 185- bract of *P. dubia*).

1965. *Praya reticulata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 123, pl. XXIII, figs. 1–4; text-fig. 74.

Material examined.—A single gonophore from INS KISTNA Station no. K 47, from a depth of 200-0 metres, by Nansen's Net.

Type locality.—Eastern tropical Pacific Ocean.

Types.—Deposited in collection of Museum of Comparative Zoology, Harvard University, Harvard, U.S.A.

Distribution.—Eastern tropical Pacific; off Peru, south of Japan; Puget Sound; Galapagos-Panama region; Monterey Bay; North Atlantic and Pacific (*see* also Table 1). This is the first record of the species from the Indian Ocean.

Description.—Gonophore.—(Text-fig. 7,C). The gonophore measures 9.0 mm in length and 7.0 mm in breadth at the base. It is flat, firm and has a triangular shape. The pedicular end is blunt and slightly trilobed. A distinctive feature of the gonophore is the trifid branching of the pedicular canal at its point of junction with the three branches extending outwards centrifugally over the apex of the bell. These branches are seen within each lobe. It is slightly asymmetrical since one of the lobes is larger than the others.

The nectosac is triangular in shape with a broad oval ostium. The musculature is missing and therefore the radial canals are not discernible. No manubrium bearing the

gonad is observed within the bell. Probably this is an asexual nectophore or the gonads must have been lost.

Remarks.—The present gonophore resembles the female gonophores of *P. reticulata* described and figured by Bigelow (1931, fig. 186) in its size and in being slightly asymmetrical. After studying many attached and detached gonophores of both sexes, Bigelow concluded that the asexual nectophores are not developed. As mentioned earlier, the gonad is not present. It may either have been lost during collection and preservation or it may be an asexual nectophore. The gonophores of *P. dubia* have never been described or figured so far. Hence it was not possible to compare the gonophores of the two species.

Genus **Prayoides** Leloup, 1934

1934. *Prayoides* Leloup, *Bull. Mus. Hist. nat. Begl.*, **10**(6), p. 11.

Prayinae with somatocyst simple and unbranched as in *Rosacea;* subumbral radial canals branched but not so profusely as in *Praya.*

Leloup (1934a) treated it as a sub-genus of *Rosacea*, but Totton (1965) raised it to generic rank.

Monotypic genus for *P. intermedia* Leloup, 1934a.

Prayoides intermedia Leloup, 1934

(Text-fig. 7, D)

1934. *Rosacea (Prayoides) intermedia* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), pl. 11, fig. 4.

1965. *Prayoides intermedia :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 125.

Material examined.—One nectophore was taken from INS KISTNA Station no. K 33, by Nansen's Net in a haul made from 200-0 metres.

Type locality.—Cape Verde and Freetown near the African continent (between Lat. 5°W and 20°W.).

Record.—This is the second record of the species.

Distribution.—North Atlantic along the west coast of Africa. The present record is from the Arabian Sea (Indian Ocean). This is the first record from the Indian Ocean area.

Description.—Polygastric phase.—(Text-fig. 7, D).—The single loose nectophore measures 5.53 mm in length. The hydroecium is in the form of a shallow depression extending on the entire ventral surface as in *R. cymbiformis.* The somatocyst occurs as a thin canal in the anterior half. It does not extend downwards. This is probably a larval nectophore. The nectosac is small, thin walled and there are about four or five radial canals. Two of these canals are distinctly seen to subdivide into two. Whether the other radial canals also divide again or not, is uncertain.

Genus **Lilyopsis** Chun, 1885

1885. *Lilyopsis* Chun, *S. B. preuss. Akad. Wiss.* for 1885, p. 511.

Prayinae with a pair of opposed (biserial), rounded, similar nectophores; ostium of nectosac bearing tubercles or pigment spots; somatocyst simple, prolonged into mesogloea with dilated tip. Eudoxid with bract possessing six bracteal canals, without central organ and with asexual nectophore.

The early history of this genus is very confused and descriptions and figures are inadequate. Chun (1885) included three species: *L. diphyes* Vogt, 1854 (= *L. diphyes* Kölliker, 1853); *L. medusa* Metschnikoff, 1870 (= ? *L. rosea* Chun) and his new one *L. rosea*, 1885.

L. diphyes Vogt. and *L. diphyes* Kölliker are considered to belong to a different genus, *Desmophyes* Haeckel (*vide* Totton, 1965, p. 126).

Provisionally two species of *Lilyopsis : L. rosea* Chun, 1885 and *L. gracilis* Fewkes, 1883 are considered as valid.

Type species.—L. rosea Chun, 1885.

Key to species of *Lilyopsis*

1. Nectosac with lateral radial canals meandering . . . . . *rosea*
2. Nectosac with lateral radial canals straight . . . . . *gracilis*

Both these species are not present in the collection.

Genus **Desmophyes** Haeckel, 1888

1888. *Desmophyes* Haeckel, *System der Siphonophoren Jena. Zeit.*, **20**, p. 36.
1888. *Desmophyes :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 169.

Prayinae with one to several pairs of rounded biserially arranged similar nectophores; ostium of nectosac bearing minute red pigment flecks and tubercles and directed downwards and outwards; somatocyst simple, club-shaped, prolonged into mesoglea, nectosac with straight lateral radial canals. Eudoxid with bract possessing four main bracteal canals, a median pear-shaped central organ and with large asexual nectophore and reduced unisexual gonophores.

Monotypic genus for *D. annectens* Haeckel, 1888.

This species is not represented in the collections.

Genus **Stephanophyes** Chun, 1888

1888. *Stephanophyes* Chun, *S. B. preuss. Akad. Wiss. for* 1888, p. 11.

Prayinae with four large, similar nectophores forming a corona; somatocyst with only one bifurcation in juvenile nectophores, and complexly branched about ten times in mature nectophores, and tips of branchlets being pigmented; ostium of nectosac lying parallel to long axis of stem; and nectosac with lateral radial canals meandering. Eudoxid or stem-groups possessing a single or 2–3 characteristic mouthless palpons bearing heteromorph tentacles in addition to gastrozooids, bracts, gonophores and asexual nectophores. Asexual nectophore with lateral radial canals meandering.

Monotypic genus for *S. superba* Chun, 1888

This species is not represented in the collections.

Subfamily III. *Nectropyramidinae* Bigelow, 1911

Prayidae with single nectophore, bearing ridges, angles and serrations. Somatocyst either simple or complexly branched. Hydroecium deep and conical. Radial canals of nectosac originating separately from pedicular canal. *Eudoxid phase :* bracts

usually with four main bracteal canals either simple or branched; special nectophore present (except in *N. diomedeae* Bigelow, 1911).

Monotypic subfamily for genus *Nectopyramis* Bigelow, 1911a.

Genus **Nectopyramis** Bigelow, 1911a

1911a. *Nectopyramis* Bigelow, *Trans. Linn. Soc. London (Zool.)*, **10**, p.
1911b. *Archiosoma* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p.

The generic characters are given under the sub-family.

This genus includes four distinct, aberrant species : *N. thetis* Bigelow, 1911a; *N. diomedeae* Bigelow, 1911b; *N. natans*, Bigelow, 1911b; and *N. spinosa* Sears, 1952. They have great affinity with not only *Rosacea* and *Amphicaryon* but also with *Hippopodius*. Nectophores of species of *Nectopyramis* are always taken singly, and without any reserve buds. These larval nectophores instead of being caducous are retained (neotenic), except in *N. spinosa* where two types : the caducous larval bell and the other heteromorph definitive nectophore, are developed.

Type species.—*N. thetis* Bigelow, 1911a.

Key to species of *Nectopyramis*

POLYGASTRIC PHASE :

1.	Somatocyst complexly branched	2
	Somatocyst simple	3
2.	Nectophore rhomboid, ovate	*diomedeae*
	Nectophore triangular	*thetis*
3.	Nectophore bow-shaped, bearing ridges	*natans*
	Nectophore globular, bearing spinose ridges	*spinosa*

EUDOXID PHASE :

1.	Bract triangular in shape, with somatocyst represented by four canals	2
	Bract long, bow-shaped; somatocyst represented by three canals	*natans*
2.	Somatocyst either simple or branching laterally once	3
	Somatocyst complexly branched; without asexual nectophore	*diomedeae*
3.	Somatocyst simple, without branches	*spinosa*
	Somatocyst branching laterally once	*thetis*

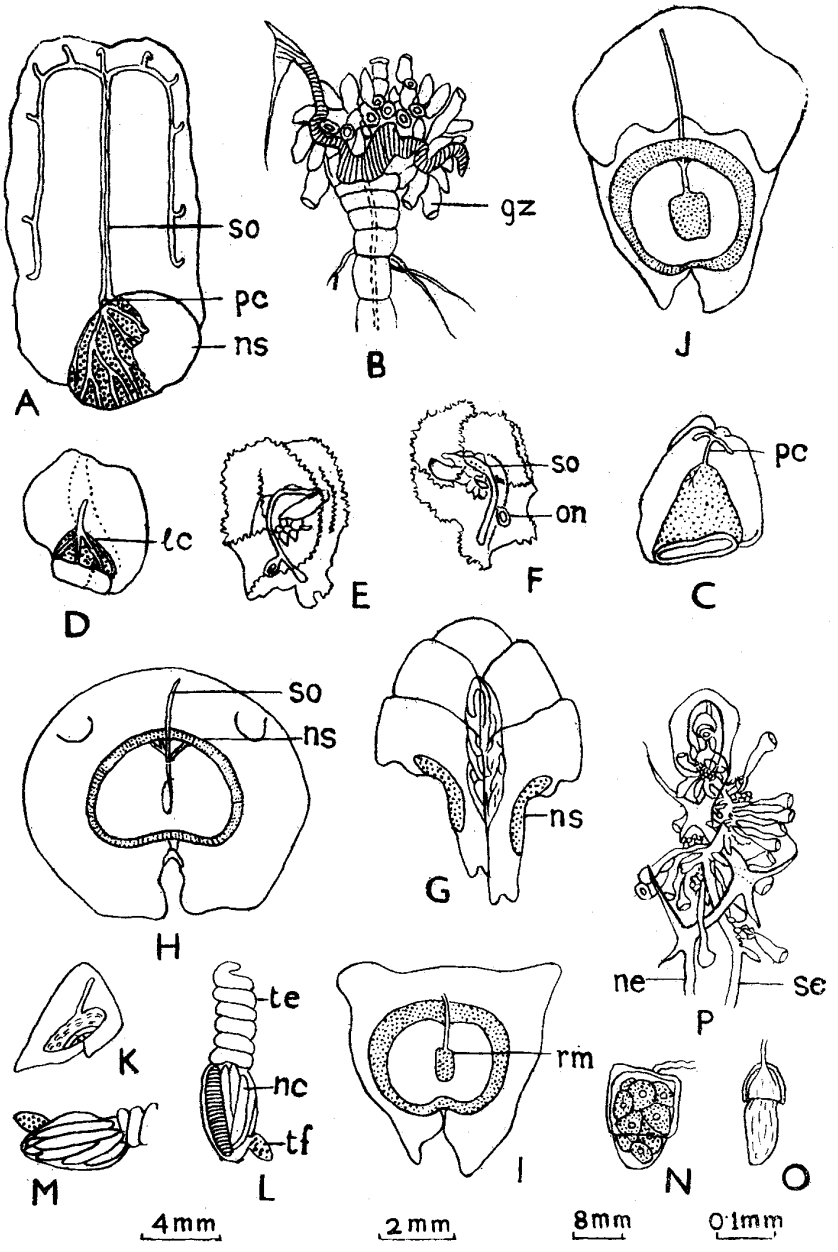
Nectopyramis spinosa Sears, 1952

(Text-fig. 7, E & F)

1925. *Hippopodius cuspidatus* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 415.
1952. *Nectopyamis spinosa* Sears, *Breviora*, **3**, pl. 1, figs 3.
1954. *Nectopyramis spinosa :* Totton, *Disc. Rep.*, **27**, p. 86.
1965. *Nectopyramis spinosa :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), Lonson, p. 137, pl. XXVII, fig. 2; text-figs. 74D, 79, 80.

Material examined.—A single polygastric phase was taken from RV VITYAZ Station no. V 5216, from a haul from 1,000 metres to surface by Ichthyological Net.

Z.S.I. Registered No.—P 1593/1.



TEXT-FIGURE 7

Praya dubia : A—B
A—polygastric phase. B—stem.
Praya reticulata : C
C—gonophore.
Prayoides intermedia : D
D—polygastric phase.
Nectopyramis spinosa : E—F
E & F—polygastric phase.
Hippopodius hippopus : G—P
G—nectophores intact (colony). H—mature nectophore. I—mature nectophores.
J—mature nectophore. K—young nectophore. L & M—tentilla. N & O—gonophores (male & female)
P—colony showing stem.
Abbreviations used :
go—gonophore. gz—gastrozooid. lc—lateral radial canal. nc—nematocyst. ne—nectosome.
ns—nectosac. on—obsolescent nectesac. pc—pedicular canal. rm—rete mirabele. Se—siphosome.
so—somatocyst. te—tentillum. tf—terminal filament.

Type locality.—Indian Ocean.

Distribution.—Indian Ocean, south Pacific, tropical Atlantic and west of Ireland. This is the second record from the Indian Ocean.

Description.—Polygastric phase.—(Text-fig. 7, E & F). The nectophore measures 3.3 mm in length and 2.8 mm in breadth. It is globular in shape, possessing many ridges and facets. All the ridges are characteristically spinose. These spines occur in groups of 2 or 3, forming continuous ridges which are raised above the surrounding facets. The ridges are arranged in a complex manner. The peri-hydroecial ridge occurs at the edge of the hydroecium. The horizontal ridge has the 'figure of 8' and occurs on the opposite side just above the ostium of the vestigeal nectosac. The buccal ridges run horizontally on either side of the 'figure of 8' ridge, from just below and outside the ostium of the nectosac, and bend upwards to about $\frac{1}{3}$rd of the length of the nectophore. The hydroecium is deep, conical in shape and its ostium is narrow and silt-like as in the larval prayids. The somatocyst is simple, long, tubular, curved and occurs on the inner surface of the hydroecium. The nectosac is obsolescent. The radial canals appear to arise from a short single canal, which bifurcates. The two radial canals are short and appear to end in the small circular canal (Text-fig. 7, E & F; on). A single gastrozooid with its much contracted tentacle occurs within the hydroecium.

Eudoxid phase.—Not present in the collections.

Remarks.—In this genus, *Nectopyramis*, the radial canals of the nectosac always originate separately from the pedicular canal. This has so far been considered as a distinct generic character. In the single specimen examined, the radial canals appear to arise as a single canal which bifurcates. More material is needed to confirm this point.

The present nectophore is considered as a larval nectophore since the nectosac is obsolescent. The definitive nectophore is known to possess functional nectosac (cf. Totton, 1954, p. 86).

Family 11 HIPPOPODIIDAE Kölliker, 1853

Hippopodiinae Kölliker, 1853
Polyphyidae Chun, 1882
Haeckel, 1888b

Calycophorae with a succession of up to 12 or more similar nectophores instead of the usual two; nectophores smooth or possessing spines or protuberances; large *rete mirabele* present in ventral radial canal during young growth stages. Bracts absent. Cormidia not separating as eudoxids.

The earliest known hippopodid is the Mediterranean form, *Gleba hippopus* Forskål, 1776, though figured and described inadequately. The generic name of *Gleba* was invalidated since this name was pre-occupied for a pteropod which Forskål had figured in the same plate, under the same generic name (*vide* Chun, 1897b, p. 34). Hence to avoid confusion, the generic name *Hippopodius* Quoy & Gaimard 1827, was selected by Chun, who included *Gleba hippopus* Forskål as a doubtful synonym of *Hippopodius luteus* Quoy & Gaimard, 1827. But only one species was considered as valid, and the oldest name, viz. *H. hippopus* Forskål, was used by Schneider, (1898) and by later authors.

Kölliker (1853) described a closely allied genus *Vogtia*, from the Mediterranean and established for these two genera the Family Hippopodiidae. Chun (1882) and Haeckel (1888) called the same family Polyphyidae (in opposition to Diphyidae and Monophyidae). Haeckel (1888b) recognized three genera : *Hippopodius* Quoy & Gaimard,

1827, with rounded nectophores without teeth and possessing diclinic cormidia; *Polyphyes* Haeckel, 1888, with rounded nectophores possessing six teeth and monoclinic cormidia; and *Vogtia* Kölliker, 1853, with prismatic nectophores, possessing five teeth and monoclinic cormidia. He arranged these genera under two sub-families "Hippopodidae" and "Vogtidae".

It had been shown by the later workers that the number of teeth in both *Hippopodius* and *Polyphyes* is merely an evidence of individual variation and that the male and female gonophores are usually associated together but not with the numerical regularity ascribed to them by Weismann (1883) and Haeckel (1888) (*vide* Chun, 1897b; Schneider, 1898; Richter, 1907; & Bigelow, 1911b). Therefore only two genera *Hippopodius* (= *Polyphyes*) and *Vogtia* were recognized as valid by Chun, but Schneider united these under a single genus *Hippopodius*. According to Bigelow the differences in the structure of the nectophores are of more than specific importance and since the status of a sub-genus (*Vogtia*) is not recognized in Siphonophora, both the genera should be retained as valid. Moser (1925) agreed with Schneider in uniting these two genera. Totton (1965) did not regard the genus *Vogtia* as distinct but for the sake of maintaining stability in nomenclature, refrained from using one generic name for the five species included in this family, inspite of the fact that Schneider and Moser had done so.

Therefore the two genera *Hippopodius* and *Vogtia* are still recognized as valid in the present study.

Both the genera are represented in the present collections.

Genus **Hippopodius** Quoy & Gaimard, 1827

1775. *Gleba* Forskål, *Descriptiones....edidit Carstem Niebuhr.*, p. 14 (preoccupied—*see* Chun, 1897).
1827. *Hippopodius* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 172.
1888. *Polyphyes* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 178.
1911. *Hippopodius* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 207.

Hippopodiidae with a series of horse-shoe shaped nectophores none of which are normally shed. Nectophores usually possess four rounded, smoky coloured protuberances just above the nectosac.

Monotypic genus for *H. hippopus* (Forskal, 1776).

Hippopodius hippopus (Forskål, 1776)

(Text-fig. 7, G–P)

1775. *Gleba hippopus* Forskål, *Descriptiones animalium....quae in itinere orientali observavit, post martem editi carsten Niebuhr*, Hauniae, p. 14.
1776. *Gleba hippopus* Forskål, *Icones rerum naturalium....post mortem autoris editi Carsten Niebuhr*, Hauniae, taf. 43, fig. R.
1823. *Gleba excisa* Otto, *Nova Acta Leop. Carol.*, **11**, p. 309, taf. 42, figs. 3a–d.
1827. *Hippopodius luteus* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 127, pl. 4A, figs. 1–12.
1829. *Hippopodius luteus :* Eschscholtz, *System der Acalephen*, Berlin, p. 146.
1830. *Hippopus excisus :* Delle Chiaje, *Memoire sulla storia e notomia degli Animali Senza Vertebrae del regno di Napoli*, **4**, *Atlas*, 1823–'31, Napoli, p. 64.
1830. *Protomedia lutea :* Blainville, *Dict. Sci. Nat.* Paris, **60**, p. 110.
1830. *Protomedia uniformis* Blainville, *Dict. Sci. Nat.* Paris, **60**, p. 110.
1830. *Protomedia calcearia* Blainville, *Dict. Sci. Nat.* Paris, **60**, p. 110.
1834. *Stephanomia hippopoda :* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolobe'....de M. J. Dumont D'Urville. Zool.*, **4**, *Atlas Zoophytes*, p. 67, taf, 2, figs. 13–21.

1834. *Protomedia lutea :* Blainville, *Manual d'actinologie ou de Zoophytologie*, Paris, p. 121, pl. 2, fig. 4.

1834. *Protomedia uniformis :* Blainville, *Manuel d'actinologie ou de Zoophytologie*, Paris, p. 121.

1834. *Protomedia calcearia :* Blainville, *Manual d'actinologie ou de Zoophytologie*, Paris, p. 121.

1936. *Hippopodius mediterraneous :* Costa, *Fauna de lBegno di Napoli, Medusari*, p. 3, taf. 2.

1841. *Hippopodius luteus :* Delle Chiaje, *Descrizione e notomia degli Animali Invertebrati della Sicilia citeriore osservati vivi negli anni* 1822–'30, 6–7, *Atlas*, Napoli. tav. 92, fig. 7.

1841. *Hippopus excisus :* Delle Chiaje, *Descrizione e notomia degli Animali Invertebrati della Sicilia citeriore osservati vivi negli anni* 1822–'30, 6–7, *Atlas*, Napoli, tav. 149, figs. 1, 2.

1843. *Hippopodius luteus :* Lesson, *Acalephs Histoire naturelle des Zoophytes*, Paris, p. 473.

1843. *Elephantopes neapolitanus* Lesson, *Acalephs Histoire naturelle des Zoophytes*, Paris, p. 473.,

1853. *Hippopodius neapolitanus :* Kölliker, *Die Schwimmpolypen oder Siphonophora von Messina* Leipzig, p. 28, taf. 6, figs. 1–5.

1854. *Hippopodius luteus :* Vogt, *Mem. Inst. Nat.* Genev., **1**, p. 93, taf. 14, figs. 7–12; taf. 15, figs. 1, 2.

1854. *Hippopodius gleba* Leuckart, *Arch. Naturgesch. Jahrg.*, **22**, p. 299, taf. 12, figs. 1–4.

1861. *Hippopodius gleba :* Kefferstein & Ehlers, *Beitrage gesammelt im winter* 1859-60 *in Neapel und Messina* I. *Beobachtungen uber die Siphonophoren*, Leipzig, p. 22, taf. 5, figs. 18–21.

1870. *Hippopodius luteus :* Spagnolini, *Catologo degli Acalefi del Golfo di Napoli. Parte Prima Siphonofori*, Milan, p. 23.

1870-71. *Hippopodius luteus :* Muller, *Naturh. tidsskrift.*, **7**, taf. 11, fig. 8; taf. 13, figs. 1–8.

1880. *Gleba hippopus :* Fewkes, *Bull. Mus. Comp. Zool. Harv.*, **6**, p. 130, taf. 3, figs. 4, 5.

1882. *Gleba hippopus :* Fewkes, *Bull. Mus. Comp. Zool. Harv.*, **9**, p. 304, pl. 1, figs. 31–33.

1883. *Hippopodius neapolitanus :* Weismann, *Die Entstchung der sexnat-Zellen bie der Hydromedusen Jena*, **40**, *Atlas*, p. 194, taf. 20, 21, figs. 9–13.

1888. *Hippopopius luteus :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1165.

1888. *Polyphyes luteus :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 36.

1888. *Hippopodius gleba :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 178.

1888. *Polyphyes ungulata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 179, pl. XXIX, figs. 1–8.

1888. *Polyphyes elephantopus* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 364.

1897. *Hippopodius luteus :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 34.

1898. *Hippopodius hippopus :* Schneider, *Zool. Anz.*, **21**, p. 82.

1907. *Hippopodius hippopus :* Richter, *Z. Wiss. Zool.*, **86**, p. 589, taf. 28, figs. 27–34; taf. 29.

1908. *Hippopodius luteus :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 62.

1911. *Hippopodius hippopus :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 208.

1926. *Hippopodius hippopus :* Biglow, *Trans. Linn. Soc.* Lond. (*Zool*), srr. 2, (2)**19**, p. 61.

1932. *Hippopodius hippopus :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 330, text-fig. 11.

1933. *Hippopodius luteus :* Leloup, *Res. Camp. Sci.* Mona o., **87**, p. 15.

1933. *Hippopodius hippopus :* Leloup, *Res. Camp. Sci.* Monaco. **87**, p. 15.

1934. *Hippopodius hippopus :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 5.

1935. *Hippopodius hippopus :* Leloup, *Bull. Mus. Roy. Hsit. nat.* Belg., **11**(31), p. 5.

1935. *Hippopodius hippopus :* Leloup, *Bull. Mus. Hist. nat.* Belg. **11**, p. 6.

1935. *Hippopodius hippopus :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlant. Exped. 'Meteor'*, **12**(2), p. 3.

1935. *Hippopodius hippopus :* Russel & Colman, *Sci. Rep. Gr. Barrier Reef. Exped.*, **11**(7), p. 258.

1936. *Hippopodius hippopus :* Leloup, *Bull. Inst. Ocean*, No. **703**, p. 7.

1936. *Hippopodius hippopus :* Totton, *Zoologica* N.Y., **21**(4), p. 232.

1937. *Hippopodius hippopus :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, pp. 14, 76, fig. 57.

1938. *Hippopodius hippopus :* Boone, *Bull. Vanderbilt Mar. Mus.*, VII, p. 40.

1949. *Hippopodius hippopus :* Moore, *Bull. Bhigham Oceanogr. Coll.* **12**(2), p. 12, figs. 12–15.

1954. *Hippopodius hippopus :* Totton, *Disc. Rep.*, **27**, p. 73.

1955. *Hippopodius hippopus :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 6.

1965. *Hippopodius hippopus :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 139, pl. XXVIII, figs. 1, 2; pl. XXIX, figs. 1–3; text-fig. 81, 1a–c.

Material examined :

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5177	I.-K.Trawl	70—100	3 nectophores	Gen. Coll.
V 5179	Pl.N. & Trawl	150—0	56 ,,	P 1631/1
V 5200	J.N.	200—0	8 ,,	P 1751/1
V 5207	I.-K. Trawl	150—100	6 ,,	P 1652/1
V 5209	J. N. & Trawl	200—0	30 ,,	P 1613/1
V 5212	J. N.	,,	9 ,,	P 1608/1
V 5214	Ich. N.	1000—0	3 ,,	Gen. Coll.
V 5216	Ring. Tr.	,,	1 ,,	,,
V 5220	J. N.	200—0	4 ,,	P 1672/1
V 5223	,,	,,	6 ,,	P 1693/1
V 5225	J.N. & IOSN	200—0	24 ,,	P 1637/1
V 5227	Pl. N.	Surface	13 ,,	P 1708/1
V 5232	J. N.	200—0	3 ,,	P 1731/1
K 7	N. N.	500—0	7 ,,	Gen. Coll.
K 10	,,	100—0	5 ,,	,,
K 15	,,	200—0	1 ,,	,,
K 26	,,	,,	3 ,,	,,
K 37	,,	,,	1 ,,	,,
K 43	,,	,,	2 ,,	,,
K 46	,,	,,	2 ,,	,,
K 532	Org. N.	,,	4 ,,	,,
K 533	,,	,,	3 ,,	,,

Type locality.—Mediterranean Sea.

Distribution.—This species is world-wide in distribution occurring commonly in the warmer belts of the open oceans. It has so far not been recorded from the neritic zone and from the Arctic & Antarctic Oceans (*see* also Table 1).

Description.—Colony (Text-fig. 7, G & P) : Of the 194 nectophores present in the collection many are found intact. The number of nectophores in each colony varies from two to several pairs. These are arranged biserially and alternately, the younger nectophores being situated in the hydroecium of its predecessor. In the preserved condition the nectophores are held firmly together as shown in text-figure 7-G.

Nectophores.—(Text-fig. 7, G-K & P) : The nectophores range in length from 3.0 mm to 11.7 mm, and breadth from 2.0 mm to 9.0 mm. In general appearance all the nectophores are horse-shoe shaped (text-fig. 7,J), but some of them show variation in the apical facet. Some have convex, rounded and smooth-edged apical facets, while others have flat, squarish and slightly sharp edges (Text-fig. 7-I). The young nectophore (Text-fig. 7-K) is not flat and horse-shoe shaped as the older nectophores. It has a deeper nectosac. Each nectophore has a cleft below the nectosac. The shape and the space between the clefts vary according to age and position of the colony. There are four prominent, rounded, smoky coloured (*i.e.*, in preserved condition) protuberances on the

dorsal side above the nectosac. In the preserved unrelaxed material the nectosac appears as a shallow depression. The nectosac is large, round in shape and possesses a broad ostium. The radial canals do not originate at the same point on the dorsal radial canal. The shape of the *rete mirabele* occurring in the ventral radial canal varies according to age. In the younger nectophores it is large, broad, squarish or rounded or bilobed or pear-shaped and occurs in the form of an opaque patch seen clearly through the large ostium of the nectosac. In the larger nectophores it is very much reduced, oval shaped or thin and elongated or completely absent.

The somatocyst is long, thin, directed anteriorly and reach almost the apex of the nectophore. The hydroecium is dome-shaped. It is deep and possesses a young nectophore which in turn may have a still younger nectophore in its hydroecium. When the nectophores are intact, the hydroecium of all the nectophores form a narrow cylindrical tube in which the stem with its cormidia is kept retracted in preserved material.

At RV VITYAZ Station no. V 5179, a colony had seven nectophores intact, of which one nectophore is exceptionally large measuring 18.0 mm in length and 21.5 mm breadth (Text-fig. 7-H). This large nectophore is nearly oval in shape, flat and has a large round nectosac. The four rounded protuberances present in the other nectophores are absent here. The dorsal edge just above the nectosac, is nearly smooth and only a faint trace of two raised regions are seen at the lateral edges of the nectophore. The hydroecium is inconspicuous.

Stem.—(Text-fig. 7, P) : The upper part of the stem (nectosome) is deflexed and turned around the lower part (siphosome) in wide spiral turns (as shown in Text-fig. 7, P, ne & se). The stem in all the colonies examined are contracted and the arrangement of the cormidia is not clearly seen. However, these occur as bunches within many of the loose nectophores or in-between two attached nectophores. The numerous gastrozooids are pinkish in colour, pedicellate and possess sub-cylindrical basigaster, large stomach and highly retractile proboscis. The edges of the proboscis are often bent backwards to form a thick girdle around the mouth. The tentacles are much contracted. These must have been quite long when expanded (as judged from the size of the bunch of the contracted tentacle occurring by the side of each siphon). The tentilla (Text-fig. 7, L & M) end in ellipsoidal cnidosacs, *i.e.*, the cnidoband is curved round till the apical end lies near the base. There are four to six large ensiform nematocysts at the base and many narrow elongated ones at lateral surface. The tentilla are coloured yellow.

Gonophores.—(Text-fig. 7, N & O) : The gonophores occur as bunches on the stem at the bases of gastrozooids. These are stalked. The manubria of the male and female gonophores project out freely from the ostia of the small medusae. These medusae represent the adult phase of the animals.

Genus **Vogtia** Kölliker, 1853

1853. *Vogtia* Kölliker, *Die Schwimmpolypen Oder Siphonophoren von Messina*, p. 31.

Hippopodiidae with several pairs of similar prismatic and facetted nectophores, either smooth-walled or bearing tubercle-like spines.

Four valid species of *Vogtia* are known : *V. spinosa* Kefferstein & Ehlers, 1861; *V. pentacantha* Kölliker, 1853; *V. serrata* Moser, 1925. and *V. glabra* Bigelow, 1918.

Type species.—Not designated so far; I hereby designate *V. pentacantha* Kölliker, 1853 as the type-species.

Key to species of *Vogtia*

1.	Nectophores pentagonal and facetted	2
	Nectophores either elongated and triangular or smooth and rounded with blunt apex . .	3
2.	With spines on facets and on the edges	*spinosa*
	With spines only on edges, facets smooth	*pentacantha*
3.	Nectophore elongated and triangular with hollows under lateral corners, with smooth facets and edges	*serrata*
	Nectophores smooth and rounded with a blunt apex with two prominences above ostium .	*glabra*

Three species of *Vogtia*, viz. *V. spinosa*, *V. pentacantha* and *V. glabra* are present in the collections.

Vogtia spinosa Kefferstein & Ehlers, 1861

(Text-fig. 8, A & B)

1861. *Vogtia spinosa* Kefferstein & Ehlers, *Beitrage gesammelt im Winter*, 1859–'60 *in Neapel und Mesiina*. I. *Beobachtungen uber die Siphonophoren*, Leipzig, p. 24, pl. 5, fig. 16.

1888. *Vogtia kollikeri* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 182, pl. 29, figs. 9–14.

1888. *Vogtia spinosa :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 364.

1897. *Vogtia spinosa :* Chun, *Ergebn. Plankton. Exped.*, **2**, k.b., p. 103.

1911. *Vogtia spinosa :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 210, pl. 15, figs. 5–12.

1918. *Vogtia spinosa :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 405.

1937. *Vogtia spinosa :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, pp. 18, 82, fig. 60.

1954. *Vogtia spinosa :* Totton, *Disc. Rep.*, **27**, pp. 27, 100.

1955. *Vogtia spinosa :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 7.

1965. *Vogtia spinosa :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 140, text-figs. 81–83.

Material examined.—Six nectophores were taken from RV VITYAZ Station no. V 5225, by Juday Net from a haul made from 200 metres to surface. These have been assigned Z.S.I. Registration no. P 1646/1.

Type locality.—Neapel and Messina (Italia).

Distribution.—This species occurs in the tropical regions of the Atlantic, Pacific and Indian Oceans, and in the Mediterranean Sea (for details of localities *see* Table 1).

Description.—Colony : Of the six definitive nectophores, two are attached with a bunch of gastrozooids occurring in-between them. The other four are loose and they do not possess any stem or cormidia.

Definitive nectophore.—(Text-fig. 8, A & B) : The largest nectophore has a length of 11.7 mm and a breadth of 16.5 mm. It is broad and pentagonal in shape. It has a pointed tip at the anterior end and the two lateral sides are produced into flared out pointed tips. The dorsal and the lateral facets and the ridges possess varying number of characteristic spiny tubercles. These tubercles are seen only on the dorsal surface while the ventral side is smooth, devoid of any spines.

As in *H. hippopus* the somatocyst is simple, threadlike and extend nearly upto the apex of the nectophore. The nectosac is relatively larger than in *H. hippopous* and rounded in shape. The lateral radial canals originate at different points from the dorsal radial canal. In this species also the *rete mirabele* occurs on the ventral radial canal

and varies in shape according to age. In the younger nectophores it almost covers the upper surface of the nectosac, and in the later stages it occurs as two lateral wings.

The cormidia are very much contracted. The gastrozooids are pedicellate and pink in colour. The gonophores are not present.

Vogtia pentacantha Kölliker, 1853

(Text-fig. 8, C & D)

1853. *Vogtia pentacantha* Kölliker, *Die Schwimmpolypen oder Siphonophoren von Messina*, Leipzig, p. 31, pl. VIII.

1859. *Vogtia pentacantha :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 56, pl. XII, fig. 7.

1861. *Vogtia pentacantha :* Kefferstein & Ehlers, *Beitrage Gesammelt im winter* 1859–'60 *in Neapel und Messina.* I. *Beobachtungen uber die Siphonophoren*, Leipzig, p. 23, taf. 5, fig. 12–15.

1863. *Hippopodius pentacanthus :* Claus, *Z. Wiss. Zool.*, **12**, p. 352, taf. 47, figs. 23–26.

1870. *Vogtia pentacantha :* Spagnolini, *Catologo degli Acalifi del Golfo di Napoli. Parte prima Siphonofori*, Milan, p. 25.

1897. *Vogtia pentacantha :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 35, taf. 1, figs. 11–14.

1911. *Vogtia pentacantha :* Bigelow, *Trans. Linn. Soc.* Lond. (*Zool.*), p. 351.

1913. non *Vogtia pentacantha :* Bigelow, *Proc. U.S. Nat. Mus.*, **44**, p. 66, pl. 5, figs. 7–9; pl. 6, fig. 6 (= ? *V. serrata* Moser).

1915. *Vogtia pentacantha :* Moser, *Sitz. k. preuss Akad. Wiss*, Berlin, **40**,p. 653.

1918. *Vogtia pentacantha :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 406, pl. 4, fig. 1.

1926. *Vogtia pentacantha :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*) ser. 2 (2)**19**), p. 61.

1954. *Vogtia pentacantha :* Totton, *Disc. Rep.*, **27**, pp. 15, 100.

1965. *Vogtia pentacantha :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 142, text-figs. 81–84 a,b.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5223	J.N.	200—0	15 nectophores	P 1692/1
V 5232	,,	312—0	22 ,,	P 1732/1
K 19	N.N.	200—0	5 ,,	Gen. Coll.
K 26	,,	,,	2 ,,	,,

Type locality.—Messina (Mediterranean).

Distribution.—This species is recorded from the tropical and temperate regions of the Atlantic, Pacific and Indian Oceans and from the Mediterranean Sea (for details of localities *see* Table 1).

Description.—Definitive nectophore.—(Text-fig. 8, C & D) : It has a length of **13.0** mm and a breadth of **15.3** mm. The nectophore is broad and pentagonal in shape as in *V. spinosa* but the lateral corners are not flared out into sharp points. Therefore, it is not so broad as *V. spinosa*. The characteristic spiny tubercles occur only along the ridges. The surfaces of the facets are smooth and devoid of any spines. The somatocyst, hydroecium, nectosac and the stem are as in *V. spinosa*. The gonophores are very much like those of *H. hippopus*.

Vogtia glàbra Bigelow, 1918

(Text-fig. 8, E & F)

1918. *Vogtia glabra* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 407, pl. 4, figs. 2–7.

1933 ?*Hippopodius glabrus :* Leloup, *Res. Camp. Sci.* Monaco, **87**, p. 17.

1934 ?*Hippopodius glabrus :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 6.

1936. *Vogtia glabra :* Totton, *Zoologica* N.Y., **21**(4), p. 232.

1937. *Vogtia glabra :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H, **2**, pp. 17, 79, fig. 20.

1954. *Vogtia glabra :* Totton, *Disc. Rep.*, **27**, pp. 15, 100, text-fig. 33, pl. IV, fig. 2.

1955. *Vogtia glabra :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 7.

1965. *Vogtia glabra :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 142, text-figs. 81, 82.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I.Regd. no.*
V 5216	Ich.N.	1000—0	One nectophore	P 1588/1
K 7	N.N.	500—0	One ,,	Gen. coll.
K 8	,,	200—0	One ,,	,,
K 46	,,	,,	Four ,,	,,

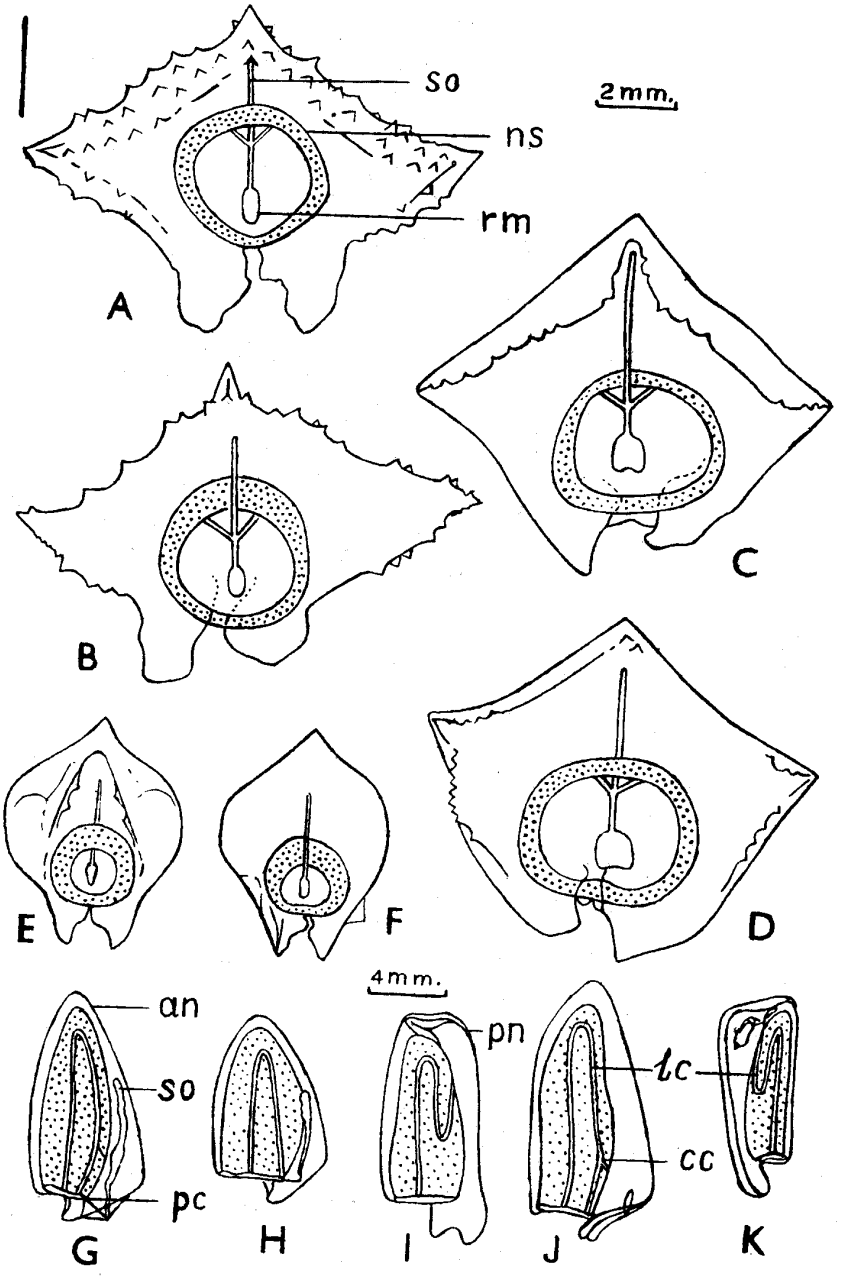
Type locality.—Straits of Florida (Lat. 25°34′ N, Long. 79°24′ W), western Atlantic from a depth of 450–0 metres.

Distribution.—This species has been recorded from the bathypelagic regions of the Atlantic, Pacific and Indian Oceans and from the Mediterranean Sea (for details of localities in the different oceans *see* Table 1).

Description.—Definitive nectophore.—(Text-fig. 8, E & F) : It has a length ranging from 4.0 mm to 15.2 mm and a breadth from 3.17 mm to 13.0 mm. The nectophores are longer than broad. The sides are not extended into pointed tips as in *V. spinosa* and *V. pentacantha* but resemble *H. hippopus* in having a smooth surface devoid of any spinous tubercles. The apex in this species is pointed and blunt. The somatocyst is thin and thread-like extending upto $\frac{1}{3}$rd the distance from the appex of the nectophore. The *rete mirable* found in the ventral radial canal is small. The hydroecium is shaped like an arrowhead. There are two pairs of very thin, small triangularly shaped teeth which occur at the edges of the hydroecium. There are only traces of the two rounded prominences noted by Totton (1965, p. 142). In the collections the stem and the cormidia are missing.

Family 12 *Diphyidae* Quoy & Gaimard, 1827

Calycophorae with two subequal, dissimilar nectophores placed one behind the other; anterior nectophore pyramidal possessing somatocyst, with or without ridges, ostia teeth and hydroecium; posterior nectophore with apical prolongation which fits into hydroecium of anterior nectophore or truncated when hydroecium is absent in anterior nectophore. Cormidia separate as free-swimming eudoxids, which may have special nectophores.



TEXT-FIGURE 8

Vogtia spinosa : A, B
A—nectophore : ventral view. B—nectophore : dorsal view.
Vogtia pentacantha : C, D
C—nectophore : ventral view. D—nectophore : dorsal view.
Vogtia glabra : E, F
E—nectophore : ventral view. F—nectophore : dorsal view.
Sulculeolaria chuni : G—I
G—anterior nectophore : with commissural canal. H—anterior nectophore : without commisural canal.
I—posterior nectophore.
Sulculeolaria turgida : J, K
J—anterior nectophore. K—posterior nectophore.
Abbreviations used :
an—anterior nectophore. cc—commissural canal. lc—lateral radial canal. ns—nectosac.
pc—pedicular canal. pn—posterior nectophore. rm—rete mirabele. so—somatocyst.

Bigelow (1911b) recognized three subfamilies of Diphyidae : Subfamily Abylinae L. Agassiz with superior nectophore prismatic and much smaller than the inferior one. Free-eudoxids having prismatic bracts.

Subfamily Galeolariinae Chun, with nectophore of about the same size; rounded, mostly without sharp ridges. Groups of appendages* permanently sessile.

Subfamily Diphyopsiinae Haeckel, with pyramidal nectophore with strong ridges. Groups of appendages detaching as free eudoxids. With rounded bracts.

The subfamily Abylinae had been accepted without doubt by Moser (1925), Browne (1926), Bigelow (1931) and Sears (1953), but Totton (1932, 1954, 1965) and Leloup (1934, 1955a, b) differed from them. Totton (1932) stated that the observations on living specimens led him to believe that the functions of the nectophores were so distinctive that separation from the Diphyidae was warranted. But this was refuted by Sears (1953) who felt that the structure rather than function should be the criterion for distinguishing the subfamilies in this group. As early as 1934 Leloup and then Totton (1954, 1965) had shown that structurally the Abylinae are very distinctive and that a separate family Abylidae should be recognized for this group of Siphonophores, which consideration is followed in the present study.

The subfamily Galeolariinae based on the genus *Galeolaria* Blainville, 1834 has been in use for years without any dispute till 1921 when Stechow pointed out that this name could not be used because it was preoccupied for a worm instituted by Lamarck (1918) and as a substitute proposed *Galetta* and Galettinae (*see* also Bigelow, 1931, p. 539; Totton, 1932). Garstang (1946, p. 191) however, was inclined to retain *Galeolaria* and stated "I must decline to substitute for this expressive name (galea, a helmet ; Text-fig. 5), so long imbedded in Siphonophore research, the barren and barbarous *Sulculeolaria* of Blainville, merely because some obsure Mollusc is also entitled to it. Who would ever confuse *Galeolaria* the Mollusc with *Galeolaria* the Siphonophore ? Such useless applications of the law of priority severely handicap the progress of Zoology". Nevertheless, Totton (1954) discussed the necessity for changing the generic name to *Sulculeolaria* Blainville, on the basis of law of priority and erected the sub-family Sulculeolariinae to accommodate the genus *Sulculeolaria* (= *Galeolaria* = *Galetta*).

The subfamily Diphyopsinae was established by Haeckel (1888) for accommodating the genera *Diphyopsis* Haeckel, 1888b and *Diphyes* Cuvier, 1817, the former distinguished by the possession of a special nectophore in the eudoxids. But Schneider (1898) considered this character to be of not more than specific importance and merged the two genera under the older name *Diphyes*. However, Bigelow (1911b) agreed with Haeckel (1888b) and Chun (1897b) in recognizing the two genera to be distinct. Later Bigelow (1931) following Schneider (1898) and Moser (1925) recognized only one genus *Diphyes* and subfamily Diphyinae Moser, 1925. This was accepted by the recent workers (Leloup, 1934, 1955a,b; Totton, 1932, 1954, 1965; and Daniel & Daniel, 1963).

To this subfamily Diphyinae, the genus *Muggiaea* Busch, 1851 (considered by Bigelow in 1911b to belong to the sub-family Muggiinae Bigelow, 1911b under the Family Sphaeronectidae Huxley 1859) was added by Bigelow & Sears (1937), following the suggestions of Totton (1932) since the genus *Muggiaea* was proved to be a true diphyid, in which the posterior nectophore is never developed.

Therefore, in the present study only two subfamilies : Sulculeolariinae and Diphyinae are considered as valid.

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*Groups of appendages—the gonophores have been shown to separate and swim freely for several days (*see* Bigelow, 1931; Totton, 1965).

Subfamily (i) SULCULEOLARIINAE Totton, 1954

Galeolariinae Chun, 1897b

Galettinae Stechow, 1921

Diphyidae with sub-equal nectophores; anterior nectophore with blunt apex, smooth, devoid of ridges and hydroecium. Posterior nectophore apically truncated, smooth devoid of ridges with lateral radial canals looped.

Monotypic subfamily for *Sulculeolaria* Blainville, 1830.

This historical account for this subfamily has been dealt with briefly under the Family Diphyidae.

Genus **Sulculeolaria** Blainville, 1830

1830. *Sulculeolaria* Blainville, *Dict. Sci. Nat. Paris*, **60**, p. (Manuscript name).

1830. *Galeolaria* Blainville, *Dict. Sci. Nat. Paris*, **60**, p. (preoccupied—Lamarck 1818).

1834. *Sulculeolaria :* Blainville, *Manual d'actionologie on de Zoophylologie*, p. 138.

1921. *Galetta* Stechow, *Arch. Naturgesch.*, A **87**, (3), p. 248.

1932. *Galetta :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 342.

1954. *Sulculeolaria :* Totton, *Disc. Rep.*, **27**, p. 100.

Sulculeolariinae with anterior nectophore apically blunt, smooth, devoid of ridges and hydroecium; ostial teeth varying in number or absent; with large wing-like divided mouth-plates. Posterior nectophore similar to anterior nectophore, but truncated apically; with undivided mouth-plate and looped lateral radial canals.

Totton (1954) has given a detailed historical account of the different species of *Sulculeolaria* and showed that at least three species : *Diphyes biloba* Sars, 1846; *D. turgida* Gegenbaur, 1853; *Galeolaria chuni* Lens & van Riemsdijk, 1908 and probably a fourth species *Sulculeolaria angusta* Totton, 1954, have been described under the name of *G. australis* Quoy & Gaimard, 1834. Bigelow & Sears (1937), Totton (1954) have shown that *S. quadridentata* Quoy & Gaimard, 1834 is a synonym of *S. quadrivalvis* Blainville, 1830. Previous workers have used the generic name *Galetta* for species without teeth around the ostium of anterior nectophore (*see* Leloup, 1955a) and *Sulculeolaria* for species with teeth around the ostium (*vide* Totton, 1954, p. 101), but Totton (1965) used the latter name for all the species.

Seven valid species of *Sulculeolaria* are known :

1. *S. quadrivalvis* Blainville, 1830 (= *S. quadridentata* Quoy & Gaimard, 1834).
2. *S. biloba* (Sars, 1846)
3. *S. turgida* (Gegenbaur, 1853)
4. *S. angusta* Totton, 1954
5. *S. chuni* (Lens & van Riemsdijk, 1908)
6. *S. monoica* (Chun, 1888)
7. *S. bigelowi* (Sears, 1950)

Type species.—*S. quadrivalvis* Blainville, 1830.

Key to Species of *Sulculeolaria*

ANTERIOR NECTOPHORE :

1.	Nectophores elongated	2
	Nectophore conical in side view with broad base	*bigelowi*
2.	Ostial teeth absent	3
	Ostial teeth present	4
3.	Somatocyst long	*chuni*
	Somatocyst small	5
4.	With two dorsal ostial teeth	*quadrivalvis*
	With three dorsal ostial teeth	*monoica*
5.	With commissural canals	6
	Without commissural canals	*angusta*
6.	With a pair of exceptionally long commissural lateral radial canals	*biloba*
	With short commissural canals	*turgida*

POSTERIOR NECTOPHORE :

1.	Nectophores with ostial teeth	2
	Nectophores without ostial teeth	3
2.	With two dorsal ostial teeth	*quadrivalvis*
	With three dorsal ostial teeth	*monoica*
3.	Mouth-plate either with two side-pieces or emarginated distally	4
	Mouth-plate undivided with round margin	*turgida*
4.	Mouth-plate emarginate distally	5
	Mouth-plate with two side-pieces and a central thickening	*biloba*
5.	Mouth-plate long, thickened proximally with a small prominence	*angusta*
	Mouth-plate thin	*chuni*

(*N.B.*: Posterior nectophore of *S. bigelowi* not known.)

Except *S. bigelowi* the rest of the *Sulcularia* species and a species *in det.* are represented in the collections.

Sulculeolaria quadrivalvis Blainville, 1830

(Text-fig. 9, A, B & K)

1830. *Sulculeolaria quadrivalvis* Blainville, *Dict. Sci. Nat.*, Paris, **60**, p. 126.

1834. *Sulculeolaria quadrivalis :* Blainville, *Manuel d' actinologie ou de Zoophytologie*, Paris, p. 138, pl. 6, fig. 6. (Lesueur MSS).

1834. *Galeolaria quadridentata :* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'....de M. J. Dumont D'Urville. Zool.*, **4**, *Atlas Zoophytes*, p. 45, pl. 5, figs. 32, 33.

1852. *Epibulia aurianiaca* Vogt, *Z. Wiss. Zool.*, **3**, p. 524, taf. 14, figs. 1, 2.

1853. *Epibulia filiformis* Leuckart, *Zoologische Untersuchungen.* I. *Die Siphonophoren*, p. 2.

1853. *Diphyes quadrivalvis :* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 315, taf. 16, figs. 8–11.

1854. *Galeolaria auriantiaca :* Vogt, *Mem. Inst. Nat.* Genev., **1**, p. 110, taf. 18, 19, 20.

1854. *Galeolaria filiformis :* Leuckart, *Arch. Naturgesch Jahrg.*, **22**, p. 280, taf. 11, figs. 14–17.

1859. *Galeolaria filiformis :* Huxley, *The Oceanic Hydrozoa* Ray Soc. London, (non Huxley, 1859, p. 38, pl. 3, fig. 5). pl. 12, fig. 1.

1861. *Diphyes quadrivalvis :* Kefferstein & Ehlers, *Zoologische Beitrage gesammelt im winter,* '1859-60 *in Neapel und Messina.* I. *Beobach tungen uber die Siphonophoren,* Leipzig, p. 18.

1862. *Diphyes (Galeolaria) quadrivalvis :* Costa, *Annuario del Museo Zoologico della R. Universita di Napoli. ann.*, **1**, p. 90, pl. 3.

1883. *Galeolaria auriantiaca :* Weismann, *Bull. Zool.* France, **71**, p. 199, taf. 21, figs. 1–8.

1888. *Epibulia (auriantaca)* var *canariensis* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1158.

1888. *Galeolaria auriantiaca :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 151.

1896. *Galeolaria auriantiaca :* Bedot, *Rev. Suisse Zool.*, **3**, p. 370.

1897. *Galeolaria quadrivalvis :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 17.

1898. *Diphyes quadrivalis :* Schneider, *Zool. Anz.*, **21**, p. 87.

1908. *Galeolaria quadrivalvis :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 58, pl. 9, fig. **74.**

1918. *Galeolaria quadridentata :* Bigelow, *Bull. Mus. Comp. Harv.*, **62**, p. 417, pl. 8, figs. **1, 2.**

1926. *Galeolaria quadrivalvis :* Browne, *Trans. Linn. Soc.* Lond., (*Zool.*), Ser. (2) **19**, p. **66.**

1931. *Galetta quadrivalvis :* Bigelow, *Zoologica* N.Y., **8**(11), p. 549, figs. 195–200.

1931. *Galetta quadridentata :* Bigelow, *Zoologica*, N.Y., **8**(11), p. 556, figs. 201–203.

1932. *Sulculeolaria quadrivalvis :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 340, text-fig. **19.**

1937. *Galeolaria auriantiaca :* Dawydoff, *Bull. Soc. Zool.* France, **61**, p. 470.

1937. *Sulculeolaria quadridentata :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* I. *Biology*, H. **2**, pp. 31, 97, fig. 69 (bibl.).

1937. *Sulculeolavia quadrivalvis :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. ***Biology,*** H, **2**, pp. 32, 97, fig. 68.

1949. *Galeolaria quadridentata :* Moore, *Bull. Bingham Oceanogr. Coll.* **12**(2), p. 22.

1950. *Sulculeolaria quadrivalvis :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Sulculeolaria quadirivalvis :* Totton, *Disc. Rep.*, **27**, p. 100.

1955. *Sulculeolaria quadrivalvis :* Leloup, *Rep. Sci. res. 'Michael Sars' north atlantic deep Sea Exped.* 1910. *Siphonophores,* **5**(11), p. 9.

1963. *Sulculeolaria quadrivalvis :* Daniel & Daniel, *J. Mar. Biol. Assoc.* India, **5**(2), p. 199, fig. **IV,** 5, 6.

1965. *Sulculeolaria quadrivalvis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 143, pl. XXIX, fig. 4; pl. XXX, figs. 1–4; pl. XXXI, figs. 1–3; text-fig. 82.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5179	I.K.T.	450—150	1 ant. necto.	Gen. Coll.
V 5200	J.N.	200—0	2 ,, ,, ; 1 post. necto.	P 1686/1
V 5217	,,	,,	1 ,, ,,	P 1579/1
V 5220	Pl. N.	Surface	1 ,, ,,	P 1749/1
K 4	N.N.	200—0	1 ,, ,, ; 1 post. ,,	Gen. Coll.
K 6	,,	,,	1 ,, ,,	,,
K 7	,,	,,	2 ,, ,, ; 2 ,, ,,	,,
K 14	,,	,,	1 ,, ,,	,,
K 34	Bm.T.	Surface	1 ,, ,,	,,
K 44	N.N.	200—0	3 ,, ,, ; 2 post. ,,	,,
K 49	,,	,,	2 ,, ,, ; 1 ,, ,,	,,
K 53	,,	,,	2 ,, ,,	,,
K 372	Org. N.	Surface	1 ,, ,,	,,
K 352	,,	,,	1 ,, ,,	,,

Type locality.

Distribution.—This species occurs in the warm regions of the Atlantic, Pacific and Indian Oceans; and in the Mediterranean Sea (*see* also Table 1).

Description.—Polygastric phase : Anterior nectophore.—(Text-fig. 9, A) : The nectophore has a length of 9.65 mm, and a breadth of 5.0 mm; the somatocyst measures 4.0 mm in length. Fifteen of the 20 anterior nectophores present in the collections are bidentate forms and the remaining five do not have any dorsal teeth.

The nectophore has a blunt apex, a broad base and lacks ridges. The bidentate forms possess two triangularly shaped dorsal ostial teeth. These teeth are always bent or tucked inwards towards the ostium of the nectosac. No lateral teeth as in the quadridentate forms are present. The sub-ostial lamellae are long, flaplike and broad. These lamellae possess two thickened vertical pads on their inner sides. The nectosac is subcylindrical in shape and has well-developed musculature. The radial subumbral canals are prominently seen. The lateral radial canals are connected with the ventral canal by an oblique commissural canal. The somatocyst is long, often threadlike or slightly thicker and it is always characteristically bent in an oblique manner. The hydroecium is completely absent. The basal end of the somatocyst is seen below the baso-ventral margin.

The stem is not present.

Posterior nectophore.—(Text-fig. 9, B & K) : These have a length of 11.5 mm and a breadth of 4.0 mm. They are longer and thinner than the anterior nectophores. There are two dorsal and two lateral triangular teeth around the mouth-opening of the nectosac. The mouth-plate is long, broad and deeply bilobed at the distal end. As in the anterior nectophore there is a pair of vertical pads or teeth-like processes on the inner basal margin of the mouth-plate.

The proximal end of the posterior nectophore is truncated and has a shallow depression in the mid-region for articulation with the base of the anterior nectophore. The lateral radial canals form a long loop in the middle of the nectosac before joining the circular canal. The hydroecium is in the form of a shallow open groove.

Remarks.—The name *quadrivalvis* used to be applied to anterior nectophores with only two dorsal ostial teeth, and *quadridentata* to those with two lateral as well as two dorsal teeth. Examination of a large series of examples from the different oceans has shown the presence of intermediate forms as well as specimens without any teeth at all (Totton, 1954; 1965). All these variations are associated with indistinguishable posterior nectophores having two dorsal and two lateral ostial teeth. In the present collection also there are five examples which lack the ostial teeth completely but resemble *quadrivalvis* in their bent and oblique somatocyst.

Sulculeolaria biloba (Sars, 1846)

(Text-fig. 9, L, M & N)

1846. *Diphyes biloba* Sars, *Fauna littoralis Norwegiae*, Christiana, **1**, p. 45, taf. 7, figs. 16–21.

1898. *Diphyes biloba :* Schneider, *Zool. Anz.*, **21**, p. 86.

1911. *Galeolaria australis :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 238, pl. 5, fig. 8.

1918. *Galeolaria australis :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 419.

1929. *Galeolaria australis :* Candeias, *Mem. Est. Mus. Zool. Univ.* Columbia, **57**, (part C, fig. 3).

1954. *Sulculeolaria biloba :* Totton, *Disc. Rep.*, **27**, p. 104, text-figs. 49–51.

1965. *Sulculeolaria biloba :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 145, text-figs. 83–86.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Reg. no.*
V 5191	Pl.N.	Surface	1 ant. necto.; 1 post. necto.	P 1747/1
V 5208	,,	,,	1 ,, ,,	Gen. Coll.
V 5218	,,	,,	3 ,, ,, ; 1 ,, ,,	P 1775/1
K 36	N.N.	200—0	1 ,, ,,	Gen. Coll.
K 46	,,	,,	1 ,, ,, ; 1 ,, ,,	,,

Type locality.—North Sea (North Atlantic).

Distribution.—This species is recorded from the temperate and tropical regions of the Atlantic, Pacific and Indian Oceans (for details of localities *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 9, M) : The nectophore measures 11.3 mm in length and has a breadth of 5.0 mm; it has a blunt apex and is smooth, devoid of ridges. It has a broad base. On the dorsal side the nectophore projects downwards beyond the level of the ostium of the necotosac to form a toothlike projection. It has no lateral teeth. The mouth-plates are long, broad and divided. The somatocyst is 1.66 mm in length, over-shaped and inclined towards the ventral side. The hydroecium is in the form of a small pit situated beside the base of the somatocyst. The oblique commissural canals are exceptionally long, extending upward from the dorsal radial canal and join the lateral canals at mid-length of the nectosac. The stem is not present.

Posterior nectophore (Text-fig. 9, L & N).—It has a length of 11.6 mm and a breadth of 4.0 mm; it is subequal in length or slightly longer than the anterior nectophore. Its proximal end is broad and truncated. The end of the pallial canal is observed within the pocket-like depression at the centre of the truncated apex. The hydroecium is an open shallow groove. The mouth-plates are long and distinctly bilobed. The two lobes are separated by a raised, thickened, median notch.

Sulculeolaria turgida (Gegenbaur, 1853)

(Text-fig. 8, J & K)

1853. *Diphyes turgida* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 344, taf. XVI, figs. 12–21.

1854. *Diphyes turgida :* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 442, taf. XXIII, figs. 1–8.

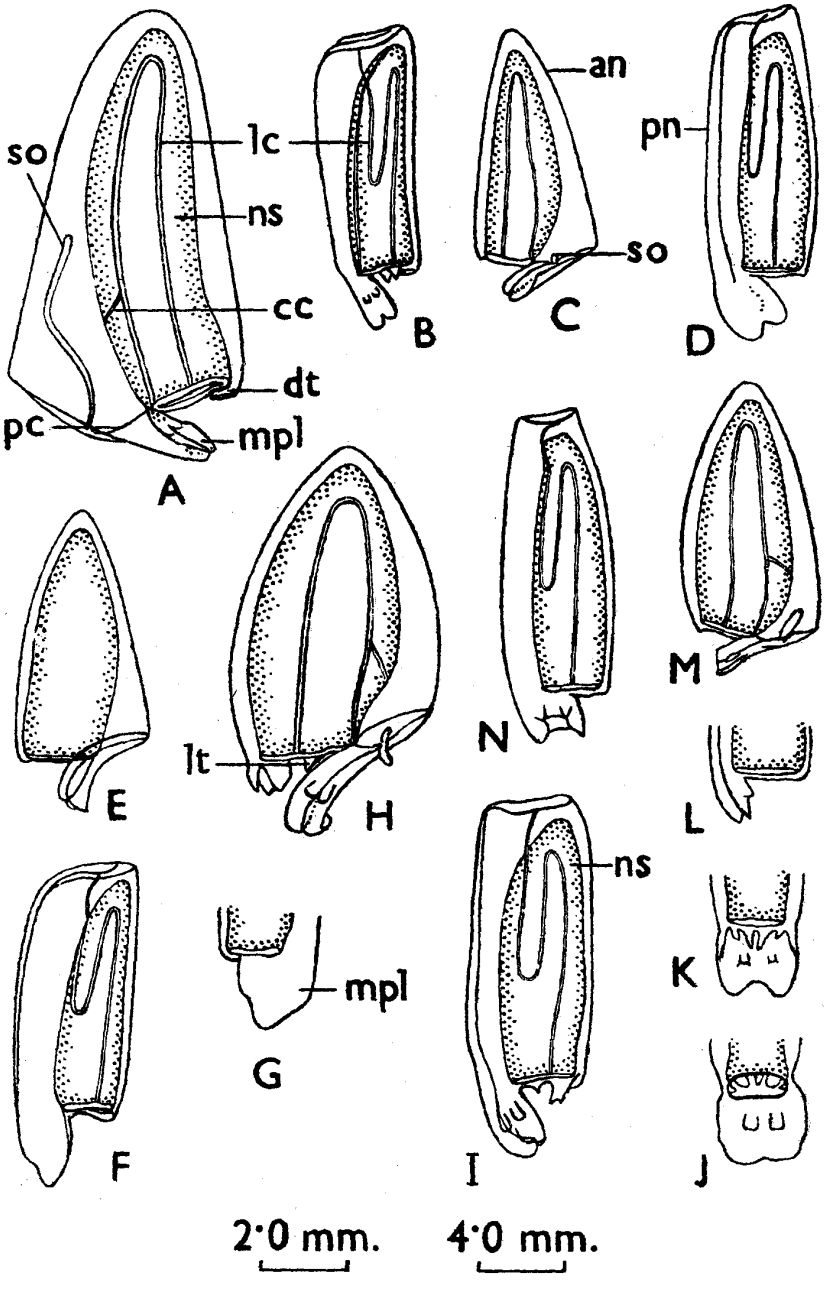
1932. *Galetta turgida :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 345.

1937. *Galetta australis :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, p. 35.

1954. *Sulculeolaria turgida :* Totton, *Disc. Rep.*, **27**, p. 107, text-fig. 52.

1963. *Sulculeolaria turgida :* Daniel & Daniel, *J. Mar. biol. Assoc.* India, **5**(2), p. 198, fig. IV, 3, 4.

1965. *Sulculeolaria turgida :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 149, pl. XXXI, figs. 8, 9; text-figs. 87, 88.



TEXT-FIGURE 9

Sulculeolaria quadrivalvis : A, B & K

A—anterior nectophore. B—posterior nectophore. K—posterior nectophore : dorsal view.

Sulculeolaria angusta : C, D

C—anterior nectophore. D—posterior nectophore.

Sulculeolaria sp. *indet :* E—G

E—anterior nectophore. F—posterior nectophore. G—posterior nectophore : dorsal view.

Sulculeolaria monoica : H—J

H—anterior nectophore. I—posterior nectophore. J—posterior nectophore : dorsal view.

Sulculeolaria biloba : LN

L—posterior nectophore—side view. M—anterior nectophore. N—posterior nectophore.

Abbreviations used :

an—anterior nectophore. cc—commissural canal. dt—dorsal tooth. lc—lateral radial canal. lt—lateral tooth. mpl—mouth plate. ns—nectosac. pc—pedicular canal. pn—posterior nectophore. so—somatocyst.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5179	Pl. N.	Surface	1 ant. necto.	Gen. Coll.
V 5184	Ich. N.	1000—0	2 ,, ,, ; 2 post. necto.	,,
V 5185	Pl. N.	Surface	2 ,, ,, ; 1 ,, ,,	P 1663/1
V 5191	,,	,,	1 ,, ,,	P 1746/1
V 5201	,,	,,	6 ,, ,, ; 4 ,, ,,	Gen. Coll.
V 5207	I.K.T.	150—100	1 ,, ,,	,,
V 5208	Ich. N.	1000—0	7 ,, ,, ; 4 ,, ,,	P 1774/1
V 5209	I.K.T.	120—70	1 ,, ,,	Gen. Coll.
V 5211	Pl. N.	Surface	2 ,, ,, ; 2 ,, ,,	,,
V 5213	,,	,,	3 ,, ,, ; 2 ,, ,,	,,
V 5218	,,	,,	50 ,, ,, ; 20 ,, ,,	P 1776/1
V 5222	Ich. N.	1000—0	3 ,, ,, ; 1 ,, ,,	Gen. Coll.
V 5225	IOSN	200—0	10 ,, ,, ; 5 ,, ,,	P 1636/1
K 3	N. N.	400—200	1 ,, ,,	Gen. Coll.
K 7	,,	200—0	1 ,, ,,	,,
K 10	,,	,,	1 ,, ,, ; 1 ,, ,,	,,
K 15	,,	,,	1 ,, ,,	,,
K 16	,,	,,	3 ,, ,, ; 4 ,, ,,	,,
K 20	,,	,,	1 ,, ,,	,,
K 22	,,	,,	1 ,, ,,	,,
K 26	,,	,,	1 ,, ,, ;	,,
K 34	Bm. T.	—	2 ,, ,, ; 1 ,, ,,	,,
K 47	,,	200—0	3 ,, ,, ; 2 ,, ,,	,,
K 49	,,	,,	1 ,, ,, ; 1 ,, ,,	,,
K 54	,,	,,	8 ,, ,, ; 6 ,, ,,	,,
K 360	Org. N.	Surface	4 ,, ,, ; 3 ,, ,,	,,
K 361	,,	,,	5 ,, ,, ; 3 ,, ,,	,,
K 367	,,	,,	4 ,, ,, ; 4 ,, ,,	,,
K 378	,,	,,	2 ,, ,, ; 2 ,, ,,	,,

Type locality.—Straits of Messina (Mediterranean Sea).

Distribution.—This species is common in the tropical regions of the Atlantic, Pacific and Indian Oceans; and in the Mediterranean. It has been recorded from the coast of Greenland also (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 8, J).—The nectophores have the following measurements :

length :	4.9 to 8.5 mm
breadth :	2.26 to 4.25 mm
Somatocyst :	0.33 to 1.00 mm

They are smooth, firm and have a blunt apex. They lack ostial teeth; the base of the nectophores is broad. The somatocyst is very small. The hydroecium is absent. All the nectophores examined have oblique commissural canals. The mouth-plates are medium-sized and divided.

Posterior nectophore (Text-fig. 8, K).—They range in length from 2.67 mm to 7.75 mm, with a breadth ranging from 2.0mm to 3.2mm. It is nearly the same size or slightly smaller

than the anterior nectophore. It has a broad truncated base. There are no ostial teeth. The hydroecium is like an open shallow groove or at times slightly deeper. The mouth-plate is long, broad, thin and its distal margin is rounded. The lateral radial canals are folded. The cormidia and a part of the stem get detached along with the posterior nectophore.

Remarks.—Some examples in the collections do not possess a somatocyst. In these nectophores no trace of it is seen. In other features, *i.e.*, shape, size and the mouth-plate they resemble *S. turgida.* The nectophore figured by Gegenbaur (1954) lacked a somatocyst. Sears (1950) and Totton (1954) were of the opinion that in these extremely transparent animals, this character could have been overlooked easily. But the present study clearly shows that such nectophores really exist. Their identity is uncertain. It is highly probable that these nectophores may have lost their somatocyst when the stems and the posterior nectophores became detached.

Sulculeolaria angusta Totton, 1954

(Text-fig. 9, C & D)

1954. *Sulculeolaria angusta* Totton, *Disc. Rep.*, **27**, p. 108, text-fig. 53.

1965. *Sulculeolaria angusta :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 149, test-fig. 89.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5207	I.K.T.	150—100	1 ant. necto.	Gen. Coll.
V 5208	Pl. N.	Surface	1 ,, ,,	,,
V 5227	J. N.	200—0	1 ,, ,,	P 1709/1
V 5229	,,	,,	2 ,, ,,	P 1765/1
K 5	N. N.	,,	1 ,, ,,	Gen. Coll.
K 9	,,	,,	1 ,, ,,	,,
K 11	,,	,,	1 ,, ,,	,,
K 18	,,	,,	2 ,, ,, ; 1 post. necto.	,,
K 20	,,	,,	1 ,, ,, ; 1 ,, ,,	,,
K 22	,,	,,	1 ,, ,,	,,
K 26	,,	,,	2 ,, ,, ; 1 ,, ,,	,,
K 32	,,	,,	1 ,, ,,	,,
K 36	,,	,,	2 ,, ,, ; 2 ,, ,,	,,
K 58	,,	,,	1 ,, ,,	,,
K 358	Org. N.	Surface	1 ,, ,,	,,
K 366	,,	,,	1 ,, ,,	,,

Holotype.—Posterior nectophore deposited at British Museum (Nat. Hist.). Anterior Nectophore uncertain.

Type locality.—RV DISCOVERY II Station no. 1586 off the coast of Natal (Africa).

Distribution.—Off the east coast of Africa; Arabian Sea; eastern Indian Ocean.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 9, C).—The nectophore has a length of 8.3 mm and a breadth of 3.3 mm. The anterior nectophore resembles *S. turgida.* The somatocyst, which is 0.33 mm in length, is like that of *S. monoica.*

The mouth-plates are medium-sized, rounded, and resemble *S. turgida*. The hydroecium and the ostial teeth are absent. The stem is missing. No commissural canals are present.

Posterior nectophore (Text-fig. 9, D).—It has a length of 10.1 mm and a breadth of 3.0 mm. It is long and narrow, almost cylindrical throughout its length. The mouth-plate is long and slightly notched in the middle as in *S. chuni* but the basal half is thick and possesses a small prominence. The articulating end is truncated as in the other species of *Sulculeolaria*.

Sulculeolaria chuni (Lens & van Riemsdijk, 1908)

(Text-fig. 8, G, H & I)

1908. *Galeolaria Chuni* Lens & van Reimsdijk, *Siboga Exped.*, **9**, p. 61, pl. IX, figs. 78, 79.
1926. *Galeolaria chuni :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*) (2)**19**, p. 70.
1932. *Galetta chuni* : Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 342, text-fig. 20.
1933. *Galetta chuni :* Leloup, *Res. Camp. Sci.* Monaco, **87**, p. 27.
1935. *Galetta chuni :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **7**(11), p. 261.
1950. *Galetta chuni :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1954. *Sulculeolaria chuni :* Totton, *Disc. Rep.*, **27**, p. 102.
1955. *Galetta chuni :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 13.
1963. *Sulculeolaria chuni :* Daniel & Daniel, *J. Mar. biol. Assoc.* India, **5**(2), p. 198, fig. IV, 1, 2.
1965. *Sulculeolaria chuni :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London. p. 150, text-fig. 90.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5198	J. N.	200—0	1 ant. necto.	P 1758/1
V 5212	IOSN	,,	2 ,, ,, ; 2 post. necto.	P 1610/1
K 1	N. N.	,,	1 ,, ,,	Gen. Coll.
K 6	,,	,,	1 ,, ,,	,,
K 7	,,	,,	1 ,, ,,	,,
K 8	,,	,,	2 ,, ,,	,,
K 10	,,	,,	2 ,, ,, ; 2 ,, ,,	,,
K 11	,,	,,	2 ,, ,,	,,
K 16	,,	,,	1 ,, ,,	,,
K 22	,,	,,	3 ,, ,, ; 1 ,, ,,	,,
K 31	,,	,,	1 ,, ,,	,,
K 35	,,	,,	1 ,, ,,	,,
K 51	,,	,,	5 ,, ,, ; 2 ,, ,,	,,
K 53	,,	,,	1 ,, ,,	,,
K 359	Org. N.	Surface	1 ,, ,,	,,
K 378	,,	,,	3 ,, ,, ; 1 ,, ,,	,,
K 529	—	—	1 ,, ,,	,,

Type locality.—SIBOGA Expedition Station no. 168 : anchorage north of Sabuda Island (Malay Archipelago).

Distribution.—Tropical regions of the Atlantic, Pacific and Indian Oceans and in the Mediterranean Sea (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 8, G & H).—They range in length from 3.4 mm to 7.0 mm and in breadth from 2.0 mm to 4.3 mm; as in the othes species of *Sulculeolaria*, the nectophore has a blunt apex and lacks ridges. It has no ostial teeth. The mouth-plates are smaller than in the other species, rounded and slightly overlapping. The hydroecium is absent. The somatocyst is long, ranging from 1.67 mm to 3.6 mm, club-shaped or sometimes narrow and lies against the side of the nectosac. In the collections two kinds of nectophores associated with the upright, long somatocyst are present. In one type commissural canals are present, and in the other these are absent. The nectophores with commissural canals are larger than those without them. The cormidia are missing.

Posterior nectophore (Text-fig. 8, I).—They range from 3.5 mm to 5.75 mm in length, from 2.0 mm to 3.25 mm in breadth. The nectophore is subequal in length. The articulating end is truncated and has a shallow depression in the middle. The ostial teeth are not present. The mouth-plate is long, thin and has a rounded notch at the distal end as in *S. angusta* but lacks the thickened region at the proximal half. The lateral radial canals are folded as in the other species

Sulculeolaria monoica (Chun, 1888)

(Text-fig. 9, H, I & J)

1888. *Epibulia monoica* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1157.
1897. *Galeolaria monoica :* Chun, *Ergebn Plankton Exped.*, **2**, K.b., p. 17.
1908. *Galeolaria monoica :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 60, pl. IX, fig. 76, 77.
1911. *Galeolaria monoica :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 239, pl. 6, figs. 4–9.
1925. *Galeolaria monoica :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 144.
1926. *Galeolaria monoica :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), (2)**19**, p. 69.
1931. *Galeolaria monoica :* Biglow, *Zoologica*, N.Y. **8**(1), p. 558.
1932. *Sulculeolaria monoica :* Totton, *Sci. Rep. Gr. Barrier Reef. Exped.*, **4**, p. 342.
1933. *Sulculeolaria monoica :* Leloup, *Res. Camp. Sci.* Monaco, **87**. p. 25.
1935. *Sulculeolaria monoica :* Russel & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **7**(11), p. 261.
1937. *Sulculeolaria monoica :* Leloup, *Mem. Mus. Roy. Hist. nat.* Belg., **1**(2), p. 122.
1949. *Sulculeolaria monoica :* Moore, *Bull. Bingham Oceanogr. Coll.* **12**(2), p. 22, fig. 50.
1950. *Sulculeolaria monoica :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1954. *Sulculeolaria monoica :* Totton, *Disc. Rep.*, **27**, p. 16.
1955. *Sulculeolaria monoica :* Leloup, *Rep. Sci. res. 'Mchael Sars' north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 8.
1963. *Sulculeolaria monoica :* Daniel & Daniel, *J. Mar. biol. Assoc.* India, **5**(2), p. 200, fig. IV, 7, 8.
1965. *Sulculeolaria monoica :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist). London, p. 152, pl. XXXI, figs. 5–7, 10, 12.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5207	IOSN	200—0	2 ant. necto.	P 1649/1
V 5216	Ich. N.	1000—0	1 ,, ,,	P 1595/1
V 5218	Pl. N.	Surface	2 ,, ,,	P 1777/1
K 7	N. N.	500—0	2 ,, ,, ; 1 post. necto.	Gen. Coll.
K 14	,,	200—0	1 ,, ,,	,,
K 16	,,	,,	1 ,, ,,	,,
K 34	Bm. T.	Surface	2 ,, ,, , 1 ,, ,,	,,
K 529	—	—	1 ,, ,, ; 1 ,, ,,	,,

Type locality.—Canary Islands.

Distribution.—This is a common species from the tropical regions of the Atlantic, Pacific and Indian Oceans (for details of localities *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 9, H).—The nectophore, measures 14.5 mm in length; 7.5 mm in breadth. It is large, has a blunt apex and bulged mid-region. It narrows considerably at the region of the ostium of the nectosac. The number and arrangement of the ostial teeth characterizes this species. There are three dorsal teeth. The median one is large, triangular and pointed while the other two (dorso-laterally placed) are larger, also triangular but with blunt tips. These occur close to the median dorsal tooth on either side of it. In between these teeth and the mouth-plates are the lateral teeth. These are smaller, triangular and have pointed tips. The mouth-plates are large, divided and possess two tooth-like processes on the proximal inner surfaces. The baso-ventral plane of the nectophore is very oblique. The somatocyst is very small (0.3 mm in length) and oval-shaped. The hydroecium is absent; the commissural canals are always present. Cormidia are missing.

Posterior nectophore (Text-fig. 9, I & J).—It has a length to 15.3 mm and a breadth of 5.3 mm; it is long and thin, having similar number of ostial teeth (*i.e.*, three dorsal and two lateral ones). The mouth-plate is long, undivided and has a small notch at the distal margin. As in the anterior nectophore, two tooth-like processes occur on the basal inner margin of the mouth-plate. The articulating surface is truncated with a depression in the middle. The lateral radial canals are folded.

Sulculeolarea sp. *in det.*

(Text-fig. 9, E–G)

Material examined.—One posterior nectophore from RV DIAMANTINA Cruise number Dm/3/62, Station no. DM 104; Lat. 33°24′ S, Long. 110°00′ E; Sample No. 846 E.

One anterior nectophore from the same sample, but its association with the posterior nectophore is uncertain.

Description.—Polygastric phase (Text-fig. 9, E, F & G).—*Anterior nectophore.*—It measures 13.0 mm in length and 5.6 mm in breadth; and resembles *S. turgida*, but differs from it in two points, *viz.*, the lateral radial canals are without commissural canals, and there is no somatocyst. The ventrobasal facet is oblique but not so oblique as in *S. bigelowi*. There are no ostial teeth.

Posterior nectophore (Text-fig. 9, F & G).—The posterior nectophore measures 14.0 mm in length and 4.8 mm in breadth. The nectophore projects out in a sweeping curve on the dorsal edge of the ostium, but it does not occur in the form of a tooth as in *S. biloba*. No other teeth are present. The mouth-plate is long and thin, devoid of thickening in the proximal end or a prominence. Its distal margin is not rounded as in *S. turgida*. The middle region is longer and the sides of the mouth-plate are not rolled inwards.

Subfamily (ii) DIPHYINAE Moser, 1925

Diphyopsiinae Haeckel, 1888;
Bigelow, 1911b.

Diphyidae with generally two nectophores, anterior one pyramidal with ridges; with or without ostial teeth and hydroecium; posterior one at times reduced or suppressed

altogether, with either truncated articulating proximal end or produced into a prolongation which fits into hydroecium of anterior nectophore; hydroecium occurs as open groove or as temporarily closed tube formed by hydroecial wings. Cormidia always separate as eudoxids having special nectophores or large gonophores.

Bigelow (1911b) recognized three genera as valid, *viz. Diphyopsis* Haeckel, 1888; *Diphyes* Cuvier, 1817; and *Chuniphyes* Lens & van Riemsdijk, 1908. *Diphyopsis* is a synonym of the older name *Diphyes* (vide *supra* page 102).

The inclusion of the genus *Chuniphyes* under the subfamily Diphyinae was a tentative one by Bigelow, mainly due to the presence of two nectophores; the original authors (Lens & van Riemsdijk) had failed to give it a clear systematic position; further, its eudoxid was not known at that time. Later, this genus was shifted to a separate subfamily Chuniphyinae Moser, 1925 of the family Diphyidae (*vide* Bigelow, 1931, p. 526; Totton, 1954, p. 16, 131). Totton (1965) removed it from the family Diphyidae to the Family Clausophyidae Totton, 1965.

Totton (1932), while revising the family Diphyidae, came to the conclusion that many unrelated species were included under the "Diphyes complex" and felt the necessity of separating the different species into : *Diphyes* Cuvier, 1817; *Eudoxoides* Huxley, 1859; *Chelophyes* Totton, 1932 and *Lensia* Totton, 1932. *Diphyes* was restricted to species with five complete ridges ending in prominent teeth. *Eudoxoides* was revived to accommodate species with five complete ridges which do not end in conspicuous teeth. The genus *Chelophyes* was created for species with three complete ridges and no ostial teeth, and *Lensia* for species with shallow hydroecium, small somatocyst and no ostial teeth.

The genus *Muggiaea* was shifted from the family Sphaeronectidae to this subfamily. Moser (1925) created the genus *Dimophyes* to accommodate *Diphyes arctica* Chun with an undivided mouth-plate open on the ventral side. Lastly, a new eudoxid phase, *Eudoxia macra* was described by Totton (1954).

Seven genera are thus considered as valid : *Diphyes, Lensia, Muggiaea, Dimophyes, Chelophyes, Eudoxoides* and *Eudoxia.*

Key to Genera of *Diphyinae*

ANTERIOR NECTOPHORE :

1.	Nectophore with divided mouth-plate	2
	Nectophore with undivided mouth-plate	3
2.	Nectophore pyramidal with five complete ridges	4
	Nectophore pyramidal with three complete ridges	*Chelophyes*
3.	With long somatocyst and deep hydroecium, mouth-plate not open on ventral side	*Diphyes*
	With shorter somatocyst and shallower hydroecium, mouth-plate wide open on ventral side	*Dimophyes*
4.	Without ostial teeth; with either deep or very shallow hydroecium	5
	With inconspicuous ostial tooth; with medium sized hydroecium	*Eudoxoides*
5.	With deep hydroecium; mouth-plates long and slightly over-lapping; somatocyst lies in close contact with nectosac	*Muggiaea*
	With very shallow hydroecium and very small rounded overlapping mouth-plates	*Lensia*

(*N.B.* This key is for anterior nectophores only, *i.e.*, polygastric phase. *Eudoxia* is not included here as only the eudoxid phase is known.

Excepting the genus *Eudoxia,* all the other genera are represented in the present collections.

Genus **Diphyes** Cuvier, 1817

1817. *Diphyes* Cuvier, *Le Regne Animal*...., 4 vols.

1888. *Diphyopsis* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 152.

Anterior nectophore five-ridged; dorsal and laterals ending in three conspicuous ostial teeth (except in *anterctica*). Mouth-plate large and undivided. Somatocyst long. Hydroecium deep. *Rete mirabele* present at velar ends of all four radial canals. Posterior nectophore when developed having apical prolongations and deep hydroecial folds, forming temporarily closed tube. Lateral radial canals form apical loops. Eudoxids with special nectophores.

There are four valid species of *Diphyes*, viz., *D. dispar* Chamisso & Eysenhardt, 1821; *D. chamissonis* Huxley, 1859; *D. bojani* Eschscholtz, 1825; and *D. antarctica* Moser, 1925, which is confined to the Antarctic zone.

Type species.—D. dispar Chamisso & Eysenhardt, 1821.

Key to Species of *Diphyes*

ANTERIOR NECTOPHORE :

1.	Nectosac prolonged apically	2
	Nectosac not prolonged apically	3
2.	Somatocyst inclined towards nectosac; dorsal wall of mouth-plate smooth	*dispar*
	Somatocyst lies alongside nectosac; dorsal wall of mouth-plate with thickened tooth-like projection	*bojani*
3.	Somatocyst long; mouth-plate undivided; dorsal tooth conspicuous	*chamissonis*
	Somatocyst short; mouth-plate divided; dorsal tooth inconspicuous	*antarctica*

POSTERIOR NECTOPHORE :

1.	Posterior nectophore well developed	2
	Nectophore reduced	*antarctica*
2.	Nectophore broad; dorsal wall of mouth-plate smooth	*dispar*
	Nectophore narrow; dorsal wall of mouth-plate with thickened tooth-like projection	*bojani*

(*N.B.*: No posterior nectophore developed in *D. chamissonis*).

EUDOXID PHASE :

1.	Bracts thick, either rounded or elongated; phyllocyst long; special nectophore or gonophore lying below bract	2
	Bract thin, shield-like; phyllocyst knob-like, special nectophore lying nearly parallel to bract	*bojani*
2.	Bract elongated, with long neck-shield; gonophore with obscure dorsal tooth	*antarctica*
	Bract rounded with similar special nectophores	3
3.	With short neck-shield; pedicular canal oblique	*dispar*
	With long neck-shield; pedicular canal horizontal	*chamissonis*

Of the above-mentioned species, the following are represented in the present collections : *D. dispar*, *D. bojani* and *D. chamissonis*.

Diphyes dispar Chamisso & Eysenhardt, 1821

(Text-fig. 10, A–C)

1804. *Salpa* (*Bipartita*) *laneolata bipartita* Bory de St. Vincent, *Voyage dans les quatres principales isles des Mers d' Afrique*, **1**, pl. VI, figs. 3A-C.

1821. *Diphyes dispar* Chamisso & Eysenhardt, *Nova Acta. Leop. Carol.*, **10**, p. 365, pl. 33, fig. 4.

1825. *Diphyes angustata* Eschscholtz, *Okens Isis.*, **16**, p. 743, taf. 5, fig. 16.

1829. *Eudoxia lessoni* Eschscholtz, *System der Acalephen.* Berlin, p. 126, taf. 12, fig. 2 (eudoxid).
1829. *Ersaea gaimardi* Eschscholtz, *System der Acalephen.* Berlin, p. 128, taf. 12, fig. 4. (eudoxid).
1829. *Diphyes angustata :* Eschscholtz, *System der Acalephen.* Berlin, p. 136.
1829. *Diphyes dispar :* Eschscholtz, *System der Acalephen.* Berlin, p. 137.
1829. *Diphyes campanulifera* Eschscholtz, *System der Acalephen.* Berlin, p. 137, taf. 12, fig. 6.
1830. *Diphyes boryi* Blainville, *Dict. Sci. Nat.* Paris, **60**, p. 123, fig. 100.
1834. *Cuculus doreyanus* Blainville, *Manuel d'actinologie ou de Zoophytologie,* Paris, p. 13 (eudoxid).
1834. *Diphyes boryi :* Blainville, *Manuel d'actinologie ou de Zoophytologie,* Paris, p. 135, taf. 5.
1834. *Diphyes boryi :* Quoy & Gaimard, *Voyage de decouvertes de l'Astrolabe'....de M. J. Dumont D'Urville Zool.*, **4**, *Atlas Zoophytes*, p. 38, pl. 4, figs. 1–6.
1834. *Diphyes cuculus* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'....de M. J. Dumont D'Urville, Zool.*, **4**, *Atlas Zoophytes*, p. 92, pl. 4, figs. 21–23.
1834. *Diphyes regularis* Van Meyen, *Nova Acta Akad. Caes. Leop. Nat. Curios*, **8** suppl. p. 334, tab. 46.
1859. *Diphyes dispar :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 30, pl. 1, fig. 1.
1859. *Eudoxia lessoni :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 57, pl. 3, fig. 6 (eudoxid).
1859. *Diphyes campanulifera :* Gegenbaur, *Nova Acta. Leop. Carol.*, **27**, p. 366, taf. 30, figs. 23–26.
1881. *Eudoxia lessoni :* Fewkes, *Bull. Mus. Comp. Zool. Harv.*, **8**, p. 166, pl. 6, figs. 8, 9 (eudoxid).
1888. *Cuculus lessoni :* Haeckel, *Jena Z. anturw.*, **22**, p. 32 (eudoxid).
1888. *Ersaea compressa* Haeckel, *Jena Z. naturw.*, **22**, p. 32 (eudoxid).
1888. *Diphyopsis compressa :* Haeckel, *Jena Z. naturw.*, **22**, p. 35.
1888. *Cuculus lessoni :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 110 (eudoxid).
1888. *Ersaea compressa :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 123, pl. 34 (eudoxid).
1888. *Diphyopsis angustata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 152.
1888. *Diphyopsis dispar :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 152.
1888. *Diphyopsis compressa :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 153.
1888. *Diphyopsis campanulifera :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 153.
1896. *Diphyopsis compressa* var. *picta* Bedot, *Rev. Suisse Zool.*, **3**, p. 372.
1897. *Diphyopsis campanulifera :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 26.
1897. *Ersaea lessoni :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 26.
1897. *Diphyopsis dispar :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 27.
1898. *Diphyes dispar :* Schneider, *Zool. Anz.*, **21**, p. 197.
1900. *Diphyopsis campanulifera :* Mayer, *Bull. Mus. Comp. Zool. Harv.*, **37**, p. 75, pl. 28, figs. 93–95.
1900. *Eudoxia lessoni :* Mayer, *Bull. Mus. Comp. Zool. Harv.*, **37**, p. 75 (eudoxid).
1902. *Ersaea appendiculata :* Agassiz & Mayer, *Mem. Mus. Comp. Zool. Harv.*, **26**, p. 161, pl. 9, fig. 2.
1902. *Diphyopsis angustata :* Agassiz & Mayer, *Mem. Mus. Comp. Zool., Harv.*, **26**, p. 162, pls. 8, 10, figs. 37, 42.
1908. *Diphyes dispar :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 42, pl. 6, figs. 51, 52.
1908. *Diphyopsis neitrstraszi* Lens & van Riemsdijk, *Soboga Exped.*, **9**, p. 43, pl. 7, fig. 53.
1908. *Ersaea lessoni :* Lens & Van Riemsdijk, *Siboga Exped.*, **9**, p. 50 (eudoxid).
1908. *Diphyopsis campanulifera :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 51, pl. 8, fig. 63.
1908. *Diphyopsis anomala* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 54, pl. 8, fig. 69; pl. 9, fig. 70.
1911. *Diphyopsis dispar :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 257, pl. 10, fig. 1; pl. 11, fig. 3.
1918. *Diphyopsis dispar :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 422.
1926. *Diphyes dispar :* Browne, *Trans. Linn. Soc. Lond.* (*Zool.*), (2)**19**, p. 79.
1931. *Diphyes dispar :* Bigelow, *Zoologica*, N.Y., **8**(11), p. 564.
1931. *Diphyes dispar :* Menon, *Rec. Indian Mus.*, **33**, p. 503.

1932. *Diphyes dispar :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 346, text-fig. 21.
1933. *Diphyes dispar :* Leloup, *Res. Camp. Sci. Monaco*, **87**, p. 28.
1933. *Diphyes dispar :* Dakin & Colefax, *Proc. Linn. Soc. N. S. Wales*, LVIII, p. 198.
1934. *Diphyes dispar :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 21.
1934. *Diphyes dispar :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(9), p. 1.
1935. *Diphyes dispar :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. atlant. Exped. 'Meteor'.*, **12**(2), p. 8, carte 3.
1935. *Diphyes dispar :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **7**(11), p. 262.
1936. *Diphyes dispar :* Leloup, *Bull. Inst. Ocean*, No. **703**, p. 9.
1936. *Diphyes dispar :* Totton, *Zoologica*, N.Y., **21**(4), p. 233.
1936. *Diphyes dispar :* Aiyer, Menon & Menon, *J. Madras Univ.*, **8**(1), pp. 6, 16, 26, 36.
1937. *Diphyes dispar :* Leloup, *Mem. Mus. Roy. Hist. nat. Belg.*, **1**(2), p. 122.
1937. *Diphyes dispar :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, pp. 40, 101, fig. 71.
1949. *Diphyes dispar :* Moore, *Bull. Bingham Oceanogr. Coll.*, **12**(2), p. 13.
1950. *Diphyes dispar :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1954. *Diphyes dispar :* Totton, *Disc. Rep.*, **27**, p. 16.
1955. *Diphyes dispar :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 10.
1955. *Diphyes, dispar :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 14.
1963. *Diphyes dispar :* Daniel & Daniel, *J. mar. biol. Assoc. India*, **5**(2), p. 206, fig. VI, 4, 5.
1965. *Diphyes dispar :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.), London, p. 153, pl. XXXIII, fig. 3; text-fig. 9.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Regd. no.*
V 5179	Pl. N.	Surface	3 ant. necto.	P 1628/1
	I.K.T.	450—150		
V 5182	Pl. N.	Surface	1 ,, ,,	Gen. Coll.
V 5195	Ich. N.	1000—0	1 ,, ,, ; 1 eudoxid	P 1722/1
				P 1723/1
V 5198	IOSN	200—0	4 ,, ,,	Gen. Coll.
V 5205	J. N.	,,	1 ,, ,,	P 1568/1
V 5207	IOSN	,,	2 ,, ,, ; 1 eudoxid	P 1657/1
V 5209	I.K.T.	120—70	4 ,, ,,	P 1611/1
V 5212	J. N.	200—0	2 ,, ,,	P 1604/1
	I.K.T.			
V 5213	Pl. N.	Surface	1 ,, ,, ; 1 eudoxid	Gen. Coll.
V 5218	,,	,,	2 ,, ,,	P 1779/1
V 5220	IOSN	200—0	13 ,, ,, ; 3 ,, ; 5 post. necto.	P 1680/1
	J. N.			
	I.K.T.			
V 5222	Ich. N.	1000—0	2 ,, ,,	Gen. Coll.
V 5223	J. N.	200—0	3 ,, ,,	,,
V 5225	J. N.	,,	5 ,, ,, ; 2 ,,	P 1639/1
	IOSN			
V 5227	I.K.T.	120—70	12 ,, ,, ; 5 ,, ; 2 ,,	P 1527/1
	IOSN	200—0		P 1700/1
V 5229	J. N.	,,	1 ,, ,,	P 1763/1

Station no.	*Net used.*	*Depth (m)*	*Materials*	*Z.S.I. Regd. no.*
K 6	N. N.	200—0	6 ant necto. 12 eudoxid	Gen. Coll.
K 7	,,	,,	1 ,, ,,	,,
	,,	500—200	2 ,, ,, ; 1 ,,	,,
K 8	,,	200—0	2 ,, ,, ; 2 ,,	,,
	,,	75—0	1 ,,	,,
K 11	,,	200—0	2 ,, ,, ; 1 ,,	,,
K 14	,,	,,	2 ,, ,, ; 2 ,,	,,
K 15	N. N.	200—0	1 ant. necto.	Gen.Coll.
K 16	,,	,,	2 ,, ,, ; 3 eudoxids; 1 post. ne	,,
K 19	,,	,,	1 ,, ,,	,,
K 20	,,	,,	3 ,,	,,
K 21	,,	,,	1 ,, ,, ; 1 ,,	,,
K 31	,,	,,	1 ,,	,,
K 34	,,	75—0	2 ,, ,, ; 2 ,,	,,
K 35	,,	200—0	5 ,, ,, ; 5 ,, ; 2 ,,	,,
K 36	,,	,,	2 ,, ,, ; 2 ,,	,,
K 37	,,	,,	1 ,,	,,
K 42	,,	,,	1 ,,	,,
K 46	,,	,,	1 ,, ,, ;	,,
K 47	,,	,,	4 ,, ,, ; 2 ,,	,,
K 48	,,	,,	5 ,,	,,
K 49	,,	,,	3 ,, ,, ; 2 ,,	,,
K 51	,,	,,	5 ,, ,, ; 1 ,, ; 3 ,,	,,
K 361	Org.N.	Surface	3 ,,	,,
K 372	,,	,,	1 ,, ,,	,,
K 378	,,	,,	4 ,,	,,
K 379	,,	,,	2 ,,	,,
K 380	,,	,,	1 ,, ,,	,,
K 538	,,	,,	1 ,,	,,
Gt.Nic. 6	N. N.	,,	4 ,, ,, ; 8 ,,	,,

Type locality.—Equatorial Pacific.

Distribution.—This is a common species occurring in great abundance in the tropical regions of the Atlantic, Pacific and Indian Oceans; and in the Mediterranean (for details of localities *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, A).—The range of size, etc., are given below :

Length :	14.0 mm —39.0 mm
Breadth :	7.5 ,, —20.0 ,,
Somatocyst :	5.5 ,, —14.0 ,,
Hydroecium :	5.8 ,, —18.0 ,,
Ostium of Hydroecium :	5.0 ,, —15.0 ,,
Nectosac :	11.8 ,, —33.5 ,,

The anterior nectophore is firm, prismatic pyramidal with five prominent complete ridges. The odd dorsal and the lateral ridges end in three broad, pointed, recurved

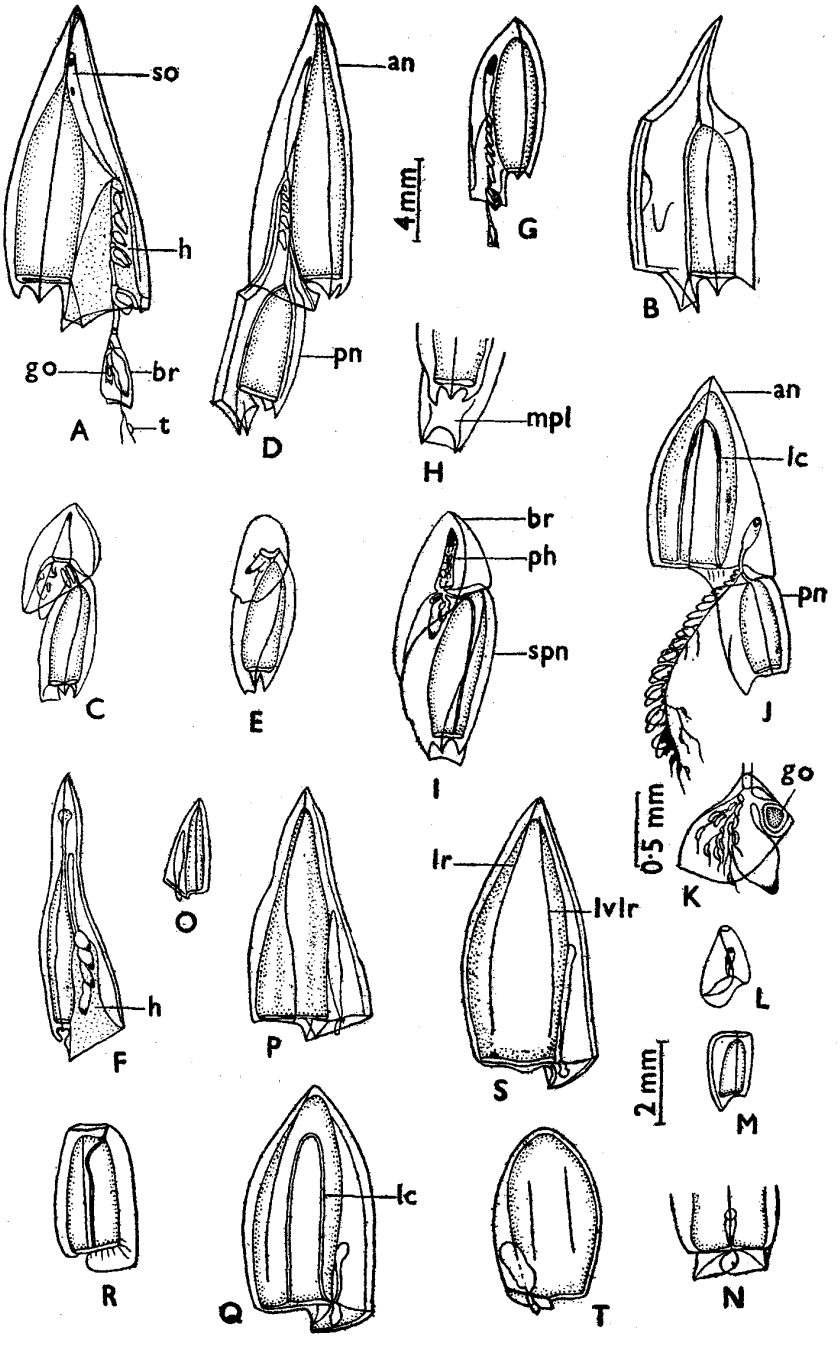
teeth at the ostium of the nectosac. These teeth are slightly serrated in some and smooth in others. The ventral ridges extend well beyond the level of the ostium of the nectosac forming $\frac{1}{3}$rd of the length of the hydroecium. The mouth-plate is undivided. The nectosac is sub-cylindrical, but anteriorly it narrows abruptly into a thin, long tube which dilates near the apex of the nectophore into a globular structure. The somatocyst is long, and thin; it is inclined towards the nectosac, extending upto the tubular region of the nectosac. The hydroecium is deep, conical, and inclined towards the ventral wall of the nectophore. It is nearly half the length of the cylindrical portion of the nectosac. The ostium of the hydroecium is broad and quadrilateral in shape. The dorsal wall of the hydroecium is smooth and flat. The pedicular canal is descending and open near the ostium of the nectosac. The lateral canals are simple and clearly seen within the well-developed musculature of the nectosac. The dorsal radial canal extends into the thin, tubelike portion of the nectosac.

Posterior nectophore (Text-fig. 10, B).—These have a length of 13.3 mm to a maximum of 30.0 mm, and a breadth ranging from 6.5 mm to 15.0 mm. The posterior nectophore is subequal in length; it is anteriorly produced into a narrow triangular extension which fits in the hydroecium of the anterior nectophore. The dorsal and the lateral ridges end in prominent teeth at the ostium of the nectosac. The dorsal tooth is large; the ridges and teeth are usually smooth, devoid of any serrations. The nectosac is sub-cylindrical in shape. The hydroecial wings are broad and they do not fuse to form a closed tube. These wings meet at the top and in the mid-region, the margin of the left wing curves over to the right thus forming a temporary tube through which the stem passes. The edges of the wings and the hydroecial teeth are smooth. The pedicular canal lies in the mid-region of the apical prolongation, and joins the nectosac slightly below the apex. The radial canals are simple and straight, without any loops.

Siphosome or stem.—The stem is long, thin, tubular and extremely contractile. When fixed without narcotization, the entire stem with its cormidia are retracted within the hydroecium.

Cormidia.—The number of cormidia varies from 4 to 10 in different specimens due to the setting free of the oldest cormidia. A young cormidium consists of a well-developed gastrozooid, its tentacle and few buds of probably the bract, gonophores or special nectophore. In the older cormidium (10th) the gonophore is well-developed though small in size. The special nectophore is small, projects out of the spathi-form bract. The bract is large, thin, tubular, transparent, with two pointed teeth at its basal margin. It is prolonged upwards, above its insertion, in the form of a cowl surrounding the stem. It is open on the ventral side. The phyllocyst is very small. The tentacle when extended is seen as a thin, threadlike structure having side-branches —tentilla. The tentilla end in elongated kidney-shaped cnidosacs packed with numerous elongated nematocysts and single terminal filaments which have a beaded appearance.

Eudoxid phase (Text-fig. 10, C).—The eudoxid measures 7.0 mm in length. The bract has a length of 3.1 mm and a breadth of 2.3 mm. The special nectophore measures 3.8 mm in length and 2.0 mm in breadth. The freed cormidia grow to large size. The bract is not thin and leaf-like, but large, conical and thick with mesoglea. The head-piece of the bract is half the size of the neck-shield. It has a deep conical hydroecial cavity. The phyllocyst is long, broad at the base, but tapers into a blunt end at the apex of the bract. It usually possesses an oil-globule. One to three gonophores are developed at a time. Of these, two are large, mirror-images of each other and of the same sex. The umbrella of the gonophore is well-developed. The nectosac has the usual four, simple radial canals. The manubrium bears the sex-cells. The gonophores have four small teeth at their bases.



TEXT-FIGURE 10

Diphyes dispar : A—C
A—anterior nectophore. B—posterior nectophore. C—eudoxid phase.
Diphyes bojani : D—F
D—anterior and posterior nectophore intact. E—eudoxid phase. F—peculiar anterior nectophore.
Diphyes chamissonis : G—I
G—anterior nectophore. H—anterior nectophore : dorsal view. I—eudoxid phase.

Contd. .. p. 121

The special nectophore lacks the manubrium. The pedicular canal descends down and opens into the four radial canals directly at the apex of the nectosac. This is a diagnostic character of this species. There are only four slightly serrated ridges which end in teeth at the ostium of the nectosac. The two ventral teeth are joined together by a web-like extension of the nectophore. The apex of the nectophore is prolonged into a small peg-like extension which fits into the cavity of the bract.

Diphyes bojani (Eschscholtz, 1825)

(Text-fig. 10, D–F)

1825. *Eudoxia bojani* Eschscholtz, *Okens' Isis*, **16**, p. 743, taf. 5, fig. 15 (eudoxid).
1825. *Eudoxidia bojani :* Eschscholtz, *Oken' Isis*, **16**, p. 743, taf. 5, fig. 15 (eudoxid).
1829. *Eudoxia bojani :* Eschscholtz, *System der Acalephen.* Berlin, p. 125, taf. 12, fig. 1, (eudoxid).
1829. *Eudoxidia bojani :* Eschscholtz, *System der Acalephen.* Berlin, p. 125, taf. 12, fig. 1.
1859. *Eudoxidia bojani :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 59, pl. 3, fig. 7.
1859. *Diphyes steenstrupi* Gegenbaur, *Nova Acta. Leop. Carol.*, **27**, p. 369, taf. 29, figs. 27–29.
1888. *Doromasia picta* Chun, *S. B. Preuss Akad. Wiss.* for 1888, p. 1154.
1888. *Ersaea bojani :* Chun, *S. B. preuss. Akad. Wiss.* for 1888, p. 1154 (eudoxid).
1888. *Diphyes serrata* Chun, *S. B. preuss. Akad. Wiss.* for 1888, p. 1158.
1888. *Eudoxia serrata :* Chun, *S. B. preuss. Akad. Wiss.* for 1888, p. 1159.
1888. *Cuculus gracilis* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 110 (eudoxid).
1888. *Ersaea dispar* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 361.
1892. *Doromasia picta :* Chun, *Abh. senckenb. naturf. Ges.*, **18**, p. 91, taf. 8, figs. 3–5; taf. 9, figs. 5–10; taf. 10, figs. 1–9.
1892. *Ersaea picta :* Chun, *Abh. senckenb. naturf. Ges.*, **18**, p. 98, 101, fig. 6 (eudoxid).
1892. *Ersaea bojani :* Chun, *Abh. senckenb. naturf. Ges.*, **18**, p. 108, fig. 7 (eudoxid).
1892. *Doromasia picta :* Chun, *Abh. sneckenb. naturf. Ges.*, **18**, pp. 108, 110; fig. 8.
1897. *Doromasia picta :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 9.
1897. *Diphyes serrata :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 26.
1897. *Eudoxia serrata :* Chun, *Ergebn Plankton Exped.*, **2**, k.b., p. 26.
1897. *Diphyes steenstrupi :* Chun, *Ergebn Plankton Exped.*, **2**, k.b., p. 103.
1898. *Diphyes dispar :* Schneider, *Zool. Anz.*, **21**, p. 84 (in part).
1898. *Diphyes appendiculata* Schneider, *Zool. Anz.*, **21**, p. 85 (in part).
1898. *Muggiaea bojani :* Schneider, *Zool. Anz.*, **21**, p. 88.
1900. *Diphyopsis picta :* Mayer, *Bull. Mus. Comp. Zool. Harv.*, **37**, p. 75.
1908. *Doromasia pictoides* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 3, pl. 1, fig. 1.
1908. *Ersaea bojani :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 6, figs. 1–6 (eudoxid).

Lensia subtiloides : J—N
J—anterior and posterior nectophores intact. K—cormidium. L—bract.
M—special nectophore. N—anterior nectophore : dorsal view.
Lensia conoidea : O, P
O—anterior nectophore. P—anterior nectophore.
Lensia leloupi : Q, R
Q—anterior nectophore. R—posterior nectophore.
Lensia multicristata : S
S—anterior nectophore.
Lensia cossack : T
T—anterior nectophore.
Abbreviations used :
an—anterior nectophore. br—bract. go—gonophore. h—hydroecium. lc—lateral radial canal.
lr—lateral ridge. lv.lr—left ventrolateral ridge. m.pl—mouth-plate. ph—phyllocyst.
pn—posterior nectophore. so—somatocyst. sp.n—special nectophore. t—tentillum.

1908. *Diphyes indica :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 44, pl. 7, fig. 54.
1908. *Diphyes serrata :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 44.
1908. *Diphyes steenstrupi :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 44.
1908. *Diphyes malayana* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 45, pl. 7, figs. 55, 56.
1908. *Diphyes gegenbauri* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 46, pl. 7, fig. 58.
1911. *Diphyes bojani :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, pp. 251, 265, pl. 7, figs. 2, 3; pl. 8, fig. 6; pl. 9, figs. 1, 2; pl. 10, figs. 2, 3; pl. 11, figs. 5, 7, 8; pl. 12, figs. 1.
1919. *Diphyopsis bojani :* Bigelow, *Bull. U.S. Nat. Mus.*, **100**(i)(5), p. 340.
1925. *Diphyes bojani :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 208, taf. XIII, fig. 1.
1926. *Diphyopsis bojani :* Browne, *Trans. Linn. Soc. Lond. Zool.*, (2)**19**, p. 80.
1931. *Diphyes bojani :* Bigelow, *Zoologica*, N. Y. **8**(11), p. 565.
1932. *Diphyes bojani :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 349, fig. 22.
1933. *Diphyes bojani :* Leloup, *Res. Camp. Sci. Monaco*, **87**, p. 30.
1934. *Diphyes bojani :* Leloup, *Bull. Mus. nat. Belg.*, **10**(6), p. 22.
1935. *Diphyes bojani :* Leloup & Hentschel, *Wiss Ergebn. dtsch. Atland. Exped. 'Meteor'*, **12**(2), p. 9, carte 6.
1935. *Diphyes bojani :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 262.
1937. *Diphyes bojani :* Leloup, *Mem. Mus. R. Hist. nat. Belg.*, **1**(2), p. 122.
1938. *Diphyes bojani :* Boone, *Bull. Vanderbilt Mar. Mus.*, VIII, p. 41.
1949. *Diphyes bojani :* Moore, *Bull. Bingham Oceanogr. Coll.*, XII(2), p. 15, fig. 22.
1950. *Diphyes bojani :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1954. *Diphyes bojani :* Totton, *Disc. Rep.*, **27**, p. 16.
1955. *Diphyes bojani :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 10.
1955. *Diphyes bojani :* Leloup, *Inst. Roy. Sci. nat. Belg.*, **3**(4), p. 14.
1963. *Diphyes bojani :* Daniel & Daniel, *J. mar. biol. Assoc. India*, **5**(2), p. 207, fig. VI, 6–8.
1965. *Diphyes bojani :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 155, text-fig. 92.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*Z.S.I. Reg. no.*
V 5179	J. N.	200–0	1 ant. necto.	P 1625/1
V 5205	IOSN	,,	1 ,, ,,	P 1572/1
V 5207	,,	,,	9 ,, ,, ; 2 post. necto.; 5 eudox.	P 1525/1
V 5209	IOSN/JN	,,	12 ,, ,, ; 3 ,, ,, ; 12 ,,	P 1616/1
V 5211	Pl. N.	Surface	3 ,, ,,	Gen.Coll.
V 5212	IOSN/JN	200–0	13 ,, ,, ; 4 ,, ,, ; 6 ,,	P 1605/1
V 5216	Pl.N./Rng.T.	1000–0	2 ,, ,, ; 5 ,,	P 1597/1
V 5217	IOSN	200–0	4 ,, ,,	P 1576/1
V 5218	Pl. N.	Surface	3 ,, ,,	P 1778/1
V 5220	IOSN/JN	200–0	18 ,, ,, ; 5 ,, ,, ; 9 ,,	P 1679/1
K 1	N. N.	,,	2 ,,	Gen.Coll.
K 3	,,	400–200	1 ,,	,,
K 4	,,	200–0	3 ,, ,, ; 2 ,,	,,
K 5	,,	,,	1 ,, ,, ; 2 ,,	,,
K 6	,,	,,	2 ,, ,, ; 1 ,,	,,
K 7	,,	,,	1 ,, ,, ; 1 ,,	,,
K 8	,,	,,	1 ,, ,, ; 5 ,,	,,
K 9	,,	,,	1 ,,	,,

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Regd. no.*
K 10	N. N.	200–0	1 ant. necto.; 8 eudox.	Gen.Coll.
K 11	,,	,,	3 ,, ,, ; 1 post.necto.; 1 ,,	,,
K 14	,,	,,	2 ,, ,, ; 2 ,, ,, ; 4 ,,	,,
K 15	,,	,,	2 ,, ,, ; 4 ,,	,,
K 16	,,	,,	2 ,, ,,	,,
K 19	,,	,,	1 ,,	,,
K 20	,,	,,	1 ,,	,,
K 21	,,	,,	1 ,, ,, ; 1 ,,	,,
K 22	,,	,,	1 ,,	,,
K 23	,,	,,	1 ,, ,, ; 3 ,,	,,
K 24	,,	,,	1 ,,	,,
K 31	,,	,,	1 ,, ,, ; 4 ,,	,,
K 32	,,	,,	1 ,, ,, ; 4 ,,	,,
K 34	,,	,,	2 ,, ,, ; 2 ,, ,, 2 ,,	,,
K 35	,,	,,	3 ,, ,, ; 1 ,,	,,
K 36	,,	,,	3 ,, ,, ; 2 ,,	,,
K 37	,,	,,	1 ,,	,,
K 39	,,	,,	1 ,, ,, ; 1 ,, ,,	,,
K 44	,,	,,	2 ,, ,,	,,
K 46	,,	,,	1 ,,	,,
K 47	,,	,,	3 ,, ,,	,,
K 48	,,	,,	3 ,,	,,
K 49	,,	,,	5 ,, ,, ; 2 ,, ,,	,,
K 51	,,	,,	2 ,, ,, ; 4 ,,	,,
K 53	,,	,,	3 ,, ,, ; 6 ,,	,,
K 54	,,	,,	4 ,,	,,
K 56	,,	,,	1 ,,	,,
K 58	,,	,,	3 ,,	,,
K 359	Org. N.	Surface	2 ,, ,, ; 2 ,, ,, ; 2 ,,	,,
K 360	,,	,,	2 ,,	,,
K 361	,,	,,	1 ,, ,, ; 1 ,, ,, ; 1 ,,	,,
K 372	,,	,,	3 ,,	,,
K 378	,,	,,	1 ,,	,,
K 533	,,	,,	1 ,, ,, ; 1 ,,	,,
K 538	,,	,,	1 ,, ,,	,,

Type locality.—St. Peter & Paul.

Distribution.—This species occurs in great abundance in the tropical and sub-tropical regions of the Atlantic, Pacific and Indian Oceans, and in the Mediterranean Sea. Details of localities are given in Table 1.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, D, an).—The range in dimensions of the anterior nectophores are as follows :

Length :	8.0—10.33 mm
Breadth :	2.8— 3.67 ,,
Somatocyst :	3.0— 4.3 ,,
Hydroecium :	3.0— 3.5 ,,
Nectosac :	6.8— 8.8 ,,

The anterior nectophore is long and slenderly pyramidal. The base of the nectophore is not broad as in *D. dispar*. The five complete ridges are well-serrated. The degree of serration varies in different specimens. In some cases, the ridges are serrated nearly from the apex of the nectophore to the tips of the teeth surrounding the ostium of the nectosac. While in some others, only the lower half of the ridges are serrated. The ostial teeth are as in *D. dispar* but the dorsal tooth in *D. bojani* is smaller. The nectosac is cylindrical at base and tapers gradually into a blunt tube towards the apex of the nectophore. The ventral ridges, as in *D. dispar*, extend below the level of the ostium. The dorsal surface of the hydroecium is undivided as in *D. dispar* and it is not smooth and flat as in the latter but raised into a prominent tooth or crest in the middle region. This is a diagnostic feature of this species. The somatocyst is long, fusiform and lies alongside the nectosac. The hydroecium is deep, conical and lies along the nectosac and is not inclined as in *D. dispar*.

Posterior nectophore (Text-fig. 10, D pn).—The nectophore measures 8.67 mm in length and 3.0 mm in breadth, and is very similar to that of *D. dispar* in shape but differs from it in being very slender. The ridges are serrated and end in three teeth at the base. The hydroecial wings are not very broad, and they overlap at the apex forming a narrow tube-like hydroecium. The dorsal wall of the hydroecium has a tooth-like crest between the two ventral teeth as in the anterior nectophore.

Cormidia.—About 6–9 cormidia are present in the specimens examined. The oldest cormidium possesses a siphon, its tentacle, bract, buds of gonophores and a small special nectophore.

Eudoxid phase (Text-fig. 10, E).—The eudoxid has a total length of 6.0 mm. The bract measures 3.0 mm in length and 1.8 mm in breadth. The special nectophore has a length of 4.9 mm and a breadth of 2.1 mm. The bract is thin and shield-like in shape. It lies parallel to the main axis of the special nectophore. The bracteal cavity is very shallow. The edge of the bract is serrated and there are two to three prominent teeth at the lower edge. The shape of the phyllocyst shows variations as described by Lens & van Riemsdijk (1908). In six specimens it is knob-like and in others, one end of it is produced into a small blunt caecum. The gonophores are small and sac-like without the umbrella or teeth. Each eudoxid is of one sex only. The manubrium fills the entire space of the sac-like gonophore. The special nectophore is as in *D. dispar* but the four ridges are well-serrated, flared-out and slightly twisted. The ridges end in four teeth. The apex of the special nectophore is blunt and not produced into a peg-like extension as in *D. dispar*.

Some peculiar nectophores of D. bojani (Text-fig. 10, F)

In the collections from the Arabian Sea and the Australian coast there are 27 anterior nectophores (6 from the Arabian Sea, and 21 from the Australian region) which possess characters of both *D. dispar* and *D. bojani*.

Anterior nectophores.—These have a length of 10.0 mm and a breadth of 2.75 mm. The somatocyst measures 2.8 mm in length; with the hydroecium measuring 4.0 mm in length. The nectosac is 7.2 mm long. They are slenderly pyramidal as in *D. bojani* but the apex of the nectophore is constricted at $\frac{1}{4}$th distance from the apex. The five ridges in this region are smoky-coloured. The ridges are slightly serrated and end in 3 prominent teeth at the base. The nectosac is shaped as in *D. dispar*, in which it narrows abruptly into a thin tube which dilates into a globular structure. It is not gradually tapering into a blunt end, as in *D. bojani*. The somatocyst and hydroecium are slightly inclined; the somatocyst towards the nectosac, and the hydroecium towards

the ventral wall of the nectophore as in *D. dispar*. The dorsal wall of the mouth-plate has the characteristic raised crest or prominence which was found to occur in the case of *D. bojani*.

Posterior nectophore.—not present in the collections.

Remarks.—These nectophores resemble *D. bojani* in their slender appearance and in the tooth-like projections on the dorsal wall of the mouth-plate. They resemble *D. dispar* in the nectosac being prolonged into a thin tube, which ends in a dilated tip. However, all the examples differ from *D. bojani* in the constricted nature of the nectophore at the level of the constriction of the nectosac, and in the ridges being smoky in colouration down to the level of the constriction of the nectophore. This smoky colouration of the ridges has been also noted by Totton (1965).

Diphyes chamissonis Huxley, 1859

(Text-fig. 10, G–I)

1859. *Diphyes chamissonis* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 36, pl. 1, fig. 3.
1888. *Muggiaea chamissonis :* Haeckel, *Jena Z. naturw.*, **22**, p. 34.
1888. *Muggiaea chamissonis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 137.
1892. *Muggiaea chamissonis :* Chun, *Abh. senckenb. naturf. Ges.*, **18**, p. 89.
1903. *Muggiaea kochii* Murbach & Shearer, *Proc. zool. Soc. London*, **2**, p. 189.
1904. *Diphyes chamissoni :* Browne, *Fauna and Geography of the Maldive and Laccadive Archipelagoes*, **2**, p. 742, pl. 54, fig. 6.
1908. *Diphyopsis weberi :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 53, pl. 8, figs. 67, 68.
1911. *Diphyopsis chamissonis :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 347.
1925. *Diphyes chamissonis :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 255.
1926. *Diphyopsis chamissonis :* Browne, *Trans. Linn. Soc. London*, (2), **19**, p. 81.
1932. *Diphyes chamissonis :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, pl. 351, text-figs. 23, 24.
1932. *Diphyes chamissonis :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **8**(11), p. 13.
1934. *Diphyes chamissonis :* Leloup, *Bull. Mus. Hist. nat. Belg.* **10** (9), p. 1.
1954. *Diphyes chamissonis :* Totton, *Disc. Rep.*, **27**, p. 130.
1963. *Diphyes chamissonis :* Daniel & Daniel, *J. mar. biol. Assoc. India*, **5**(2), p. 209, fig. VI, 9, 10.
1965. *Diphyes chamissonis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 156, text-figs. 93, 94.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5227	IOSN	200–0	1 ant. necto.;	P 1701/1
K 6	N. N.	,,	16 ,, ,, ; 10 eudox.	Gen.Coll.
K 8	,,	,,	2 ,, ,,	,,
K 33	,,	50–0	2 ,, ,,	,,
K 36	,,	200–0	2 ,, ,, ; 2 ,,	,,
K 46	N. N.	200–0	2 ,, ,, ; 5 ,,	,,
K 48	,,	,,	3 ,, ,, ; 1 ,,	,,
K 49	,,	,,	4 ,,	,,
K 380	Org. N.	Surface	2 ,, ,, ; 2 ,,	,,
K 522	,,	,,	1 ,, ,, ; 2 ,,	,,
K 525	,,	,,	11 ,, ,, ; 17 ,,	,,
K 527	,,	,,	1 ,, ,, ; 1 ,,	,,
K 533	,,	,,	1 ,, ,,	,,

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
Digha 6	Org. N.	Surface	353 ant. necto.; 1358 eudox.	Gen.Coll.
KRL 26	,,	,,	55 ,, ,, ; 7 ,,	,,
KRL 34	,,	,,	235 ,, ,, ; 756 ,,	,,
	,,	25–10	48 ,, ,, ; 671 ,,	,,
MC-S 4	,,	Surface	1 ,, ,,	,,
Puri 7	,,	,,	56 ,, ,, ; 123 ,,	,,
Puri 8	,,	,,	29 ,, ,, ; 50 ,,	,,

Type locality.—East coast of Australia.

Distribution.—This is a neritic species found abundantly along the shores of the continental slope of the Pacific and Indian Oceans and Red Sea (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, G & H).—The nectophores have the following dimensions :—

	Range (mm)
Length :	3.75—9.75
Breadth :	1.47—3.65
Somatocyst :	1.15—3.00
Hydroecium :	1.82—4.75
Nectosac :	2.9 —7.14

The anterior nectophore is firm, pyramidal and bulged in the middle. The five complete ridges are serrated only at the base. The dorsal and lateral ridges and in broad serrated teeth at the ostium. The ventral ridges extend down well beyond the level of the ostium. Hence the hydroecium is deep and $\frac{1}{3}$rd of it occurs below the level of the ostium. The somatocyst is long, spindle-shaped and lies alongside the nectosac. The nectosac is sub-cylindrical and slightly bulged in the middle. Its apex is blunt and not produced into a narrow tube.

The posterior nectophore is never developed. In the thousands of examples examined there is no evidence of a bud that may develop into the posterior nectophore.

Cormidia.—The number of cormidia varies from 7 to 15. The young cormidium consists of the siphon, its tentacle and bud of bract or gonophore or special nectophore. The older cormidium has a well-developed bract which resembles that of *D. dispar* in shape and structure, but it is smaller, broader and not so deep in this species. The phyllocyst is very small. The special nectophore is also small and bears four serrated teeth.

Eudoxid phase (Text-fig. 10, I).—The bract has a length of 3.75 mm and a breadth of 1.8 mm. The special nectophore measures 4.75 mm in length and 2.0 mm in breadth. The bract is similar to *D. dispar* but the head-piece is as long as the neck-shield. The distal edge of the bract extends down to half the length of the special nectophore. The phyllocyst is broad and finger-like in shape. The bracteal cavity is deep and conical. The apex of the bract is much more pointed than in *D. dispar.* The special nectophore articulates at an angle of 45° to the long axis. In general shape, the special nectophore resembles those of *D. dispar*, but the pedicular canal is short and horizontal and enters the nectosac at a point below the apex of the nectosac. This is the diagnostic character of this species. The sexes are separate. Five to six sac-like gonophores are present in each eudoxid. No umbrella is developed in the gonophores.

Genus **Lensia** Totton, 1932

1932. *Lensia* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 364.

Small diphyid Calycophorae, with pentagonal anterior and smaller fragile posterior nectophores. Anterior nectophore with very shallow hydroecium, short, divided overlapping mouth-plates; short or medium sized somatocyst, without ostial teeth; and radial canals lacking commissural canals. Posterior nectophore anteriorly truncated, with rounded undivided mouth-plate and without ostial teeth; lateral radial canals not looped but apically bent. Eudoxids possessing bracts with broad rounded posterior edge, without teeth and special nectophores; gonophores anteriorly truncated with small rounded mouth-plate.

The earliest record of *Lensia* was that of *L. conoidea* (Kefferstein & Ehlers, 1861). Upto 1934, seven species of *Lensia* were known (Chun, 1886; Lens & van Riemsdijk, 1908; Bigelow, 1911a; Moser, 1925; and Leloup, 1933, 1934a). Twenty-three species were added on to this list (Totton, 1941, 1954, 1965; Daniel & Daniel, 1963a,b; 1979. A study of these 30 species shows that the number of ridges varies greatly, but they have certain common characters such as the shallow hydroecium (except in *L. havock* Totton, *L. exeter* Totton, *L. hostile* Totton), short somatocyst (except in *L. conoidea*, *L. multicristata* Moser, and *L. panikkari* n. sp.), lack of ostial teeth and the lateral radial canals of the posterior nectophore (when known) being slightly curved at their proximal ends.

In the present monograph, these species of *Lensia* are divided into four main groups : "A", "B", "C" & "D".

The Group "A" is characterized by the occurrence of five complete (or some incomplete) ridges in the anterior nectophores. It is further sub-divided into four small sub-groups, *viz.*, A 1–4.

The Group "B" is distinguished by the apically blunt anterior nectophores which lack complete ridges.

The group "C" is demarkated by its members all having seven ridges (complete, or some incomplete).

The Group "D" is diagnosed by the occurrence of many ridges—the multicristate forms, which may have a velar ridge above the ostium of the nectosac.

Key to the proposed groups of species of the Genus *Lensia*

1.	Nectophore with 3–5 ridges	2
	Nectophore with 7 or multiple ridges	3
2.	Nectophore with 5 complete or some incomplete ridges, with pointed tip	GROUP "A"
	Nectophore with blunt apex which lacks complete ridges	GROUP "B"
3.	Nectophore with 7 complete or some incomplete ridges	GROUP "C"
	Nectophore with multiple (many crested) ridges with or without velar ridge	GROUP "D"

The list of the valid species of *Lensia* is given below :

GROUP "A"

Sub-group "A-1" :

1. *Lensia subtiloides* (Lens & van Riemsdijk, 1908)
2. *L. conoidea* (Kefferstein & Ehlers, 1861)

3. *L. hotspur* Totton, 1941
4. *L. gnanamuthui* Daniel & Daniel, 1963b
5. *L. roonwali* Daniel 1970

Sub-group "*A*–2" :

6. *L. hardy* Totton, 1941
7. *L. fowleri* (Bigelow, 1911a)
8. *L. challengeri* Totton, 1954

Sub-group "*A*–3" :

9. *L. achilles* Totton, 1941
10. *L. baryi* Totton, 1965a
11. *L. cordata* Totton, 1965b

Sub-group "*A*–4" :

12. *L. leloupi* Totton, 1954
13. *L. tottoni* Daniel & Daniel, 1963a
14. *L. panikkari* Daniel, 1970
15. *L. nagabhushanami* Daniel, 1970

GROUP "B"

16. *L. campanella* (Moser, 1925)
17. *L. cossack* Totton, 1941
18. *L. subtilis* (Chun, 1886)
19. *L. subtilis* var. *chuni* Totton, 1965
20. *L. meteori* (Leloup, 1934a)
21. *L. tiwarii* Daniel, 1970

GROUP "C"

22. *L. multicristata* (Moser, 1925)
23. *L. hunter* Totton, 1941
24. *L. havock* Totton, 1941

GROUP "D"

25. *L. lelouveteau* Totton, 1941
26. *L. exeter* Totton, 1941
27. *L. hostile* Totton, 1941
28. *L. grimaldi* Leloup, 1933
29. *L. ajax* Totton, 1941
30. *L. reticulata* Totton, 1954

Type species.—Lensia subtiloides (Lens & van Riemsdijk, 1908).

Key to species of *Lensia*
(Modified after Totton, 1965)

GROUP "A"

Sub-Group A-1 : (with complete lateral ridges) :

1. Five complete non-crested straight ridges 2

   Five non-crested ridges, with right-ventral ridge not reaching apex; all ridges slightly twisted . . . . . *roonwali*

2.	Five complete non-crested straight ridges; with short somatocyst either stalked or non-stalked and inclined	3
	Five complete non-crested straight ridges; somatocyst either half as long as nectophore or very minute	4
3.	With short, stalked somatocyst; mouth-plates 1/3rd as long as somatocyst	*subtiloides*
	With short, non-stalked and inclined somatocyst	*hotspur*
4.	Somatocyst half as long as nectophore	*conoidea*
	Somatocyst very minute, placed close to ventral corner of nectosac	*gnanamuthui*

Sub-group A-2 : (with complete, straight, lateral ridge, somatocyst lying at or below ostial level) :

1.	Five single crested ridges; somatocyst below ostial level	2
	Five single crested ridges; somatocyst at level of ostium; hydroecium extending below somatocyst	*hardy*
2.	Five single crested ridges; somatocyst horizontal, below ostial level hydroecium not extending below somatocyst	*fowleri*
	Five single-crested ridges; somatocyst spheroidal, with peak-shaped basal extension of dorsal wall	*challengeri*

Sub-group A-3 : (with complete, but distal ends of, lateral ridge bent dorsad) :

1.	With short either spindle-shaped or heart-shaped somatocyst	2
	With long somatocyst with terminal constriction	*baryi*
2.	With short spindle-shaped somatocyst	*achilles*
	With short heart-shaped somatocyst	*cordata*

Sub-group A-4 : (with lateral ridges not reaching ostium) :

1.	Somatocyst lying close against wall of nectosac	2
	Somatocyst not lying close against wall of nectosac	3
2.	Somatocyst lying close against wall of nectosac; more than half as long as nectophore	*panikkari*
	Somatocyst lying close against wall of nectosac; short	*nagabhushanami*
3.	Somatocyst short, not lying close against wall of nectosac; mouth-plates half as long as somatocyst	*leloupi*
	Somatocyst short, not lying close against wall of nectosac, inclined ventrally	*tottoni*

GROUP "B"

1.	Three non-crested ridges only (no ventrolateral ridges between lateral and ventral facet	2
	Ridges very inconspicuous; somatocyst short, tubular and inclined over nectosac	*tiwarii*
2.	Three non-crested ridges; apex of nectophore either twisted or not twisted	3
	Three to five non-crested, furrowlike ridges	4
3.	Three non-crested ridges; apex of nectophore twisted; with very minute mouth-plates	*campanella*
	Three non-crested ridges; apex of nectophore not twisted; with short mouth-plates	*cossack*
4.	Three to five non-crested, furrowlike ridges; somatocyst globular and long, thin pedicel	*subtilis*
	Three to five non-crested furrowlike ridges; somatocyst small on very short pedicel	*meteori*

GROUP "C"

1.	Five crested longitudinal ridges and two ventrolateral crests; some incomplete . .	2
	Seven crests, complete; apex to base	*havock*
2.	Seven crests, some incomplete, ventrolateral pair meeting mouth-plate . . .	*hunter*
	Seven crests some incomplete, ventrolateral pair not meeting mouth-plate . . .	*multicristata*

GROUP "D"

1.	Five ridges, each with more than a single crest	2
	At least five ridges; branching with reticulations	*reticulata*
2.	Five two-crested ridges and a horizontal basal (velar) ridge	*grimaldi*
	Five ridges each with more than two crests and a velar ridge	3
3.	Five multicristate ridges and a velar ridge	4
	Five multicristate ridges but no velar ridge	5
4.	Five multicristate (3) ridges and a velar ridge	*exeter*
	Five multicristate (3–7) ridges and a velar ridge	*lelouveteau*
5.	Five multicristate ridges; no velar ridge; crests extending to ostium	*hostile*
	Five multicristate ridges; no velar ridge, crests not extending to ostium	*ajax*

The present author feels that more researches on perfect material would reveal that some of these groups and sub-groups indicated above, inculding species with close natural affinities may have to be eventually recognized as distinct genera and a new subfamily be erected for them. Totton (1965) had suggested the inclusion of *L. hardy*, *L. fowleri* and *L. challengeri* (the sub-group "A-2" of the present report) into a separate genus and left it to later workers to group the different species of the genus *Lensia* which has been initiated in this study.

The following seventeen species of *Lensia* are represented in the present collections :—

GROUP "A" : *Sub-group "A–1" : Lensia subtiloides; L. conoidea; L. hotspur;* & *L. roonwali.*

Sub-group "A–2" : L. fowleri & L. challengeri

Sub-group "A–3" : no representatives

Sub-group "A–4" : L. leloupi; L. panikkari & *L. nagabhushanami*

GROUP "B" : *L. campanella; L. cossack; L. subtilis; L. meteori ; & L. tiwarii;*

GROUP "C" : *L. multicristata & L. hunter*

GROUP "D" : *L. ajax.*

Lensia subtiloides (Lens & van Riemsdijk 1908)

(Text-fig. 10, J–N)

1908. *Diphyes subtiloides* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 46, pl. 7, figs. 59–61.

1911. *Diphyes subtiloides :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 347.

1932. *Lensia subtiloides :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 363, text-figs. 31–33.

1937. *Lensia subtiloides :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped., Medit.* II. *Biology*, H. **2**, p. 58, figs. 100, 121.

1950. *Lensia subtiloides :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Lensia subtiloides :* Totton, *Disc. Rep.* **27**, p. 112, text-figs. 55D.

1955. *Lensia subtiloides :* Leloup, *Rep. Sci. res. "Michael Sars" north Atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 16.

1955. *Lensia subtiloides :* Leloup, *Inst. Roy. Sci. nat. Belg.* **3**(4), p. 12.

1963. *Lensia subtiloides :* Daniel & Daniel, *J. mar. biol. Assoc. India*, **5**(2), p. 202, fig. IV, 9–12.

1965. *Lensia subtiloides :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 159, text-figs. 95, 96, 97b.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5227	J. N.	200–0	4 ant. necto.;	P 1711/1
K 6	N. N.	,,	3 ,, ,,	Gen.Coll.
K 7	,,	500–0	3 ,, ,, ; 2 eudox.	,,
K 8	,,	200–0	19 ,, ,, ; 5 ,,	,,
K 16	,,	,,	1 ,, ,, ; 3 ,,	,,
K 20	,,	,,	2 ,, ,, ;	,,
K 21	,,	,,	10 ,, ,, ; 2 ,,	,,
K 22	,,	,,	2 ,, ,,	,,
K 23	,,	,,	1 ,, ,,	,,
K 26	,,	,,	4 ,, ,,	,,
K 36	,,	,,	4 ,, ,,	,,
K 42	,,	,,	1 ,, ,,	,,
K 51	,,	,,	2 ,, ,,	,,
K 358	Org. N.	Surface	1 ,, ,,	,,
K 378	,,	,,	3 ,, ,,	,,
K 379	,,	,,	2 ,,	,,
K 380	,,	,,	4 ,, ,, ; 8 ,,	,,
K 522	,,	,,	5 ,, ,, ; 2 ,,	,,
K 525	,,	,,	8 ,, ,, ; 5 ,,	,,
K 529	Org. N.	Surface	2 ant. necto.; 3 eudox.	Gen.Coll.
K 538	,,	,,	2 ,, ,, ;	,,
Puri 7&8	,,	,,	40 ,, ,, ; 24 ,,	,,
Digha-6	,,	,,	48 ,, ,, ; 53 ,,	,,
Gt.Nic.-2	,,	,,	21 ,, ,, ; 21 ,,	,,

(*Note :* Posterior nectophores were present in the collections, but not counted.)

Type locality.—Sulu Island (Malay Archipelago).

Distribution.—It is a neritic species occurring in great abundance along the coast of the continental shelf of the Pacific, Atlantic and Indian Oceans (for details *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, J, an; N).—They range in length from 3.0 mm to 6.5 mm, in breadth from 2.0 mm to 3.5 mm, and have a somatocyst ranging in length from 1.25 mm to 2.2 mm. The hydroecium measures 0.5 mm in length. There are five complete non-crested ridges. The ventral

ridges curve towards the dorsal side before they meet at the pointed tip of the nectophore. It is devoid of ostial teeth. The mouth-plates are short, rounded, divided and overlapping. The hydroecium is a very shallow conical depression, and it is in level with the velum. The somatocyst is small, stalked, club-shaped and is either straight or slightly inclined ventrally. The stem and cormidia are well developed and persist in most of the fixed specimens. The radial canals are simple as in *Diphyes*.

Posterior nectophore (Text-fig. 10, J, pn).—These range in length from 3.0 mm to 5.0 mm and in breadth from 1.85 mm to 2.0 mm; the nectophore is truncated anteriorly. The dorsal and lateral ridges are as in the anterior nectophore. The hydroecium is in the form of a shallow open groove on the ventral side. The mouth-plate is small, undivided and rounded in shape. The lateral radial canals are slightly bent in the apical region. The pedicular canals enters the nectosac nearly at the apex.

Cormidia (Text-fig. 10, K).—The stem is long bearing more than twenty cormidia. The older ones are released as eudoxids as in *Diphyes*. A special nectophore is present.

Eudoxid phase (Text-fig. 10, L & M).—The bract ranges in length from 1.85 mm to 2.0 mm; the special nectophore has a length ranging from 2.0 mm to 3.5 mm. The bract (Text-fig. 10, L) is small, conical and the posterior margin is smooth, rounded and does not extend as the neck-shield. The bracteal cavity is small and conical. The phyllocyst is small and club-shaped. The special nectophore (Text-fig. 10, M) is very similar to the posterior nectophore in shape and structure, but smaller than it. In certain examples the anterior end is not truncated but extends into a globular structure. The gonophores are sac-like without well-developed umbrella. The sexes are separate.

Lensia conoidea (Kefferstein & Ehlers, 1861)

(Text-fig. 10, O & P)

1846. *Diphyes truncata* Sars, *Fauna littoralis Norwegiae*, Christiana, **1**, (non *D. truncata* Quoy & Gaimard, 1827).

1861. *Diphyes conoidea* Kefferstein & Ehlers, *Zoologische Beitrage gesammelt im witer* 1859-'60 *in Neapel und Messina*. I. *Beobachtungen uber die Siphonophoren* Leipzig, p. 16, pl. Vb.

1932. *Galeolaeia truncata :* Runnstrom, *Bergens Mus. Arbok, pour* 1931, **2**(7), p. 32.

1932. *Lensia truncata :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 371.

1933. *Lensia truncata :* Leloup, *Res. Camp. Sci. Monaco*, **87**, p. 36.

1934. *Lensia truncata :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 42.

1935. *Lensia truncata :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **11**(31), p. 9.

1935. *Lensia truncata :* Leloup & Hentschel, *Wiss. Ergebn dtsch. Atlant. Exped. 'Meteor'*, **12**(2), p. 17, carte 14.

1935. *Lensia truncata :* Hardy & Gunther, *Disc. Rep.* XI, p. 106.

1936. *Lensia conoidea :* Totton, *Zoologica*, N.Y. **21**(4), p. 235.

1937. *Lensia conoidea :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, pp. 48, 112, fig. 74.

1939. *Lensia conoidea :* Bigelow & Sears, *Mem. Mus. Comp. Zool. Harv.*, **54**(4), p. 367, figs. 42a.

1942. *Lensia conoidea :* Kramp, *Medd. Gronland*, **80**, p. 8.

1950. *Lensia conoidea :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Lensia conoidea :* Totton, *Disc. Rep.*, **27**, p. 114, text-fig. 56.

1955. *Lensia conoidea :* Leloup, *Rep. Sci. res. "Michael Sars" north Atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 11.

1965. *Lensia conoidea :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 162, text-fig, 99a; pl. XXXI, fig. 11.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
K 10	N. N.	200–0	1 ant. necto.	Gen.Coll.
K 15	,,	,,	1 ,, ,,	,,
K 16	,,	,,	1 ,, ,,	,,
K 25	,,	,,	3 ,, ,,	,,
K 35	,,	,,	2 ,, ,,	,,
K 58	,,	,,	1 ,, ,,	,,

Type locality.—Nepal & Messina (Italia)—Mediterranean.

Distribution.—This species occurs in the tropical and temperate regions of the three oceans (for details of localities *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, O & P).—The anterior nectophore has a length ranging from 2.6 mm to 6.6 mm and a breadth ranging from 1.1 mm to 3.1 mm. The somatocyst ranges from 1.25 mm to 2.75 mm in length. The anterior nectophore has five complete ridges. The dorsal one extends distally as a smooth tooth-like projection beyond the level of the ostium. The somatocyst is long, thin or broad, shortly stalked and reaches nearly half the length of the nectosac. The musculature of the nectosac is well developed. The hydroecium is very shallow and lies below the level of the ostium. The pedicular canal is descending. The mouth-plates and divided, rounded in shape and overlapping.

The posterior nectophore, stem and eudoxid are not present in the collections.

Lensia hotspur Totton, 1941

(Text-fig. 11, C & D)

1941. *Lensia hotspur*, Totton, *Ann. Mag. nat. Hist.*, London, (11) **8**, p. 155, figs. 14–16, (fig. 13 = *L. challengeri*).

1950. *Lensia hotspur :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Lensia hotspur :* Totton, *Disc. Rep.*, **27**, p. 110, fig. 54 C-E.

1955. *Lensia hotspur :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 11.

1963. *Lensia hotspur :* Daniel & Daniel, *J. mar. biol. Assoc. India*, **5**(2), p. 203, fig. V, 3.

1965. *Lensia hotspur :* Totton, *A synopsis of the Siphonophora*. Brit. Mus. (Nat. Hist.) London, p. 167, fig. 102 C–E.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5205	J. N.	200–0	2 ant. necto.	P 1565/1
V 5212	IOSN	,,	2 ,, ,,	Gen.Coll.
V 5225	,,	,,	1 ,, ,,	,,
K 1	N. N.	,,	7 ,, ,,	,,
K 2	,,	,,	2 ,, ,,	,,
K 3	,,	400–200	2 ,, ,,	,,
K 4	,,	200–0	6 ,, ,, ; 3 eudox.	,,
K 5	,,	,,	8 ,, ,, ; 6 ,,	,,
K 6	,,	500–0	5 ,, ,,	,,
K 7	,,	,,	6 ,, ,,	,,

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
K 8	N. N.	200–0	14 ant. necto.; 12 eudox.	Gen.Coll.
K 10	,,	,,	5 ,, ,, ; 2 ,,	,,
K 11	,,	,,	1 ,, ,,	,,
K 14	,,	,,	4 ,, ,, ;	,,
K 15	,,	,,	3 ,, ,, ; 5 ,,	,,
K 16	,,	,,	3 ,, ,, ; 2 ,,	,,
K 18	,,	,,	1 ,, ,,	,,
K 19	,,	,,	1 ,, ,, ; 1 ,,	,,
K 20	,,	,,	6 ,, ,, ; 6 ,,	,,
K 23	,,	,,	2 ,, ,, ; 1 ,,	,,
K 31	,,	,,	5 ,, ,,	,,
K 32	,,	,,	3 ,, ,,	,,
K 34	,,	,,	2 ,,	,,
K 35	,,	,,	3 ,, ,,	,,
K 37	,,	,,	3 ,, ,,	,,
K 38	,,	,,	4 ,, ,,	,,
K 39	,,	,,	1 ,, ,, ; 3 ,,	,,
K 41	,,	,,	3 ,,	,,
K 46	,,	,,	2 ,, ,, ; 4 ,,	,,
K 48	,,	,,	1 ,, ,,	,,
K 49	,,	,,	7 ,, ,, ; 2 ,,	,,
K 50	,,	500–200	1 ,, ,,	,,
K 51	,,	200–0	1 ,, ,, ; 7 ,,	,,
K 53	,,	,,	6 ,, ,,	,,
K 54	,,	,,	2 ,, ,, ; 20 ,,	,,
K 56	,,	,,	12 ,, ,, ; 20 ,,	,,
K 58	,,	500–200	2 ,, ,,	,,
K 358	Org. N.	Surface	1 ,, ,,	,,
K 522	,,	70–0	1 ,, ,,	,,
K 529	,,	Surface	1 ,, ,,	,,

(*Note :* Many loose posterior nectophores were present in the collections, but were not counted.)

Type locality.—South Atlantic Ocean, near Cape of Good Hope.

Distribution.—Tropical regions of Atlantic, Pacific and Indian Oceans. For further details *see* Table 1.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, C, an).—These range in length from 3.15 mm to 5.0 mm, with a breadth range from 1.63 mm to 2.3 mm; and a somatocyst ranging in length from 0.5 mm to 0.65 mm. The anterior nectophore has five complete ridges. In the contracted condition, it has a slender pyramidal shape. The hydroecium is usually very shallow, lying below the level of the ostium or sometimes it may be absent. The somatocyst is ovate, slender, with a short stalk and inclined towards the ventral side.

Posterior nectophore (Text-fig. 11, C, pn).—These have a length of 3.75 mm and a breadth of 1.4 mm. The posterior nectophore is nearly of the same length as the anterior one. The articulating end is truncated. The lateral radial canals are apically bent. The mouth-plate is long and broad, with a sharp median notch. Cormidia are about four and are borne on a very much contracted stem.

Eudoxid phase (Text-fig. 11, D).—The bract measures 1.2 mm in length; the gonophore, 1.5 mm in length. The bract is small, conical and has a conical cavity. The posterior edge of the bract is smooth as in *L. subtiloides*. The phyllocyst is slender. The male and female gonophores resemble the posterior nectophore in having a sharp notch in their mouth-plates.

Lensia roonwali Daniel, 1970

(Text-fig. 12, B & C)

Lensia roonwali Daniel, *J. zool Soc. India*, **22** (182) p. 149, fig, 1 b & c.

Material examined.—One example from RV VITYAZ Station no. V 5216 (Lat. 2°03′ S; Long. 91°27′ E) taken by Ichthyological Net in a haul from a depth of 1000 metres to surface.

Diagnosis.—Anterior nectophore very small, with five slightly twisted ridges; right ventral ridge incomplete; dorsal displaced to right. Nectosac large, extending upto tip of nectophore. Somatocyst stalked and minute. Hydroecium very shallow.

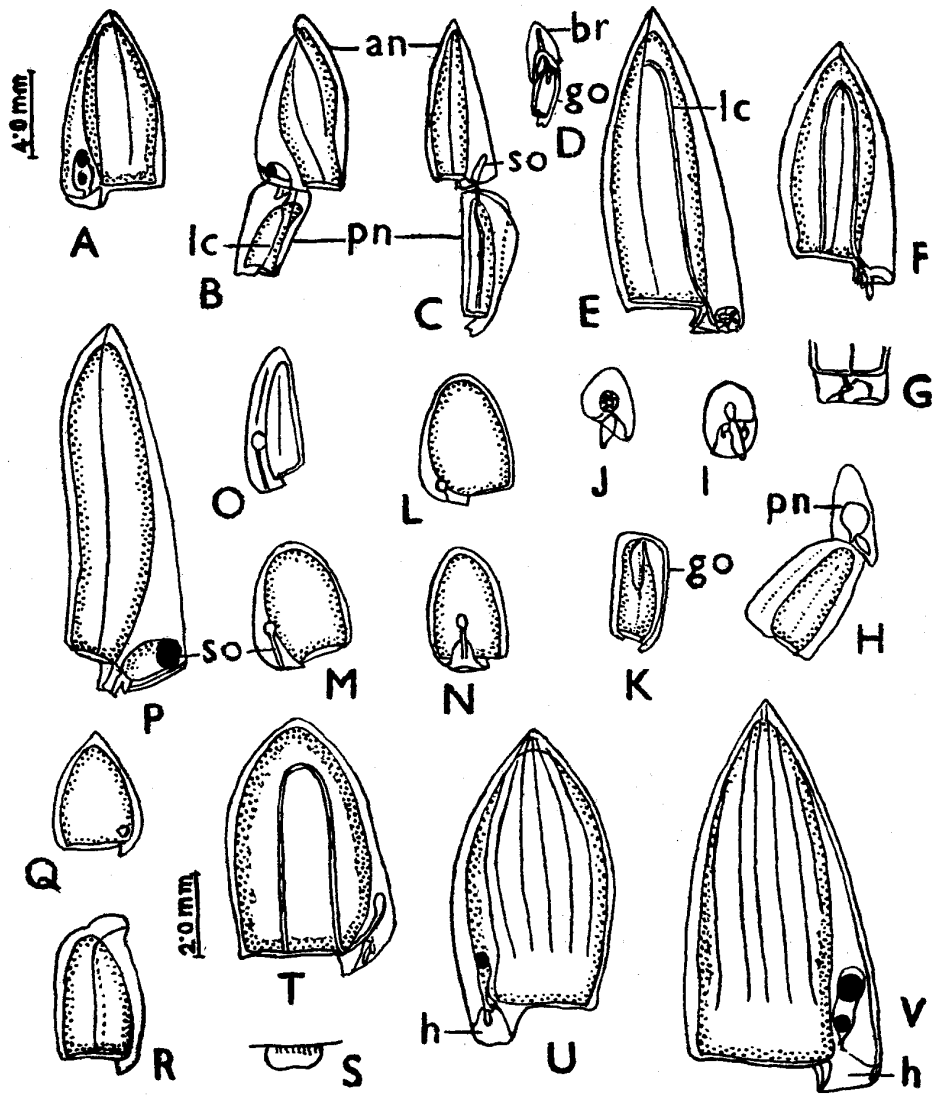
Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, B & C).—The specimen measures 2.5 mm in length, 1:5 mm in breadth and its somatocyst is 0.33 mm long. It has five ridges; the these the dorsal, laterals and the left ventral ridges are complete, extending from apex to base. The right ventral ridge is incomplete. It reaches the base but ends anteriorly near the apex of the nectosac. All these ridges are slightly twisted, therefore the dorsal ridge is displaced towards the right. The nectosac is large, leaving very little mesoglea between the walls of the nectosac and nectophore. The mouth of the nectosac is large, round and wide open. The hydroecium is very shallow (nearly absent). The ventral facet is rounded and slopes upwards. The somatocyst is minute and stalked. There is no basoventral ridge. The stem is contracted. No posterior nectophore is present in the collections.

Remarks.—Of all the thirty valid species, this one resembles *L. campanella* Moser, 1925 in the twisted nature of the ridges. In *L. campanella* the apex of the nectophore is twisted in the preserved condition, the dorsal ridge is vestigeal and the somatocyst is large and globular. In both the forms the mouth-plates are short, the right ventral ridge does not reach the apex and the ventrolateral margin is rounded, but in *L. roonwali* the right ventral ridge does not form the basal ridge at the ventrobasal facet as in *L. campanella*. In general shape, somatocyst and hydroecium it resembles *L. meteori* Leloup, 1934a, but in the latter the nectophore is blunt and lacks proper ridges.

Lensia fowleri (Bigelow, 1911)

(Text-fig. 11, F & H)

1911. *Diphyes fowleri* Bigelow, *Trans. Linn. Soc. Lond. (Zool.)*, **10**, p. 346 pl. 28, fig. 5.
1911. *Diphyes fowleri :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 255, pl. 8 fig. 4; pl. 9, fig. 5.
1918. *Diphyes fowleri :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 422.
1926. *Diphyes fowleri :* Browne, *Trans. Linn, Soc.* Lond. (*Zool.*), (2) **19**, p. 74.
1932. *Lensia fowleri :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 370.
1934. *Lensia fowleri :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 41.
1935. *Lensia fowleri :* Leloup & Hentschel, *Wiss. Ergebn. dtsh. Atlant. Exped.' Meteor.'*, **12**(2), p. 17, carte 13.
1935. *Lensia fowleri :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **7**(11), p. 268.



TEXT-FIGURE 11.

Lensia hunter : A
A—anterior nectophore.
Lensia campanella : B
B—anterior and posterior nectophores intact.
Lensia hotspur : C, D
C—anterior and posterior nectophores intact. D—eudoxid phase.
Lensia challengeri : E, G & P
E—anterior nectophore from Arabian Sea. G—anterior nectophore from Arabian Sea : dorsal view.
P—anterior nectophore from eastern India Ocean.
Lensia fowleri : F, H
F—anterior nectophore. H—eudoxid phase.
Lensia subtilis : I—O
I—bract. J—bract. K—gonophore. L—anterior nectophore with short somatocyst.
M—anterior nectophore with long somatocyst. N—same nectophore, ventral view.
O—anterior nectophore : contracted.

(*Contd. . . p. 137*)

1937. *Lensia fowleri :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H, **2**, pp. 53, 115, fig. 75.

1939. *Lensia fowleri :* Bigelow & Sears, *Mem. Mus. Comp. Zool. Harv.*, **54**(4), p. 368.

1949. *Lensia fowleri :* Moore, *Bull. Bingham Oceanogr. Coll.*, XII(2), p. 21, figs. 44–48.

1950. *Lensia fowleri :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Lensia fowleri :* Totton, *Disc. Rep.*, **27**, p. 110.

1955. *Lensia fowleri :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 16.

1955. *Lensia fowleri :* Leloup, *Inst. Ray. Sci. nat.* Belg., **3**(4), p. 11.

1965. *Lensia fowleri :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 174, text-figs. 112, 113.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5223	J. N.	200–0	1 ant. necto.	P 1688/1
V 5225	IOSN	,,	2 ,, ,,	P 1642/1
K 18	N. N.	,,	2 ,, ,,	Gen.Coll.
K 37	N. N.	200–0	4 ant. necto.; 1 eudox.	Gen.Coll.
K 42	,,	,,	3 ,, ,,	,,
K 50	,,	,,	1 ,, ,, ; 1 ,,	,,
K 529	,,	,,	2 ,, ,, ; 1 ,,	,,

Type locality.—Bay of Biscay.

Distribution.—This species occurs in the tropical and subtropical regions of the Atlantic, Pacific and Indian Oceans, and in the Mediterranean Sea. For details *see* Table 1.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, F).—The anterior nectophore has a length of 8.0 mm, a breadth of 3.7 mm and has a somatocyst which is 0.8 mm long. There are five complete slightly crested ridges. The base of the lateral ridges bend ventrally before reaching the velar end. The ventrobasal region extends well below the level of the ostium. The pear-shaped somatocyst is situated well below the level of the ostium and is horizontal in position. The pedicular canal descends almost vertically. The mouth-plates are broad, as in *L. challengeri*, these are divided, overlap each other and the right one is larger than the other. The hydroecium is shallow and occurs mostly towards the mouth-plate.

Posterior nectophore is not present in the collections.

Eudoxid phase (Text-fig. 11, H).—The bract measures 2.65 mm in length and the gonophore, 3.1 mm. The bract is elongated, unlike the other species of *Lensia*, due to the presence of the neck-shield The apex of the bract is rounded. The phyllocyst is globular in shape The gonophore is small and the mouth-plate appears to be absent.

Lensia meteori : Q—T
QL—anterior nectophore from Arabian Sea. R—posterior nectophore from same sample.
S—posterior nectophore from same sample : mouth-plate.
T—anterior nectophore from eastern Indian Ocean.
Lensia ajax : U, V
U—anterior nectophore from Arabian Sea. V—anterior nectophore from eastern Indian Ocean.
Abbreviations used :
an—anterior nectophore. br—bract. go—gonophore. h—hydroecium. lc—lateral radial canal.
m.pl.—mouth-plate. ph—phyllocyst. pn—posterior nectophore. so—somatocyst.

Lensia challengeri Totton, 1954

(Text-fig. 11, E, G & P)

1941. *Lensia hotspur* Totton, *Ann. Mag. nat. Hist.* London, (11) **8**, p. 154, fig. 13 (in part).

1954. *Lensia challengeri* Totton, *Disc. Rep.*, **27**, p. 111, figs. 54A & B.

1965. *Lensia challengeri :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 166, text-figs. 102A & B.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5209	I.K.T.	120–70	1 ant. necto.*	Gen.Coll.
V 5225	IOSN	200–0	1 ,, ,,	P 1634/1
V 5227	I.K.T.	150–100	1 ,, ,, *	Gen.Coll.
K 6	N. N.	500–200	2 ,, ,,	,,
K 8	,,	75–0	1 ,, ,,	,,
K 15	,,	200–0	1 ,, ,,	,,
K 20	,,	,,	1 ,, ,,	,,
K 41	,,	,,	1 ,, ,,	,,
K 49	,,	,,	1 ,, ,,	,,
K 53	,,	500–200	1 ,, ,,	,,
K 58	,,	200–0	1 ,, ,,	,,

(* from the Sonic Scattering Layer.)

Type locality.—Southern California (Lat. 23°51′N; Long. 112°59′W).

Holotype.—British Museum (Nat. Hist.) Reg. no. 1953, 8.11.1.

Distribution.—Between 21°41′N & 31°12′N and 111°43′W & 117°31′W, North Pacific, south Atlantic. The present record is the first record from the Indian Ocean.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, E, G & P).—The anterior nectophore has a length ranging from 6.1 mm to 8.0 mm, a breadth ranging from 2.0 mm to 3.4 mm, and has a somatocyst measuring 1.0 mm to 1.2 mm in length. It is long and slenderly pyramidal. Five complete ridges are present. Somatocyst is spherical or egg-shaped and lies at the level of the ostium. It is inclined towards the ventral wall, almost touching it. The hydroecium does not extend to the ventral side. The ventrobasal margin is slightly oblique. The mouth-plates are broad, divided and overlapping; the mouth-plate on the left is broader than its fellow. The pedicular canal is descending.

The posterior nectophore and the eudoxid phase are not present in the collections.

Lensia leloupi Totton, 1954

(Text-fig. 10, Q & R)

1954. *Lensia leloupi* Totton, *Disc. Rep.*, **27**, p. 113, fig. 55C.

1965. *Lensia leloupi* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 161, text-fig. 97Z.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5225	IOSN	200–0	1 ant. necto.	P 1640/1
V 5232	Pl. N.	Surface	1 ,, ,, ; 1 post. necto.	P 1729/1
K 3	N. N.	400–200	1 complete specimen	Gen.Coll.
K 50	,,	200–0	1 ant. necto.	,,
K 522	,,	70–0	4 ,, ,, ; 1 post. necto.	,,

Type locality.—Cape Lopez, Gulf of New Guinea (not far from the mouth of Ogowe River).

Holotype.—in British Museum (Nat. Hist.) Reg. no. 1952.11.19.1.

Distribution.—Gulf of New Guinea; eastern Indian Ocean and Arabian Sea (present record : first record from Indian Ocean).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, Q).—The anterior nectophore is 6.55 mm in length, 3.4 mm in breadth, has a somatocyst 1.7 mm in length, with hydroecium measuring 0.7 mm in length. It resembles *L. subtiloides;* it has five prominent ridges of which the lateral ones do not reach the ostium of the nectosac but terminate just above the base. The lateral ridges occur more toward the dorsal side, such that the lateroventral facets are large and broadly triangular in shape. The somatocyst is nearly $\frac{1}{3}$rd the length of the nectosac and is upright in position. It is not inclined as in *L. subtiloides.* The hydroecium is as in *L. subtiloides,* but it is more conical and deeper than in the latter. The nectosac is highly transparent and extends upto the apex of the nectophore. The mouth-plates are larger than in *L. subtiloides;* they are rounded, divided and overlapping.

Posterior nectophore (Text-fig. 10, R).—It measures 7.6 mm in length, 4.4 mm in breadth. A specimen taken from RV VITYAZ Station no. V 5232 along with an anterior nectophore, probably belongs to this species since no other species of *Lensia* occurred in the sample taken there. It appearance it resembles the anterior nectophore in being highly transparent and broad. The mouth-plate is large, undivided and flap-like. Its edge is smooth, without a notch in the middle. The lateral radial canals are apically bent.

Lensia panikkari Daniel, 1970

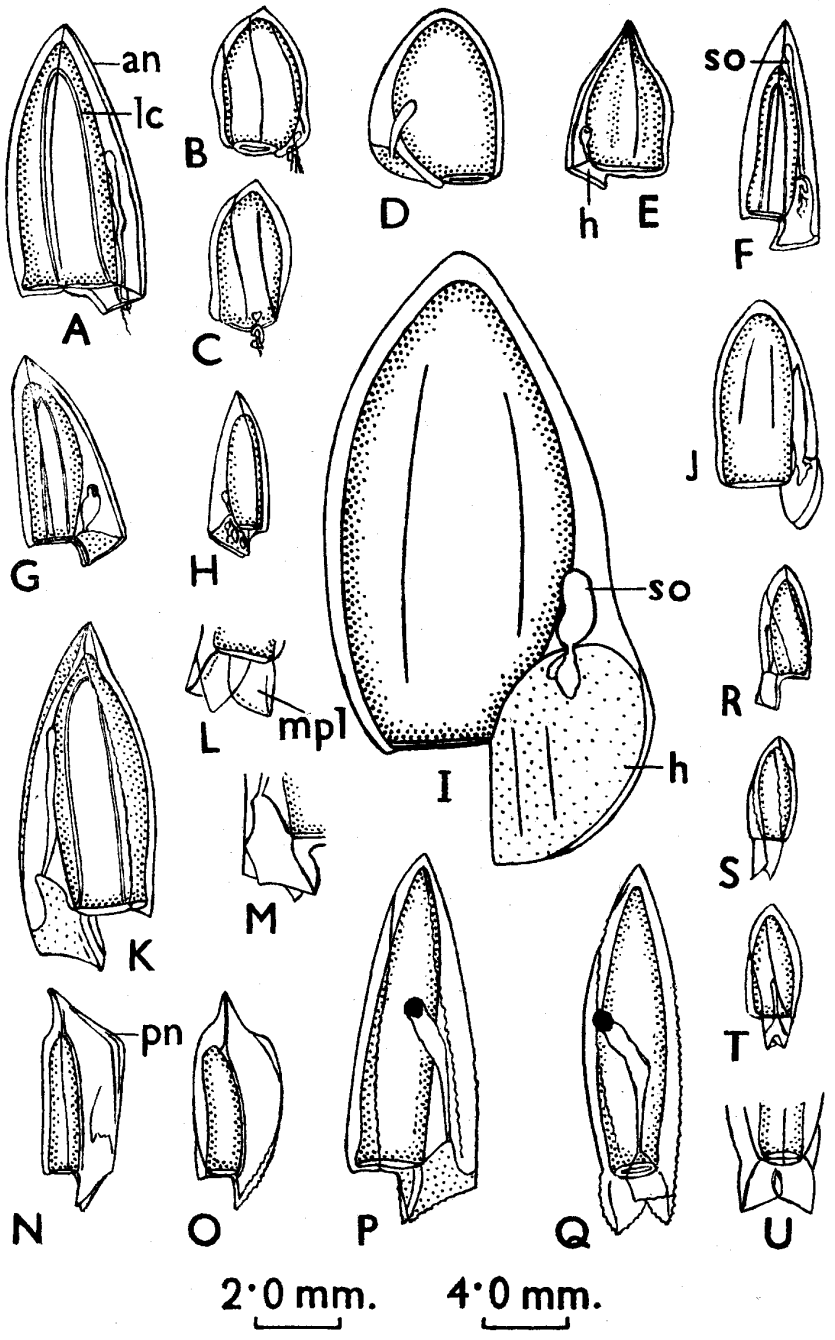
(Text-fig. 12, A)

1970. *Lensia panikkari* Daniel, *J. zool. Soc. India,* **22**, (1 & 2), p. 150, fig. 1sd.

Material examined.—One example from RV VITYAZ Station no. V 5193 (Lat. 32°48′S; Long. 103°58′E) taken in a haul from 1,000 metres to surface using the Ichthyological Net.

Diagnosis.—Anterior nectophore long, slenderly pyramidal, five prominent faintly crested ridges, laterals not reaching base, somatocyst long, reaching more than half the length of nectosac; hydroecium shallow, conical and occurring below level of ostium.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, A).—The anterior nectophore measures 9.7 mm in length, 4.5 mm in breadth and has a somatocyst measuring 5.1 mm in length, and an hydroecium 0.83 mm in length. It is long and slenderly pyramidal, having five prominent faintly crested ridges. All the ridges meet



TEXT-FIGURE 12

Lensia panikkari : A
A—anterior nectophore.
Lensia roonwali : B, C
B—anterior nectophore. C—anterior nectophore : ventral view.
Lensia tiwarii : D
D—anterior nectophore

(*Contd. . . p. 141*)

at the apex. The lateral ridges alone do not reach the base *i.e.*, velar or ostial level. The ventral facet is narrow. The somatocyst is long measuring more than half the length of the nectosac, thin and club-shaped. It lies close against the nectosac. The hydroecium is shallow, occurring below the velar level and is conical in shape. The mouth-plates are prominent, slightly rounded and overlapping The basoventral ridge is short.

The stem and the posterior nectophores are not present in the collections.

Remarks.—Among the thirty valid species of the genus *Lensia*, the present species resembles *L. leloupi* Totton, 1954 and *L. tottoni* Daniel & Daniel, 1963a, in respect of the lateral ridges not reaching the velar level. It differs from these other species in possessing a long somatocyst and a narrow ventral facet. *Lensia panikkari* is probably the same as the *Lensia* sp. indet. described by Totton (1932) from the Great Barrier Reef Expedition Station no. 50, outside Papuan Pass.

Lensia nagabhushanami Daniel, 1970

(Text-fig. 12, E)

1970. *Lensia nagabhushanami* Daniel, *J. zool. Soc. India*, **22**, (1 & 2) p. 150, fig. 1 f.

Material.—One example from INS KISTNA Cruise no. III, Station no. K 26, (Lat. 8°0′N; Long. 63°0′E; on 30.11.1962) by a Nansen Net haul from 200 metres to surface.

Distribution.—Arabian Sea (Indian Ocean).

Diagnosis.—Nectophore with five ridges, laterals not meeting velar edge; nectosac produced apically into a blunt extension.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, E).—It has a length of 8.5 mm and a breadth of 5.0 mm; the somatocyst measures 1.7 mm in length; the nectosac is 7.2 mm long, and the hydroecium is 0.9 mm long. It has a pointed tip, bulged middle region and a broad ostium. There are five prominent ridges which reach the apex. Of these, the lateral ridges do not meet the velar edge or ostium. On either side of the ridges on both sides of the nectophore, there are two shallow (vestigeal ridges) depressions or folds (Text-fig. 12, E). The apex of the nectosac is produced into a blunt, narrow extension which reaches up to the tip of the nectophore. It is bulged in the

Lensia nagabhushanami : E
E—anterior nectophore.
Muggiaea atlantica : F
F—anterior nectophore.
Muggiaea delsmani : G, H
G—anterior nectophore from Madras coast. H—anterior nectophore from Puri coast.
Dimophyes arctica : I, J
I—anterior nectophore from eastern Indian Ocean. J—anterior nectophore from Arabian Sea.
Chelophyes appendiculata : K—N
K—anterior nectophore. L—anterior nectophore : mouth plates. M—anterior nectophore : side view.
N—posterior nectophore : side view.
Chelophyes contorta : O—Q
O—posterior nectophore : lateral view. P—anterior nectophore. Q—anterior nectophore : ventral view.
Eudoxoides spirlais : R—U
R—anterior nectophore : lateral view. S—anterior nectopphore : dorsal view.
T—anterior nectophore : ventral view. U—anterior nectophore : mouth-plates.
Abbreviations used :
an—anterior nectophore. h—hydroecium. lc—lateral radial canal.
m.pl—mouth-plate. pn—posterior nectophore. so—somatocyst.

middle region and slightly narrower near the ostium. The ostium is broad. The somatocyst is about $\frac{1}{4}$th the length of the nectosac, stalked and club-shaped. It occurs in close contact with the nectosac which is curved according to the shape of the somatocyst. The hydroecium is conical in shape and the apex lies in close contact with the base of the nectosac. It does not extend beyond the velar level. The ventrobasal ridge is slightly oblique. The mouth-plates are medium-sized with rounded overlapping margins.

Remarks.—Of the thirty valid species belonging to the genus *Lensia*, the present one resembles *L. leloupi* Totton, 1934a, *L. tottoni* Daniel & Daniel, 1963a and *L. panikkari* in possessing five ridges of which the laterals do not reach the velar edge. The somatocyst of *L. tottoni* and *L. panikkari* are entirely different. This species resembles *L. leloupi* in its somatocyst and hydroecium; but differs from it in the shape of its nectosac which narrows apically into a blunt tube, and in possessing four longitudinal folds.

Lensia campanella (Moser, 1925)

(Text-fig. 11, B)

1925. *Galeolaria campanella* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 152, pl. IV, figs. 1, 2.
1932. *Lensia campanella :* Totton, *Sci. Rep. Gr. Barrier Reef. Exped.*, **4**, p. 368, text-figs. 35, 36.
1934. *Lensia campanella :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 40, (bibl.).
1935. *Lensia campanella :* Leloup & Hentschel, *Wiss. Ergebn dtsch. Atlant. Exped. 'Meteor'*, **12**(2), p. 17, carte 13.
1935. *Lensia campanella :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef. Exped.*, **7**(11), p. 268.
1950. *Lensia campanella :* Sears, *J. Mar. Res.* **9**(1), p. 3.
1954. *Lensia campanella :* Totton, *Disc. Rep.*, **27**, p. 16.
1955. *Lensia campanella :* Leloup, *Inst. Roy. Sci. nat. Belg.*, **3**(4), p. 15.
1965. *Lensia campanella :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 165, pl. XXXI, fig. 4; text-fig. 100.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5217	J. N.	200–0	2 ant. necto.	P 1575/1
K 5	N. N.	,,	1 ,, ,,	Gen.Coll.
K 6	,,	,,	2 ,, ,,	,,
K 7	,,	,,	1 ,, ,,	,,
K 9	,,	,,	2 ,, ,, ; 2 post. necto.	,,
K 14	,,	,,	3 ,, ,, ; 1 ,, ,,	,,
K 20	,,	,,	1 ,, ,,	,,
K 22	,,	,,	2 ,, ,,	,,
K 23	,,	,,	3 ,, ,, ; 1 ,, ,,	,,
K 34	,,	75–0	1 ,, ,,	,,
K 37	,,	200–0	3 ,, ,, ; 1 ,, ,,	,,
K 38	,,	,,	1 ,, ,,	,,
K 41	,,	,,	1 ,, ,, ; 1 ,, ,,	,,
K 44	,,	,,	1 ,, ,,	,,
K 48	,,	,,	2 ,, ,,	,,
K 49	,,	,,	3 ,, ,, ; 1 ,, ,,	,,
K 53	,,	,,	2 ,, ,,	,,
K 54	,,	,,	1 ,, ,,	,,
K 56	,,	,,	1 ,, ,,	,,

Type locality.—Tropical Atlantic (?)

Distribution.—This species occurs in the tropical regions of the Atlantic, Pacific and Indian Oceans (*see* Table 1 for details).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, B,an).—It has a length of 3.0 mm, a breadth of 1.5 mm, and has a somatocyst measuring 0.5 mm in length. It is very small and the apex is characteristically twisted (about half a complete turn). The apex of the nectophore is blunt, the dorsal ridge is vestigeal; the laterals and the left ventral ridges are long and research the base but terminate near the twisted end of the nectophore. The right ventral ridge does not reach the apex but forms a continuous ridge at the base (resembling the letter 'L'). This basal ridge is incomplete and does not join the left ventral ridge but ends in the mid-region. The ventrobasal facet shows hardly any hydroecial cavity and slopes off at about 45° into the ventral facet. The nectosac shows well developed musculature. The somatocyst is short, oblique, globular or club-shaped. The mouth-plates are very small and divided.

Posterior nectophore (Text-fig. 11, B, pn).—It has a length of 2.1 mm and a breadth of 1.25 mm. It has a truncated proximal end and the ridges are hardly visible. The lateral radial canals are of the typical *Lensia*-type, with the slight bend in the apical half. The mouth-plate is small and rounded in shape. The apex of the nectosac is flat.

Cormidia.—The stem is very much contracted, and details are not distinguishable.

Eudoxid phase.—Not yet identified.

Lensia cossack Totton, 1941

(Text-fig. 10, T)

1926. *Diphyes subtiloides* Browne, *Trans. Linn. Soc. Lond.* (*Zool.*), (2) **19**, p. 76.
1941. *Lensia cossack* Totton, *Ann. Mag. nat. Hist.*, London, (11) **8**, p. 150, figs. 8, 9.
1954. *Lensia cossack :* Totton, *Disc. Rep.*, **27**, p. 112.
1963. *Lensia cossack :* Daniel & Daniel, *J. mar. biol. Assoc. India*, **5**(2), p. 202, fig. V, 1.
1965. *Lensia cossack :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 166, text-fig. 101A.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5185	J. N.	200–0	1 ant. necto.	Gen.Coll.
K 8	N. N.	,,	1 ,, ,,	,,
K •35	,,	,,	1 ,, ,,	,,
K 36	,,	,,	1 ,, ,,	,,
K 39	,,	,,	1 ,, ,,	,,
K 56	,,	500–200	2 ,, ,,	,,
K 378	Org. N.	Surface	1 ,, ,,	,,

Type locality.—RV DISCOVERY II Station 100 (Lat. 33°20′S; Long. 15°18′E), in south Atlantic near Cape of Good Hope.

Distribution.—This species occurs in the tropical and subtropical regions of the Atlantic, Pacific and Indian Oceans (*see* Table 1 for details).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, T).—It has a length ranging from 3.1 mm to 5.5 mm and a breadth ranging from 1.83 mm to 3.0 mm.

The somatocyst ranges from 1.3 mm to 2.0 mm in length. It has a blunt apex and a smooth bulged appearance. The specimens in the collection have only half the length of the Atlantic forms described by Totton (1941). There are found longitudinal ridges which are incomplete and vestigeal. These ridges appear like folds on the surface of the nectophore. The ventrobasal facet is oblique and horse-shoe shaped. The middle region of the ventrobasal facet projects below the level of the ventrobasal ridge and therefore the hydroecium is completely absent. The mouth-plates are very short and divided. The somatocyst is oblong in shape and has a short stalk. It measures about $\frac{1}{3}$rd the length of the nectophore.

The posterior nectophore and the stem are not present in the collection.

Eudoxid phase.—Not identified so far.

Lensia subtilis (Chun, 1886)

1885. *Monophyes irregularis* Chun, *S. B. preuss. Akad. Wiss.* for 1885, p. 513 (in part), figs. 3–5, (non Claus 1874)—posterior nectophore.
1886. *Diphyes subtilis* Chun, *S. B. preuss. Akad. Wiss.* for 1886, p. 681.
1888. *Cuculus subtilis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 111 (eudoxid).
1888. *Monophyes diptera* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 129.
1897. *Diphyes subtilis :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 47.
1898. *Diphyes elongata* Schneider, *Zool. Anz.*, **21**, p. 85 (non Hydman, 1841).
1908. *Diphyes subtilis :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 47.
1911. *Diphyes subtilis :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 347.
1925. *Galeolaria subtilis :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 162, pl. IV, figs. 5–8.
1926. *Galeolaria subtilis :* Browne, *Trans. Linn. Soc. Lond., (Zool.)*, (2) **19**, p. 70.
1932. *Lensia subtilis :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 367, text-fig. 34.
1934. *Lensia subtilis :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 31.
1935. *Lensia subtilis :* Leloup, *Bull. Mus. Hist. nat. Belg.* **11**(31), p. 9.
1935. *Lensia subtilis :* Leloup & Hentschel, *Wiss. Ergebn. dtsch atlant. Exped. 'Meteor'*, **12**(2), p. 14, carte 12.
1935. *Lensia subtilis :* Leloup & Hentschel, *Wiss. Ergebn. dtsch atlant. Exped. 'Meteor'.*, **12**(2), p. 14, carte, 12.
1935. *Lensia subtilis :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **7**(11), p. 267.
1949. *Lensia subtilis :* Moore, *Bull. Bingham Oceano. Coll.* XII(2), p. 20, figs. 41–43.
1950. *Lensia subtilis :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1954. *Lensia subtilis :* Totton, *Disc. Rep.*, **27**, p. 114, text-figs. 57–59.
1955. *Lensila subtilis :* Leloup, *Inst. Roy. Sci. nat. Belg.*, **3**(4), p. 12.
1965. *Lensia subtilis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 168, text-figs. 104, 105.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5198	J. N.	200–0	2 ant. necto.; 1 post. necto.	Gen.Coll.
K 5	N. N.	,,	1 ,, ,,	,,
K 6	,,	,,	2 ,, ,,	,,
K 7	,,	,,	1 ,, ,,	,,
K 16	,,	,,	1 ,, ,,	,,
K 23	,,	,,	1 ,, ,, ; 1 ,, ,,	,,

Type locality.—Mediterranean.

Distribution.—This species occurs in the tropical and temperate regions of the Atlantic, Pacific and Indian Oceans (for details of localities *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, L, M, N & O).—These have a length ranging from 2.5 mm to 3.0 mm, and a breadth ranging from 1.1 mm to 2.0 mm; and have a somatocyst measuring from 0.75 mm to 1.5 mm in length. The anterior nectophore has a blunt apex. All the ridges—probably two or four—are vestigeal; the lateral ridges are short not reaching the apex or base and appear as folds on the surface of the contracted specimens. The ventrobasal margin of the nectophore is oblique and therefore the nectophore has a smooth rounded base. The somatocyst is long, having a thin, threadlike stalk and a globular tip. Except in length, this feature never varies and is therefore considered as an important diagnostic character. The mouth-plates are very small, rounded and overlapping. There is no hydroecium.

Posterior nectophore.—These measure 2.3 mm in length and 1.05 mm in breadth. The nectophore is truncated anteriorly and the pedicular canal lies below the apex of the nectosac. The lateral radial canals are apically bent. The mouth-plate is small and rounded.

Cormidia.—Not present in the collections.

Eudoxid phase (Text-fig. 11, I, J & K).—The bract measures 1.5 mm in length and the gonophore is 2.25 mm long. The bract is small, smooth, blunt and rounded in shape. The bracteal cavity is shallow. The phyllocyst is short, club-shaped or globular. The gonophore resembles the posterior nectophore in size and shape of the mouth-plate. The manubrium bears about 16 ova.

Lensia meteori (Leloup, 1934)

(Text-fig. 11, Q, R, S & T)

1934. *Galetta meteori* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 15, fig. 6.
1937. *Galetta meteori* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, pp. 56, 118.
1954. *Lensia meteori* Totton, *Disc. Rep.*, **27**, p. 117, text-fig. 60.
1965. *Lensia meteori* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 170, text-fig. 107.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5216	Ich. N.	1000–0	4 ant. necto.; 1 post. necto.	P 1592/1
K 7	N. N.	200–0	1 ,, ,, ; 1 ,, ,,	Gen.Coll.
K 7	,,	500–200	1 ,, ,,	,,
K 538	—	—	1 ,, ,,	,,

Type locality.—Cape Vert, Freetown (West Africa).

Distribution.—This species occurs in the tropical and temperate regions of the Atlantic and Indian Oceans (*see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, Q & T).—The nectophores have a length ranging from 2.0 to 4.17 mm, and breadth ranging from 1.4 mm to 2.67 mm; and have a somatocyst ranging from 0.3 mm to 1.1 mm. These nectophores are very minute and appear like tiny, delicate, round bubbles. There are no ridges. The apex is blunt, but sharper than in *L. subtilis*. The mouth of the nectophore is wide open giving the nectophores a bulged basal end. The nectosac is large and

bulged so that very little mesoglea is present between the walls of the nectophore and nectosac. The somatocyst is very small with a threadlike stalk and a globular or kidney-shaped tip. It is situated at the basal corner of the nectosac. The canals are the usual diphyid type. The mouth-plates are small, rounded and overlapping. The ventrobasal margin is slightly oblique. The hydroecium is very shallow and sloping upwards on the ventral side.

The stem is missing from the nectophore.

Posterior nectophore (Text-fig. 11, R & S).—A single specimen was taken from INS KISTNA Station no. K 7, along with a single anterior nectophore which resemble each other in their bulged transparent bubble-like appearance and rounded ostium. The anterior end is truncated, but has a small peg-like extension on one side. It is slightly longer than the anterior nectophore, measuring 2.5 mm in length and 1.5 mm in breadth. A similar loose posterior nectophore was sorted out from RV VITYAZ Station no. V 5216. These posterior nectophores probably belong to this species.

Lensia tiwarii Daniel, 1970

(Text-fig. 12, D)

1970. *Lensia tiwarii* Daniel, *J. zool. Soc. India*, **22**, (182), p. 151, fig. 1c.

Material examined.—A single nectophore was taken in a haul at RV VITYAZ Station no. V 5216 from a depth of 1,000 metres to surface by the Ichthyological Net.

Type locality.—Lat. 2°03′S; Long. 91°27′E (Indian Ocean).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, D).—This specimen has a length of 2.9 mm and a breadth of 2.26 mm; the somatocyst measures 1.0 mm. The anterior nectophore has a smooth, rounded appearance. The apex of the nectophore is rounded and the nectosac is also rounded. The nectosac is large and its wall lies close to that of the nectophore, and therefore there is very little mesoglea present between the walls of the nectosac and the nectophore except in the ventrobasal corner; the ventrobasal edge is rounded and has a sloping margin. The somatocyst is slender, uniformly thick and has a short stalk; and it arises from the middle of a very shallow hydroecium and is inclined over the nectosac. The ventral side of the hydroecium is on a higher level than the ostium of the nectosac. The mouth-plates are very small and lie close to the ventral corner of the nectosac. The stem and the posterior nectophores are missing.

Remarks.—Of all the valid species of *Lensia*, this new species *L. tiwarii* is close to *L. subtilis* in general appearance but differs from it in the shape and location of the somatocyst and in its peculiar hydroecium.

Lensia multicristata (Moser, 1925)

(Text-fig. 10, S)

1925. *Galeolaria multicristata* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 165, pl. 111, fig. 9.
1926. *Diphyes bigelowi* Browne, *Trans. Linn. Soc. Lond. (Zool.)*, (2) **19**, p. 77.
1932. *Lensia multicristata :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 364.
1933. *Lensia multicristata :* Leloup, *Res. Camp. Sci. Monaco.*, **87**, p. 36.
1934. *Lensia multicristata :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 33.
1934. *Lensia multicristata :* forme *typica* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 34, fig. 8.
1936. *Lensia multicristata :* Totton, *Zoologica*, N.Y., **21**(4), p. 235.

1936. *Lensia profunda* Totton, *Zoologica*, N.Y., **21**(4), p. 235.

1937. *Lensia multicristata :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology* H. **2**, pp. 55, 118, figs. 40–44, 47.

1950. *Lensia multicristata :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Lensia multicristata :* Totton, *Disc. Rep.*, **27**, p. 110.

1955. *Lensia multicristata :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 11.

1965. *Lensia multicristata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 164, text-fig. 99D.

Material examined.—A total of three anterior nectophores were taken one each from INS KISTNA Station nos. K 7, K 20 & K 26 respectively, in hauls made from 200 metres to surface using a Nansen's Net.

Type locality.—Tropical Atlantic (?)

Distribution.—This species occurs in the subtropical and tropical regions of the Atlantic, Pacific and Indian Oceans (*see* Table 1 for further details).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 10, S).—These have a length ranging from 4.87 mm to 7.0 mm; in breadth they range from 2.0 mm to 3.25 mm; the somatocyst ranges in length from 1.67 mm to 2.0 mm. The anterior nectophore has seven longitudinal ridges—one dorsal, two dorsolaterals, two ventrolaterals, and two ventral ridges; the dorsal ridge is complete, reaching both apex and base; the dorsolateral ridges originate from the apex but do not reach the velar margin and terminate just above it; the ventrolaterals reach neither the apex nor the basal margin; the ventral ridges are complete. The basal margin of the ventral facet is rounded. The hydroecium is shallow, lies below the level of the ostium. The somatocyst is long, slenderly club-shaped, with threadlike stalk and lies close against the nectosac. The mouth-plates are divided, rounded and they overlap.

The cormidia and the posterior nectophore are not present in the collections.

Lensia hunter Totton, 1941

(Text-fig. 11, A)

1941. *Lensia hunter* Totton, *Ann. Mag. nat. Hist.* Lond. (11) **8**, p. 154, figs. 11, 12.

1954. *Lensia hunter :* Totton, *Disc. Rep.*, **27**, p. 16.

1965. *Lensia hunter :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 164, text-fig. 101 B, C.

Materia examined.—A single anterior nectophore was taken at RV VITYAZ Station no. V 5193 in a haul from 1,000 metres to surface using an Ichthyological Net.

Z.S.I. Registered no. P 1733/1.

Type locality.—Carnegie Cruise VII, Station no. 64 (Lat. 31°54′S; Long. 88°17′W) from a depth of 1,000 metres.

Distribution.—South Atlantic Ocean; off south & east coasts of Africa; south-east Indian Ocean; present record is from the eastern Indian Ocean (for details *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, A).—The nectophore has a length of 9.7 mm; a breadth of 5.6 mm; the hydroecium is 0.7 mm long and the somatocyst measures 2.4 mm in length. The nectophore is characterized by the presence of seven ridges—one dorsal, two dorsolaterals, two ventrolaterals, and two ventral ridges, as in *L. multicristata*. The dorsal ridge is complete from apex to base of ostium;

the dorsolaterals are incomplete, *i.e.*, they join the apex but do not reach the velar or ostial level, they terminate well above the velar edge; the two ventrolateral ridges are also incomplete and do not reach the apex but extend down to the lateral edges of the mouth-plates. The two ventral ridges are complete. The somatocyst is slightly irregular in shape and stalked. The ventral wall of the hydroecium is oblique and slopes down towards the somatocyst. The hydroecium is shallow and lies below the level of the ostium. The nectosac is bulged in the middle and has a narrow ostium.

The stem and the posterior nectophore are not present in the collections.

Lensia ajax Totton, 1941
(Text-fig. 11, U & V)

1941. *Lensia ajax* Totton, *Ann. Mag. nat. Hist.* Lond. (11) **8**, p. 147, figs. 4, 5.

1954. *Lensia ajax :* Totton, *Disc. Rep.*, **27**, p. 16.

1965. *Lensia ajax :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 179, fig. 118.

Material examined.—Two nectophores (anterior) were examined; one each being taken in hauls made from 200 metres to surface at RV VITYAZ Station no. V 5227 and INS KISTNA Station no. K46, using a Juday Net and Nansen's Net respectively.

Type locality.—33°20′S; 15°18′E; RV DISCOVERY Station no. 100.

Distribution.—South Atlantic; off south and east coasts of Africa; present record from eastern Indian Ocean and Arabian Sea.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 11, U & V).—The measurements of the specimens taken in the KISTNA and VITYAZ hauls are given below :

	KISTNA specimen	VITYAZ specimen
Length ..	10.33 mm	13.00 mm
Breadth ..	5.00 ,,	6.60 ,,
Hydroecium ..	1.33 ,,	1.40 ,,
Somatocyst ..	1.67 ,,	2.73 ,,

This is a multicristate form having five groups of ridges, each group consisting of 2–4 longitudinal crests or ridges. The velar ridge is not present; the lateral ridges are four in number of which two ridges in the VITYAZ specimen and three in the KISTNA one, reach the apex. All the ridges terminate well above the ostium. The ridges occurring between the lateral groups and the first ventral ridge on either side, are very short and vestigeal in the VITYAZ specimen. In the KISTNA specimen it is long and does not reach the apex, but touches the mouth-plates. On the dorsal side there are three ridges, of which only the middle one reaches the apex. The ventral group consists of two or three ridges and two are seen to reach the apex. There are altogether about 15 ridges; of these, 7–9 reach the apex. Except for the two ventrolateral ridges—which reach the mouth-plates—all the others stop short of the base, terminating well above the ostial level. The nectophores have a bulged appearance in the middle. In both specimens, the nectosac is large, bulged and occupies almost the entire space leaving little mesoglea in between the walls of the nectosac and nectophore. Both specimens are very transparent. The somatocyst is short, stalked, club-shaped and has one or two oil-globules. The hydroecium does not extend above the level of the ostium but is fairly deep, for the "*Lensia*-group" of diphyids due to the presence of large, broad, divided and overlapping mouth-plates.

The posterior nectophore and the eudoxid phase of this species are not identified so far.

Remarks.—The present specimens are larger than the type material described by Totton (1941) from the Atlantic Ocean. It is seen that the number of ridges in each group varies from specimen to specimen. It would be worthwhile to study the extent of this variation when more material is available.

Genus **Muggiaea** Busch, 1851

1851. *Muggiaea* Busch, *Beoback tungen iiben anatomie....Seethierre*, p. 48.

Diphyinae with small pentagonal, five-ridged anterior nectophore (except in *M. bargmannae* Totton) which lacks ostial teeth, Mouth-plates broad, rounded, divided and overlapping, its basolateral angle not produced. Hydroecium deep, placed against nectosac. Somatocyst variable in length. Posterior nectophore never developed.

Four species of *Muggiaea* were recognized prior to Bigelow's time : *M. kochii* (Will, 1844) Chun (= *M. pyramidalis* Busch = *Monophyes primordialis* Chun); *M. pyramidalis* Haeckel, 1888; *M. (Cymbonectes) huxleyi* (Haeckel, 1888) and *M. atlantica* Cunningham, 1892. Neither Chun (1892) nor Schneider (1898) recognized *M. pyramidalis* Haeckel as distinct from *M. kochii*. The validity of *M. huxleyi*, known from one record only, was doubted by Bigelow. Therefore he considered only two valid species of *Muggiaea : M. kochii* and *M. atlantica* on the basis of the length of the somatocyst and the hydroecium. Two more species were added by Totton (1954) : *M. delsmani*, from Java Sea and *M. bargmannae* from the Arctic and Antarctic Oceans.

Type species.—*Muggiaea kochii* (Will, 1844).

Key to species of *Muggiaea*

1.	Nectophore with short somatocyst	2
	Nectophore with long somatocyst	3
2.	Nectophore with short somatocyst; hydroecium sharply conical	*kochi*
	Nectophore with shorter somatocyst; hydroecium shallower with upper wall nearly horizontal	*delsmani*
3.	Nectophore with long narrow somatocyst extending beyond apex of nectosac; deep hydroecium	*atlantica*
	Nectophore with rounded apex; somatocyst tubular to sausage-shaped, reaching more than half length of the nectosac; shallow hydroecium	*bargmannae*

Of these, *M. atlantica* and *M. delsmani* are present in the collections.

Muggiaea atlantica Cunningham, 1892

1888. *Muggiaea pyramidalis** Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 137 (non Busch, 1851).

1888. *Cucubalus pyramidalis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 109 (eudoxid).

1892. *Muggiaea atlantica :* Cunningham, *J. mar. biol. Ass. U.K.* (*N.S.*), **2**(3), p. 214.

1905. *Muggiaea atlantica :* Gough, *Pub. Circ. cons. Explor. Mer.* **29**, p. 1.

1906. *Muggiaea atlantica :* Vanhoeffen, *Nordisches Plankton*, **5**(11), p. 13.

1930. *Muggiaea atlantica :* Bigelow & Leslie, *Bull. Mus. Comp. Zool. Harv*,. **70**, p. 550.

* Specific name *pyramidalis* Haeckel is preoccupied for *M. kochi* Busch, 1851.

1934. *Muggiaea atlantica :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 21, (bibl.).

1934. *Muggiaea atlantica :* Russell, *J. mar. biol. Ass. U.K.*, **19**, p. 555.

1935. *Muggiaea atlantica :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlant. Exped. 'Meteor'*, **12**()2, p. 8, carte 4.

1937. *Muggiaea atlantica :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, pp. 39, 99, fig. 71.

1938. *Muggiaea atlantica :* Russell, *J. mar. biol. Ass. U.K.*, **22**, p. 441, figs. 1–6.

1939. *Muggiaea atlantica :* Bigelow & Sears, *Mem. Mus. Comp. Zool. Harv.*, **54**(4), p. 367.

1954. *Muggiaea atlantica :* Totton, *Disc. Rep.*, **27**, p. 120.

1955. *Muggiaea atlantica :* Leloup, *Rep. Sci. res. ''Michael Sars'' north atlantic deep sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 9.

1955. *Muggiaea atlantica :* Leloup, *Inst. Roy. Sci. nat. Belg.*, **3**(4), p. 14.

1965. *Muggiaea atlantica :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 181, text-fig. 119B; pl. XXXII, fig. 3.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
K 14	N. N.	200–0	4 ant. necto.	Gen.Coll.
K 44	,,	,,	1 ,, ,,	,,
K 48	,,	,,	4 ,, ,,	,,
K 49	,,	,,	5 ,, ,,	,,

Type locality.—Off Plymouth (English Channel).

Distribution.—This is a neritic species occurring along the slopes of the continental shelf of the temperate and tropical regions of the Atlantic, Pacific and Indian Oceans (*see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, F).—The nectophores have a length of 3.83 mm, a breadth of 1.23 mm; the hydroecium measures 1.2 mm in length. The somatocyst is 2.3 mm long, and the nectosac is 2.6 mm in length. The nectophore has five complete, slightly serrated ridges; the dorsal and lateral ridges do not end in teeth around the ostium. The ventral ridges extend below the level of the ostium. The nectosac does not extend up to the apex of the nectophore. The somatocyst is long, slender and lies in close contact with the nectosac; the tip of the somatocyst extends above the apex of the nectosac. The hydroecium is deep, half its length lying below the level of the ostium. The mouth-plates are broad, rounded, divided and slightly overlapping.

Posterior nectophore.—Not developed.

Cormidia.—About 3–6 cormidia are seen on the very much contracted stem found within the hydroecium.

Larval stage.—"Calyconula"—Three examples of this stage of development of *M. atlantica* are present in the collections. This larval nectophore has a rounded apex, smooth and is devoid of ridges or teeth. The somatocyst is small, club-shaped and lies nearly at the apex of the nectosac. There is a single gastrozooid, a tentacle and a bud of the definitive nectophore. The hydroecium is shallow and broad.

Muggiaea delsmani Totton, 1954

(Text fig. 12, G & H)

1954. *Muggiaea delsmani* Totton, *Disc. Rep.*, **27**, p. 123, text-fig. 55B.

1963. *Muggiaea delsmani :* Daniel & Daniel, *J. mar. biol. Ass. India*, **5**(2), p. 204, fig. V, 7.

1965. *Muggiaea delsmani :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 183, text-fig. 121.

1966. *Muggiaea delsmani :* Rees & White, *Some Contemporary Studies in Marine Sciences.* Harold Barnes, London, p.

Material examined.—Four nectophores were taken during a survey of the Digha Coast at Station no. 6, in a surface haul with an Organdie Net.

Type locality.—Java Sea (Lat. 5°57′S ; Long. 108°23′E).

Holotype.—Deposited in the British Museum (Nat. Hist.)

Registered no. 1937.12.9.1.

Distribution.—Java Sea; off Madras & Orissa coast (Bay of Bengal); North Pacific.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, G & H).—The nectophores are 4.13 mm long, 2.0 mm broad, with a hydroecium measuring 1.0 mm in length. The somatocyst is 0.75 mm in length.

There are five complete longitudinal ridges and none of them end in teeth around the ostium. The ventral ridges are short and the nectophore is slightly inclined towards the ventral side. The ridges are not serrated. The somatocyst is small with a thick stalk and a thicker tip. As in the other species it lies in close contact with the nectosac. The hydroecium is shallow, inclined towards the nectosac and its apex is nearly horizontal. There is a slight notch on the ventral wall of the hydroecium. The mouth-plates are divided, large, rounded and they overlap slightly. The left plate overlaps the right one. The apex of the nectosac does not extend up to the tip of the nectophore.

Posterior nectophore.—Not developed.

The stem is missing from the specimens.

Genus. **Dimophyes** Moser, 1925

1925. *Dimophyes* Moser, *Dtsch. Scidpol. Exped.*, **18**, p. 389.

Diphyinae with anterior nectophore not pyramidal, rounded apex and devoid of complete ridges. Mouth-plate undivided, smoothly rounded and wide open on ventral side. Posterior nectophore reduced and half enclosed in hydroecium.

Monotypic genus for *D. arctica* (Chun, 1897).

This species was included in the genus *Muggiaea* by Schneider (1898, p. 89) but retained in the Diphyidae by Bigelow, However, this genus *Dimophyes* was regarded as constituting a monotypic Family Dimophyidae by Moser (1925). In general shape of the nectophore and the somatocyst *D. arctica* resembles *M. bargmannae* and differs in the structure of the mouth-plates and in the presence of a reduced posterior nectophore which is never developed in *Muggiaea.*

Dimophyes arctica (Chun, 1897)

(Text-fig. 12, I & J)

1897. *Diphyes arctica* Chun, *Erbebn. Plankton Exped.*, **2**, k.b., p. 19, taf. 1, figs. 1–10.

1897. *Diphyes borealis* Chun, *Ergebn, Plankton Exped.*, **2**, k.b., p. 99.

1898. *Diphyes arctica :* Vanhoeffen, *Die fauna und flora Gronland. In Drygalski E. von Gronland Exped. Ges. fur Erdkunde Zu Berlin*—1891–1893, **2**(1), p. 274, taf. 2, fig. 3.

1898. *Muggiaea arctica:* Schneider, *Zool. Anz.*, **21**, p. 89.

1899. *Diphyes arctica :* Schaudin & Romer, *Verh. Dtsch. Zool. Ges.*, **9**, p. 245.

1902. *Diphyes arctica :* Romer, *Die Siphonophoren : In Fauna Arctica*, **2**, p. 174.
1906. *Diphyes arctica :* Vanhoeffen, *Siphonophoren. Nordisches Plankton* **5**(11), p. 17, figs.6.1-18.
1907. *Diphyes arctica :* Damas & Koefoed, *Le plankton de la Mer du Gronland. Due d' Orleans Croisiere Oceanographique accomple a bord de la Belgica dans la Mer du Gronland.* Brussels, p. 348.
1908. *Diphyes arctica :* Broch, *Ark. für Zool.*, **4**, p. 3.
1925. *Dimophyes arctica :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 389, pl. XXXI, figs. 2-5.
1926. *Diphyes arctica :* Browne, *Trans. Linn. Soc. Lond. Zool.*, (2) **19**, p. 75.
1932. *Dimophyes arctica :* Runnstrom, *Bergens Mus. Arbok pour* 1931, **2**(7), p. 32.
1932. *Dimophyes arctica :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 363.
1933. *Dimophyes arctica :* Leloup, *Res. Camp. Sci. Monaco.*, **87**, p. 35.
1934. *Dimophyes arctica :* Bernstein, *Trans. Arctic Inst.*, **9**, pp. 9, 14, 27, 40, 42, 44, tab. 8.
1934. *Dimophyes arctica :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10** (6), p. 29.
1934. *Dimophyes arctica :* Mackintosh, *Disc. Rep.*, **9**, pp. 72, 86, 90, 98, 125, 127, 134, figs. 2b, 2o; tab. I–VIII.
1935. *Dimophyes artica :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlant. Exped. 'Meteor'*, **12**(2), p. 12, fig. 11.
1935. *Dimophyes arctica :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 266.
1936. *Dimophyes arctica :* Leloup, *Bull. Inst. Ocean.* No. **703**, p. 9.
1938. *Dimophyes arctica :* Leloup, *Res. voyage de la ''Belgica''* 1897-99 *Exped. Antarctique belge. Zoologie*, p. 3.
1942. *Dimophyes arctica :* Dunbar, *Canad. J. Res.* Ottawa, **20**(D3), p. 75.
1942. *Dimophyes arctica :* Kramp, *The Godthaab Exped.* 1928. *Siphonophora. Medd. Grenland*, **80**, p. 9.
1943. *Dimophyes arctica :* Kramp. *Medd. om Gronland udgivne of Kommissionen for Videnskabelige undersgelier Gronland*, **121**(12), p. 9, fig. 2.
1949. *Dimophyes arctica :* Kramp, *Sci. Res. Norwegian Antarctic Exped.*, **30**, p. 7, fig. 3.
1950. *Dimophyes arctica :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1952. *Dimophyes arctica :* Kielhorn, *J. Fish. Res. Board Canada*, IX(5), p. 248.
1954. *Dimophyes arctica :* Totton, *Disc. Rep.*, **27**, p. 123.
1955. *Dimophyes arctica :* Leloup, *Rep. Sci. res. ''Michael Sars'' north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 8.
1965. *Dimophyes arctica :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 184, pl. XXXIII, figs. 1, 2, 7; text-fig. 122.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5216	Ich. N.	1000–0	1 ant. necto.	P 1590/1
K 7	N. N.	500–0	1 ,, ,,	Gen.Coll.
K 35	,,	200–0	1 ,, ,,	,,

Type locality.—Baffins Bay, Arctic Ocean.

Distribution.—This cold water species is known to occur from a depth of 1650 metres to the surface in waters with a mean temperature of from—1° to 14°C, with a maximum record in waters with a temperature of from 1° to 3°C, from the Arctic, Antarctic, Atlantic, Pacific and Indian Oceans.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, I & J).—The nectophores from RV VITYAZ (Text-fig. 12, I) and INS KISTNA (Text-fig.12, J) collec-

tions look alike except for the length of the somatocyst. The measurements of the specimens are given below :

	KISTNA specimen (mm)	VITYAZ specimen (mm)
Length ..	3.8	10.0
Breadth ..	1.67	5.0
Somatocyst ..	1.8	1.3
Hydroecium ..	1.2	3.5
Nectosac ..	2.87	7.63

The nectophore has a rounded apex and the ridges are vestigeal. The lateral ridges do not reach the apex or the base. No dorsal or lateral teeth are present. The somatocyst in the VITYAZ specimen is small, not extending to more than $\frac{1}{6}$th the length of the nectosac. Somatocyst in the two KISTNA examples, is the typical type described by Totton (1965); it is long, broad at the base and tapering at the apex and is spindle shaped; it reaches up to half the length of the nectophore and lies close against the ventral wall of the nectosac. The hydroecium in all these examples is characteristically shaped like the 'spathe' of the Arum-lily, and its apex is slightly above the level of the ostium while the major portion of the hydroecium lies below the level of the ostium. The mouth-plate is undivided and rounded with a smooth edge. It is wide open on the ventral side, up to the level of the ostium. The stem is very much contracted.

The posterior nectophore and the eudoxid phase are not present in the collections.

Genus **Chelophyes** Totton, 1932

1932. *Chelophyes* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 353.

Diphyinae with medium sized anterior nectophore having a vestigeal dorsal ridge and no conspicuous ostial teeth. Hydroecium of medium depth with large divided serrated tooth-like mouth-plates. Basolateral angles not markedly produced. Posterior nectophore with a flap on left hydroecial wing reaching over to right side to form a closed hydroecial cavity, ending in prominent serrated teeth, of which left one is longer. Eudoxid phase with conical bracts, short neck-shield and large gonophores. No special nectophore.

In 1932, *Diphyes appendiculata* Eschscholtz, 1829 and *D. contorta* Lens & van Riemsdijk, 1908 which resemble each other more than either resembles any other species, were separated into a new genus *Chelophyes* Totton (1932).

Type species.—*Chelophyes appendiculata* (Eschscholtz, 1829).

Key to species of *Chelophyes*

1. Anterior nectophore with 3 complete ridges; left lateral ridge not reaching apex; somatocyst long and straight . . . . . *appendiculata*

2. Anterior nectophore with 3 complete ridges; right lateral ridge not reaching apex; somatocyst long and bent like a 'J' (hockey-stick shaped) . . . . . *contorta*

Both these species are represented in the present collections.

Chelophyes appendiculata (Eschscholtz, 1829)

(Text-fig. 12, K, L, M & N)

1829. *Diphyes appendiculata* Eschscholtz, *System der Acalephen.* Berlin, p. 138, pl. 12, fig. 7.

1836. *Diphyes bipartita* Costa, *Fauna del Regno di Napoli. Medusari*, p. 4, taf. 4.

1841. *Diphyes elongate* Hyndman, *Ann. Mag. nat. Hist.* Lond., **7**, p. 165, figs. 1–4.

1853. *Eudoxia campanella* Leuckart, *Zoologische Untersuchungen.* I. *Die Siphonophoren*, p. 43.

1853. *Diphyes acuminata* Leuckart, *Zoologische Untersuchungen.* I. *Die Siphonophoren*, p. 61, taf. 3, figs. 11–20.

1853. *Diphyes sieboldii* Kölliker, *Die Schwimmpolypen oder Siphonophore n von Messina*, Leipzig, p. 36, taf. 11, figs. 1–8.

1853. *Diphyes sieboldii* Kölliker, *Die Schwimmpolypen oder Siphonophoren von Messina*, Leipzig, p. 36, taf. 11, figs. 1–8.

1853. *Eudoxia messanensis* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 285.

1853. *Diphyes gacilis* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 309, taf. 6, figs. 5–7, (non *D. gracilis* Bedot, 1896).

1854. *Diphyes sieboldu :* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 453.

1857. *Eudoxia alata* McCrady, *Proc. Elliott Soc.*, **1**, p. 172, pl. 8, figs. 9, 10.

1857? *Diphyes pusilla* McCrady, *Proc. Elliott Soc.*, **1**, p. 174.

1859. *Diphyes appendiculata* Huxley, *The Oceanic Hydrozoa.* Roy Soc. London, p. 34, pl. 1, fig. 2.

1859. *Diphyes acuminata :* Gegenbaur, *Nova Acta Leop. Carol.*, **27**, p. 375.

1861. *Diphyes sieboldu :* Kefferstein & Ehlers, *Zoologische Beitrage gesammelt im Winter* 1859-60 *in Neapel und Messina.* I. *Beobachtungen uba die Siphonophoren*, p. 15.

1870/71. *Eudoxia campanella :* Muller, *Naturh. tidsskrift*, **7**, taf. 11. figs. 1-4; taf. 13, fig. 10.

1888. *Diphyes bipartita :* Chun, *S. B. preuss. Akad. Wiss.* for 1888, p. 1158.

1888. *Cuculus gegenbauri* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 110.

1888. *Cuculus elongata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 110.

1897. *Diphyes bipartita :* Chun, *Ergebn Plabkton Exped.*, **2**, k.b., p. 24.

1898. *Diphyes appendiculata :* Schneider, *Zool. Anz.*, **21**, p. 85.

1900. *Diphyes bipartita :* Mayer, *Bull. Mus. Comp. Zool. Harv.*, **37**, p. 74, pl. 34, fig. 114.

1900. non *Ersaea appendiculata :* Agassiz & Mayer, *Mem. Mus. Comp. Zool. Harv.*, **26**.

1902. *Diphyes bipartita :* Romer, *Fauna Arctica*, **2**, p. 175.

1904. *Diphyes appendiculata :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **39**, p. 265.

1908. *Eudoxia campanella :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 48, pl.7, fig. 62.

1911. *Diphyes appendiculata :* Bigelow, *Trans. Linn. Soc. Lond.* (*Zool.*), X, p. 344.

1911. *Diphyes appendiculata :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 248, pl. 7, figs. 5, 6; pl. 8, figs. 7, 8; pl. 9, fig. 6; pl. 10, fig. 6; pl. 11, fig. 1.

1918. *Diphyes appendiculata :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 420.

1926. *Diphyes appendiculata :* Browne, *Trans. Linn. Soc. Lond.* (*Zool.*), (2)**19**, p. 71.

1931. *Diphyes appendiculata :* Bigelow, *Zoologica*, N.Y., **8**(11), p. 564.

1932. *Diphyes appendiculata :* Candeias, *Mem. Est. Mus. Zool. Univ.*, Coimbia, **57**, p. 9, pl. II, figs. 7, 8.

1932. *Chelophyes appendiculata :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 354.

1932. *Eudoxia russelli :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 355, text-figs. 25, 26.

1933. *Chelophyes appendiculata :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 31.

1934. *Chelophyes appendiculata :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 24.

1935. *Chelophyes appendiculata :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **11**(31), p. 5.

1935. *Chelophyes appendiculata :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlant. Exped. 'Meteor'*, **12**(2), p. 9, carte 7.

1935. *Chelophyes appendiculata :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 264.

1936. *Chelophyes appendiculata :* Leloup, *Bull. Inst. Ocean.* No. 703, p. 5.

1936. *Chelophyes appendiculata :* Totton, *Zoologica*, N.Y., **21**(4), p. 233.

1937. *Chelophyes appendiculata :* Leloup, *Mem. Mus. Roy. Hist. nat. Belg.* **1**(e), 9, 6, p. 123.

1937. *Chelophyes appendiculata :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology*, H. **2**, pp. 41, 101, fig. 72.

1939. *Chelophyes appendiculata :* Bigelow & Sears, *Mem. Mus. Comp. Zool. Harv.* **54**(4), fig. 42B.

1939. *Chelophyes appendiculata :* Kramp. *The Zoology of Iceland.* II part, **56**, p. 16.

1940. *Chelophyes appendiculata :* Legendre, *Inst. Ocean. nouv. Ser.*, No. 20, fasc. **4**, p. 145, fig. 3.

1949. *Chelophyes appendiculata :* Moore, *Bull. Bingham Oceanogr. Coll.* XII(2), p. 18, figs. 37–40.

1950. *Chelophyes appendiculata :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1954. *Chelophyes appendiculata :* Totton, *Disc. Rep.*, **27**, p. 127, pl. IV, figs. 1–3.

1955. *Chelophyes appendiculata :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 15.

1955. *Chelophyes appendiculata :* Leloup, *Inst. Roy. Sci. nat. Belg.* **3**(4), p. 10.

1955. *Chelophyes appendiculata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 185, pl. XXXII, fig. 4; pl. XXXIII, fig. 6.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5177	I.K.T.	200–90	5 ant. necto.	Gen.Coll.
V 5179	I.K.T.	450–150	4 ant. necto.	P 1626/1
V 5184	Ich. N.	1000–0	2 ,, ,, ; 2 post. necto.	Gen.Coll.
V 5192	,,	,,	3 ,, ,,	,,
V 5193	Ring. T.	,,	14 ,, ,,	P 1736/1
V 5194	Pl. N.	Surface	1 ,, ,,	Gen.Coll.
V 5195	Ich. N.	1000–0	1 ,, ,,	,,
V 5196	Pl. N.	Surface	3 ant. necto.	P 1767/1
V 5197	Ich. N.	1300–0	2 ,, ,, ; eudox.	Gen.Coll.
V 5198	J. N.	200–0	1 ,, ,,	,,
V 5199	Pl. N.	Surface	2 ,, ,,	,,
V 5200	IOSN/JN	200–0	7 ,, ,,	P 1748/1
V 5201	Ring T.	1000–0	6 ,, ,, ; 2 ,, ; 3 post. necto.	Gen.Coll.
V 5202	IOSN	200–0	4 ,, ,,	,,
V 5203	,,	,,	3 ,, ,,	,,
V 5204	,,	,,	2 ,, ,,	,,
V 5205	IOSN/JN	,,	10 ,, ,, ; 2 ,, ,,	P 1515/1
V 5207	IOSN/Pl.N.	,,	7 ,, ,,	Gen.Coll.
V 5209	IOSN/IKT	,,	46 ,, ,,	P 1620/1
V 5211	Pl. N.	Surface	3 ,, ,,	Gen.Coll.
V 5212	IOSN/JN	200–0	8 ,, ,,	P 1609/1
V 5213	Pl. N.	Surface	1 ,, ,,	Gen.Coll.
V 5216	Ich.N./RT	1000–0	9 ,, ,,	P 1586/1
V 5217	IOSN	200–0	3 ,, ,,	P 1583/1
V 5220	,,	,,	6 ,, ,,	P 1514/1
V 5223	J. N.	,,	1 ,, ,,	P 1689/1
K 15	N. N.	,,	1 ,, ,,	Gen.Coll.
K 25	,,	,,	2 ,, ,, ; 1 ,, ,,	,,
K 36	,,	,,	1 ,, ,,	,,

Type locality.—North Atlantic

Distribution.—This species occurs in great numbers in the open sea in the temperate and tropical regions of the three oceans (for further details see Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, K, L & M).— the nectophores measure 12.3 mm in length, 4.3 mm in breadth, the hydroecium is 3.0 mm long; the somatocyst is 6.0 mm in length. There are five ridges of which the two ventrals and the right lateral are complete; the right lateral ridge curves towards the dorsal side in the apical region; the left lateral ridge originates just below the apex of the nectophore and reaches the base; the dorsal ridge is vestigeal, occurring in the ostial region only. There are no dorsal and lateral teeth around the ostium, though there is a slight projection on the dorsal edge. The ridges are serrated from about the mid-region to the base. There is a depression at the apex between the two ventral ridges. The nectosac has a pointed apex. The somatocyst is long, thin and club-shaped and inclined towards the nectosac. The hydroecium is sharply conical and is inclined towards the ventral wall of the nectophore. The mouth-plates are broad, long overlapping and end in pointed, serrated teeth.

Posterior nectophore (Text-fig. 12, N).—These have a length of 7.7 mm and a breadth of 2.7 mm. The nectophore is smaller than the anterior nectophore and has a slender appearance. The dorsal ridge is incomplete and occurs in the ostial region only. The lateral ridges extend up to the triangular extension of the nectophore. There are no ostial teeth. The ventral ridges end in strong teeth at the base. The tooth on the left side is longer. The ridges and teeth are serrated. There are two curved smaller teeth on the ventral ridges at the level of the ostium. The ventral ridges are extended to form the hydroecial wings. On the inside of the left hydroecial wing there is a long flap-like structure which reaches over to meet the other wing and so covers the hydroecium completely.

Eudoxid phase.—The bracts vary in length from 1.5 to 3.1 mm; the gonophore ranges from 2.0 mm to 3.5 mm in length. The bract resembles that of *D. dispar* with a deep bracteal cavity. The phyllocyst is long, cylindrical with a tapering apex which nearly reaches the apex of the bract. The margin of the neck-shield is smooth and rounded. The peduncle of the gonophore lies within the bracteal cavity. The male and female gonophores occur in different eudoxids. The lateral ridges of the gonophore are slightly twisted

Chelophyes contorta (Lens & van Riemsdijk, 1908)

(Text-fig. 12, O, P & Q)

1908. *Diphyes contorta* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 39, pl. VI, figs. 48–50.

1911. *Diphyes contorta :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 254.

1925. *Diphyes contorta :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 247.

1926. *Diphyes contorta :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), (2)**19**, p. 71.

1932. *Chelophyes contorta :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 357, text-fig. 27.

1954. *Chelophyes contorta :* Totton, *Disc. Rep.*, **27**, p. 130. text-fig. 65.

1963. *Chelophyes contorta :* Daniel & Daniel, *J. mar. biol. Ass. India*, **5** (2), p. 204, fig. V, 9; VI, 1–3.

1965. *Chelophyes contorta :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 187, pl. XXXII, figs. 7, 8; text-figs. 125, 126.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5185	J. N.	200–0	1 ant. necto.	Gen.Coll.
V 5200	IOSN	,,	2 ,, ,,	P 1748/1
V 5205	J. N.	,,	6 ,, ,,	P 1570/1
V 5207	IOSN	,,	4 ,, ,,	P 1660/1
V 5208	Pl. N.	Surface	1 ,, ,,	Gen.Coll.
V 5209	IOSN/IKT	200–0	11 ,, ,,	P 1614/1
V 5211	Pl. N.	Surface	2 ,, ,,	Gen.Coll.
V 5212	IOSN	200–0	5 ,, ,,	P 1606/1
V 5216	Ich.N.	1000–0	9 ,, ,,	P 1587/1
V 5217	IOSN	200–0	3 ,, ,,	P 1582/1
V 5220	IOSN/JN	,,	19 ,, ,,	P 1511/1
				P 1683/1
V 5223	J. N.	,,	5 ,, ,,	P 1691/1
V 5225	Pl. N.	,,	60 ,, ,,	P 1512/1
	IOSN			P 1513/1
	J. N.			P 1635/1
V 5227	IOSN	Surface	16 ant. necto.	P 1702/1
V 5228	J. N.	,,	8 ,, ,,	Gen.Coll.
V 5229	,,	,,	9 ,, ,,	P 1764/1
V 5231	Pl. N.	,,	9 ,, ,,	Gen.Coll.
V 5232	J. N.	200–0	23 ,, ,,	P 1730/1
V 5234	Pl. N.	Surface	1 ,, ,,	Gen.Coll.
V 5235	,,	,,	1 ,, ,,	,,
V 5236	,,	,,	2 ,, ,,	,,
K 1	N. N.	200–0	1 ,, ,,	,,
K 3	,,	400–200	15 ,, ,,	,,
K 4	,,	200–0	32 ,, ,,	,,
K 6	,,	,,	14 ,, ,,	,,
K 7	,,	,,	8 ,, ,, ; 2 post. necto.	,,
K 8	,,	,,	43 ,, ,, ;	,,
K 9	,,	,,	15 ,, ,, ; 1 ,, ,,	,,
K 10	,,	,,	22 ,, ,,	,,
K 11	,,	,,	28 ,, ,,	,,
K 14	,,	,,	12 ,, ,,	,,
K 15	,,	,,	26 ,, ,,	,,
K 17	,,	200–0	1 ,, ,,	,,
K 18	,,	,,	2 ,, ,,	,,
K 20	,,	,,	13 ,, ,,	,,
K 20	,,	,,	15 ,, ,,	,,
K 21	,,	,,	12 ,, ,,	,,
K 22	,,	,,	3 ,, ,,	,,
K 23	,,	,,	3 ,, ,,	,,
K 25	,,	,,	2 ,, ,,	,,
K 26	,,	,,	1 ,, ,,	,,
K 27	,,	,,	10 ,, ,,	,,
K 28	,,	,,	1 ,, ,,	,,

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
K 30	N. N.	200–0	1 ant. necto.; post. necto.	Gen.Coll.
K 31	,,	,,	5 ,, ,,	,,
K 32	,,	,,	12 ,, ,, ; 4 6 ,, ,,	,,
K 34	,,	,,	7 ,, ,,	,,
K 34	,,	75–0	18 ,, ,, ; 6 ,, ,,	,,
K 35	,,	200–0	31 ,, ,, ; 3 ,, ,,	,,
K 36	,,	,,	13 ,, ,, ; 2 ,, ,,	,,
K 37	,,	,,	6 ,, ,,	,,
K 38	,,	,,	3 ,, ,,	,,
K 39	,,	,,	2 ,, ,,	,,
K 43	,,	,,	2 ,, ,,	,,
K 47	,,	,,	4 ,, ,,	
K 48	,,	,,	29 ,, ,, ; 6 ,, ,,	,,
K 49	,,	,,	11 ,, ,,	,,
K 50	,,	500–200	3 ,, ,,	,,
K 51	,,	200–0	5 ,, ,,	,,
K 53	,,	,,	38 ,, ,, ; 4 ,, ,,	,,
K 54	,,	202–0	36 ,, ,,	,,
K 56	,,	,,	40 ,, ,, ; 10 ,, ,,	,,
K 58	,,	,,	7 ,, ,,	,,
K 358	Org. N.	Surface	4 ,, ,, ; 1 ,, ,,	,,
K 359	,,	,,	6 ,, ,,	,,
K 361	,,	,,	7 ,, ,, ; 3 ,, ,,	,,
K 363	,,	,,	2 ,, ,,	,,
K 366	,,	,,	3 ,, ,,	,,
K 367	,,	,,	3 ,, ,,	,,
K 378	,,	,,	18 ,, ,, ; 4 ,, ,,	,,
K 380	,,	,,	1 ,, ,,	,,
K 529	—	—	1 ,, ,,	,,
K 538	—	—	2 ,, ,,	,,
GTNIC-6	—	Surface	2 ,, ,,	,,
KRL 26	—	,,	2 ,, ,,	,,

Type locality.—Malay Archipelago.

Distribution.—This species occurs in great abundance over the continental slopes in the tropical regions of the Atlantic, Pacific and Indian Oceans. It rarely occurs in the open sea (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, P & Q).—The nectophores range in length from 1.67 mm to 5.1 mm, in breadth from 0.8 mm to 2.25 mm; the hydroecium ranges from 0.33 mm to 1.25 mm in length; the somatocyst ranges in length from 0.67 mm to 2.75 mm. Of the five ridges present in the anterior nectophore, only the laterals and the left ventral ridges reach the apex and the base. The dorsal ridge is very short, starts from the middle region of the nectophore and reaches the base. The right ventral ridge is also incomplete, it starts just below the apex and terminates near the base. The left ventral ridge is slightly twisted. All the ridges are well serrated, specially at the base. There are no dorsal or lateral teeth around the ostium. The stalk of the somatocyst is straight, but the club-shaped (or hockey-stick shaped) end curves to the right side across the nectosac. The hydroecium is conical

and lies below the level of the ostium and is inclined towards the ventral side. The basoventral edge slopes towards the dorsal side and ends in two sharply projected tooth-like mouth-plates. The mouth-plates are broad, divided, slightly overlapping and have small teeth.

Posterior nectophore (Text-fig. 12, O).—It has a length of 3.5 mm and a breadth of 2.0 mm; it is smaller than the anterior nectophore. The dorsal ridge is vestigeal; the lateral ridges are complete and curve over to the dorsal side. There are no ostial teeth. The hydroecial folds are broad at the proximal end and taper down into two prominent teeth, of which the right one is larger. The hydroecial groove is open at the proximal and distal ends but in the middle region it is closed over by overlapping extended margins. The ridges and the hydroecial folds are well-serrated. The nectophore has a "bowed" appearance.

Genus **Eudoxoides** Huxley, 1859

Diphyinae with complete dorsal ridge in pentagonal anterior nectophore; no conspicuous ostial teeth; mouth-plate divided, basolateral angles produced into lancet-shaped wings.

The generic name of *Eudoxoides* was used by Huxley for the eudoxid of *Diphyes mitra* Huxley, 1859 which he named as *Eudoxoides sagittata*. When the family Diphyidae was reviewed by Totton (1932), the genus *Eudoxoides* was revived. Two species of *Diphyes : D. mitra* and *D. spiralis* Bigelow, 1911b are included in this genus.

Type species.—Eudoxoides mitra Huxley, 1859.

Key to Species of *Eudoxoides*

1. Nectophore with five longitudinal, straight, complete ridges; dorsal tooth present . . . . *mitra*
2. Nectophore with five longitudinal, twisted ridges; left ventral ridge meets right ventral ridge before reaching apex; no ostial teeth . . . . . *spiralis*

Eudoxoides mitra (Huxley, 1859)

(Text-fig. 13, C–H)

1859. *Diphyes mitra* Huxley, *The Oceanic Hydrozoa.*, Ray Soc. London, p. 36, pl. 1, fig. 4.
1859. *Eudoxoides sagittata* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 59, pl. IV, fig. 1 (eudoxid).
1888. *Cymbonectes mitra :* Haeckel, *Jena. Z. naturw.*, **22**, p. 34.
1888. *Cymbonectes mitra :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 133.
1892. *Muggiaea mitra :* Chun, *Abh. senckenb. naturf. Ges.*, **18**, p. 89.
1896. *Diphyes gracilis* Bedot, *Rev. Suisse Zool.*, **3**, p.370, pl. 12, figs. 4, 8 (non *D. gracilis* Gegenbaur 1853 = *Chelophyes appendiculata*).
1898. *Muggiaea kochii* Schneider, *Zool. Anz.*, **21**, p. 88 (in part, non Will, 1844).
1908. *Diphyopsis diphyoides* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 51, pl. 8, figs. 65, 66.
1911. *Diphyopsis mitra :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 258, pl. 7, fig. 9; pl. 9, fig. 4; pl. 10; figs. 4, 5; pl. 11, fig. 6; pl. 12, fig. 5.
1918. *Diphyopsis mitra :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 423.
1925. *Diphyes mitra :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 256.
1926. *Diphyes mitra :* Browne, *Trans. Linn. Soc. Lond. Zool.*, (2), **19**, p. 73.
1931. *Diphyes mitra :* Bigelow, *Zoologica*, N.Y., **8**(11), p. 566.
1932. *Eudoxoides mitra :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 358, text-figs. 28,29.
1933. *Eudoxoides mitra :* Leloup, *Res. Camp. Sci. Monaco*, **87**, p. 35.

1934. *Eudoxoides mitra :* Leloup, *Bull. Mus. Hist. nat. Belg.* **10**(6), p. 28.
1935. *Eudoxoides mitra :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 265.
1935. *Eudoxoides mitra :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlant. Exped. 'Meteor'.*, **12**(2), p. 12, carte 10.
1936. *Eudoxoides mitra :* Leloup, *Bull. Inst. Ocean.* No. 703, p. 9.
1936. *Eudoxoides mitra :* Totton, *Zoologica*, N.Y., **21**(4), p. 234.
1937. *Eudoxoides mitra :* Leloup, *Mem. Mus. Roy. Hist. nat. Belg.*, **1**(2), fasc. 6, 9, p. 123.
1949. *Diphyes mitra :* Moore, *Bull. Bingham Oceanogr. Coll.*, XII(2), p. 17, figs. 30–36.
1950. *Eudoxoides mitra :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1954. *Eudocides mitra :* Totton, *Disc. Rep.*, **27**, p. 16.
1955. *Eudoxoides mitra :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), pl. 11.
1955. *Eudoxoides mitra :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 15.
1963. *Diphyes mitra :* Daniel & Daniel, *J. mar. biol. Ass. India*, **5**(2), p. 209, fig. VII, 1–5.
1965. *Eudoxoides mitra :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 188, pl. XXXIII, figs. 4, 5; text-fig. 127.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5177	I.K.T.	200–90	2 ant. necto.	Gen.Coll.
V 5179	,,	150–450	1 ,, ,,	P 1623/1
V 5200	IOSN	200–0	1 ,, ,,	P 1678/1
V 5205	IOSN/JN	,,	9 ,, ,,	P 1567/1
V 5207	,,	,,	7 ,, ,, ; 2 eudox.	P 1526/1
V 5209	IOSN/JN	,,	10 ,, ,,	P 1615/1
V 5212	,,	,,	13 ,, ,, ; 4 ,,	P 1607/1
V 5216	Ich. N.	1000–0	4 ,, ,,	P 1596/1
V 5220	IOSN/JN	200–0	3 ,, ,,	Gen.Coll.
V 5229	J. N.	,,	2 ,, ,,	P 1762/1
V 5232	IOSN	,,	10 ,, ,, ; ; 3 post. necto.	Gen.Coll.
V 5234	I.K.T.	150–100	1 ,, ,,	,,
K 1	N. N.	200–0	1 ,, ,, ; 2 ,,	,,
K 3	,,	400–200	2 ,, ,, ; 3 ,,	,,
K 4	,,	200–0	2 ,, ,, ; 2 ,,	,,
K 5	,,	,,	6 ,, ,, ; 7 ,,	,,
K 6	,,	500–0	6 ,, ,, ; 13 ,,	,,
K 7	,,	,,	6 ,, ,, ; 5 ,,	,,
K 8	,,	200–0	2 ,, ,, ; 4 ,,	,,
K 9	,,	,,	6 ,,	,,
K 10	,,	,,	3 ,, ,, ; 5 ,,	,,
K 11	,,	,,	4 ,, ,, ; 8 ,,	,,
K 15	,,	,,	12 ,, ,, ; 5 ,, ; 2 ,, ,,	,,
K 16	,,	,,	1 ,, ,,	,,
K 18	,,	,,	2 ,, ,, ; 3 ,,	,,
K 19	,,	,,	7 ,, ,, ; 35 ,, ; 3 ,, ,,	,,
K 20	,,	,,	; 4 ,,	,,
K 21	,,	,,	5 ,, ,, ; 4 ,,	,,
K 22	,,	,,	2 ,, ,, ; 2 ,,	,,
K 23	,,	,,	3 ,, ,, ; 8 ,,	,,

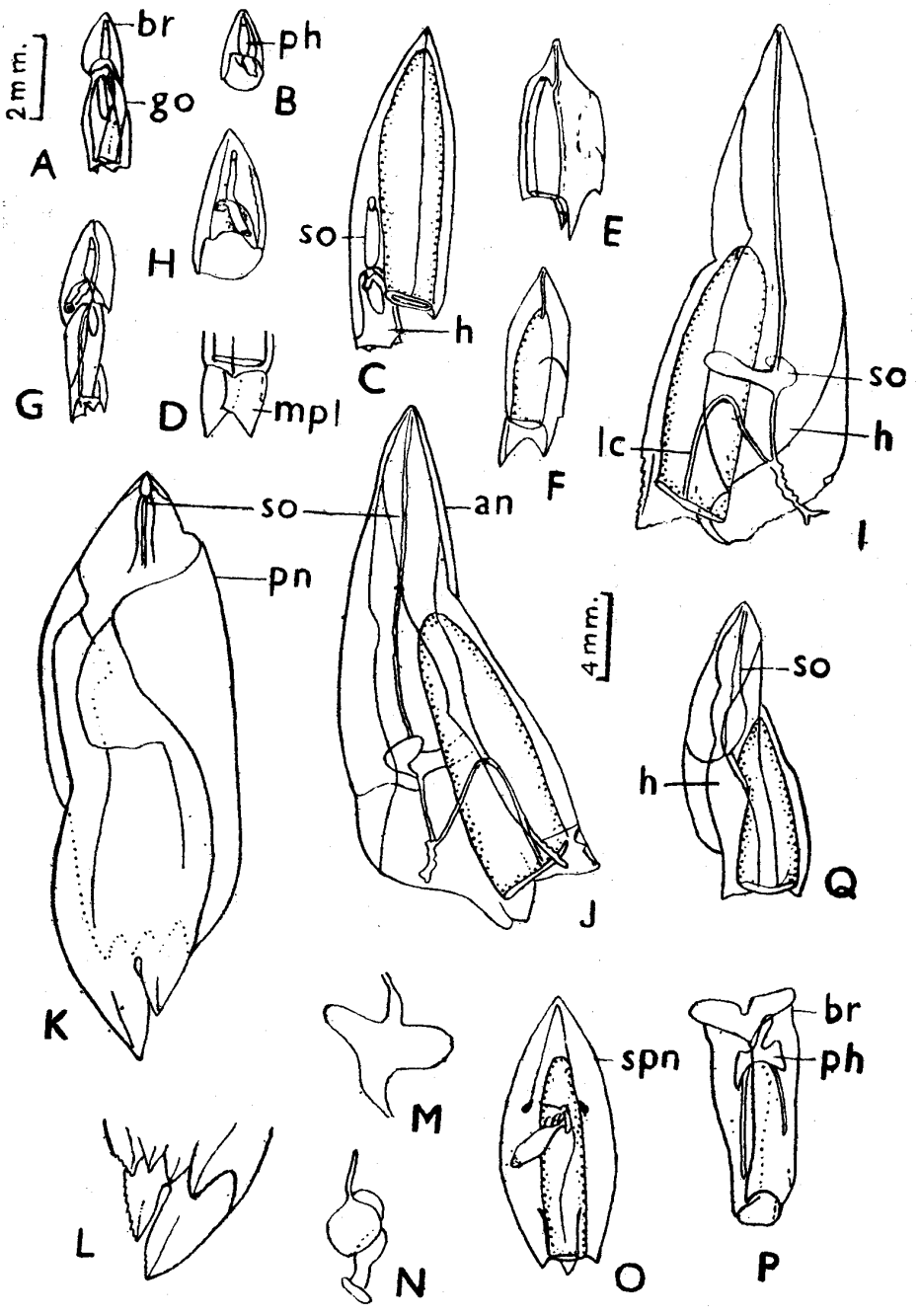
Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
K 25	N. N.	200–0	2 ant. necto.; 2 eudox.;	Gen.Coll.
K 26	,,	,,	4 ,,	,,
K 28	,,	,,	1 ,, ,,	,,
K 31	,,	,,	3 ,, ,, ; 5 ,,	,,
K 32	,,	,,	5 ,, ,, ; 6 ,,	,,
K 34	,,	,,	1 ,, ,, ; 2 ,,	,,
K 35	,,	,,	9 ,, ,, ; 10 ,,	,,
K 36	,,	,,	1 ,, ,, ; 5 ,,	,,
K 40	,,	,,	3 ,, ,, ; 6 ,,	,,
K 41	,,	,,	1 ,, ,, ; 2 ,,	,,
K 42	,,	,,	2 ,, ,, ; 27 ,,	,,
K 43	,,	,,	1 ,, ,, ; 3 ,,	,,
K 44	,,	,,	4 ,, ,, ; 4 ,,	,,
K 46	,,	,,	5 ,, ,, ; 22 ,,	,,
K 47	,,	,,	26 ,, ,, ; ; 5 post. necto.	,,
K 48	,,	,,	9 ,, ,, ; 1 ,, ; 2 ,, ,,	,,
K 49	,,	,,	12 ,, ,, ; 18 ,, 3 ,, ,,	,,
K 50	,,	500–200	4 ,, ,, ;	,,
K 51	,,	200–0	12 ,, ,, ; 12 ,,	,,
K 53	,,	,,	6 ,, ,, ; 6 ,,	,,
K 54	,,	,,	1 ,, ,, ; 1 ,,	,,
K 56	,,	,,	2 ,, ,, ; 3 ,,	,,
K 358	Org. N.	Surface	1 ,, ,, ; 1 ,,	..
K 533	,,	,,	1 ,,	,,
K 538	,,	,	2 ,, ,,	,,

Type locality.—South-east of Mauritius.

Distribution.—This species occurs in large numbers from the tropical regions of the Atlantic, Pacific and Indian Oceans (for details of localities *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 13, C & D).—The nectophores have a length of 9.25 mm, a breadth of 3.25 mm; the hydroecium measures 2.5 mm in length, and the somatocyst is 2.3 mm long. There are five complete longitudinal ridges which are serrated at the base. The presence of a single dorsal tooth and absence of the lateral ones characterizes this species. The ridges are not spirally twisted and sometimes the top of the nectosac is flat. The somatocyst is pear-shaped with a broad base, tapering apical end and a short stalk; it reaches the mid-region of the nectosac. The hydroecium is truncated above and the greater portion of it lies below the ostial level. The mouth-plate is divided, broad and forms two serrated overlapping wings, the outer angles being acute with a concave distal edge. The left hand wing is longer than the other and bears a secondary triangular flap or tooth.

Posterior nectophore (Text-fig. 13, E & F).—These have a length of 4.0 mm and a breadth of 2.2 mm. The nectophore is about half the length of the anterior nectophore. There is a characteristic notch between the apex and the pedicel—the apicodorsal notch. Only the dorsal tooth is present. The hydroecial groove is open except near the upper end where a tongue-shaped broadening of the left hydroecial wing is overlapped by the broadened portion of the right hydroecial wing thus forming a covered hydroecium. The hydroecial wings end in large serrated teeth at the base, of which the left



TEXT-FIGURE 13

Eudoxoides spiralis : A, B
A—eudoxid phase. B—bract.
Eudoxoides mitra : C—H
C—anterior nectophore : lateral view. D—anterior nectophore : dorsal view.
E—posterior nectophore : lateral view. F—posterior nectophore : ventral view.
G—eudoxid phase. H—bract.

(*Contd. . . p. 163*)

tooth is longer. There is a deeply curved tooth on the edge of each hydroecial wing at the level of the ostium as in *Chelophyes appendiculata.*

Eudoxid phase (Text-fig. 13, G & H).—The eudoxid has a length of 7.0 mm; the bract ranges in length from 3.67 mm to 5.3 mm; and the gonophore, from 5.0 mm to 7.2 mm. The bract has a pointed apex, the sutural surface of the bract forms an acute angle with the dorsal wall of the deep hydroecial cavity. Therefore the pedicel of the gonophore is long. Both the sutural ridges are serrated and the left ridge curves away to a tooth at the distal edge. The opening of the hydroecium is nearly quadrangular in shape. The distal edge is serrated up to the tooth and smooth in the other edges. The gonophore has four prominent serrated ridges and ends in four serrated teeth—two dorsolateral and two ventral. The mouth-plate has a concave serrated edge.

Eudoxoides spiralis (Bigelow, 1911)

(Text-fig. 12, R–U; 13, A & B)

1911. *Diphyes spiralis* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 249, pl. 7, fig. 4; pl. 8, figs. 1, 2; pl. 9, fig. 3; pl. 11, fig. 4.
1913. *Diphyes spiralis :* Bigelow, *Proc. U.S. nat. Mus*, **44**, p. 76.
1918. *Muggiaea spiralis :* Bigelow, *Bull. Mus. Comp. Zool. Harv.*, **62**, p. 402.
1915. *Muggiaea spiralis :* Moser, *K. preuss Akad. Wiss. Berlin*, **40**, p. 654.
1925. *Muggiaea spiralis :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 290.
1926. *Muggiaea spiralis :* Browne, *Trans. Linn. Soc. Lond. Zool.*, (2)**19**, p. 59.
1932. *Muggiaea spiralis :* Candeias, *Mem. Est. Mus. Zool. Univ.* Coimbia., **57**, p. 9, pl. 1, fig. 6.
1932. *Eudoxoides spiralis :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 360, text-fig. 30.
1933. *Eudoxoides spiralis :* Leloup, *Res. Camp. Sci. Monaco.*, **87**, p. 34.
1934. *Eudoxoides spiralis :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 25.
1935. *Eudoxoides spiralis :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **11**(31), p. 9.
1935. *Eudoxoides spiralis :* Leloup, *Bull. Mus. Roy. Hist. nat. Belg.*, **11**(34), p. 5.
1935. *Eudoxoides spiralis :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlant. Exped. 'Meteor,* **12**(2), p.12, carte 9.
1935. *Eudoxoides spiralis :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 265, fig. 27.
1936. *Eudoxoides spiralis :* Totton, *Zoologica*, N.Y., **21**(4), p. 234.
1936. *Eudoxoides spiralis :* Leloup, *Bull. Inst. Ocean.* No. 703, p. 9.
1937. *Eudoxoides spiralis :* Leloup, *Mem. Mus. Roy. Hist. nat. Belg.*, **1**(2), p. 123.
1937. *Eudoxoides spiralis :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II. *Biology,* H. **2**, pp. 44, 108, fig. 73.
1939. *Eudoxoides spiralis :* Bigelow & Sears, *Mem. Mus. Comp. Zool. Harv.*, **54**(4), pp.
1949. *Eudoxoides spiralis :* Moore, *Bull. Bingham Oceanogr. Coll.*, XII, (2), p. 16, figs. 23–29.
1950. *Eudoxoides spiralis :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1954. *Eudoxoides spiralis :* Totton, *Disc. Rep.*, **27**, p. 16.

Chuniphyes multidentata : I—P
I—anterior nectophore : lateral view. J—anterior nectophore : lateral view.
K—posterior nectophore : ventral view. L—posterior nectophore : dorsal view.
M,N—somatocyst. O—eudoxid phase : special nectophore. P—eudoxid phase : bract.
Chuniphyes moserae : Q
Q—anterior nectophore.
Abbreviations used :
an—anterior nectophore. br—bract. go—gonophore. h—hydroecium. lc—lateral radial canal.
m.pl—mouth-plate. ph—phyllocyst. pn—posterior nectophore. so—somatocyst. sp.n—special nectophore.

1955. *Eudoxoides spiralis :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 11.

1955. *Eudoxoides spiralis :* Leloup, *Inst. Roy. Sci. nat. Belg.*, **3**(4), p. 15.

1965. *Eudoxoides spiralis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus (Nat. Hist.) London, p. 189, pl. XXXII, figs. 5, 6; text-figs. 128, 129.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5191	Pl. N.	Surface	2 ant. necto.	P 1745/1
V 5193	Ich. N.	1000–0	12 ,, ,,	P 1737/1
V 5194	Pl. N.	Surface	1 ,, ,,	Gen.Coll.
V 5198	IOSN	200–0	9 ,, ,,	P 1757/1
V 5200	,,	,,	9 ,, ,,	P 1524/1
V 5207	,,	,,	1 ,, ,,	P 1658/1
K 6	N. N.	,,	1 ,, ,,	Gen.Coll.
K 7	,,	500–0	1 ,, ,, ; 1 eudox.	,,
K 8	,,	200–0	1 ,, ,,	,,
K 9	,,	,,	1 ,, ,, ;	,,
K 10	,,	,,	1 ,, ,, ; 5 ,,	,,
K 15	,,	,,	3 ,, ,, ; 2 ,,	,,
K 16	,,	,,	1 ,, ,,	,,
K 26	,,	,,	1 ,, ,,	,,

Type locality.—Gulf of California (eastern tropical Pacific).

Distribution.—Tropical regions of all three oceans (for further details *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 12, R, S, T & U).—The nectophore has a length of 5.0 mm, a breadth of 1.7 mm; the hydroecium is 1.3 mm long; the somatocyst is 1.3 mm in length. The nectophore is spirally twisted clockwise. There are five serrated ridges of which four (dorsal, the two laterals and the left ventral) are complete. The courses of these are displaced due to the twisting of the nectophore as a whole. The right ventral ridge arises near the apex at the level of the apex of the nectosac, very close to the left ventral ridge; the courses of these ridges are very clear in well preserved, uncontracted nectophores. In much contracted specimens the courses of these ridges are not clear and the right ventral appears to divide from the left ventral and the whole nectosac is also strongly twisted, no dorsal and lateral teeth are present. The somatocyst is cylindrical in shape, less than half the length of the nectosac, almost upright in position and slightly asymmetrical. The hydroecium is short, conical and not truncated as in *E. mitra.* Its basolateral margins are concave and each ends dorsally in a pronounced tooth. The mouth-plates are divided into two lanceolate wings, of which the right one is larger. The left wing has triangular flap, as in *E. mitra.*

The posterior nectophore is not developed.

Eudoxid phase (Text-fig. 13, A & B).—The bract has a length of 2.1 mm, and the gonophore is 3.25 mm in length. It is similar to that of *E. mitra* but the phyllocyst is relatively longer and cylindrical. There is no basal tooth on the margin of the neck-shield. The sutural surface of the bract forms at its base a right-angle with the dorsal wall of the hydroecium, so that the hydroecial cavity is not as deep as it is in *E. mitra.* Therefore, the gonophore does not develop a long pedicel but is truncate at its upper end. The four serrated ridges are twisted rather more than $\frac{1}{4}$ of a turn to the left or right, according to the order of budding.

Genus **Eudoxia** Eschscholtz, 1825

1825. *Eudoxia* Eschscholtz, *Okens Isis*, **16**, p. 743.

Eudoxia macra Totton, 1954 of unknown parentage was tentatively included by him in the Diphyidae, until the polygastric phase is known (*vide* Totton, 1965, p. 191). All eudoxids which have not so far been connected with the polygastric phase, are usually included in this genus till detailed identification with their respective polygastric phase has been firmly established. [Thus, the genus *Eudoxia* Huxley, 1859 is at present a very tentative one; in case *Eudoxia macra* Totton, 1954 is ultimately found to be quite distinctive from all other valid species and genera, then the genus *Eudoxia* becomes firmly established in its own right.]

Family 13. CLAUSOPHYIDAE Totton, 1865

Clausophyinae Bigelow, 1913
Heteropyramidinae Moser, 1925
Chuniphyinae Moser, 1925; Bigelow, 1931; Totton, 1954
Thalassophyinae Moser, 1925
Crystallophyinae Moser, 1925

Siphonophora with somatocysts in both anterior and posterior nectophores. Eudoxid with two longitudinal horns, or lateral branches of phyllocyst, lying in neck-shield of bract.

Chun (1897b) considered *Diphyes ovata* Kefferstein & Ehlers 1860 (= *Clausophyes ovata*) as a connecting link between the two families Prayidae and Diphyidae. Bigelow (1913, p. 71), however, poined out that *Clauosphyes* was really an offshoot of the Diphyidae basing his conclusion mainly on the anterior and posterior nectophores of *C. galeata* Lens & van Riemsdijk, 1908, which were unlike; and also because the somatocyst of the posterior nectophore was structurally like that of the anterior one in being a specialized organ deeply embedded in the gelatinous substance, whereas in Prayids it was merely a slight thickened extension of the canal system. As pointed out by Totton (1965) it is probable that the anterior nectophore of the Clausophyidae is the larval one retained and the posterior one is the first definitive heteromorph nectophore which develops a somatocyst, unlike those of Abylids. He therefore considered the Clausophyids to be more primitive than the Abylids and established this family Clausophyidae (based on the earliest known species of *Clausophyes*) to include the six mid-water species recognized till then in five subfamilies mentioned above.

The following valid genera are included in this Family : *Clausophyes* Lens & van Riemsdijk, 1908; *Chuniphyes* Lens & van Riemsdijk, 1908; *Crystallophyes* Moser, 1925; *Heteropyramis* Moser, 1925 and *Thalassophyes* Moser, 1925.

Key to the Genera of the Family Clausophyidae

1.	Nectophores pyramidal; somatocyst broad or spindle-shaped at base	2
	Nectophore smooth, rounded; somatocyst thin and long with spindle-shaped apical expansion	*Clausophyes*
2.	Somatocyst with thin, long median branch reading upto apex; ostial teeth present . ,	3
	Somatocyst with short median branch; no ostial teeth or mouth-plate	4
3.	Four ridges at apex, dividing dichotomously below to form eight ridges at base; somatocyst broad (butterfly shaped) at base; hydroecium not extending entire length of nectophore	*Chuniphyes*
	Five ridges at apex which do not divide dichotomously; somatocyst spindle-shaped; hydroecium extending almost entire length of nectophore	*Crystallophyes*
4.	Five ridges with opaque spots at apex and on lateral ridges	*Heteropyramis*
	Five ridges without opaque spots on lateral ridges	*Thalassophyes*

The genera *Chuniphyes* and *Heteropyramis* are represented in the collections.

Genus **Clausophyes** Lens & van Riemsdijk, 1908

1908. *Clausophyes* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 12.

Clausophyidae with anterior nectophore large, rounded at apex; a long stemmed somatocyst with spindle-shaped apical expansion; oblique ostium and long hydroecium bounded by two basoventral wings. Posterior nectophore larger with similar somatocyst and long open hydroecium extending entire length; lateral radial canals looped. Bract with rounded apex; phyllocyst with thick median branch and two lateral thin branches extending down to basal margin. Gonophore unknown.

Two species : *Clauophyes ovata* (Kefferstein & Ehlers, 1860) and *C. galeata* Lens & van Riemsdijk, 1908, are considered as valid.

Type species.—Clausophyes ovata (Kefferstein & Ehlers, 1860).

The anterior nectophores of *C. galeata* and *C. ovata* are indistinguhishable from each other. They are rounded and smooth; the somatocyst has a long, thin stalk and spindle-shaped expansion at its apex. Therefore the key is for the posterior nectophores only.

Key to species of Clausophyes

1. Nectophore having straight, not emarginated basal edge to mouth-plate; left hydroecial fold fits into a notch at basal edge of right-hand fold, with the notch being bounded on inner side by a prominence . . . . . *ovata*
2. Nectophore with posterior end thick and gelatinous; emarginated mouth-plate being concave on dorsal side; basal ends of hydroecial folds extending further than in *ovata;* basal end of right hydroecial wing thick and trihedral and overlaps left one . . . . . *galeata*

Both the above species are not represented in the present collections.

Genus **Chuniphyes** Lens & van Riemsdijk, 1908

1908. *Chuniphyes* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 13.

Clausophyidae with pyramidal anterior nectophore having four ridges at apex which divide dichotomously below; deep, broad conical hydroecium with broad ostium bounded by two ventral wings; somatocyst with broad base and long thin branch extending up to apex. Posterior nectophore longer, with or without the markedly asymmetrical ventrobasal teeth and thick mesoglea separating hydroecium from nectosac. Three-ridged at apex, dividing dichotomously at lower level. Hydroecium closed at apex by flaps from hydroecial wings and open below. Eudoxid phase with thin leaf-like folded bract; phyllocyst with thick median portion and two long longitudinal arms; gonophore with five ridges; flattened dorsoventrally.

Two species of *Chuniphyes* are recognized as valid : *C. multidentata* Lens & van Riemsdijk, 1908 and *C. moserae* Totton, 1954.

Type species : C. multidentata Lens & van Riemsdijk, 1908.

Key to species of Chuniphyes

1. Somatocyst with butterfly-shaped base and long, thin, apical branch . . . . . *multidentata*
2. Somatocyst with cylindrical base and irregularly shaped thin, apical branch . . . *moserae*

Both these species are represented in the collection.

Chuniphyes multidentata Lens & van Riemsdijk, 1908

(Text-fig. 13, I–P)

1908. *Chuniphyes multidentata* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 13, pl. 1, figs. 9–11; pl. II, figs. 12–15.

1911. *Chuniphyes multidentata :* Bigelow, *Trans. Linn. Soc. Lond. Zool.*, X, p. 348.

1911. *Chuniphyes multidentata :* Bigelow, *Mem. Mus. Comp. Zool. Harv.*, **38**, p. 262, pl. 8, fig. 9; pl. 10, fig. 7; pl. 12, fig. 6.

1913. *Chuniphyes multidentata :* Bigelow, *Proc. U.S. nat. Mus.*, **44**, p. 73.

1918. *Chuniphyes multidentata :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 425.

1919. *Chuniphyes multidentata :* Bigelow, *Bull. U.S. Nat. Mus.*, **100**(i,5), p. 344.

1925. *Chuniphyes multidentata :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 357, pl. 23, figs. 2–4; pl. 24, figs. 1,2.

1925. *Chuniphyes problematica :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 360, pl. XXIV, fig. 3; pl. XXV, figs. 1, 2 (eudoxid).

1930. *Chuniphyes multidentata :* Bigelow & Leslie, *Bull. Mus. Comp. Zool. Harv.*, **70**, pp. 560, 564, 566.

1931. *Chuniphyes multidentata :* Bigelow, *Zoologica*, N. Y. **8**(11), p. 566, text-fig. 208, 209.

1933. *Chuniphyes multidentata :* Leloup, *Res. Camp. Sci. Monaco.*, **87**, p. 39.

1934. *Chuniphyes multidentata :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 44.

1934. *Eudoxia problematica :* Leloup, *Bull. Mus. Hist. nat. Belg.*, **10**(6), p. 46, figs. 12, 13 (eudoxid).

1935. *Chuniphyes multidentata :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlant. Exped. 'Meteor'*, **12**(2), p. 17, carte 8.

1935. *Chuniphypes multidentata :* Hardy & Gunther, *Disc. Rep.*, XI, p. 105.

1936. *Chuniphyes multidentata :* Leloup, *Bull. Inst. Ocean.* No. 703, p. 10.

1936. *Chuniphyes multidentata :* Totton, *Zoologica*, N.Y., **21**(4), p. 234.

1937. *Chuniphyes multidentata :* Bigelow & Sears, *Sci. Rep. Danish. Oceanorg. Exped. Medit.* II. *Biology*, H. **2**, pp. 60, 122, figs. 48, 77.

1942. *Chuniphyes multidentata :* Kramp, *The 'Godthaab' Exped.* 1928. *Siphonophora. Medd. Gronland*, **80**, p. 8, fig. 1.

1954. *Chuniphyes multidentata :* Totton, *Disc. Rep.*, **27**, p. 131.

1955. *Chuniphyes multidentata :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.* 1910. *Siphonophora*, **5**(11), p. 12.

1965. *Chuniphyes multidentata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat Hist.), London, p. 194, text-fig. 132B.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5182	Pl. N.	Surface	2 ant. necto.	P 1740/1
V 5185	Ich. N.	1000–0	1 ,, ,,	P 1665/1
V 5186	,,	,,	1 ,, ,, ; 1 post. necto.	Gen.Coll.
V 5193	,,	,,	7 ,, ,, ; 2 ,, ,,	P 1738/1
V 5195	,,	,,	2 ,, ,,	P 1724/1
V 5196	Pl. N.	Surface	1 ,, ,,	P 1766/1
V 5199	,,	,,	2 ,, ,, ; 1 ,, ,,	Gen. Coll.
V 5201	Ring. T	1000.0	; 1 complete	,,
V 5207	I.K.T.	150–100	3 ,, ,, ex.	Gen. Coll.
V 5208	Ich. N.	,,	1 ,, ,,	P 1772/1
V 5216	,,	,,	2 ,, ,, ; 1 ,, ,,	Gen.Coll.
V 5223	J. N.	200–0	2 ,, ,,	,,

Type locality.—Malay Archipelago (SIBOGA Exped. Station no. 141 : Lat. 1°0.4′S, Long. 127°25.3′E).

Distribution.—This is a bathypelagic species recorded from the tropical and temperate regions of the Atlantic, Pacific and Indian Oceans (for details *see* Table I).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 13, I, J, M & N).—The dimensions of the nectophore and its parts are given below :

Nectophore,	Length :	18.01 mm;	Breadth :	7.0	mm
Somatocyst,	Length :	14.67 ,,	Breadth :	3.13	,,
Hydroecium,	Length :	5.67 ,,	Breadth at base :	7.0	,,
Nectosac,	Length :	9.47 ,,	Breadth :	3.2	,,
Ostium to Pedicular Canal,	Length :	3.2 ,,			

Except one complete example (anterior and posterior nectophores *intact*) from RV VITYAZ Station no. V 5201, the rest of the examples are very much contracted. The present description and measurements are based on this single good specimen.

The nectophore is firm, colourless (soon after preservation) and the ridges are beginning to darken (after 5 years in preservative). There are four ridges at the apex; the dorsal and pair of laterals branch dichotomously at a point 3–5 mm below the apex; the dorsal ridges end in inconspicuous teeth, while the dorsolaterals end in prominent teeth; the ventrolaterals end in a small pointed tooth at the edge of the hydroecium. There is a prominent tooth in the basal margin of each lateral wall of the hydroecium. The ventral ridge divides into two at the opening of the hydroecium and runs down, forming the two lateral edges of the hydroecium (as observed by Bigelow, 1931, p. 566, and by Moser, 1925, p. 358). All the ridges are finely serrated at the base. The shape of the somatocyst varies in different specimens. The characteristically butterfly-shaped somatocyst is present in most of the specimens (figured in Text-fig. 13, I, J & M). It consists of a pair of thick, curved arms embracing the nectosac and a thin, threadlike branch extending up to the tip of the nectophore. In some other examples (Text-fig. 13, N) the base of the somatocyst is in the form of a large, bilobed structure, as was previously also observed by Totton (his fig. 132B, 1965, p. 195). The somatocyst and the pedicular canal form a 'U' shaped loop within the hydroecium, and enter the nectosac at $\frac{1}{3}$rd the distance from the base.

The nectosac is about $\frac{1}{2}$ the length of the nectophore, and nearly cylindrical in shape. The lateral radial canals are looped apically but comparatively short. The hydroecium is large, wide and occurs from the base of the ventral ridge down to the basal hydroecial teeth. The lateral sides are flaplike. The stem and the cormidia are very much contracted and occur within the hydroecium.

Posterior nectophore (Text-fig. 13, K & L).—The nectophore has a length of 19.47 mm and a breadth of 6.47 mm; it is slightly longer than the anterior nectophore. There are three ridges at the apex; one dorsal and two ventrolaterals, each of which divide dichotomously lower down, so that there are six longitudinal ridges and six basal teeth. The dorsal ridge divides at a higher level than the ventrolaterals; the basal ends of all the ridges are faintly serrated. The two ventral teeth are broad, long and the left ventral tooth is longer than the other. The hydroecium is in the form of an open groove, but a broad flaplike structure measuring 4.3 mm in length and 3.0 mm in width from the right hydroecial wing, covers the proximal end. The flap on the left side is very much reduced. There is thick mesoglea separating the hydroecium from the nectosac, as also observed by Totton. The pedicular canal leading to the junction of the four radial canals is given off at a point 3.3 mm below the junction of the 'Stiel-canal' and the pallial canal.

Eudoxid phase (Text-fig. 13, O & P).—The bract has a length of 7.73 mm; the phyllocyst measures 5.67 mm in length. The asexual nectophore has a length of 9.4 mm and a breadth of 4.0 mm.

The bract is thin and membraneous. The lateral sides of the bract are rolled inwards in the preserved and detached bract; the right-hand side overlaps the other, thus forming a tubelike structure. The phyllocyst has a broad, thick, three-armed anterior portion and two, thin, threadlike longitudinal arms posteriorly. The left arm is longer than the other. Apically, the bract has a rounded deep notch in the middle.

Special nectophore (Text-fig. 13, O).—It has a pointed tip and the five longitudinal ridges are distinct due to the peculiar colouration. The dorsal and lateral ridges are complete, ending in teeth at the ostium. The ventrals are incomplete and terminate near the shallow depression. These occur again at the base as two short ridges which end in the two minor teeth near the ostium. A part of the stem and a siphon are found attached in the middle of this shallow depression.

Remarks.—The present record of a complete specimen (both the nectophores intact) definitely proves the identity of the posterior nectophore of this species which was hitherto uncertain.

Chuniphyes moserae Totton, 1954

(Text-fig. 13, Q; 14, A)

1954. *Chuniphyes moserae* Totton, *Disc. Rep.*, **27**, p. 131, text-fig. 66A.

1965. *Chuniphyes moserae :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 196, pl. XXXV, fig. 2; text-fig. 132A.

Material examined.—

Station. no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5216	Ich. N.	1000–0	1 anterior necto.	P 1589/1
V 5218	,,	,,	1 ,, ,, ; 1 (?) Post. necto.	Gen.Coll.

Type locality.—Lat. 58°35′S; Long. 92°06′2″E (DISCOVERY II Station no. 1639) from a depth of 2400–1150 metres.

Holotype.—Deposited in the British Museum (Nat. Hist.), bearing registered no. 1951.3.24.1.

Distribution.—Off Italian Somaliland; off Zanzibar, south and east coasts of Africa; south-east Indian Ocean.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 13, Q).—The nectophore has the following dimensions :

Nectophore	Length :	10.0	mm;	Breadth :	4.0 mm.
Somatocyst	Length :	5.0	,,		
Hydroecium	Length :	5.0	,,		
Nectosac	Length :	6.0	,,		
Ostium to pedicular canal	Length :	4.67	,,		

The two anterior nectophores present in the RV VITYAZ collections resemble *C. multidentata* in general colouration and in the number of ridges. The dorsolateral teeth are smaller than in *C. multidentata.* The division of the lateral ridges occurs near the apex

of the nectophore; nearer to the apex than was observed in *C. multidentata.* The somatocyst is not horizontally expanded at base as in *C. multidentata,* but typically fusiform or spindle-shaped. It has a broader base and tapering apical end. It does not possess short, irregularly shaped side-branches, whereas Totton (1954) had noted such side-branching. The hydroecium slopes upwards extending to $\frac{2}{3}$rd of the length of the nectophore and is broad at the ventrobasal sides. Therefore, the apical end of the hydroecium is at a higher level than the base of the somatocyst. The somatocyst and the pedicular canal do not form the 'U' shaped junction as in *C. multidentata.* The location of the protuberance for the attachment of the posterior nectophore, and the origin of the entry of the pedicular canal into the nectosac are well above the mid-level of the nectosac; unlike the condition of relationship of these structures in *C. multidentata.*

Posterior nectophore (Text-fig. 14, A).—There is a single posterior nectophore from RV VITYAZ Station no. V 5218, which undoubtedly belongs to this genus, but whose specific identity is not certain. The ventral teeth are symmetrical in size. There is a relatively thin wall of mesoglea separating the hydroecium from the nectosac. These two characteristics imply that the specimen probably belongs to this species.

Eudoxid phase.—Not at present distinguishable.

Genus **Crystallophyes** Moser, 1925

1925. *Crystallophyes Moser, Dtsch. Siidpol. Exped.*, **18**, ?.

Clausophyidae with anterior nectophore having five longitudinal ridges not dividing dichotomously; hydroecium extending entire length of nectophore having a pair of small pointed flaps on the inner edges of hydroecial wings; somatocyst with spindle-shaped base and thin, apical portion reaching upto the apex; mouth-plates minute. Posterior nectophore flattened dorsoventrally at proximal region; five longitudinal ridges not meeting in a point; the ventrals joining laterals at the apex. Eudoxid phase not recorded.

Monotypic genus for *C. amygdalina* Moser, 1925.

It is not represented in the present collections.

Genus **Heteropyramis** Moser, 1925

1925. *Heteropyramis* Moser, *Dtsch. Siidpol. Exped.*, **18**, p. 117.
1925. *Thalassophyes* Moser, *Dtsch. Siidpol. Exped.*, **18**, ?.

Clausophyidae with anterior nectophores five-ridged at apex; hydroecium extending $\frac{2}{3}$rd length of nectophore; series of opaque spots on dorsolateral ridges; somatocyst oblique and spindle-shaped below, and apically produced into a fine vertical tube; nectosac pear-shaped, less than half the length of the nectophore.

Eudoxid phase : Bract four-ridged with broad neck-shield into which penetrate two lateral longitudinal horns of phyllocyst. Gonophore five-ridged, with opaque spots on dorsolateral ridges and at tip of bract.

Monotypic genus for *H. maculata* Moser, 1925.

The eudoxid phase of the above species in represented in the collections.

Heteropyramis maculata Moser, 1925

1925. *Heteropyramis maculata* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 117, pl. II, text-figs. 26–28.
1932. *Heteropyramis maculata* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 347.
1934. *Heteropyramis maculata* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 52.
1954. *Heteropyramis maculata* Totton, *Disc. Rep.*, **27**, p. 137, text-figs. 70, 71.
1965. *Heteropyramis maculata* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 198, text-fig. 135.

Material examined.—One bract each were taken in hauls made from 200 metres to surface at RV VITYAZ Stations V 5212 & V 5232 using a Juday Net and IOSN apparatus respectively; the bract taken from RV VITYAZ Station V 5212 bears a registered number P 1662/1.

Type locality.—Antarctic Ocean, from a depth of 2000 metres.

Distribution.—Antarctic ocean; south Georgia (from a depth of 800 and 600 metres); Indian Ocean; Atlantic ocean (*see* Table 1).

Eudoxid phase (Text-fig. 14, B).—The bract, shown in the figure, has a length of 5.3 mm. The bracts are slightly crushed, but show clearly the typical phyllocyst of this species. The bract has four ridges; it is four-sided in the apical half and has a well developed neck-shield in the basal half. The bracteal cavity is deep and conical. The distal edges of the neck-shield end in four prominent tooth-like projections. The phyllocyst is in the form of three branches. The anterior apical branch has a broad thin-walled base which tapers into a threadlike portion reaching upto the tip of the bract. The two basal branches curve downwards into the neck-shield. There are no spots at the apex or at the bases of the dorsolateral ridges.

Remarks.—Totton (1965) is of the opinion that *H. maculata* Moser, 1925 (p. 117) and *Thalassophyes crystallina* Moser, 1925 (p. 367) are one and the same species. Except for the presence of opaque spots in the former and its absence in the latter, these two species are indistinguishable from one another. Further, the number and opacity of the spots varies from one specimen to another.

The present bracts resemble *H. maculata* (figured by Totton, 1954, p. 140, text-fig. 71A) in many respects, since no opaque spots are seen in both cases.

Genus **Thalassophyes** Moser, 1925

Clausophyidae with anterior nectophore very similar to *Heteropyramis*. Except for the opaque spots it is difficult to distinguish the anterior nectophore from that of *Heteropyramis*.

Monotypic genus for *T. crystallina* Moser, 1925.

This species is not represented in the present collections.

Family 14 SPHAERONECTIDAE Huxley, 1859

Calycophorae with a single, rounded nectophore; short, curved or straight somatocyst; large nectosac and a cylindrical or funnel-shaped hydroecium. Cormidia always separating as eudoxids.

The two genera of this family : *Sphaeronectes* Huxley, 1859 and *Monophyes* Claus, 1873, recognized by Haeckel (1888b) and by Chun (1892, 1897b) were distinguished mainly on the differences in the form of the hydroecium and somatocyst; these differences

are so slight that they can be only of specific importance. Therefore, Schneider (1898) and Bigelow (1911b) united them under the older name *Sphaeronectes*.

Bigelow divided this family into three subfamilies : Sphaeronectinae, Muggiinae and Nectopyramidinae. Since this arrangement did not reflect the natural relationship, later workers (Totton, 1932; Bigelow & Sears, 1937) recognized only a monotypic family Sphaeronectidae, and transferred Muggiinae and Nectopyramidinae to the families Diphyidae and Prayidae respectively.

In this study, the family Sphaeronectidae is considered as a monotypic family for the genus *Sphaeronectes* Huxley, which is represented in the present collections.

Genus **Sphaeronectes** Huxley, 1859

1853/54. *Diplophysa* Gegenbaur, *Zeitsch f. wiss. zool.*, **5**, p. 291 (eudoxid phase).
1859. *Sphaeronectes* Huxley, The Oceanic Hydrozoa. *Ray Soc.*, London, p. 50.
1874. *Monophyes* Claus, *Schriften zool. Inh. Wien.*, **1**, p. 29.

Diplophysa Gegenbaur, 1853b (eudoxid phase)

Monophyes Claus, 1873; Stepanyants, 1967

Sphaeronectidae with single rounded nectophores having short, curved or straight somatocyst; and high or shallow funnel-shaped hydroecium.

This genus had been studied by Claus (1873) and Chun (1892). The validity of the then known 5 species : *S.* (*Monophyes*) *gracilis* (Claus), *S. köllikeri* Huxley, *S.* (*Monophyes*) *irregularis* Claus, *S.* (*Monophyes*) *brevitruncata* Chun, and *S.* (*Monophyes*) *princeps*. Haeckel was discussed in detail by Chun (1892), Schneider (1898) and by Bigelow (1911b). Chun recognized the first four species mentioned above as valid while Schneider considered them to be of one varietal series. However, Bigelow recognized three species : *S. truncata* Will (= *S. gracilis*), *S. irregularis* and *S. princeps*.

Bigelow (1911b) agreed with Schneider (1898) in uniting *S. köllikeri* with *S. gracilis* since there was much individual variation in the nature of the curvature of the somatocyst. Applying the rules of priority they established *S. truncata* Will, 1844, relegating *S. gracilis* and *S. köllikeri* as its synonyms since the eudoxid phase of a species of *Sphaeronectes* had already been described as *Ersaea truncata* by Will (1844). But Totton (1965) was of the opinion that the eudoxid described by Will could either belong to *S. gracilis* or to *S. irregularis* since they both occur in the Mediterranean Sea. Therefore he reinstated *S. gracilis* Claus, 1873 as valid, and included *S. köllikeri* as its synonym and treated *S. truncata* as a doubtful synonym.

The differences between *S. irregularis* and *S. brevitruncata* were so slight, based on variable characters such as the size of the somatocyst and number of groups of cormidia, that these two species were united by Bigelow (1911b) under the older name *S. irregularis* Claus.

The third species described by Haeckel from the Indian Ocean as *Monophyes princeps* had not been discussed by Chun (1892), Schneider (1898) or by Totton (1965). Bigelow (1911b) was of the opinion that, "in case the characters such as the high nectosac (higher than in *S. irregularis*) and the hydroecium in the form of a mere groove, prove constant and that the specimen was in fact a Monophyid, *S. princeps* would deserve recognition." However, this species has not been recorded since Haeckel described it in 1888. To these species, two more species *S. gamulini* Carre, 1966 and *S. japonica* (Stepanyants, 1967) were added.

This genus thus includes *S. gracilis* (Claus, 1873); *S. irregularis* (Claus, 1873); *S. princeps* Haeckel, 1888; *S. gamulini* Carre, 1966 and *S. japonica* (Stepanyants, 1967). *S. japonica* resembles *S. irregularis* in many respects. The validity of *S. princeps* and *S. japonica* needs confirmation.

In *S. princeps* Haeckel, (1888b) the hydroecium occurs as a mere groove, bounded by two hydroecial lobes and the somatocyst is upright with the nectosac deep.

Stepanyants (1967) described a new species *Monophyes japonica* in which the hydroecium is funnel-shaped, wide-open on the dorsal wall; the somatocyst is as in *S. irregularis* but differs from it in the form and nature of the curves of the radial lateral canals of the nectosac. As discussed earlier under the Family Sphaeronectidae, the generic name *Monophyes* has been synonymised under *Sphaeronectes*, and is therefore considered by me as a species of *Sphaeronectes*.

Type species.—*S. gracilis* (Claus, 1873).

Key to species of Sphaeronectes

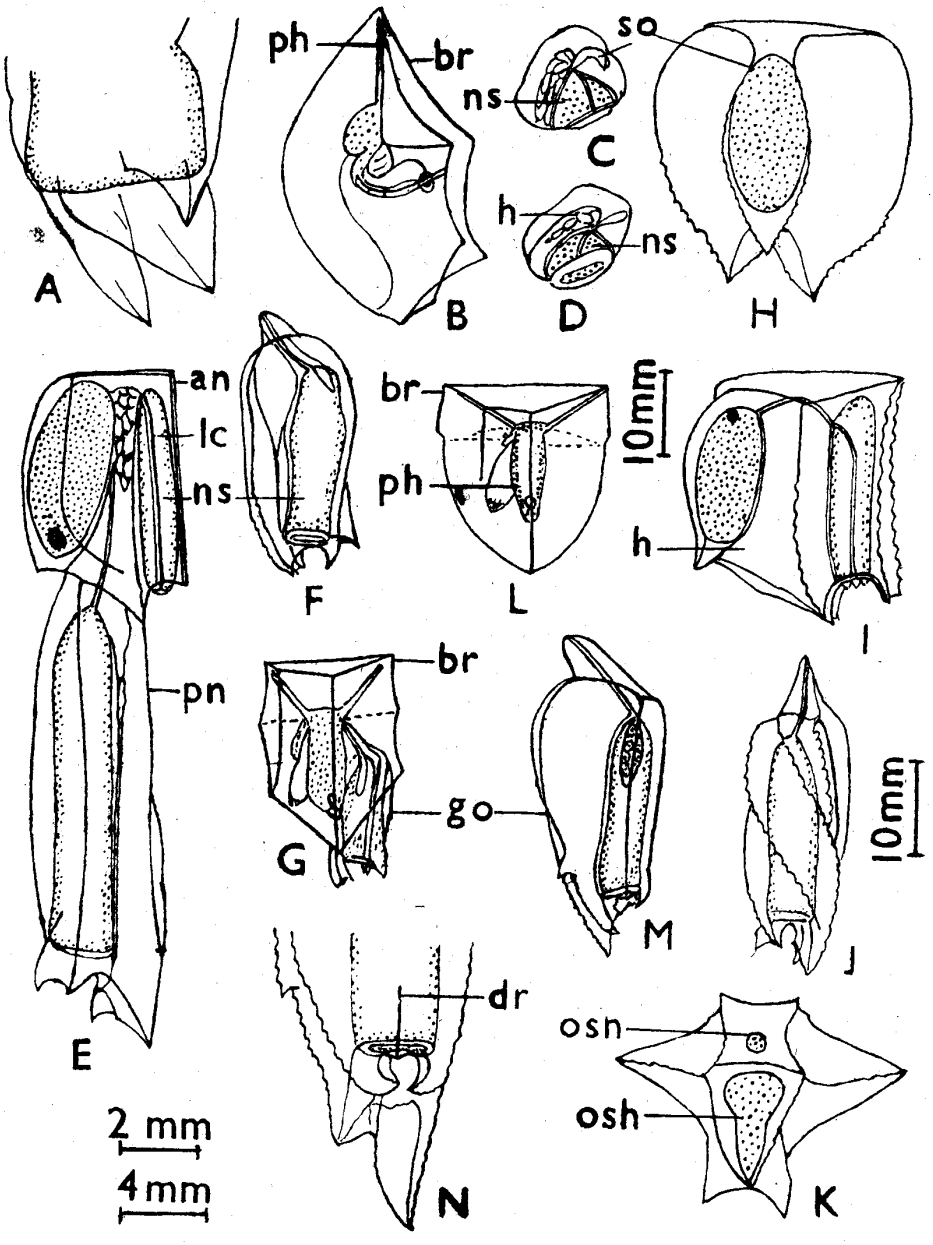
1. Nectophore with shallow hydroecium, open wide on dorsal side 2
   Nectophore with deep hydroecium, cylindrical, not open wide on dorsal side; somatocyst usually curved; lateral radial canals of nectosac not bowed . . . . . *gracilis*
2. Somatocyst upright with indistinct stalk; nectosac large, with bowed lateral radial canals . . . . . *irregularis*
   Somatocyst lying horizontally across nectosac, with distinct thin stalk and globular tip . *gamulini*

Only *S. gracilis* is present in the collections.

Sphaeronectes gracilis (Claus, 1873)

(Text-fig. 14, C & D)

1844? *Ersaea truncata* Will, *Hora Tergestinae....der im Herbste* 1843 *bei Trieste beobacteten Acalephen*, Leipzig, p. 82, taf. 2, fig. 28 (eudoxid).
1853. *Diplophysa inermis* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 105.
1853. *Diplophysa inermis :* Gegenbaur, *Z. Wiss. Zool.*, **5**, p. 291.
1859. *Sphaeronectes kollikeri* Huxley, *The Oceanic Hydrozoa.* Ray. Soc. London, p. 50, pl. 3, fig. 4.
1873. *Diplophysa inermis :* Claus, *Nacht. Ges. Wiss.* Gottingen for 1873, p. 27, taf. 4, figs. 1–4.
1873. *Monophyes gracilis :* Claus, *Nacht. Ges. Wiss.* Gohingen for 1873, p. 258.
1874. *Monophyes gracilis :* Claus, *Schriften Zool. Inh.* Wien., **1**, p. 30, taf. 4, figs. 8–10.
1874. *Praya inermis :* Metschnikoff, *Z. Wiss. Zool.*, **24**, p. 46.
1880. *Sphaeronectes* (*Monophyes*) *inermis :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **6**, p. 144, pl. 3, fig. 6.
1881. *Diplophysa inermis :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **8**, p. 166, pl. 6, fig. 12.
1885. *Monophyes gracilis :* Chun, *S. B. preuss. Akad. Wiss.* for 1885, p. 265, taf. 2, figs. 1, 2.
1888. *Sphaeronectes gracilis :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1154.
1888. *Diplophysa truncata :* Haeckel, *Jena Z. naturw.*, **22**, p. 32.
1888. *Diplophysa kollikeri :* Haeckel, *Jena Z. naturw.*, **22**, p. 32.
1888. *Monophyes kollikeri :* Haeckel, *Jena Z. naturw.*, **22**, p. 34.
1888. *Diplophysa inermis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 107.
1888. *Diplophysa kollikeri :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 108.
1888. *Sphaeronectes kollikeri :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 130.
1888. *Sphaeronectes gracilis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 130.
1889. *Sphaeronectes gigantea :* Fewkes, *Bull. Essex Inst.*, **21**, p. 119.
1892. *Diplophysa inermis :* Chun, *Abh. Senckenb. naturf. Ges.*, **18**, p. 85.
1898. *Sphaeronectes truncata :* Schneider, *Zool. Anz.*, **21**, p. 75 (in part).
1899. *Sphaeronectes kollikeri :* Agassiz & Mayer, *Bull. Mus. Comp. Zool.*, Harv., **32**, p. 177, pl. 17, fig. 53.
1900. *Sphaeronectes gracilis :* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 73, pl. 27, fig. 89.



TEXT-FIGURE 14

Chuniphyes moserae : A
A—posterior nectophore—ostial teeth.
Heteropyramis maculata : B
B—eudoxid phase : bract.
Sphaeroonectes gracilis : C, D
C—nectophore with bent somatocyst. D—nectophore with straight somatocyst.
Ceratocymba leuckarti : E—G
E—anterior and posterior nectophores intact. F—gonophore. G—bract.
Ceratocymba dentata : H—N
H—anterior nectophore : ventral view. I—anterior nectophore : lateral view.
J—posterior nectophore. K—anterior nectophore : ostrial view. L—bract
M—gonophore. N—posterior nectophore : ostial teeth.
Abbreviations used :
an—anterior nectophore. br—bract.Tdr—dorsal ridge. go—gonophore. h—hydroecium
lc—lateral radial canal. ns—nectosac. osh—ostium of hydroecium. osn—ostium of nectosac.
ph—phyllocyst. pn—posterior nectophore. so—somatocyst.

1911. *Sphaeronectes truncata :* Bigelow, *Mem. Mus. Comp. Zool.*, Harv., **38**, p. 184.

1965. *Sphaeronectes gracilis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), Lond, p. 202, pl. XXXVI, fig. 1;, text-figs. 137, 138.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
K 35	N. N.	200–0	1 nectophore	Gen.Coll.
K 44	,,	,,	7 ,,	,,
K 525	,,	,,	1 ,,	,,

Type locality.—Mediterranean.

Distribution.—Mediterranean Sea; Pacific Ocean; Atlantic Oceans (generally found in the warmer waters of the three oceans) for details *see* Table 1.

Description.—Polygastric phase (Text-fig. 14, C & D).— The nectophores have a breadth of 4.0 mm; the hydroecium is 3.0 mm long; the somatocyst is 1.0 to 2.0 mm in length; the nectosac is 2.0 mm long.

The nectophore is nearly globular in shape. It is soft and the exterior is rather adhesive such that sand and other particles stick to the surface, rendering examination of its interior difficult. Of the nine examples in the collection, five have curved somatocysts while in the others this structure is somewhat straight. These are inclined towards the nectosac. The curved somatocyst is bent towards the nectosac as in "*S. köllikeri*", reaching nearly the outer surface of the nectophore. The hydroecium is deep, tubular in shape and the opening is round and narrow. The apex of the hydroecium is above the level of the apex of the nectosac. The nectosac is small, broad with a large ostium, and it has a well-developed velum. The lateral radial canals are simple, straight and not conspicuously arched or bowed.

The stem and the cormidia are very much contracted and occur within the hydroecium in a crowded manner.

Eudoxid phase.—is not present.

Family 15 ABYLIDAE L. Agassiz, 1862

Abylidae L. Agassiz, 1862; Haeckel, 1888; Totton, 1932, 1954, 1965; Leloup, 1934.
Abylinae Lens & van Riemsdijk, 1908; Bigelow, 1911b; Moser, 1925; Sears, 1953.

Calycophorae with two dissimilar nectophores, anterior one smaller, prismatic with hydroecium closed on ventral side to form a tube which opens below; somatocyst placed on dorsal side of hydroecium (except in *Bassia*); posterior heteromorph definitive nectophore larger, bearing large teeth or comb on hydroecial wing, long apophysis which fits into hydroecial tube (except in *Enneagonum*, where no posterior nectophore is developed), and without somatocyst. Cormidia always separating as eudoxids with large gonophores; special nectophores absent.

The older workers recognized two subfamilies : Abylinae L. Agassiz; and Ceratocymbinae Moser, of the Family Diphyidae (Bigelow, 1911b, 1931; Moser, 1925), except Totton (1932) and Leloup (1934) who elevated Abylinae to the status of a Family. Totton (1954) agreed with Sears (1953) in not recognizing the Subfamily Ceratocymbinae of Moser as valid. The genus *Ceratocymba* considered as monotypic for the species *C. sagittata* Quoy & Gaimard, with peculiar prolongations of the apex of the superior nectophore hardly seemed sufficient reason to warrant a special subfamily. She agreed with Totton (1932) who showed its close relationship to the genus *Abyla*. Further, Sears transferred two species *A. leuckarti* Huxley and *A. dentata* Bigelow, until then

included under *Abyla*, to the genus *Ceratocymba* and described a new species *C. intermedia* which formed a well-defined transition from a species with no apical prolongation (species of *Abyla* and *C. leuckarti* and *C. dentata*) to a marked one as seen in *C. sagittata*. Kikewise, in agreement with Totton's view the later workers (Leloup, 1934; Bigelow & Sears, 1937; Sears, 1953) transferred the genus *Enneagonum*—a true monophyid—from the Family Monophyidae (Bigelow, 1911b, see *Cuboides*) to this Family Abylidae, leading to a more natural grouping of the heterogenous genera.

Sears (1953) described some new genera and species as *Pseudabyla irregularis*, *P. dubia*, *Pseudocymba asymmetrica*, *P. anomala*, *Abylopsoides ventralis*, *A. dorsalis*, *A. basalis* and *Pseudobylopsis anomala* which, according to Totton (1954) belong to species of *Abyla*, *Ceratocymba* or *Abylopsis*, whose development have been abnormal. In all these species certain portion of the nectophore is either so suppressed or overgrown that they do not have the appearance of normal healthy specimens, and so rare, that they are probably freaks.

The Family is divided into two subfamilies : Abylinae L. Agassiz (for *Abyla* and *Ceratocymba*) and Abylopsinae Totton (for *Abylopsis*, *Bassia* and *Enneagonum*).

Subfamily (i) *Abylinae* L. Agassiz, 1862

Cymbonectinae Haeckel, 1888 (*partim*)
Lens & van Riemsdijk, 1908
Diphyabylinae Lens & van Riemsdijk, 1908
Ceratocymbinae Moser, 1925
Abylinae Totton, 1932; 1954.

Abylidae with anterior nectophore having a rectangular apical facet.

Key to genera of Abylinae

ANTERIOR NECTOPHORE :

1. Anterior nectophore with apical facet divided by a transverse ridge . . . . . *Abyla*
2. Anterior nectophore with apical facet not divided by a transverse ridge . . . . *Ceratocymba*

POSTERIOR NECTOPHORE :

1. Left lateral ridge running down to mid-dorsal tooth and not to left tooth; dorsal ridge absent . . . . . *Abyla*
2. Left and right lateral ridges terminating on lateral teeth and a short dorsal ridge terminating in dorsal tooth . . . . . *Ceratocymba*

EUDOXID :

1. Eudoxid is an "amphiroa", *i.e.*, bract with rectangular dorsal facet; thick posterior branch of phyllocyst not recurved at its tip . . . . . *Abyla*
2. Eudoxid is a "cymba", *i.e.*, bract flattened with a prominent ridge on median dorsal side; the tip of posterior branch of phyllocyst recurved . . . . . *Ceratocymba*

Both genera are represented in the present collections.

Genus **Ceratocymba** Chun, 1888

1827. *Cymba* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 16.
1830. *Nacella* Blainville, *Dict. Sci. Nat.*, **60**, p. 120.
1888. *Ceratocymba* Chun, *S. B. preuss. Akad. Wiss.* for 1888, p. 1160.
1908. *Diphyabyla* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 36.

1911. *Diphyabyla* Bigelow, *Mem. Mus. comp. Zool. Harv.*, **38**, p. 231.
1932. *Diphyabyla* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 332.
1953. *Pseudocymba* Sears, *Bull. Mus. Comp. Zool. Harv.*, **109**, p. 72.

Abylinae with apical facet of anterior nectophore not divided by a transverse ridge; posterior nectophore with short, median dorsal ridge terminating in dorsal tooth; left and right dorsolateral ridges terminating in lateral teeth; eudoxid is a 'cymba'.

The genus *Ceratocymba* includes the following species : *C. leuckarti* (Huxley, 1859); *C. dentata* (Bigelow, 1918); *C. intermedia* Sears, 1953; *C. sagittata* Quoy & Gaimard, 1827 and a new species *C. indica*, described in this report.

Type species.—*C. sagittata* Quoy & Gaimard, 1827.

Key to species of Ceratocymba

ANTERIOR NECTOPHORE :

1.	Nectophore not produced apically into a pointed tip	2
	Nectophore produced apically into a pointed tip	3
2.	Apical facet flat; lateral ridges not expanding into wings; finely serrated	*leuckarti*
	Apical facet concave; lateral ridges expanding into wings; strongly serrated	*dentata*
3.	Nectosac twice as long as hydroecium	4
	Nectosac one half as long as hydroecium	*intermedia*
4.	Nectophore triangular; nectosac reaching nearly upto apex of nectophore	*sagittata*
	Nectophore not triangular, with a constriction at level of somatocyst; nectosac reaching mid-level of elongated portion of nectophore	*indica* n.sp.

POSTERIOR NECTOPHORE :

1.	Nectophore 3–4 times as long as it is wide; narrow	2
	Nectophore equal or slightly longer than anterior nectophore; broad	3
2.	Soft and slender; finely serrated; 5–6 comb-teeth on right hydroecial wing	*leuckarti*
	Nectophore firm and slender, strongly serrated; 15–16 comb-teeth on right hydroecial wing	*dentata*
3.	Left ventral tooth long; 6–7 comb-teeth on right hydroecial wing	*sagittata*
	Left ventral tooth twice as long as in *C. sagittata;* four comb-teeth on right hydroecial wing	*indica* n.sp.

(*N.B.*: The posterior nectophore is not known in *C. intermedia.*)

EUDOXID PHASE :

1.	Bract with incomplete ridge on left side	2
	Bract with complete ridge on left side	*leuckarti*
2.	Bract broad, ridge not reaching base	*dentata*
	Bract slender; ridge not reaching apical facet	*sagittata*

(*N.B.*: Bracts are not known in *C. intermedia* and *C. indica.*).

Except *C. intermedia*, the rest of the species are represented in the present collections.

Ceratocymba leuckarti (Huxley, 1859)

(Text-fig. 14, E–G)

1859. *Abyla leuckarti* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 49, pl. 3, fig. 2.
1898. *Enneagonum leuckarti :* Schneider, *Zool. Anz.*, **21**, p. 93.

1902. *Abyla leuckarti :* Agassiz & Mayer, *Mem. Mus. Comp. Zool.* Harv., **26**, p. 165 (in part.).

1908. *Ceratocymba assymetrica* Lens & van Riemsdiik, *Siboga Exped.*, **9**, p. 9, pl. 1, figs. 2–5; text-figs. 7–11, (eudoxid).

1908. *Abyla leuckarti :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 34, pl. 5, figs. 42–46; text-figs. 41–45.

1911. *Abyla leuckarti :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 216, pl. 13, figs. 5–8; pl. 15, figs. 3, 4.

1913. *Abyla leuckarti :* Moser, *Zool. Anz.*, **41**(4), p. 149.

1915. *Abyla leuckarti :* Kawamura, *Zool. Mag.* Tokyo, **27**, p. 580, pl. 15, figs. 29–31.

1918. *Abyla leuckarti :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 409.

1919. *Abyla leuckarti :* Bigelow, *Bull. U.S. nat. Mus.*, **100**(i,5), p. 333.

1925. *Abyla leuckarti :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 288, pl. 17, figs. 4–6.

1925. *Abyla leuckarti :* Totton, *Ann. Mag. nat. Hist.* London, **9**(16), p. 448.

1926. *Abyla leuckarti :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), (2)**19**, p. 62.

1931. *Abyla leuckarti :* Bigelow, *Zoologica*, N.Y. **8**(11), p. 543.

1932. *Abyla leuckarti :* Leloup, *Bull. Mus. Hist. nat.* Belg. **8**(11), p. 22.

1932. *Abyla leuckarti :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 332, text-fig. 17A.

1953. *Ceratocymba leuckarti :* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 67.

1954. *Ceratocymba leuckarti :* Totton, *Disc. Rep.*, **27**, p. 16.

1955. *Abyla leuckarti :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.* 1910. *Siphonophores*, **5**(11), p. 8

1963. *Ceratocymba leuckarti :* Daniel & Daniel, *J. Mar. Biol. Assoc.* India, **5**(2), p. 215, fig. VIII, 8–11.

1965. *Ceratocymba leuckarti :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 205, pl. XXXVI, figs. 2–5, 7; text-figs, 139, 141B.D.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5207	I.K.T.	150–100	6 ant. necto.; 3 eudox.	P 1648/1
V 5217	J.N./IOSN	200–0	8 ,, ,, ; 2 ,,	P 1578/1
V 5218	Pl. N.	Surface	1 ,, ,, ; 1 ,,	Gen.Coll.
V 5220	IOSN	200–0	4 ,, ,, ; 1 ,,	P 1674/1
K 1	N. N.	,,	1 ,, ,, ; 1 ,, ; 1 complete ex.	Gen.Coll.
K 8	,,	,,	1 ,, ,, ; 1 ,,	,,
K 15	,,	,,	1 ,, ,, ; 3 ,,	,,
K 32	,,	,,	1 ,, ,, ; 2 ,, ; 1 ,, ,,	,,
K 36	,,	,,	1 ,, ,, ; 2 ,,	,,

Type locality.—East coast of Australia (South Pacific).

Distribution.—Warmer belts of all the three major oceans (for details of localities *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 14, E, an.).—

Size :	Length : 4.7 mm	Breadth :	2.8 mm
Somatocyst :	,, 2.6 ,,		
Nectosac :	,, 3.5 ,,		
Hydroecium :	,, 3.85 ,,		

The anterior nectophore is laterally flattened and has six facets arranged around its logitudinal axis. The single apical facet is flat; the facet cuts the dorsal and ventral

ones nearly at right angles. The apical and the dorsal facets are rectangular in shape. The ventral facet is narrow and ends in a pointed tip at the base. The large lateral facets are incompletely and unequally divided into two by the incomplete lateral ridges, which occur nearer to the ventral side than in the other species. The ventral and the lateral ridges are more than $\frac{2}{3}$rd serrated, while the dorsal ones are serrated only at the base. The dorsal ridges and the ventrolateral facets end in four serrated teeth around the ostium of the nectosac. The somatocyst, hydroecium and the nectosac are arranged parallel to the long axis of the nectophore and the apices of these lie at the same level. The somatocyst is smaller than the hydroecium or the nectosac, oval in shape and lies within the ventral facet. The hydroecium is slenderly conical in shape and lies between the somatocyst and nectosac and has a triangular mouth-opening. The nectosac is cylindrical in shape. The pedicular canal runs over the apex of the hydroecium to the nectosac. The radial canals are simple, straight and have small enlargements (*rete*) at the junction of the circular canal.

The stem is very much contracted.

Posterior nectophore (Text-fig. 14, E, pn.).— It measures 11.83 mm in length and is 2.33 mm broad. It is laterally flattened, slender, and long (about 4 times as long as wide). The dorsal ridge is very faintly marked and ends in a tooth at the base; the left lateral ridge is displayed towards the dorsal side; the two lateral ridges end in teeth and occur close to the dorsal tooth. The hydroecial wings also end in teeth of which the left one is slightly larger than the other. All the ridges are serrated at the base. About 5–6 comb-teeth occur on the inner apical thickened region of the right hydroecial wing. Its basal edge bears 5–6 denticulations. The left hydroecial wing does not bear any marked denticulation.

Eudoxid phase (Text-fig. 14, F & G).—The bract measures 5.0 mm in length and is 3.75 mm broad. The gonophore is 7.5 mm in length. There are five facets; the apical and basal facets are flat and nearly rectangular in shape; the upper surface of the bract is convex and has two ridges—the median dorsal ridge is prominent and complete, the left lateral ridge is also complete extending from the apical facet down to the edge of the lateral facet. The bract is highly asymmetrical. The phyllocyst has three branches : two threadlike thin branches are directed apically towards the apical angles of the bract; the other branch is thicker, and lies just below the dorsal ridge with its posterior tip curved upwards. The cavity of the bract is not very deep; it is conical in shape and bounded on the ventral side by a rectangular basal facet. The tip of the bract is serrated.

Gonophore (Text-fig. 14, G).—It has five ridges, of which the dorsal ridge is short extending from the mid-region to the dorsal tooth. The two lateral ridges are complete originating just above the apex of the nectosac and end in two pointed teeth at the base as in the posterior nectophore. The ventral ridges are slightly expanded to form the hydroecial wings, having marked denticulations at their basal edges. Two gonophores developed from the same bract are mirror images of each other. Its apophysis is small and peglike.

Ceratooymba dentata (Bigelow, 1918)

(Text-fig. 14, H–N)

1918. *Abyla dentata* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 409, pl. 5, figs. 1–4.

1925. *Abyla quadrata* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 293, pl. 17, figs. 1–3; pl. 8, figs. 1–5; pl. 19, figs. 1, 2; text-fig. 41.

1932. *Abyla dentata :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 334, text-fig. 14A, 15A.

1936. *Abyla dentata :* Totton, *Zoologica*, N.Y., **21**(4), p. 233.

1949. *Abyla dentata :* Moore, *Bull. Bingham Oceanogr. Coll.*, XII(2), p. 12.

1953. *Ceratocymba dentata :* Sears, *Bull. Mus. Comp. Zool.*, **109**(1), p. 69, figs. 19C,E,E & 21.

1954. *Ceratocymba dentata :* Totton, *Disc. Rep.*, **27**, p. 1152, pls. X, XI; text-figs. 80, 81.

1965. *Ceratocymba dentata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 207, pl. XXXVIII, figs. 1–3.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5179	I.K.T.	450–150	7 ant. necto.; 1 post. necto.; 2 eudox.	P 1629/1
V 5195	Ich. N.	1000–0	1 ,,	Gen.Coll.
V 5207	I.K.T.	150–100	2 ,, ,, ; 1 ,, ,,	,,
V 5211	Ich. N.	1000–0	1 complete ex.	P 1720/1
V 5212	I.K.T.	150–100	3 ant. necto.; 1 bract	P 1601/1
V 5220	I.K.T.	120–70	6 ,, ,,	Gen.Coll.

Type locality.—Lat. 32°33′N; Long. 72°14′W—line Chesapeake Bay to Bermusa (Western Atlantic).

Distribution.—Warmer belts of the Atlantic, Pacific and Indian Oceans (for details *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 14, H, I & K). The anterior nectophore has the following measurements : Length 9.0 mm; breadth, 7.67 mm; Somatocyst Length, 5.1 mm; Hydroecium, 7.67 mm; Nectosac, 6.53 mm.

The nectophore is nearly cuboidal and has pronounced lateral ridges which are expanded into wings. It is opaque; it lacks the horizontal and transverse apical ridges. The most distinctive feature is the triangular dorsal facet with strongly bowed and heavily serrated lateral margins. The serrations are in the form of strong denticulations. Its apex together with the portions of the adjacent facets is produced to form a short peak. The apex of the nectosac is slightly higher than the apices of the somatocyst and hydroecium. The apical facet is square in shape and is deeply concave.

Posterior nectophore (Text-fig. 14, J & N).—It is 35.0 mm long and 10.0 mm broad. It is at least three times as long as wide and opaque. The ridges are pronounced and highly serrated. The dorsal ridge is vestigeal and the dorsal tooth is large, strong and thrust forward. There are 16 teeth on the comb of the right ventral wing which are smaller in size compared to other species. The basal thickened margin of the ventral wings are prominently denticulated with seven spiny teeth on the inner edge of the left ventral wing and serrated outer margin. There are about 6–7 similar teeth on the right ventral wing also. The supernumerary ridge on the left ventral wing runs full length of the nectosac and is almost as pronounced as the other wing.

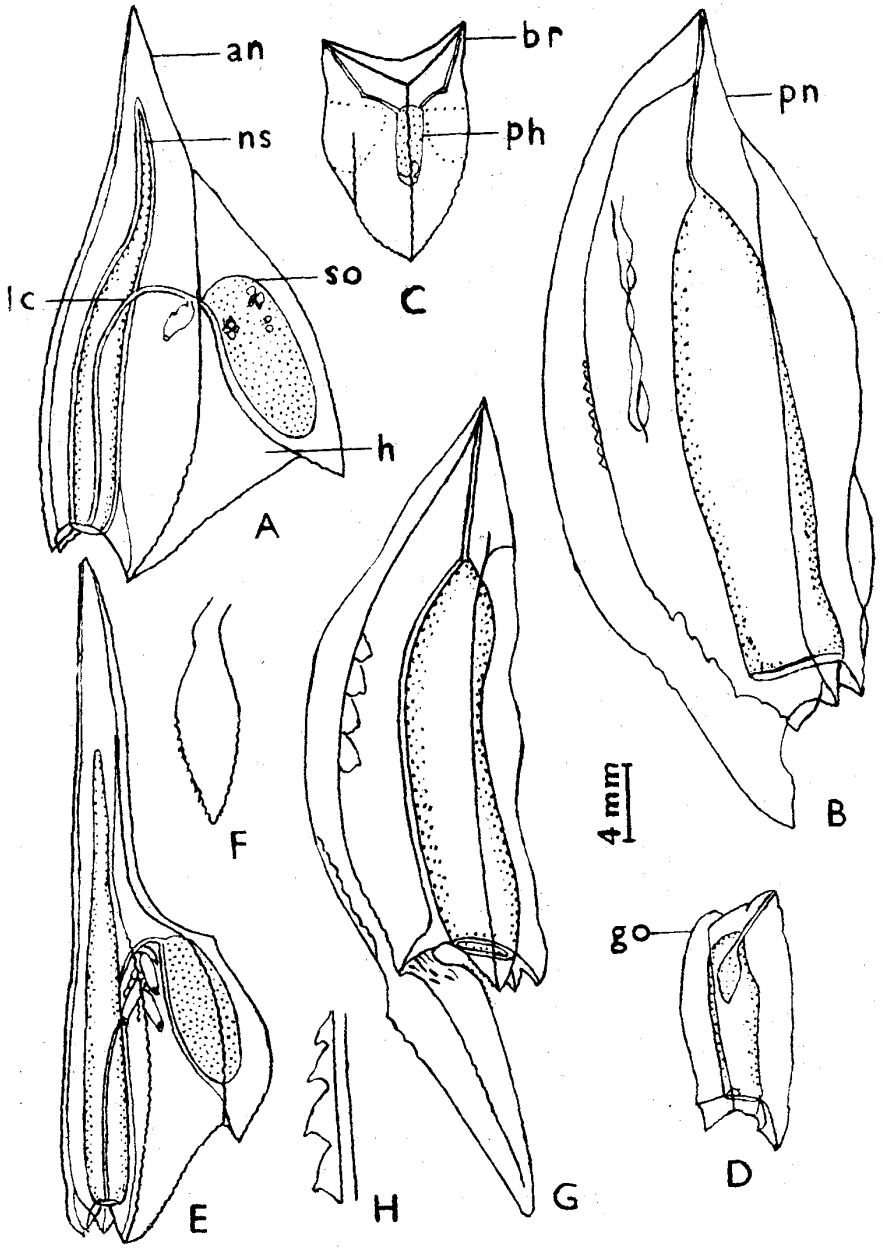
Eudoxid phase.—Bract (Text-fig. 14, L).—The bract is 20.0 mm long and is 18.0 mm broad. It is large, as wide as long, strong and opaque. The dorsal ridge is arched and prominent. The left lateral ridge is incomplete, always joining the apicodorsal ridge but not the basal margin. The descending branch of the phyllocyst occupies only the anterior half of the bract.

Gonophore (Text-fig. 14, M).—It has a length of 11.3 mm. The lateral ridges are strongly serrated for more than half their length. A large conspicuous hook-like tooth arises from one of the ventral wings, it is curved inwards towards the floor of the hydroecium. The teeth surrounding the ostium are large. The apex of the gonophore is broader than the lower half, the left ventral tooth is larger than the other. The gonophores occur in pairs which are mirror-images of each other.

Ceratocymba sagittata (Quoy & Gaimard, 1827)

(Text-fig. 15, A–D)

1827. *Cymba sagittata* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 16, pl. 2C, figs. 1–9.
1829. *Cymba sagittata ;* Eschscholtz, *System der Acalephen.* Berlin, p. 134.
1830. *Nacella sagittata :* Blainville, *Dict. Sci. Nat.*, Paris, **60**, p. 120.
1834. *Nacella sagittata :* Blainville, *Manuel d' actinologie ou de Zoophytologie*, Paris. p. 131, pl. 4, fig. 2.
1834. *Diphyes cymba* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'....de M. J. Dumont D'Urville. Zool.*, **4**, *Atlas, Zoophytes*, p. 95.
1834. *Diphyes nacella* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe'....de M. J. Dumont D'Urville. Zool.*, **4**, *Atlas, Zoophytes*, p. 5, figs. 12–17.
1843. *Cymba sagittata :* Lesson, *Acalephs Histoire naturelle des Zoophytes*, Paris, p. 454.
1888. *Ceratocymba spectabilis :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1160.
1888. *Ceratocymba sagittata :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1162.
1897. *Ceratocymba sagittata :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 33.
1898. *Enneagonum sagittatum :* Schneider, *Zool. Anz.*, **21**, p. 92.
1902. *Abyla leuckarti* Agassiz & Mayer, *Mem. Mus. Comp. Zool.* Harv., **26**, p. 165 (in part).
1904. *Ceratocymba sagittata :* Bedot, *Res. Camp. Sci.* Monaco., **27**, p. 5, pl. 1, figs. 1–3.
1908. *Diphyabyla hubrechti* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 36, pl. 6, fig. 47; text-figs. 46–51.
1911. *Ceratocymba sagittata :* Moser, *Zool. Anz.*, **38**, p. 431.
1911. *Diphyabyla hubrechti :* Moser, *Zool. Anz.*, **38**, p. 431.
1911. *Diphyabyla hubrechti :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 231, pl. 12, fig. 7.
1912. *Ceratocymba sagittata :* Moser, *Sitz. Ges. Nat.* Berlin, 1912, **10**, figs. 22, 23.
1912. *Ceratocymba sagittata :* Moser, *Verhandt. Dtsch. Zool. Ges.*, **22**, p. 408.
1913. *Ceratocymba sagittata :* Moser, *Zool. Anz.*, **41**(4), p. 149.
1918. *Ceratocymba sagittata :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 411, pl. 5, fig. 5; pl. 6, figs. 1–3; pl. 7, figs. 1–5.
1925. *Ceratocymba sagittata :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 269, text-fig. 40; pls. 15, 16, figs. 1–5.
1925. *Ceratocymba sagittata :* Totton, *Ann. Mag. nat. Hist.* London, **9**(16), p. 446.
1926. *Ceratocymba sagittata :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), (2)**19**, p. 65.
1931. *Ceratocymba sagittata :* Bigelow, *Zoologica*, N.Y., **8**(11), p. 548.
1932. *Ceratocymba sagittata :* Leloup, *Bull. Mus. Hist. nat.* Belg., **8**(11), p. 18.
1932. *Diphyabyla hubrechti :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 332.
1932. *Ceratocymba sagittata :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 332.
1933. *Ceratocymba sagittata :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 19.
1934. *Ceratocymba sagittata :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 54.
1935. *Ceratocymba sagittata :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. Atlantic Exped. 'Meteor'*, **12**(2), p. 19, carte 3.
1936. *Ceratocymba sagittata :* Totton, *Zoologica*, N.Y., **21**(4), p. 233.
1937. *Ceratocymba sagittata :* Bigelow & Sears, *Rep. Danish. Oceanogr. Exped. 'Medit'*. II. *Biology*, H. **2**, pp. 28, 96, fig. 68.
1939. *Ceratocymba sagittata :* Bigelow & Sears, *Mem. Mus. Comp. Zool.* Harv., **54**(4).
1949. *Abyla sagittata :* Moore, *Bull. Bingham Oceanogr. Coll.* XII(2), p. 13.
1954. *Ceratocymba sagittata :* Totton, *Disc. Rep.*, **27**, p. 16, text-figs. 79B, D.
1955. *Ceratocymba sagittata :* Leloup, *Rep. Sci. res. ''Michael Sars'' north atlantic deep Sea Exped.*, 1910. *Siphonopnores*, **5**(11), p. 8.
1965. *Ceratocymba sagittata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 206, text-figs. 140, 141, A, C; pl. XXXVII, figs. 1–4.



TEXT-FIGURE 15

Ceratocymba sagittata : A—D

A—anterior nectophore. B—posterior nectophore. C—bract. D—gonophore.

Ceratocymba indica n.sp. : E—H

E—anterior nectophore. F—anterior nectophore : ventral facet
G—posterior nectophore. H—posterior nectopohore : comb-teeth.

Abbreviations used :

an—anterior nectophore. br—bract. go—gonophore. h—hydroecium. lc—lateral radial canal.
ns—nectosac. ph—phyllocyst. pn—posterior nectophore. so—somatocyst.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5192	Ich. N.	1000–0	1 eudox.	Gen.Coll.
V 5195	,,	,,	1 ,,	P 1725/1
V 5207	I.K.T.	150–100	8 ,, ; 2 complete exs.	P 1650/1
V 5212	Ich. N.	1000–0	2 ,,	Gen.Coll.
V 5216	,,	,,	1 ,,	P 1585/1

Type locality.—Off Gibraltar.

Distribution.—Occurs in the tropical and subtropical regions of the three oceans (*see* Table 1 for further details).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 15, A).—Size: Length, 22.2 mm; breadth at base, 11.47 mm; Somatocyst length, 8.0 mm; Hydroecium, length, 11.3 mm; Nectosac, length 17.0 mm; length from apex of nectosac to apex of nectophore, 3.0 mm.

The anterior nectophore is laterally flattened. Due to the apical prolongation of the nectophore, the dorsal and ventral facets are triangular in shape. The pyramidal apical prolongation occurs above the characteristically abylid basal half. It has a broad base. The whole nectophore is opaque. The mesogoea is firm and therefore preserves well. There are four non-serrated ridges at the apex, two dorsals and two ventrals. The two oblique lateral ridges originate from the mid-region of the dorsal ridges and terminate at the base of the hydroecium. The somatocyst, hydroecium and nectosac are arranged parallel to one another. The somatocyst is broad and oval in shape. The hydroecium is conical and has a broad, nearly rectangular opening. The nectosac is produced into a narrow blunt tube, apically extending upto three-fourth the distance of the nectophore. There are two dorsal and two lateral teeth around the ostium. The ridges are faintly serrated at the base.

About 3–6 cormidia are seen within the hydroecium.

Posterior nectophore (Text-fig. 15, B).—Size : length, 31.8 mm; breadth, 12.0 mm; length of the left ventral tooth, 5.8 mm; length of the right ventral tooth, 2.0 mm.

There are four ridges; two dorsolaterals and two ventrals occur from the base of the triangular apical extension of the nectophore. The dorsal ridge is vestigeal. The dorsal and the lateral ridges end in prominent teeth around the ostium. The ventral ridges form the hydroecial wings and end in two large teeth at the base. The left ventral tooth is longer than the other. The basal half of all the ridges, and the teeth, are serrated. There are six comb-teeth present on the inner thickened wall of the right hydroecial wing. The basal edge of this wing has about seven prominent denticulations. The basal edge of the left hydroecial wing is slightly denticulated, and it is continuous with the inner surface of the corresponding tooth.

Eudoxid phase.—Bract (Text-fig. 15, C).—The bract has a length of 15.6 mm, and a breadth of 10.0 mm. In this species the bract is unique, possessing prominent apical lateral corrers in the form of horns. It has a triangular, deeply concave apical facet. The left lateral ridge in all the bracts examined does not reach the apico-dorsal ridge; this ridge always originates from the posterior edge and terminates just before the apicodorsal ridge. The phyllocyst has three branches; the anterior ones are very fine and bent in the middle, the posterior branch is short, thicker with its distal tip curved upwards, the phyllocyst occurs in the mid-region of the bract.

Gonophore (Text-fig. 15, D).—It measures 10.0 mm in length and resembles that of *C. dentata* but has a small inconspicuous hook-like tooth arising from the right ventral

ridge and curved in towards the floor of the hydroecium. The ventral ridges are serrated and end in prominent teeth at base. The dorsal ridge is vestigeal.

Ceratocymba indica Daniel

(Text-fig. 15, E–H)

1970. *Ceratocymba indica* Daniel, J. Zool. Soc. India. **99** (182) : 152.

One complete specimen was taken in a haul from 1000 metres to surface, at Station no. V 5194 by RV VITYAZ, using an Ichthyological Net; type locality : Lat. 32°39'S; Long. 101°12'E.

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 15, E & F).—The nectophores have the following measurements : Length, 26.0 mm; breadth at base, 7.67 mm; breadth at apical prolongation, 1.87 mm; somatocyst, 5.87 mm; hydroecium, 11.3 mm; nectosac, 17.2 mm; length from apex of nectosac to apex of nectophore, 7.3 mm.

The anterior nectophore has a broad base and narrows abruptly at the level of the apex of the somatocyst into an extremely long apical prolongation. There are four ridges, two dorsal and two ventral at the apex. The lateral ridges are not sharply oblique; these occur at the middle of the nectophore, at the base; then run alongside the ventral ridges at the apical region and meet the ventral ridges at the level of the apex of the nectosac. The dorsal facet is long, triangular and end in two prominent teeth at the dorsal side of the ostium. The ventral facet is oval in shape, pointed at the base and narrows at the level of the apex of the somatocyst. In the apical region the ventral facet is long and narrow. The basal ends of all the ridges are finely serrated, while they are faintly serrated at the apical prolongation. The somatocyst, hydroecium and the nectosac are arranged parallel to one another. The nectosac is produced into a blunt tube at the apex and terminates in the middle region of the apical prolongation.

Posterior nectophore (Text-fig. 15, G & H).—These have a measurement as given below : Length, 31.3 mm; breadth, 8.0 mm; length of left ventral tooth, 10.87 mm; length of right ventral tooth, 1.0 mm; The posterior nectophore is long and thin. The dorsal ridge is not vestigeal but extends upto half the length of the nectosac and forms a median dorsal tooth at the ostium. The left and right lateral ridges occur from the base of the apophysis to the base of the nectosac and end in broad teeth. Apically these ridges are connected by a short cross-ridge at the base of the apophyses. The right ventral ridge ends in a much reduced projection and has two small curved teeth at the outer margin. The inner margin is curved and is continuous with the extremely long left ventral tooth. The left ventral ridge ends in this tooth. This tooth is three-faceted, but the edges are not sharply defined, and are not serrated; but faint projections are present at the corners of the facets. There are four large comb teeth on the inner thickened margin of the right ventral hydroecial wing. These are in the form of raised rounded prominences and the tips of these are sharply curved into pointed teeth (Text-fig. 15, H). Faint denticulation is present at the basal margin of the right wing, while the denticulations (about 8 in number) are more marked on the left one.

Remarks.—The genus *Ceratocymba* includes four valid species : *C. sagittata* (Quoy & Gaimard, 1827); *C. leuckarti*, Huxley, 1859; *C. dentata* (Bigelow, 1918), and *C. intermedia* Sears, 1953; the present species *C. indica* is an addition to this list.

The anterior nectophores of *C. leuckarti* and *C. dentata* are not produced into apices as in *C. sagittata* and the present new species *C. indica*. In *C. intermedia* the anterior nectophore is slightly extended apically and the nectosac is about $\frac{1}{3}$rd the total height of the nectophore (cf. Sears, 1953, text-fig. 22). *C. indica* resembles *C. sagittata* in possessing long, triangular dorsal facet, and in the nectosac being extended into a

long narrow blunt tube at apex. It differs from it in the shape of the anterior nectophore, the apical prolongation being very narrow, long and not pyramidal; the abruptly narrowing ventral facet at the region of the apex of the somatocyst; the lateral ridges in not being sharply oblique but running alongside the ventrals before joining them; and the apex of the nectosac in terminating far below the tip of the nectophore. The posterior nectophore differs from these of *C. sagittata* in being thinner, with only four comb-teeth differently shaped, in the right hydroecial wing and the left ventral tooth being 2–3 times as long as in *C. sagittata*.

The measurements of *C. sagittata* and of *C. indica* are given below :

Character	*C. indica* n.sp.	*C. sagittata*
Anterior nectophore :		
Length	26.0 mm	22.2 mm
Breadth at base ..	7.67 ,,	11.47 ,,
Breadth at apical prolongation ..	1.87 ,,	4.5 ,,
Somatocyst, length ..	5.87 ,,	8.0 ,,
Hydroecium, length ..	11.3 ,,	11.3 ,,
Nectosac, length ..	17.2 ,,	17.0 ,,
Length from apex of nectosac to apex of nectophore	7.3 ,,	3.0 ,,
Posterior nectophore :		
Length ..	31.3 ,,	31.8 ,,
Breadth ..	8.0 ,,	12.0 ,,
Length of left ventral tooth ..	10.87 ,,	5.8 ,,
Length of right ventral tooth ..	1.0 ,,	2.0 ,,

The differences in the measurements of the breadth at apical prolongation, the length from apex of nectosac at apical tip of the anterior nectophore and the size of the ventral teeth in the posterior nectophore firmly establishes the validity of *C. indica*.

It is of interest to note that Sears (1953, p. 65) described two kinds of bracts of *C. sagittata*, one with incomplete lateral ridge and the other with complete lateral ridge, and suggested that this variability in the nature of the lateral ridge may indicate the occurrence of more than one species.

The present record of the anterior and posterior nectophores (intact) of *C. indica* confirms the existence of closely allied but distinct species : *C. sagittata* (Quoy & Gaimard, 1827) and *C. indica* Daniel.

Genus **Abyla** Quoy & Gaimard, 1827

1827. *Abyla* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 14.
1834. *Amphiroa* Blainville, *Munuel d'actinologie*...., p. 133.
1953. *Pseudabyla* Sears, *Bull. Mus. Comp. Zool.*, Harv., **109**, p. 49.

Abylinae with anterior nectophore possessing 10 or 11 facets; apical facet subdivided by an apical transverse ridge into an apicodorsal and apicoventral facets. Posterior nectophore with dorsal ridge completely suppressed; distal end of left lateral ridge deflected towards dorsal side ending in the mid-dorsal tooth; left and right hydroecial ridges usually well-expanded into wings; right hydroecial wing having varying number of comb-teeth. Eudoxid is an "amphiroa".

Sears (1953) considered nine species of *Abyla* as valid : *A. trigona* Quoy & Gaimard, 1827; *A. carina* Haeckel, 1888; *A. schmidti* Sears, 1953; *A. ingeborgae* Sears, 1953; *A.*

haeckeli Lens & van Riemsdijk, 1908; *A. peruana* Sears, 1953; *A. bicarinata* Moser, 1925; *A. brownia* Sears, 1953, and *A. tottoni* Sears, 1953.

Totton (1954) recognised all these species except *A. brownia*, while in 1965 he doubted the validity of *A. carina*, *A. ingeborgae* and *A. peruana*, and synonymized *A. brownia* under *A. bicarinata*.

Type species.—*A. trigona* Quoy & Gaimard, 1827.

Key to species of Abyla

(after Sears, 1953)

ANTERIOR NECTOPHORE :

1.	Apicoventral facet subdivided by a transverse ridge	2
	Apicoventral facet not subdivided by a transverse ridge	3
2.	Ventral facet approaches a regular pentagon in shape; protrusion at juncture of horizontal and lateral ridges markedly overhangs basal half of ventrolateral surface; ridges elevated like a rim of a pie plate	*A. haeckeli*
	Ventral facet elongate with basal sides of pentagon roughly three times as long as apical ones; protrusion at juncture of lateral and horizontal ridges not excessive; ridges well defined but not markedly elevated above facets	*A. ingeborgae*
3.	Nectophores nearly circular in dorsal or ventral view due to pronounced expansion of lateral ridges	4
	Nectophores elongate in dorsal or ventral view, but with more or less pronounced knob at juncture of the lateral and horizontal ridges	5
4.	All ridges well defined; a definite angle at juncture of horizontal and lateral ridges; greatest width of ventral facet about ½ length from insertion of horizontal ridges to basal tip .	*A. brownia*
	Ridges delineating the apicodorsal facet as well as horizontal ridge rounded and often indistinct, lateral ridge circular throughout, not angular, greatest width of ventral facet greater than distance from insertion of horizontal ridges to basal tip . . .	*A. bicarinata*
5.	Greatest width of ventral facet is about the same (0.87 to 1.0) as its length from the insertion of the horizontal ridges to its basal tip	6
	Greatest width of ventral facet is only about ½ to 2/3rds (0.45 to 0.6) the length from the insertion to the horizontal ridges to its basal tip	7
6.	In side view, apex of hydroecium considerably higher, the apex of nectosac lower than that of somatocyst; horizontal ridge crosses somatocyst only slightly above its middle; no obvious depression ventrad to transverse apical ridge	*A. peruana*
	Apices of nectosac and somatocyst at about the same level, apex of hydroecium only slightly higher; horizontal ridge crosses somatocyst well above middle; obvious depression ventrad to transverse apical ridge	*A. tottoni*
7.	Transverse ridge in side view lies above somatocyst, resulting in elongate apicodorsal facet	*A. schmidtii*
	Transverse ridge in side view lies above hydroecium	8
8.	In side view, apicodorsal facet almost vertical from insertion of lateral ridge to apical transverse ridge; lateral border of basal facet curved and tends to parallel horizontal plane; heavy and irregular serrations on lateral ridges	*A. trigona*
	In side view, apicodorsal facet essentially flat; lateral border of basal facet diagonal and only slightly curved; serrations fine	*A. carina*

POSTERIOR NECTOPHORE :

1.	About 2–5 teeth on comb of right* ventral wing	2
	About 6–10 teeth on comb of right* ventral wing	4

* right = left in Sears' Key; & left = right in Sears' Key.

2. Two or three teeth on comb of right ventral wing; base of left ventral wing with thickening outlined by rather small teeth, the two ventral ones on both inner and outer row being the heaviest . . . . . *A. haeckeli*

   Four or five teeth on comb of right ventral wing; left ventral wing triangular . . . 3

3. Base of left ventral wing with inner row of stout teeth continuous with its ventral margin and outer row of finer teeth projecting below on a more or less well-defined triangular pad; right ventral wing not continuous with the right ventral tooth . . . . *A. schmidti*

   Base of left ventral wing with three or four stout teeth on inner margin, with a few weak teeth almost scallop-like on outer; right ventral wing continuous with the right ventral tooth . . . . . *A. ingeborgae*

4. Outer row of teeth on basal margin of left ventral wing continuous with its ventral margin; inner row ending on inner surface 5

   Inner and outer rows of teeth on basal margin of left ventral wing merge to become its ventral margin 6

5. Nectophore (exclusive of apophysis) about as wide as it is long, nearly circular in general appearance, usually about seven teeth on comb of right ventral wing . . . . *A. bicarinata*

   Nectophores (exclusive of adophysis) somewhat longer than wide; ovoid in general appearance; 8–9 teeth on comb of right ventral wing . . . . . *A. tottoni*

6. Ventral teeth elongate, heavily serrated; about 6 teeth on comb of right ventral wing; teeth on basal margin of left ventral wing heavy and prominent . . . . . *A. trigona*

   Ventral teeth stubby, 9–10 teeth on comb of right ventral wing; teeth on basal margin of left ventral wing scarcely more than strong serrations . . . . . *A. carina*

Of these, *Abyla trigona* Quoy & Gaimard, 1827; *A. schmidti* Sears, 1953; *A. haeckeli* Lens & van Riemsdijk, 1908; *A. bicarinata* Moser, 1925; and an eudoxid phase belonging to *Abyla* sp. (in det.) have been studied in the present collections.

Abyla trigona Quoy & Gaimard, 1827

(Text-fig. 16, A & B)

1827. *Abyla trigona* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 14, pl. 20, figs. 1-8 (in part).

1829? *Abyla trigona :* Eschscholtz, *System der Acalephen.* Berlin, p. 131.

1830? *Amphiroa alata* Blainville, *Dict. Sci. Nat.* Paris, p. 121.

1830? *Abyla trigona :* Blainville, *Dict. Sci. Nat.* Paris, p. 123.

1834. *Diphyes abyla* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe....de. M. J. Dumont D'Urville. Zool.* **4**, *Atlas, Zoophyts.*, p. 87, pl. 4, figs. 12–17, (in part).

1834? *Amphiroa alata :* Blainville, *Manuel d' actinologie ou de Zoophytologie*, Paris, p. 133, pl. 4, fig. 1.

1834? *Abyla trigona :* Blainville, *Manuel d'actinologie ou de Zoophytologie*, Paris, p. 135, pl. 4, fig. 4.

1854. non *Abyla trigona :* Vogt, *Mem. Inst. Nat.*, Geneva, **1**. pl. 121, pl. 15, fig. 4; pl. 20, figs. 4–7; pl. 21, figs. 3–6, 10–13 (= *Abylopsis tetragona*).

1859. non *Abyla trigona :* Huxley, *The Oceanic Hydrozoa* Ray Soc. London, p. 41, pl. 3, fig. 1.

1859? *Amphiroa alata :* Huxley, *The Oceanic Hydrozoa* Ray Soc. London, p. 64, pl. 5, fig. 1.

1859. *Abyla trigona :* Gegenbaur, *Nova. Acta Leop. Garol.*, **27**, p. 1, pls. 1, 2; figs. 1–12.

1859. *Abyla trigona :* Gegenbaur, *Nova. Acta Leop. Carol.*, **27**, p. 337, pls. 26, 27, figs. 1–12.

1888? *Abyla trigona :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1160.

1888? *Amphiroa alata :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1160.

1888? *Abyla trigona :* Haeckel, *Jena Z. naturw.*, **22**, p. 35.

1888? *Amphiroa carina :* Haeckel, *Jena Z. naturw.*, **22**, p. 114, pl. 36.

1888. *Abyla carina :* Haeckel, *Jena Z. naturw.*, **22**, p. 156, pl. 35 (in part).

1889? *Abyla trigona :* Fewkes, *Rep. U.S. Fish. Comm.* for 1886, p. 519.

1897? *Amphiroa alata :* Chun, *Ergebn. Plankton Exped.*, **3**, k.b., p. 31.

1898? *Abyla trigona :* Schneider, *Zool. Anz.*, **21**, pp. 90, 197.
1904? *Abyla trigona :* Bedot, *Res. Camp. Sci.* Monaco., **27**, p. 27.
1908? *Amphiroa alata :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 28, pl. 4, figs. 37, 38.
1908. *Abyla trigona :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 29, text-fig. 24–31; pl. 4, figs. 34–36.
1911. *Abyla trigona :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 221 (in part).
1911. non *Abyla trigona :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 221, pl. 13, figs. 3–4 (in part).
1912? *Abyla trigona :* Moser, *Sitz. Ges. Nat.*, Berlin, 1912 (10), fig. 20.
1915? *Abyla trigona :* Kawamura, *Zool. Mag.*, Tokyo, **27**, p. 578, pl. 15, figs. 27, 28.
1918. *Abyla trigona :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 408 (in part).
1918. non *Abyla trigona :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 408 (in part).
1919. non *Abyla trigona :* Bigelow, *Bull. U.S. nat. Mus.*, **100**, (i, 5), p. 334.
1925. *Abyla trigona :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 301, pl. 18, fig. 7 (in part).
1926? *Abyla trigona :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*) (2)**19**, p. 62.
1932? *Abyla trigona :* Leloup, *Bull. Mus. Hist. nat.* Belg., **8**(11), p. 20, fig. 3.
1932? *Abyla trigona :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 332, fig. 17B.
1933? *Abyla trigona :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 21.
1935? *Abyla trigona :* Leloup, *Bull. Mus. Hist. nat.* Belg., **11**(31), p. 5.
1949. *Abyla trigona :* Moore, *Bull. Bingham Oceangr. Coll.*, XII(2), p. 13, (in part).
1953. *Abyla trigona :* Sears, *Bull. Mus. Comp. Zool.* Harv. **109**(1), p. 35, figs. 8B, 9B, 10B, 11A.
1954. *Abyla trigona :* Totton, *Disc. Rep.*, **27**, p. 143.
1965. *Abyla trigona :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 208, pl. XXXVI, figs. 9, 10, text-fig. 142A, D, E.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5208	Pl. N.	Surface	1 ant. necto.; 1 post. necto.	Gen.Coll.
V 5212	I.K.T.	150–100	1 ,, ,,	

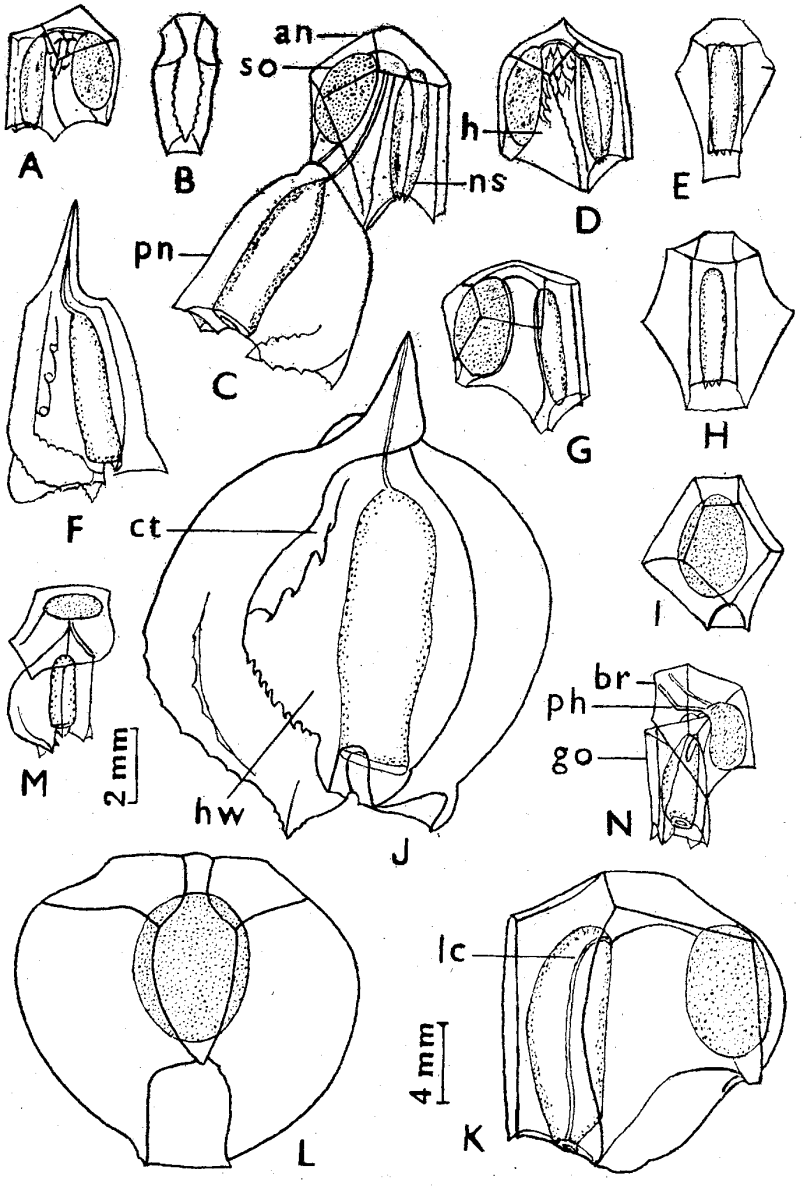
Type locality.—Off Gibraltar.

Distribution.—Tropical regions of the three oceans (for further details *see* Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 16 A & B).—The anterior nectophore has the following measurements : Height, 5.3 mm; Breadth 4.2 mm; somatocyst length, 3.0 mm; hydroecium length, 4.33 mm; nectosac length 3.4 mm.

There are two anterior and one posterior nectophores in the collections. The ridges of the anterior nectophore are well-serrated at the base. The ventral facet is narrow, not subdivided by a transverse ridge; its two ventral ridges run almost parallel to each other to nearly $\frac{2}{3}$rds their lengths and then they meet at their bases to form a pointed tip. The apicoventral facet is continuous with the ventral facet. The apicodorsal facet is sharply bent upwards from the point of insertion of the lateral ridges to the transverse apical ridge which lies above the centre of the hydroecium. In side view, the lateral ridges of the basal facet form a semicircle close to the dorsal wall of the hydroecium and end parallel to the horizontal plane and into the prominent teeth at the base near the ostium of the nectosac. The facets of the nectophore are slightly depressed below the ridges surrounding them, thus appearing thin and fragile.

Posterior nectophore.—The loose posterior nectophore found in the same plankton sample as the anterior ones is about half as wide as long. None of the ridges are markedly expanded. There are about 8 comb-teeth on the inner margin of the right hydroecial wing. The lateral ridges are complete forming teeth at the ostium, but the course of



TEXT-FIGURE 16

Abyla trigona : A, B
A—anterior nectophore : laterval view. B—anterior nectophore : ventral view.
Abyla schmidti : C—F, N
C—anterior and posterior nectophores intact. D—anterior nectophore : laterral view.
E—anterior nectophore : dorsal view. F—posterior nectophore.
N—eudoxid phase, probably belonging to this species.
Abyla haeckeli : G—I
G—anterior nectophore : lateral view. H—anterior nectophore : dorsal view.
I—anterior nectophore : ventral view.
Abyla bicariata : J—L
J—posterior nectophore. K—anterior nectophore : lateral view. L—anterior nectophore : ventral view.
Abyla sp. : M
M—eudoxid phase.
Abbreviations used :
an—anterior nectophore. br—bract. ct—comb teeth. go—gonophore. h—hydroecium.
hw—hydroecial wings. lc—lateral radial canal. ns—nectosac. ph—phyllocyst.
pn—posterior nectophore. so—somatocyst.

these ridges and other details in the distal end are not clear since the nectophore is much contracted and damaged.

Abyla schmidti Sears, 1953

(Text-fig. 16, C–F & N)

1908. *Abyla trigona* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 29 (in part).
1919. *Abyla trigona :* Bigelow, *Bull. U.S. nat. Mus.*, **100** (i,5), p. 334.
1925. *Abyla bicarinata :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 298 (posterior nectophore), p. 19, figs. 7–9 (in part).
1953. *Abyla schmidti* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 38, fig. 8C, 9C, 10C & 15C.
1954. *Abyla schmidti :* Totton, *Disc. Rep.*, **27**, p. 147, figs. 73, 76, 77.
1965. *Abyla schmidit :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 212, text-figs. 145C, 146–148.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
G 184 G/4/62* Sample 653/E	IOSN	200–0	1 ant. necto.	Gen.Coll.
G 205 G/4/62* Sample 770/E	,,	,,	1 complete ex.	,,
DM 91 DM/3/63* Sample 1700/E	,,	,,	1 ,, ,,	,,
DM 111 DM/3/63* Sample 1803/E	,,	,,	1 ,, ,, ; 1 eudox.	,,

(* For details of these cruises, *see* MATERIAL & METHODS).

Type locality.—RV DANA Station no. 3922—Lat. 3°45′S; Long. 56°33′E—from a depth of 1000 metres to surface.

Holotype.—Deposited at Universitets Zoologiske Museum Kobenhavn, Denmark.

Distribution.—Tropical and temperate regions of the Atlantic Pacific and Indian Oceans (*see* also Table 1).

Description.—Polygastric phase (Text-fig. 16 C).—The length of the polygastric phase when both nectophores are intact, is 20.3 mm.

Anterior nectophore (Text-fig. 16C, an.; D & E).—The anterior nectophore has a length of 7.8 mm, a breadth of 5.2 mm; the somatocyst measures 3.67 mm; hydroecium is 6.67 mm long; and the nectosac is 5.0 mm in length. The anterior nectophore of this species is easily differentiated from that of *A. trigona* by its proportionately larger and longer apicodorsal facet. In true side view the transverse ridge lies above the somatocyst, resulting in an elongate apicodorsal facet. The dorsal facet tapers towards the base rather than bulging in the middle, as in *A. trigona.*

Posterior nectophore (Text-fig. 16C, pn.; & F).—these have a length of 13.0 mm and a breadth of 6.67 mm. The nectophore is typically triangular in shape. The basal half of the left ventral wing is expanded so that the width in this region nearly equals its length. There are about 6–7 denticulations on the inner margin of the left ventral wing, these denticulations join the outer row of teeth. A triangular thickening between the two rows of teeth at the basal corner characterizes this species. The right ventral

wing is not so highly expanded and has 3–4 comb-teeth on the inner thickened edge. The teeth are strong and robust. Altogether there are 5 teeth at the ostium—one dorsal, two lateral and two ventral teeth.

Eudoxid phase (Text-fig. 16, N).—*Bract.*—The lateral facets of the bract are not expanded or rounded. The edges are concave. The dorsal facet is rectangular in shape. The phyllocyst is the characteristic one found in all *Abyla* bracts.

Gonophore.—The dorsal ridge is absent. The two lateral ridges occur close to the dorsal side and end in prominent teeth at the ostium. The ventral ridges are not expanded into wings. These also end in teeth at the ostium.

Remarks.—This eudoxid probably belongs to *A. schmidti*, since it occurred along with the polygastric phase at Station no. DM 111. In this plankton sample no other species of *Abyla* was present.

Abyla haeckeli Lens & van Riemsdijk, 1908

(Text-fig. 16, G–I)

1859? *Abyla trigona* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 47, pl. 3, fig. 1.
1859? *Amphiroa angulata* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 64, pl. 5, fig. 2.
1888? *Abyla alata* Haeckel, *Jena Z. naturw.*, **22**, pp. 113, 156.
1888? *Amphiroa carina* Haeckel, *Jena Z. naturw.*, **22**, p. 114, pl. 36.
1896. non *Amphiroa dispar* Bedot, *Rev. Suisse Zool.*, **3**, p. 373, pl. 12, figs. 5,6.
1908. *Abyla haeckeli* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 32, text-figs. 32–40; pl. 5, figs. 39–41.
1911. *Abyla haeckeli :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 222, pl. 13, figs. 1,2.
1925. *Abyla haeckeli :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 310, pl. 18, fig. 6.
1925? *Abyla haeckeli :* Totton, *Ann. Mag. nat. Hist.* Lond., **9**(16), p. 446.
1926? *Abyla haeckeli :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), (2)**19**, p. 63.
1932? *Abyla haeckeli :* Leloup, *Bull. Mus. Hist. nat.* Belg., **8**(11), p. 19.
1932. *Abyla haeckeli :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 331, text-fig. 13.
1953. *Abyla haeckeli :* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 39, figs. 11b, 12D, 13D, 14D, 26A.
1954. *Abyla haeckeli :* Totton, *Disc. Rep.*, **27**, p. 151.
1965. *Abyla haeckeli :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 210, pl. XXXVI, figs. 6, 8; text-fig. 143.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5177	I.K.T.	200–90	2 ant. necto.	Gen.Coll.
V 5207	IOSN	200–0	2 ,, ,,	P 1647/1
V 5209	I.K.T.	120–70	1 ,, ,,	P 1617/1
V 5211	Pl. N.	Surface	1 ,, ,,	P 1719/1

Type locality.—RV SIBOGA EXPEDITION No. 106 : anchorage off Kapul Island, Sulu Archipelago.

Distribution.—Tropical and temperate regions of the three oceans (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore.—(Text-fig. 16, G, H, I). The anterior nectophore has the following measurements :

Height :	5.7 mm
Breadth :	5.9 ,,
Somatocyst, Length :	3.9 ,,
Hydroecium, Length	6.0 ,,
Nectosac, Length	4.0 ,,
Breadth of ventral facet :	3.53 ,,
Length of ventral facet :	4.0 ,,

The anterior nectophore is as wide as it is high. The facets are well formed, clear and flat in appearance. The apicoventral facet is separated by a second transverse ridge to form a quadrangular facet on the ventral half of the apical surface, and nearly regular pentagonal facet on the ventral surface. The ventral facet is nearly as wide as it is long. The apicoventral facet is large and overhangs the basal ventrolateral facet. The horizontal ridges lie below the mid-level of the somatocyst.

No posterior nectophore is present in the collections.

Abyla bicarinata Moser, 1925

1925. *Abyla bicarinata* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 298, pl. 19, figs. 3–6 (anterior nectophore).

1925. non *Abyla bicarinata :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 299, pl. 19, figs. 7–13 (posterior nectophore of *A. schmidti* Sears, 1953).

1953. *Abyla bicarinata :* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 45, figs. 12A, 13A, 14A & 15A.

1953? *Abyla brownia* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 46, figs. 12C, 13C & 14C.

1965. *Abyla bicarinata :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat Hist.), London, p. 211, pl. XXXVIII, figs. 4–7.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg no.*
V 5179	I.K.T.	450–150	1 complete ex.	Gen.Coll.
V 5207	,,	150–100	1 ant. necto.	,,
V 5211	Ich.N.	1000–0	1 ,, ,,	P 1718/1
V 5212	,,	,,	1 ,, ,,	P 1599/1
V 5216	Ring.T.	1000–0	1 ant. necto.	P 1584/1
V 5220	I.K.T.	120–70	1 ,, ,, ; 1 ant. necto.	Gen.Coll.

Type locality.—Not known.

Distribution.—Warmer belts of the three oceans and north Pacific near Japan (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 16, K & L).—The anterior nectophores have the following measurements :

Height :	10.0 —11.8 mm
Breadth (side view) :	8.57—10.0 ,,
Breadth (when ventral or dorsal facet is uppermost) :	11.4 —13.1 ,,
Somatocyst, length :	4.8 — 5.67 ,,
Hydroecium, length :	7.8 — 9.53 ,,
Nectosac, length :	7.2 — 8.3 ,,

The anterior nectophore of this species is opaque and unique in that it is wider than it is high. This is due to the extraordinary wing-like expansion of the lateral ridges. The lateral ridges are not sharply defined as in the other species of *Abyla* and these are faintly serrated at the base. The horizontal ridge lies very high, almost near the apex of the somatocyst. The somatocyst is large, oval in shape, and situated near the apex. The basal facet is large, broad and almost rectangular in outline. Owing to the peculiar arrangement of the facets and ridges in lateral view, the entire somatocyst is seen through the ventrolateral facet.

Posterior nectophore (Text-fig. 16, J).—These have a length of 20.3 mm and a breadth of 15.3 mm; the length of the apophysis is 5.0 mm. The posterior nectophore (exclusive of the apophysis) is as wide as long. The entire nectophore is opaque and has well-expanded ridges, the edges of which are rounded and tumid, as in the anterior nectophore. The dorsal ridge is absent, but a prominent dorsal tooth is present. In addition, two flared out, thick and strong lateral teeth are present at the ostium. The left ventral wing is highly expanded so as to form a semicircle, and ends in a large tooth below. There are two rows of teeth on the basal margin of this wing; the outer row consisting of 6 denticulations, and the inner of 9 teeth borne on a slightly thickened mesogloea. The right ventral wing is smaller, bearing 9–10 prominent denticulations at its basal margin, and 3–4 comb-teeth on the inner thickened, apical, margin which is tucked inwards. The comb-teeth are very large. This wing also ends in a tooth at the ostium, but is smaller than the left one.

Abyla sp. (in det.)

(Text-fig. 16, M)

An eudoxid phase of an *Abyla* sp. was sorted out from a haul made at Station no. G 185, Cruise no. G/4/62, Sample 658/E (HMAS GASCOYNE).

Bract.—It is a typical amphiroa. The dorsal facet is rectangular. The phyllocyst has three branches with two thin anterior arms and an oval-shaped posterior branch. The lateral facets are broad, flap-like and smooth-edged.

Gonophore.—The gonophore lacks the dorsal ridge. Two lateral ridges occur toward the dorsal side forming the dorsal facet, (as in the anterior nectophore) and end in two small teeth at the ostium. The two ventral ridges form large expanded wings–which form a semicircle on the ventral side.

Remarks.—The specific identity of this eudoxid phase is uncertain. The gonophore has expanded hydroecial wings as in the posterior nectophores of *A. bicarinata* and *A. tottoni*, this eudoxid phase probably belongs to one of these named species.

Subfamily (ii) *Abylopsinae* Totton, 1954

Abylidae with anterior nectophore having (instead of an apical facet) a ridge formed by junction of two lateral facets. Posterior nectophore, when present, with a flap on the inner side of both right and left hydroecial wings.

Totton (1954) erected this subfamily to accomodate the three valid genera : *Abylopsis* Chun, 1888; *Bassia* L. Agassiz, 1862; and *Enneagonum* Quoy & Gaimard, 1827 in which the anterior nectophore has a ridge formed by the junction of two lateral facets, instead of an apical facet, as in the Abylinae. In *Abylopsis* and *Bassia* the anterior and posterior nectophores are characteristically articulated at an angle of about 45° to each other; whereas in abylines, the posterior nectophore is articulated with its long axis in line with the long axis of the anterior nectophore. In *Enneagonum*, the posterior nectophore is not developed.

Key to genera of the Abylopsinae (after Sears, 1953)

ANTERIOR NECTOPHORE :

1.	Nectophores with median apical ridge, dorsal and ventral facets, as well as lateral facets subdivided by a horizontal ridge	2
	Nectophores with one or more of these facets replaced by ridges; opening to nectosac next to dorsal wall of hydroecium at the base of a large triangular basal facet	*Enneagonum*
2.	Somatocyst with apical diverticulum	*Abylopsis*
	Somatocyst without apical diverticulum; ridges opaque	*Bassia*

POSTERIOR NECTOPHORE .

1.	Nectophore with 5 ridges, their edges transparent, well-developed ostial teeth . . .	*Abylopsis*
	Nectophore with 4 ridges, their edges opaque; ostial teeth as slightly developed projections . (*N.B.* : Posterior nectophores not developed in *Enneagonum*).	*Bassia*

BRACT :

1.	Bracts with a dorsal facet	2
	Bracts with median dorsal ridge; without ventrolateral branches to somatocyst; . . .	*Bassia*
2.	Bracts cuboidal; somatocyst with apical horn and two short, stubby ventrolateral branches .	*Enneagonum*
	Bracts with pentagonal dorsal facet; somatocyst with a slender descending branch, a small apical horn and two short, inflated ventrolateral branches	*Abylopsis*

GONOPHORES :

1.	Gonophores with four relatively inconspicuous teeth	2
	Gonophores with 5 prominent teeth; dorsal, one lateral and one ventral ridge incomplete; deep pockets beneath apophysis	*Enneagonum*
2.	Ventral ridges diagonal apically	*Abylopsis*
	Ventral ridges vertical; all ridges opaque	*Bassia*

Three genera : *Abylopsis*, *Bassia* and *Enneagonum*, are represented in the collections.

Genus **Abylopsis** Chun, 1888

1827. *Calpe* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 11.
1829. *Aglaisma* Eschscholtz, *System der Acalephen*...., p. 129 (eudoxid phase).
1859. *Aglaismoides* Huxley, *The Oceanic Hydrozoa.* Ray, Soc., London, p. 60.
1953. *Abylopsoides* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**, d. 87 (freak).
1953. *Pseudabylopsis* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**, p. 92 (freak).

Abylopsinae with anterior nectophore having flat, pentagonal dorsal facet; somatocyst extending well over to ventral side of hydroecium; lower walls of hydroecium extending beyond ventral and basal facet and its ostium being square in shape.

Posterior nectophore having a characteristically hooklike, short apophysis; with right ventral ridge forked at its apical end, and with a deep hydroecium effectively covered by interlocking flaps from inner surfaces of hydroecial wings.

Eudoxid phase having bract with seven facets; dorsal facet being pentagonal in shape. Phyllocyst with 4 branches, thin anterior and posterior branches and two thick, bean-shaped lateral branches. Gonophores with 4 ridges ending in 4 teeth at ostium.

Chun (1888) substituted in the present name *Abylopsis* for the old one *Calpe* because the latter was preoccupied for a genus of Lepidoptera (Insecta).

Two distinct species of the genus *Abylopsis* are recognized : *A. tetragona* (Otto, 1823), and *A. eschscholtzi* (Huxley, 1859).

Type species.—Abylopsis tetragona (Otto, 1823).

Key to species of Abylopsis (after Sears, 1953)

ANTERIOR NECTOPHORES :

1. Ridges not obviously serrate; dorsal surface irregular pentagon, narrower, more elongate than in *A. eschscholtzi*: dorsal surface smaller than ventral; apex of nectosac extends apically above main body of somatocyst; lateral subumbral canals arched . . . *A. tetragona*
2. Ridges heavy, serrate; dorsal surface nearly regular pentagon of same size and shape as ventral; apex of nectosac does not extend apically beyond main body of somatocyst; lateral subumbral canals not arched . . . . . *A. eschscholtzi*

POSTERIOR NECTOPHORES :

1. Nectophore at least twice as long as wide; margin of flap on inner surface of right ventral ridge denticulate; left lateral subumbral canal broken . . . . . *A. tetragona*
2. Nectophore only slightly longer than wide; margin of flap on inner face of right ventral ridge entire; canals normal . . . . . *A. eschscholtzi*

EUDOXID PHASE : BRACT :—

1. Dorsal facet of bract subrectangular; general appearance cuboidal . . . . . *A. tetragona*
2. Dorsal facet of bract almost a regular pentagon . . . . . *A. eschscholtzi*

GONOPHORE :—

1. One ventral ridge diagonally crosses lateral surface to join dorsal and apicolateral ridges roughly dividing lateral surface into 1/4ths towards the apex, and 3/4ths towards the base; lower half of ventral ridges only very weakly serrated . . . . . *A. tetragona*
2. One ventral ridge diagonally crosses lateral surface to join dorsal and apicolateral ridges, roughly dividing lateral surface into two equal portions; lower half of ventral ridges markedly serrated . . . . . *A. eschscholtzi*

Both species are represented (in abundance) in the collections.

Abylopsis tetragona (Otto, 1823)

(Text-fig. 17, A–I)

1823. *Pyramis tetragona* Otto, *Nova Acta. Leop. Carol.*, **11**, p. 306,pl. 42, figs. 2a-e.

1825. *Aglaja baerii* Eschscholtz, *Oken's Isis*, **16**, p. 743, pl. 5, fig. 14.

1826. *Plethosoma crystalloides* Lesson, *Voyage autour du Monde Sur la Corvette de sa Majeste' 'La Coquille' pentent les annees* 1822–25. *Atlad, Zoophytes.*, pl. 4, fig. 2 (in part).

1827. *Calpe pentagona* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 11, pl. 2A, figs. 1–7.

1829. *Aglaisma baeru* Eschscholtz, *System der Acalephen.* Berlin, p. 129, pl. 12, fig. 5 (eudoxid).

1829. *Abyla, pentagona :* Eschscholtz, *System der Acalephen.* Berlin, p. 132.

1830. *Plethesoma crystalloides :* Lesson, *Voyage autour du Monde surla corvelte de sa Mayest'e 'La coquille'. . Atlas Zoophytes*, **2**, p. 64.

1830. *Calpe pentagona :* Blainville, *Dict. Sci. Nat.* Paris., **60**, p. 132.

1834. *Calpe pentagona :* Blainville, *Manuel d' actinologie ou de Zoophytologie*, Paris, p. 134, pl. 4, fig. 3.

1834. *Diphyes calpe* Quoy & Gaimard, *Voyage de decoubertes de l' 'Astrolabe'. . . . de M. J. Dumont D'Urville. Zool.*, **4**, *Atlas, Zoophytes*, Paris, p. 89, pl. 4, figs. 7–11.

1843. *Calpe pentagona :* Lesson, *Acalephs Histoire naturelle des Zoophytes*, Paris, p. 449.

1853. *Eudoxia cuboides* Leuckart, *Zoologische Untersuchungen.* I. *Die Siphonophores*, p. 54, pl. 8, figs. 7–10.

1853. *Abyla pentagona :* Leuckart, *Zoologische Untersuchungen.* I. *Die Siphonophoren,* p. 56, pl. 3, figs. 5, 6.

1853. *Aglaisma pentagonum :* Leuckart, *Zoologische Untersuchungen.* I. *Die Siphonophoren,* p. 150, pl. 3, figs. 2, 3.

1853. *Abyla pentagona :* Kolliker, *Die Schwimmpolypon oder Siphonophoren von Messina.* Leipzig., p. 41, pl. 10.

1853. *Abyla pentagona :* Gegenbaur, *Z. Wiss. Zoot.,* **5**, p. 292, pl. 16, figs. 1–2.

1854. *Abyla pentagona :* Leuckart, *Arch. Natur. Jahrg.,* **22**, p. 259, pl. II, figs. 1–10.

1854. *Abyla trigona* Vogt, *Mem. Inst. Nat.* Genev., **1**, p. 121, pl. 15, figs. 4; pl. 20, figs. 4–7; pl. 21, figs. 3–6, 10–13.

1857. *Abyla pentagona :* Sars, *Nyt. Nag. Natur.* Christiana, **10**, p. 13.

1859. *Abyla pentagona :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 40, pl. 2, fig. 2.

1859. *Aglaismoides elongata* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 61, pl. 4, fig. 3.

1859. *Abyla pentagona :* Gegenbaur, *Nova. Acta Leop. Carol.,* **27**, p. 349, pl. 28, figs. 17–19.

1861. *Abyla pentagona :* Kefferstein & Ehlers, *Zoologische Beitrage gesammelt im winter 1859–'60 in Neapel und Messina.* I *Beobachtungen uber die Siphonophoren.* Leipzig, p. 14, pl. 3, figs. 5, 6.

1870. *Abyla pentagona :* Spagnolini, *Catologo degli Acalefi del Golfo di Napoli. Parte prima Siphonofori.* Milan, p. 21.

1871. *Eudoxia cuboides :* Muller, *Naturh. tidsskrift,* **7**, p. 264, pl. II, figs. 6, 7; pl. 13, fig. 9.

1880. *Abyla pentagona :* Fewkes, *Bull. Mus. Comp. Zool.* Harv., **6**, p. 132.

1880. *Abyla pentagona :* Fewkes, *Proc. Boston Soc. Nat. Hist.,* **20**, p. 318, pl. 3, fig. 1.

1883. *Abyla pentagona :* Fewkes, *Amer. nat.,* **17**, p. 835, figs. 1–4.

1885. *Abyla pentagona :* Chun, *S. B. preuss Akad. Wiss.* for 1885, p. 525, pl. 2, fig. 11.

1885. *Eudoxia cuboides :* Chun, *S. B. preuss Akad. Wiss.* for 1885, pl. 2, fig. 12.

1888. *Eudoxia cuboides :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1160.

1888. *Calpe huxleyi* Haeckel, *Jena Z. naturw.,* **22**, p. 36.

1888. *Aglaisma gegenbauri* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.,* **28**, p. 119, p. 40.

1888. *Calpe gegenbauri :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.,* **28**, p. 164, pls. 39, 40.

1888. *Calpe huxleyi :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.,* **28**, p. 164.

1896. *Eudoxia cuboides :* Bedot, *Rev. Suisse Zool.,* **3**, p. 375.

1897. *Abyla pentagona :* Chun, *Ergebn. Plankton Exped.,* **2**, k.b., p. 30.

1897. *Aglaisma cuboides :* Chun, *Ergebn. Plankton Exped.,* **2**, k.b., p. 30.

1897. *Abyla (Abylopsis) pentagona* Chun, *Ergebn. Plankton Exped.,* **2**, k.b., p. 30.

1898. *Abyla tetragona* Schneider, *Zool. Anz.,* **21**, pp. 89, 197.

1900. non *Abyla pentagona :* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 77, pl. 30, figs. 101–103.

1900. non *Aglaisma cuboides :* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 77, pl. 30, fig. 104.

1902. *Abyla huxleyi* Agassiz & Mayer, *Mem. Mus. Comp. Zool.* Harv., **26**, p. 166, pl. 11, fig. 48.

1908. *Abyla pentagona :* Lens & van Riemsdijk, *Siboga Exped.,* **9**, p. 17, pl. 2, figs. 17–20.

1908. *Aglaisma cuboides :* Lens & van Riemsdijk, *Siboga Exped.,* **9**, p. 19, pl. 2, fig. 21.

1911. *Abyla pentagona :* Moser, *Zool. Anz.,* **38**, p. 431.

1911. *Abylopsis tetragona :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 224, pl. 14, figs. 6–8; p. 15, fig. 2.

1912. *Abyla pentagona :* Moser, *Sitz. Ges. Nat.* Berlin, 1912, (10), p. 531, fig. 13.

1912. *Abyla pentagona :* Moser, Verhandt, *Dtsch. Zool. Ges.,* **22**, fig. 14.

1912. *Abyla pentagona :* Moser, *Zool. Anz.,* **39**, p. 408.

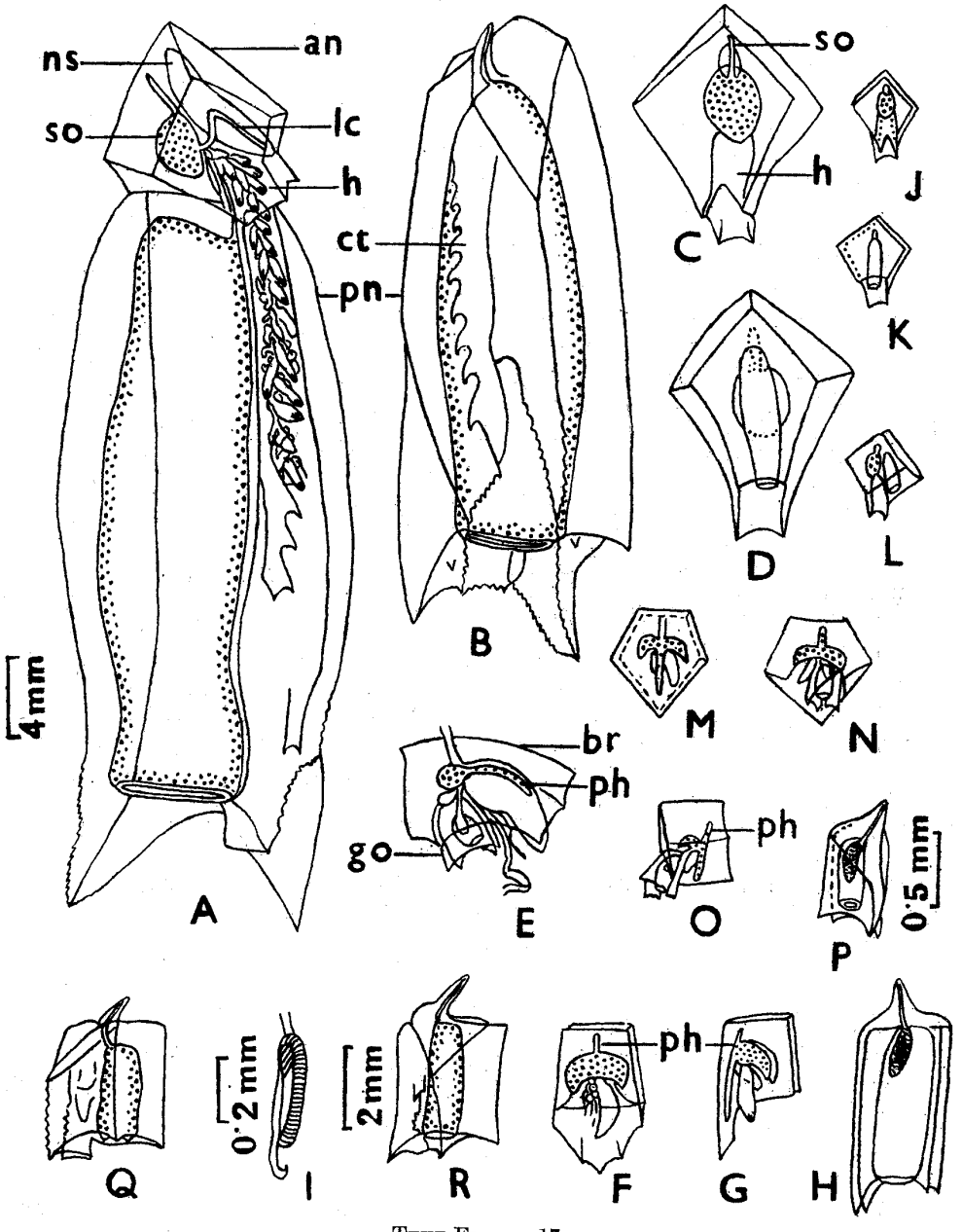
1913. *Abylopsis tetragona :* Bigelow, *Proc. U.S. Nat. Mus.,* **44**, p. 68.

1915. *Abylopsis tetragona :* Kawamura, *Zool. Mag.,* Tokyo, **27**, p. 581, pl. 15, figs. 32–36.

1917. *Abyla pentagona :* Moser, *S. B. preuss Akad. Wiss. Wein. Math-nat Klasse,* **1**, 126, p. 732.

1918. *Abylopsis tetragona :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 411.

1919. *Abylopsis tetragona :* Bigelow, *Bull. U.S. Nat. Mus.,* **100**, (i, 5), p. 334.



TEXT-FIGURE 17

Abylopsis tetragona : A—I

A—anterior and posterior nectophores intact. B—posterior nectophore :ventral view. C—anterior nectophore : ventral view. D—anterior nectophore : dorsal view. E—cormidium. F—bract : dorsal view. G—bract : lateral view. H—gonophore. I—tentillum.

Abylopsis eschscholtzi : J—R

J—anterior nectophore : ventral view. K—anterior nectophore : dorsal view. L—anterior nectophore : lateral view. M—bract : dorsal. view. N—bract : ventral view. O—bract : lateral view. P—gonophore. Q—posterior nectophore : lateral view. R—posterior nectophore : ventral view.

Abbreviations used :

an—anterior nectophore. br—bract. ct—comb teeth. go—gonophore. h—hydroecium. lc—lateral radial canal. ns—nectosac. ph—phyllocyst. pn—posterior nectophore. so—somatocyst.

1925. *Abylopsis pentagona :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 320, text-figs. 52, 53; pl. 20, figs. 1–4; pl. 21, figs. 3, 4.

1926. *Abylopsis tetragona :* Browne, *Trans. Linn. Soc.* Lond. *Zool.* (2) **19**, p. 63.

1931. *Abylopsis tetragona :* Bigelow, *Zoologica*, N.Y. **8**(11), p. 544, figs. 191, 192.

1932. *Abylopsis pentagona :* Leloup, *Bull. Mus. Hist. nat.* Belg. **8**(11), p. 23.

1932. *Abylopsis tetragona :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 333, figs. 14B, 15B, 17C.

1933. *Abylopsis tetragona :* Boone, *Bull. Vanderbilt Mar. Mus.*, IV, p. 36.

1933. *Abylopsis tetragona :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 21.

1934. *Abylopsis tetragona :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 55, fig. 14.

1935. *Abylopsis tetragona :* Leloup, *Bull. Mus. Hist. nat.* Belg., **11**(31),' p. 10.

1935. *Abylopsis tetragona* : Leloup & Hentschel, *Wiss. Ergebn. dtsch. atlant. Exped.* '*Meteor*', **12**(2), p. 19, carte 7.

1935. *Abylopsis tetragona :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 259.

1936. *Abylopsis tetragona :* Leloup, *Bull. Inst. Ocean.* Monaco. No. 703, p. 6.

1936. *Abylopsis tetragona :* Totton, *Zoologica*, N.Y. **21**(4), p. 233.

1937. *Abylopsis tetragona :* Leloup, *Mem. Mus. R. Hist. nat.* Belg., **1**(2), 6, 9, p. 123.

1937. *Abylopsis tetragona* : Bigelow & Sears, *Sci. Rep. Danish. Oceanogr. Exped., Medit.* II *Biology*, H. **2**, p. 23.

1948. *Abylopsis tetragona :* Gamulin, *Acta Adriatica*, **3**(7), p. 9.

1948. *Abylopsis tetragona :* Rose, Hamon & Mettesy, *C. R. Acad. Sci.*, Paris, **227**, p. 299.

1949. *Abylopsis tetragona :* Moore, *Bull. Bingham Oceanogr. Coll.*, XII(2), p. 13.

1950. *Abylopsis tetragona :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1953. *Abylopsis tetragona :* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 80, figs. 2C, 25A, C, D.

1954. *Abylopsis tetragona :* Totton, *Risc. Rep.*, **27**, p. 155, text-figs. 82, 83.

1955. *Abylopsis tetragona :* Leloup, *Rep. Sci. res.* "*Michael Sars*" *north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 8.

1955. *Abylopsis tetragona :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 12.

1963. *Abylopsis tetragona :* Daniel & Daniel, *J. Mar. Biol. Assoc.* India, **5**(2), p. 210, figs. VII, 6, 7; VIII.

1965. *Abylopsis tetragona :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 216, pl. XI, figs. 1–3; text-fig. 149.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5179	I.K.T.	450–150	1 ant. necto.	P 1624/1
V 5202	IOSN	200–0	3 ,, ,, ; 6 post. necto.	Gen.Coll.
V 5203	,,	,,	1 ,, ,, ; 3 ,, ,,	,,
V 5204	,,	,,	4 ,, ,, ; 4 ,, ,,	,,
V 5205	J. N.	,,	2 ,, ,, ; ; 3 eudox.	P 1571/1
V 5207	IOSN	,,	1 ,, ,, ; 1 ,, ,, ; 1 ,,	Gen.Coll.
V 5209	,,	,,	20 ,, ,, ; ; 3 ,,	P 1528/1
				P 1621/1
V 5212	J. N.	,,	1 ,, ,, ; 2 ,, ,, ; 2 ,,	Gen.Coll.
V 5216	Ich. N.	1000–0	4 ,, ,, ; 1 ,,	P 1594/1
V 5217	J. N.	200–0	1 ,, ,, ; 1 ,,	P 1581/1
V 5220	IOSN	,,	6 ,, ,, ; 1 ,,	P 1677/1
V 5223	J. N.	,,	2 ,, ,, ; 1 ,,	P 1696/1
V 5225	IOSN	,,	8 ,, ,, ; 2 ,, ,, ; 8 ,,	P 1641/1
V 5227	IOSN/I.K.T	,,	3 ,, ,, ; 1 ,,	P 1699/1
V 5229	J. N.	,,	2 ,, ,, ; 4 ,,	P 1760/1

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5232	J. N.	200–0	7 ant. necto.; 2 eudox.	P 1727/1
K 3	N. N.	400–200	1 ,, ,, ; 1 post. necto.; 2 ,,	Gen.Coll.
K 6	,,	200–0	1 ,, ,, ; 1 ,,	,,
K 7	,,	,,	2 ,, ,,	,,
K 8	,,	,,	2 ,,	,,
K 10	,,	,,	1 ,, ,, ; 1 ,,	,,
K 11	,,	,,	1 ,,	,,
K 14	,,	,,	3 ,, ,, ; 7 ,,	,,
K 15	,,	,,	5 ,, ,, ; 5 ,,	,,
K 16	,,	,,	2 ,, ,, ; 6 ,,	,,
K 18	,,	,,	3 ,, ,, ; 1 ,, ,, ; 1 ,,	,,
K 19	,,	,,	8 ,,	,,
K 20	,,	,,	1 ,, ,, ; 1 ,,	,,
K 21	,,	,,	2 ,,	,,
K 23	,,	,,	1 ,, ,, ;	,,
K 26	,,	,,	1 ,, ,, ;	,,
K 35	,,	,,	2 ,, ,, ; 2 ,,	,,
K 36	,,	,,	3 ,,	,,
K 42	,,	,,	1 ,,	,,
K 43	,,	,,	1 ,,	,,
K 44	,,	,,	1 ,,	,,
K 46	,,	,,	2 ,, ,, ; 2 ,,	,,
K 47	,,	,,	8 ,, ,, ; 3 ,, ,,	,,
K 48	,,	,,	5 ,, ,, ; 2 ,, ,, ; 4 ,,	,,
K 49	,,	,,	4 ,, ,, ; 11 ,,	,,
K 50	,,	500–200	2 ,, ,, ; 26 ,,	,,
K 51	,,	200–0	3 ,, ,, ; 7 ,,	,,
K 532	,,	,,	1 ,, ,,	,,
WC-S 3	,,	Surface	4 ,, ,, ; 2 ,,	,,
KRL 26	,,	,,	6 ,, ,, ; 12 ,,	,,
Puri 7	,,	,,	2 ,, ,, ; 4 ,,	,,
Gt.Nic. 2	,,	,,	4 ,, ,, ; 3 ,,	,,

Holotype.—In Breslau Museum.

Distribution.—It is a common species occurring in abundance in tropical and temperate regions of the Atlantic, Pacific and Indian Oceans (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 17, A, an; C & D).—The anterior nectophores are 7.0 mm in length; 5.67 mm broad; the nectosac is 5.0 mm long; the somatocyst is 4.0 mm in length and the hydroecium is 3.47 mm long.

The ridges are not strongly serrated, sometimes the edges are smooth even at the base. The dorsal and ventral facets are proportionately more elongate along the apico-basal axis. The dorsal facet is pentagonal in shape. In dorsal view the apex of the nectosac extends above the main body of the somatocyst. The somatocyst has a broad oval-shaped base and a thin elongate apical half. The hydroecium is small, conical in shape and lies between the nectosac and somatocyst, but at a much lower level. The nectosac is elongate and in large specimens slightly bent towards the dorsal facet. The lateral radial canals are highly arched.

Posterior nectophore (Text-fig. 17, A, pn.; B).—These nectophores range in length from 22.67 mm to 26.0 mm, and in breadth from 8.0 mm to 9.47 mm; they are nearly three times as long as wide. Their apophysis is short and inclined. Five ridges are present. The dorsal ridge is complete but inconspicuous and its teeth are very small, and it does not extend much beyond the mouth of the nectosac. The lateral ridges are prominent and complete—each ending in a broad tooth at the ostium. The left lateral tooth is larger than its fellow on the right side. On the basal surface beneath each of the lateral teeth, there is a small spine. The fork of the right hydroecial wing is 'V'-shaped, thick, prominent and the base of the fork lies well below the level of the apex of the nectosac. Both the ventral wings end in teeth of which the right ventral tooth is larger. The hydroedium is closed over by flap-like extensions from both the wings. There are about 8–9 comb-teeth on the inner margin of the right wing. These teeth are large, thin, pointed, deeply recurved, and extend from the region of the apex of the nectosac down to more than half the length of the nectophore. The free basal margin of the left ventral wing has about 7 small teeth. The entire hydroecium is displaced towards the left.

Another unique character of this species is the peculiar modification of the subumbral canals. Four radial canals leave the pedicular canal at the apex of the nectosac on the ventral corner (two lateral, one ventral and one dorsal canals), but at the base there are about $4\frac{1}{2}$ canals. The dorsal, right lateral and the ventral canals are complete, but from the *rete* at the junction between the circular canal and the ventral radial canal there arises towards the left a blind canal; this blind canal is separated at its apex from the left lateral radial canal which has a short, blind downgrowth; slightly above this blind downgrowth, the left lateral canal is deflected to the left (see figure). This half-canal lies under the left ventral ridge.

Cormidia (Text-fig. 17, E & I).—the stem carries about 30 cormidia. The older ones are well-developed bracts and the phyllocysts are clearly discernible.

Eudoxid phase—Bract (Text-fig. 17, F & G)—The bract is 6.3 mm long and 4.7 mm broad; in general appearance it is cuboidal in shape due to the square configuration of the ventral and apical facets. The dorsal facet is pentagonal in shape and the edges between the lateral facets and the dorsal facet are straight and perpendicular. The basolateral facets are small and therefore the basal sagittal ridge is very short. The phyllocyst has four branches—two thin branches, one directed anteriorly and the other towards the pointed tip of the pentagonal dorsal facet; two thick, bean-shaped lateral branches are directed towards the lateral facets. The bracteal cavity is deep and broadly conical in shape.

Gonophore (Text-fig. 17, H).—These range in length from 3.2 mm to 4.0 mm. The gonophore is elongate with shallow ridges which are not flared out. There are four ridges which end in four large pointed teeth. Often, after the shedding of the eggs or sperm the manubrium shrinks very much so that the gonophore appears like a special nectophore. The radial canals are simple and straight.

Abylopsis eschscholtzi (Huxley, 1859)

(Text-fig. 17, J–R)

1859. *Aglaismoides eschscholtzi* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 60, pl. 4, (eudoxid).

1859. *Eudoxia prismatica* Gegenbaur, *Nova Acta Leop. Carol.*, **27**, p. 363, pl. 27, figs. 13–16.

1888. *Aglaismoides eschscholtzi :* Chun, *S. B preuss Akad Wiss.* for 1888, p. 1160.

1888. *Abylopsis quineunx* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1160.

1896. *Aglaismoides eschscholtzi :* Bedot, *Rev. Suisse Zool.*, **3**, p. 375.

1896. *Abylopsis quincunx* Bedot, *Rev. Suisse. Zool.*, **3**, p. 375.

1897. *Abyla* (*Abylopsis*) *quincunx* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 29.

1897. *Aglaismoides quiscunx :* Chun, *Ergebn. Plankton Exped.*, **2**, k.b., p. 29.

1898. *Abyla tetragona* Schneider, *Zool. Anz.*, **21**, p. 89 (in part).

1899? *Abyla quincunx :* Agassiz & Mayer, *Bull. Mus. Comp. Zool.* Harv., **32**, p. 180.

1900. *Aglaisma cuboides* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 77, pl. 30, fig. 104.

1900. non *Abyla pentagona* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 77, pl. 30, figs. 101–103.

1900. *Abyla quincunx :* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 78, pl. 34, figs. 115–117.

1900. *Chunia capillaria* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 78, pl. 27, fig. 90.

1900. *Aglaisma quincunx :* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, p. 78.

1902. *Abyla quincunx :* Agassiz & Mayer, *Mem. Mus. Comp. Zool.* Harv., **26**, p. 163, pl. 11, figs. 46, 47.

1902. *Aglaisma quincunx :* Agassiz & Mayer, *Mem. Mus. Comp. Zool.* Harv., **26**, p. 164, pl. 10, fig. 45.

1908. *Abylopsis quincunx :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 21, pl. 3, figs. 22–27.

1908. *Aglaismoides eschscholtzi :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 25, pl. 3, figs. 28–31.

1911. *Abylopsis quincunx :* Moser, *Zool. Anz.*, **38**, p. 431.

1911. *Abylopsis eschscholtzi :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 226, pl. 14, figs. 1–5; pl. 15, fig. 1.

1913. *Abylopsis eschscholtzi :* Bigelow, *Proc. U.S. Nat. Mus.*, **44**, p. 69.

1915. *Abylopsis eschscholtzi :* Kawamura, *Zool. Mag.*, Tokyo, **27**, p. 584, pl. 15, figs. 37, 38.

1918. *Abylopsis eschscholtzi :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 411.

1919. *Abylopsis eschscholtzi :* Bigelow, *Bull. U.S. nat. Mus.*, **100**, 1(5), p. 335.

1925. *Abylopsis eschscholtzi :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 334, pl. 20, figs. 5, 6; pl. 21, figs. 1, 2, 5.

1926. *Abylopsis eschscholtzi :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), (2) **19**, p. 65.

1931. *Abylopsis eschscholtzi :* Bigelow, *Zoologica*, N.Y. **8**(11), p. 546, figs. 193, 194.

1932. *Abylopsis eschscholtzi :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 338, fig. 17E.

1932. *Abylopsis eschscholtzi :* Leloup, *Bull. Mus. Hist. nat.* Belg., **8**(11), p. 24.

1933. *Abylopsis eschscholtzi :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 22.

1933. *Abylopsis eschscholtzi :* Boone, *Bull. Vanderbilt Mar. Mus.*, IV, p. 35.

1934. *Abylopsis eschscholtzi :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 57.

1935. *Abylopsis eschscholtzi :* Leloup, *Bull. Mus. Hist. nat.* Belg., **11**(31), p. 5.

1935. *Abylopsis eschscholtzi :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. atlant. Exped. 'Meteor'.*, **12**(2), p. 20, carte 5.

1935. *Abylopsis eschscholtzi :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 259, fig. 23.

1936. *Abylopsis eschscholtzi :* Totton, *Zoologica*, N.Y., **21**(4), p. 233.

1937. *Abylopsis eschscholtzi :* Leloup, *Mem. Mus. R. Hist. nat.* Belg., **1**(2), 6, 9, p. 123.

1949. *Abylopsis eschscholtzi :* Moore, *Bull. Bingham Oceanogr. Coll.*, XII(2), p. 13.

1950. *Abylopsis eschscholtzi :* Sears, *J. Mar. Res.*, **9**(1), p. 3.

1953. *Abylopsis eschscholtzi :* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 84, figs. 2D, 25B, 26B.

1954. *Abylopsis eschscholtzi :* Totton, *Disc. Rep.*, **27**, p. 16.

1955. *Abylopsis eschscholtzi :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 7.

1955. *Abylopsis eschscholtzi :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 12.

1963. *Abylopsis eschscholtzi :* Daniel & Daniel, *J. Mar. Biol. Assoc.* India, **5**(2), p. 212, fig. VII, 8–10, fig. VIII, 2, 3.

1965. *Abylopsis eschscholtzi :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.), London, p. 218, pl. XL, figs. 2, 4, 6.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5200	IOSN	200–0	3 ant. necto.; 2 eudox.	P 1752/1
V 5201	Pl. N.	Surface	1 ,,	Gen.Coll.
V 5202	IOSN	200–0	5 ,, ,, ; 2 post. necto.	,,
V 5203	,,	,,	2 ,, ,, ;	,,
V 5204	,,	,,	2 ,, ,, ; 1 ,,	,,
V 5205	IOSN/JN	,,	4 ,, ,, ; 22 ,,	P 1569/1
V 5207	,,	,,	6 ,, ,, ; 12 ,,	P 1655/1
V 5209	IOSN/JN	,,	20 ,, ,, ; 15 ,,	P 1529/1
				P 1622/1
V 5212	J. N.	,,	15 ,, ,, ; 10 ,,	P 1603/1
V 5216	Ich. N.	1000–0	4 ,, ,, ; 4 ,,	P 1598/1
V 5217	IOSN/JN	200–0	3 ,, ,, ; 6 ,,	P 1577/1
V 5220	,,	,,	1 ,, ,, ; 12 ,,	P 1676/1
V 5223	J. N.	,,	4 ,, ,, ; 8 ,,	P 1695/1
V 5225	IOSN/JN	,,	6 ,, ,, ; 2 ,,	P 1638/1
V 5227	,,	,,	5 ,, ,, ; 2 ,,	Gen.Coll.
V 5229	J. N.	,,	21 ,, ,, ; 4 ,, ,, ; 36 ,,	P 1761/1
V 5232	IOSN/JN	,,	9 ,, ,, ; 17 ,,	P 1726/1
K 3	N. N.	400–200	3 ,, ,, ; 3 ,,	Gen.Coll.
K 6	,,	200–0	6 ,,	,,
K 7	,,	,,	2 ,, ,, ; 2 ,, ,,	,,
K 8	,,	,,	2 ,, ,, ; 6 ,,	,,
K 10	,,	,,	2 ,, ,, ; 9 ,,	,,
K 11	,,	,,	4 ,,	,,
K 14	,,	,,	5 ,, ,, ; 2 ,, ,, ; 5 ,,	,,
K 15	,,	,,	2 ,, ,, ; 2 ,,	,,
K 17	,,	,,	3 ,,	,,
K 19	,,	,,	1 ,,	,,
K 20	,,	,,	1 ,, ,, ; 3 ,,	,,
K 21	,,	,,	1 ,, ,, ; 3 ,,	,,
K 22	,,	,,	1 ,, ,, ; 1 ,,	,,
K 23	,,	,,	1 ,,	,,
K 24	,,	,,	1 ,, ,,	,,
K 26	,,	,,	5 ,, ,, ; ,, ,, ; 2 ,,	,,
K 34	,,	,,	2 ,, ,, ; 2 ,,	,,
K 35	,,	,,	3 ,,	,,
K 36	,,	,,	7 ,, ,, ; 5 ,,	,,
K 40	,,	,,	1 ,, ,,	,,
K 41	,,	,,	1 ,, ,,	,,
K 44	,,	,,	1 ,,	,,
K 46	N. N.	200–0	1 ,, ,, ; 6 ,,	,,
K 47	,,	,,	6 ,, ,, ; 3 post. necto.	,,
K 49	,,	,,	6 ,, ,, ; 4 ,,	,,
K 50	,,	500–200	1 ,, ,,	,,
K 51	,,	200–0	1 ,, ,, ; 2 ,,	,,
K 358	Org. N.	Surface	2 ,,	,,

K 359	Orgn. N.	Surface	2 ant. necto.;	4 eudox. Gen.Coll.
K 361	,,	,,		3 ,, ,,
K 363	,,	,,		1 ,, ,,
K 372	,,	,,		2 ,, ,,
K 378	,,	,,		5 ,, ,,
K 379	,,	,,	1 ,, ,, ;	1 ,, ,,
K 533	,,	,,		1 ,, ,,
K 538	,,	,,		6 ,, ,,
Gt.Nic. 2	,,	,,	5 ,, ,, ;	4 ,, ,,
KRL 34	,,	,,	2 ,, ,, ;	11 ,, ,,
Puri 7	,,	,,	3 ,, ,, ;	5 ,, ,,
WC-S 6	,,	,,	5 ,, ,, ;	12 ,, ,,

Type locality.—Sea area between the northern end of the Great Barrier Reef (off Australia & New Guinea) and the Louisiade Archipelago.

Distribution.—Warmer belts of all the three oceans (*see* also Table 1).

Description.—Polygastric phase.—Anterior nectophore (Text-fig. 17, J, K & L).—The nectophores have a length of 3.78 mm and a breadth of 3.78 mm; the somatocyst is 1.75 mm long and the hydroecium is 2.0 mm in length; the nectosac is 2.0 mm long. The anterior nectophore looks very much like that of *A. tetragona*, but it is perfectly squarish. The ridges are as in *A. tetragona*. When viewed ventrally or dorsally the body of the somatocyst does not extend above the nectosac. The dorsal and ventral facets are more regularly pentagonal than in *A. tetragona* and nearly of the same size. The lateral facets are more nearly perpendicular to the dorsal and ventral facets. The ridges are much more serrated than in *A. tetragona*. The nectosac is short and the lateral radial canals are not conspicuously arched.

Posterior nectophore (Text-fig. 17, Q & R).—These have a length of 5.0 mm and a breadth of 3.5 mm. The nectophore is less than twice as long as broad. The apophysis is bigger and more robust than in *A. tetragona*. There are five prominent, complete and highly serrated ridges. The serrations are strong, occur throughout the length of the ridges, and these are more like denticulations along the ventral ridges. The ridges are flared out. Both the hydroecial wings have secondary flaps which overlap and fuse to form a closed hydroecial tube in the proximal half. The flap on the inner surface of the left ventral wing has five distinct denticulations along its basal margin. The smaller right ventral wing possesses 3–4 teeth or a small flap, which is the homologue of the comb in *A. tetragona*. The basal rim of the hydroecial cavity is simple and semi-circular in outline. The nectosac has simple, straight radial canals.

Eudoxid phase (Text-fig. 17, M, N & O).—The bract is 2.48 mm long and 2.96 mm broad and has a perfect pentagonal shape. The basal cross ridge of the lateral facet is higher up and the lateral ridges of the dorsal facet on either side are oblique and not straight as in the bract of *A. tetragona*. The phyllocyst is four-limbed as in *A. tetragona*, with two thin branches directed anteriorly and posteriorly and two thick, bean-shaped lateral branches.

Gonophore (Text-fig. 17, P).—These are of a length-range between 2.3 mm and 3.5 mm. They are small, resemble the posterior nectophore in general shape. There are four serrated ridges, the ventral one curving over to the lateral side and joining the dorsal and apicolateral ridges. The sexes are separate.

Genus **Bassia** L. Agassiz, 1862

1859. *Sphenoides* Huxley, *The Oceanic Hydrozoa*. Ray Soc. London, p. 61.

1862. *Bassia* Agassiz, *Contr. nat. hist. U.S.A.*, pt. IV, Hydroidea, **4**, p. 372.

Apylopsinae with globular somatocyst of anterior nectophore not extending over ventral side of hydroecium; apex of nectosac not extending between somatocyst and dorsal facet; ventral facet without median ridge.

Posterior nectophore barrel-like, lacking dorsal ridge; inner flaps of ventral wings appearing to be fused to roof the proximal half of hydroecium. Bract with an apical ridge (instead of an apical facet), long baso-sagittal ridge; phyllocyst without lateral branches. Gonophores having four-straight ridges and four ostial teeth. All the ridges of anterior, posterior nectophores, bracts and gonophores are opaque.

It is a monotypic genus for *B. bassensis* (Quoy & Gaimard, 1834).

The generic name of *Bassia* was first published by Blainville (1830), for a manuscript name (*nomen nudum*) of Quoy & Gaimard. *Sphenoides* Huxley, 1859 seems to have priority over it, but is an *nomen oblatum* (*vide* Totton, 1965, p. 219).

Bassia bassensis (Quoy & Gaimard, 1834)

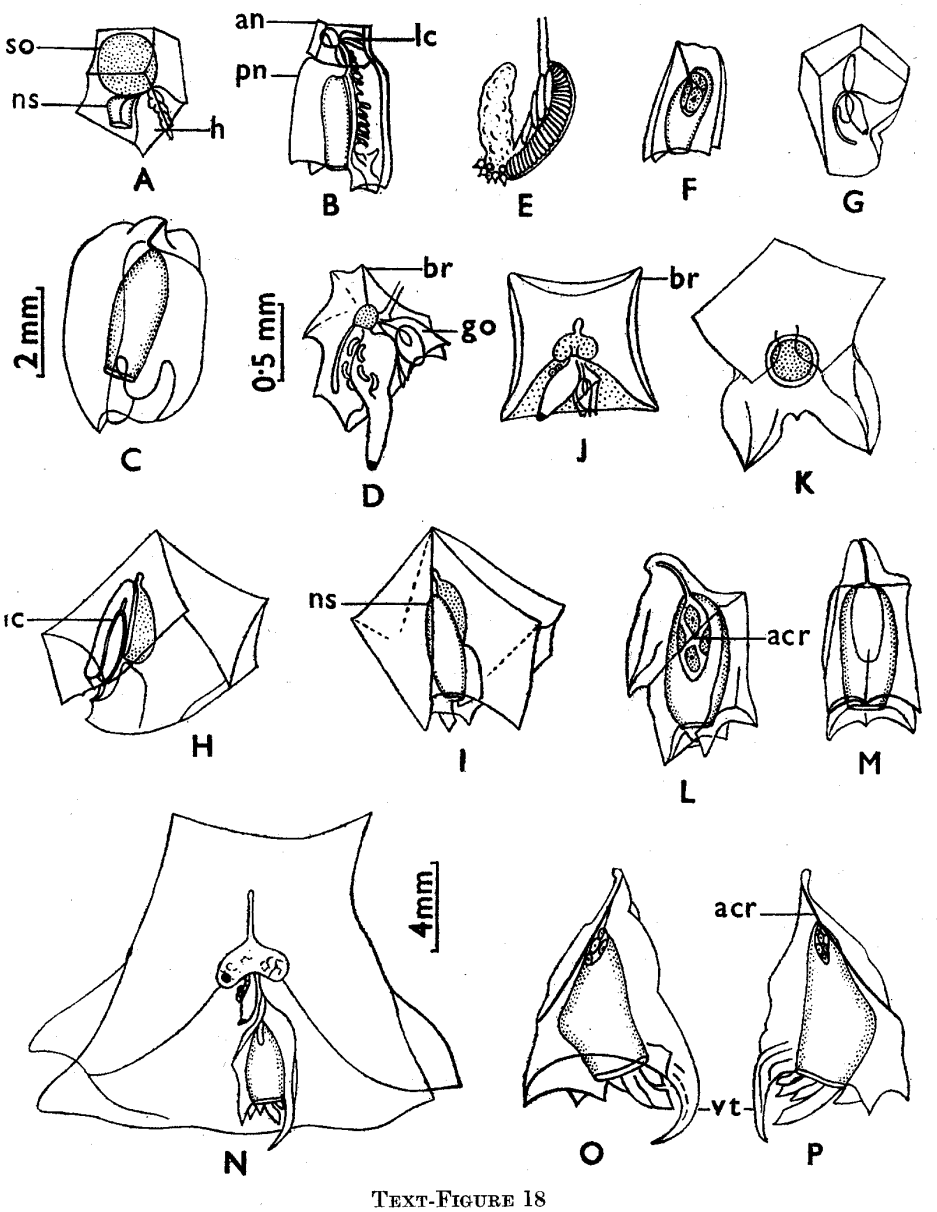
(Text-fig. 18, A–G)

1830. *Abyla quadrilatera* Blainville, *Dict. Sci. nat.* Paris, **60**, p. 123.
1834. *Diphyes bassensis* Quoy & Gaimard, *Voyage de decouvertes de l' 'Astrolabe....de M. J. Dumont D'Urville. Zool.* IV, *Atlas, Zoophytes.* Paris, p. 91, pl. 4, figs. 18–20.
1843. *Calpe bassensis :* Lesson, *Acalephs Histoire naturelle des Zoophytes*, Paris, p. 451.
1859. *Abyla bassensis :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 45, pl. 2, fig. 1.
1859. *Sphenoides australis* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 62, pl. 4, fig. 4.
1859. *Abyla perforata* Gegenbaur, *Nova Acta Leop. Carol.*, **27**, p. 356, pl. 29, figs. 20, 21.
1862. *Bassia perforata :* L. Agassiz, *Contr. Nat. Hist. U.S.A.* Pt. IV, *Hydroidea.*, **4**, p. 372, Boston.
1888. *Sphenoides australis :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1160.
1888. *Bassia perforata :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1160.
1888. *Sphenoides obliscus* Haeckel, *Jena Z. naturw.*, **22**, p. 33.
1888. *Sphenoides perforata :* Haeckel, *Jena. Z. naturw.*, **22**, p. 33.
1888. *Bassia perforata :* Haeckel, *Jana Z. naturw.*, **22**, p. 36.
1888. *Sphenoides obliscus :* Haeckel, *Rep. Sci. res. H.M.S. Challenger. Zool.*, **28**, p. 116, pl. 38.
1888. *Abyla bassensis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger. Zool.*, **28**, pp. 116, 160.
1888. *Abyla perforata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger. Zool.*, **28**, p. 160.
1888. *Bassia perforata :* Haeckel, *Rep. Sci. res. H.M.S. Challenger. Zool.*, **28**, p. 160, pls. 37,38.
1888. *Abyla quadrilatera :* Haeckel, *Rep. Sci. res. H.M.S. Challenger. Zool.*, **28**, p. 160.
1888. *Bassia tetragona* Haeckel, *Rep. Sci. res. H.M.S. Challenger. Zool.*, **28**, p. 160.
1888. *Bassia quadrilatera :* Haeckel, *Rep. Sci. res. H.M.S. Chaltenger, Zool.*, **28**, p. 160.
1888. *Sphenoides australis :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 360.
1896. *Sphenoides australis :* Bedot, *Rev. Suisse Zool.*, **3**, p. 375.
1896? *Parasphenoides amboinensis* Bedot, *Rev. Suisse Zool.*, **3**, p. 376, pl. 12, figs. 2, 3.
1897. *Sphenoides perforata :* Chun, *Ergebn. Plankton Exped.*, **2**, K.b., p. 32.
1897. *Abyla (Bassia) perforata :* Chun, *Ergebn. Plankton Exped.*, **2**, K.b., p. 32.
1898. *Abyla bassensis :* Schneider, *Zool. Anz.*, **21**, pp. 91, 197.
1900. *Abyla pentagona* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, pl. 30, fig. 101.
1900. non *Abyla pentagona :* Mayer, *Bull. Mus. Comp. Zool.* Harv., **37**, pl. 30, figs. 102, 103.
1908. *Abyla bassensis :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 26, pl. **4**, fig. 32.
1908. *Sphenoides australis :* Lens & Van Riemsdijk, *Siboga Exped.*, **9**, p. 27, pl. 4, fig. 33.
1911. *Bassia bassensis :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 229, pl. 12, fig. 8; pl. 14, fig. 9.
1913. *Bassia bassensis :* Bigelow, *Proc. U.S. nat. Mus.*, **44**, p. 69.
1915. *Bassia bassensis :* Kawamura, *Zool. Mag.* Tokyo, **27**, p. 585, pl. 15, figs, 39, 40.

1917. *Bassia bassensis :* Moser, *S. B. preuss. Akad. Wiss.*, **1**, 126, p. 733.
1918. *Bassia bassensis :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 411.
1919. *Bassia bassensis :* Bigelow, *Bull. U.S. nat. Mus.*, **100**(1,5), p. 336.
1925. *Bassia bassensis :* Moser, *Dtsch. Sudpol. Exped. Zool.*, **18**, p. 347, pl. 21, figs. 7, 8; pl. 22.
1926. *Bassia bassensis :* Browne, *Trans. Linn. Soc.* Lond. (*Zool.*), (2)**19**, p. 65.
1931. *Bassia bassensis :* Bigelow, *Zoologica*, N.Y., **8**(11), p. 548.
1932. *Bassia bassensis :* Leloup, *Bull. Mus. Hist. nat.* Belg., **8**(11), p. 25.
1932. *Bassia bassensis :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 339, fig. 17E, 18.
1933. *Bassia bassensis :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 24.
1934. *Bassia bassensis :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 60.
1935. *Bassia bassensis :* Leloup, *Bull. Mus. Hist. nat.* Belg., **11**(31), p. 11.
1935. *Bassia bassensis :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. atlant. Exped. 'Meteor'*, **12**(2), p. 20, carte 15.
1935. *Bassia bassensis :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 260, fig. 24.
1936. *Bassia bassensis :* Leloup, *Bull. Inst. Ocean.* No. 703, p. 2.
1936. *Bassia bassensis :* Leloup, *Res. Camp. Sci.* Monaco, **93**, p. 8.
1937. *Sphenoides australis :* Daurfdoff, *Bull. Soc. Zool.*, France, **61**, p. 470.
1937. *Bassia bassensis :* Leloup, *Mem. Mus. R. Hist. nat.* Belg., **1**(2), 6, 9, p. 125.
1937. *Bassia bassensis :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II *Biology*, H.**2**, p. 26.
1939. *Bassia bassensis :* Delsman, *Treubia*, **17**, figs. 32–36.
1948. *Bassia bassensis :* Gamulin, *Acta Adriatica*, **3**(7), p. 9.
1949. *Bassia bassensis :* Moore, *Bull. Bingham Oceangr. Coll.*, XII(2), p. 13.
1950. *Bassia bassensis :* Sears, *J. Mar. Res.*, **9**(1), p. 3.
1953. *Bassia bassensis :* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 94, figs. 2, 28B, C.
1954. *Bassia bassensis :* Totton, *Disc. Rep.*, **27**, p. 16.
1955. *Bassia bassensis : Rep. Sci. res. "Michael Sars" north atlantic deep Sea Exped.*, 1910. *Siphonophores*, **5**(11), p. 8.
1955. *Bassia bassensis :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 12.
1963. *Bassia bassensis :* Leloup, Daniel & Daniel, *J. Mar. Biol. Assoc.* India, **5**(11), p. 213, fig. VIII, 4, 5.
1965. *Bassia bassensis :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 219, pl. XL, fig. 5; text-fig. 151, 152.

Material examined.-

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5198	J. N.	200–0	3 eudox.	P 1756/1
V 5205	IOSN/JN	,,	2 ant. necto.	P 1573/1
V 5207	,,	,,	10 ,, ,, ; 7 ,,	P 1654/1
V 5209	IOSN/JN	,,	16 ,, ,, ; 6 post. necto.; 9 ,,	P 1530/1 P 1618/1
V 5212	J. N.	,,	2 ,, ,,	Gen.Coll.
V 5216	Ich. N.	1000–0	2 ,, ,,	,,
V 5217	IOSN/JN	200–0	6 ,, ,, ; 4 ,, ,,	P 1580/1
V 5220	,,	,,	3 ,, ,, ; 2 ,,	P 1673/1
V 5223	J. N.	,,	3 ,, ,, ; 2 ,,	P 1690/1
V 5225	IOSN/JN	,,	3 ,, ,,	P 1632/1
V 5227	IOSN/IKT	,,	2 ,, ,,	Gen.Coll.
V 5232	IOSN/JN	,,	2 ,, ,,	,,
K 1	N. N.	,,	2 ,, ,,	,,



TEXT-FIGURE 18

Bassia bassensis : A—C

A—anterior nectophore : lateral view. B—anterior and posterior nectophores intact. C—posterior nectophore : ventral view. D—cormidium. E—tentillum. F—gonophore. G—bract : lateral view.

Enneagonum hyalinum : H—M

H—nectophore : lateral view. I—nectophore : dorsal view. J—bract. K—ostial teeth of gonophore. L—gonopore : lateral view. M—gonophore : dorsal view.

Enneagonum searsae : N—P

N—bract. O—gonophore : lateral view of one side. P—gonophore : lateral view of other side.

Abbreviations used :

acr—apical cross-ridge. an—anterior nectophore. br—bract. go—gonophore. h—hydroecium. lc—lateral radial canal. ns—nectosac. pn—posterior nectophore. so—somatocyst. vt—ventral tooth.

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
K 3	,,	400–200	1 ant. necto.	Gen Coll.
K 6	,,	500–0	2 ,, ,, 5 eudox.	,,
K 7	,,	,,	2 ,, ,, ; 4 ,,	,,
K 8	,,	200–0	2 ,, ,, ;	,,
K 10	,,	,,	2 ,,	,,
K 11	,,	,,	6 ,, ,, ; 3 post. necto.; 11 ,,	,,
K 14	,,	,,	5 ,, ,, ; 4 ,, ,, ; 4 ,,	,,
K 15	,,	,,	2 ,, ,, ; 3 ,,	,,
K 18	,,	,,	1 ,,	,,
K 19	,,	,,	4 ,,	,,
K 20	,,	,,	2 ,,	,,
K 21	,,	,,	2 ,,	,,
K 34	,,	,,	3 ,, ,, ; 2 ,,	,,
K 35	,,	,,	2 ,, ,, ;	,,
K 36	,,	,,	2 ,, ,, ; 2 ,,	,,
K 37	,,	,,	1 ,, ,, ; 1 ,,	,,
K 39	,,	,,	2 ,,	,,
K 42	,,	,,	3 ,, ,, ;	,,
K 44	,,	,,	3 ,, ,, ; 6 ,,	,,
K 46	,,	,,	11 ,, ,, ; 7 ,, ,, ; 30 ,,	,,
K 47	,,	,,	33 ,, ,, ; 14 ,, ,, ; 2 ,,	,,
K 48	,,	,,	7 ,, ,, ; 34 ,,	,,
K 49	,,	,,	40 ,, ,, ; 17 ,, ,, ; 50 ,,	,,
K 51	,,	,,	9 ,, ,, ; 15 ,,	,,
K 53	,,	,,	1 ,, ,, ; 2 ,,	,,
K 54	,,	,,	1 ,, ,, ;	,,
K 56	,,	,,	1 ,, ,,	,,
K 58	,,	,,	1 ,, ,, ; 2 ,,	,,
K 358	Org. N.	Surface	1 ,, ,,	,,
K 359	,,	,,	5 ,, ,, ; 8 ,,	,,
K 361	,,	,,	4 ,, ,, ; 4 ,,	,,
K 363	,,	,,	6 ,, ,, ; 2 ,,	,,
K 378	,,	,,	2 ,, ,, ; 3 ,, ,, ; 4 ,,	,,
K 379	,,	,,	1 ,, ,, ;	,,
K 525	,,	,,	13 ,, ,, ; 6 ,, ,, ; 5 ,,	,,
K 538	,,	,,	2 ,, ,, ; 2 ,,	,,
J 4	Ny. N.	,,	2 ,, ,, ; 2 ,,	,,
J 8	,,	,,	2 ,, ,, ; 4 ,,	,,
KRL 26	Org. N.	,,	6 ,, ,, ; 2 ,,	,,
KRL 34	,,	,,	15 ,, ,, ; 20 ,,	,,
Puri 7	,,	,,	3 ,, ,, ; 6 ,,	,,
Puri 8	,,	,,	4 ,, ,, ; 4 ,,	,,
Gt.Nic. 6	,,	,,	2 ,, ,, ; 5 ,,	,,
Digha 6	,,	,,	4 ,, ,, ; 2 ,,	,,

Type locality.—Entrance of Bass Strait (?).

Distribution.—This is a common species occurring in abundance in the tropical regions of the three oceans (*see* Table 1).

Description.—Polygastric phase.—(Text-fig. 18, B).—The nectophores are fragile and flaccid, but occasionally well preserved (not contracted) and firm ones occur in the collections. The smaller anterior nectophore is better preserved than the posterior one. Their edges and corners are opaque and milky-white in colour.

Anterior nectophore (Text-fig. 18, A, B, an.).—The anterior nectophore has a length of 3.9 mm, a breadth of 2.5 mm; the somatocyst is 1.75 mm long, the hydroecium is 1.85 mm long, and the nectosac is 1.6 mm in length. There are seven facets : the dorsal and ventral facets are pentagonal in shape; the basolateral facets are elongate and broad; the apicolateral facets are smaller and rectangular in shape. The somatocyst is globular in shape and has no apical branch and does not extend into the apicoventral part of the nectophore. It has a short stalk and occurs anterior to the nectosac and hydroecium. The hydroecium is rather shallow, conical in shape and does not project below the basal facet; the opening of the hydroecium is broad. The nectosac is small and its apex does not extend above the apex of the hydroecium. The lateral radial canals are simple and not arched.

Posterior nectophore (Text-fig. 18, B, pn.; C).—These have a length of 9.35 mm and a breadth of 6.75 mm. In general appearance they resemble the posterior nectophores of *A. eschscholtzi*. However, their ridges are opaque and only four ridges are present. The median dorsal ridge is suppressed. The teeth at the base are not pronounced but have a keel-like appearance. The ostial end is twisted so that the posterior end of the right lateral ridge and the left ventral teeth come to lie almost in the sagittal plane. When the nectophore is big and well-preserved, it has a rounded smooth barrel-like appearance and the lateral ridges are not distinct. The flaps from the ventral ridges are firmly held in place by the turgid mesogloae and they are definitely not fused. The two flaps are so interlocked even at the basal half that the hydroecium appears as a closed tube throughout its length. When examined carefully it is seen that the free basal end of the flaps from the inner surface of the right ventral ridge is overlapped by a flap from the left ventral ridge and protrudes into the enlarged basal portion of the hydroecium. The flap extends from this protrusion upto the apex. The basal margin of the hydroecium is serrated.

Cormidia (Text-fig. 18, D & E).—The stem consists of 10–15 cormidia. Immature bracts look different from those of the mature bracts of the eudoxid phase. The phyllocyst of *B. bassensis* in the young stage resembles that of *A. tetragona*. The tentillum has about 7–10 large rounded nematocysts at the tip; each nematocyst has a prominent cnidocil.

Eudoxid phase.—Bract (Text-fig. 18, G).—These have a length and breadth of 3.67 mm; there are seven facets and their ridges are milky-white in colour. Instead of an apical facet there is an apical ridge dividing it into two apicolateral facets. Similarly, the ventral facet is divided into two by another ridge. These four facets are quadrangular in shape, and their corners meet at a pointed tip. The dorsal and the basolateral facets are elongated. The basolateral facets are broad at the base due to the presence of a long basosagittal ridge. The phyllocyst has only two arms—the thicker one anteriorly directed towards the pointed tip of the bract, and the thin one posteriorly directed towards the baso-sagittal ridge.

Gonophore (Text-fig. 18, F).—The gonophores have a length of 6.8 mm and a breadth of 3.67 mm; they are four-sided and small. The four ridges are prominent, straight and milky-white in colour. The four teeth are not prominent.

Genus **Enneagonum** Quoy & Gaimard, 1827

1827. *Enneagonum* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 18.

1827. *Cuboides* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 19.

Abylopsinae with nectophore having a pyramidal shape and flared out facets and an additional dorsal ridge bisecting dorsal facet; somatocyst and nectosac in vertical position above hydroecium; ostium of nectosac occuring next to dorsal wall of hydroecium at base of a triangular basal facet.

Posterior nectophore not developed.

Bract cuboidal; phyllocyst lacking descending branch, lateral branches swollen, and a short apical branch.

Gonophore with 5 well-serrated ridges and 5 prominent ostial teeth; dorsal, one lateral and one ventral ridges incomplete; deep pockets beneath apophysis may be present or absent.

Upto 1968 this genus was considered as a monotypic genus for *E. hyalinum* Quoy & Gaimard, 1827. In the present collections, there is an eudoxid phase of this genus which differs from those of *E. hyalinum*, and resembles *Enneagonum searsae* Alvarino.

Key to the species of Enneagonum

EUDOXID PHASE : BRACT :—

1. Bract of medium size; phyllocyst with a short knob-like apical branch . . . . *E. hyalinum*
2. Bract large; phyllocyst with a long, thin, apical branch . . . . . *E. searsae*

GONOPHORE :—

1. Apophysis of gonophore large, conical and blunt above the horizontal apical cross-ridge; with deep pockets and a hook-like tooth below it . . . . . *E. hyalinum*
2. Apophysis of gonophore very narrow above oblique apical cross-ridge ending in pointed tip; without deep pockets and without hook-like tooth . . . . . *E. searsae*

(*N.B.*: Anterior nectophore not so far known in *E. chauhani*).

Enneagonum hyalinum Quoy & Gaimard, 1827

(Text-fig. 18, H–M)

1827. *Enneagonum hyalinum* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 18, pl. 2D, figs. 1–6.
1827. *Cuboides vitreus* Quoy & Gaimard, *Ann. Sci. Mag.*, **10**, p. 19, pl. 2C, figs. 1–3.
1829. *Cuboides vitreus :* Eschscholtz, *System der Acalephen.* Berlin, p. 135.
1859. *Abyla vogtii* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 46, pl. 2, fig. 3.
1859. *Cuboides vitreus :* Huxley, *The Oceanic Hydrozoa.* Ray Soc. London, p. 63, pl. 4, fig. 5.
1859. *Cuboides vitreus :* Gegenbaur, *Nova Acta. Leop. Carol.*, **27**, p. 364.
1888. *Halopyramis adamantina* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1155.
1888. *Cuboides adamantina :* Chun, *S. B. preuss Akad. Wiss.* for 1888, p. 1155.
1888. *Cymba vogtii :* Haeckel, *Jena Z. naturw.*, **22**, p. 34.
1888. *Cymba crystallus* Haeckel, *Jena Z. naturw.*, **22**, p. 34.
1888. *Cuboides crystallus :* Haeckel, *Jena Z. naturw.*, **22**, p. 37.
1888. *Cuboides vitreus :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 111.
1888. *Abyla vogtii :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 111.
1888. *Cuboides crystallus :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 111, pl. 42.
1888. *Cymba crystallus :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, pp. 111, 138, pls. 41, 42.
1888. *Cymba vogtii :* Haeckel, *Rep. Sci. res. H.M.S. Challenger, Zool.*, **28**, p. 138.
1892. *Halopyramis adamantina* Chun, *Abh. Senckenb. naturf. Ges.*, **18**, p. 111, pl. 11, figs. 1–4; pl. 12, figs. 1–3.
1892. *Cuboides adamantina :* Chun, *Abh. Senckenb. naturf. Ges.*, **18**, p. 121, pl. 10, figs. 10, 11; pl. 11, figs. 5–7; pl. 12, figs. 4–29.

1896. *Halopyramis adamantina :* Bedot, *Rev. Suisse Zool.*, **3**, p. 369.
1896. *Cuboides adamantina :* Bedot, *Rev. Suisse Zool.*, **3**, p. 369.
1898. *Enneagonum hyalinum* Schneider, *Zool. Anz.*, **21**, p. 91.
1908. *Halopyramis adamantina :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 7.
1908. *Cuboides adamantina :* Lens & van Riemsdijk, *Siboga Exped.*, **9**, p. 8.
1911. *Cuboides vitreus :* Bigelow, *Mem. Mus. Comp. Zool.* Harv., **38**, p. 190.
1918. *Cuboides vitreus :* Bigelow, *Bull. Mus. Comp. Zool.* Harv., **62**, p. 403.
1919. *Cuboides vitreus :* Bigelow, *Bull. U.S. nat. Mus.*, **100**(i,5), p. 331.
1931. *Cuboides vitreus :* Bigelow, *Zoologica*, N.Y. **8**(11), p. 529.
1932. *Enneagonum hyalinum :* Totton, *Sci. Rep. Gr. Barrier Reef Exped.*, **4**, p. 335, figs. 16, 17D.
1933. *Enneagonum hyalinum :* Leloup, *Res. Camp. Sci.* Monaco., **87**, p. 23.
1934. *Enneagonum hyalinum :* Leloup, *Bull. Mus. Hist. nat.* Belg., **10**(6), p. 58, fig. 15.
1935. *Enneagonum hyalinum :* Leloup & Hentschel, *Wiss. Ergebn. dtsch. atlant. Exped. 'Meteor'*, **12**(2), p. 20, carte 7.
1935. *Enneagonum hyalinum :* Russell & Colman, *Sci. Rep. Gr. Barrier Reef Exped.*, **11**(7), p. 258, fig. 22.
1937. *Enneagonum hyalinum :* Leloup, *Mem. Mus. R. Hist. nat.* Belg., **1**(2), 6, 9, p. 125.
1937. *Enneagonum hyalinum :* Bigelow & Sears, *Rep. Danish Oceanogr. Exped. Medit.* II *Biology*, H.2, pp. 20, 84, figs. 21–25, 65.
1938. *Enneagonum hyalinum :* Boone, *Bull. Vanderbilt Mar. Mus.*, VII, p. 38.
1950. *Enneagonum hyalinum :* Sears, *J. Mar. Res.* **9**(1), p. 3.
1953. *Enneagonum hyalinum :* Sears, *Bull. Mus. Comp. Zool.* Harv., **109**(1), p. 98, figs. 2E, 28A, 29.
1954. *Enneagonum hyalinum :* Totton, *Disc. Rep.*, **27**, p. 16.
1955. *Enneagonum hyalinum :* Leloup, *Rep. Sci. res. "Michael Sars" north atlantic deep sea Exped.*, 1910, *Siphonophores*, **5**(11), p. 7.
1955. *Enneagonum hyalinum :* Leloup, *Inst. Roy. Sci. nat.* Belg., **3**(4), p. 11.
1963. *Enneagonum hyalinum :* Daniel & Daniel, *J. Mar. Biol. Assoc.* India, **5**(2), p. 213, fig. VIII, 6, 7.
1965. *Enneagonum hyalinum :* Totton, *A synopsis of the Siphonophora.* Brit. Mus. (Nat. Hist.) London, p. 221, text-fig. 153.

Material examined.—

Station no.	*Net used*	*Depth (m)*	*Material*	*ZSI Reg. no.*
V 5225	IOSN/JN	200–0	2 ant. necto.; 1 eudox.	P 1633/1
V 5227	IOSN/I.KT.	,,	4 ,, ,, ; 2 ,,	P 1705/1
K 6	N. N.	,,	2 ,,	Gen.Coll.
K 7	,,	,,	1 ,, ,, ; 1 ,,	,,
K 8	,,	,,	1 ,,	,,
K 10	,,	,,	1 ,, ,, ; 1 ,,	,,
K 19	,,	,,	2 ,,	,,
K 21	,,	,,	1 ,,	,,
K 23	,,	,,	1 ,,	,,
K 37	,,	,,	1 ,,	,,
K 38	,,	,,	1 ,, ,, ;	,,
K 40	,,	,,	1 ,,	,,
K 41	,,	,,	2 ,,	,,
K 42	,,	,,	1 ,, ,,	,,
K 43	,,	,,	2 ,, ,, ; 5 ,,	,,
K 44	,,	,,	1 ,, ,, ; 1 ,,	,,

K 47	N. N.	200–0	4 ant. necto.		Gen.Coll.
K 49	,,	,,	1 ,, ,, ;	3 eudox.	,,
K 50	,,	500–200	1 ,, ,,		,,
K 51	,,	200–0		1 ,,	,,
K 53	,,	,,		2 ,,	,,
K 54	,,	,,	3 ,, ,,		,,
K 56	,,	500–200	1 ,, ,,		,,
K 358	Org. N.	Surface	1 ,, ,,		,,
Digha 6	,,	,,	2 ,, ,, ;	2 ,,	,,
WC-S 4	,,	,,	6 ,, ,, ;	13 ,,	,,
Puri 7	,,	,,	3 ,, ,, ;	5 ,,	,,
KRL 26	,,	,,	3 ,, ,, ;	7 ,,	,,
Gt.Nic. 6	,,	,,	2 ,, ,, ;	2 ,,	,,

Type locality.—off Gibraltar.

Distribution.—Warmer regions of all the three oceans (for details *see* Table 1).

Description.—Polygastric phase.—Only the anterior nectophore is developed.

Anterior nectophore (Text-fig. 18, H & I).—The measurements of the anterior nectophore are given below :

Length from tip to base :	8.75 mm
Breadth :	9.75 ,,
Somatocyst, length	3.5 ,,
Hydroecium, length	4.75 ,,
Nectosac, length :	4.5 ,,

The nectophore is easily recognised by its pyramidal shape and the flared out, prominent, pointed angles. However, its relationship to the other abylids is not based on the number and arrangement of the facets (*vide* Huxley, 1859; Totton, 1932; Sears, 1953). The major alteration in this species is the addition of a median dorsal ridge bisecting the dorsal facet present in *Abylopsis*. Beneath and between these two dorsal facets is a nearly triangular basal facet. Ventral to these are the apicolateral facets. Basal to and between the apicolaterals and the dorsals are the basolaterals. Basal to and between the apicolaterals is the ventral facet. The basal ends of the ridges are serrated. The somatocyst is elongate with a pronounced constriction below its apex and has a short stalk below the broad base. As in *Bassia*, it lies above the hydroecium. The hydroecium is deep and has four serrated teeth at the opening. It does not extend between the somatocyst and nectosac. The nectosac lies alongside the somatocyst but its apex is slightly at a lower level than the apex of the somatocyst. The lateral radial canals are arched and have blind apical diverticula.

Cormidia occur crowded within the hydroecium. No posterior nectophore is developed.

Eudoxid phase (Text-fig. 18, J).—The bract has a length of 5.5 mm, and a breadth of 5.0 mm. It is cuboid, and has 5 slightly concave facets—an apical, dorsal, ventral and two lateral facets. The basal portion is occupied by the broad opening of the bracteal cavity. The phyllocyst lacks the descending branch found in all the other abylids. It has a broad, slightly bilobed base and a short blunt knoblike apical portion. The bracteal cavity is broad, deep and conical in shape. Its opening is broad and slitlike.

Gonophore (Text-fig. 18, K, L & M).—The gonophore has a length of 6.67 mm and a breadth of 3.67 mm; the apophysis of the gonophore is large, blunt and conical

in shape, and it is separated from the basal half by a prominent "apical cross-ridge" which girdles the mid-region. The dorsal ridge is short and incomplete. The lateral ridges are longer and almost reach the "apical ridge", these are not straight but deviate towards the dorsal side at the apex and end in prominent teeth at the base. The unique feature connected with these teeth is the extensive concave (to nearly flat) surface beneath the dorsal and the lateral teeth. This feature is seen when the gonophore is cut horizontally in the mid-region and the distal end examined with the ostium uppermost (Text-fig. 18, K). It is seen that at the base of each lateral tooth there is a semicircular serrated lappet. Another such lappet is seen between the ventral teeth. The ventral teeth are longer and larger in the dorsal and lateral teeth. The ventral ridges are complete. At the junction between the right ventral ridge and the "apical ridge" there is a hook like tooth which characterizes this species.

Enneagonum *searsae* Alvarino, 1968

(Text-fig. 18, N–P)

1968. *Enneagonum searsae* Alvorino, *Pacific, Science,* **22**(3) : 340.

The eudoxid phase of a species of *Enneagonum* is present in the collections, whose phyllocyst and gonophore differ from those of *E. hyalinum.* These are described as *Enneagonum searsae* Alvarino, 1968.

Material examined.—Two examples of the eudoxid phase were taken from (i) RV VITYAZ Station no. 5212 by Ichthyological Net in a haul from 1000 metres to surface–1ex.; (ii) RV DIAMANTINA Station no. DM 90, (DM' 2'62; sample no. 522E) by IOS Net, in a haul from 200 metres to surface–1 ex.

Type locality.—Gulf of Thailand.

Holotype.— USNM No. 52701.

Description.—Eudoxid phase (Text-fig. 18, N, O & P).—*Bract* (Text-fig. 18, N).—The bract has a length of 9.0 mm and a breadth (at base) of 12.0 mm. It is large and nearly cuboidal in shape. The bracteal cavity is large, conical in shape and has a broad opening at the base. The phyllocyst has a broadly deeply bilobed base and a thin, threadlike and long anterior portion.

Gonophore (Text-fig. 18, O & P).—These have a length of 4.4 mm and a breadth of 3.0 mm. The apophysis is not large or conical or blunt as in *E. hyalinum,* but it is narrow and ends with a pointed tip. The apical cross-ridge is very oblique and occurs at the apical end of the gonophore (Text-fig. 18, O & P, acr.). There are many teeth at the ostium of the gonophore. One of the ventral teeth is long and bent over the other smaller teeth (text-fig. 18, O & P vt.). The nectosac is bent and this bent region is parallel to the apical ridge. The figures of the gonophore of *E. searsae* (Text-fig. 18, O & P) compared with the figures of the gonophore of *E. hyalinum* (text-fig. 18, K, L & M) show the differences clearly.

Remarks.—The bract of *E. searsae* is larger than those of *E. hyalinum.* The phyllocyst of the two species differ in the anterior arm being short and knoblike in *E. hyalinum,* and long and thin in *E. searsae.* In *E. hyalinum* half the apical portion of the gonophore lies above the apical cross-ridge, while in the *E. searsae* very little portion is seen above this ridge. Further, this ridge in *E. searsae* occurs in an oblique manner, whereas in *E. hyalinum* it is nearly horizontal. The shape and number of the ostial teeth are different in the two species (*vide* text-fig. 18, O & P, for *E. searsae* text-fig. 18, K, L & M, for *E. hyalinum*).

The differences in the phyllocyst and the gonophore of *E. searsae* clearly shows that this species is distinct from *E. hyalinum.* However, a study of a large series from

different localities and growth stages, is required to prove the constancy of the above-mentioned characters.

VII.—GEOGRAPHICAL DISTRIBUTION

The collections include Siphonophores from the coastal plankton over continental shelves which occur in the relatively shallow zone roughly delimited by the 200 metre isobath—referred to as neritic forms. It is difficult to delimit sharply the neritic from the oceanic forms since the distance to which the neritic species extend from the shore is very variable, depending on the topography of the coast and the depth of water as well as the local water currents (*vide* Ekman, 1953; Raymont, 1963—for zooplankton).

Of the eighty species encountered in this study, 78 are oceanic forms and only 2 are true neritic species, *viz.*, *Diphyes chamissonis* and *Lensia subtiloides*. These were observed to be greater in numbers in the collections of the Bay of Bengal than in the collections of the Arabian Sea. This may probably be due to the broader continental shelf along the east coast of India, and to the slightly reduced salinity of these waters. A single example of *D. chamissionis* and 4 examples of *L. subtiloides* present in RV VITYAZ Station V 5227, may be probably stray forms from the neritic zone of the Andaman & Nicobar group of Islands.

Some species like *Chelophyes contorta*, *Lensia hotspur*, *Abylopsis tetragona*, *A. eschscholtzi* and *Bassia bassensis* occur in the neritic as well as the oceanic zone.

The geographical distribution of the world species of the Siphonophora is given in Table 1.

In Table 1 details of the geographical distribution (based on published records and the present work) of 150 species and one variety of Siphonophora are presented. From an analysis of this Table these species can be arranged according to their known range of distribution as follows :

I. *Species known from the Atlantic Ocean only :—*

?*Salacella polygastrica*
**Agatma clausi*
Halistemma striata
Nanomia cara
**Lychnagalma utricularia*
Rhodalia miranda
**Sphaeronectes gamulini*
Angelopsis globosa
**Forskalia formosa*
**Lilyopsis rosea*
**Lilyopsis gracilis*
Stephanophyes superba
Lensia hardy

Of these 13 species known so far from Atlantic Ocean only, six species (marked with an *) are recorded only from the Mediterranean Sea.

II. *Species known from the Pacific Ocean Only :—*

Bathyphysa sibogae
?*Bathyphysa japonica*
?*Epibulia chamissonis*
Halistemma cupulifera
Angelopsis dilata
Archangelopsis typica
Dromalia alexandri
?*Forskalia misakiensis*
Sulculeolaria bigelowi
Lensia baryi
Sphaeronectes japonica
Abyla peruana

TABLE 1.—The geographical distribution of the

SPECIES	ARCTIC OCEAN	ATLANTIC OCEAN						
		1	2	3	4	5	6	7
Suborder CYSTONECTAE :								
1. *Physalia physalis*				x	xt	x	x	x
2. *Rhizophysa filiformis*			xt	x	x		x	x
3. *R. eysenhardti*				x		x	x	x
4. *?Salacella polygastrica*								xt
5. *Bathyphysa conifera*			x	x	x	x		
6. *B. sibogae*								
7. *?B. japonica*								
8. *?Epibulia chamissonis*								
9. *?E. ritteriana*								
Suborder PHYSONECTAE :								
10. *Apolemia uvaria*			xt	x				
11. *Agalma okeni*			x	x	x	x	x	x
12. *A. haeckeli*								
13. *A. clausi*			xt					
14. *A. elegans*		xt	x				x	
15. *Halistemma rubrum*			xt				x	
16. *H. cupulifera*								
17. *H. striata*				x	x		xt	
18. *?H. amphytridis*				x			x	
19. *Cordagalma cordiformis*			x				x	
20. *Nanomia bijuga*			xt			x		x
21. *N. cara*		xt	x	x				
22. *Frillagalma vityazi*								

Note : Numeration under the Oceans at top of this Table represents as follows :

1 : North Sea; 2 : Mediteranean Sea; 3 : North of Equator (upto 45°N); 4 : South of Equator (upto 55°S); 5 : Central Atlantic; 6 : West Indies; 7 : Canary Islands and West coast of Africa; 8 : Eastern tropical Pacific; 9 : Cocos & Galapagos Islands; 10 : Malaysian area; 11 : South Pacific; 12 : North Pacific; 13 : Off south and east coast of Africa; 14 : Arabian Sea; 15 : Bay of Bengal; 16 : Red Sea; 17 : Gulf of Aqaba; 18 : Gulf of Aden; 19 : Seychelles & Chagos Archipelago; 20 : South & Eastern Indian Ocean.

world-species of the Order Siphonophora.

PACIFIC OCEAN					INDIAN OCEAN								ANTARCTIC OCEAN
8	9	10	11	12	13	14	15	16	17	18	19	20	
x		x	x		x	x	x				x	x	
x		x	x									x	
		x					x				x		
?	?	x	?										
		xt											
				xt									
				xt									
						xt							
?			x	x		x							
x	x	x	x	x	x	x	x	x	x	x	x	x	
							xt						
x		x		x		x	x				x	x	
		x	x		x	x	x	x				x	
		xt											
x		x	x				?					x	
			xt		x	x		x	x			x	
x		x	x	x	x	x	x	x		x			
												xt	

TABLE 1.—

SPECIES	ARCTIC OCEAN	ATLANTIC OCEAN						
		1	2	3	4	5	6	7
23. *Marrus antarcticus*								
24. *M. orthocanna*	xt							
25. *M. orthocannoides*								
26. *Moseria convoluta*								
27. *Lychnagalma utricularia*			xt					
28. *?L. vesicularia*								
29. *Erenna richardi*							x	
30. *Pyrostephos vandoeffeni*								
31. *Bargmannia elongata*				x	x			xt
32. *Physophora hydrostatica*		x	xt	x	x			
33. *Athorybia rosacea*			xt	x	x			
34. *Melophysa melo*			xt	x	x			x
35. *Angelopsis globosa*				xt				
36. *A. dilata*								
37. *Stephalia corona*		x	x	x	x	x		
38. *Rhodalia miranda*					xt			
39. *Archangelopsis typica*								
40. *Dromalia alexandri*								
41. *Forskalia edwardsi*			xt					
42. *F. leuckarti*			xt					
43. *F. formosa*			xt					
44. *F. tholoides*				xt				
45. *F. cuneata*								xt
46. *?F. misakiensis*								
Suborder CALYCOPHORAE :								
47. *Amphicaryon acaule*			x	x			x	xt
48. *A. peltifera*				x		xt		x
49. *A. ernesti*				x				x
50. *A. intermedia*								

continued

PACIFIC OCEAN					INDIAN OCEAN								ANTARCTIC OCEAN
8	9	10	11	12	13	14	15	16	17	18	19	20	
													xt
					xt								
													xt
							xt						
x	x	x		x									
													xt
				x	x	x							
x	x	x	x	x	x	x							
x	x	x	x	x				x	x		x	x	
	x				x							x	
xt													
		x	x	x									
		xt		x									
xt													
		x	x										
		x					x						
				x									
					x			x	x				
				xt									
x	x				x	x		x			x	x	
					x								
					xt			x					
						xt							

TABLE 1.—

SPECIES	ARCTIC OCEAN	ATLANTIC OCEAN						
		1	2	3	4	5	6	7
51. *Marsearsia praeclara*						x	x	
52. *Rosacea plicata*			xt	x	x			
53. *R. cymbiformis*		x	x	x	x		x	
54. *Praya dubia*							x	x
55. *P. reticulata*				x				
56. *Prayoides intermedia*								xt
57. *Lilyopsis rosea*			xt					
58. *L. gracilis*			xt					
59. *Desmophyes annectens*			x					
60. *Stephanophyes superba*								xt
61. *Nectopyramis diomediae*	x			x	x		x	
62. *N. thetis*				xt	x			x
63. *N. natans*					x			
64. *N. spinosa*					x		x	x
65. *Hippopodius hippopus*			xt	x	x	x	x	x
66. *Vogtia spinosa*			xt	x			x	
67. *V. pentacantha*			xt	x		x	x	
68. *V. serrata*								
69. *V. glabra*			x	x			xt	
70. *Sulculeolaria quadrivalvis*		x	x	x	x		x	
71. *S. biloba*		xt						
72. *S. turgida*			xt	x	x		x	
73. *S. angusta*								
74. *S. chuni*			x	x	x			
75. *S. monoica*				x	x		x	xt
76. *S. bigelowi*								
77. *Diphyes dispar*		x	x	x	x	x	x	x
78. *D. bojani*			x	x	x	x	x	x
79. *D. chamissonis*								

continued

PACIFIC OCEAN					INDIAN OCEAN								ANTARATIC OCEAN
8	9	10	11	12	13	14	15	16	17	18	19	20	
					xt							x	
x		x	x		x	x	?					x	x
x		x	x		x	x					x		
x	x		xt		x							x	
xt	x	x	x	x		x							
						x							
				x			xt						
xt	x			x	x							x	
				x	x							x	
xt	x			x	x							x	
			xt								x	x	
x	x	x			x	x					x	x	
x	x				x							x	
			x		x	x					x	x	
					x								xt
					x	x				x		x	
x	x	x	x	x	x	x	x	x	x	x	x	x	
		x			x	x				x		x	
?	x	?	?		x	x	x				x	x	
					xt	x						x	
		xt	x	x	x	x	x	x	x	x	x	x	
x	x	x	x		x	x	x				x	x	
			xt										
x	x	x	x	x	x	x	x	x		x	x	x	
x	x	x	x	x	x	x	x			x	x	x	
x		x	xt	x	x	x	x	x		x	x	x	

TABLE 1.—

SPECIES	ARCTIC OCEAN	ATLANTIC OCEAN						
		1	2	3	4	5	6	7
80. *D. antarctica*								
81. *Lensia subtiloides*				x	x			
82. *L. conoidea*		x	xt	x			x	
83. *L. hotspur*				x	xt			
84. *L. gnanamuthui*								
85. *L. roonwali*								
86. *L. hardy*					xt			
87. *L. fowleri*			x	xt	x		x	
88. *L. challengeri*								
89. *L. achilles*					xt			
90. *L. baryi*								
91. *L. cordata*								
92. *L. leloupi*								xt
93. *L. tottoni*								
94. *L. panikkari*								
95. *L. nagabhushanami*								
96. *L. campanella*			x	x	x			
97. *L. cossack*				x	xt			
98. *L. subtilis*	x	?	xt	x	x			x
99. *L. subtilis* var. *chuni*								
100. *L. meteori*			x		xt			
101. *L. tiwarii*								
102. *L. multicristata*				x	x		x	
103. *L. hunter*					xt			
104. *L. havock*					x		xt	
105. *L. lelouveteau*				x	xt			
106. *L. exeter*					xt			
107. *L. hostile*					xt			
108. *L. grimaldi*					xt			

continned

PACIFIC OCEAN					INDIAN OCEAN								ANTARCTIC OCEAN
8	9	10	11	12	13	14	15	16	17	18	19	20	
													xt
		xt	x	x	x	x	x	x		x	x	x	
		x	x		x	x						x	
		x	x		x	x	x	x	x			x	
							xt						
												xt	
x		x	x		x	x		x	x			x	
			xt	x		x						x	
					x								x
				xt									
					xt								
						x						x	
							xt						
												xt	
						xt							
		x	x		x	x	x	x				x	
		x	x		x	x	x				x	x	
		x	x		x	x		x	x		x	x	
					xt								
					x	x		x	x			x	
												xt	
x		x	x		x	x					x	x	
					x							x	
				x	x								x
					x								
					x								
					x							x	
		?	x		x								

TABLE 1.—

SPECIES	ARCTIC OCEAN	ATLANTIC OCEAN						
		1	2	3	4	5	6	7
109. *L. ajax*					xt			
110. *L. reticulata*	x							
111. *Muggiaea kochi*		x	xt	x	x			
112. *M. atlantica*		xt	x	x	x			
113. *M. delsmani*								
114. *M. bargmannie*	x							
115. *Dimophyes arctica*	xt	x		x	x			
116. *Chelophyes appendiculata*			x	xt	x		x	
117. *C. contorta*							x	
118. *Eudoxoides mitra*			x	x	x		x	
119. *E. spiralis*			x	x	x		x	
120. *Eudoxia macra*								
121. *Clausophyes ovata*			xt		x			
122. *C. galeata*								
123. *Chuniphyes multidentata*			x	x	x		x	
124. *C. moserae*							x	
125. *Crystallophyes amygdalina*					x			
126. *Heteropyramis maculata*					x			
127. *Thalassophyes crystallina*					x			
128. *Sphaeronectes gracilis*			xt					
129. *S. irregularis*			xt					
130. *?S. princeps*								
131. *S. gamulini*			xt					
132. *S. japonica*								
133. *Ceratocymba leuckarti*				x	x		x	x
134. *C. dentata*					x		xt	
135. *C. intermedia*					xt			
136. *C. sagittata*			xt	x	x	x	x	x
137. *C. indica*								

continued

PACIFIC OCEAN					INDIAN OCEAN								ANTARCTIC OCEAN
8	9	10	11	12	13	14	15	16	17	18	19	20	
					x	x						x	
				x	xt								
x				x									
x				x		x		x		x			
		xt	x	x	x		x						
													xt
		?	x								x	x	x
x	x	x	x	x	x	x				x	x	x	
x		xt	x	x	x	x	x	x	x	x	x	x	
x	x	x	x	x	x	x	x			x	xt	x	
xt		x	x	x	x	x					x	x	
					xt								
					x	x						x	
		xt											x
x		xt			x							x	x
					xt							x	x
					x								xt
					x								xt
					x								xt
		?	x	x		x							
		?											
						xt							
				xt									
x	x	x	xt		x	x	x				x	x	
	x		x	x	x						x	x	
		x											
x	x	x	x		x						x	x	
												xt	

TABLE 1.—

SPECIES	ARCTIC OCEAN	ATLANTIC OCEAN					
		1	2	3	4	5	6	7
138. *Abyla trigona*			xt	x	x	x	x	x
139. *A. carina*				x	x			xt
140. *A. schmidti*								x
141. *A. haeckeli*					x			
142. *A. ingeborgae*					x			xt
143. *A. bicarinata*					xt			
144. *?A. brownia*								
145. *A. tottoni*					xt			
146. *A. peruana*								
147. *Abylopsis tetragona*			x	x	x	x	x	x
148. *A. eschscholtzi*			x	x	x	x	x	x
149. *Bassia bassensis*			x	x	x	x	x	x
150. *Enneagonum hyalinum*			xt	x	x	x	x	x
151. *Enneagonum searsae*								

Total species : 150 species and one variety New species : 7

III. *Species known from the Indian Ocean Only :—*

?*Epibulia ritteriana*
Agalma haeckeli
Frillagalma vityazi
Marrus orthocannoides
?*Lychnagalma vesicularia*
**Amphicaryon intermedia*
Sulculeolaria angusta
Lensia gnanamuthui
?*Sphaeronectes princeps*
**Enneagonum searsae*
**Lensia roonwali*
Lensia cordata
Lensia tottoni
**Lensia panikkari*
**Lensia nagabhushanami*
Lensia subtilis var. *chuni*
**Lensia tiwarii*
Eudoxia macra
**Ceratocymba indica*

Of these 19 species, 7 species marked with an * are new records for the Indian Ocean.

IV. *Species known from the Atlantic and Pacific Oceans :—*

Bathyphysa conifera
Erenna richardi
Stephalia corona
Forskalia edwardsi
Forskalia tholoides
Muggiaea kochi
Sphaeronectes irregularis
Ceratocymba intermedia
Alyla tottoni

continued

PACIFIC OCEAN					INDIAN OCEAN								ATLANTIC OCEAN
8	9	10	11	12	13	13	15	16	17	18	19	20	
x		x	x	x	x					x	x	x	
		x	x		x						x	x	
		x	x		x					x	x	x	
x		xt	x	x	x	x					x	x	
					x						x		
			x	x	x						x	x	
		x	xt		x								
		x	x										
			xt										
x	x	x	x	x	x	x	x	x	x	x	x	x	
x	x	x	xt	x	x	x	x	x		x	x	x	
x	x	x	xt	x	x	x	x	x		x	x	x	
x	x	x	x	x	x	x	x	x		x	x	x	
			xt									xt	

x—present xt—type locality.

V. *Species known from the Pacific and Indian Oceans.*—

Diphyes chamissonis
Lensia challengeri
Muggiaea delsmani
?*Abyla brownia*

L. challengeri was hitherto known only from the Pacific Ocean.

VI. *Species known from the Atlantic and Indian Oceans.*—

Forskalia cuneata
Amphicaryon peltifera
Amphicaryon ernesti
Maresearsia praeclara
**Prayoides intermedia*
Vogtia glabra
Lensia meteori
**Lensia leloupi*
Abyla ingeborgae
Lensia hunter
Lensia lelouveteau
Lensia exeter
Lensia hostile
Lensia ajax
Clausophyes ovata

The distribution of *Prayoides intermedia* and *Lensia leloupi* are extended to the Indian Ocean in this report for the first time.

VII. *Species widely distributed in the Atlantic, Pacific and Indian Oceans.*—

Physalia physalis
**Rhizophysa filiformis*
Rhizophysa eysenhardti
Apolemia uvaria
Agalma okeni
Agalma elegans
Athorybia rosacea
Melophysa melo
Forskalia leuckarti
Amphicaryon acaule
Rosacea cymbiformis
Praya dubia
**Praya reticulata*
Desmophyes annectens
Nectopyramis thetis
Nectopyramis natans
Nectopyramis spinosa
Hippopodius hippopus
Vogtia spinosa
Vogtia pentacantha
Sulculeolaria quadrivalvis
Sulculeolaria biloba
Sulculeolaria turgida
Sulculeolaria chuni
Sulculeolaria monoica
Diphyes dispar
Diphyes bojani
Lensia subtiloides
Lensia conoidea
Lensia hotspur
Halistemma rubrum
*?*Halistemma amphytridis*
Cordagalma cordiformis
Nanomia bijuga
Bargmannia elongata
Physophora hydrostatica
Lensia fowleri
Lensia campanella
Lensia cossack
Lensia multicristata
Lensia grimaldi
Muggiaea atlantica
Chelophyes appendiculata
Chelophyes contorta
Eudoxoides mitra
Eudoxoides spiralis
Sphaeronectes gracilis
Ceratocymba leuckarti
Ceratocymba sagittata
Ceratocymba dentata
Abyla trigona
Abyla carina
Abyla schmidti
Abyla haeckeli
Abyla bicarinata
Abylopsis tetragona
Abylopsis eschscholtzi
Bassia bassensis
Enneagonum hyalinum

The distribution of the species marked with an * is extended to the Indian Ocean in the present report for the first time.

VIII. *Species known from the Arctic Ocean.*—

Marrus orthocanna
Nectopyramis diomedeae
Lensia subtilis
Lensia reticulata
Muggiaea bargmannae
Dimophyes arctica

Of these six species, *Marrus orthocanna* is restricted to the high Arctic zone of the Baffin Bay and has been found penetrating South, west of the Faroes. *Muggiaea bargmannae* has been recorded from the Antarctic Ocean also. *Nectopyramis diomedeae* and *Lensia subtilis* are distributed in the Atlantic, Pacific and Indian Oceans also. *Dimophyes arctica* has a very wide range of distribution occurring in all the Oceans. *Lensia reticulata* occurs in the Pacific and Indian Oceans also.

IX. *Species known from the Antarctic Ocean.*—

Moseria convoluta
Pyrostephos vanhoeffeni
Vogtia serrata
Dimophyes arctica
Clausophyes galeata
Chuniphyes multidentata

Diphyes antarctica
Marrus antarcticus
Rosacea plicata
Lensia achilles
Lensia havock
Muggiaea bargmannae
Chuniphyes moserae
Crystallophyes amygdalina
Heteropyramis maculata
Thallossophyes crystallina

Of these, *Moseria convoluta, Pyrostephos vanhoeffeni* and *Diphyes antarctica* are restricted to the Antarctic zone. *Marrus antarcticus* and *Vogtia serrata* occur mainly in this zone; the former species has also been reported in waters that had left the zone recently and the latter from Indian Ocean (south and east coasts of Africa). *Clausophyes galeata* is known from the Pacific Ocean also. *Lensia achilles, Chuniphyes moserae, Crystallophyes amygdalina, Heteropyramis maculata* and *Thalassophyes crystallina* are known from the Atlantic and Indian Oceans also, whereas *Rosacea plicata, Lensia havock* and *Chuniphyes multidentata* have a much wider range occuring in all the oceans except in the Arctic Ocean.

It will be noted from the above break-up that 65 species have a wide range of distribution in 3 oceans; 59 occur in the Atlantic, Pacific and Indian Oceans; 5 from the Atlantic, Indian and Antarctic Oceans and one from the Arctic, Pacific and Indian Oceans. Five species occur in 4 oceans and one is known from all five oceans, indicating thereby the great adaptibility of these species to varying environmental and hydrographical factors. Further research may well reveal that the species so far known to be restricted to a particular ocean may also be found more widely distributed as intensive sampling data become available.

Very few accounts of the geographical distribution of the Siphonophora are available for comparison. The only detailed discussion on geographical distribution of the Siphonophora was by Bigelow (1911b) correlating salinity and temperature of the then known species when their distribution in the Indian and the Antarctic Oceans was practically unknown. Borwne (1926), Sears (1953), Totton (1954) and Daniel & Daniel (1963) and present records show that many species which were considered to be restricted to the Atlantic or Pacific also occur in the Indian Ocean.

Furthermore *Dimophyes arctica* considered as a valuable 'indicator' of water masses was shown by Totton (1954) as a species which was not found north of 06°05'N. lat. However, the present records from the INS Kistna stations K 7 and K 35 show that this species occurs upto latitude 12°N in the Arabian Sea, in the colder months. These examples were recorded from a depth of 500–0 and 200–0 m. respectively. Data on salinity and temperature is not available for comparison. The occurrence of this species in this area is probably due to the upwelling of one of the three deep water currents, from the Antarctic or subantarctic zone. An example of *Dimophyes arctica* from the 91°E meridian (Lat. 2°03'N) at Vityaz station number V 5216 and from a depth range of 1000–0 m where the salinity ranges from 34.20 to 34.97‰ and temperature ranges from 6.70°C to 28.44°C lends support to the salinity-temperature tolerance of this species as pointed out by Totton (1954). The occurrence of this species along this meridian is probably due to the third arm of the deep Antarctic current running along this meridian.

It is to be remembered, therefore, that no hard and fast lines can be drawn between cold and temperature water species or between temperature and tropical species, especially in view of the spread due to ocean currents and the possible colonization of the deeper water layers, so that unfavourable temperature strata may be avoided. However, the greater concentration of species of the Siphonophores appears to be in the tropical waters of the three oceans; the number of species decreasing gradually in the higher latitudes (cf. Raymont, 1963). A study of the R.V. Vityaz collections show that about 48 species (out of the 61 species encountered) appear to be concentrated around

the equator extending between 5°N and 10°S latitudes (*vide* Daniel & Daniel, 1968), indicating that probably many species of Siphonophores have their centre of distribution in this region.

VIII.—Bathymetrical Distribution

The world species of Siphonophora known to be mesoplanktonic or bathypelagic in habit are given below. Their depth ranges from different oceans are indicated when known. In many of the older works the exact depth ranges were not given.

Bathyphysa conifera (Atl : 1780—0; Pac : 4391—521 m).
? B. japonica Not known (from deep water).
B. sibogae (Pac : 2081 m).
Apolemia uvaria (Medit : 600 m).
? Halistemma amphytridis (Pac : cable from deep depth—Cf. L. & R., 1908; Ind: 1000—0)
Marrus antarcticus (Ant : 1750—1300; 700—400; 240—110).
Marrus orthocanna (Not known)
Marrus orthocannoides (Ind : 1400—700).
Moseria convoluta (Ant : 1750—1300; 700—400; 240—110).
Erenna richardi (Atl : 1900—1500; 1000 m).
Pyrostephos vanhoeffeni (Ant : 1750—1300; 700—400; 240—110).
Rhodalia miranda (Atl : 1200 m).
Stephalia corona (Atl : 1280 m)
Angelopsis globosa (Atl : 2790 m).
A. dilata (Pac. 1266—0 m).
Archangelopsis typica (Pac : 112 m.)
Dromalia alexandri (Pac : 586—0 m).
Amphicaryon acaule (Atl : 1274—0; Pac : 500—0; Ind : 1000—0 & Surface).
Maresearsia praeclara (Atl : 1826—0; Ind : 1000—0).
Rosacea plicata (Ant : 500—100; Atl : 600—400; —0; Pac : 9000—500—100; Ind : 1000—0 & Surface).
Praya dubia (Pac : 900—0; Ind : 1000—0 & Surface).
Praya reticulata (Pac : 1090—0; Ind : 200—0).
Nectopyramis diomedeae (Arc : 875—275; Atl : 1829—500—0; Pac : 2500—500—0; Ind : 1600—650).
N. thetis (Pac : 4000—0); Ind : 1700—0; 1250—800; Atl : 2800—2300; 1000—800; 1000—0; 1000—250).
N. natans (Pac : 5500—0; Ind : 1650—950; 2580—2480).
N. spinosa (Atl : 2400—1150; 500—250; Ind : 1000—0).
Hippopodius hippopus (Atl : 2181—300—100—0; Pac : 1274—0 & Surface; Ind : 1000—0; 150—100 & Surface).
Vogtia spinosa (Atl : 500—300; Pac : 1274—0; Ind : 200—0).
V. serrata (Ant : 3868—1000; 700—280; 1200—0).
Sulculeolaria turgida (Atl : 300—0; Ind : 1000—0; 150—100 & Srf.)
S. monoica (Atl : 200—0) Pac : 1090—0; Ind : 1000—0 & Surface).
Lensia roonwali (Ind : 1000—0).
Lensia multicristata (Atl : 2500—100; Ind : 2100—200; 1400—0; 200—
Lensia panikkari n. sp. (Ind : 1000—0).
L. hunter (Atl : 1400—1000; 1000—0; Ind : 1000—0).
L. meteroi (Atl : 366—0; Ind : 1400—0; 500—50).
L. lelouveteau (Atl : 1000—220; 1000—50).
L. reticulata (Arc : 1500—0; 3000; Ind : 1400—700—0).

L. hardy (Atl. : 2500—1200; 1000—0).
L. achilles (Atl : 2500—2000; 1000—900; Ind : 1400—1000).
L. havock (Atl : 3000—0; Pac : 3400—0).
L. exeter (Atl : 1500—0; 750—500; 475—0).
L. hostile (Atl : 3000—2000—0).
L. cordata (Ind : 950—650).
L. tiwarii (Ind : 1000—0).
Muggiaea bargmannae (Arc : 1360—0; 500—50; Ant : 750—500—50).
Dimophyes arctica (Arc : 2800—800—500—0; Atl : 2000—500—100; Ind : 1750—250—100—0).
Chelophyes appendiculata (Atl : 1300—800—100—0; Pac : 1000—0; Ind : 1300—0; 450—150; 200—0).
Chelophyes contorta (Pac : Not given; Ind : 1900—600—50; 200—0).
Clausophyes ovata (Atl : 3000—260 ; Ind : 1350—0).
C. galeata (Pac : 2400—1150; Ant : 2400—1150).
Chuniphyes multidentata (Atl : 3000—1300; 1800—0; Ind : 1000—200—0 & Surface).
C. moserae (Atl : 1800—1450; 900—0; Ind : 1260—600; 1000—0; Ant : 2400—1150).
Crystallophyes amygdalina (Atl : 3000—250; Ind : 1650—950—700).
Heteropyramis maculata (Atl : 1500—250; Ind : 1400—250; 450—0; Ant : 3000—500—0).
Thalassophyes crystallina (Atl : 2000—500; 250; 1097—0; Ind : 1400—700, -200; Ant : 2400—875—600—0).
Ceratocymba dentata (Atl : 1000—0; Ind : 1000—0; 150—100).
C. sagittata (Atl : 1000—0; 50—0; Pac : 2180—0 & Surface; Ind : 1000—0; 150—100).
C. indica (Ind : 1000—0).
Abyla ingeborgae (Atl : 1200—600).
A. bicarinata (Pac : Not known; Ind : 1000—0; 150—100).
Enneagonum hyalinum (Atl : 1200—1000—0; Pac : 636—0; Ind : 500—200; 200—0 & Surface).

In the collections under report the bathymetric distribution pattern could not be studied in detail since the collections were mainly from a layer between 200 meters to surface and rarely from 500 to 200 m. Real deep water samples from 1000 m depth are available only in the R. V. Vityaz collections. From these samples were collected only by an open ichthylogical net or a Ring Trawl making it difficult to determine the exact depth at which these species occurred. However, since the other nets used at the levels (200—0) did not collect any of the deep water forms, it has been possible to enumerate the deep water species present in the collection. These are :

?Halistemma amphytridis
Maresearsia praeclara
Nectopyramis spinosa
Lensia roonwali
Lensia panikkari
Lensia tiwarii
Lensia hunter
Chuniphyes moserae
Ceratocymba indica
Ceratocymba dentata
Certacymba sagittata
Abyla bicarinata

The last 3 species were collected from a depth of 1000—0 and from the sonic scattering layer occurring between a depth of 450—70 m.

These were not recorded from hauls made from 200—0 m. A few species like *Rosacea plicata, Sulculeolaria turgida, Lensia meteori, Dimophyes arctica, Chelophyes appendiculata, Chuniphyes multidentata, Heteropyramis maculata* and *Enneagonum searse* show

a great vertical range (from 1000—200, & 200—0 m) and some times occur even at the surface collected by Pleistone net. For example, *Chuniphyes multidentata* which was considered as only occurring in deep water has been collected from the surface by Pleistone net from the Vityaz Station No. V 5182 (2 anterior nectophores) and V 5196 (1 anterior nectophore) and by Juday net from a depth range of 200—0 m at V. 5223 (2 anterior nectophores), but these were highly distorted.

The vertical distribution of *Dimophyes arctica* has been dealt with earlier (*see* p. 227). where it has been shown as occurring at the upper layers probably due to the upwelling of deep water masses.

As our knowledge of the current systems of all the oceans and their seasonal variations of the upwelling regions increases the old concept that certain species of Siphonophora are restricted to certain depths may have to be changed.

IX.—Siphonophores as an important constituent of the sonic scattering layer

During recent years it has been demonstrated that the Siphonophores from an important constituent of the Sonic Scattering Layer (Barham, 1963; Daniel, Nagabhushanam & Daniel, 1968). The Siphonophore constituent of this layer at 7 stations (*viz.*, those established by the RV VITYAZ on her 35th Cruise in the eastern part of the Indian Ocean : V 5177, V 5179, V 5207, V 5209, V 5212, V 5220 & V 5227) were studied along with other zoological constituents. These investigations revealed that the percentage composition of the Siphonophores ranged from 36% to 44%, with an average of 40%, at the Upper Sonic Scattering Layer (USSL). Below and above this layer, the Siphonophores ranged from 6% to 12% only. Fuller details are given in the paper (Daniel, Nagabhushanam & Daniel, 1968, op. cit.).

The Siphonophores encountered in the USSL included 20 species. These are :

Agalma okeni, Halistemma rubrum, Hippopodius hippopus, Sulculeolaria quadrivalvis, S. angusta, S. turgida, Lensia challengeri, Diphyes dispar, Chelophyes appendiculata, C. contorta, Eudoxoides mitra, Chuniphyes multidentata, Ceratocymba dentata, C. sagittata, C. leuckarti, Abyla bicarinata, A. haeckeli, Abylopsis tetragona, Bassia bassensis and *Enneagonum hyalinum.*

The data obtained so far has proved to be of very great interest, and it is hoped that further studies related with density of these forms in the various parts of the Sonic Scattering Layer would serve to throw fresh light on their response to various hydrographical factors.

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