J. mar. biol. Ass. India, 1973, **15** (1) : 125-159

SIPHONOPHORES OBTAINED DURING THE CRUISES OF R. V. *VARUNA* FROM THE WEST COAST OF INDIA AND THE LACCADIVE SEA*

K. RENGARAJAN

Central Marine Fisheries Research Institute, Cochin, India

ABSTRACT

Very little work has been carried out on the siphonophores of the west coast of India and the Laccadive Sea.

This paper gives an account of thirty seven species including one new species of siphonophores obtained during the cruises of R. V. *VARUNA*. The species are described and illustrated to facilitate their identification. While thirty of the species are being recorded for the first time from along the west coast of India and the Laccadive Sea, twelve are new records for Indian Seas.

INTRODUCTION

SIPHONOPHORA forms one of the major constituents of the marine tropical plankton (Isamu Yamazi, 1971) and plays an important role in the marine food chain. They are also very good indicators of water masses.

A good deal of work is now available on the Zooplankton, especially on their distribution, abundance and seasonal fluctuations along the east and west coasts of India (Aiyer *et al.*, 1936; Bal and Pradhan, 1945; Bal, 1952; Chacko, 1950; Chidambaram and Menon, 1945; Devanesan, 1942; George, 1953; Menon, 1945; Prasad, 1954, 1964; Prasad *et al.*, 1952; etc.). However, little attention has been paid to the study of siphonophores of this region. Haeckel (1888 b), Browne (1926), Totton (1954), Daniel (1966, 1970), Daniel and Daniel (1967), and Daniel *et al.* (1969) have studied material from the Indian Ocean while Sundara Raj (1927), Menon (1931), Leloup (1934), and Daniel and Daniel (1962, 1963a, 1963b) have worked on material from the east coast. Thus, practically no information is available on the species of Siphonophora occuring along the west coast of India and the Laccadive Sea except information on the occurrence of the group as a whole along this coast in some earlier plankton studies. The present descriptive account dealing with thirty seven species including one new species forms essential background for future works on the biology, ecology and seasonal abundance of siphonopores and their role in the marine ecosystem and this will partly fulfil a void.

The author is thankful to Dr. S. Z. Qasim, Director, Central Marine Fisheries Research Institute for his keen interest in this work. He is greatly indebted to Dr. E. G. Silas, Head of the Division of Marine Biology and Oceanography for suggesting the problem, guidance, examining the material, helpful suggestions and critically going through the manuscript. He also wishes to thank Mrs. R. Daniel for the useful discussions he had with her, on species problems in Siphonophora.

*Presented at the 'Symposium on Indian Ocean and Adjacent Seas – Their Origin, Science and Resources' held by the Marine Biological Association of India at Cochin from January 12 to 18, 1971.

MATERIAL AND METHODS

This study is based on the Zooplankton samples collected during the research cruises of R. V. *Varuna* along the west coast of India and the Laccadive Sea from January 1962 to December 1963. The area covered by these cruises is between 68° 53′ E and 76° 25′ E and 08° 15′ N and 21° 36′ N. A total of

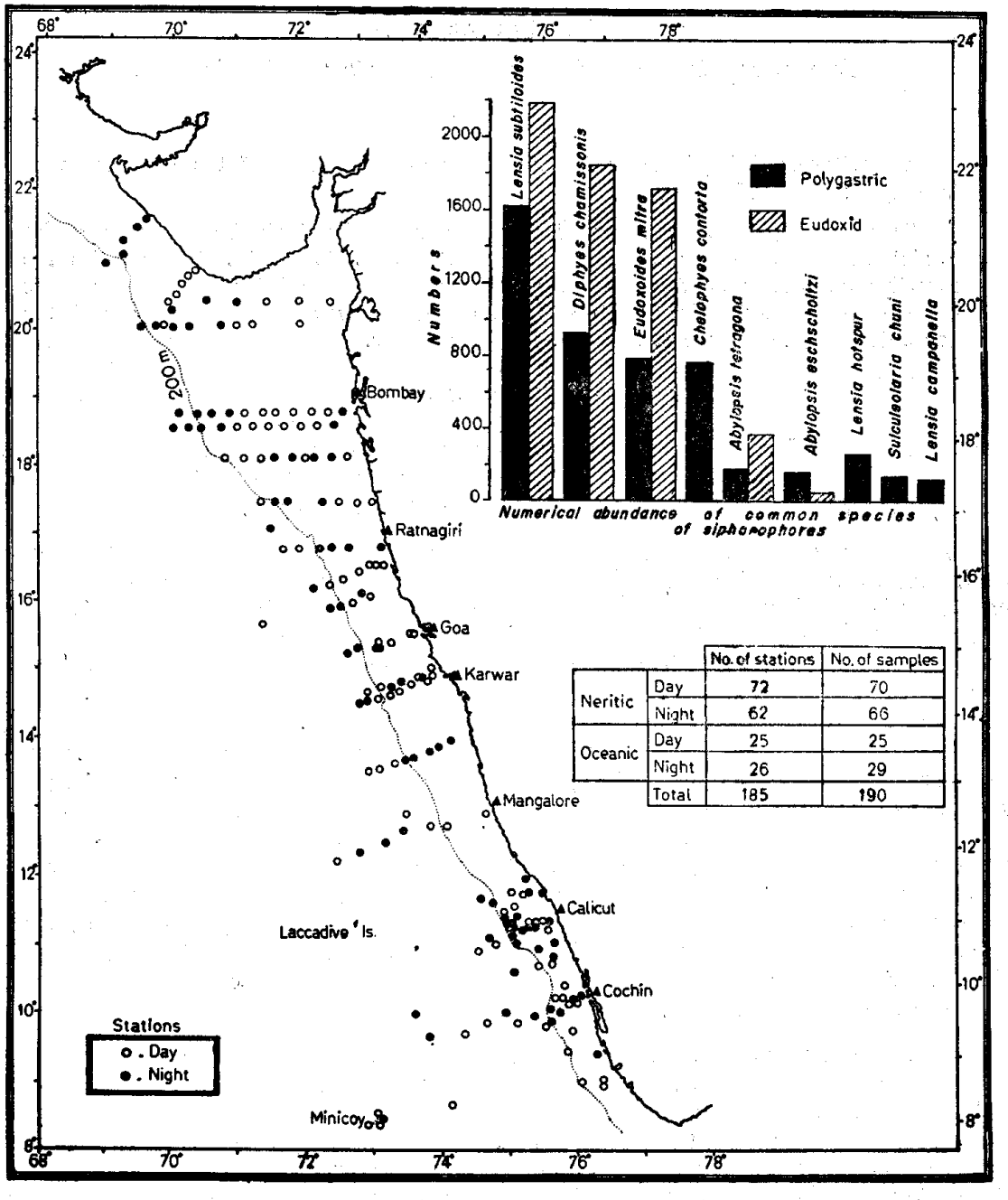

Fig. 1. Map showing the station position along the west coast of India and the Laccadive Sea, and numerical abundance of common species of siphonophores.

190 samples from 185 stations of which 136 samples (70 day collections and 66 night collections) from neritic waters and 54 samples (25 day collections and 29 night collections) from oceanic waters beyond 200 m depth contour were

analysed. The day, night, neritic and oceanic stations are shown in Fig. 1. The samples were mostly collected using the Indian Ocean Standard net and the Nansen net as vertical tows from a maximum of 200 m to surface or from 5 m above bottom to surface in the continental shelf waters and preserved in 5% formalin in sea water buffered with 1% Hexamine.

For qualitative studies, siphonophores were sorted out totally from the Zooplankton samples and identified, as far as possible up to the species level. Following Totton (1954), Delafield's haematoxylin and Borax carmine stains were used to get a better visibility of ridges and canals. Drawings were made using a camera lucida and the measurements were taken using an ocular micrometer.

External and internal characters such as shape of the animal, number and nature of ridges, and the position and size of the somatocyst were considered for species identification.

References given under the species pertain to nominal species or earlier records from the Indian Ocean and for a more detailed list, reference is invited to Totton (1965).

The details of Station numbers, date and time of collection, positions, depth at stations, depth of collection, etc. are available in *Indian Journal of Fisheries*, Volume 11, No. 2 from pages 736 to 965; Volume 12, No. 1 from pages 238 to 457 (upto stations 2000) and in Table 1 of this account (for stations 2015 to 2079).

ABBREVIATIONS USED

TL	: Total length	WAN	: Width of anterior nectophore
W	: Width	WPN	: Width of posterior nectophore
LN	: Length of nectosac	LNAN	: Length of nectosac in anterior nectophore
LS	: Length of somatocyst	LNPN	: Length of nectosac in posterior nectophore
HB	: Height of bract	LG	: Length of gonophore
LP	: Length of phyllocyst	LDT	: Length of dorsal tooth

WNS: Width of nectosac

All measurements are in millimetres

LIST OF SPECIES

Though there are controversies about the classification of Siphonophora, in general, the system followed by Totton (1965) is adopted in this account. In the following list, species marked with one asterisk (*) are first definite records for the west coast of India and those marked with two asterisks (**) are new records for the Indian coasts as a whole.

ORDER : SIPHONOPHORA

Sub order: PHYSONECTAE Haeckel, 1888

Family: *AGALMIDAE* Brandt, 1835

Genus: **Agalma** Eschscholtz, 1825

* 1. *Agalma elegans* (Sars) 1846

* Larva of *A. elegans* (Sars) 1846

* 2. *A. okeni* Eschscholtz, 1825

Genus: **Halistemma** Huxley, 1859

* 3. *Halistemma rubrum* (Vogt) 1852
4. *Halistemma* sp. young one

Genus: **Nanomia** A. Agassiz, 1865

5. *Nanomia bijuga* (Delle Chiaje) 1841

Sub order: CALYCOPHORAE Leuckart, 1854

Family: *HIPPOPODIIDAE* Kölliker, 1853

Genus: **Hippopodius** Quoy and Gaimard, 1827

**6. *Hippopodius hippopus* (Forsskål) 1776

Genus: **Vogtia** Kölliker, 1853

**7. *Vogtia pentacantha* (Kölliker) 1853
**8. *V. spinosa* Keferstein and Ehlers, 1861
**9. *V. glabra* Bigelow, 1918

Family: *DIPHYIDAE* Quoy and Gaimard, 1827

Subfamily: *Sulculeolariinae* Totton, 1954

Genus: **Sulculeolaria** Blainville, 1834

* 10. *Sulculeolaria chuni* (Lens and Van Riemsdijk) 1908
* 11. *S. quadrivalvis* Blainville, 1834
* 12. *S. turgida* (Gegenbaur) 1853
* 13. *S. angusta* Totton, 1954

Subfamily: *Diphyinae* Moser, 1925

Genus: **Diphyes** Cuvier, 1817

14. *Diphyes dispar* Chamisso and Eysenhardt, 1821
15. *D. chamissonis* Huxley, 1859
* 16. *D. bojani* (Eschscholtz) 1829

Genus: **Lensia** Totton, 1932

* 17. *Lensia subtiloides* (Lens and Van Riemsdijk) 1908
**18. *L. subtilis* (Chun) 1886
**19. *L. campanella* (Moser) 1925
* 20. *L. hotspur* Totton, 1941

* 21. *L. tottoni* Daniel and Daniel, 1963
**22. *L. lelouveteau* Totton, 1941
* 23. *L. cossack* Totton, 1941
**24. *L. fowleri* (Bigelow) 1911
**25. *L. multilobata* sp. nov.
26. *Lensia* sp. A

Genus: **Muggiaea** Busch, 1851

* 27. *Muggiaea delsmani* Totton, 1954

Genus: **Chelophyes** Totton, 1932

* 28. *Chelophyes contorta* (Lens and Van Riemsdijk) 1908
**29. *Ch. appendiculata* (Eschscholtz) 1829

Genus: **Eudoxoides** Huxley, 1859

* 30. *Eudoxoides mitra* (Huxley) 1859
**31. *E. spiralis* (Bigelow) 1911

Family: *ABYLIDAE* L. Agassiz, 1862

Subfamily: *Abylopsinae* Totton, 1954

Genus: **Abylopsis** Chun, 1888

* 32. *Abylopsis eschscholtzi* Huxley, 1859
* 33. *A. tetragona* (Otto) 1823

Genus: **Bassia** L. Agassiz, 1862

34. *Bassia bassensis* (Quoy and Gaimard) 1834

Genus: **Enneagonum** Quoy and Gaimard, 1827

35. *Enneagonum hyalinum* Quoy and Gaimard, 1827

Subfamily: *Abylinae* L. Agassiz, 1862

Genus: **Ceratocymba** Chun, 1888

* 36. *Ceratocymba leuckarti* (Huxley) 1859

Family: *CLAUSOPHYIDAE* Totton, 1965

Genus: **Heteropyramis** Moser, 1925

* 37 *Heteropyramis maculata* Moser, 1925

DESCRIPTION OF SPECIES

Agalma elegans (Sars) 1846, (Fig. 2 a and c)

Agalma elegans Totton, 1954; Totton and Fraser, 1955; Daniel and Daniel, 1963, 1967; Patriti, 1970.

Material: From R. V. *Varuna* Stns. : 695, 732, 744, 748, 762, 934, 941, 943, 964, 1767, 1798, 2017, 2024, 2025, 2032, 2033, 2055, 2067, and 2075.

A small colony from 10° 25′ N - 75° 07′ E (Stn. 964), twentysix young nectophores and eighteen larvae of this species were taken in the collection. Complete adult animals were not seen in the present study.

Description: A young specimen measuring 6.6 mm long with a few swimming bells. Pneumatophore long and spindle-shaped with a few young nectophores near apex; stem thick; siphon larger than pneumatophore.

Larval nectophore round, pigmented and surrounded by bracts; margin of bracts serrated; distal ends of bracts with cnidocyst at extremity of canals; tips of canals connected at point above pneumatophore; other details of developing young zooids not clear.

Distribution: Red Sea, Gulf of Aden, Arabian Sea, Bay of Bengal, Indian Ocean, Malay area, Eastern Tropical Pacific, Great Barrier reef area, Mediterranean, Celtic Sea and Atlantic Ocean.

Remark: The larval form was described by various authors as larva *Physonectarum* after Haeckel (1888) and now it has been identified as 'Athorybia' larva of *Agalma elegans* (Totton, 1965).

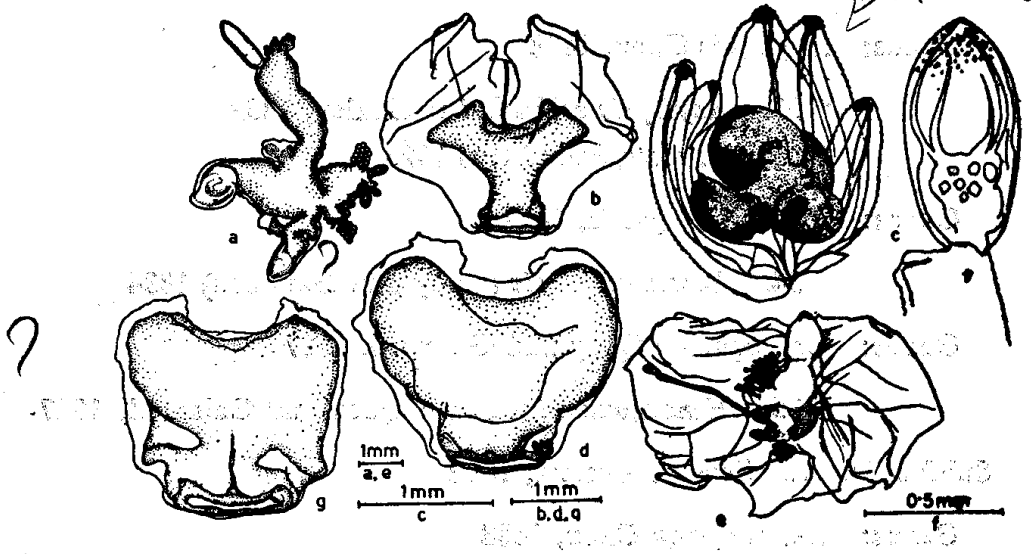

Fig. 2. a. *Agalma elegans*; b. nectophore of *Agalma okeni*; c. larva of *Agalma elegans*; d. nectophore of *Halistemma rubrum*; e. young one of *Halistemma* sp.; f. pneumatophore of *Halistemma rubrum*; and g. nectophore of *Nanomia bijuga*.

Agalma okeni Eschscholtz, 1825, (Fig. 2 b)

Crystallodes vitrea Haeckel, 1888.

Agalma okenii Browne, 1926; Totton, 1954; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967.

Material: Forty nectophores and eight bracts from R. V. *Varuna* Stns. : 723, 734, 737, 745, 747, 750, 764, 954, 967, 969, 976, 981, 1806, and 2033.

Description: Nectophore thick with large lateral extensions and nectosac with a conspicuous neck and characteristically prolonged posteriorly into two lateral lobes; mouth of nectosac surrounded on one side by short flap like 'lip' and the other by a long spatulate 'lip'; ridge joining mouth of nectosac to lateral sides of nectophore conspicuous; bracts with gelatinous with 2 or 3 distal facets of unequal size and with well developed bracteal canal.

Distribution: Tropical Atlantic and Pacific Oceans, Gulf of Aden, Gulf of Aqaba, Red Sea, Arabian Sea, Bay of Bengal, Indian Ocean, Mediterranean, and Great Barrier reef areas,

Halistemma rubrum (Vogt) 1852, (Fig. 2 d and f)

Stephanomia rubra Totton, 1954; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967.

Material: From R. V. *Varuna* Stns. : 750, 764, 934, 937, 939; 941, 942, 946, 948, 953, 954, 958, 960, 963 - 965, 967, 969 - 974, 976 - 978, 984, 985, 987, 989 - 992, 1767, 1770, 1778 - 1784, 1791, 1793, 1794, 1797, 1799, 1804, 1806, 1807, 2017, 2022, 2023, 2025, 2032, 2033, 2036, 2055, 2067, 2071 - 2075.

One hundred and ninety four adult nectophores and 13 pieces of pneumatophores were obtained.

Description: Pneumatophore spindle-shaped; pigment spot at apex prominent; four radial longitudinal septa clear; gas secreting cells at base large; lateral wings and latero-posterior wedges of nectophore not expanded laterally; nectosac more or less squarish and produced into two broad lateral extensions; mouth of nectosac wide and tubular; nectosac devoid of inward foldings.

Distribution: Atlantic Ocean, Mediterranean, Red Sea, Arabian Sea, Bay of Bengal, Western Indian Ocean, and Eastern Tropical Pacific.

Halistemma sp., (Fig. 2 e)

Material: The only specimen was collected at 10° 25′ N - 75° 07′ E (Stn. 764) on 3rd February, 1962 in the night collection.

Description: Apparently a young colony with a cluster of gelatinous bracts whose distal facets were not clear. Pneumatophore oval with a few pigment spots at apex; siphon indistinct with finger like contracted palpons crowded at one end; male and female gonophores seen close together side by side.

Remark: Daniel and Daniel (1963) recorded a 'larva of *Stephanomia*' from Madras coast. The present specimen which resembles larval bract of Daniel and Daniel's specimen, but at the same time possess developed male and female gonophores. The facets of bract are not clearly disernable and the tentacles are partly missing. The presence of developed gonophores indicates that the specimen is not a larval form, but specific identification is not possible and hence it is described here as *Halistemma* sp.

Nanomia bijuga (Delle Chiaje) 1841, (Fig. 2 g)

Halistemma tergestinum Claus, 1878.

Nanomia bijuga Totton, 1954; Daniel and Daniel, 1963, 1967; Patriti, 1969.

Material: From R. V. *Varuna* Stns.: 743, 744, 746, and 750. Only four well developed nectophores were identified in the collection. No complete animal was seen.

Description: Nectophore flattened; its broad lateral upper end round; nectosac large and covers almost entire space of the nectophore; mouth of nectophore wide with a thick marginal rim.

Distribution: Tropical Atlantic, Mediterranean, Red Sea, Gulf of Aden, Arabian Sea, Bay of Bengal, Indian Ocean, Great Barrier reef areas and Pacific Ocean.

Sulculeolaria quadrivalvis Blainville, 1834, (Fig. 3 e and f)

Sulculeolaria quadrivalvis Totton, 1954; Daniel and Daniel, 1963, 1967; Patriti, 1954, 1969, 1970; Daniel, Nagabhushanam and Daniel, 1967; Alvarino, 1968.

Galeolaria quadrivalvis Browne, 1926.

Material: From R. V. *Varuna* Stns.: 940, 976, 978, 980, 1772, 1778, 1779, and 1806. Anterior nectophore (7 specimens): TL : 3.19 - 8.13; W : 1.63 - 4.13; LS : 2.19 - 5.25; LN : 3.0 - 7.38; LDT : 0.38 - 1.31. Posterior nectophore (7 specimens) : TL : 6.25 - 8.50; W : 2.94 - 3.25; LN : 5.63 - 7.38.

Description: Anterior nectophore has two characteristic dorsal teeth and two baso-ventral flaps with a small projecting process on inner margin; lateral teeth absent; somatocyst thread-like at base with a long, but blunt apex extending to middle of nectosac; hydroecium absent; lateral canals connected with ventral canals by oblique commissural canals to posterior one third of lateral canals.

Posterior nectophore: long more or less cylindrical with apex oblique; two large triangular dorsal and lateral teeth and with an enlarged bilobed baso-ventral flap carrying two 'denticulation' on inner side at midlength of flap, nectosac large, extending almost entire length of nectophore and with characteristic constriction near base; canals distinct at anterior portion.

Distribution: Atlantic Ocean, South and east coasts of Africa, Gulf of Aden, Gulf of Aqaba, Red Sea, Bay of Bengal, Indian Ocean, Mediterranean, Canary Island, Eastern Tropical Pacific, Malay area and Great Barrier reef area.

Sulculeolaria chuni (Lens and Van Riemsdijk) 1908, (Fig. 3 a and d)

Galeolaria chuni Browne, 1926.

Sulculeolaria chuni Totton, 1954; Daniel and Daniel, 1963, 1967; Patriti, 1964, 1969, 1970.

Material: From R. V. *Varuna* Stns.: 707, 715, 719, 723, 730, 732, 734, 736, 737, 742 - 747, 749, 762, 941, 943, 951 - 953, 962, 964 - 967, 976, 977, 979 - 981, 983, 986, 990 - 992, 1771 - 1773, 1778 - 1780, 1787, 1789, 1790, 1797, 1801 - 1803,

1805 - 1807, 2016, 2022 - 2024, 2033, 2035, 2052, 2068, 2072, 2074, and 2077. No complete animal was seen except 101 loose anterior nectophores and 130 posterior nectophores. Anterior nectophore : TL : 2.06 - 3.63; W: 0.81 - 1.50; LS : 0.88 - 2.13; LN : 1.81 - 2.94. Posterior nectophore : TL : 2.88 - 5.31; W: 0.81 - 1.38; LN : 2.13 - 3.88.

Description: Anterior nectophore smooth with blunt apex; dorsal and lateral ridges and teeth absent; baso-ventral flaps with rounded margin; apex of nectosac rounded; hydroecium absent.

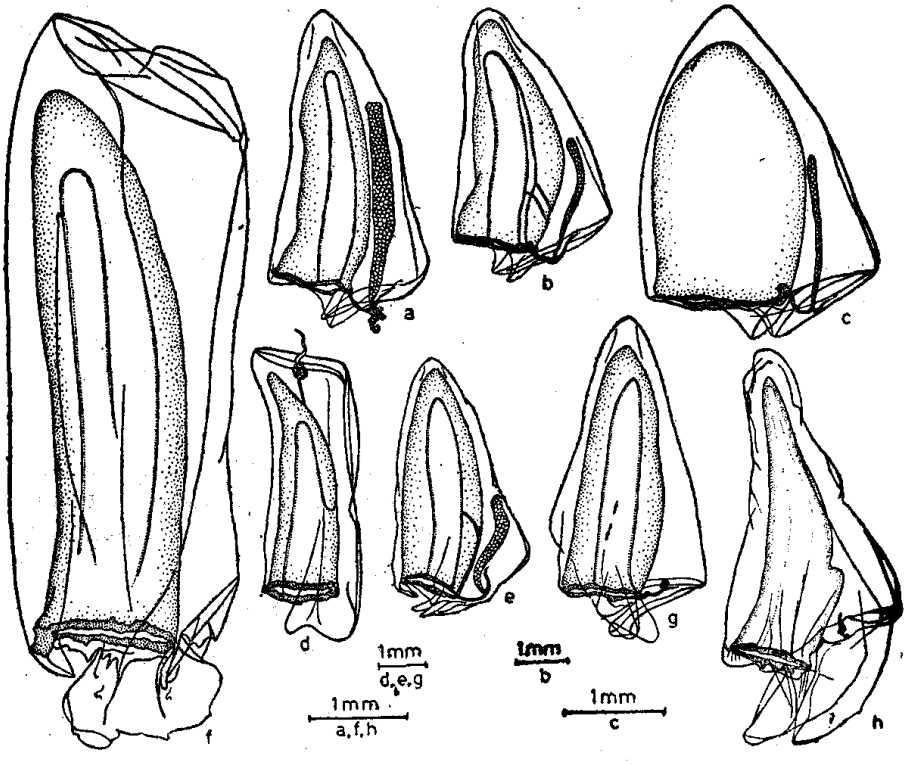

Fig. 3. a - c. anterior nectophores of *Sulculeolaria chuni*; d. posterior nectophore of *S. chuni*; e. anterior nectophore of *S. quadrivalvis*; f. posterior nectophore of *S. quadrivalvis*; g. anterior nectophore of *S. angusta*; and h. anterior nectophore of *S. turgida*.

In specimen A (Fig. 3 a) from Station No. 1778, lateral canals do not have lateral commissures; somatocyst broad and long extending more than 2/3 of the nectosac.

Specimen B (Fig. 3 b) from the same Station, has oblique lateral commissures between lateral and ventral canals; somatocyst very slender extending below 1/2 the height of the nectosac.

The third specimen C (Fig. 3 c) from Station No. 747 is abnormally broad with long and slender somatocyst extending slightly above half the height of the nectosac which occupies almost entire space of the nectophore; nectophore and nectosac 2/3 of their height.

Posterior nectophore: Apex truncated; baso-ventral flap large with a notch at middle; hydroecium openly grooved; apex of nectosac bluntly pointed; pedicular canal starting below apex of nectosac.

Remark: This species appears to envince variability in the anterior nectophore of which three types are described above. Browne (1926) while recording this species from Maldives has noted that the somatocyst is either thread-like or cylindrical and extends from about 1/2 to 2/3 length of the nectosac.

In a combination of characters, three types of specimens are identifiable from the present collections as indicated above and illustrated here. The significance of these are not understandable particularly as no such difference si noticeable in the posterior nectophore of the species occurring in the same samples. There is need for more investigations to be carried out on the structural modifiications of the anterior nectophore of this species and until such time we may consider these types as belonging to the species *Sulculeolaria chuni.*

Distribution: Tropical Atlantic, Indian Ocean, Arabian Sea, Bay of Bengal, Malay Archipelago, Great Barrier reef area, and Pacific Ocean.

Sulculeolaria turgida (Gegenbaur) 1853, (Fig. 3 h)

Sulculeolaria turgida Totton, 1954; Daniel and Daniel, 1963, 1967; Daniel, Nagabhushanam and Daniel 1967; Patriti, 1970.

Material: From R. V. *Varuna* Stns.: 952, 962, 977, and 2016. Anterior nectophore (4 specimens) : TL : 3.82 - 4.37; W : 1.69 - 1.94; LN : 2.69 - 3.13; LS : 0.19 - 0.31.

Description: Anterior nectophore smooth without ridges and teeth; mouth plates two and very broad; hydroecium very shallow; somatocyst very small and club-shaped; pedicular canal ascending; nectosac narrows at apex of nectophore; commissural canals invisible.

Distribution: Strait of Messina, Adriatic Sea, Mediterranean, East coast of Africa, Arabian Sea, Bay of Bengal, Indian Ocean, and Great Barrier reef area.

Sulculeolaria angusta Totton, 1954, (Fig. 3 g)

Sulculeolaria angusta Alvarino, 1964; Daniel and Daniel, 1967; Daniel, Nagabhushanam, and Daniel 1967.

Material: From R. V. *Varuna* Stns.: 952, 1767, 1778, 2022, and 2024. Anterior nectophore (7 specimens): TL: 6.88 - 7.44; W : 3.38 - 3.66; LN: 4.69 - 5.44; LS : 0.13 - 0.17.

Description: General shape as for species of the genus; rim of nectosac closely connected with basal margin of nectophore; apex of nectosac not sharp and does not reach apex of nectophore; baso-ventral mouth plate into two halves, having rounded and pointed edges; no dorsal or lateral teeth; pedicular canal thick; somatocyst minute; no commissural canal.

Distribution: Southeast coast of Africa, Gulf of Aden, Madagascar, Equatorial region of the Indian Ocean and Pacific Ocean.

Diphyes dispar Chamisso and Eysenhardt, 1821, (Fig. 4 a - c)

Diphyes dispar Browne, 1926; Menon, 1931; Leloup, 1934; Daniel and Daniel, 1963, 1967; Daniel, Nagabhushanam and Daniel, 1967; Alvarino, 1964; Patriti, 1970.

Material: From R. V. *Varuna* Stns.: 697, 713, 715, 730, 732 - 734, 736, 737, 745, 934, 937, 941, 946, 953, 961 - 963, 967, 977, 983, 1770 - 1772, 1777 - 1779, 1781, 1782, 1788 - 1791, 1797 - 1805, 1807, 2025, 2030, 2035, and 2036. Anterior nectophore (58 specimens) : TL : 7.06 - 19 . 88; W : 2 63 - 6.89; LS : 3.0 - 6.50; LH: 2.63 - 5.19; LN : 5.56 - 8.31. Posterior nectophore (27 specimens): TL : 7.19-12.75; W : 2.75 - 6.89; LN : 3.94 - 6 81. Eighteen eudoxids, 24 bracts and 9 gonophores were also obtained in the collections.

Description: Anterior nectophore: Shape pyramidal with five longitudinal serrated ridges; all ridges meet at apex of nectophore; serrations more defined towards tip of teeth; nectosac obliquely placed and uniformally barrel-shaped upto about 3/4 its length from where it narrows into a slender apically blunt tube reaching to almost apex of nectophore; hydroecium enlarged, broad at base and almost half as long as nectosac; dorsal wall of hydroecium slopes gently to ventral side; hydroecial opening markedly oblique and rectangular; somatocyst long and obliquely slanding towards nectosac dorsaly; somatocyst slender and long being about 1/2 of nectosac; stem very clear with developing zooids.

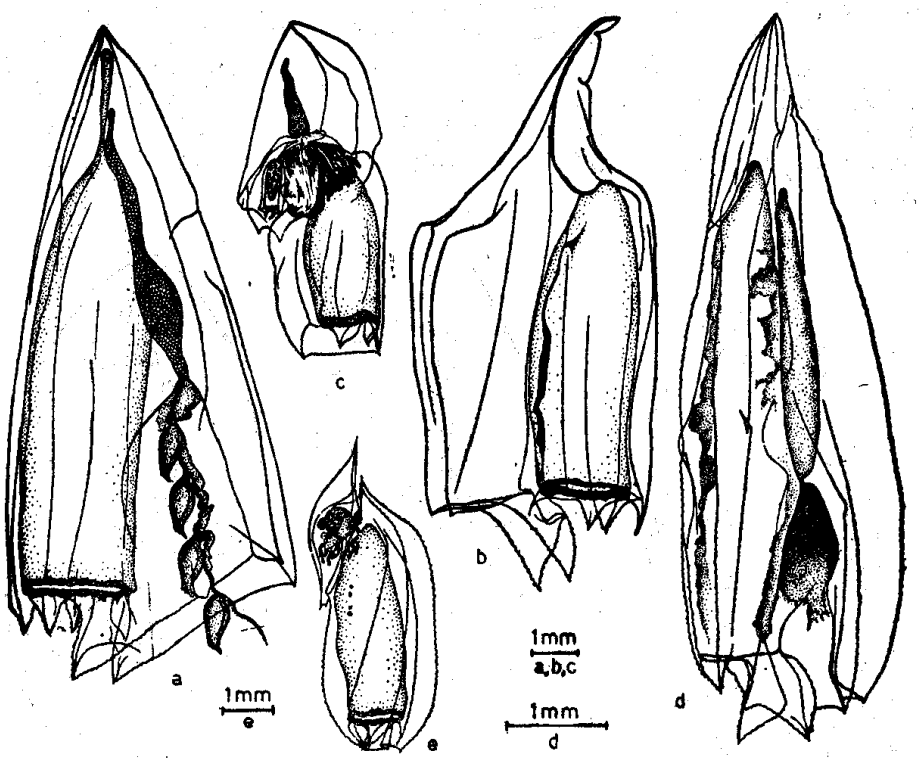

Fig. 4. a - c. *Diphyes dispar*, a. anterior nectophore, b. posterior nectophore, c. eudoxid; d and e. *Diphyes bojani*, d. anterior nectophore, and e. eudoxid.

Posterior nectophore: asymmetrical and anteriorly produced into triangular extension by which it fits into hydroecium of anterior nectophore; teeth and ridges indistinctly serrrated; lateral flaps meet at top and curves over right side of the hydroecium; nectosac slightly short with broadly rounded apex; pedicular canal connecting anterior nectophore and posterior nectophore distinct.

Eudoxid stage: bract broadly pointed, translucent, overlapping part of superior portion of eudoxid bell; edges of bract smooth; teeth two on posterior end; phyllocyst narrowly conical and long; canal from bract to eudoxid bell

runs almost vertically downwards; eudoxid bell more or less rectangular; ridges and teeth of eudoxid bell more or less rectangular; ridges and teeth of eudoxid bell distinctly serrated; mature gonophore well developed; siphon large and conspicuous with few finger like structures.

Distribution: Atlantic Ocean, Arabian Sea, Bay of Bengal, Indian Ocean, Marquesas Island, Fiji Island, Marshall Island, Philippines, Eastern Tropical Pacific and Great Barrier reef area.

Diphyes chamissonis Huxley, 1859, (Fig. 5 a - c)

Diphyes chamissonis Totton, 1954; Leloup, 1934; Daniel and Daniel, 1963, 1967; Alvarino 1964; Patriti, 1970.

Diphyopsis chamissonis Browne, 1926.

Material: From R. V. *Varuna* Stns. : 703, 713, 717, 719, 723, 730, 732, 733, 736 - 738, 741 - 750, 752, 753, 755, 757 - 760, 762, 764, 935, 937, 940, 941, 943 - 945, 948, 952, 953, 958, 960, 961, 963, 965, 967, 970 - 972, 974 - 977, 980, 981, 983, 986, 987, 992, 1770 - 1794, 1797 - 1801, 1804, 2016 - 2020, 2022, 2024 - 2030, 2033, 2035, 2036, 2047 - 2051, 2055, 2056, 2059 - 2062, 2066, 2068, 2070, 2072, and 2079. Anterior nectophore (927 specimens) : TL : 1.56 - 8.81; W : 0 63 - 3.38; LS : 0.50 - 2.19; LH : 0 75 - 4.06; LN : 1.06 - 6.38. Eudoxid (1152 specimens) : TL : 2.25 - 5.94. Bract (551 specimens) : TL : 1.75 - 4.13; LP: 1.06 - 1.19.

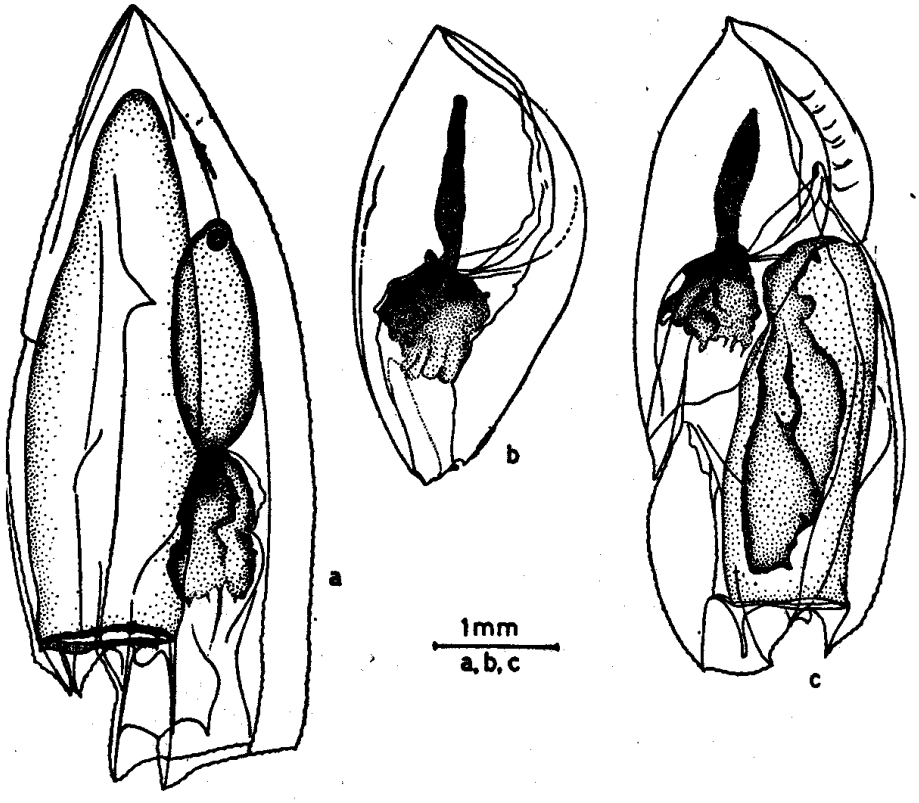

Fig. 5. a - c. *Diphyes chamissonis*, a. anterior nectophore, b. bract, and c. eudoxid.

Description: Anterior nectophore: rounded girth in appearance; five longitudinal ridges with basal serrations distinct; dorsal and lateral teeth prominent

on margin of nectophore; nectosac large with a shallow constriction behind mouth and apically bluntly rounded, broadest at mid-length; hydroecium elongate but not reaching mid-length of nectosac; hydroecial opening well below level of margin of nectosac and narrow but rectangular with outer margin gently sloping upwards; somatocyst conspicuously robust, relatively shorter being less than half length of nectosac and with an oil droplet close to its apex.

Eudoxid : viewed dorsally sides of bracts more or less parallel and diverging basally; interspace between lateral edges concave; phyllocyst finger-like and situated at centre of gelatinous thick bract; course of canal to eudoxid bell from bract horizontal; apex of nectosac of eudoxid bell above level of this canal; ridges and teeth well serrated.

Remark: This is well known and widely distributed species, of which only the anterior nectophore and eudoxid stages are available in the collections. These agree well with the descriptions of *D. Chamissonis* given by various authors (Browne, 1926; Totton, 1932; Daniel and Daniel, 1963) described from Indo-Pacific.

Distribution: Red Sea, Arabian Sea, Bay of Bengal, Malay Archipelago, Philippines, Great Barrier reef area in Indo-Pacific.

Diphyes bojani Eschscholtz, 1829, (Fig. 4 d and e)

Cacullus gracilis Haeckel, 1888.
Diphyes bojani Daniel and Daniel, 1963, 1967; Alvarino, 1964; Patriti, 1970.
Diphyopsis bojani Browne; 1926.

Material: From R. V. *Varuna* Stns. : 690, 715, 733, 734, 736, 738, 743, 745 - 747, 940, 941, 944, 946, 952, 962, 963, 965, 974, 976, 983, 1774, 1775, 1787, 1797 - 1799, 1801 - 1803, 1805, 2016, 2017, 2025, 2026, 2031, 2033 - 2036, 2050, and 2053. Anterior nectophore (25 specimens) : TL : 5.06 - 7.66; W : 1.38 - 2.31; LN : 4.06 - 5.75; LS : 2.56 - 3.13; LH : 1.96 - 2.56. Eudoxid (38 specimens) : TL : 4.06 - 9.06; W : 1.63 - 3.13; HB : 2.31 - 3.75; LN : 2.56 - 4.44.

Description: Anterior nectophore : slender in appearance with a pointed apex; five longitudinal ridges with serrations throughout; dorsal and lateral teeth well developed and serrated; nectosac narrow, tube-like and extending to almost apex of nectophore except in one specimen where it extends to about 3/4 length of the nectophore; apex of nectosac blunt while apex of nectophore pointed; hydroecium about one third of nectophore, but shorter than somatocyst; latter elongate more than half length of nectosac.

Eudoxid : bract helmet-shaped and highly translucent; edges serrated with three prominent teeth on lower edge; bracteal cavity very shallow since attachment of eudoxid bell to bract is more or less lateral; phollocyst small and knob-like; eudoxid bell with four serrated longitudinal ridges and four basal marginal teeth; nectosac cylindrical and apex blunt; canal connecting eudoxid bell short and horizontal.

Remark: The variability in the extend of the nectosac seen in the present material is interested.

Distribution: Warm and tropical regions of Atlantic, Pacific and Indian Oceahs, Arabian Sea, and Bay of Bengal.

Lensia subtiloides (Lens and Van Riemsdijk) 1908, (Fig. 6 a - e)

Diphyes subtiloides Browne, 1926.

Lensia subtiloides Totton, 1954; Sears, 1950; Leloup, 1955, 1955a; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Patriti, 1966, 1970.

Material: From R. V. *Varuna* Stns. : 690, 692, 694 - 696, 699, 700, 702, 704, 705, 707, 711, 713, 715, 717, 719, 721, 723, 730, 732 - 734, 736 - 739, 741 - 750, 752, 753, 755, 757, 758, 760. 762, 764, 935, 937, 939, 941 - 944, 946, 948, 951 - 953, 956, 958, 960 - 967, 969 - 972, 974 - 981, 983 - 992, 1769 - 1794, 1797 - 1802, 1804 - 1807, 2016 - 2020, 2022 - 2036, 2047 - 2055, 2058 - 2060, 2065, 2067 - 2079. Complete (52 specimens) : TL : 3.25 - 4.13; WAN : 0.88 - 1.31; WPN : 0.56 - 0.75; LS : 0.31 - 0.69; LNAN : 1.63 - 2.38; LNPN : 1.13 - 1.25. Anterior nectophore (1558 specimens) : TL : 2.34 - 4.75; W : 1.13 - 2.34; LS: 0.56 - 1.24; LH : 0.19 - 0.38; LN : 2.0 - 4.19. Posterior nectophore (677 specimens): TL : 1.50 - 2.63; W: 0.56 - 1 44; LN : 1.13 - 2.25. Eudoxid (49 specimens) - Bract (252 specimens) : TL : 1.25 - 3.13; W : 0.88 - 2.44; LP : 0.50 - 1.34. Gonophore (2133 specimens) : TL : 1.44 - 2.50; W : 0.69 - 1.25.

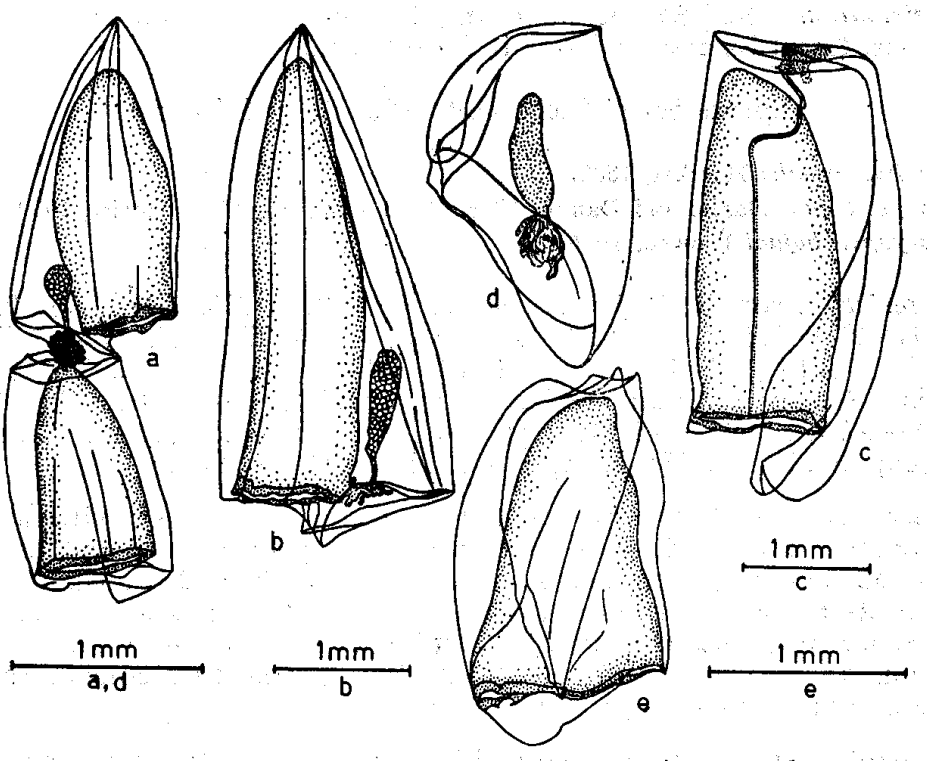

Fig. 6. a - e. *Lensia subtiloides*, a. complete form, b. anterior nectophore, c. posterior nectophore, d. bract, and e. gonophore.

Description: Anterior nectophore : shape conical with five longitudinal non-serrated ridges; complete nectophore smooth and flabby; nectosac reaches nearly apex of nectophore; base of nectosac in level with mouth of nectophore (ostial level); mouth plate divided; somatocyst ovoid or club-shaped with slender stalk and lies very close to ventral wall of nectosac; hydroecium shallow.

Posterior nectophore : externally smooth with anterior ovoid in circumference and anteriorly truncated; ridges indistinct; baso-ventral corner of mouth plate rounded; nectosac large with wide mouth occupying most of necto-

phore; pedicular canal commences apically close to hydroecial groove: hydroecial groove extending beyond level of mouth of nectosac; pedicular canal slightly curved close to apex of nectosac.

Eudoxid: Complete eudoxid stage very rarely seen; bract conical, very translucent, smooth and gelatinous in appearence with a centrally situated small phyllocyst; gonophore with large bell shaped nectosac extending to almost apex; hydroecial fold and groove well defined and fold extends posteriorly beyond level of mouth of nectosac.

Distribution: Indian Ocean, Arabian Sea, Bay of Bengal, Malay Archipelago, Great Barrier reef region and Tropical Pacific.

Lensia subtilis Chun, 1886, (Fig. 7 a)

Lensia subtilis Totton, 1954; Alvarino, 1964; Patriti, 1964, 1965, 1965a, 1969, 1970; Daniel and Daniel, 1970.

Material: From R. V. *Varuna* Stns.: 705, 734, 962, 1776, 1779, 1806, and 1807. Anterior nectophore (7 specimens): TL: 1.75; W: 0.81; LS: 0.88; LN: 0.63.

Description: Anterior nectophore: smooth with five longitudinal ridges; apex rounded; hydroecium very shallow; somatocyst globular on a long slender thread-like stalk which extends upto half height of nectosac; basal facet oblique; mouth plates small and pointed with smooth margin.

Distribution: Atlantic Ocean, South and West Ireland, Bay of Biscay, Mediterranean, Madagascar, Gulf of Aqaba, Arabian Sea, Rodriquez, Chagos, Indian Ocean, Great Barrier reef area and off New Guenia.

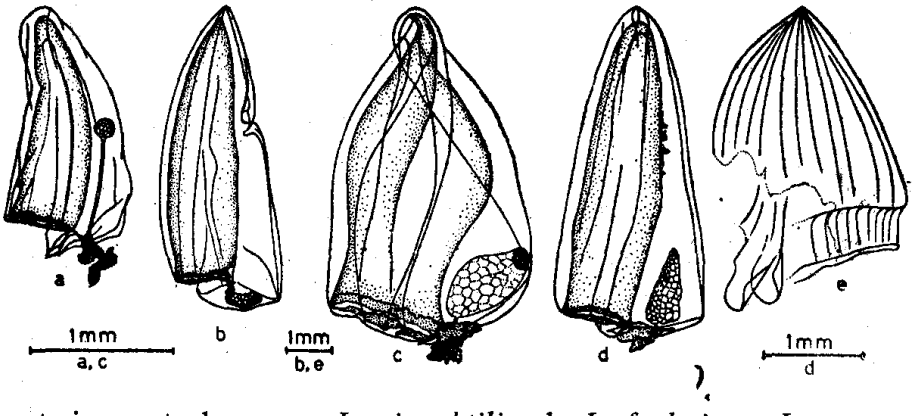

Fig. 7. anterior nectophores - a. *Lensia subtilis*, b. *L. fowleri*, c. *L. campanella*, d. *L. cossack*, and e. *L. lelouveteau*.

Lensia fowleri Bigelow, 1911, (Fig. 7 b)

Lensia fowleri Browne, 1926; Patriti, 1965, 1965a, 1966, 1970; Daniel and Daniel, 1967.

Material: From R. V. *Varuna* Stns.: 2022, 2033, 2034, and 2036. Anterior nectophore (11 specimens): TL: 6.63, W: 2.50; LS: 0.81 LN: 5.81.

Description: Anterior nectophore with five longitudinal ridges; apex of nectosac reaches tip of nectophore; apex pointed; hydroecium shallow and well

below margin of nectosac; base of hydroecium nearly rectangular; somatocyst kidney-shaped with descending pedicular canal and placed below level of margin of nectosac; somatocyst relatively small, its disposition at right angles to that of nectophore and does not extend above margin of nectosac.

Distribution: Atlantic Ocean, Outside Trinity opening, Chagos, Farquhar, Northern North Sea, South and West Ireland, Arabian Sea, Malay Archipelago, and Faroe Shetland area.

Lensia campanella (Moser) 1925, (Fig. 7 c)

Lensia campanella Totton, 1954; Alvarino, 1964; Patriti, 1964, 1970; Daniel and Daniel, 1967.

Material: From R. V. *Varuna* Stns. : 694, 707, 733, 734, 939, 941, 963, 965, 979. 983, 984, 986, 1771, 1773, 1774, 1778, 1779 - 1781, 1786 - 1791, 1799, 1801, 1802, 1804 - 1806, 2016, 2022, 2024, 2031 - 2036, 2067, 2072, 2073, 2075 - 2078.

Anterior nectophore (120 specimens) : TL: 1.75 - 3.13; W: 0.88 - 1.69; LS: 0.34 - 0.56; LN: 1.56 - 2.69. Posterior nectophore (15 specimens) : TL: 1.31 - 2. 13; W: 0.75 - 1 06; LN: 0.87 - 1.63.

Description: Anterior nectophore: smooth with five longitudinal ridges; apex of nectophore and nectosac with a characteristic twist to nearly half of a complete turn; nectosac conspicuously broad about its mid-length; twist being from right to left, in otherwords clockwise; mouth plates greatly reduced, divided and inconspicuous; somatocyst well developed, oval and with a distinct oil droplet at its apex; stalk of somatocyst very short; somatocyst placed obliquely; baso-ventral facet slopes obliquely.

Posterior nectophore : similar to that of *Lensia subtiloides*, but apex of nectosac is flat and pedicular canal very short.

Distribution: Tortugas, Ceylon, Arabian Sea, Malay Archipelago, German New Guinea.

Lensia lelouveteau Totton, 1941, (Fig. 7 e)

Lensia grimaldii Leloup, 1934 b.
Lensia lelouveteau Totton, 1941, 1954; Patriti, 1965.

Material: Only one partly damaged anterior nectophore was recorded at 15° 10′ N - 72° 41′ E (Stn. No. 943) on 2nd April, 1962.

Description: Anterior nectophore : specimen partly damaged; on the whole very transparent; nectophore multistriate and 'onion' shaped; velar ridge present; well developed basal lamellae present; short stalk of somatocyst visible, latter missing.

Distribution: Atlantic Ocean, Arabian Sea, Indian Ocean, and Great Barrier reef area.

Lensia cossack Totton, 1941, (Fig. 7 d)

Diphyes subtiloides Browne, 1926.
Lensia cossack Totton, 1941, 1954; Daniel and Daniel, 1963, 1967; Patriti, 1970.

Material: From R. V. *Varuna* Stns. : 951, 976, 1771, 1778, 1979, 1790, 1806, 2033, and 2077. Anterior nectophore (11 specimens): TL: 2.25 - 3.75; W: 1.63 - 1.75; LS: 0.81 - 1.25; LN: 2.00 - 3.19.

Description: Anterior nectophore: smooth; apex rounded; longitudinal ridges wrinkled and not well marked; basal plates smooth; basal facet oblique; nectosac long; cylindrical with rounded apex reaching almost tip of nectophore; hydroecium absent; somatocyst ovoid with very short stalk; length of somatocyst reaches 1/3 length of nectosac.

Distribution: Atlantic Ocean, South and West Ireland, Indian Ocean, Arabian Sea, Bay of Bengal, Chagos, Mauritius, Farquhar, and Amirante.

Lensia hotspur Totton, 1941, (Fig. 8 a)

Lensia hotspur Totton, 1941, 1954; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Patriti, 1970.

Material: From R. V. *Varuna* Stns. : 694, 707, 715, 719, 723, 732 - 734, 746, 748, 758, 943, 960, 962, 963, 965, 967, 977, 980, 981, 983, 984, 1777 - 1780, 1798, 1801, 1804 - 1807, 2016, 2017, 2022 - 2024, 2035, 2036, 2056, 2067, 2068, 2071 - 2075, and 2077. Anterior nectophore (257 specimens): TL: 1.75 - 5.06; W: 0.63 2.19; LS: 0.31 - 1.25; LN: 1.44 - 4 25.

Description: Anterior nectophore : smooth with five longitudinal ridges; anterior tip of nectophore blunt; somatocyst 'bean' shaped with short distinct stalk curved downwards and upwards to margin of nectosac; part of somatocyst and curved stalk lying outside the slightly oblique facet; hydroecium shallow and broad and does not extend above level of velum. Posterior nectophore and eudoxids not seen.

Remark: The variability seen among specimens in the size and disposition of somatocyst is indicated in Fig. 9.

Distribution: Atlantic Ocean, Rongerik atoll, Red Sea, Aqaba, Arabian Sea, Bay of Bengal, and Indian Ocean.

Lensia tottoni Daniel and Daniel, 1963, (Fig. 11 e)

Lensia tottoni Totton, 1965; Daniel and Daniel, 1965.

Material: An anterior nectophore from Station No. 746. TL: 3.8; W: 2.33; LN : 3.15; WNS: 1.52; and LS: 0.76.

Description: Anterior nectophore smooth with five longitudinal ridges; laterals not reaching ostium characteristic; laterals slightly curved ventrally; nectosac broad at middle; mouth plate divided; hydroecium absent; somatocyst shrunken with descending pedicular canal and lies below basal level.

Distribution: Bay of Bengal and Arabian Sea.

Remark: This species is closely allied to *L. hotspur*, from which it differs in the lateral ridges not reaching the ostium.

Lensia multilobata *sp. nov.*, (Fig. 8 a, b and c)

Material: Three anterior nectophores, two posterior nectophores and four gonophores of this species were collected from Station No. 970 of R. V. *Varuna* (17° 21′ N-72° 35′ E) on 13th May, 1962.

Holotype: Registration No. CMFRI 191. Anterior nectophore. TL: 2.00.

Paratype: Registration No. CMFRI 192/1 to 192/8.

All the specimens have been deposited in the Reference Collection at the Regional Centre of the Central Marine Fisheries Research Institute, Mandapam Camp.

Measurements

	Anterior nectophore			Posterior nectophore		Gonophore			
TL	2.00	1.81	1.56	2.00	1.80	1.86	1.70	1.70	1.64
W	1.68	1.28	0.88	1.18	1.00	0.92	1.00	0.76	0.92
LS	1.34	0.63	0.40	—	—	—	—	—	—
LN	1.58	1.63	1.00	1.38	1.36	—	—	—	—
Reg. No. CMFRI	191	192/1	192/2	192/3	192/4	192/5	192/6	192/7	192/8

Diagnosis: Anterior nectophore : size minute; longitudinal ridges with thin scale like expansions; ridges meet at apex of nectophore, their correct number is being difficult to count on account of considerable overlapping; nectosac broad extending to almost tip of nectophore and with a bluntly rounded apex; somatocyst moderately large, spindle-shaped, less than half length of nectosac and with an oil droplet at its apex; hydroecium indistinct; basal plates developed; margin smooth.

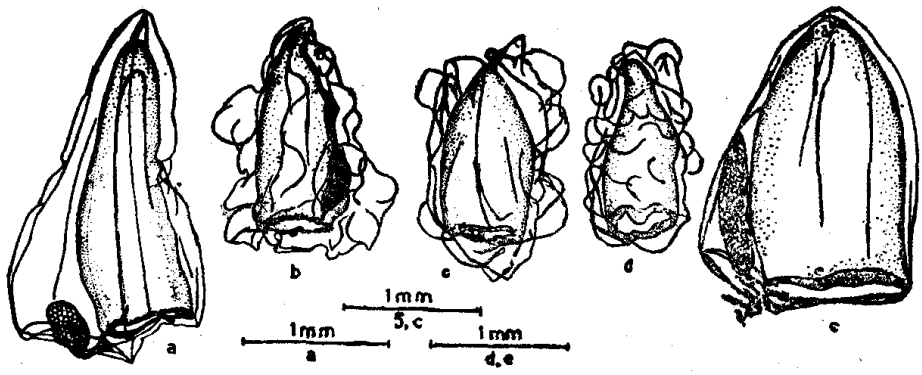

Fig. 8. a. anterior nectophore of *Lensia hotspur*, b-d. *Lensia multilobata* sp. nov., b. anterior nectophore, c. posterior nectophore, d. gonophore, and e. anterior nectophore of *Lensia* sp.

Posterior nectophore : short, squarish with scale like flaps on ridges as in anterior nectophore; nectosac broad and extending to tip of nectophore; as in nectosac of anterior nectophore broadest part is just above midlength; basal plate present and hydroecial fold developed; pedicular canal short and close to apex of nectosac.

Gonophore: it also has characteristic scale like flaps along outer ridges; nectosac of gonophore similar to that of *Lensia subtiloides*; rim of nectosac broad and distinct.

Remark: The presence of scale like expansions all over the body of anterior nectophore, posterior nectophore and gonophore and markedly minute size of the animal are diagnostic characters to differentiate this as a new species.

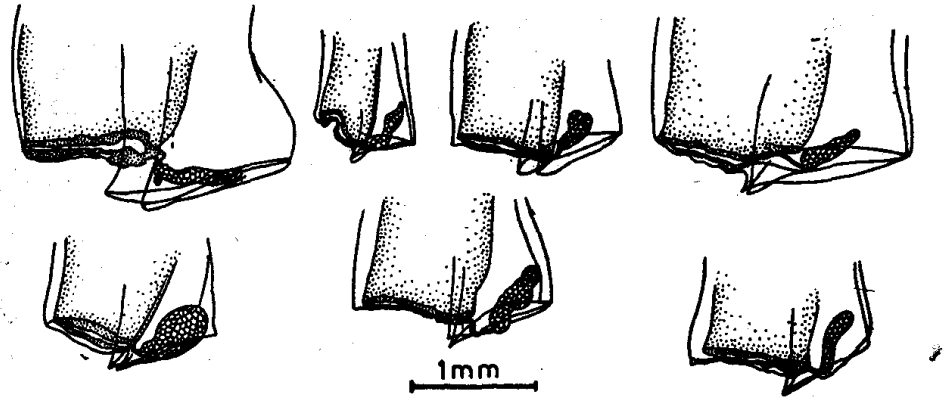

Fig. 9. Portions of the anterior nectophores of *Lensia hotspur* to show the variability in size and position of the somatocyst.

Lensia sp., (Fig. 8 e)

Material: An anterior nectophore of a specimen was recorded from 11° 09′ N - 75° 03′ E (Stn. 747) on 2nd February, 1962. TL : 2.19; W: 1.50; LS: 1.13; LN : 1.94.

Description: Anterior nectophore : Broad, 'bell' shaped with indistinct ridges and consequently outer surface smooth; nectosac conspicuously large, almost completely filling nectophore; width of nectophore almost 3/4 its length; somatocyst finger-like and elongate extending slightly beyond mid-length of nectosac and obliquely placed; hydroecium very shallow; basal facet oblique.

Remark: The abnormal size makes it difficult to assign this to any of the known species.

Muggiaea delsmani Totton, 1954, (Fig. 10 a)

Muggiaea delsmani Totton, 1954; Daniel and Daniel, 1963.

Material: From R. V. *Varuna* Stns.: 702, 730, 758, 760, 762, 935, 939, 958, 963, 972, 974, 992, 1785, 1786, 1790, 1793, 2028, and 2029. Anterior nectophore (25 specimens) : TL : 2.69 - 4.49; W : 0.94 - 2.69; LS : 0.81 - 1.25; LH: 0.56 - 1.13; LN : 1.88 - 3.50.

Description: Anterior nectophore : smooth with five longitudinal non-crested ridges; apically pointed; tip of nectosac bluntly pointed and does not extend to apex of nectophore; somatocyst small and stumpy having one or two oil droplets with broadened apical portion lying close to ventral wall of nectosac; stalk of somatocyst short and arises at summit of hydroecium which is shallow and broad and extends above ostium; two mouth plates broad and rounded.

Distribution: Arabian Sea, Bay of Bengal, and Java Sea.

Chelophyes contorta (Lens and Van Riemsdijk) 1908, (Fig. 10 b, and c)

Diphyes contorta Browne, 1926.

Chelophyes contorta Totton, 1954; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967; Patriti, 1970.

Material: From R. V. *Varuna* Stns. : 690, 692, 694, 695, 699, 700, 702, 704, 705, 707, 711, 715, 717, 719, 721, 723, 730, 732 - 734, 736 - 738, 742 - 749, 752, 755, 757, 758, 762, 764, 937, 939, 941, 943, 951, 952, 956, 958, 961 - 967, 969, 976 - 980, 983, 984, 986, 1771 - 1783, 1787, 1789, 1790, 1799, 1800, 1802, 1805 - 1807, 2016, 2017, 2020, 2022 - 2025, 2027, 2031 - 2036, 2049, 2053 - 2060, 2062, 2065 - 2070, 2072 - 2079. Six complete specimens, 750 anterior nectophores and 224 posterior nectophores. Anterior nectophore with posterior nectophore: TL : 5.94; W : 1.69; LS : 1.69; LH : 1.06; LNAN : 3.50; LNPN : 1.56. Anterior nectophore : TL : 3.13 - 5.25; W: 1.00 - 2.50; LS : 1.19 - 2.06; LH: 0.57 - 1.00; LN : 2.50 - 4.06. Posterior nectophore : TL : 2.31 - 3.50; W : 1.00 - 1.31; LN : 1.56 - 1.88.

Description: Anterior nectophore : with five longitudinal serrated ridges; dorsal, left lateral and left ventral reaching apex of nectophore while right lateral and ventral join just below apex and does not reach apex of nectophore; right ventral ridge indistinct opposite hydroecium; dorsal and lateral teeth absent; hydroecium truncate apically extending well beyond velum and bounded by two marginally serrated and slightly overlapping wings; somatocyst characteristically club-shaped on a long slender thread-like stalk; club of somatocyst with a globular mass of granules turns right and slopes across nectosac; baso-ventral facet oblique; nectosac uniformly cylindrical with rounded apex.

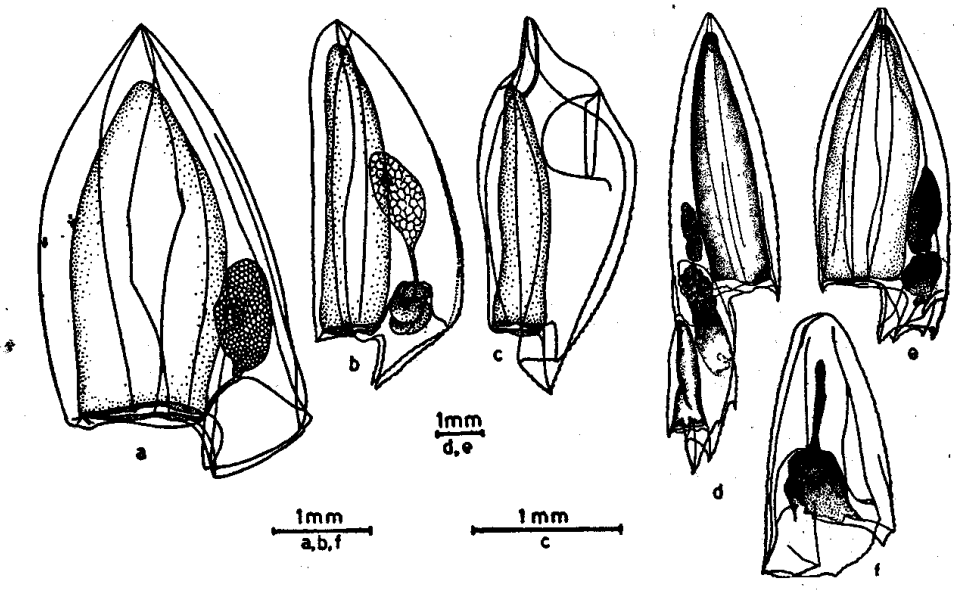

Fig. 10. a. anterior nectophore of *Muggiaea delsmani*, b. anterior nectophore of *Chelophyes contorta*, c. posterior nectophore of *Ch. contorta*; d - f. *Eudoxoides mitra*, d. complete form, e. anterior nectophore, and f. bract.

Posterior nectophore : no lateral or dorsal teeth, but on ventral side there is a small undivided projecting lobe with two terminal teeth, right longer than left; apex of nectosac and nectophore bluntly pointed; on ventral side ridges less pronounced near mouth and wide apart in middle giving convex profile on

ventral side; margins serrated and hydroecial groove open; pedicular canal starts from ventral side just below apex of nectosac and runs almost vertically to apex of nectophore.

Distribution: Atlantic Ocean, Bay of Bengal, Malay Archipelago, Arabian Sea, Indian Ocean, Eastern Tropical Pacific and Great Barrier reef area.

Chelophyes appendiculata (Eschscholtz) 1829, (Fig. 10 c and d)

Chelophyes appendiculata Totton, 1954; Alvarino, 1964; Daniel and Daniel, 1967; Daniel, Nagabhushanam and Daniel, 1967.

Eudoxia russelli Totton, 1954.

Material: Seventy five eudoxids, 249 bracts and 937 gonophores from R. V. *Varuna* Stns. : 692, 704, 705, 707, 713, 715, 717, 719, 721, 723, 730, 732 - 734, 736 - 739, 741 - 750, 752 - 757, 758, 760, 762, 937, 939 - 941, 943, 944, 948, 958, 961 - 967, 969, 970, 973, 975 - 979, 981, 983 - 986, 988, 989, 1771 - 1780, 1787 - 1791, 1797, 1798, 1801, 1802, 1804 - 1807, 2016 - 2018, 2022 - 2027, 2031 - 2036, 2054 - 2056, 2067, 2068, 2070 - 2079. Bract : TL : 1.44 - 1.50; W : 0.75 - 1.00; LP: 0.81 - 0.87. Gonophore : TL: 2.13 - 2.38; W: 0.81 - 1.25; LN : 1.63 - 1.75.

Description: Eudoxid : bract smooth and more less conical; bracteal cavity deep; phyllocyst stout with broad base tapering towards apex with an enlargement at middle; reaches almost tip of bract; gonophore with oblique basally projecting spur, separating base from proximal part of slightly twisted hydroecium; basal margin of gonophore not smooth.

Remark: Totton (1932) described this eudoxid stage as *Eudoxia russelli* and in 1954 he presumed that these eudoxids are of *Chelophyes contorta*, but in 1965 he has clearly identified this as eudoxid phase of *Chelophyes appendiculata*.

Distribution: Off Trinity opening, Arabian Sea and Great Barrier reef region.

Eudoxoides mitra Huxley, 1859, (Fig. 10 d, e and f)

Diphyes mitra Browne, 1926; Daniel, Nagabhushanam and Daniel, 1967.

Diphyopsis mitra Alvarino, 1964.

Eudoxoides mitra Totton, 1954; Daniel and Daniel, 1967; Patriti, 1970.

Material: From R. V. *Varuna* Stns. : 694, 695, 699, 707, 711, 715, 723, 732 - 734, 736 - 738, 743 - 747, 750, 752, 755, 757, 759, 762, 937, 940, 941, 943-946, 952, 960, 962, 964, 965, 967, 973, 976, 977, 981, 989, 1774, 1777 - 1779, 1781, 1782, 1802, 1804 - 1807, 2015 - 2019, 2022 - 2027, 2030 - 2036, 2049, 2051 - 2057, 2067 - 2079. A single complete specimen, 771 anterior nectophores, 184 posterior nectophores, 341 eudoxids, 998 bracts and 1369 gonophores. Complete : TL : 10.31; W: 2.50; LS : 1.00; LH : 20.0; LNAN : 5.88, LNPN : 2.63. Anterior nectophore : TL : 7.56 - 8.13; W: 2 34 - 2.63; LS : 1.88 - 2.13; LH : 1.81 - 2.19; LN : 5.75 - 6.31. Bract : TL: 3.06 - 3.13; W: 1.19 - 1.50; LP: 0.63 - 0.81. gonophore : TL : 3.50 - 4.44; W: 1.06 - 1.31; LN: 2.56 - 3.31.

Description: Anterior nectophore: with five longitudinal serrated ridges which meet at pointed apex; serrations prominent at basal region; presence of a single dorsal pointed tooth on basal margin characteristic. of which serrated; nectosac relatively slender, long and with a bluntly

pointed apex falling short of tip of nectosac; hydroecium relatively shallow with inner margin sloping towards ventral side; its dorsal side bounded by two slightly overlapping flaps and left one has a secondary tooth like projection situated just inside right margin; base of hydroecium quadrangular with concave facets; somatocyst more or less spindle-shaped with short stalk and closely adpressed to ventral margin of nectosac.

Posterior nectophore : a small baso-dorsal tooth similar to that of anterior nectophore present; no baso-lateral teeth; apex of nectosac distinctly posterior to tip of nectophore; pedicular canal starts and runs from ventral side of nectosac just below apex of nectosac; both sides of hydroecial groove have conspicuous teeth formed by a sudden incurving of margin, right tooth smaller than left one; ridges well serrated; towards apex ridges show slight twist; pedicular canal vertical.

Eudoxid : bract upright with sharp tip and well serrated ridges especially ventral ridge along its posterior region; phyllocyst broader at base and tapers towards apex; bracteal cavity very deep; nectosac of gonophore quadrangular; basal margin of gonophore produced into four tooth-like projections; ridges and teeth well serrated; pedicular canal runs vertically downwards to join apex of nectosac; some have developed gonads.

Distribution: South of Mauritius, Arabian Sea, Bay of Bengal, Malay area, and tropical zones of all Oceans.

Eudoxoides spiralis (Bigelow) 1911, (Fig. 11 a and b)

Muggiaea spiralis Browne, 1926.

Eudoxoides spiralis Alvarino, 1964; Patriti, 1964, 1965, 1965 a, 1966, 1969, 1970; Danie and Daniel, 1967.

Material: From R. V. *Varuna* Stns. : 2022, 2032, 2051, 2074, and 2077. Two anterior nectophores : TL : 3.81 - 4.44; W : 1.34 - 1.50; LS : 1.25 - 1.63; LH : 1.00 - 1.06; LN : 2.44 - 3.00. Three Gonophores : TL : 2.19; W : 0.88.

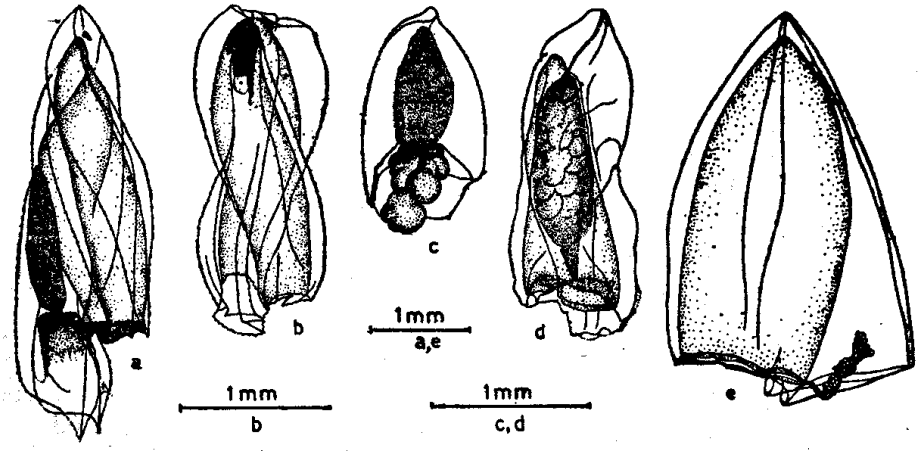

Fig. 11. a. anterior nectophore of *Eudoxoides spiralis*, b. gonophore of *E. spiralis*; c. bract and d. gonophore of *Chelophyes appendiculata* and e. anterior nectophore of *L. tottoni*.

Description: Anterior nectophore : spirally twisted, twist from left to right; five longitudinal ridges well serrated and twisted; left ventral ridge meets right below apex; serrations more conspicuous along proximal part of ridges; hydroecium medium and shallower than in *E. mitra*; roof of hydroecium truncate; soma-

tocyst with a short stalk and broader at base and tapers at apex; somatocyst stout throughout, its length exceeding half length of nectosac; nectosac conspicuously broad at midlength and does not extend to apex of nectophore; basal wing well serrated.

Gonophore : showing characteristic twist as in anterior nectophore; nectosac occupies almost full length of gonophore with a short pedicular canal; 'Saddle' area which articulates with bract slightly depressed; ridges well serrated and twisted; gonad developed.

Distribution: South and west Ireland, Atlantic Ocean, South and east coasts of Africa, Arabian Sea, Southeast Indian Ocean.

Hippopodius hippopus (Forsskål) 1776, (Fig. 12 a)

Hippopodius hippopus Browne, 1926; Totton, 1954; Patriti, 1964, 1965, 1969, 1970; Daniel and Daniel, 1967; Daniel, Nagabhushanam and Daniel, 1967.

Material: From R. V. *Varuna* Stns. : 943, 963, 966, 973, 984, 1775, 1777, 1778, 1780, 1802, 1804 - 1807, 2017, 2035, 2070, and 2075. Seventy loose nectophores and only one with additional nectophore.

Description: Nectophore : general shape round with characteristic four dorsal small protuberances; transparent ventral sinus streak-like and long; oral rim characteristically wrinkled giving appearance of broad lobes uniformly flat along edge.

Distribution: Tropical regions of Atlantic, Indian and Pacific Oceans, Northern North Sea, south and western Ireland, Mediterranean, Foroe Shetland area, Foroe Iceland area, Norwegian Sea, Chagos Island area, Arabian Sea, Malay area, Japan and Great Barrier reef area and western Australia.

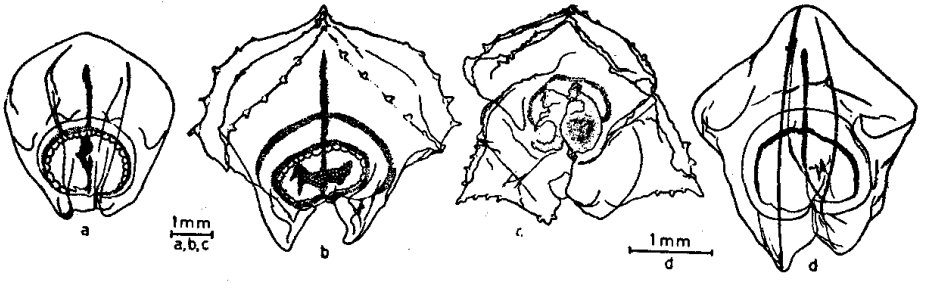

Fig. 12. Nectophores - a. *Hippopodius hippopus*, b. *Vogtia pentacantha*, c. *V. spinosa*, and d. *V. glabra*.

Vogtia pentacantha Kolliker, 1853, (Fig. 12 b)

Vogtia pentacantha Browne, 1926; Totton, 1954; Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967.

Material: From R. V. *Varuna* Stns. : 943, 2052, 2053, 2071, and 2074. Twelve loose nectophores were seen in the collection.

Description: Nectophore : transparent and prismatic with 10 spiny tubercles on edges of facets; surface of facets smooth; tubercles large, prominent and sub-equal, those along lateral margin more prominent; ventral sinus with a

wing-like extension at lateral side and a long streak extending to well below apex; oral rim uniformly lobate especially along dorsal margin; ventral flap conical.

Distribution: Atlantic Ocean, Mediterranean, and Arabian Sea.

Vogtia spinosa Keferstein and Ehlers, 1861, (Fig. 12 c)

Vogtia spinosa Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967.

Material: Only a single nectophore from Stn. No. 943.

Description: Nectophore: general shape more or less pentagonal with spinous prominences on facets and along edges; transparent nectosac moderately large.

Distribution: Atlantic Ocean, North Sea, and Arabian Sea.

Vogtia glabra Bigelow, 1918, (Fig. 12 d)

Vogtia glabra Totton, 1954; Patriti, 1965, 1965a, 1966, 1970; Daniel, Nagabhushanam and Daniel, 1967.

Material: Four nectophores from Stn. No. 943 and 2071.

Description: Nectophore: slightly rectangular and very similar to that of *H. hippopus*; prominences large and indistinct on dorsal side; dorsal sinus thread-like with an enlargement on lateral sides; ventral flap slightly pointed.

Distribution: Atlantic Ocean, South and west Ireland, Foroe Shetland area, Off south and east coast of Africa, Gulf of Aden, Arabian Sea, and Indian Ocean.

Remark: The above species of the genera *Hippopodius* and *Vogtia* were present in one station (943) of R. V. *Varuna* cruise at 15° 10′ N - 72° 41′ E on 2nd April, 1962 in night collections open tows from 100 m to surface.

Ceratocymba leuckarti (Huxley) 1859, (Fig. 13 a - e and 14 a)

Abyla leuckartii Browne, 1926.

Ceratocymba leuckarti Totton, 1954; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967.

Material: From R. V. *Varuna* Stns.: 736, 940, 941, 983, 984, 986, 1771, 1774, 1778, 1779, 1787, 1790, 1802, 1806, and 2036. Two complete animals, one anterior nectophore, 3 posterior nectophores, 12 eudoxids, 4 bracts and 9 gonophores. Anterior nectophore: TL: 4.75 - 5.94; W: 3.00 - 4.31; LS: 2.81 - 3.63; LH: 3.50 - 4.44; LN: 3.69 - 4.44. Posterior nectophore: TL: 14.50; W: 4 31; LN: 8.88. Eudoxid: TL: 4.63; W: 3.00; LP: 2.81; LG: 2.50. Gonophore: TL: 6.75; W: 2.94; LN: 3.94.

Description: Anterior nectophore: laterally flattened with 6 facets of which dorsal facet is longest and rectangular; a characteristic lateral ridge lies near to ventral surface and broadly curves to dorsal side near base not extending to

opposite to mouth of nectosac and runs parallel to basal margin ending well above lateral tooth on dorsal wall of hydroecium resulting in dorso-lateral and ventro-lateral facets being incomplete and unequally divided; ridges of facets finely serrated; hydroecium long and cylindrical placed between somatocyst and nectosac; somatocyst conspicuously large and oval with oil globules; nectosac long, cylindrical with bluntly rounded apex; lateral canal long extending almost whole length of nectosac with an enlargement at distal extremity; nectosac, hydroecium and somatocyst lie parallel to each other and they are apically almost on same level.

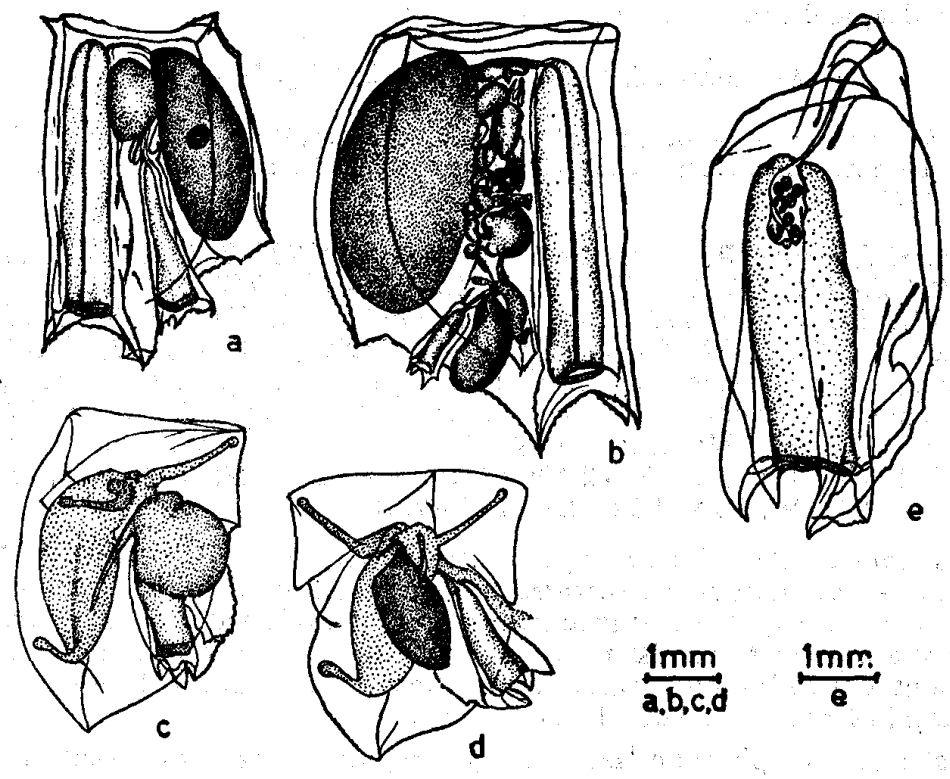

Fig. 13. a-e. *Ceratocymba leuckarti*, a. anterior nectophore with a young posterior nectophore, b. anterior nectophore with a developing eudoxid, c. bract, d. bract-ventral view, and e. gonophore.

Posterior nectophore: four times longer than wide and flattened laterally; right lateral ridge along its midlength turns dorsally and appears as dorsal ridge while latter not prominent; about 5 to 7 teeth on comb of left ventral wing; basal tooth of right ventral wing longer than left; tip between two basal teeth dividing hydroecial cavity from opening of nectosac thickened overlapped with a definite pocket; nectosac narrow, long and uniformly slender with rounded apical margin; pedicular canal runs straight downwards to join nectosac at apex; single dorsal and two lateral teeth more or less same size with margins faintly serrated; lateral canal runs from apex of nectosac to its mouth joining circular canal; inner side of right side of hydroecial groove in its posterior 1/4 having about 5 sub-equal teeth, placed at irregular intervals.

Eudoxid: bract has a flat and quadrilateral apical facet; left lateral ridge usually extends posteriorly to basal margin dividing left lateral facet unequal; margin serrated and more prominent at tips and at corners; phyllocyst with two

thread-like thin ascending branches which directed towards angles of apical facets and a thick descending branch with a curved tip; descending branch extends almost to posterior margin of bract; gonophore with winged dorsal ridge ends in a broad non-serrated tooth at base; lateral ridges end in pointed, non-serrated teeth while ventral ridge strongly serrated forming sides of open groove of hydroecium; one ridge lying within this groove ends in a pointed smooth tooth between folds; nectosac relatively shorter and long; pedicular canal joining it just close to bluntly rounded apex.

Distribution: Tropical Pacific and Atlantic Oceans, Malay Archipelago, Arabian Sea, and Indian Ocean.

Abylopsis tetragona (Otto) 1823, (Fig. 14 b - e)

Abylopsis tetragona Browne, 1926; Totton, 1954; Leloup, 1934; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967; Patriti, 1964, 1969, 1970.

Material: From R. V. *Varuna* Stns. : 694, 702, 705, 707, 711, 715, 719, 721, 723, 730, 732 - 734, 736 - 739, 742 - 749, 755, 758 - 760, 762, 764, 937, 939 - 941, 1770, 1771, 1773 - 1776, 1778, 1779, 1787, 1797 - 1799, 1802 - 1804, 1806, 1807, 2015 - 2018, 2022 - 2027, 2030 - 2036, 2049, 2052, 2055, 2057, 2066 - 2078. Eight complete specimens, 166 anterior nectophores, 32 posterior nectophores, 136 eudoxids, 232 bracts and 140 gonophores. Complete: TL: 14.88; W: 5.94; LS: 2.56; LH: 2.25; LN: 3.13; LNPN: 7.63. Anterior nectophore: TL: 2.06 - 5.06; W: 1.34 - 3.13; LS: 0.88 - 2.50; LH: 1.06 - 2.19; LN: 0.94 - 2.88. Eudoxid: TL: 2.19 - 3.88; W: 1.25 - 1.94; LP: 1.25 - 2.31.

Description: Anterior nectophore: dorsal and ventral facets more elongate along apico-basal axis; ridges serrated though not prominently except on basal margin where it is quite conspicuous; somatocyst ovoid with apical diverticulum which has a pointed tip; stalk of somatocyst short; nectosac with uniform width throughout and with blunt pointed tip; pedicular canal short joining nectosac at about mid-length, and lateral canals arched.

Posterior nectophore: conspicuously long and large with ventral profile slightly curved outward; right ridge posteriorly broader; right ventral tooth conspicuously large and elongate; left dorso-lateral tooth also enlarged but much smaller than right ventral tooth; dorsal and dorso-lateral teeth small; nectosac broad and occupying a greater part of nectophore; apex of nectosac broadly rounded; pedicular canal running vertically downward and joining nectosac apically; lateral canal strongly curved downward and thickened along its posterior length.

Eudoxid: bract cuboidal; dorsal and apico-laterals squared only towards apex; ventral facet almost straight; ridge separating lateral facet diagonal; free margin of baso-sagittal serrated; phyllocyst with slightly thickened lateral branches which may be curved downward towards tip and with a slender short ascending diverticulum and similar but long descending diverticulum.

Gonophore: more or less rectangular and about twice as broad as long with well developed ridges which are slightly serrated; basal teeth sub-equal two being markedly larger than other two; apically gonophore flattened with one edge conically pointed; nectosac broad and occupying whole length of gonophore; apically nectosac truncate and at one end pedicular canal from phyllocyst joins it.

Distribution: Atlantic Ocean, Mediterranean, Red Sea, Off Port of Sudan, Arabian Sea, Bay of Bengal, Indian Ocean and Pacific Ocean.

Abylopsis eschscholtzi (Huxley) 1859, (Fig. 14 f - h)

Abylopsis eschscholtzi Browne, 19 6; Leloup, 1934; Totton, 1954; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Patriti, 1970.

Material: From R. V. *Varuna* Stns. : 692, 707, 719, 721, 730, 732 - 734, 736, 738, 741, 743 - 745, 747, 750, 757, 758, 760, 762, 939 - 944, 948, 951 - 953, 958, 960 - 967, 970, 971, 975, 977, 978, 981, 983 - 988, 992, 1771, 1773, 1775 - 1779, 1787, 1788, 1794, 1797, 1798, 1801, 2015 - 2018, 2020, 2022 - 2024, 2026, 2049, 2050, 2054, 2055, 2066, 2072, 2076, and 2077. Eleven complete specimens, 149 anterior nectophores, 73 posterior nectophores, 16 eudoxids, 38 bracts and 13 gonophores. Anterior nectophore: TL: 2.06 - 5.56; W: 1.88 - 5.00; LS: 1.13 - 3.06; LN: 1.25 - 3.25; LH: 1.06 - 2.63. Posterior nectophore: TL: 2.31 - 6.31; W: 1.95 - 4.81; LN: 1.50 - 3.88.

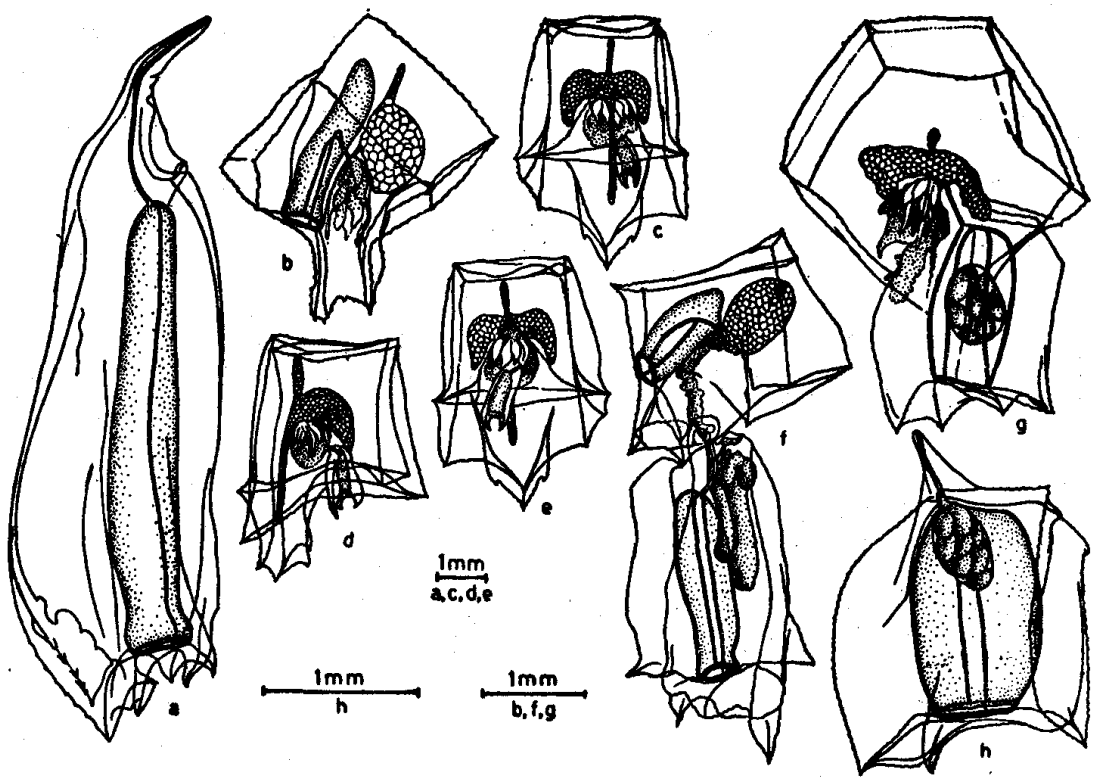

Fig. 14. a. *Ceratocymba leuckarti* - posterior nectophore, b - e. *Abylopsis tetragona*, b. lateral view of the anterior nectophore, c. dorsal view of bract, d. lateral view of bract, e. ventral view of bract; f - h. *Abylopsis eschscholtzi*, f. complete form, g. eudoxid, and h. gonophore.

Description: Anterior nectophore: dorsal and ventral facets more regularly pentagonal and nearly of same size; ridges separating facets not markedly serrated, but serrations distinctly seen at junctions of ridges; apex of nectosac does not extend apically beyond main body of somatocyst; lateral sub-umbral canal not arched; hydroecium shallow; somatocyst large and round with oil droplet.

Posterior nectophore: relatively much shorter in this species than in *A. tetragona*; ridges five conspicuously denticulated; five teeth at base subequal in size; ventral teeth large with marginal serrations; margin of flap on inner face of left ventral ridge smooth; nectosac relatively smaller, finger-shaped and does

not extend to tip of nectophore; pedicular canal slightly bent but lateral canal running straight to posterior to mouth of nectosac.

Eudoxid: general appearance pentagonal with five facets; apical and lateral facets rectangular; phyllocyst with four branches - a short ascending, much longer one descending and two stout lateral branches which are curved downwards; ridges on gonophore strongly serrated; nectosac large extending full length of gonophore; apex of nectosac bluntly rounded; pedicular canal straight joining apex of nectosac on ventral side, well developed gonad present in nectosac.

Distribution: Cosmopolitan.

Bassia bassensis (Quoy and Gaimard) 1834, (Fig. 15 a - f)

Bassia bassensis Browne, 1926; Totton 1954; Leloup, 1934; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Patriti, 1964; 1965a, 1966, 1969, 1970; Daniel, Nagabhushanam and Daniel, 1967.

Material: From R. V. *Varuna* Stns.: 711, 730, 732 - 734, 736 - 738, 741 - 745, 749, 750, 759, 764, 935, 940 - 946, 951 - 954, 956, 960, 963 - 965, 967, 969 - 972, 974 - 978, 980, 981, 983, 985 - 988, 992, 993, 1770 - 1783, 1785 - 1791, 1794c, 1797 - 1807, 2016 - 2020, 2022 - 2036, 2047 - 2050, 2054, 2056 - 2058, 2060 - 2062, 2065, 2068 - 2070, 2073, 2077, and 2079. Thirteen complete specimens, 74 anterior nectophores, 126 posterior nectophores, 390 eudoxids, 511 bracts and 445 gonophores. Complete: TL: 9.75; W: 6.50; LS: 1.69; LNAN: 1.44; LNPN: 4.81. Anterior nectophore: TL: 3.25 - 4.06; W: 2.06 - 2.31; LS: 1.25 - 1.50; LN: 1.56 - 1.89; LH: 0.34 - 1.75. Eudoxid: TL: 3.88 - 5.75; LP excluding descending branch : 0.81 - 1.19.

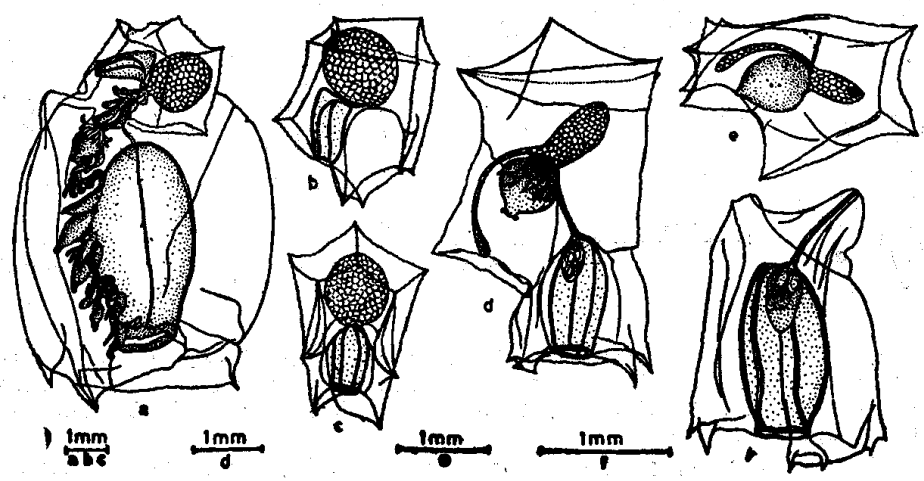

Fig. 15. a - f. *Bassia bassensis*, a. complete form, b. lateral view of the anterior nectophore, c. ventral view of the anterior nectophore, d: eudoxid, e. bract, and f. gonophore.

Description: Anterior nectophore: general appearance prismatic, short, edge oblique; pentagonal but being more elongate; apico-lateral facets quadrangular, ridges serrated, more prominent at corners; somatocyst and nectosac characteristic, former conspicuously large and globular occupying more than half of nectophore; somatocyst with a short stalk and lies above nectosac;

nectosac (when viewed from lateral side) more or less rectangular with apical side much broader than mouth; pedicular canal starting from ventral angle of apical part of nectosac and running horizontally to base of somatocyst; hydroecium shallow but broad and bounded by two baso-lateral facets.

Posterior nectophore: large, laterally smooth and bulged at middle; ridges four, ventral ridge prominent extending beyond mouth of nectosac into teeth; two flaps of ventral ridges closely held in place by turgidity of jelly, as well as at free ends at base; so that, hydroecium appears tubular, but flaps not fused; right flap rather flat with a wide toothed basal margin; pedicular canal runs vertical from hydroecium but directed dorsad to join below apex of nectosac; lateral canals straight; nectosac long extending to almost tip of nectophore.

Eudoxid: wedge-shaped bract has seven facets with a median horizontal ridge; dorsal facet quadrilateral; ventral facet subdivided by a median longitudinal ridge; bracteal cavity large with rounded apical part with wide opening; phyllocyst with a curved descending diverticulum along roof of bracteal cavity and an enlarged apical diverticulum; lateral canals prominent and runs downward vertically to mouth of nectosac. Gonophore has four ridges with four serrated large teeth projecting well below mouth of nectosac; canals running very close to wall of nectosac.

Distribution: Atlantic, Indian and Pacific Oceans, Arabian Sea and Bay of Bengal.

Enneagonum hyalinum Quoy and Gaimard, 1827, (Fig. 16 a, b)

Cuboides vitreus Browne, 1926.

Enneagonum hyalinum Totton, 1954; Leloup, 1934; Daniel and Daniel, 1963, 1967; Alvarino, 1964; Daniel, Nagabhushanam and Daniel, 1967; Patriti, 1970.

Material: From R. V. *Varuna* Stns.: 717, 983, 1777 - 1779, 1784 - 1787, 1790, 1792, 1804, 1805, 1807, 2015, 2017, 2019, 2020, 2022 - 2024, 2028, 2036, 2048, 2057, 2068, 2070, and 2071. Twentyfive anterior nectophores, 14 eudoxids, 12 bracts and 4 gonophores.

Description: Anterior nectophore: general shape pyramidal with prominent angles; four anterior and four posterior facets; triangular basal facet between and below 2 dorsal facets; baso-laterals situated between and below apico-laterals and dorsals; characteristic of this species is addition of median dorsal ridge subdividing dorsal facet; somatocyst spindle-shaped with a constriction just below its apex; somatocyst and nectosac surrounded by three lappets, two of which separate it from basal facet.

Eudoxid: bract nearly cuboidal with five facets - an apical, dorsal, ventral and two laterals; opening of bracteal cavity covers entire basal portion; phyllocyst unique and pyriform with broad swollen lateral halves with a short apical diverticulum; gonophore with well serrated five ridges which end in five pointed teeth; dorsal and lateral teeth prominent; ridges bearing these teeth very pronounced; extensive concave surface beneath dorsal and lateral teeth characteristic; a semi-circular serrated lappet at base of each lateral teeth; left ventral ridge bifurcates but joins apically, one branch bearing a definite hook; nectosac bell-shaped with rounded apex and pedicular canal short and slightly bent; canals in nectosac runs to circular canal.

Distribution: Tropical regions of Atlantic, Pacific and Indian Oceans, Arabian Sea, Bay of Bengal, Southeast coast of New Guinea, and Great Barrier reef area.

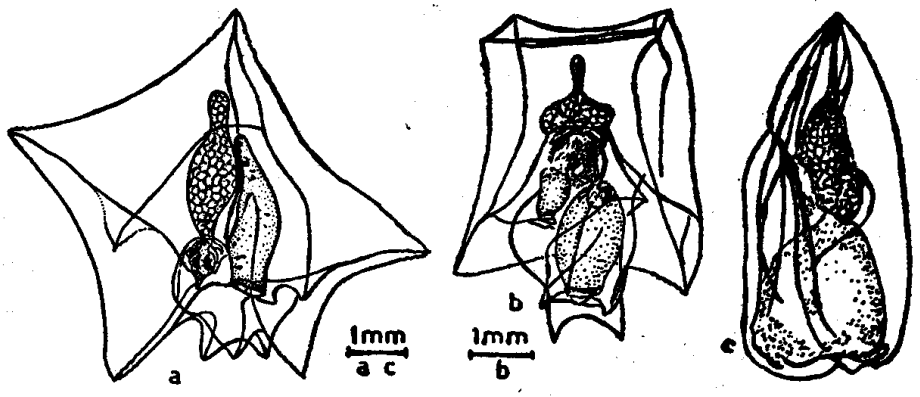

Fig. 16. a. and b. *Enneagonum hyalinum*, a. anterior nectophore, b. eudoxid, and c. anterior nectophore of *Heteropyramis maculata*.

Heteropyramis prox. **maculata** Moser, 1925, (Fig. 16 c)

Heteropyramis maculata Leloup, 1934, Totton, 1954; Daniel and Daniel, 1967; Patriti, 1970.

Material: Only one anterior nectophore: TL: 6·15; W: 3.85; LS: 3.35; LN: 2.50.

Description: Anterior nectophore: smooth; ridges very thin; dorso-ventrally flattened along its mid-length; hydroecium occupies a considerable part of nectophore and is broad; nectosac extends upto half height of nectophore; somatocyst long and placed at apex of nectosac; anterior tip of somatocyst thread-like; pigment patches at apex of nectophore where longitudinal ridges meet and one each at middle of lateral ridges.

Remark: It is one of the deep water species and only one nectophore was found in the collections which are mostly from 200 m to surface.

Distribution: Cape Verde Island, Ascension Island, South Georgia region, South and west Ireland, Atlantic Ocean, Off San Diego, Southeast coast of Madagascar, Arabian Sea and Malay Archipelago.

ABUNDANCE OF SIPHONOPHORES

Counts of polygastric and eudoxid stages of each species from the samples were analysed to know their numerical abundance. The anterior nectophore or the posterior nectophore of a species whichever is more has been taken to the count of the complete animal as the total polygastric stage of the species. The bract or the eudoxid bell which ever is more has been taken to the total count to know the abundance of eudoxid stage of the species. The following nine species in the order of abundance are common in the plankton collections studied: *Lensia subtiloides, Diphyes chamissonis, Eudoxoides mitra, Chelophyes contorta, Abylopsis tetragona, A. eschscholtzi, Lensia hotspur, Sulculeolaria chuni,* and *Lensia campanella.* The numerical abundance of these nine species are shown in Fig. 1. Detailed investigations on the distribution of Siphonophora in space and time along the west coast of India and the Laccadive Sea and their ecology will be discussed elsewhere.

TABLE 1. *R. V.* VARUNA *Station particulars (From Stns. 2015 to 2079)**

Station No.	Date	Time	Position Latitude	Position Longitude	Depth at Station (m)	Depth of Haul (m)
2015	16-11-1963	1200-1420	10° 43′	74° 3[illegible]′	2180	200 - 0
2016	,,	1635-1900	10° 50′	74° 51′	1600	,,
2017	,,	2055-2145	10° 57′	75° 07′	220	,,
2018	,,	2310-2330	11° 02′	75° 17′	63	40 - 0
2019	17-11-1963	0130-0145	11° 07′	75° 27′	40	25 - 0
2020	,,	0240-0300	11° 12′	75° 39′	37	,,
2021	,,	0330-0340	11° 14′	74° 43′	10	—
2022	,,	1615-1840	09° 41′	75° 10′	2460	200 - 0
2023	,,	2040-2305	09° 45′	75° 26′	1600	,,
2024	18-11-1963	0020-0105	09° 49′	75° 40′	200	175 - 0
2025	,,	0235-0300	09° 53′	75° 53′	60	40 - 0
2026	,,	0410-0435	09° 54′	76° 04′	34	25 - 0
2027	,,	0525-0545	09° 56′	76° 09′	22	15 - 0
2028	7-12-1963	0900- ..	16° 28′	73° 16′	24	,,
2029	,,	0950-1020	16° 27′	73° 12′	34	28 - 0
2030	,,	1055-1115	16° 25′	73° 07′	46	40 - 0
2031	,,	1305-1355	16° 20′	72° 53′	78	60 - 0
2032	,,	1540- ..	16° 15′	72° 38′	110	100 - 0
2033	,,	.. ..	16° 10′	72° 25′	..	200 - 0
2034	,,	2320- ..	16° 06′	72° 10′	1660	,,
2035	8-12-1963	0425- ..	16° 01′	72° 56′	2000	,,
2036	,,	0945- ..	15° 37′	71° 22′	2600	,,
2047	11-12-1963	0825- ..	14° 48′	74° 02′	36	25 - 0
2048	,,	0955-1015	14° 44′	73° 52′	46	40 - 0
2049	,,	1115- ..	14° 40′	73° 40′	60	50 - 0
2050	,,	1344- ..	14° 35′	73° 30′	96	90 - 0
2051	,,	1650- ..	14° 32′	73° 20′	119	100 - 0
2052	,,	1742- ..	14° 31′	73° 10′	920	200 - 0
2053	,,	2032- ..	14° 27′	73° 00′	500	,,
2054	12-12-1963	0445-0730	14° 23′	72° 52′	1920	200 - 0
2055	,,	1012- ..	13° 23′	73° 00′	1850	,,
2056	,,	1540-1625	13° 25′	73° 10′	300	,,
2057	,,	1707-1740	13° 30′	73° 2[illegible]′	100	80 - 0
2058	,,	1844- ..	13° 33′	73° 32′	76	60 - 0
2059	,,	1945-2004	13° 36′	73° 40′	66	50 - 0
2060	,,	2038-2052	13° 42′	73° 57′	60	,,
2061	,,	2134-2148	13° 4[illegible]′	74° 04′	50	40 - 0
2062	,,	2228-2248	13° 49′	74° 15′	46	35 - 0
2065	18-12-1963	1940-2000	09° 56′	76° 03′	40	30 - 0
2066	,,	2100-2105	09° 53′	75° 50′	60	50 - 0
2067	,,	2240-2341	09° 51′	73° 38′	325	200 - 0

*Zooplankton collections were made by using the Indian Ocean Standard net. For details of other R. V. *Varuna* stations, reference is invited to Volume 11, No. 2 and Volume 12, No. 1 of the *Indian Journal of Fisheries*.

TABLE 1 (contd.)

Station No.	Date	Time	Position Latitude	Position Longitude	Dept at Station (m)	Dept of Haul (m)
2068	19-12-1963	0536-0752	09° 50′	75° 00′	2100	,,
2069	,,	1025-1210	09° 42′	74° 40′	2500	,,
2070	,,	1435-1712	09° 31′	74° 19′	,,	,,
2071	,,	1850-2045	09° 30′	73° 50′	2420	,,
2072	20-12-1963	1620-1745	12° 08′	72° 30′	1818	,,
2073	,,	.. -2015	12° 15′	72° 51′	2000	,,
2074	21-12-1963	0035-0205	12° 20′	73° 12′	1200	,,
2075	,,	0440-0620	12° 28′	73° 32′	1200	,,
2076	,,	0905-1010	12° 35′	73° 55′	550	,,
2077	,,	1044-1115	12° 36′	74° 10′	180	150 - 0
2078	,,	1304-1320	12° 44′	74° 44′	60	50 - 0
2079	,,	1410-1415	12° 47′	73° 34′	45	30 - 0

REFERENCES

*AGASSIZ, A. 1863. On *Nanomia cara*. *Proc. Boston Soc. Nat. Hist.*, **9** : 180 - 181.

*AGASSIZ, L. 1862. *Contribution to the natural history of the United States of America Hydroidae*, 4. Boston (II – VIII) : 1 - 380.

AIYAR, R. G., K. S. MENON and M. G K. MENON 1936. Plankton records for the year 1929 and 1930. *J. Madras Univ.*, **8** (1) : 97 - 139.

ALVARINO, A. 1964. Report on the Chaetognatha, Siphonophorae and Medusae of the Monsoon Expedition in the Indian Ocean. Preliminary results of SIO Investigations in the Indian Ocean during Expedition Monsoon and Lusiad (1960 - 1963). *Univ. Calif., San Diego*. Pp : 103 – 108, 209 - 212.

_____. 1968. The New Calycophorae, Siphonophorae. *Pacific Science*, **12** (3) : 340 - 346.

BAL, D. V. 1952. Records of zooplankton in Bombay waters during 1944 - 1947. *Jour. Univ. Bombay*, **20** : 75 - 80.

_____and L. B. PRADHAN 1945. A Preliminary note on the plankton of Bombay harbour. *Curr. Sci.*, **14** : 211 - 212.

BIGELOW, H. B. 1911. The Siphonophorae. Reports on the scientific results of the Expedition to the Eastern trophical Pacific ..... *Mem. Harv. Mus. Comp. Zool.*, **28** (2); 173 - 401.

_____. 1918. Some Medusae and Siphonophorae from the Western Atlantic. *Bull. Mus. Comp. Zool. Harv. Coll.*, **62** (8) : 363 - 442.

*BLAINVILLE, H. M. 1830. Zoophytes. *Dictionnaire des science naturelles*. Paris. **60** : 1 - 548.

*BRANDT, J. F. 1835. Polypus, Acalephas Discophores et Siphonophoras nec non Echinodermata continens. Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatum. *Mem. Acad St. Petersb.*, **4** (2) : 1 - 76.

BROWNE, E. T. 1926. Siphonophorae from the Indian Ocean. *Trans. Linn. Soc., Lond. (Zool).*, **19** (2) : 55 - 86.

*BUSCH, W. 1851. *Beobachtungen über Anatomie und Entwicklung einiger wirbellosen Seethiere. Berlin.* Pp : 1 - 143.

CHACKO, P. I. 1950. Marine plankton from waters around the Krusadi Island. *Proc. Indian Acad. Sci.*, **31**, Sec. B : 162 - 174.

*CHAMISSO, A de and C. G. EYSENHARDT 1821. De Animalibus quibusdam e classe vermium Linneana..... *Fasc.* 2. *Nova Acta Leop. Carol*, **10**: 343 - 374.

CHIDAMBARAM, K and M. D. MENON 1945. The correlation of the West coast fisheries with plankton and certain oceanographical factors. *Proc. Indian Acad. Sci.*, **22**, Sec. B: 355 - 367.

*CHUN, C. 1886. Uber Bau und Entwicklung der Siphonophoren. *S. B. preuss. Akad. wiss.*, **38**: 681 - 688.

*————— 1888. Bericht uber eine nach den Canarischen Inselin im Winter 1887 - 1888 ausgefurhrte Reise. *Ibid.*, **44**: 1141 - 1173.

*CLAUS, C. 1878. Uber *Halistemma tergestinum* n. sp. nebst. Bemerkungen uber den feinern Bau der Physophoriden. *Arb. Zool. Inst. Univ. Wien*, **1**: 1 - 56.

*CUVIER, G. 1817. *Le Regne animal* .....Paris. **4**: 1 - 225.

DANIEL, A. and R. DANIEL 1962. A new siphonophore of the genus *Lensia* from the Bay of Bengal. *Ann. Mag. Nat. Hist., Ser.* 13, **5** (58): 621 - 623.

————and————. 1963. *Lensia gnanamuthi* a new siphonophore from the Madras plankton. *J. Bombay nat. Hist. Soc.*, **60** (3): 751 - 753.

————, A. K. NAGABHUSHANAM, and R. DANIEL 1967. Preliminary studies on the zoological constituents of the sonic scattering layer at seven stations established in the eastern part of the Indian Ocean by the R. V. *Vityaz* in 1962. *Proc. Symp. Indian Ocean, New Delhi*, 1967. NISIINCOR (Bulletin NISI. No. 38): 585 - 593.

DANIEL R. 1966. On a new Physonectae *Frillagalma vityazi* Gen. nov., sp. nov. (Siphonophora: Coelenterata) from the Indian Ocean. *Ann. Mag. Nat. Hist.*, Ser. 13, **9** (106, 107 and 108): 689 - 692.

————. 1970. Some new species of Siphonophora (Coelenterata) from the Indian Ocean. *J. Zool. Soc. India*, **22** (1 and 2): 147 - 156.

————and A. DANIEL 1963. On the siphonophores of the Bay of Bengal - I. Madras coast. *J. mar. biol. Ass. India*, **5** (2): 185 - 220.

————and————. 1967. Siphonophores collected during the 35th cruise of the R. V. *Vityaz* in the eastern part of the Indian Ocean. *Proc. Symp. Indian Ocean, New Delhi*, 1967. NISIINCOR (Bulletin NISI. No. 38): 571 - 574.

*DELLE CHIAJE, S. 1841. Descrizione e notomia degli Animali Invertebrati della Sicilia citeriore osservati vivi negli anni 1822 - 1830. **6 - 7**, Atlases, 181 pls.

DEVANESAN, D. W. 1942. Plankton studies in the fisheries branch of the Department of Industries and Commerce, Madras. *Curr. Sci.*, **11**: 142 - 143.

*ESCHSCHOLTZ, F. 1825. Bericht uber die zoologische Ausbeute wahrend der Reise von Kronstadt bis St. Peter und Paul. *Oken's Isis*, **16**: 733 - 747.

*————. 1829. *System der Acalphen*, Berlin. Pp: 1 - 190.

*FORSSKÅL, P. 1775. Descriptiones Animalium, Avum, Amphibiorum, Piscium, Insectorum, Vermium quae in itinere orientali observavit. *Hauniae*, 1 - 164.

*————. 1776. Icones rerum naturalium quas in itinereorientalidepingi curavit Petrus Forsskål. Postmorten editit Carsten Niebuhr. *Ibid.*, 1 - 15.

*GEGENBAUR, C. 1853. Beitrage zur naheren Kenntniss der Schwimmpolypen (Siphonophoren). *Z. wiss. Zool.*, **5**: 285 - 344.

*————. 1854. Uber *Diphyes turgida* n. sp. nebst Bemerkungen uber Schwimmpolypon. *Ibid.*, **5**: 442 : 454.

GEORGE, P. C. 1953. The marine plankton of the coastal waters of Calicut with the observations on the hydrological conditions. *J. Zool. Soc. India*, **5** (1): 76 - 107.

HAECKEL, E. 1888a. System der Siphonophoren auf phylogenetischer Grundlage entworven. *Jena Z. naturw.*, **22**: 1 - 46.

HAECKEL, E. 1888 b. The Siphonophorae. *Rep. Sci. Res. Voy. 'H. M. S. Challenger'* Zool. **28**: 1 - 380.

*HUXLEY, T. H. 1859. The Oceanic Hydrozoa. *Ray Soc., London.* Pp: 1 - 144.

ISAMU YAMAZI 1971. Data Report and Distributional Maps of the CSK Standard Zooplankton samples. *Miscellaneous Reports of the National Science Museum,* **6** (1).

*KEFERSTEIN, W. and E. EHLERS 1861. Zoologische Beitrage gesammelt in winter 1859 - 1860 in Neapel und Messina. I. Beobachtungen uber die Siphonophoren von Neapel and Messina. *Leipzig*: 1 - 34.

KOLLIKER, A. 1853. Die Schwimmpolypen oder Siphonophoren von Messina. *Ibid.*, 1 - 96.

LELOUP, E. 1934. Calycophorides de 1'Ocean Atlantique Tropical et Austral. *Bull. Mus. Hist. nat. Belg.*, **10** (6): 1 - 87.

————. 1934 a. Siphonophores de Madras (Indes anglaises). *Ibid.*, **10** (9): 1 - 5.

————. 1955. "Siphonophores". Expedition Oceanographique Belge dans les Eaux Cotieres Africaines De L'Atlantique Sud, (1948 - 1949). *Institut Royal des Sciences Naturelles de Belgique*, **3** (4): 11 - 19.

————. 1955 a. "Siphonophorae". *Report on the Scientific results of the 'Michael Sars' North Atlantic Deep-Sea Exped.*, **1910, 5** (11): 1 - 24.

LENS, A. D. and THEA VAN RIEMSDIJK, 1908. The Siphonophora of the Siboga Expedition. *Siboga Exped.*, **9 (38)**: 1 - 130.

*LEUCKART, R. 1854. Zur naheren Kenntniss der Siphonophoren von Nizza. *Arch. Naturgesch. Jahrg.*, **20** (1): 249 - 377.

MENON, K. S. 1931. A preliminary account of the Madras plankton. *Rec. Indian Mus.*, **33**: 489 - 516.

MENON, M. A. S. 1945. Observation on the seasonal distribution of the plankton of the Trivandrum coast. *Proc. Indian Acad. Sci., Sec.* **B, 22**: 31 - 62.

MOSER, F. 1925. Die siphonophoren der Deutschen Süd-polar Expedition, 1901 - 1903. *Dtsch. Sudpol. Exped.*, XVII (Zool)., **9**: 1 - 541.

*OTTO, A. W. 1823. Beschreibung einiger neuer Mollusken und zoophyten. *Nova Acta Leop. Carol*, **11**: 273 - 314.

PATRITI, GILBERT. 1964. Les siphonophores calycophores du Golfe de Marseille. *Res. Trav. Sta. Mar. End. Bull.*, **35**, Fasc. 51 : 185 - 258.

————. 1965. Contribution a l'etude de siphonophores calycophores recueillis dans le Golfe de Gascogne. Note preliminaire - 1. Campagne du "Job ha Zelian". (Juillet - Aout, 1964). *Ibid.*, **37**, Fasc. 53 : 151 - 160.

————. 1965a. Contribution a l'etude de siphonophores calycophores recueillis dans le Golfe de Gascogne. Note preliminaire - 2. Campagne du "Job ha Zelian". (Oct. - Novembre, 1964). *Ibid.*, **38**, Fasc. 54 : 15 - 31.

————. 1966. Contribution a l'etude de siphonophores calycophores recueillis dans le Golfe de Gascogne (3 e note). Campagnes du "Job ha Zelian" (Ete et automne 1964). Donnees hydrologiques. Conclusions. *Ibid.*, **41**, Fasc. 57: 109 - 116.

————. 1969. Apercu sommaire sur la distribution des siphonophores dans le Golfe de Gabes et dans les eaux cotieres de tripolitaine. Campagne de la 'Calypso', Avril - Mai, 1965. *Tethys*, **1** (2): 249 - 254.

————. 1970. Apercu systematique de la faune de siphonophores des zones superficielles et subsuperficielles des eaux du large de tulear (S. W. de L'Ocean Indian, Madagascar). *Rec. Trav. Sta. mar. End.*, Fasc. hors serie suppl. No. **10**: 285 - 303.

*PERON, F. and C. A. Lesueur 1807. Voyage de Decouvertes aux Terres Australes execute sur les Corvettes le Geographe, le Naturaliste et la Goelette le Casuarina, pendant les annes, 1800 - 1804. Paris : 1 - 496.

PRASAD, RAGHU R. 1954. The characteristic of marine plankton at an inshore station in the Gulf of Mannar near Mandapam. *Indian J. Fish.*, **1** : 1 - 36.

————. 1964. *A bibliography of plankton of the Indian Ocean.* Publs. No. 3. Indian natn. Comm. Oceanic Res., I. C. A. R., New Delhi.

————, S. V. BAPAT and P. R. S. TAMPI 1952. Observations on the distribution of plankton at six inshore stations in the Gulf of Mannar. *Jour. Zool. Soc. India*, **4**: 141 - 151.

*QUOY, J. R. C. and J. P. GAIMARD 1827. Observations zoologiques faites abord de l'Astrolabeen mai 1826, dans de detroit de Gibraltar. *Ann. Sci. nat. Paris*, **10** : 1 - 21.

*————and———— 1833. Voyage de decouvertes de l'Astrolabe, execute 1826 - 1829 sous le commandement de M. J. Dumont D. Urville. Paris. *Zoologie*, **4**: 1 - 390.

*SARS, M. 1846. *Fauna littoralis Norvegiae.* Christiana : 1 - 94.

SEARS, M. 1950. Notes on siphonophores. 1. Siphonophores from the Marshall Islands. *J. Mar. Res.*, **9** : 1 - 16.

————. 1953 Notes on Siphonophores. 2. A Revision of the Abylinae. *Bull. Mus. Comp. Zool., Harvard Coll.*, **109** (1) : 1 - 119.

SUNDARARAJ, B. 1927. Littoral fauna of Krusadi Island in the Gulf of Mannar. Siphonophora. *Bull. Madras Govt. Mus. Nat. Hist.*, **1** (1): 21 - 23.

TOTTON, A. K., 1932. Siphonophora. *Sci. Rep. Great Barrier Reef Exped.*, **4** (10) : 317 - 374.

————. 1941. New species of the siphonophoren genus *Lensia* Totton, 1932. *Ann. Mag. nat. Hist., Ser.* 11, **8** : 145 - 168.

————. 1954. Siphonophora of the Indian Ocean. *Discovery Report*, **27** : 1 - 162.

————. 1965. A synopsis of the Siphonophora. *Trustees of the British Museum* (Nat. *Hist.*) London. Pp. : 1 - 230.

VOGT, C. 1852. Uber die Siphonophoren. *Z. wiss. Zool.*, **3** : 522 - 525.

*Originals not refered to.

ADDENDUM

Recently Alvarino (1974) has recorded *Chelophyes contorta, Diphyes bojani, D. dispar, Lensia campanella, L. meteori**, L. subtilis, Sulculeolaria quadrivalvis, S. turgida, Rosacea plicata**, *Apolemia uvaria**, *Physophora hydrostatica**, *Eudoxia russelli* (eudoxid of *Ch. appendiculata)*, *S. angusta* and *S. chuni* for the first time from the eastern Mediterranean, of which the last three have not been previously recorded in any region of the Mediterranean.

The other new records, she has listed for the Gulf of Elat are *D. dispar, L. subtilis, L.subtiloides, S. chuni, S. quadrivalvis, A. eschcholtzi, A. tetragona, Enneagonum hyalinum, Cordagalma cordiformis**, *Athoribya rosacea**, *Agalma elegans, Agalma okeni, Ch. appendiculata (Eudoxia russelli)* and *Diphyopsis (Eudoxoides) mitra,* the last two being new records also for the Red Sea.

She has also mentioned that most of the thirty species of siphonophores observed in the Caribbean and Pacific regions adjacent to the Panama Canal, are new records. These new distributional records may be appended in appropriate places under the sub-heading '*Distribution*' of the respective species of this account. For details, reference may be made to:

Alvarino, A. 1974. Distribution of siphonophores in the regions adjacent to the Suez and Panama Canals. *Fish. Bull.*, **72** (2): 526-546.

*These species are not described in this paper.