

ON THE SIPHONOPHORES OF THE BAY OF BENGAL I. MADRAS COAST

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INTRODUCTION

ALTHOUGH the study of the siphonophores of the Indian Ocean has received considerable attention (*vide* Totton, 1954) not much is known on the siphonophores of the Madras Coast. The only available references are (i) a record of three species—*Physalia utriculus*, *Porpita pacifica* and *Verella* sp. off the Krusadi Islands (Sundara Raj, 1927); (ii) a brief reference to *Diphyes* sp., *Porpita pacifica* and *Physalia utriculus* (Menon, 1931); and (iii) on *Diphyes dispar*, *D. chamissonis*, *Rhizophysa eysenhardtii*, *Physalia physalis*, *Porpita porpita* and *Verella spirans*, obtained off the coast of Madras (Leloup, 1934 b). Hence it was thought desirable to undertake a detailed taxonomic study of this interesting group of animals, which constitute a stable part of the plankton of the Madras waters.

The present work is based on the collection of siphonophores made from in-shore and offshore plankton and from the beach off Madras over a period of six years (1952-54 and 1956-60). The collection includes 29 species.

LIST OF SPECIES

1. *Porpita porpita* (Linné.)
2. *Verella varella* (Linné.)
3. *Physalia physalis* (Linné.)
4. *Rhizophysa eysenhardtii* Gegenbaur
- *5. *Agalma okeni* Eschscholtz
- *6. *A. elegans* (Sars)
- *6a. Larva *Physonectarum* Haeckel
- *7. *Stephanomia rubra* (Vogt)
- *7a. Larva of *Stephanomia*
- *8. *Nanomia bijuga* (Delle Chiaje)
- *9. *Forskalia contorta* (M. Edwards)
- *10. *Sulculeolaria chuni* (Lens & van Reimsdijk)
- *11. *S. turgida* (Gegenbaur)
- *12. *S. quadrivalvis* Blainville
- *13. *S. monoica* (Chun)
- *14. *Lensia subtiloides* (Lens & van Riemsdijk)
- *15. *L. cossack* Totton
- *16. *L. hotspur* Totton
17. *L. gnanamuthui* Daniel & Daniel

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* New record for Madras Coast.

18. *L. tottoni* Daniel & Daniel
- *19. *Muggiaea delsmanni* Totton
- *20. *Chelophyes contorta* (Lens & van Riemsdijk)
21. *Diphyes dispar* Chamisso & Eysenhardt
- *22. *D. bojani* Eschscholtz
23. *D. chamissonis* Huxley
- *24. *D. mitra* Huxley
- *25. *Abylopsis tetragona* (Otto)
- *26. *Abylopsis eschscholtzi* Huxley
- *27. *Bassia bassenis* (Quoy & Gaimard)
- *28. *Enneagonum hyalinum* Quoy & Gaimard
- *29. *Ceratocymba leuckartii* (Huxley)

MATERIAL AND METHODS

The material examined consists of plankton samples collected at the surface with a tow-net. Offshore collections were made at depths ranging from 10-70 metres with Nansen's net. *Physalia* and *Velella* were collected from the Madras beach.

The siphonophores were sorted out and narcotised with menthol or magnesium sulphate. All drawings were made with the aid of a *camera lucida*.

SYSTEMATIC ACCOUNT

Order CHONDROPHORA (Chamisso and Eysenhardt), 1821
(=DISCONANTHAE Haeckel, 1888).

Family PORPITIDAE Brandt, 1835.

The family Porpitidae includes two genera, *Porpita* and *Porpema*, the former including *Porpita porpita* and the latter *P. prunella* (*vide* Totton, 1954).

Genus *Porpita* Lamarck, 1801

1. *Porpita porpita* (Linné.) 1758
(Fig. I, 1-5)

(For synonymy up to 1911 see Bigelow, 1911 *b*, pp. 333, 352, 353)

Porpita porpita Moser, 1925, p. 456.

Leloup, 1934 *b*, p. 3.

Totton, 1954, p. 33.

Porpita pacifica Sundara Raj, 1927, p. 21.

Bigelow, 1931, p. 585.

Menon, 1931, p. 503.

Record—20 specimens from surface plankton off Madras Coast during December, January and February, 1952-53; 10 specimens from surface plankton off Madras Coast during January-February, 1956-58.

Distribution—Represented in all Oceans.

Description—Pneumatophore: (Fig. I, 1): Diameter 4-40 mm; upper surface divided into four zones, with numerous radiating ridges; entire upper surface beset with many tubercles. Stigmata few, more towards margin. Lower surface with single central gastrozoid, numerous gonozooids and tentacles. Limbus relatively narrow; canals of limbus forming irregular network in adults. Central disc pale blue, with tentacles deep ultra-marine blue.

Pneumatocysts: (Fig. I, 3): Circular, disc-like, 3 to 35 mm., very thin in middle, thick peripherally. Eight equidistant primary rays diverge from centre; secondary rays numerous. Annular septa 13-50; margin deeply wavy. Stigmata more towards the margin. Lower surface strongly folded, bearing numerous articulate tracheae from conical protuberance at periphery.

Centradenia: Occur in between pneumatocyst and single central siphon (Fig. I, 2); central gland with numerous canals. Sexual siphons (Fig. I, 4) numerous, occur between central siphon and tentacles; proximal half covered with bunches of gonophores; among the sexual siphone 12-14 considerably large siphons occur with mouth openings arranged in concentric manner. Tentacles (Fig. I, 5) arranged in concentric rows of various lengths, club-shaped, three-sided. Stalked cnidospheres number 24, 12, 11 on each corner and 3 at tip.

Family VELELLIDAE Brandt, 1835

This family includes one genus, *Velella* (vide Totton, 1954)

Genus *Velella* Lamarck, 1801

According to recent authors (vide Totton, 1954, p. 35) only two species of this genus were considered as valid, viz., *Velella velella* of the Atlantic Ocean and *V. lata* of the Indo-Pacific, the breadth in proportion to the length being greater in *lata* than in *velella*. Since, in other respects there is no constant difference between the two species, Schneider (1898), Bigelow and Sears (1937) and Totton (1954) considered them as belonging to a single species, *velella*, with which view we agree. However, as pointed by Totton (1954) more data are needed on the proportion and direction of the sail of this species from the Indian Ocean.

2. *Velella velella* (Linné.) 1758

(Fig. I, 6-10)

(For synonymy up to 1911 see Bigelow 1911 *b*, p. 353)

Velella spirans Leloup, 1934 *b*, p. 3.

Velella velella Totton, 1954, p. 34.

Record—20 specimens from Madras beach during November-December, 1952-'53; 8 specimens from plankton off Madras Coast during November-December, 1956-'58.

Distribution—Atlantic and Pacific Oceans, Mediterranean and Indian Ocean, Pacific Ocean, Malaysia, Madras Coast.

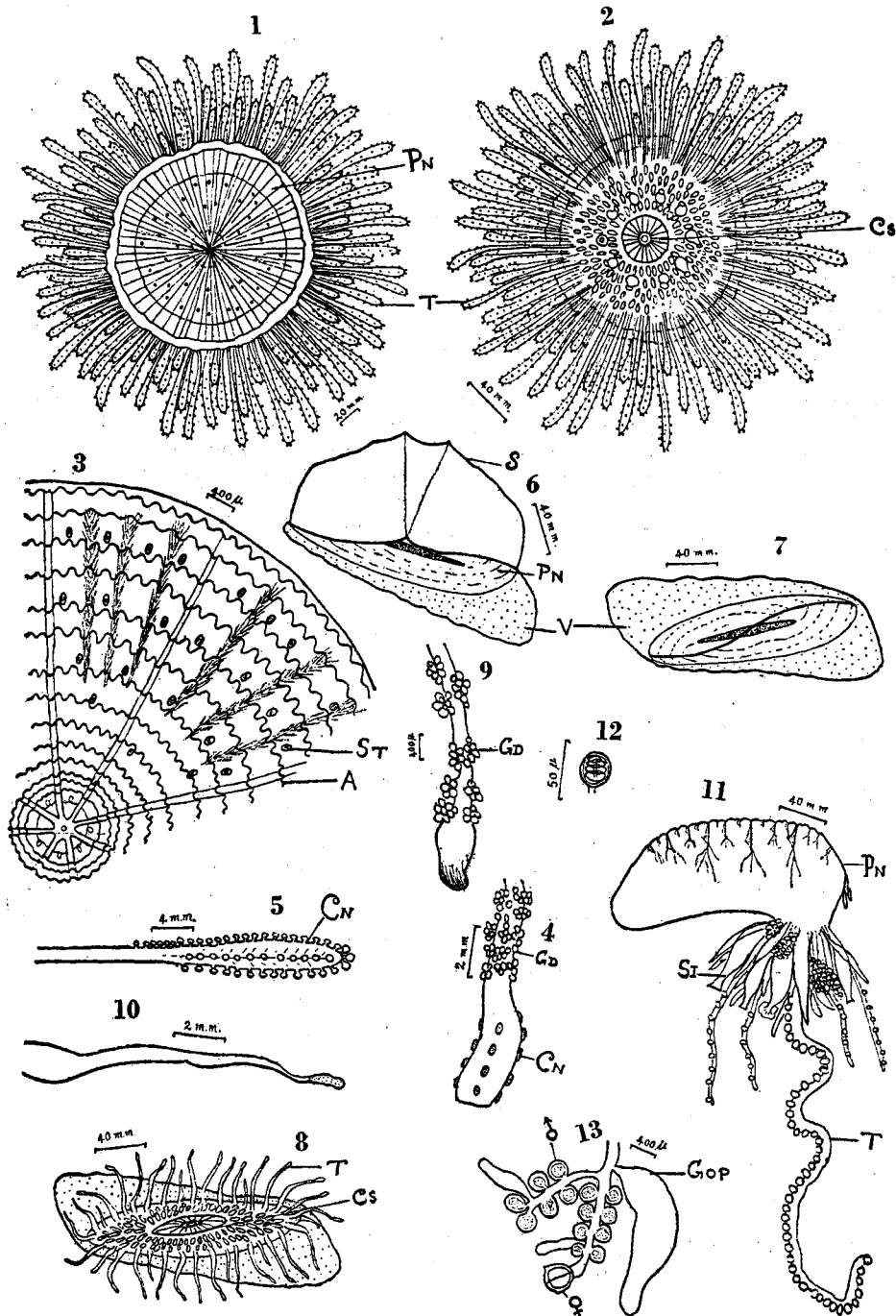


FIGURE I. *Porpita porpita* (Linné).—1. Dorsal view; 2. Ventral view; 3. Pneumatocyst; 4. Sexual siphon; 5. Tentacle. *Verella verella* (Linné).—6. Lateral view; 7. Upper view; 8. Ventral view; 9. Sexual siphon; 10. Tentacle. *Physalia physalis* (Linné).—11. Lateral view; 12. Nematocyst; 13. Gonodendra-part. (see abbreviations given at the end of the paper).

Description—Large colony 52 mm. in length, 17 mm. in breadth, 20 mm. in height; other specimens smaller; roughly rectangular. Velarium at opposite corners to direction of sail, large, gradually narrowing near origin of diagonal sail. Sail (Fig. I, 6) more rounded in large specimens, triangular in young ones. Single central siphon (Fig. I, 8) lies along longitudinal axis. As in *Porpita*, space between central siphon and tentacles occupied by sexual siphons (Fig. I, 9) having long pedicel bearing gonophores. Tentacles in single concentric row not having cnidospheres (Fig. I, 10). Tip of tentacle coloured orange; polyps, float and sail dark blue.

Remarks—In the present collection, the breadth in proportion to length is 1 : 3 and the direction of the sail is S.W. (Fig. I, 7), resembling the Atlantic forms. The N.W. direction of the sail is much more common in Pacific forms (Bigelow, 1911b) but more data are needed.

Order SIPHONOPHORA (Eschscholtz), 1829

=SIPHONANTHAE Haeckel, 1888

Suborder CYSTONECTAE Haeckel, 1888

=PNEUMATOPHORIDEN Chun, 1882

=RHIZOPHYSALIAE Chun, 1897

Family PHYSALIDAE Brandt, 1825

Physalia is the only genus included in this family.

Genus *Physalia* Lamarck, 1801

Physalia physalis (Linne) is the only species included in this genus.

3. *Physalia physalis* (Linné.) 1758

(Fig. I, 11-13)

(For synonymy see Leloup, 1934b, p. 2)

Record—20 specimens from Madras beach during January-February, 1952-'53; 16 specimens from surface plankton off Madras Coast during January-February, 1956-'59.

Distribution—Represented in all Oceans.

Description—Whole colony dark-blue. Pneumatophore (Fig. I, 11) large, bladder-like, subcylindrical and asymmetrical, varying in length from 5 to 40 mm. Crest many-chambered, lying on one side. Cormidia lie on ventral side at one end, in two groups; one consisting of few siphons and palpons and other of large number of siphons; with single large main tentacle and numerous smaller ones; palpons and variously developed gonodendra. Main tentacle with numerous kidney-shaped

cnidospheres having numerous round cnidocysts (Fig. I, 12) ; shorter tentacles many, similar in structure ; very contractile bearing muscular suspensorium.

Of 36 specimens examined, one has a considerably long siphosome (30 mm. in length) and the cormidia are not crowded together as in the other specimens but separated from one another. The cormidia at the distal end has a well developed gonodendra. The large single main tentacle measuring 140 mm. in length is continuous with the siphosome.

Gonodendra (Fig. I, 13) : with velvety appearance, highly branched, each branch bearing a single pedicellate medusoid gynophore at distal end and numerous sessile androphores along sides.

Family RHIZOPHYSIDAE Brandt, 1835

This family has 3 subfamilies, Epibulinae Bigelow, 1911*b* ; Bathyphysinae Chun, 1897 ; and Rhizophysinae Chun, 1897.

Subfamily RHIZOPHYSINAE Chun, 1897

This subfamily includes two valid genera—*Rhizophysa* Peron and Lesueur, 1807 and *Salacia* (Fewkes) Haeckel, 1888*b*.

Genus *Rhizophysa* Peron and Lesueur, 1807

The genus *Rhizophysa* includes two species—*filiformis* (Forskal), 1775 and *eysenhardti* Gegenbaur, 1860.

In the present collection *R. eysenhardti* is present.

4. *Rhizophysa eysenhardti* Gegenbaur, 1860

(Fig. II, 1 & 2)

(For synonymy up to 1911 see Bigelow, 1911*b*, p. 320)

Rhizophysa eysenhardti Browne, 1926, p. 83.

Bigelow, 1931, p. 584.

Leloup, 1934*b*, p. 2.

Record—12 specimens from surface plankton off Madras Coast during October, November 1952, January and December 1963. 3 specimens from open haul from 0 to 25 metres, off Madras in November and December, 1958.

Distribution—Indian Ocean, Malay Archipelago, tropical Pacific, tropical Atlantic.

Description—Largest specimen in the collection 45 mm. in length, with a well developed female gonodendra. Colony colourless, except for pigment cap in pneumatophore. Pneumatophore large, measuring 5 to 9 mm. in length and 3 to 6 mm. in breadth. Highly differentiated into many parts—pneumatossaccus, pneumatocyst,

mitra ocellaris or the apical pigment cap, sacculus pericystalis, pneumatocone and hypocystic villi, which occupy pericystic cavity (Fig. II, 1).

Siphosome with siphons and their tentacles and one female gonodendrum; extremely contractile. Tentacles branched, tentilla simple, provided with rounded cnidocysts. Female gonodendra occur on internode between two siphons forming clusters (Fig. II, 2).

Suborder PHYSONECTAE Haeckel, 1888

(=PHYSOPHORAE Eschscholtz, 1829)

Family AGALMIDAE Brandt, 1835

This family includes seven genera, *Agalma* Eschscholtz, 1825; '*Stephanomia*' Peron and Lesueur, 1807; *Nanomia* Agassiz, 1863; *Marrus* Totton, 1954; *Cordagalma* Totton, 1932; *Bargmannia* Totton, 1954; and *Lychnagalma* Haeckel, 1888.

Genus *Agalma* Eschscholtz, 1825

This genus includes four species—*okeni* Eschscholtz, 1825; *elegans* (Sars) 1846; *clausii* Bedot, 1888 (= *sarsii* Fewkes, 1881) and *haeckeli* Bigelow, 1911b (= *eschscholtzi* Haeckel, 1888b).

In the present collection *A. okeni* and *A. elegans* are present.

5. *Agalma okeni* Eschscholtz, 1825

(Fig. II, 3-6)

(For synonymy up to 1911 see Bigelow 1911b, p. 277)

Agalma okeni Browne, 1926, p. 83.

Bigelow, 1931, p. 575.

Totton, 1932, p. 321; 1954, p. 64.

Record—3 specimens from surface plankton off Madras in February-March, 1953. 2 specimens from a open haul from 0-25 metres at Lat. 13° 14' N. long 80° 52' E. December, 1958.

Distribution—Indian Ocean, eastern tropical Pacific, Barrier Reef, Red Sea, Gulf of Aden, Mediterranean.

Description—One complete colony measures 25 mm. in length, pinkish-red. Colony rigid, short and non-contractile, with thick prismatic closely crowded bracts. Nectosome and siphosome of subequal length.

Nectosome: (Fig. II, 3): 15 mm. in length. Pneumatophore oval, apically pigmented. Nectophores five pairs, arranged closely in two regular opposed rows; well developed ones 2-3 mm. in length and 5-6 mm. in breadth; laterally produced into large angular extensions; nectosac prolonged into these as horns. Lateral canals long and coiled. Well developed nectophores slightly shrunk, nature and number of ridges not clear.

In the collection there are two very immature nectophores, which are well preserved. In one, (Fig. II, 4) two very prominent ridges occur on ventro-lateral sides, with ridges connected by two smaller ridges, dividing the nectophore into three. In the other nectophore (Fig. II, 5) nectosac ends prolonged into tubular extensions. In both these nectophores lateral canals thick and coiled.

Siphosome: (Fig. II, 3): 10 mm. in length, with 3 cormidia; each cormidium with single large siphon (gastrozoid) and its tentacles; palpons many with tentacles or palpules. Tentacles of siphon with many tentilla; each tentillum (Fig. II, 6) much coiled, coils varying from 6-8 in cnidoband, proximal 2 or 3 coils covered over by companulate involucre, characterising immature tentillum; mature ones completely covered by involucre; tentillum tricornuate with the middle one large, spindle shaped, with vibratile cilia and two longer lateral horns; palpons numerous, palpule unbranched having beaded appearance. Bracts prismatic, roughly triangular, thickest at distal end; distal margin divided into four concave facets by three vertical ridges; some canals end in curved looplike structures.

6. *Agalma elegans* (Sars), 1846

(Fig. II, 7)

(For synonymy see up to 1911 Bigelow, 1911*b*, p. 281)

Agalma elegans Browne, 1926, p. 83.

Totton, 1932, p. 322; 1954, p. 61.

Record—2 specimens from surface plankton off Madras Coast during 1952-'54; 3 specimens from an open haul 0-50 metres at Lat. 13° 14' N. and Long. 80° 56' E. in December, 1958.

Distribution—Indian Ocean, Red Sea, Malay areas, eastern tropical Pacific, Atlantic and Mediterranean, Gulf of Aden, Celtic Sea, North-West of British Isles and Great Barrier Reef.

Description—(Fig. II, 7): 3-4 mm. in length, with one or two siphons, tentacle and few palpons. Pneumatophore oval, without radial septa; apex pigmented, showing radial rays. 3 or 4 buds of nectophores present. Bracts missing. Tentacle with tricornuate tentilla (Fig. II, 7); tentilla four, each with thin long pedicel, coiled cnidoband with 2-3 coils and involucre covering coils partially. Terminal ampulla small and lateral arms long.

6a. 'Larva *Physonectarum*' Haeckel, 1888

(Fig. II, 8)

Record—Two specimens from surface by horizontal haul with tow-net off Madras Coast in November-December, 1953.

Description—(Fig. II, 8); Pneumatophore round, large, pigmented and surrounded by a corona of six bracts; 4 bracts three sided and serrated having at their distal ends highly reduced nectosacs represented by two kidney shaped cnidocysts at extremity of canals; other two bracts oval; leaf-like and serrated; all bracts appear to meet at tip above pneumatophore. Siphon single, palpons two, tentacle contracted.

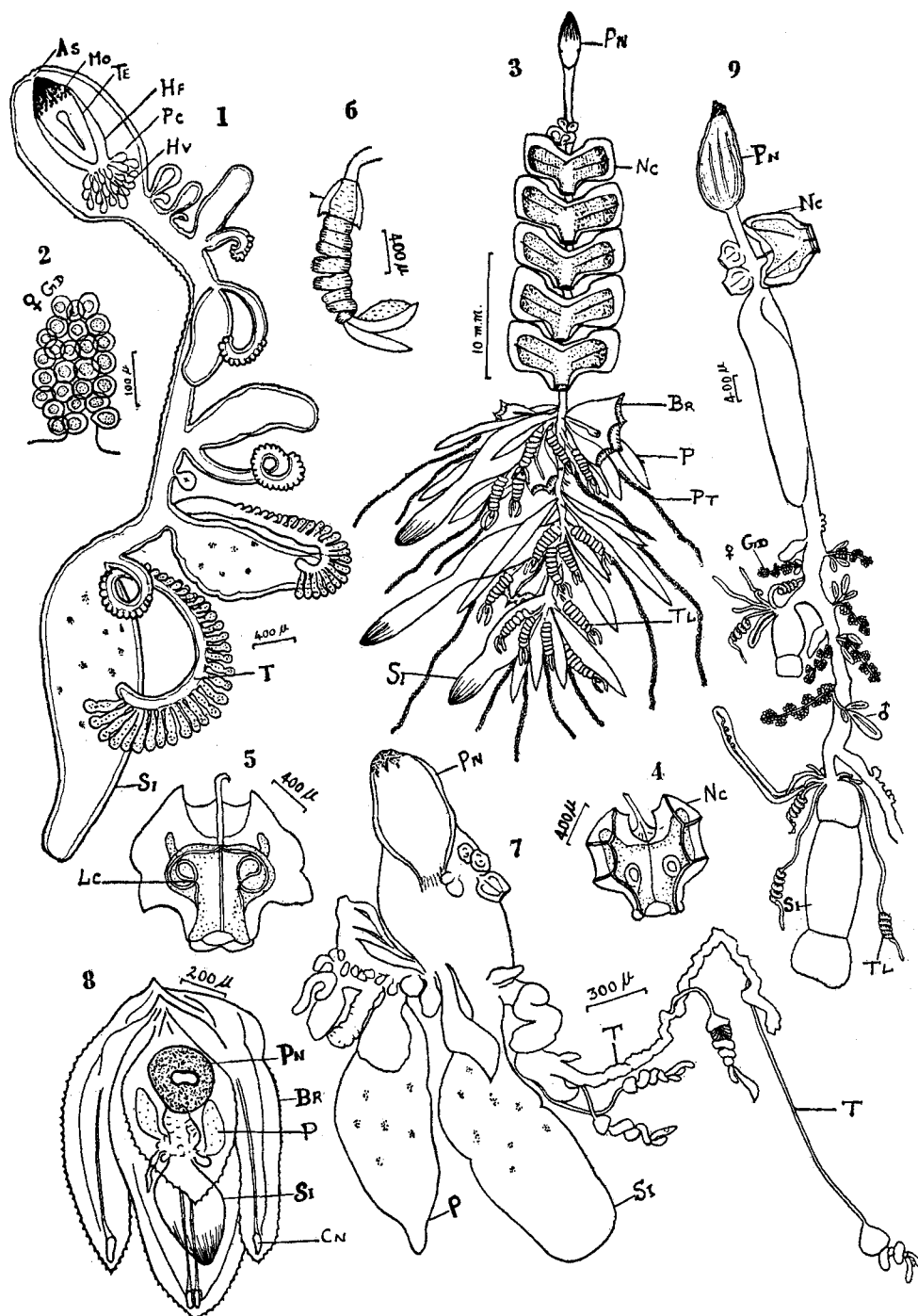


FIGURE II. *Rhizophysa eysenhardtii* Gegenbaur—1. A young specimen; 2. Female gonodendra (Young). *Agalma okeni* Eschscholtz—3. Entire animal (Diagrammatic); 4. Ventral view of a young nectocalyx; 5. Dorsal view of a young nectocalyx; 6. Tricornuate tentilla. *Agalma elegans* (Sars)—7. Young colony; 8. Larva *Physonectarum* Haeckel. *Stephanomia rubra* (Vogt)—9. Entire colony.

Remarks—The larva resembles the athoria stage of *Agalma elegans* described by Fewkes (1881). It also resembles the adults of the species belonging to the family 'Athoridae' (Haeckel, 1888b) in possessing nectosac, highly reduced at the distal end of the bracts; corona of bracts surrounding the pneumatophore, a single siphon, a group of palpons and a single tentacle, but differs from them in not possessing gonads. More developmental stages must be studied before this larva could definitely be assigned to any known species.

Genus '*Stephanomia*' Peron and Lesueur, 1807

Totton (1954) assigning *Stephanomia rubra* (Vogt), 1852 (= *Agalma rubra* Vogt, 1852 and *Halistemma rubrum* Huxley, 1859) to the genus '*Stephanomia*' points out that this is done only for temporary convenience and has acknowledged that *S. amphitrides* Lesueur & Pitit 1807, as at present unidentifiable. *S. (Halistemma) cupulifera* Lens & van Riemsdijk, 1908 is the probable third species of this genus. In the present collection *S. rubra* is represented.

7. *Stephanomia rubra* (Vogt), 1852

(Fig. II, 9)

Stephanomia rubra Bigelow, 1911b, p. 348.

Totton 1954, p. 47.

Record—6 specimens from surface plankton off Madras Coast during 1952-'54; 3 specimens from surface haul off Madras during December-January, 1958-'59.

Distribution—Mediterranean Sea, Indian Ocean, eastern tropical Pacific.

Description—(Fig. II, 9): Colony 90 mm. in length, of which 1/9th part is constituted of muscular nectosome. Siphons, palpons and gonostyles loosely arranged. Pneumatophore large, 2.5 mm. in length, with 4 incomplete radial longitudinal septa; apex tapering and pigmented.

Nectophore with two thick curved lateral ridges, sides prolonged into extensions with nectosac produced into these. In the collections some loose nectophores, showing similar ridges, but larger in size are present. Squarish nectosac extend into well produced extensions of nectophore. Mouth of nectosac tubular.

Cormidia arranged loosely along thin, extremely contractile siphosome; siphons pedicellate, with tentacles; cnidoband naked, with 4-6 coils and a single terminal filament. Palpons fewer and smaller than siphons. Gonostyles irregularly arranged between siphons along stem; each with a single peculiarly shaped female gonostyle and 2-3 male gonostyles; female gonostyles have twisted appearance due to arrangement of gonads; male gonostyles fewer, pedicellate and oval occurring at base of female ones.

7a. Larva of *Stephanomia*

(Fig. III, 1)

Record—A single live specimen from plankton off Madras on 20th January, 1953.

Description—(Fig. III, 1): 6.5 mm. in length in contracted state. Pneumatophore ovate, with 3-4 radial longitudinal septa as in *Stephanomia rubra*. Siphosome extremely contracted with variously developed palpons; siphons and tentacles crowded together; bracts forming corona around pneumatophore. Siphons 4-6; palpons many; tentacles not well developed. Larval bracts very large, 3.1-3.5 mm. in breadth and 2-4 mm. in length; very thick at distal end and 3-5 faceted formed by vertical ridges, similar to bracts of *Agalma okeni* but softer and not so rigid.

Remarks—Due to the presence of larval bracts, this specimen is considered to be a larva of an *Agalma*, since this group is characterized by the presence of large bracts in the larval stage, used for locomotion and nectophores only in adult. In having 3 or 4 radial longitudinal septa in pneumatophore, it resembles *Stephanomia rubra*.

Genus *Nanomia* Agassiz, 1863

The genus *Nanomia* includes two species,—*N. bijuga* (Delle Chiaje), 1841(= *Cupulita picta* Metchnikoff, 1874); and *N. cara* (A. Agassiz), 1865, (= *Cupulita sarsii* Haeckel, 1888b). In the present collection *N. bijuga* is represented.

8. *Nanomia bijuga* (Delle Chiaje), 1841

(Fig. III, 2-6)

(For synonymy see Bigelow, 1911 *b*, p. 284, and Totton, 1954, p. 52)

Record—Occurs in great abundance in the plankton collected during April and August, 1952-'54 and 1956-'59.

Distribution—Tropical Atlantic, Mediterranean, Red Sea, Gulf of Aden, Indian Ocean, Indopacific, Great Barrier Reef, Misaki—Japan.

Description—Colony very contractile, pinkish. Pneumatophore small, oval, without radial septa, apex pigmented. Nectophores (Fig. III, 3) 1-5 pairs, well developed, softer and more rounded than those of *Stephanomia rubra*; bell-shaped lateral upper end of each produced into lobes, nectosac not extending into lobes; buds of nectophore 2-4; 2-3 red pigmented spots on nectosome on point of attachment. Nectophores biserially and alternately arranged on nectosome. Lateral canals folded (Fig. III, 3).

Siphosome long extremely contractile; siphons, palpons, bracts and gonostyles variously arranged; base of siphons and palpons with red pigment. Tentacles of siphons long, tentilla (Fig. III, 5) with involucre cnidoband having 2-3 coils and simple terminal filament. Palpons with oil globule as in *Nanomia cara*; palpacles simple.

Bracts (Fig. III, 2, BR) numerous, at right angles to stem, tetragonal with 3 distal tips and small peg-like structure for attachment; one or two bracts folded at base of siphons forming cavity for siphons and tentacles for retraction. Some bracts very broad with thickened distal ends.

Gonostyles (Fig. III, 4) in small groups between palpons and siphons; sometimes at base of palpons. Female gonostyles 8-10, rounded with ovum at one end; Male gonostyle 2 or 3, pedicellate, oval, with two distinct regions; either intermingled with or separated from female gonostyle.

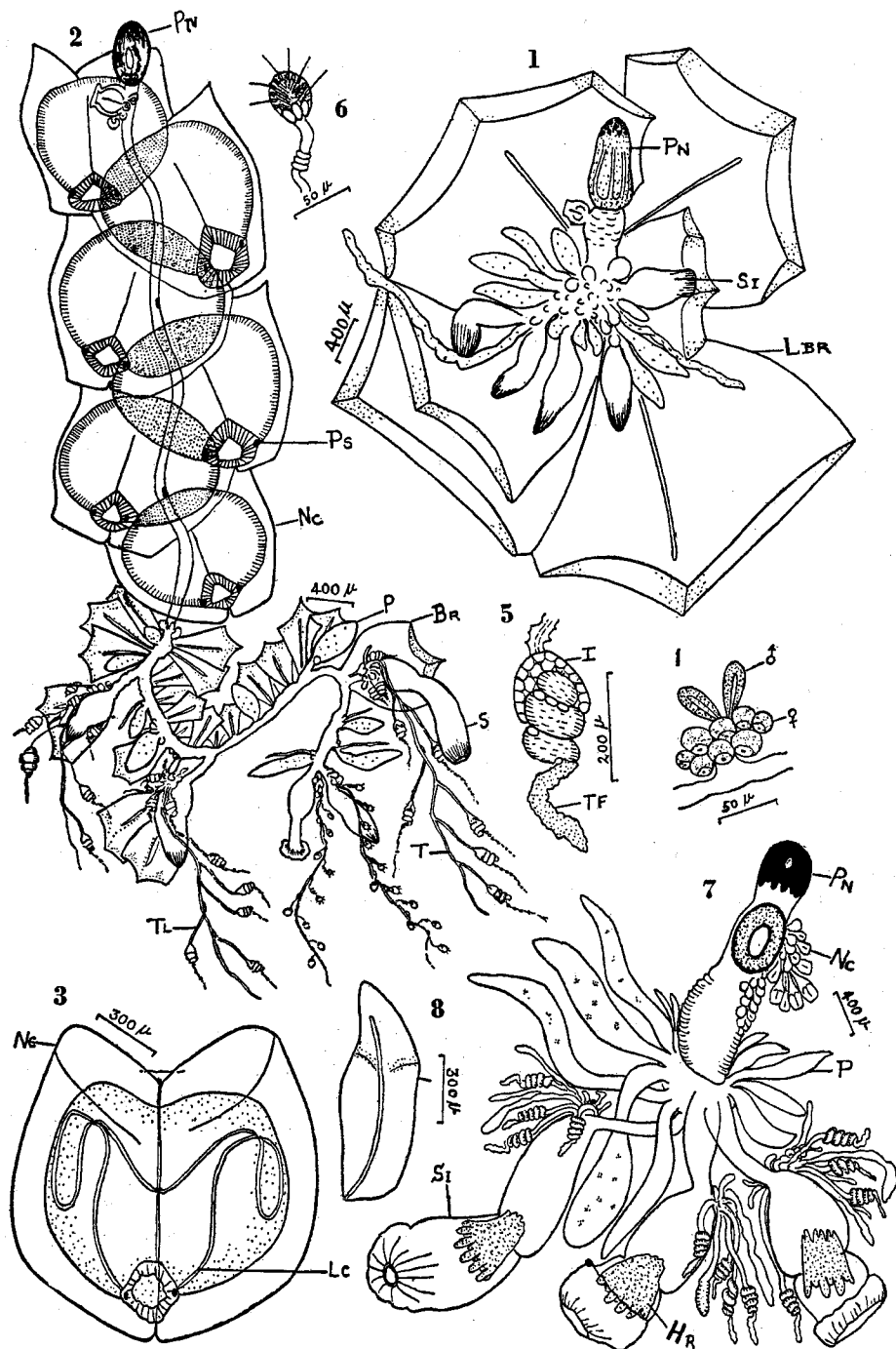


FIGURE III. 1. Larva of *Stephanomia*. *Nanomia bijuga* (Delle Chiaje)—2. Entire animal; 3. Nectophore; 4. Gonostyle; 5. Adult tentillum; 6. Larval tentillum. *Forskalia contorta* (M. Edwards)—7. Entire animal; 8. Bract.

Larval tentacle persistent in adult, with tentilla having round tentacular knobs, proximal half with 6-8 large rounded cnidocyst ; distal half having smaller, elongated cnidocysts with long pointed cnidocils ; without terminal filaments (Fig. III, 6).

Family FORSKALIDAE Haeckel, 1888

The family Forskalidae includes one genus *Forskalia*.

Genus *Forskalia* Kolliker, 1853

9. *Forskalia contorta* (M. Edwards), 1841

(Fig. III, 7 & 8)

(For synonymy see Lens & van Riemsdijk, 1908, p. 63)

Record—3 small specimens from surface plankton off Madras Coast on 18th June, 1953 ; 2 specimens from open haul from 0-50 metres off Madras at Lat. 13° 14' N. Long. 80° 50' E. in June, 1958.

Distribution—Malay Archipelago, tropical Pacific, and Atlantic Ocean.

Description—6 mm. in length in contracted state. Pneumatophore small, rounded and pigmented ; devoid of radial septa, open below, sometimes with air bubble within nectosome. Nectosome with numerous minute nectophores on one side, characteristically shaped, with an elongate, triangular pedicel and enlarged distal portion with radial canals.

Siphons three (Fig. III, 7), palpons many with tentacles, and single bract. Siphon at end of long muscular pedicel ; proboscis highly expandable, often folding backwards in living condition forming a girdle round the mouth opening. Several, short and long maroon-coloured hepatic ridges in stomach region (Fig. III, 7 HR). Tentilla naked with 4-6 coils of cnidoband, single terminal filament ; palpacles simple. Gonostyles absent. Bract (Fig. III, 8) long, lanceolate with two distal depressions, bracteal canal lying in midregion.

Sub-order CALYCOPHORAE Leuckart, 1854

Family DIPHYIDAE Eschscholtz, 1829

This family includes three subfamilies—Sulculeolariinae Totton, 1954 ; Diphyinae Moser, 1925 and Chuniphyinae Totton, 1954.

Subfamily SULCULEOLARIINAE Totton, 1954

(=GALETTINAE Stechow, 1921)

The genus *Sulculeolaria* (= *Galeolaria* and *Galetta*) is the only genus included in this subfamily.

Genus *Sulculeolaria* Blainville, 1830

The following are the valid species of this genus :

1. *Sulculeolaria biloba* (Sars), 1846.
= *Galeolaria australis* Bigelow, 1911b.
2. *Sulculeolaria chuni* (Lens & van Riemsdijk), 1908.
3. *Sulculeolaria turgida* (Gegenbaur), 1854.
4. *Sulculeolaria angusta* Totton, 1954.
5. *Sulculeolaria quadrivalvis* Blainville, 1830.
= *S. quadridentata* (Same species as reviewed by Bigelow & Sears '37).
6. *Sulculeolaria monoica* (Chun), 1888.
7. *Sulculeolaria bigelowi* Sears, 1950.

In the present collection, *Sulculeolaria chuni*, *S. turgida*, *S. quadrivalvis* and *S. monoica* are present.

10. *Sulculeolaria chuni* (Lens & van Riemsdijk), 1908

(Fig. IV, 1 & 2)

Galeolaria chuni Lens & van Riemsdijk, 1908, p. 61

Browne, 1926, p. 70

Galettia chuni Totton, 1932, p. 342.

Sulculeolaria chuni Totton, 1954, p. 102.

Record—About 60 anterior nectophores from surface plankton off Madras Coast during December in 1952, 1953 and 1956-'59.

Distribution—Indian Ocean, tropical zone of the Atlantic, tropical Pacific, Malay Archipelago and the Great Barrier Reef.

Description—Anterior nectophore length—7-8 mm., breadth—4.3-5.3 mm., somatocyst length—3.6-3.9 mm., posterior nectophore length—5.5-6.5 mm.

Anterior nectophore : (Fig. IV, 1) smooth, with blunt apex ; characterized by absence of dorsal and lateral teeth and ridges. Somatocyst long, club-shaped with thread like stalk. Hydroecium absent. Lateral canals as in diphyids, without lateral commissural (or oblique) canal. Stem and appendages missing.

Posterior nectophore : (Fig. IV, 2) with apex truncated ; teeth absent ; baso-ventral flap or lamella notched slightly in middle. Hydroecium simple, openly grooved. Lateral canals folded, with pedicular canal joining lateral ones just below prolonged apex of nectosac.

11. *Sulculeolaria turgida* (Gegenbaur), 1854

(Fig. IV, 3 & 4)

Diphyes turgida Gegenbaur, 1854, p. 442.

Galettia turgida Totton, 1932, p. 345.

Sulculeolaria turgida Totton, 1954, p. 107.

Record—10 anterior nectophores and six posterior nectophores from surface plankton off Madras Coast during 1952-'53; 6 anterior nectophores and two posterior nectophores from surface plankton off Madras during 1956-'59.

Distribution—Strait of Messina, Mediterranean Sea, Great Barrier Reef, Indian Ocean.

Description—Anterior nectophore length—8-9.1 mm., breadth—4-5.2 mm., somatocyst length—1-1.2 mm., posterior nectophore length—5.75-6.25 mm.

Anterior nectophore (Fig. IV, 3) smooth, devoid of ridges and teeth; mouth plates broad. Somatocyst very small and club-shaped. Hydroecium very shallow. Lateral commissure canal absent. Stem and appendages missing.

Posterior nectophore (Fig. IV, 4) with baso-ventral flaps having entire margin without notch or depression. Lateral canals folded.

12. *Sulculeolaria quadrivalvis* Blainville, 1830

(Fig. IV, 5 & 6)

(=*Galetta quadridentata* Quoy and Gaimard, 1834)

(For synonymy up to 1925 see Bigelow 1911 *b*, p. 237 and Moser, 1925, p. 139)

Galeolaria quadrivalvis Browne, 1926, p. 66.

Galetta quadrivalvis Bigelow, 1931, pp. 549; 556.

Sulculeolaria quadrivalvis Totton, 1932, p. 340, 1954, p. 100.

Record—20 anterior and 18 posterior nectophores from surface plankton off Madras during September-December, 1952-'53.

Distribution—Indian Ocean, Mediterranean, Canary Isles, eastern tropical Pacific, Malay area, Great Barrier Reef, Atlantic and Indo-Pacific.

Description—Anterior nectophore length—9.65-10.25 mm., breadth—5-5.65 mm., somatocyst length—4-4.6 mm., posterior nectophore length—11.5-11.8 mm.

Anterior nectophore (Fig. IV, 5) with two dorsal triangular teeth (quadridentate forms not collected); lateral teeth absent; basoventral flaps two, rounded and non-denticulate. Lateral canals connected with ventral canals by oblique cross-commissure canals. Somatocyst long and thread-like, bent in an oblique manner. Hydroecium absent. Stem and appendages missing.

Posterior nectophores (Fig. IV, 6) with two dorsal and two triangular lateral teeth; baso-ventral flaps bilobed having two denticulate processes on inner side. Lateral canals folded.

13. *Sulculeolaria monoica* (Chun), 1888

(Fig. IV, 7 & 8)

Epibulia monoica Chun, 1888, p. 1157.*Galeolaria monoica* Chun, 1897, p. 17.

Lens & van Riemsdijk, 1908, p. 60.

Bigelow, 1911*b*, p. 239 ; 1931, p. 558.

Moser, 1925, p. 144.

Browne, 1926, p. 69.

Sulculeolaria monoica Totton, 1932, p. 342 ; 1954, p. 16.

Record—2 anterior nectophores one from a depth of 20 metres (December) and the other from 18 metres (November) and one posterior nectophore from surface plankton off Madras in 1953 ; 2 anterior nectophores from surface plankton off Madras in December, 1958.

Distribution—Indian Ocean, Malay areas, Canary Isles, eastern tropical Pacific, Japanese Seas, Great Barrier Reef.

Description—A large anterior nectophore measures : length 14.5 mm., breadth 7.5 mm., somatocyst length—0.3 mm., posterior nectophore—length—12.5 mm.

Anterior nectophore (Fig. IV, 7) with one large, triangular and pointed dorsal tooth ; dorso-lateral teeth paired, large, triangular with blunt edge, more flap-like in shape ; ventro-lateral teeth paired, smaller than others, triangular and pointed (Fig. IV, 8). Ventral flaps large with teeth-like processes on inner surface. Somatocyst very minute, oval. Lateral canals arise from ventral canal ; oblique canal present.

Posterior nectophore with dorsal and lateral teeth of subequal size ; ventro-lateral teeth very similar to that of anterior nectophore ; ventral flap single, teeth-like processes not divided in the middle. Lateral canals folded.

Subfamily DIPHYINAE Moser, 1925

The subfamily Diphyinae includes the following genera : *Lensia* Totton, 1932 ; *Muggiaea* Busch, 1851 ; *Chelophyes* Totton, 1932 ; *Eudoxoides* Huxley, 1859 ; *Diphyes* Moser, 1925 and *Diphyes* Cuvier, 1817.

Genus *Lensia* Totton, 1932

There are 23 valid species included in this genus. They are :—*subtiloides* Lens & van Riemsdijk, 1908 ; *subtilis* Chun, 1886 ; *conoidea* Keferstien & Ehlers, 1861 ; *fowleri* Bigelow, 1911*b* ; *campanella* Moser, 1925 ; *multicristata* Moser, 1925 ; *grimaldii* Leloup, 1933 ; *meterei* Leloup, 1934 ; *exter* Totton, 1941 ; *ajax* Totton, 1941 ; *hostile* Totton, 1941 ; *lelouveteau* Totton, 1941 ; *achilles* Totton, 1941 ; *cossack* Totton, 1941 ; *hardy* Totton, 1941 ; *hunter* Totton, 1941 ; *hotspur* Totton, 1941 ; *havok* Totton, 1941 ; *challengeri* Totton, 1954 ; *leloupi* Totton, 1954 ; *reticulata* Totton, 1954 ; *gnanamuthui* Daniel & Daniel, 1963 and *tottoni* Daniel & Daniel, 1963.

In the present collection, *subtiloides*, *cossack*, *hotspur*, *gnanamuthui* and *tottoni* are present.

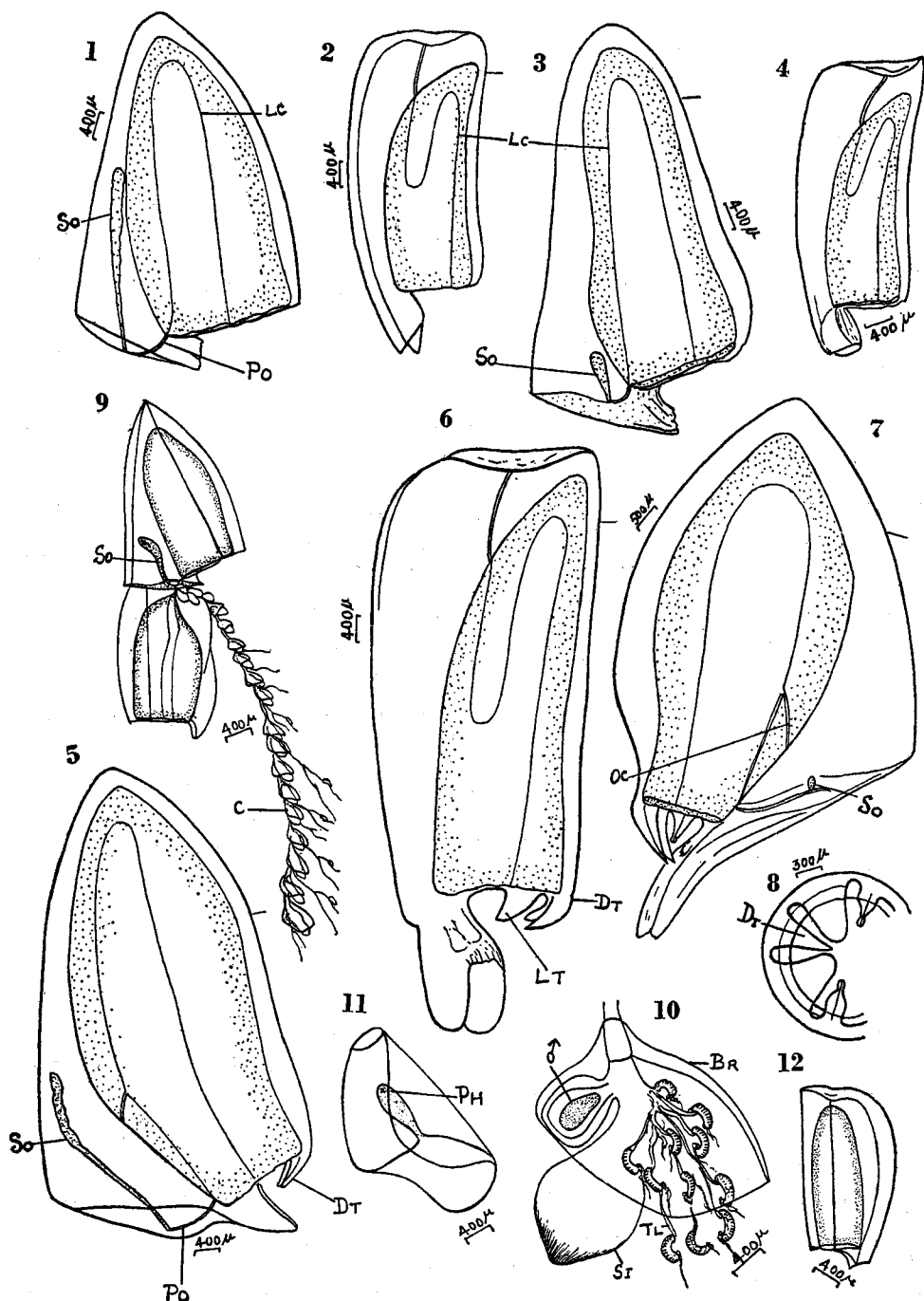


FIGURE IV. *Sulculeolaria chuni* (Lens & van Riemsdijk)—1. Anterior nectophore; 2. Posterior nectophore. *Sulculeolaria turgida* (Gegenbaur)—3. Anterior nectophore; 4. Posterior nectophore. *Sulculeolaria quadrivalvis* Blainville—5. Anterior nectophore; 6. Posterior nectophore. *Sulculeolaria monoica* (Chun)—7. Anterior nectophore; 8. Mouth of nectosac and marginal teeth. *Lensia subtiloides* (Lens & van Riemsdijk)—9. Entire colony; 10. Cormidium; 11. Bract; 12. Special nectophore.

14. *Lensia subtiloides* (Lens & van Riemsdijk), 1908

(Fig. IV, 9-12)

Diphyes subtiloides Lens & van Riemsdijk, 1908, p. 46.

Bigelow, 1911b, p. 347.

Browne, 1926, p. 76.

Lensia subtiloides Totton, 1932, p. 363 ; 1954, p. 112.

Record—More than 1000 specimens were collected from the plankton off the Madras Coast during 1952-'54 and 1956-'59. This species occurs in great abundance during September.

Distribution—Malay area, Indian Ocean, Great Barrier Reef, tropical Pacific.

Description—Anterior nectophore length—5.3-5.5 mm., breadth—3.3-3.6 mm., somatocyst length—1.5-2 mm., posterior nectophore length—3-3.5 mm., breadth—1.85 mm.

Anterior nectophore (Fig. IV, 9) with 5 complete non-crested ridges, devoid of any teeth. Mouth plates divided, subequal in size, with overlapping rounded margins. Somatocyst stalked, anterior end oval or club-shaped, inclined towards ventral side. Stem and appendages (Fig. IV, 9 & 10) long and well developed.

Posterior nectophore (Fig. IV, 9) anteriorly truncated, with ridges as in anterior nectophore. Mouth plate rounded and undivided. Hydroecium shallow, openly grooved. Lateral canals slightly bent anteriorly.

Eudoxid (Fig. IV, 11 & 12) :—Bract length—1.95-2 mm., gonophore length—3-3.5 mm.

Bract smooth, without any teeth. Phyllocyst small, and club-shaped. Gonophores similar to posterior nectophore in number of ridges and in nature of hydroecial groove ; sometimes anterior end of gonophore enlarged into spherical structure ; gonads occur separately, and saccular.

15. *Lensia cossack* Totton, 1941

(Fig. V, 1)

Lensia cossack Totton, 1941, p. 150 ; 1954, p. 112.

Record—3 anterior nectophores from plankton off Madras Coast on 8th December, 1953 at a depth of 24 metres.

Distribution—Atlantic and Indian Ocean.

Description—Anterior nectophore—length 5.5 mm., breadth 3 mm., somatocyst length 2 mm.

Anterior nectophore (Fig. V, 1) smooth, having bulged appearance. Longitudinal ridges very faintly marked, not reaching blunt apex ; ventral ridges vestigial. Basal facet oblique, horse-shoe shaped, and divided. Somatocyst ovoid, with very short stalk ; oleocyst or oil globule found near stalk.

Stem and posterior nectophore missing.

16. *Lensia hotspur* Totton, 1941

(Fig. V, 2 & 3)

Lensia hotspur Totton, 1941, p. 155 ; 1954, p. 110.

Record—15 specimens from plankton off Madras shore in December, 1952-'53 and 1956-'59 at depth of 24-30 metres.

Distribution—Atlantic and Indian Oceans.

Description—Anterior nectophore length—3.6-4 mm., breadth—2.5 mm., somatocyst length—0.7-0.8 mm.

Anterior nectophore (Fig. V, 2 & 3) with 5 complete non-crested longitudinal ridges as in *L. subtiloides*. Hydroecium very shallow (Fig. V, 2) below level of velum. Somatocyst ovate or elongate (highly variable shortly stalked and oblique in position). In 2 specimens somatocyst reaches below baso-lateral margins, and hydroecium absent (Fig. V, 3).

Stem and posterior nectophore missing.

17. *Lensia gnanamuthui* Daniel & Daniel, 1963

(Fig. V, 4 & 5)

Diagnostic features—Anterior nectophore (Fig. V, 4) small, 3.8 mm. in length and 1.8 mm. in breadth ; 5 distinct non-crested complete ridges ; Somatocyst placed near the mouth of nectosac characteristically minute, 0.3 mm., with a stalk and a minute globular tip (Fig. V, 5) Hydroecium on level with velum.

Record—2 anterior nectophores from surface plankton off Madras Coast during February-March, 1960.

Distribution—Madras Coast.

18. *Lensia tottoni* Daniel & Daniel, 1963

(Fig. V, 6)

Diagnostic features—Anterior nectophore (Fig. V, 6) broadly pyramidal, 5 non-crested ridges, laterals not reaching the base, inclined towards the ventral side. Nectosac large, bulged with broad mouth opening. Somatocyst non-stalked, transparent, with spinular projections on margin, inclined ventrally, with small round yellow concretions. Hydroecium absent.

Record—3 anterior nectophores from surface plankton off Madras Coast during January-February, 1960.

Distribution—Madras Coast.

Genus *Muggiaea* Busch, 1851

The genus *Muggiaea* includes the following 4 species : *atlantica* Cunningham, 1892 ; *kochii* (Will), 1844 ; *bargmanne* Totton, 1954 ; and *delsmani* Totton, 1954. In the present collection *M. delsmanni* is present.

19. *Muggiaea delsmanni* Totton, 1954

(Fig. V, 7 & 8)

Muggiaea delsmanni Totton, 1954, p. 123

Record—8 specimens from surface plankton off Madras Coast in 1952-'54 ; 6 specimens from surface plankton from same locality during 1956-'59.

Distribution—Java Sea.

Description—Anterior nectophore length—4.12 mm., breadth—2 mm., somatocyst 0.75 mm., hydroecium 1.0 mm.

Anterior nectophore (Fig. V, 7 & 8) with 5 non-crested, complete ridges ; odd dorsal and laterals longer than ventrals, with apex slightly inclined towards ventral side. Hydroecium shallow, conical, upper wall flat, extending slightly above mouth of nectosac ; inclined towards nectosac that one side (dorsal) lies in contact with nectosac. Mouth plates (Fig. V, 8) two, large, rounded and slightly overlapping. Apex of nectosac not reaching upto apex of nectophore ; basoventral ridges slope ventrally. Somatocyst small, with thin stalk and a broad tip ; laterally appears to arise from within apex of hydroecium, lying alongside, in contact with ventral wall of nectosac. Stem and appendages missing.

Genus *Chelophyes* Totton, 1932

The genus *Chelophyes* includes two species—*appendiculata* (Eschscholtz), 1829 and *contorta* (Lens & van Riemsdijk), 1908.

20. *Chelophyes contorta* (Lens & van Riemsdijk), 1908

(Fig. V, 9 and Fig. VI, 1-3)

Diphyes contorta Lens & van Riemsdijk, 1908, p. 39.

Bigelow, 1911 b, p. 254.

Browne, 1926, p. 71.

Chelophyes contorta Totton, 1932, p. 357 ; 1954, p. 130.

Record—About 50 specimens were collected during 1952-'53, 1956-'59 in the month of December.

Distribution—Malay Archipelago, eastern tropical Pacific, Atlantic and Southern Indian Ocean, Indian Ocean, and Great Barrier Reef.

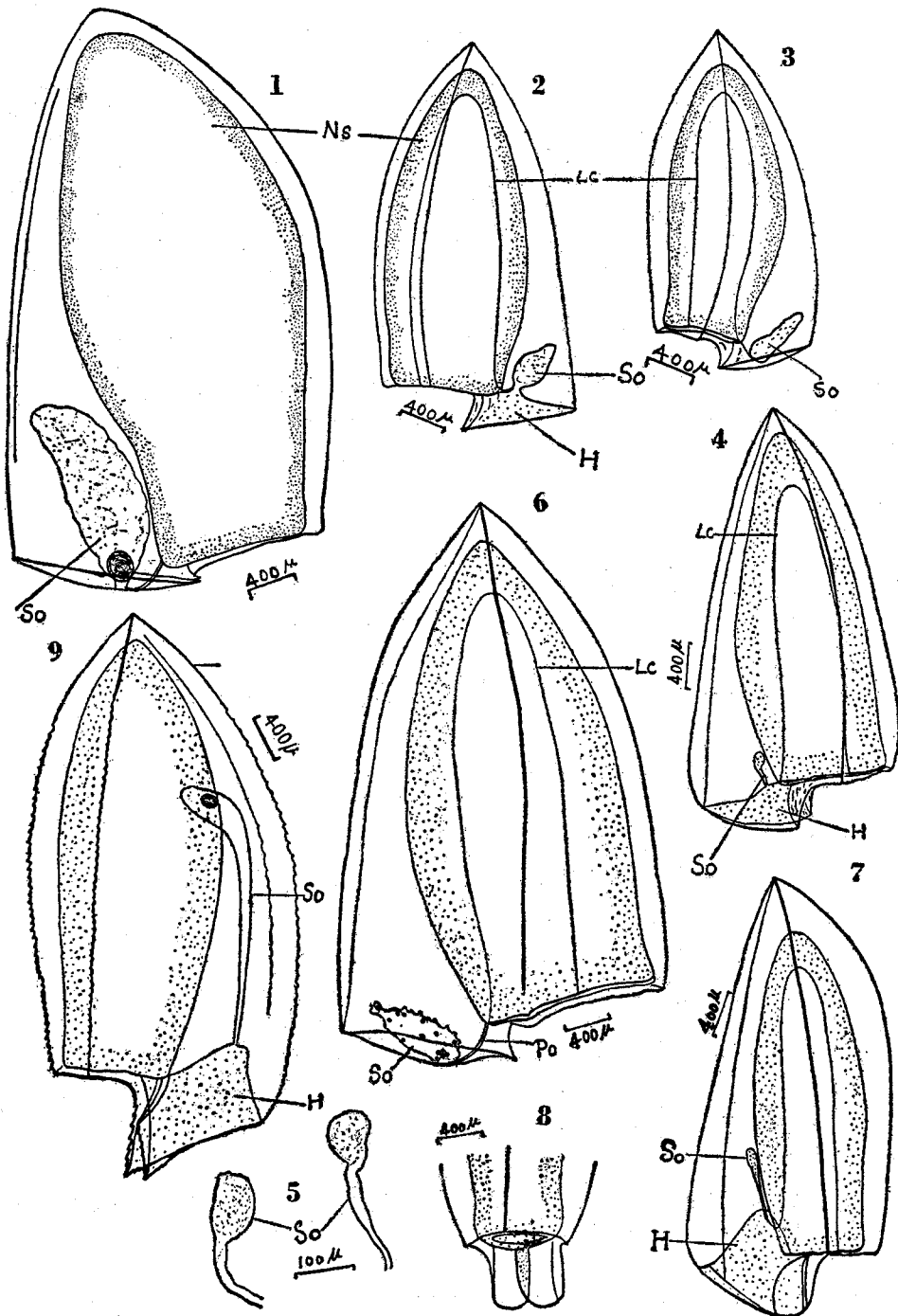


FIGURE V. *Lensia cossack* Totton—1. Anterior nectophore. *Lensia hotspur* Totton—2 & 3. Anterior nectophores. *Lensia gnanamuthui* Daniel & Daniel—4. Anterior nectophore; 5. Somatocyst. *Lensia tottoni* Daniel & Daniel—6. Anterior nectophore. *Mugglaea delsmanni* Totton—7. Anterior nectophore—lateral view; 8. Anterior nectophore—dorsal view. *Chelophyes contorta* (Lens & van Riemsdijk)—9. Anterior nectophore—lateral view.

Description—Anterior nectophore length—5.1 mm., breadth—2.25 mm., somatocyst—2.75 mm., hydroecium—1.25 mm., posterior nectophore length—3.5 mm.

Anterior nectophore (Fig. V, 9 & Fig. VI, 1) with five ridges, laterals and left ventral reaching apex and base of nectophore; dorsal one very short, beginning from middle of nectophore and reaching base; right ventral starting just below apex and not reaching base; left ventral ridge and lateral slightly twisted; all ridges well serrated. Absence of dorsal and lateral teeth and shape of somatocyst characterize species (Fig. V, 9). Stalk of somatocyst long and straight, with club-shaped end curving to left side across nectosac. Hydroecium conical, lying below level of velum; ventral edge gradually sloping down forming two teeth; dorsal wall bounded by two wings having small teeth at base.

Posterior nectophore (Fig. VI, 2 & 3) devoid of lateral and dorsal teeth. Ventral ridges less deep near mouth, wider in middle region giving ventral side a bowed appearance. Hydroecial groove open but partly closed by overlapping margins; margin serrated ending in two teeth at base; right tooth larger than left. Apex of nectosac pointed.

Genus *Diphyes* Cuvier, 1817

The genus *Diphyes* includes 5 species—*dispar* Chamisso & Eysenhardt, 1821; *bojani* Eschscholtz, 1825; *mitra* Huxley, 1859; *chamissonis* Huxley, 1859 and *spiralis* Bigelow, 1911*b* of which the first four are represented in the present collection.

21. *Diphyes dispar* Chamisso & Eysenhardt, 1821

(Fig. VI, 4 & 5)

(For synonymy see Bigelow, 1911 *b*, p. 257; Moser, 1925, p. 170; and Browne, 1926, p. 79)

Diphyes dispar Bigelow, 1931, p. 564.

Menon, 1931, p. 503.

Totton, 1932, p. 346.

Leloup, 1934*b*, p. 1.

Totton, 1954, p. 16.

Record—Over 50 specimens (5 with both nectophores intact, 30 loose anterior nectophores, 20 posterior nectophores and 25 eudoxids) from plankton off Madras coast during the years 1952-'53 and 1956-'59 in the month of September.

Distribution—Marquesas Islands, Fiji Islands, Philippines, Marshal Islands, the eastern tropical Pacific, the Atlantic Ocean, Indian Ocean, Great Barrier Reef and Madras Coast.

Description—Anterior nectophore length—14-18 mm., breadth—7.5-8.5 mm., somatocyst length—5.5-5.8 mm., hydroecium length—5.8-6.0 mm., posterior nectophore length—13-14 mm., breadth 6.5-6.7 mm.

Anterior metophore (Fig. VI, 4) with 5 ridges, prominent basolateral and smaller dorsal teeth; tips of teeth very slightly denticulated. Nectosac prolonged into thin

canal anteriorly, ending blindly near apex. Somatocyst long, inclined towards nectosac. Hydroecium directed outwards away from nectosac. Pedicular canal descending down and opening near mouth of nectosac.

Posterior nectophore (Fig. VI, 4) of sub-equal length, anteriorly produced into triangular extension, fitting in hydroecium; ridges and teeth non-serrated. Lateral flaps meet at top, margin of left side overlap the right.

Eudoxid stage (Fig. VI, 5) characterized by presence of special nectophore, and medusoid gonophores, with well formed umbrella; edges of bract smooth, curve more or less inwards. Canal from phyllocyst runs downward entering special nectophore.

22. *Diphyes bojani* Eschscholtz, 1825

(Fig. VI, 6-8)

(For synonymy up to 1911 see Bigelow, 1911 *b*, p. 251 and p. 264)

Diphyopsis bojani Bigelow, 1919, p. 340.
Browne, 1926, p. 80.

Diphyes bojani Moser, 1925, p. 208.
Bigelow, 1931, p. 565.
Totton, 1932, p. 349.

Record—About 15 anterior nectophores and 18 eudoxids from plankton off Madras coast during 1952-'54 and 1956-'59. Posterior nectophores absent in the present collection.

Distribution—This species is widely distributed in the warm and tropical regions of Atlantic, Pacific and Indian Oceans.

Description—Anterior nectophore length—8-10 mm., breadth—2.8-2.9 mm., somatocyst length—3.0-3.4 mm., hydroecium length—2.75-2.8 mm.

Anterior nectophore (Fig. VI, 6) slender, pointed at apex and truncated at base; ridges five, well serrated from near the apex to base; dorsal and lateral teeth prominent and serrated. Nectosac produced into blunt tube anteriorly. Somatocyst long, fusiform, lies alongside of nectosac. Hydroecium not inclined; a row of small teeth situated on vertical crest in middle of dorsal wall of hydroecium characterizes this species.

Eudoxid stage—(Fig. VI, 7 & 8). Bract length—3.25 mm., breadth—2.0 mm., special nectophore length—3.5 mm., with four prominently serrated ridges and four teeth; breadth—1.5 mm. Bract (Fig. VI, 8) very thin in texture; edge serrated with three prominent teeth on lower edge. Phyllocyst shows variations in shape. In two specimens phyllocyst is small and knob-like and in others, one end of it is produced into a blunt tube. Gonophores absent.

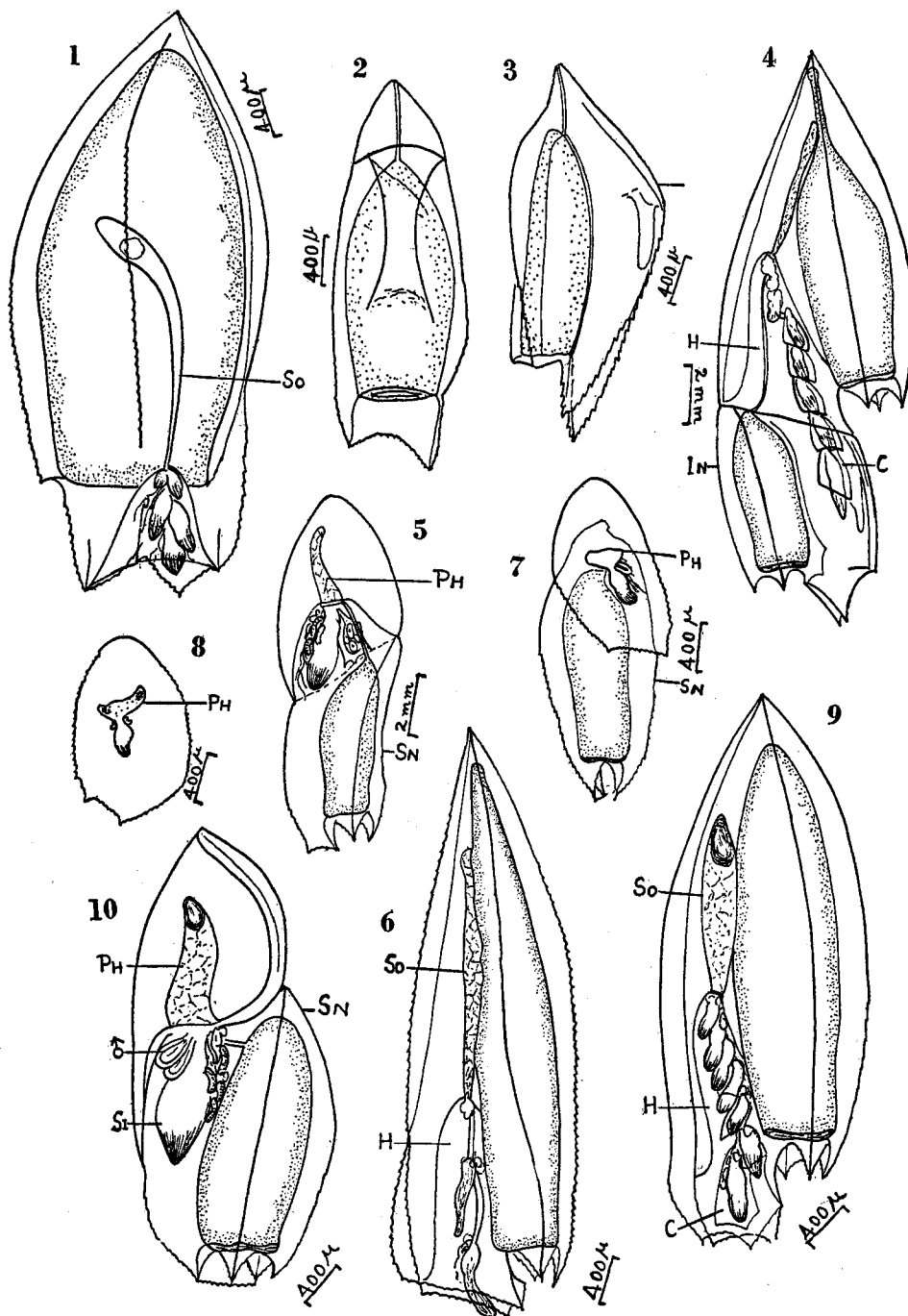


FIGURE VI. *Chelophyes contorta* (Lens & van Riemsdijk)—1. Anterior nectophore—ventral view; 2. Posterior nectophore—ventral view; 3. Posterior nectophore—lateral view. *Diphyes dispar* Chamisso & Eysenhardt—4. Entire colony—lateral view; 5. Eudoxid stage. *Diphyes bojani* Eschscholtz—6. Anterior nectophore; 7. Eudoxid stage; 8. Bract. *Diphyes chamissonis* Huxley—9. Anterior nectophore; 10. Eudoxid stage.

23. *Diphyes chamissonis* Huxley, 1859

(Fig. VI, 9 & 10)

- Diphyes chamissonis* Huxley, 1859, p. 36.
Browne, 1904, p. 742.
Moser, 1925, p. 255.
Totton, 1932, p. 351 ; 1954, p. 130.
Leloup, 1934*b*, p. 1.
Muggiaea chamissonis Haeckel, 1888*a*, p. 34 ; 1888*b*, p. 137.
Chun, 1892, p. 89.
Muggiaea kochii Murbach and Shearer, 1903, p. 189.
Diphyopsis weberi Lens & van Riemsdijk, 1908, p. 53.
Diphyopsis chamissonis Bigelow, 1911*b*, p. 347.
Browne, 1926, p. 81.

Record—More than 800 specimens of this species were collected from the Madras Coast during 1952-'54, and 1956-'59. It occurs in great abundance during the months of November and December.

Distribution—Indian Ocean, Malay Area, Atlantic Ocean and the Barrier Reef.

Description—Anterior nectophore—length—9.75-10 mm., breadth—3.75-4.0 mm., somatocyst length—3.0-3.2 mm., hydroecium length—4.75-4.9 mm., bract—3.65-3.90 mm., special nectophore length—2.75-3.0 mm.

Anterior nectophore (Fig. VI, 9) with five ridges, serrated at base ; dorsal and lateral teeth present ; nectosac sub-cylindrical or slightly bulged in middle. Cylindrical somatocyst and great length of the hydroecium (Fig. VI, 9) characterize this species.

Eudoxid stage: (Fig. VI, 10). Bract similar to that of *D. dispar*, but smaller and with more pointed apex. Canal leading from phyllocyst horizontal ; apex of nectosac of special nectophore well above level of canal. Gonophores devoid of umbrella, and sac-like. Special nectophore similar to that of *D. dispar* in having four ridges and teeth, but are well serrated.

Remarks—The posterior nectophore has not been so far recorded. Lens & van Riemsdijk (1908) have noted a well developed bud of the posterior nectophore in many specimens. Browne (1926) was also able to confirm its presence but in the present collections such buds were not found in any of the specimens examined by us.

24. *Diphyes mitra* Huxley, 1859

(Fig. VII, 1-5)

(For synonymy upto 1925 see Moser, 1925, p. 256)

- Diphyes mitra*, Browne, 1926, p. 73.
Bigelow, 1931, p. 566.
Totton, 1932, p. 358 ; 1954, p. 16.

Record—The collection contains 35 anterior nectophores, 10 posterior nectophores and 10 bracts without the special nectophore, obtained from the plankton off the Madras coast during 1952-'54, 1956-'59.

Distribution—In the tropical zones of all the Oceans.

Description—Anterior nectophore length—9.25 mm., breadth—3.25 mm., somatocyst length—2.30 mm., hydroecium length—2.5 mm., posterior nectophore length—4.0 mm., phyllocyst length—2.1 mm.

Colour: Edges and corners of hydroecium and bract with peculiar greenish and pinkish hue.

Anterior nectophore (Fig. VII, 1) ridges five, serrated, serrations large and conspicuous towards base. Presence of single dorsal tooth, and absence of lateral ones characterize this species. Apex of nectosac blunt or flat. Somatocyst with broad base tapering towards apex; shortly stalked. Hydroecium truncated, sloping towards ventral side, great portion lying below velar level. Mouth plates with lancet-shaped wings (Fig. VII, 2 & 3). Dorsal wall bounded by two flaps; right side overlapping other, left flap with a small tooth-like projection on inner margin. Posterior nectophore (Fig. VII, 4). As in anterior nectophore only dorsal tooth present. Lateral ridges slightly twisted. Hydroecial groove open, partly covered by a flap from margin; both sides of hydroecial flap with conspicuous small teeth in middle region formed by incurving of margins and ending in large teeth at base; right teeth smaller than left.

Eudoxid stage: (Fig. VII, 5) only bracts collected; bracts upright with sharp tip and serrated ridges, Phyllocyst large at base tapering towards apex; cavity of bract deep.

Family ABYLIDAE Totton, 1932

This Family includes 2 subfamilies—Abylopsinae Totton, 1954 and Abylinae L. Agassiz, 1862.

Subfamily ABYLOPSINAE Totton, 1954

This subfamily includes three valid genera—*Abylopsis* Chun, 1888; *Bassia* L. Agassiz, 1862; and *Enneagonum* Quoy and Gaimard, 1827.

Genus *Abylopsis* Chun, 1888

The genus *Abylopsis* includes two species *tetragona* (Otto), 1823 and *escholtzii* Huxley, 1859. Both the species are represented in the collection.

25. *Abylopsis tetragona* (Otto), 1823

(Fig. VII, 6 & 7, Fig. VIII, 1)

(For synonymy see Sears, 1953, p. 80)

Abylopsis tetragona Totton, 1954, p. 155

Record—15 anterior nectophores and 20 eudoxids from the Madras plankton luring 1952-'54 and 1956-'59. There were no posterior nectophores.

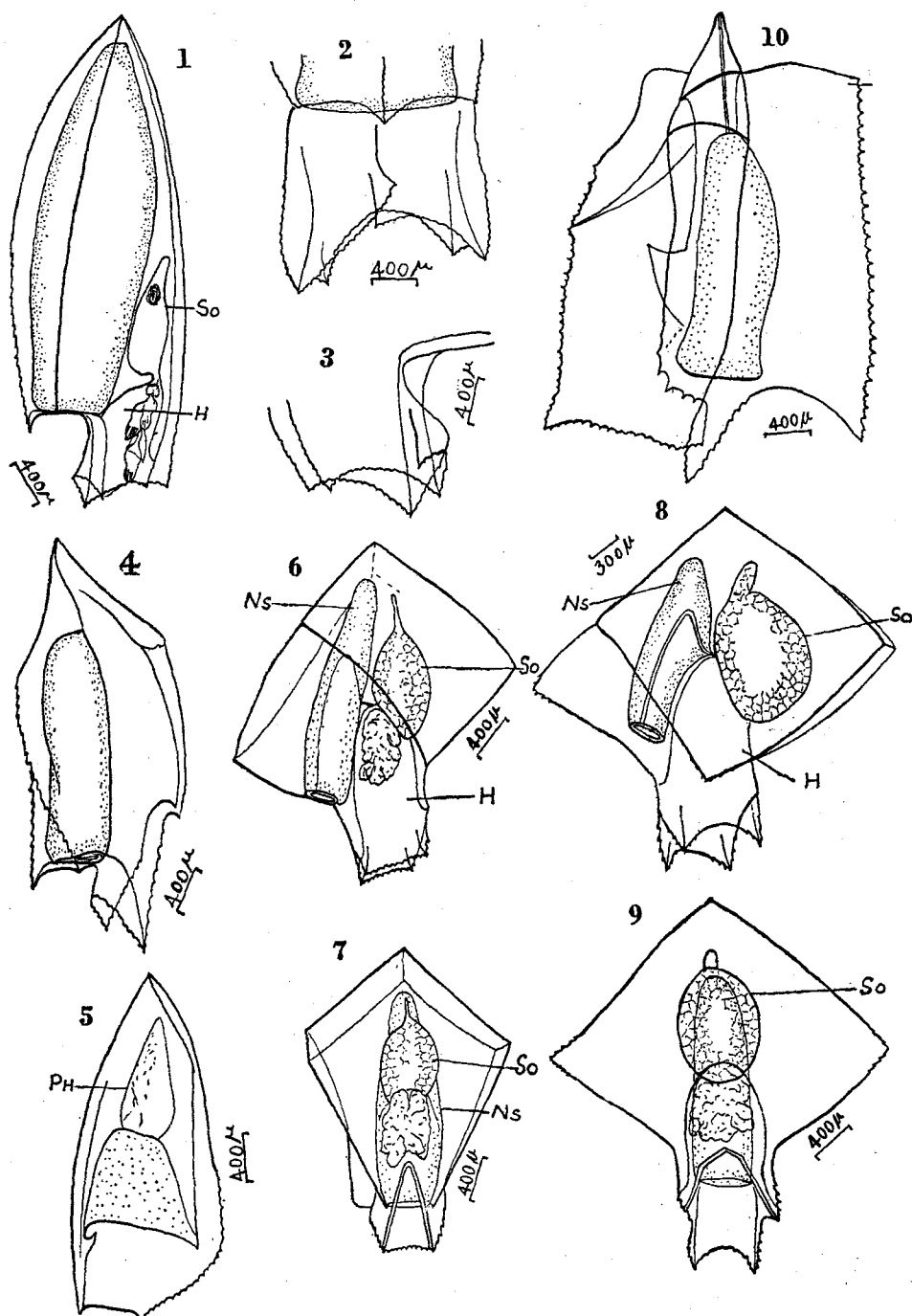


FIGURE VII. *Diphyes mitra* Huxley—1. Anterior nectophore; 2. Mouth plates—dorsal view; 3. Mouth plates—lateral view; 4. Posterior nectophore—lateral view; 5. Bract. *Abylopsis tetragona* (Otto)—6. Anterior nectophore—lateral view; 7. Anterior nectophore—ventral view. *Abylopsis eschscholtzi* (Huxley)—8. Anterior nectophore—lateral view; 9. Anterior nectophore—ventral view; 10. Posterior nectophore—ventral view.

Distribution—Indian Ocean, Mediterranean, Atlantic and Pacific Oceans, Great Barrier Reef.

Description—Anterior Nectophore length—6.25-6.5 mm., breadth—5.5-5.9 mm., somatocyst length—2.75-2.9 mm., hydroecium length—3.1-3.2 mm., nectosac length—4-4.25 mm.

Anterior nectophore (Fig. VII, 6 & 7) with dorsal and ventral facets more or less rectangular in shape. When viewed dorsally nectosac seen to hide somatocyst completely. Lateral canals highly arched. Stem and appendages very much contracted. Posterior nectophore missing. Hydroecium mouth triangular.

Eudoxid stage (Fig. VIII, 1). Bract length 6.3-6.5 mm., breadth—4.7-4.9 mm. Gonophore length—2.85-2.90 mm.

Dorsal facet pentagonal, longitudinal axis very long; triangular extensions with two prominent teeth on either side of median plane. Ventral facet almost straight. Phyllocyst four limbed, ascending and descending limbs single, long, and threadlike; laterals paired, horizontal, thick and bent at right angles. Gonophores narrow and elongate. Ridges not expanded, teeth long, straight and very slightly serrated.

26. *Abylopsis eschscholtzii* (Huxley), 1859

(Fig. VII, 8-10; Fig. VIII, 2 & 3)

(For synonymy see Sears, 1953, p. 84)

Record—The collection contains 10 anterior nectophores, 6 posterior nectophores and 50-60 Eudoxids—off Madras during 1952-54, and 1956-59.

Distribution—It has a very wide range having been recorded from the Pacific, Atlantic and the Indian Oceans.

Description—Anterior nectophore length—3.78-3.9 mm., breadth—3.78-3.9 mm., Somatocyst length—1.75-1.82 mm., Hydroecium length—2-2.2 mm., Nectosac length—2-2.1 mm.

Anterior nectophore (Fig. VII, 8 & 9) more squarish in shape than in *A. tetragona*; dorsal and ventral facets more or less square. When viewed dorsally somatocyst projects beyond apex of nectosac. Lateral canals slightly arched. Hydroecium mouth pentagonal in shape. Stem and appendages very much contracted.

Posterior nectophore (Fig. VII, 10; Fig. VIII, 2) measures 5-5.5 mm. in length and 3.5-3.7 mm. in breadth. Ridges five, highly denticulated. Hydroecium with two folds, denticulated and groove partly closed by a flap from right side overlapping left side; with 5 prominent teeth-like structures at base. The left flap is smooth. Teeth more or less uniform in size and the ridges flare outwards.

Eudoxid stage (Fig. VIII, 3). Bracts pentagonal with 5 facets; ventral facet half the size of dorsal, arched and serrated; apical and lateral facets rectangular. Phyllocyst is as in *A. tetragona* with one ascending, one descending and two lateral canals. Gonophores more or less resembling inferior nectophore. Ridges elevated, flared and strongly serrated.

Genus *Bassia* L. Agassiz, 1862

The genus *Bassia* is represented by a single species *bassensis* distributed in great numbers in all Oceans.

27. *Bassia bassensis* (Quoy and Gaimard), 1834

(Fig. VIII, 4 & 5)

(For synonymy see Sears, 1953, p. 94)

Record—The collection contains 26 loose anterior nectophores, 10 posterior nectophores and 30 eudoxids, during December 1952-53 and 1957-59.

Distribution—Represented in all Oceans.

Description—Anterior nectophore : length—3.9-4.1 mm., breadth—2.5-2.7 mm., Somatocyst length—1.75-1.8 mm., Nectosac length—1.6-1.7 mm.

Anterior nectophore (Fig. VIII, 4) bounded by six facets, one pentagonal anterior facet, one posterior facet with seven ridges, two rectangular dorsal facets forming a ridge in middle and two pentagonal large lateral facets. Somatocyst large, globular, shortly stalked with a concentric line round it. Nectosac placed below somatocyst. Subumbral canals of same length as nectosac. Hydroecium situated beneath somatocyst and bounded by two lateral facets.

Posterior nectophore : Length—9.35-9.7 mm., breadth—6.75-6.9 mm. (Fig. VIII, 4). It is large, smooth and bulged out in middle ; anterior end truncated and deeply notched. Ridges four, two ventral ridges very prominent, prolonged beyond mouth of nectosac into blunt teeth ; right ventral ridge overlaps left at distal region ; flaps held tightly in place by rigid gelatin forming closed tube.

Eudoxid stage : (Fig. VIII, 5) Hydrophyllum (bract) wedge-shaped with seven facets ; four anterior tetragonal facets, two large lateral pentagonal facets and one elongated, tetragonal dorsal facet. Phyllocyst with two limbs, one thick, oval shaped, directed towards angle formed by four anterior facets and other thin and thread like, lying toward dorsal facet ; cavity broad and open ventrally. Gonophore four sided with four serrated large teeth.

Genus *Enneagonum* Quoy and Gaimard, 1827

This genus comprises only one species.

28. *Enneagonum hyalinum* Quoy and Gaimard, 1827

(Fig. VIII, 6 & 7)

(For synonymy see Sears, 1953, p. 98)

Record—70 specimens and 50 Eudoxid stages of this species were taken from the plankton of the Madras Coast during the month of September, 1952-53 and 1956-59.

Distribution—Indian Ocean, Malay Archipelago, Atlantic Ocean, eastern tropical Pacific, Great Barrier Reef.

Description—Anterior nectophore length—8.75 mm., breadth—9.75 mm., Nectosac length—4.5 mm., Somatocyst length—4.75 mm., Hydroceium length—3.5 mm.

Anterior nectophore (Fig. VIII, 6) pyramidal, with four tetragonal facets anteriorly; four pentagonal facets posteriorly. Posterior ends of four anterior facets produced into sharp, serrated teeth. Ridges prominent and winged. Lateral canals of one side with a small, blind, and short caecum at apex. Somatocyst large, elongate, shortly stalked, longer than nectosac. Nectosac and somatocyst occur side by side in a vertical position. Hydroceium bounded by two large, lateral facets, and elongated in shape; with four serrated teeth at base.

Eudoxid Stage: (Fig. VIII, 7) Bract perfectly cuboidal, with six equal, slightly concave facets and prominent angles.

Size: 5.5 mm. in length and 5 mm. in breadth. Bract cavity lies posteriorly, its apex reaching to centre of cube. Phyllocyst pyriform with broad base slightly bilobed and narrow short caecum above. Gonophore with five well serrated ridges, ending in five well pointed teeth; proximal half large and conical, forming well marked ridges in middle.

Subfamily ABYLINAE *L. Agassiz 1862*

This subfamily includes two genera, *Abyla* Quoy and Gaimard, 1827 and *Ceratocymba*, Chun, 1888.

Genus *Ceratocymba* Chun, 1888

The genus *Ceratocymba* includes the following four valid species—*leuckartii* Huxley, 1859; *dentata* Bigelow, 1918; *intermedia* Sears, 1953; and *sagittata* Quoy and Gaimard, 1827.

In this collection only *Ceratocymba leuckartii* is present.

29. *Ceratocymba leuckartii* (Huxley), 1859

(Fig. VIII, 8-11)

(For synonymy see Sears, 1953, p. 67)

Ceratocymba leuckartii Totton, 1954, p. 153

Record—8 anterior nectophores, 2 bracts, and 6 gonophores were taken from a depth of 18 metres on 8-12-1953. 4 anterior nectophores and 3 gonophores during December 1959.

Distribution—Indian Ocean, tropical Pacific, tropical Atlantic, Malay area.

Description—Anterior nectophore length—4.7 mm., breadth—2.8 mm., Somatocyst length—2.6 mm., Hydroecium length—3.85 mm., Nectosac length—3.5 mm.

Anterior nectophore (Fig. VIII, 8 & 9) with six facets arranged round longitudinal axis; laterally flattened, with dorsal, apical and ventral facets narrow and elongate; 2 lateral pentagonal facets; dorso-lateral and ventro-lateral facets incompletely and unequally divided. Lateral ridge lies near ventral surface, curving sharply dorsally near base, almost parallel to basal margin, ending well above lateral tooth on dorsal wall of hydroecium. All ridges finely serrated. Somatocyst, hydroecium, and nectosac parallel to each other. Somatocyst, oval on ventral side. Hydroecium slenderly conical, placed in between somatocyst and tubular nectosac. Hydroecium with triangular opening. Lateral canals with small enlargement at distal extremity near circular canal.

Eudoxid Stage: (Fig. VIII, 10 & 11), bract length—5 mm., breadth—3.75 mm., gonophore length—7.5 mm. Bract with 7 facets, apical facet flat, quadrilateral; left lateral facet divided unequally by a ridge from apical facet; ventral facet rectangular. Phyllocyst with descending branch thick, tip curved, extending almost to basal margin; two ascending branches, thin, threadlike and directed towards angles of apical facets.

Gonophore (Fig. VIII, 11) with six ridges, dorsal one winged ending in broad tooth at base; lateral ridges end in pointed, nonserrated teeth at base; ventral ridges strongly serrated, forming sides of open groove of hydroecium; sixth ridge lies within this groove ending in pointed nonserrated teeth between folds. Gonads within gonophores.

SUMMARY

Twenty-nine species of Siphonophores collected from Madras coast during 1952-54; and 1956-60 are described. Of these, twenty-one species are being recorded for the first time in this region. Subfamilies, genera and species validly included under the families studied are also given.

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ABBREVIATIONS

A. annular septa, AS. Apical stigmata, BR. bract, C. cormidium, CN. cnidosphere, CS. central siphon, DT. dorsal tooth, GD. gonodendra, GO. gonophore, GOP. gonopalpon, H. hydroecium, HF. hypocystic funnel, HR. hepatic ridges, HV. hypocystic villi, I. involucre, IN. inferior nectophore, LC. lateral canal, LBR. larval bract, LT. lateral teeth, MO. mitra ocellaris, NC. nectocalyx, NS. nectosac, OC. oblique canal, P. palpon, PC. pericystic cavity, PH. phyllocyst, PN. pneumatophore, PO. pedicular canal, PS. pigmented spot, PT. palpacle, S. sail, SI. siphon, SN. special nectophore, SO. somatocyst, ST. stigmata, T. tentacle, TE. tapetum endocystalis, TF. terminal filament, TL. tentillum, V. velarium.