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I ON SOME UNDESCRIBED APHIDES FROM  
THE COLLECTION OF THE INDIAN  
MUSEUM.

By P. VAN DER GOOT, *Salatiga, Java.*

During the course of the years 1913 to 1915, Mr. F. H. Gravely had the kindness to submit to me for investigation and determination some 60 tubes of Aphididae from the collections of the Indian Museum. Some of the specimens contained therein had already been determined by Mr. Buckton; many others proved to be well-known species, already described either from Europe or from other tropical countries. Three of them however, appeared to me to be new to science. With the kind permission of the Superintendent of the Indian Museum I am giving here the descriptions of these new species.

**Rhopalosiphum indicum, sp. nov.**

*Apterous viviparous female.*

Measurements.

|                      |          |
|----------------------|----------|
| Length of body       | 4.40 mm. |
| Breadth of body      | 2.70 „   |
| Length of antennae   | 4.30 „   |
| Length of siphunculi | 1.03 „   |
| Length of cauda      | 0.47 „   |

*Colour*.—Body light reddish-brown. Eyes black. Antennae black. Legs brownish-black, the base of the femur more yellowish. Siphunculi dark brown. Cauda light reddish brown.

*Morphological characters*<sup>1</sup>.—Body ovate, slightly arched; dorsum with only a few very short hairs, integument with distinct reticulation.

Antennae nearly as long as the body, with a few short hairs; relative lengths of the last antennal joints about as: 70. 45. 34. 12. 58. The third antennal joint bears at its base some 5 small circular sensoriae. Frontal tubercles fairly large, distinctly protruding and rounded on the inner side.

Rostrum reaching to the second pair of coxae.

Siphunculi relatively short only slightly swollen, considerably constricted near the tip, with a fine reticulation only at the

---

<sup>1</sup> Notes from specimen in alcohol.

extreme top-end. Cauda short, club-shaped, about half as long as the cornicles.

Legs fairly long, with a few short hairs.

*Biology*.—Collected in large numbers on the shoots of an unknown plant. Only wingless females and numerous larvae were captured.

*Locality*.—Kurseong, Darjeeling (4700 feet), 24-xi-1910.

*Types* in the collection of the Indian Museum, Calcutta; labelled no. 9602/19.

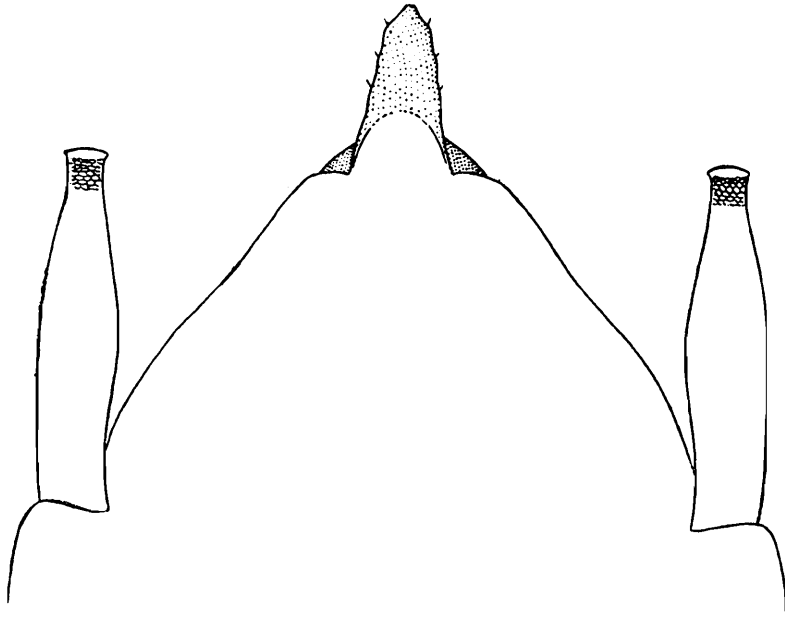


FIG. 1.—*Rhopalosiphum indicum*, sp. nov.  
Hind part of body of apterous female (dorsal view)  $\times 50$ .

### ***Trichosiphum minutum*, sp. nov.**

*Alate viviparous female.*

#### Measurements.

|                      |          |
|----------------------|----------|
| Length of body       | 2.07 mm. |
| Breadth of body      | 0.86 „   |
| Length of antennae   | 1.98 „   |
| Length of siphunculi | 1.53 „   |
| Expanse of wings     | 7.70 „   |

*Colour*.—Head and thorax brown, abdomen brownish-yellow. Eyes red. Antennae black. Legs yellowish. Siphunculi yellowish-brown. Wings hyaline.

*Morphological characters*<sup>1</sup>.—Body elongate, with the forehead, the prothorax and the sides of the body clothed with long bristles.

Antennae nearly as long as the body, with numerous bristles, seven-jointed; relative lengths of the five last antennal joints about as: 40. 13. 15. 12. 16. The third antennal joint bears on

<sup>1</sup> Notes from specimen in alcohol.

its whole length about 20 sensoriae; these are broadly oval and occupy nearly half of the antennal circumference.

Rostrum slender, reaching to the third pair of coxae.

Siphunculi very long, about  $\frac{3}{4}$  of the whole length of the body, cylindrical, thin, with numerous fine bristles. Cauda obsolete, the last abdominal segment broadly rounded, without a small point at the apex. Rudimentary gonapophyses apparently 3.

Wings with the same venation as in the genus *Greenidea*, with the *media* II curved. Hooking-hairs 2.

*Biology*.—The aphids described above were collected on a jungle creeper. Only a number of nymphs and a few winged individuals were caught.

*Locality*.—Kurseong, Darjeeling (4700 feet).

*Types* in the collection of the Indian Museum, Calcutta; labelled no. 9620/19.

#### NOTE.

In the genus *Trichosiphum* (Perg.), v. d. G. I include those species that differ from *Greenidea*, Schout., in having the caudal segment broadly rounded, not protruding into a small point like the species of the genus *Greenidea*.

### ***Pterochlorus tropicalis*, sp. nov.**

#### *Apterous viviparous female.*

#### Measurements.

|                    |          |
|--------------------|----------|
| Length of body     | 5.40 mm. |
| Breadth of body    | 2.90 „   |
| Length of antennae | 2.70 „   |
| Siphunculi (diam.) | 0.14 „   |

*Colour*.—Head and prothorax brownish-black; the rest of the body greyish, with four longitudinal rows of minute black dots on the dorsum. Eyes, antennae and legs black. Siphunculi surrounded by a broad black ring; caudal segment brownish-black.

*Morphological characters*<sup>1</sup>.—Body broadly oval, slightly arched, clothed with numerous fine, short hairs.

Antennae half as long as the body, six-jointed, with numerous short hairs; relative lengths of the last four joints about as : 55 23. 18. 11.

Distribution of sensoriae on the different joints mostly as follows: III<sub>9</sub> IV<sub>6</sub> V<sub>1</sub> VI<sub>1</sub> (+4). The secondary sensoriae are round and small. *Processus terminalis* fairly long, about  $\frac{1}{3}$  of the length of the entire sixth joint.

Rostrum long, nearly reaching halfway to the ventral part of the abdomen.

Siphunculi only very slightly protruding, nearly reduced to pores. Caudal segment not constricted at the base, nearly obsolete. Rudimentary gonapophyses 3.

<sup>1</sup> Notes from specimen in alcohol.

Legs long, especially the hind shins, with numerous short fine hairs.

*Alate viviparous female.*

Measurements.

|                    |          |
|--------------------|----------|
| Length of body     | 5.05 mm. |
| Breadth of body    | 2.07 „   |
| Length of antennae | 2.52 „   |
| Siphunculi (diam.) | 0.13 „   |
| Expanse of wings   | 12.70 „  |

*Colour*.—Head light brownish, thorax black, abdomen greyish. Eyes black. Antennae and legs black. Siphunculi surrounded by a broad dark ring; caudal segment black.

Forewings beautifully tinged with brown; the following parts only are hyaline: the basal part of the radial cell, a small stretch from the base of the *media* I to the first furcation, a larger one from the first furcation point of the *media* I to the top of the

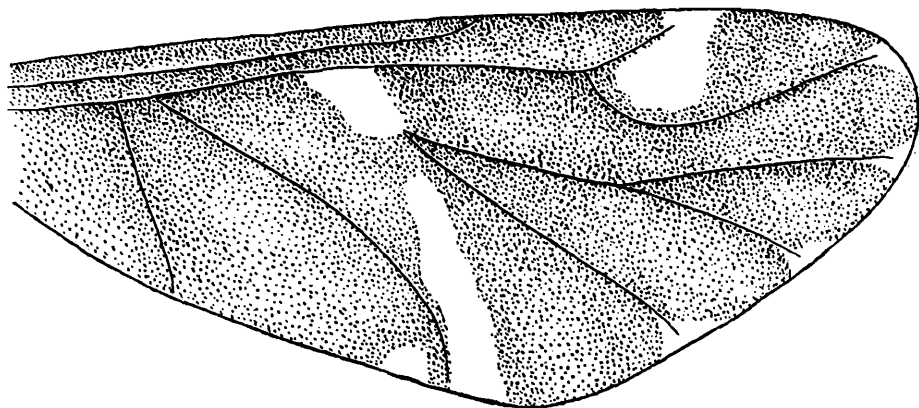


FIG. 2.—*Pterochlorus tropicalis*, sp. nov.  
Forewing of alate female,  $\times 60$ .

*media* II, the tips of all veins except the *cubitus* and the base of the forewing itself. The hind wings are uniformly light brownish.

*Morphological characters*<sup>1</sup>.—Body clothed with numerous fine, short hairs.

Antennae about half as long as the body; relative lengths of the four last antennal joints about as: 50. 25. 24. 15. The distribution of sensoriae on the different joints is as follows: III<sub>12-16</sub> IV<sub>5-7</sub> V<sub>1</sub> VI<sub>1</sub> (+6). The secondary sensoriae are circular and moderately small.

Rostrum, siphunculi, etc. as in the apterous female.

Wings with the normal *Pterochlorus*-venation, the *media* II distinctly curved. Hooking-hairs 6 in number.

*Foodplant*.—Unknown.

*Locality*.—Dibrugarh, N.-E. Assam (Abor Exped.), 20-xi-1911.

*Types* in the collection of the Indian Museum, Calcutta; labelled no. 4695/20.

<sup>1</sup> Notes from specimen in alcohol.

## II ON SOME INDIAN CESTODA

### PART II.

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The object of the present paper is merely to record a number of parasites for the most part found commonly in certain Indian birds. The characters given for the members of the family Ptychobothridae are after Lühe. Those of the families Tetrabothridae, Davaineidae and Hymenolepidae are after Ransom. The writer hopes in succeeding papers to confine his attention to the anatomical details of a series of families.

#### Family PTYCHOBOTHRIIDAE, Lühe, 1910.

Scolex unarmed, or rarely armed, and always with two separate, more or less perfectly-developed suckers, which may exceptionally be replaced by a pseudo-scolex. Neck absent. Outer differentiation of segments always present, but very often imperfect, or partly obliterated by secondary formation of folds. Genital organs numerous, but single in each proglottid. Genital apertures single. Cirrus devoid of spines, but with a striated cuticle. Apertures of the cirrus and vagina behind that of the uterus, arranged on the surface, or on the edge. In the first instance, the openings of the cirrus and vagina are on the opposite surface to that of the uterus, and are approximately median. No muscular bulbus in connection with the inner extremity of the cirrus sac. Usually, the receptaculum seminis is missing, but, if present, it has the shape of a small caecum, placed internal to, and in close connection with, the vagina. Ovary and shell-gland median; testes in two side fields. Uterus never takes the shape of a rosette, but usually exists as a wide, uniform cavity. Eggs with a thin shell, without operculum; embryonic development takes place in the uterus, and, on account of the cessation of the egg-production, all the eggs of the tapeworm are ultimately in the same stage of development. The cessation of egg-production however, appears, in some species, to have a relation to the season of the year. Mature in the intestine of fish. Development of larva unknown. There are two sub-families.

#### CHARACTERS OF THE SUB-FAMILIES.

- |                                                            |     |     |     |     |                  |
|------------------------------------------------------------|-----|-----|-----|-----|------------------|
| (1) Apertures of cirrus and vagina arranged on the surface | ... | ... | ... | ... | Ptychobothriinae |
| (2) Apertures of cirrus and vagina arranged on the edges   | ... | ... | ... | ... | Amphicotylinac.  |

Sub-family *AMPHICOTYLINAE*, Lühe, 1910.

Scolex unarmed. Mouth of cirrus and vagina marginal, irregularly alternate, with a more or less strongly pronounced partiality for being unilateral. The deferens strongly coiled. Mouth of uterus median; aperture of uterus large. In the intestines of fishes. In fresh water there are two genera.

## CHARACTERS OF THE GENERA.

- (1) Yolk-gland follicles numerous, irregularly formed, in loose coils, and situated, at least partly, between the muscle bundles ... .. *Abothrium*.
- (2) Yolk-gland follicles in small numbers, on each side, pressed together very closely, on the outer edge of the nerve strands, between the main longitudinal nerves and the muscles ... .. *Bathybothrium*.

*Abothrium* (Van Ben.), 1871.

Scolex unarmed, not very long, with two strong (but not specially deep) suckers. Segmentation of the posterior part of the strobila is often indistinct on account of the superficial wrinkling of the skin. The ripe segments are considerably wider than long. Nerve strands lateral, dorsal to the cirrus sac and vagina. Vesicula seminis lies exclusively between the two nerve strands, in the two lateral fields. Yolk-glands irregular in shape, in two broad lateral fields, situated partly between the bundles of the longitudinal muscles. The yolk-glands of each proglottid do not appear to be distinctly separated. Ovary somewhat bean or kidney-shaped, median, and situated, along with the aperture of the uterus, ventrally. Shell-gland dorsal to ovary. Aperture of uterus, in mature proglottides, is a uniform sac, almost filling the whole of the nerve areas.

The uterine apertures appear as a more or less distinctly marked median, longitudinal, furrow, running the length of the proglottides. There are three species.

## CHARACTERS OF THE SPECIES.

- (1) Yolk-glands partly internal to the longitudinal muscles.  
Parasitic in Gadoid fishes ... .. *A. rugosum*.
- (2) Yolk-glands only between the longitudinal muscles.  
Parasitic in Salmonidae ... .. *A. crassum*.
- (3) Yolk-glands partly external to the longitudinal muscles.  
Parasitic in *Clupea finta* (Cuvier) ... .. *A. fragile*  
(After Lühe)

*Abothrium crassum* (Bloch, 1779) Lühe, 1910.

ZEV  $\frac{5+3.9}{7}$       Pyloric caeca of      Sebago Lake,      H. B. Ward.  
                                 *Salmo sebago*.      Maine, U.S.A.

One specimen named and presented by Professor H. B. Ward of the University of Illinois.

Literature:—Lühe, 1910.

## Family TETRABOTHRIIDAE, Linton, 1891.

= Tetrabothridae, Diesing, 1850 (in part).

Family diagnosis:—Taenioidea. Scolex unarmed, without rostellum. Suckers with an outwardly projecting auricular appendage on the anterior border. Neck short. Segments of the strobila, with the exception of the hindermost segments, always much broader than long. A single set of reproductive organs in each segment. Genital pores unilateral. Genital cloaca deep. Cirrus pouch small, and nearly spherical, united with the genital cloaca by a muscular cloacal canal. Yolk-gland in front of ovary. Eggs with three transparent envelopes. Adult in birds and mammals.

Type-genus:—*Tetrabothrius*, Rudolphi, 1819.

Genus *Tetrabothrius*, Rudolphi, 1819.

- = *Amphotercotyle*, Diesing, 1863 (type, *A. elegans*, Diesing, 1863).
- = *Prosthecocotyle*, Monticelli, 1892 (type, *Taenia fosteri*, Krefft, 1871).
- = *Bothridiotaenia*, Lonnberg, 1896 (type, *Taenia erostris*, Lonn., 1889).

Generic diagnosis:—Tetrabothriidae. With the characters of the family.

Type-species:—*Bothriocephalus macrocephalus*, Rudolphi, 1810.

*Tetrabothrius erostris*, Lonnberg, 1889.

ZEV  $\frac{60 \pm 7}{7}$  *Sterna bergii*. Tangleam, T. Southwell. Ten specimens.  
(Tern). Ceylon.

This parasite has previously been recorded from Ceylon by Shipley.

Synonym:—*Taenia immerina*, Abildg., 1790.

Literature:—Shipley, 1903; Johnston, 1912; Ransom, 1909; Fuhrmann, 1908; Monticelli, 1892.

## Family DAVAINIIDAE, Fuhrmann, 1907.

(See *Rec. Ind. Mus.*, Vol. IX, Part V, Dec. 1913).

## Sub-family DAVAININAE, Braun, 1900.

Sub-family diagnosis:—Davaineidae. Suckers armed around periphery with several rings of hooklets which are unstable or persistent. Uterus breaks down into numerous egg capsules, each containing one or more eggs. Para-uterine organs not present. Adult in mammals and birds.

Type-genus:—*Davainea*, Blanchard and Railliet, 1891.

Genus *Cotugnia*, Diamare, 1893.

Generic diagnosis:—Davaineinae. Segments broader than long. Several layers of longitudinal muscles, alternating with layers of transverse muscle fibres. A double set of reproductive

organs in each segment, close to the longitudinal excretory canals. Genital canals pass dorsal of longitudinal excretory vessels and nerve. Testicles numerous, filling the median fields, and extending dorsal of the female organs and excretory vessels to the extreme edge of the medullary parenchyma. Uterus breaks down and the eggs become enclosed singly in egg capsules. Adult in birds.

Type-species:—*Cotugnia digonopora* (Pasquale 1890) Diamare, 1893.

**Cotugnia digonopora** (Pasquale, 1890) Diamare, 1893.

ZEV  $\frac{6162}{7}$  *Corvus macrorhynchus*. Calcutta. T. Southwell. Two specimens.  
(Crow).

ZEV  $\frac{6163}{7}$  *Gallus gallus?* Berhampur, Major Lane, I.M.S. Five specimens.  
(Hen). Bengal.

Length 70 mm. Greatest breadth 6 mm. Length of last segment 1.2 mm. Head 1.4 mm. broad. Suckers .45 mm. broad, globular and prominent. Spines on rostellum exceedingly minute. Neck absent. Genital pores double and situated about the middle of the segment. Calcareous corpuscles large.

Synonym:—*Taenia digonopora*, Pasquale, 1890.

Literature:—Pasquale, 1890; Diamare, 1893; Stiles and Hassall, 1896; Ransom, 1909.

Genus **Davaínea**, Blanchard and Railliet, 1891.

= *Bothriotaenia*, Railliet, 1892,  
(type, *Dibothrium longicolle*, Molin, 1858).

Generic diagnosis:—*Davaineinae*. A single set of reproductive organs in each segment. Genital pores unilateral or occasionally irregularly alternate. Uterus breaks down into egg capsules each containing one or several eggs. Adult in mammals and birds.

Type-species:—*Davainea proglottina* (Davaine 1860) Blanchard, 1891.

**Davainea friedbergeri** (Von Linstow, 1878) R. Blanchard, 1891.

ZEV  $\frac{6051}{7}$  *Pavo nigripennis*. Berhampur, Major Lane, I.M.S. One specimen.  
(Black shouldered Bengal.  
peacock).

I very doubtfully refer a single damaged specimen to the above species. It measured 140 mm. long and the greatest breadth was 5 mm. The genital pores were unilateral.

Synonyms:—*Taenia friedbergeri*, Von Linstow, 1878.

*Taenia agama*, Megnin, 1878.

*Taenia infundibuliformis* var. *phasianorum*, Megnin, 1878.

*Taenia cesticillus* var. *phasianorum*, Neumann, 1878.

Literature:—Stiles and Hassall, 1896.

**Davainea echinobothrida** (Megnin, 1881) R. Blanchard, 1891.

ZEV  $\frac{6177}{7}$  *Gallus bankiva*. Berhampur, Major Lane, I.M.S. Over thirty  
(Hen). Bengal. specimens.

Synonyms:—*Taenia intundibuliformis*, Megnin (part.), 1880.

*Taenia echinobothrida*, Megnin, 1880.

Literature:—Stiles and Hassall, 1896; Ransom, 1905

**Davainea corvina**, Führmann, 1905.

ZEV  $\frac{6146}{7}$  *Pica rustica*. Zoological Gardens, Two specimens.  
(Magpie.) Calcutta.

Our specimens agree exactly with the description given by Führmann.

Synonym:—*Davainea polycalcaria*, von Linstow, 1906.

Literature:—Führmann, 1905; von Linstow, 1906.

Examples of this parasite were also obtained as under:—

|                 |                                                           |                      |               |
|-----------------|-----------------------------------------------------------|----------------------|---------------|
| Nine specimens, | <i>Corvus macrorhynchus</i> .                             | Chilka Lake, Orissa. | T. Southwell. |
| Twenty-one ,,   | <i>Corvus macrorhynchus</i> and <i>Corvus splendens</i> . | Sabour, Bihar.       | T. Southwell. |
| Twelve ,,       | <i>Corvus splendens</i> .                                 | Calcutta.            | T. Southwell. |
| Six ,,          | <i>Corvus macrorhynchus</i> and <i>Corvus splendens</i> . | Colombo, Ceylon.     | T. Southwell. |

**Davainea cesticillus** (Molin, 1858) R. Blanchard, 1891.

ZEV  $\frac{6138}{7}$  Small intestine of chick. ? H. B. Ward.

One specimen named and presented by Professor H. B. Ward of the University of Illinois. The locality is not given; presumably it is from the United States (Nebraska?).

Literature:—Molin, 1858; R. Blanchard, 1891.

**Family HYMENOLEPIDIDAE**, Railliet and Henry, 1909.

For characters of family see *Rec. Ind. Mus.*, Vol. IX, Pt. V, December 1913.

**Sub-family HYMENOLEPIDINAE**, Ransom, 1909.

= Hymenolepinae, Perrier, 1897.

Sub-family diagnosis:—Hymenolepididae. Rostellum armed with a single crown of hooks, or more rarely rudimentary and unarmed. Segments always broader than long. Longitudinal muscles in two layers. A single set of reproductive organs in each segment. Genital pores unilateral. Genital canals pass on the dorsal side of the longitudinal excretory vessels and nerve. Vas deferens always short, with seminal vesicle. Uterus persistent, sac-like. Eggs with three transparent shells. Adult in mammals and birds.

Type-genus:—*Hymenolepis*, Weinland, 1858.

### Genus *Hymenolepis*, Weinland, 1858.

= *Diplocanthus*, Weinland, 1858; = *Lepidotrias*, Weinland, 1858; = *Drepanidotaenia*, Railliet, 1892; = *Dicranotaenia*, Railliet, 1892; = *Echinocotyle*, Blanchard, 1891; = *Triorchis*, Clerc, 1903.

Generic diagnosis:—*Hymenolepidinae*. Rostellum generally well developed, and armed with a single crown of hooks, or more rarely, rudimentary and unarmed. Suckers in adult rarely armed with hooklets of fine spines; are generally unarmed. Testicles three in each segment. Vas deferens with internal (*i.e.* inside the cirrus pouch) as well as external seminal vesicle (outside the cirrus pouch). Sacculus accessorius generally absent. Adult in mammals and birds.

Type-species:—*Hymenolepis flavopunctata*, Weinland, 1858.

= *Hymenolepis diminuta* (Rudolphi, 1819) Blanchard, 1891.

### Sub-genus *Hymenolepis*, Weinland, 1858.

Sub-generic diagnosis:—*Hymenolepis*. Rostellum generally well developed, and armed with a single crown of hooks, or more rarely rudimentary and unarmed. Suckers in adults generally unarmed, or, rarely, their entire surface may be covered with rudimentary spines. Sacculus accessorius generally absent. Adult in mammals and birds.

Type-species:—*Hymenolepis flavopunctata*, Weinland, 1858.

= *Hymenolepis diminuta* (Rud., 1819) Blanchard, 1891.

### *Hymenolepis capillaroides*? Führmann, 1906.

ZEV  $\frac{616}{7}$  *Corvus macrorhynchus*. Calcutta. T. Southwell. Twenty-eight specimens.  
(Crow).

The specimens under consideration are placed in the above species with a little uncertainty. The rostellum in every specimen was slightly damaged and the exact size and number of spines could not be determined. If not absolutely identical, our specimens are closely related to *Hymenolepis capillaroides*, Führmann.

The specimens measured 25 to 30 mm. long. The last segments were .22 mm. long, .22 mm. broad, and the edges were slightly salient. In one specimen, only, which was more mature than the rest, and which had contracted to a greater degree, the greatest breadth was .58 mm. The head is .14 mm. long, and .2 mm. broad. As far as could be ascertained, there was a single row of 10 hooks, .021 mm. long, on the rostellum. The suckers were .098 mm. in diameter. Neck .4 mm. long. The genital pores unilateral. The testes are three in number, and have a diameter of .06 mm. Two were situated posteriorly, one on each side, and the third was lateral and somewhat anterior. The variable disposition of the testes noted by Führmann (1906) was not seen in our specimens. The cirrus bulb measured .12 mm. long, and was situated anteriorly. The internal extremity abutted on the posterior edge of the preceding segment. It will be noted

that the last segments in our specimens are square. The segments figured by Führmann for this species are broader than long, but possibly those figured were not the posterior gravid segments.

Literature:—Führmann, 1906.

### **Hymenolepis sp.**

ZEV  $\frac{60.50}{7}$  *Chenopus atrata*. Berhampur, Major Lane, I.M.S. Numerous  
(Black Australian Bengal. swan). specimens.

Our specimens are without heads and were badly preserved. They measured 17 mm. long and .6 mm. broad. The segments are all much longer than broad, the genital pores are all on one side and are situated anteriorly. The cirrus pouch is enormous. It is placed at the anterior end and lies transversely across two-thirds of the segment. It is one-third the length of the segment. The penis is also very long and covered with exceedingly minute spines. As far as could be ascertained, the testes were three in number, and posterior and median in situation. Near them, and on the side opposite to that on which the genital pore occurs, was a darkish mass, which appeared to be the ovary. No further anatomical details could be determined.

### **Hymenolepis sp.**

Two specimens from *Chrysophlegma flavinucha* (woodpecker), Zoological Gardens, Calcutta. The specimens, which have been permanently stained and mounted, were so badly preserved that, although they appear to be new species, I have been obliged to defer a careful description until more material can be collected. They measure 25 mm. long and are thin and filamentous. The last few segments were gravid. The rostellum is comparatively long, and, owing to contraction, appears wrinkled. There appears to be a single row of ten hooks. Suckers unarmed. There is no neck. The first segments are much broader than long and the last few are slightly longer (.26 mm.) than broad (.19 mm.). The reproductive apertures are almost, but not quite, unilateral. The testes are very large and are three in number, two being posterior, (one on each side of the middle line) and the third being anterior to one of the former. The genital cloaca is large, and the cirrus small. The ovary and vittellarium appear to be situated between, and anterior to the two posterior testes. The receptaculum seminis (?) was enormous, and situated anteriorly, in the middle of the segment. The uterus occupied the whole of the last segments, and appeared to be divided into two, by a dorso-ventral septum running from the anterior to the posterior end of the segment.

### **Sub-genus Drepanidotaenia, Railliet, 1892.**

Head provided with a single row of uniform hooks, few (8-20) in number, with dorsal root much longer than ventral root,

the latter always small, with prong directed posteriorly when the rostellum contracts.

Type-species:—*Drepanidotaenia lanceolata* (Bloch, 1782) Railliet, 1892.

Larval stages have been found in small crustaceans.

This genus does not appear to differ from *Hymenolepis*, Weinland, 1858.

***Drepanidotaenia gracilis*** (? Zeder, 1803) Krabbe, 1869, Railliet, 1892.

ZEV  $\frac{60+8}{7}$  *Phenicopterus roseus*. (Flamingo). Zoological Gardens, T. Southwell. About two hundred specimens. Calcutta.

Synonyms:—*Taenia collo-longissimo*, Bloch, 1782 ?

*Taenia gracilis* (Zeder) Rudolphi, 1810 ?

*Halysis gracilis*, Zeder, 1803 ?

Literature:—Stiles and Hassall, 1896 ; Führmann, 1908.

Stiles gives the following description of this worm:—

“About 270 mm. long, by 1·5 to 2 mm. broad. Head sub-globular. Rostellum cylindrical, obtuse, armed with a simple crown of 8 hooks, 77-80 $\mu$  long. Neck very short, . . . genital pores unilateral. Receptaculum pyriform ; penis unarmed. Genital sinus provided with large spines.” Our specimens, although extremely small, undoubtedly are of the same species. They measured only 3 mm. long and .5 mm. broad. The posterior segments measured .15 mm. long and .6 mm. broad, and were not fully mature. They showed a tendency to become square. The genital pores are unilateral. The rostellum is cylindrical and measures .3 mm. long. It is marked by transverse wrinkles. The hooks are eight in number and they measure .08 mm. long. These hooks are attached to the extreme end of the rostellum. There is no neck. The testes are three in number, and are situated posteriorly, two being lateral and one median. The vas deferens runs nearly straight to the anterior aporose corner of the segments and swells into a very large vesicula seminalis. The cirrus is long. The penis was not observed. Unfortunately the female reproductive organs did not appear to be sufficiently developed to admit of description.

For notes on the systematic position of this genus see Führmann, 1908.

### Genus *Diorchis*, Clerc, 1903.

Generic diagnosis:—Hymenolepidinae. Rostellum with a single crown of ten hooks with long dorsal and short ventral roots, or exceptionally, with very short dorsal root and with ventral root nearly as long as the blade. Surface of the suckers may be armed with minute spines. Inner longitudinal muscular layer consisting of 8 bundles, 4 dorsal and 4 ventral. Two testicles in each segment. Adult in birds.

Type-species:—*Diorchis acuminata* (Clerc 1902) Clerc, 1903.

**Diorchis americana**, Ransom, 1909.

ZEV <sup>5953</sup><sub>7</sub> *Dendrocitta* sp. Zoological Gardens, T. Southwell. Eighteen  
(Tree pie). Calcutta. specimens.

In our specimens the surface of the suckers was armed with very minute spines, but the longitudinal bands of muscles were not well defined. The segments were mature, but not gravid, and were extremely short. Three fairly well defined sizes were noticed, for which the following are the dimensions:—

|                     | I.     | II.    | III.   |
|---------------------|--------|--------|--------|
| Length of specimens | 9 mm.  | 12 mm. | 16 mm. |
| Extreme breadth     | ·7 mm. | ·5 mm. | ·9 mm. |
| Breadth of head     | ·1 mm. | ·1 mm. | ·1 mm. |

Literature:—Ransom, 1909.

Sub-family *DIPYLIDIINAE*, Stiles, 1896.

Genus **Gryporhynchus**, Nordman, 1832.

= *Acanthocirrus*, Fühmann, 1907.

(type, *Acanthocirrus macrorostratus*, Fühmann, 1907).

Generic diagnosis:—Dipylidiinae. Rostellum armed. Genital pores unilateral. Genital canals pass between the longitudinal excretory vessels. Root of cirrus with one or two pairs of powerful spines lying in special pockets. Testicles few (6-8). Uterus sac-like. Adult in birds.

Type-species:—*Gryporhynchus pusillus*, Nordman, 1832.

= larva of *Acanthocirrus macropeos* (Wedl, 1856).

**Gryporhynchus (Acanthocirrus) macropeos**, Wedl, 1855.

ZEV <sup>6161</sup><sub>7</sub> *Ardeola grayi*. Zoological Gardens, T. Southwell. Over one  
(Pond heron). Calcutta. hundred  
specimens.

Our specimens measured 4 mm. long, and each consisted of about 30 segments. The last segments measured ·3 mm. long, and ·3 mm. broad. The neck is 1 mm. long. The number of hooks could not be satisfactorily counted as many of them were missing. They measured ·03 mm. long. The genital pores are unilateral, and are situated in the anterior  $\frac{1}{4}$  of the segment. The penis is ·13 mm. long, ·018 mm. broad, and covered with exceedingly minute spines. There are six testes. The cirrus sac is situated transversely at the anterior and extends two-thirds the distance across the segment. The uterus, in gravid segments, consisted of two circular sacs, one on each side, which appeared to communicate with each other.

Synonyms:—*Taenia macropeos*, Wedl, 1856.

*Acanthocirrus macropeos*, Fühmann, 1908.

Literature:—Fühmann, 1907; Fühmann, 1908; Ransom, 1909; Lühe, 1910.

For a discussion of the synonymy of this species the reader is referred to Ransom and Fühmann (above).

Sub-family *PARUTERININAE*, Ransom, 1909.= *Paruterinae*, Führmann, 1907.

Sub-family diagnosis:—Hymenolepididae. Scolex usually armed, rarely without rostellum. A single (double in *Stilesia* provisionally placed in the sub-family) set of reproductive organs in each segment. Uterus simple or double, with a single para-uterine organ, or multiple with several para-uterine organs, into which the eggs pass in the final stage of development of the segment. Adult in birds and Amphibia. (*Stilesia* in mammals).

Type-genus:—*Paruterina*, Führmann, 1906.

Genus *Metroliaesthes*, Ransom, 1900.

Generic diagnosis:—*Paruterininae*. Scolex unarmed, without rostellum. Genital pores irregularly alternate. Genital canals pass between dorsal and ventral longitudinal excretory vessels and dorsal of the nerve. Testicles rather numerous (20 to 40) in posterior portion of segment. Uterus single in origin and consisting, when fully developed, of two spherical sacs touching in the median line and more or less fused with one another. A para-uterine organ, developing in front of the uterus, and into which the eggs pass, becomes transformed finally into a spherical egg capsule. Adult in birds.

Type-species:—*Metroliaesthes lucida*, Ransom, 1900.

*Metroliaesthes lucida*, Ransom, 1900.

ZEV  $\frac{6179}{7}$  *Gallus bankiva*? Angul, Orissa Vety. Asstt., Twenty-one  
(Hen). Angul, Orissa. specimens.

Our specimens measured 12 cms. long and 1.7 mm. broad.

Literature:—Ransom, 1905.

Genus *Nematotaenia*, Lühe, 1899.

Generic diagnosis:—*Paruterininae*. Scolex unarmed, without rostellum. Segmentation of strobila distinct only at posterior end. Strobila circular in cross section. Genital pores alternate. Genital canals pass dorsal of longitudinal excretory vessels and nerves. Uterus horse-shoe shaped, disappears early. Eggs, through the action of numerous para-uterine organs, become inclosed in egg capsules, 3 or 4 in each capsule. Adult in Amphibia.

Type-species:—*Taenia dispar*, Goeze, 1782.

*Nematotaenia dispar* (Goeze 1782) Lühe, 1910.

ZEV  $\frac{6778}{7}$  *Bufo* sp. Lucknow. Capt. F. H. Stewart, I.M.S.  
(Toad).

A few fragments are referred to this species with some hesitation. Only one damaged scolex was available. The anterior extremity was unsegmented, and the worm was circular in cross section. Segmentation was distinct only towards the posterior extremity. The fragments in no case measured more than 7 mm.

Literature:—Lühe, 1910; Ransom, 1909.

## Family ICHTHYOTAENIIDAE, Ariola, 1899.

Head with four unarmed suckers. Genitalia as in other Tetraphyllidae. The uterus does not open to the exterior by a pore. The openings of the cirrus and vagina are situated at the side. Yolk-glands double, situated laterally and consisting of numerous follicles. Ovary situated behind the shell gland. Adult in reptiles and birds.

Genus *Ichthyotaenia*, Lonn., 1894.

Scolex armed with four suckers and often a fifth apical sucker. Genital pores marginal, irregularly alternate. Testes numerous. The vagina forms coils at the posterior margin of the proglottides in the middle, which replace a receptaculum seminis. Parasitic in fishes, birds and reptiles.

*Ichthyotaenia (Acanthotaenia) nilotica*, Beddard, 1913.

ZEV  $\frac{0.045}{7}$  *Varanus bengalensis*. Balugaon, T Southwell. Numerous specimens.  
Orissa.

Our specimens agree in every detail with the excellent description given by Beddard of this species in the P.Z.S., London, March 1913, and to this paper the reader is referred for a discussion of the relationship of the genus.

The lizard was caught near a small freshwater ditch 8 miles north of Balugaon, and about 3 miles from the west shore of the Chilka lake.

*Ichthyotaenia (Proteocephalus) pusillus*, Ward, 1910.

ZEV  $\frac{0.437}{7}$  *Cristovomer namaycush*. Lake Temnoganai, H. B. Ward.  
Ontario, Canada.

One specimen named and presented by Professor H. B. Ward of the University of Illinois.

Literature:—Benedict, 1900; George La Rue, 1909; George La Rue, 1911; Johnstone, 1911; Beddard, 1913.

*Ichthyotaenia (Proteocephalus) ambloplitis* (Leidy, 1887)

Benedict, 1900.

ZEV  $\frac{0.429}{7}$  Stomach of *Amia* Put-in-Bay, Ohio, H. B. Ward.  
*calva*. U.S.A.

Two specimens, named and presented by Professor H. B. Ward of the University of Illinois.

Literature:—Benedict, 1900; George La Rue, 1909; George La Rue, 1911; Johnstone, 1911; Beddard, 1913.

Considerable confusion exists with reference to many of the genera included in the family Ichthyotaeniidae, Areola, 1899. It is not proposed in the present paper attempting to review the anatomical relationships of the various genera in question. Details relating thereto are given in the papers cited. La Rue

(1911), as a result of a prolonged investigation of the three genera *Proteocephalus*, Weinland, *Ichthyotaenia*, Lonnberg, and *Tetracotylus*, Monticelli stated that "the genera *Proteocephalus*, Weinland, and *Ichthyotaenia*, Lonnberg, are synonyms. The name *Proteocephalus*, being the older should be retained to designate the species"

Unfortunately I have not the material before me for the proper discussion of the question, and I have therefore left the species in the nominal genus to which they were referred by their authors.

#### ADDENDUM.

Professor Albert Hassall of the United States Department of Agriculture (Bureau of Animal Industry) has called my attention to certain remarks I made in my report "On some Indian Cestoda, Part I" (*Rec. Ind. Mus.*, Vol. IX, Part V, December, 1913) regarding the occurrence of certain cestode parasites in particular hosts.

As a result, I have examined the material again and now wish to make the following remarks and corrections.

#### *Cysticercus cellulosae* (pp. 292 and 293 of above paper).

I remarked upon the fact that it was unusual to find this larva in the muscles of *Bos taurus*. The armature on the head led me to the above identification. Professor Hassall, referring to this identification remarks that "we have been in the habit of determining the armed larval form in the sheep as a larval stage of *Taenia solium* (i.e. as *C. cellulosae*), but on closer examination Dr. Ransom determined that it was an entirely different form, and experiment proved this to be a fact. Perhaps .. you may find that these forms represent new species."

Unfortunately, I have been unable to obtain a copy of Dr. Ransom's paper (Occurrence of *Cysticercus* of *Taenia solium* in sheep. *Amer. Ass. Adv. Sc. N.Y.*, U.S. (703), June 19, 1908). My material consists of three cysts only. The further elucidation of the exact nature of these larval forms will depend on my being able to obtain more and fresh material.

I was in error with regard to the identification of *Cysticercus fasciolaris* and *C. pisiformis* (page 292). The data with reference to the above species should read as follows :—

#### *Hymenolepis murina* (Duj., 1845) R. Blanchard, 1891.

|                      |                                   |                       |                             |
|----------------------|-----------------------------------|-----------------------|-----------------------------|
| ZEV $\frac{2367}{7}$ | <i>Mus decuma-</i><br><i>mus.</i> | Calcutta?             | Col. A. Alcock, I.M.S.      |
| ZEV $\frac{4672}{7}$ | <i>Mus rattus</i> ?               | Lahore, Punjab,       | Punjab Civil Vety. Dept.    |
| ZEV $\frac{4689}{7}$ | No history.                       |                       |                             |
| ZEV $\frac{5146}{7}$ | <i>Mus rattus</i> ?               | Berhampur,<br>Bengal. | Major Clayton Lane, I.M.S., |
| ZEV $\frac{927}{7}$  | <i>Mus rattus</i> ?               | Calcutta.             | Major R. Milne, I.M.S.      |

***Cysticercus fasciolaris*, Rudolphi, 1808.**(Larval form of *Taenia crassicollis*, Rudolphi, 1810).ZEV ~~4977-8~~ Liver of *Mus* Amritsar, Capt. G. I. Davis, I.M.S.  
*rattus*. Punjab.

Large numbers of larval forms of *C. fasciolaris* were removed from their cysts. The error arose in consequence of the above two forms being mixed in the same bottle.

***Thysanosoma* sp., Diesing, 1835.**

The specimens referred to *T. actinioides* on page 286 were two in number. One specimen consisted of a scolex and about 12 segments only; the other was a mature worm. The measurements of the latter were as follows:—

|                           |     |     |     |        |
|---------------------------|-----|-----|-----|--------|
| Entire length of worm     | ... | ... | ... | 90 mm. |
| Greatest breadth          | ... | ... | ... | 13 mm. |
| Length of longest segment | ... | ... | ... | 1 mm.  |
| Breadth of head           | ... | ... | ... | 19 mm. |

Scolex unarmed. Rostellum absent. There was no neck. The suckers are four in number and symmetrical. They face slightly forward. Proglottides numerous and always much broader than long throughout the entire length of the worm. The posterior flap of each segment markedly overhangs the succeeding segment both dorsally and ventrally. As I had only one complete specimen, sections were not prepared but I concluded from an examination of the external character that the specimen was *Thysanosoma actinioides*.

A more careful examination which I have just made has, however, conclusively proved that the specimen, although probably belonging to the genus *Thysanosoma*, does not agree with any known species of that genus.

The following details have been definitely established:—

The head is unarmed. There are four symmetrical suckers directed slightly forward. There is no unsegmented portion succeeding the head, but the neck portion is flattened dorso-ventrally. The posterior edge of each segment very markedly overlaps the succeeding segment both dorsally and ventrally, but the free edge of this flap is puckered or frilled and *not* broken up into fimbriae. The gonads appear in the 11th segment, on one side only, and the genital pores are absolutely unilateral. Details with reference to the reproductive organs could not be made out satisfactorily as the material was badly preserved, but sections of the terminal segment led me to the definite conclusion that many para-uterine organs were present surrounding small clusters of embryos.

It is clear that these characters distinguish this worm both from *T. actinioides* and from *T. giardii*. The only other known species of this genus is *T. gambianum*, Beddard (Contributions to the anatomy and systematic arrangement of the *Cestoides*, by

F. E. Beddard, F.R.S., P.Z.S., September 1911, London). Our specimens agree with *T. gambianum* in all the anatomical details which I have been able to elucidate, particularly with reference to the unilateral genital pores, the probable presence of numerous para-uterine organs, the absence of armature on the head and the absence of a "neck." At the same time, judging from Beddard's figures, I am of opinion that our specimens are not *T. gambianum*.

Beddard's specimens were from the Gambian Pouched Rat (*Cricelomys gambianus*). Our specimens are recorded as being obtained from *Rhinoceros sondaicus*, but no locality or date is given, nor is the name of the collector known. The absence of armature on the head, the absence of a neck, together with unilateral genital pores and the presence of para-uterine organs leads me to place our specimens in the genus *Thysanosoma*. A determination of the species will not be possible until more material is available.

In view of the preceding facts, the details given on page 286 of my report (*vide ante*) under "*Thysanosoma actinioides*, Diesing, 1835" should read as follows:—

#### *Thysanosoma* sp.

ZEV  $\frac{46.80}{7}$  *Rhinoceros sondaicus*. ?

Literature:—Beddard, 1911.

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### III NOTES ON ORIENTAL DRAGONFLIES IN THE INDIAN MUSEUM

#### No. 4.—THE GENUS *PSEUDAGRION*.

By F. F. LAIDLAW.

#### Genus *Pseudagrion*, de Selys.

A genus showing the essential features of the dominant section of the Agrioninae both as regards venation and in other respects. It ranges from S. Africa through the tropical regions of the old world to Australia (I can find no record for Ceylon). It is characterized especially by the following characters:—

- (i) Extent of petiolation of the wing. This ceases at the level of the basal post-costal nerve; this latter lies at a level between the first and second antenodal nerves.
- (ii) Presence of post-ocular spots, and by certain sexual characters:—
  - (a) Pterostigmata of all four wings of males alike.
  - (b) Shape of superior anal appendages of males.
  - (c) Structure of hind margin of prothorax of female.
  - (d) Absence of a spine on the ventral surface of the eighth abdominal segment of the female.

Morton has published admirable figures of the anal appendages of three species, viz. *P. decorum* (Ramb.), *P. hypermelas*, Selys, and of *P. bidentatum*, Morton (*Trans. Ent. Soc. London*, 1907, pl. xxiv). Tillyard has figured the anal appendages of a male *P. australasiae*, Selys, from Queensland, the base of the wing of the same species, and the prothorax of the female of an allied form *P. aureofrons*, Tillyard, the latter exhibiting the characteristic generic features (*Proc. Linn. Soc. N.S. Wales*, XXXVII, 3, pls. xlviii, xlix). The anal appendages of *P. microcephalum* (Ramb.) have been figured by myself in a recent paper (*Mem. Ind. Mus.*, V, p. 179). In the Museum collection examples of four Indian species are preserved.

I give below a table which will, I hope, be of service in facilitating the recognition of the Indian species.

#### CHARACTERS OF MALES.

- A. Abdominal segments 1-7 with black or bronze black markings.
  - i. Segments 8, 9, 10 black.
    - a. Thorax black with olive-coloured antehumeral band, superior anal appendage bifurcate in profile, with a single large internal tooth ... .. *P. hypermelas*, Selys.

- b. Thorax blue with a black line on either side of carina. Superior anal appendage falcate in profile with a large internal two-pointed tooth ... *P. bidentatum*, Morton.
- ii. Segments 8-9 blue,<sup>1</sup> 10 black dorsally.
  - c. Dorsum of thorax with three narrow black stripes. Superior anal appendages as long as segment 10; marked with white internally ... *P. microcephalum* (Ramb.).
  - d. Dorsum of thorax with three broad black bands. Superior anal appendages only half as long as segment 10 ... *P. australasiae*, Selys.
- iii. Segments 8, 9, 10 blue.<sup>1</sup>
  - e. Upper lip and head largely blue, anal border of segment 10 moderately excavate, spines on border very small. Superior anal appendages unequally bifurcate in profile, black above, whitish below; lower pair truncate, much shorter than upper pair ... *P. decorum* (Ramb.).
  - f. Upper lip and head largely orange-brown: anal border of segment 10 deeply excavate, beset with strong black spines. Upper anal appendages not bifurcate in profile. Lower pair nearly as long, pointed ... *P. rubriceps*, Selys.
- B. Abdominal segments all blue except 9, which is black above ... *P. azureum*, Selys.

To supply any key for discrimination between the females of these species is a much more difficult matter.

In the first place the Museum material includes female specimens of two species only *viz.* of *P. microcephalum* in some abundance, and a solitary female of *P. decorum*. Secondly the females of *P. hypermelas* and of *P. bidentatum* are quite unknown and thirdly it is evident that characters which can be used for purposes of identification are much harder to find than in the case of the males.

In a general way the female of *P. azureum* can be contrasted with those of the other species that have been described by the absence in it of any black markings on the abdomen, which according to Selys is bluish (bleuâtre) in colour, paler beneath.

The remaining species of which any account is available all have black markings on the abdomen on segments 1-9.

*P. microcephalum* has the post-ocular spots of a fairly bright blue colour with blue on the thorax. *P. decorum*, which is a rather larger insect, has green post-ocular spots and the ground colour of the thorax is distinctly green. That of *P. australasiae* is also larger than *P. microcephalum* and according to Selys the black marks on segments 8 and 9 are more extensive than in the smaller species.

Lastly *P. rubriceps* is described as having the upper lip of an orange colour, the rest of the head yellowish with blue post-ocular spots, the thorax orange yellow.

---

<sup>1</sup> The sutures of these segments are ringed with black.

***P. australasiae*, Selys.**

*P. australasiae*, Kirby, *Cat. Odonata*, p. 183 ; Tillyard, *Proc. Linn. Soc. N. S. Wales*, XXXVII, 3, p. 469, pl. xlviii, figs. 23-24 ; pl. xlix, fig. 15.

*Range*.—India to Australia.

*Recorded Stations*.—Pulo Besaor (*Selys*), Queensland (*Selys*), Cape York to National Park, N.S.W. (*Tillyard*).

The males of this species are exceedingly like those of *P. microcephalum*. The build is a trifle more robust than in that species, and the three black bands of the thorax are much broader, whilst the black marking on segment 10 of the abdomen is more extensive. Examination of the anal appendages of the males will facilitate the distinction of the two species.

I believe the Calcutta specimens can be further differentiated from Australian forms by the characters of the anal appendages, but have no specimens for comparison. Tillyard, *loc. cit.*, describes the superior anal appendages as having the upper lobe shorter than the lower ; in the Calcutta specimens both lobes appear equal in length, whilst the lower appendages in the latter seem to me to be rather more conical and tapering. The specimens are, however, not in the best of condition and study of further material is necessary for a satisfactory determination of possible differences. *A priori* I am inclined to expect the two forms to be moderately distinct.

The Museum collection contains an old specimen of the male labelled by Selys. I have found also a single male from Calcutta, amongst specimens of *Ischnura senegalensis*.

Approximate dimensions :

|   |         |            |           |        |
|---|---------|------------|-----------|--------|
| ♂ | abdomen | 31-32 mm., | hind-wing | 21 mm. |
| ♀ | ,,      | 29-30 mm., | ,,        | 21 mm. |

***P. microcephalum* (Ramber).**

*P. microcephalum*, Kirby, *Cat. Odonata*, p. 153 ; Selys, *Ann. Mus. Genova*, (2) X, p. 83 (1891) ; Martin, *Mission Pavie* (sep.), p. 18 ; Ris, *Archiv. f. Naturgesch.*, 1900, p. 198.

*Range*.—India, Burma, Tonkin, Malaya to the Bismark Archipelago.

I have recently dealt with this species in an account of Odonata found about Lake Chilka in Orissa (*Mem. Ind. Mus.*, V, p. 178, 1915). In the accompanying diagrammatic text-figure I show the colour pattern of the thorax of the female viewed from above. The dotted areas are brown in colour, the unshaded spaces blue. The immature male has the same colouring ; in mature males the brown is entirely replaced by black on the three stripes.

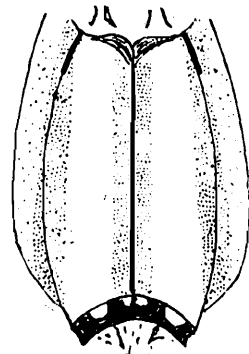


FIG. 1.—Dorsum of thorax of *P. microcephalum* ♀

*P. microcephalum* is evidently one of the commonest of dragonflies in the low-lying parts of Bengal.

Approximate dimensions:

♂ abdomen 27-29 mm., hind-wing 17-18 mm.  
♀       ,,       27-28 mm.,       ,,       18-19 mm.

### *P. decorum* (Ramb.).

*P. decorum*, Kirby, *Cat. Odonata*, p. 153; Kruger, *Stettin Ent., Zeit.*, 1898, p. 119; Morton, *Trans. Ent. Soc. London*, 1907, p. 307, pl. xxiv, figs. 7, 8.

2 ♂♂ Calcutta, 4-i-15 ( $\frac{8.3.3.0}{2.0}$ ).

1 ♂ Calcutta ( $\frac{8.3.0.1}{4}$ ). Labelled by de Selys.

1 ♂ Sar Lake, Puri District, Orissa, 9-iv-15 ( $\frac{11.6}{11.1}$ ).

*Range*:—Peninsular India, Sumatra.

*Recorded Stations*:—Bombay (*Rambur*), Deesa (*Morton*), Soekranda, Sumatra (*Kruger*).

The adult male closely resembles the newly-emerged male of the closely allied *P. microcephalum* in colour, so far as the thoracic pattern is concerned.

Approximate dimensions:

♂ abdomen 28-30 mm., hind-wing 19 mm.  
♀       ,,       25-27 mm.,       ,,       18 mm.

### *P. rubriceps*, Selys.

*P. rubriceps*, Kirby, *Cat. Odonata*, p. 183; Selys, *Ann. Mus. Genova*, (2) X, p. 83 (1891).

1 ♂ immature, with larval skin. Museum Tank, Calcutta ( $\frac{6.6.0.7}{2.0}$ ).

*Range*:—India, Burma, Java.

*Recorded Stations*:—Palon (*Selys*), "India" (*Selys*), "Java" (*Selys*).

The specimen was preserved shortly after emerging, consequently it is not possible to make any examination of the wing characters.

Fortunately the anal appendages are well shown. The colouring of the thorax resembles closely that of an immature

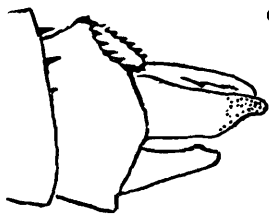


FIG. 2—Apex of abdomen of *P. rubriceps* seen from the side obliquely.

*P. decorum*. In general the insect both as regards colour and the structure of the anal appendages is a typical *Pseudagrion*. Segments 9-10 of the abdomen are (apparently) blue; 8 would appear to have a longitudinal bronze band dorsally, narrowing in front. The upper pair of anal appendages are tinged with brown, the lower pair are white. The curious series of spines developed along the border of the excavation of segment 10 are black (see text-fig 2).

Selys' accounts of the colouring of the abdomen are contradictory. In the synopsis he states that segment 10 is black

above ; in the "*Odonates de Birmanie*" that segments 8-10 are light blue. The present specimen is too young to show colours satisfactorily, but so far as one can judge segment 10 is blue.

The larval skin, which is lacking the gill lamellae, shows a close general resemblance to that of *P. microcephalum* described by me.

Approximate dimensions :

♂ abdomen 29 mm., hind-wing 18-20 mm.

♀       ,,     27-29 mm.,       ,,     19-20 mm.

### ***P. bidentatum*, Morton.**

*P. bidentatum*, Morton, *Trans. Ent. Soc. London*, 1907, p. 308, pl. xxiv, figs. 11-12.

*Recorded Stations* :—Deesa, Gujerat.

*Dimensions* : ♂ abdomen 23.75 mm., hind-wing 16.5 mm.

### ***P. hypermelas*, Selys.**

*P. hypermelas*, Kirby, *Cat. Odonata*, p. 183 ; Kruger, *Stettin Ent. Zeit.*, 1898, p. 119 ; Morton, *Trans. Ent. Soc. London*, 1907, p. 307, pl. xxiv, figs. 9-10.

*Range* :—India, Sumatra.

*Recorded Stations* :—Deesa (*Morton*), Sambong, Sumatra (*Krug r*).

*Approximate dimensions* : ♂ abdomen 15-18 mm., hind-wing 24-26 mm.

### ***P. azureum*, Selys.**

*P. azureum*, Selys, *Ann. Mus. Genova*, (2) X, pp. 81-83 (1891).

*Range* :—Burma.

*Recorded Stations* :—Karin Hills in June ; Cobapo in September (*Selys*).

*Dimensions* : ♂ abdomen 30-36 mm., hind-wing 21-23 mm.

♀       ,,     36 mm ,       ,,     23 mm.





IV REPORT ON A COLLECTION OF  
MOLLUSCA FROM THE COCHIN AND  
ENNUR BACKWATERS

By H. B. PRESTON, F.Z.S.

Class GASTROPODA.

Order OPISTHOBRANCHIATA.

Suborder TECTIBRANCHIATA.

Family TORNATINIDAE.

*Retusa estriata* (Preston).

*Rec. Ind. Mus.* X, 1914, p. 303 (as *Tornatina*).

Cochin backwater, near Ernakulam (*F. H. Gravely*).

Mr. T. Iredale having pointed out to the author that the name "*Tornatina*" is antedated by *Retusa*, the latter must take precedence.

*Retusa ennurensis*, sp. n.

Shell cylindrical, whitish in the median part, painted with a broad pale red band above, and having the base also painted red, but of a deeper hue than that on the upper part of the shell, sculptured throughout with fine, closely set, revolving striae which the microscope reveals to be also of a reddish colour, transversely marked with microscopic growth striae; apex deeply sunken; columella margin white, polished, calloused, sloping, scarcely curved; labrum acute, slightly inwardly bent over the aperture in the lower median part; aperture narrow, straightish, broadening above and especially below; interior of shell tinged with lilac.

Alt. 5.5, diam. 2.25 mm.

*Hab.*—Ennur backwater, Madras.

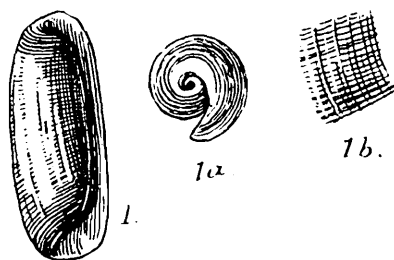


FIG. 1, 1a. — *Retusa ennurensis*,  
sp. n.  $\times 4$ .

FIG. 1b.— do., sculpture,  
 $\times 8$ .

## Order PROSOBRANCHIATA.

## Suborder PECTINIBRANCHIATA.

## Family NASSIDAE.

**Nassa denegabilis**, Preston.*Rec. Ind. Mus.* X, 1914, pp. 297-298.

Ennur backwater, Madras ; Cochin backwater, near Ernakulam.

**Nassa kieneri**, Desh.*Moll. Ile Bourbon*, 1863, p. 129.Cochin backwater, near Ernakulam ; a single young specimen (*F. H. Gravely*).**Nassa orissaënsis**,<sup>1</sup> Preston var. **ennurensis**, var. n.

Shell differing from the type in its much larger size, it having 6 whorls, and in its more exaggeratedly fusiform shape, moreover both the canal and aperture are narrower.

Alt. 10·25, diam. maj. 4·5, diam. min. 4 mm.

Aperture: alt. 4·25, diam. 2 mm.

*Hab.* — Ennur backwater, Madras (*Type*) ; Canal near Chingrighatta, outskirts of Calcutta (a single specimen only).

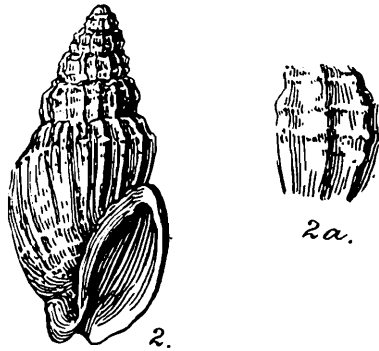


FIG. 2.—*Nassa orissaënsis* var. *ennurensis*, var. n. × 3.

FIG. 2a.—*do.*, sculpture, × 6.

**Alectrion unicolorata**, Kiener.*Monog. Buccinum*, p. 60, pl. xix, fig. 69.Cochin backwater, near Ernakulam ; a single young specimen (*F. H. Gravely*).**Nassodonta insignis**, H. Ad.*Proc. Zool. Soc. London*, 1866, p. 445.Cochin backwater, near Ernakulam (*F. H. Gravely*).

In the *Proc. Malac. Soc. London*, vol. I, 1895, pp. 257-258, Mr Edgar A. Smith doubted the validity of the genus *Nassodonta*, this view however the author is unable to accept, hence its reinstatement in the present paper.

<sup>1</sup> *Rec. Ind. Mus.* X, p. 299.

**Nassodonta gravelyi**, sp. n.

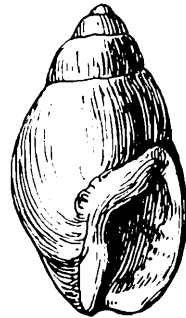
Shell allied to *N. insignis*, H. Ad., with which it occurs, but differing from that species in its narrower form, external dark blackish brown colour and internal dark livid violet tinge.

Alt. 7.5, diam. maj. 4.25, diam. min. 3.5 mm.

Aperture: alt. 3.5, diam. 1.5 mm.

*Hab.*—Cochin backwater, near Ernakulam; *Type* (F. H. Gravely); Ennur backwater, Madras.

At first sight this might be taken for a variety of *N. insignis*, the author has, however, been able to examine a fairly large series of both forms, and as they never seem to blend he is of opinion that the one above described is quite worthy of specific rank.



3.

FIG. 3.—*Nassodonta gravelyi*, sp. n. × 4.

## Family MURICIDAE.

**Thais carinifera**, Lamark.

*Anim. sans Vertébres*, VII, 1822, p. 241.

Cochin backwater, near Ernakulam; a single very immature specimen (F. H. Gravely).

## Family CERITHIIDAE.

**Bittium gravelyi**, sp. n.

Shell minute, fusiform, purplish-brown, encircled by a spiral band of a darker colour; whorls 6, spirally lirate, not convex; suture impressed; columella margin curved; labrum acute, yellowish; aperture sub-circular.

Alt. 2.25, diam. maj. 1.25 (nearly) mm.

*Hab.*—Cochin backwater, near Ernakulam (F. H. Gravely).



4.



4a.

FIG. 4.—*Bittium gravelyi*, sp. n. × 8.  
FIG. 4a.—do., sculpture, × 16.

**Potamides (Tympanotonos) fluviatilis**, Pot. and Mich.

*Cat. Moll. de Douai*, p. 363, pl. xxi, figs. 19-20.

Cochin backwater, near Ernakulam (F. H. Gravely).

## Family TIARIDAE.

**Tiara (Platia) scabra** (Müller).

*Hist. Verm.* II, p. 136 (as *Buccinum*).

Ennur backwater, Madras.

## Family LITTORINIDAE.

*Littorina arboricola*, Reeve.*Conch. Icon.* pl. vi, figs. 27, *a* and *b*.

Ennur backwater, Madras.

## Family FOSSARIDAE.

*Conradia cancellata*, sp. n.

Shell perforate, small, turbinate, in dead condition whitish; whorls 4, the first two smooth, the remainder cancellately sculptured with spiral lirae crossed by slightly oblique, transverse riblets, the last whorl convex; suture impressed; perforation narrow, smooth within; columella margin descending in a curve, labrum continuous; aperture rather oblique, ovate.

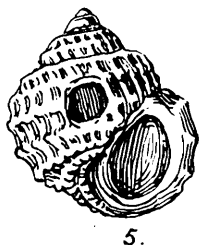


FIG. 5.—*Conradia cancellata*,  
sp. n.  $\times 6$ .  
FIG. 5a.— do., sculpture,  
 $\times 12$ .

Alt. 3, diam. maj. 2.5, diam. min. 1.75 mm.

Aperture: alt. 1.25, diam. 1 mm.

*Hab.*—Ennur backwater, Madras.

## Family LITIOPIDAE.

*Alaba rectangulata*, Craven.*Ann. Soc. Mal. Belg.* XCVI, 1880.

Ennur backwater, Madras.

## Family RISSOIDAE.

*Iravadia funerea*, sp. n.

Shell small, ovately fusiform, covered with a grayish-black periostracum; remaining whorls 3, sculptured with coarse, spiral lirae and showing traces of transverse striation; suture impressed; columella margin vertically descending, diffused above into a very restricted, well defined, parietal callus which joins it with the upper margin of the labrum; labrum acute, angled by the terminations of the spiral lirae; aperture slightly oblique, elliptical.



FIG. 6.—*Iravadia funerea*, sp.  
n.  $\times 8$ .  
FIG. 6a.— do., sculpture,  
 $\times 16$ .

Alt. 2.75, diam. maj. 2, diam. min. 1.25 mm.

*Hab.*—Cochin backwater, near Ernakulam.

***Iravadia ennurensis*, sp. n.**

Shell imperforate, small, cylindrically fusiform, in dead condition yellowish-white; whorls 5, sculptured with regular, revolving lirae crossed by fine, transverse striae; suture impressed, finely lirate above; columella margin slightly oblique, diffused above into a thick, restricted and well defined, parietal callus which unites it with the upper margin of the labrum; labrum varicosely thickened behind, outwardly bevelled, angled at each point of termination of the revolving lirae; aperture rather oblique, ovate.

Alt. 4, diam. maj. 1.75, diam. min. 1.5 mm.

Aperture: alt. 1, diam. .75 mm.

*Hab.*—Ennur backwater, Madras.

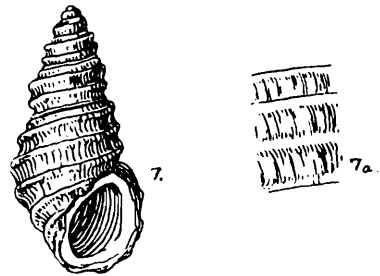


FIG. 7.—*Iravadia ennurensis*, sp. n.  $\times 6$ .

FIG. 7a.— do., sculpture,  $\times 18$ .

***Iravadia annandalei*, sp. n.**

Shell allied to *T. ennurensis*, but differing from that species in its more slender form, more acute lirations and obsolete, transverse striae, these latter being only indistinctly visible with the aid of the microscope; the aperture moreover is much smaller than in that species and the labrum is quite continuous, while it is possessed of an extra whorl, making 6 in all.

Alt. 3.75, diam. maj. 1.5, diam. min. 1.5 mm.

Aperture: alt. 1, diam. .5 mm.

*Hab.*—Ennur backwater, Madras

(*Type*); Cochin backwater, near Ernakulam (*F. H. Gravely*).

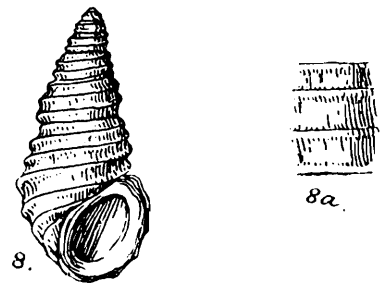


FIG. 8.—*Iravadia annandalei*, sp. n.  $\times 6$ .

FIG. 8a.— do., sculpture,  $\times 18$ .

**Family HYDROBIIDAE.*****Stenothyra perpumila*, sp. n.**

Shell perforate, minute, shortly fusiform, semi-transparent, polished, shining, milky white; whorls 4, the last convex; suture well impressed; umbilicus narrow; labrum continuous, opaque white, a little projecting in front; aperture almost circular.

Alt. 1.5, diam. .75 mm.

*Hab.*—Cochin backwater, near Ernakulam (*F. H. Gravely*).



FIG. 9.—*Stenothyra perpumila*, sp. n.  $\times 16$ .

## Family NATICIDAE.

**Natica marochiensis**, Gmelin.*Syst. Nat.* p. 3675, No. 15.

Cochin backwater, near Ernakulam (*F. H. Gravely*); Ennur backwater, Madras (a single young and dead specimen from each locality).

## Family TURRITELLIDAE.

**Vanesia rambhaensis** (Preston).*Rec. Ind. Mus.* X, 1914, p. 297 (as *Terebra*).

Cochin backwater, near Ernakulam; a single specimen only (*F. H. Gravely*).

The author is again indebted to Mr. T. Iredale for the above generic rectification; the genus *Vanesia* was described by A. Adams in the Annals and Magazine of Natural History, ser. 3, vol. VIII, 1851, p. 242, in whose opinion it might be allied to *Mesalia* and here the present writer is inclined to leave it; it certainly is far removed from the Opisthobranch genera among which it has found a resting place in the British Museum collection.

**Syrnola attenuata** (A. Ad.).*Sowerby, Thes. Conch.*, II, p. 811, pl. clxxi, fig. 22, 1855 (as *Obeliscus*).

Cochin backwater, near Ernakulam; a single dead and worn specimen (*F. H. Gravely*).

**Pyrgulina humilis** (Preston).

*Journ. Malac.* XII, 1905, p. 6, pl. ii, fig. 27 (as *Pyramidella* (*Mormula*)),  
*Rec. Ind. Mus.* XI, 1915, pp. 294-295 (as *Mormula*).

Cochin backwater, near Ernakulam (*F. H. Gravely*).

Mr. T. Iredale has again kindly assisted the author to a correction of former errors, he having very rightly pointed out that the present species should not remain in the genus *Mormula* but should be removed to *Pyrgulina*.

var. **chilkaensis** (Preston).*Rec. Ind. Mus.* XI, 1915, p. 295 (as *Mormula*).

Cochin backwater, near Ernakulam; found with the type from (*F. H. Gravely*).

## Family NERITIDAE.

**Theodoxus sowerbyana** (Recluz).*Proc. Zool. Soc. London*, 1842, p. 174.

Ennur backwater, Madras.

***Septaria crepidularia*, Lamarck.***Anim. s. Vert.*, VI, 2, 1822.Cochin backwater, near Ernakulam (*F. H. Gravely*).

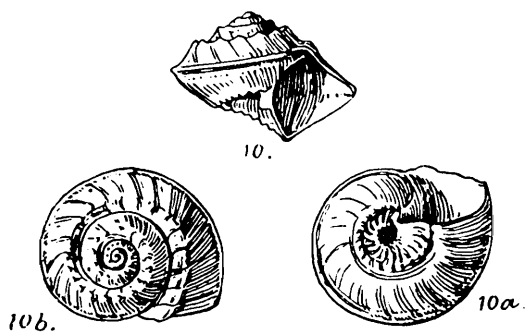
## Family TROCHIDAE.

***Solariella deliciosa*, sp. n.**

Shell small, rather depressedly conic, pale brownish-green, somewhat iridescent above, highly so on the base; whorls 4, carinately angled above the last volution also strongly carinate at the periphery, the upper carination being tubercled throughout, sculptured with very minute and closely-set microscopic, oblique, transverse striae; suture impressed; umbilicus ornamented round its margin with a broad ridge crossed by regular transverse costulae, moderately wide; columella margin rather sharply curved, outwardly expanded above into a white wing-like projection; labrum acute, sharply angled at the base and at the point of termination of the peripheral carina; aperture depressedly diamond shaped.

Alt 1.5, diam. maj 3.25, diam. min. 2.75 mm.

Aperture: alt. 1.25, diam. 1 mm.

*Hab.*—Ennur backwater, Madras.FIGS. 10, 10a, 10b.—*Solariella deliciosa*, sp. n.  $\times 6$ .

## Family CYCLOSTREMATIDAE.

***Cyclostrema micans*, A. Ad.***Proc. Zool. Soc. London*, 1850, p. 44.

Ennur backwater, Madras.

## Class LAMELLIBRANCHIATA.

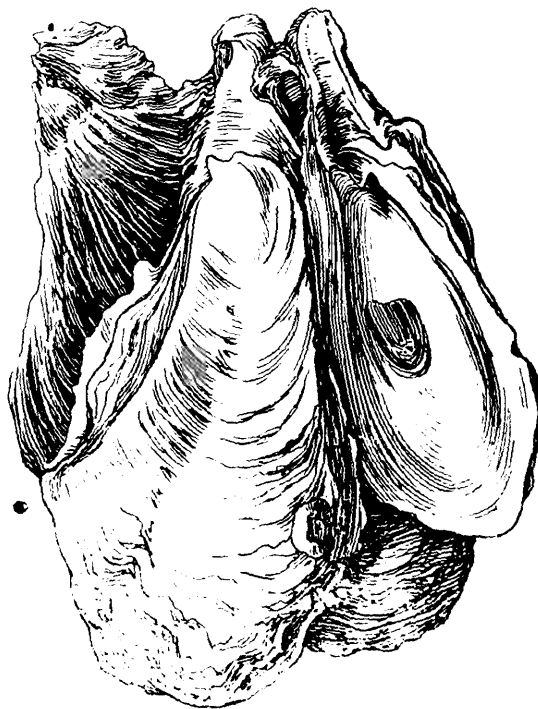
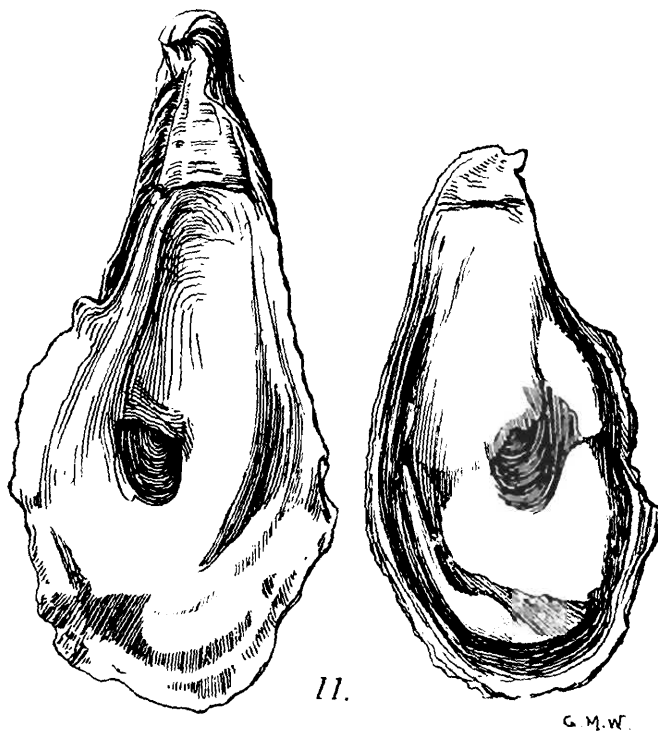
## Order TETRABRANCHIATA.

## Suborder OSTRACEA.

## Family OSTREIDAE.

***Ostrea madrasensis*, sp. n.**

This species may be compared to *O. virginica*, Gmel. (= *O. canadensis*, Lk.) from the E Coast of N. America, it is however of a straighter form and thinner texture and is much more foliaceous externally, the left valve is more concave and the



11a

FIGS. 11, 11a.—*Ostrea madrasensis*, sp. n.  $\frac{1}{2}$  nat. size.

inner margins of both valves, as well as the muscular scars, are of a deep purplish-black colour.

Long. 140, lat. 56.5 mm.

*Hab.*—Ennur backwater, Madras.

**Placuna placenta**, Linnaeus.

*Syst. Nat.* ed. 12, p. 1154 (as *Anomia*).

Ennur backwater, Madras (a single very juvenile specimen).

Suborder *MYTILACEA*.

Family MYTILIDAE.

**Modiola taprobanensis**, Preston.

*Ann. Mag. Nat. Hist.* ser. 8, XVI, p. 84.

Ennur backwater, Madras.

Suborder *ARCACEA*.

Family ARCIDAE.

**Arca granosa**, Lin.

*Syst. Nat.* ed. 12, p. 1142.

Ennur backwater, Madras.

**Arca (Fossularca) lactea**, Lin.

*Syst. Nat.* ed. 12, p. 1141.

Ennur backwater, Madras.

Suborder *CONCHACEA*.

Family VENERIDAE.

**Meretrix casta**, Chem.

*Conch. Cab.* VI, p. 349, pl. xxxiii, fig. 346 (as *Venus*).

Ennur backwater, Madras; Cochin backwater, near Ernakulam; juvenile specimens (*F. H. Gravely*).

**Meretrix ovum**, Hanley.

*Proc. Zool. Soc. London*, 1845, p. 21.

Cochin backwater, near Ernakulam.

**Meretrix zonaria**, Lamk.

*Anim. s. Vert.* VI, p. 299.

Ennur backwater, Madras; Cochin backwater, near Ernakulam (young specimens only from both localities).

**Chione imbricata, Sow.***Thes. Conch.* II, 1855, p. 715, pl. clvi, figs. 81, 82.

Ennur backwater, Madras.

**Chione marmorata, Lamarck.***Anim. s. Vert.* VI, p. 261 (as *Venus*).

Cochin backwater, near Ernakulam.

**Anomalocardia squamosa, Lin.***Syst. Nat.* ed. 12, p. 1133.

Ennur backwater, Madras (young specimens only).

**Tapes turgida, Lamk.***Anim. s. Vert.* VI, p. 353 (as *Venus*).

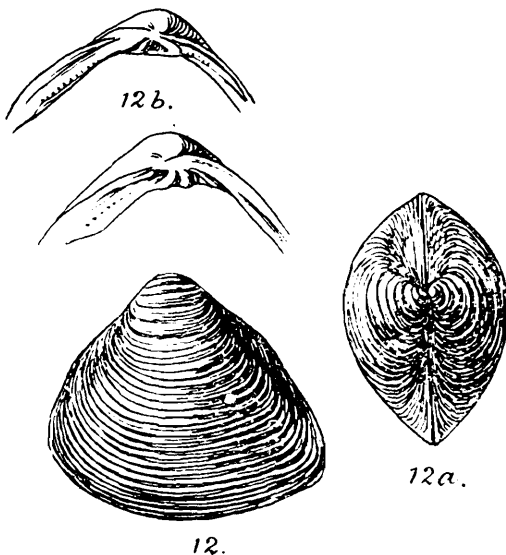
Cochin backwater, near Ernakulam.

## Family CYRENIDAE.

**Corbicula cochinensis, sp. n.**

Shell small, trigonal, covered generally and in type specimen

with a dark olive periostracum and showing traces of radiate painting; umbones not very prominent; both valves somewhat contracted in the posterior median part and coarsely and somewhat distantly, concentrically ridged towards the umbonal region, the ridges becoming suddenly finer and more closely-set and continuing thus to the margin; dorsal margin narrowly and strongly arched; ventral margin gently anteriorly rounded, elongated and very slightly contracted posteriorly; posterior side steeply sloping

FIG. 12, 12a.—*Corbicula cochinensis* sp. n.  $\times 6$ .FIG. 12b.—do., hinge,  $\times 9$ .

above, rounded below; anterior side also sloping above, rostrate below; interior of shell dark livid brownish-violet.

Long. 4, lat. 4.5 mm.

*Hab.*—Cochin backwater, near Ernakulam.

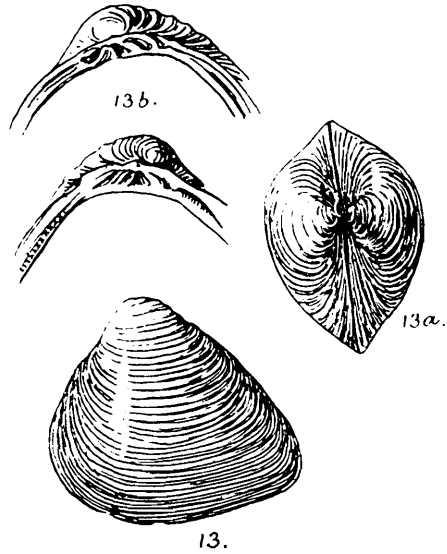
The colour of the shell varies from pale yellowish-green in certain specimens to the dark olive of the type, the paler specimens showing a number of narrow, transverse, radiate, reddish or purple bands.

***Velorita delicatula*, sp. n.**

Shell small, trigonal, dark olive gray; both valves sculptured in the umbonal region with fine, distant, concentric ridges which suddenly become much more serried and numerous, continuing thus throughout the remainder of the shell; umbones small, inwardly bent; dorsal margin sharply arched; ventral margin slightly rounded, a little contracted posteriorly; anterior side rather sharply rounded; posterior side sloping above, angularly rounded and a little rostrate below.

Long. 5, lat. 6 mm.

*Hab.*—Cochin backwater, near Ernakulam (F. H. Gravely).



FIGS. 13, 13a.—*Velorita delicatula*, sp. n.  $\times 4$ .  
FIG. 13b.—do., hinge,  $\times 8$ .

Family SOLENIDAE.

***Cultellus subellipticus*, Dunk.**

*Proc. Zool. Soc. London*, 1861, p. 421.

Ennur backwater, Madras (two young specimens).

***Solen fonesi*, Dunk.**

*Proc. Zool. Soc. London*, 1861, p. 419.

Cochin backwater, near Ernakulam (F. H. Gravely).

Order DIBRANCHIA.

Suborder LUCINACEA.

Family LUCINIDAE.

***Codokia fischeriana*, Issel.**

*Mal. del Mar. Rosso*, 1869, p. 83.

Ennur backwater, Madras.

## Suborder TELLINACEA.

## Family TELLINIDAE.

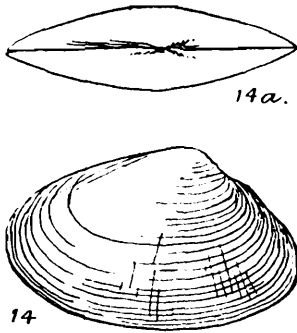
***Tellina ennurensis*, sp. n.**

Shell small, ovate, whitish, faintly tinged with pink, iridescent, polished, shining, marked with fine, concentric growth lines and indistinct, closely-set, transverse striae, these latter being only visible with the aid of the microscope; umbones small, not prominent; dorsal margin gently sloping anteriorly, rather steeply sloping posteriorly; ventral margin anteriorly, and in the median part, gently rounded, a little contracted posteriorly; anterior side rounded, somewhat produced;

posterior side shortly and bluntly rostrate.

Long. 4.75, lat. 7.25 mm.

*Hab.*—Ennur backwater, Madras.



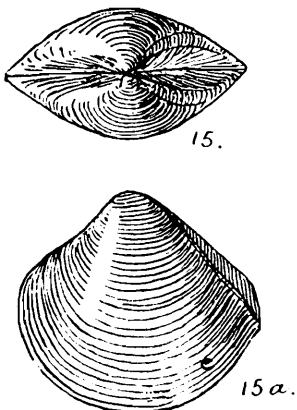
FIGS. 14, 14a.—*Tellina ennurensis*,  
sp. n.  $\times 4$ .

***Tellina brunneo-flavida*, sp. n.**

Shell convex, rather small, thin, roundly trigonal, pale yellowish-brown; both valves sculptured with slightly distant, concentric striae; umbones small, not very prominent; dorsal margin strongly arched, steeply descending on both sides; ventral margin rounded, posteriorly excavated; anterior side rounded; posterior side bluntly and abruptly rostrate, angled from the umbone downward.

Long. 7, lat. 7.5 mm.

*Hab.* — Ennur backwater,  
Madras.



FIGS. 15, 15a.—*Tellina brunneo-*  
*flavida*, sp. n.  $\times 3$ .

## Family SCROBICULARIIDAE.

***Theora opalina* (Hinds).**

*Proc. Zool. Soc. London*, 1843, p. 78 (as *Neaera*).

Ennur backwater, Madras; Cochin backwater, near Ernakulam (*F. H. Gravely*).

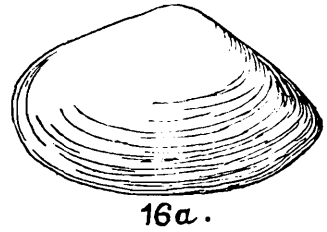
***Theora translucens*, sp. n.**

Shell allied to *T. iridescens* (Hinds)<sup>1</sup> from the Philippines, but much smaller and of a transparent yellowish-white colour, it having none of the milky semi-opaque appearance of that species; it also differs in the somewhat more prominent concentric lines and in being of a generally more regularly oval form, lacking as it does, the posterior ventral excavation and both the anterior and posterior dorsal curves of *T. iridescens*.

Long. 5, Lat. 8.25 mm.

*Hab.*—Ennur backwater, Madras.

FIGS. 16, 16a.—*Theora translucens* sp. n. × 4.

Suborder *ANATINACEA*.Family *CUSPIDARIIDAE*.***Cuspidaria annandalei*, Preston.**

*Rec. Ind. Mus.* XI, 1915, p. 308.

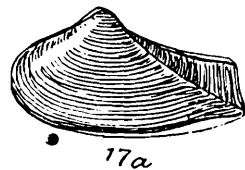
Ennur backwater, Madras; Cochin backwater, near Ernakulam (*F. H. Gravely*).

***Cuspidaria cochinensis*, sp. n.**

Shell small, thin, oblong, grayish-white, inequivalve, the left valve being slightly the smaller, both valves finely concentrically striate; umbones small, rather prominent; dorsal margin sloping anteriorly in a very slight curve and rather strongly curved and elongate posteriorly; ventral margin very gently and elongately rounded; anterior side sharply rounded; posterior side produced, strongly angled from the umbone downwards, very abruptly and squarely truncate.

Long. 1.5, lat. 3 mm.

*Hab.*—Cochin backwater, near Ernakulam (*F. H. Gravely*).



FIGS. 17, 17a.—*Cuspidaria cochinensis*, sp. n. × 8.

<sup>1</sup> *Proc. Zool. Soc. London*, 1843, p. 78 (as *Neaera*).



V FOUR NEW SPECIES OF *AULACOBOLUS*  
POC: (DIPLOPODA: SPIROBOLIDAE)  
FROM INDIA

By F. SILVESTRI.

The genus *Aulacobolus* was proposed by Pocock<sup>1</sup> for *Spirobolus uroceros*, Poc, from Madras and up to the present comprises in addition only *Spirobolus thurstoni*, Poc., also from Madras. Mr. F. H. Gravely has sent me specimens of two species collected at Kavalai and Mr. L. Newton specimens of two more collected on the Pulney Hills. Examination of this material has shown that the four species received by me are distinct among themselves and from the species named by Pocock, they are therefore described here as new.

It is worthy of record that the species of *Aulacobolus* are all from Madras and South India, as are also the two species of *Eucentrobolus*, Poc., a genus distinguished from *Aulacobolus* only by the very strange sculpture of the body.

*Aulacobolus excellens*, sp. n.

♀ Corpus niger capite, antennis pedibusque rubro-testaceis, vel testaceo-latericiis.

Caput sulco mediano in fronte, inter antennis, interrupto instructum, sublaevigatum, striis tantum nonnullis transversis per faciem inferiorem exaratum, clypei depressione laterali sat profunda; oculi subrotundi, ocellis c. 38 compositi; antennae (fig. I, 3) accomodatae mandibularum stipites haud superantes. Collum (fig. I, 1) margine antico ad oculorum latum externum rotundatim vix producto, lateribus sat angustatis trunci segmenti primi latera brevi spatio haud attingentibus, angulo antico acuto, rotundato, angulo postico exciso, obtuso, late rotundato, superficie sublaevigata.

Truncus. Segmentum primum lateribus quam colli latera deorsum aliquantum magis productis, carinam longitudinalem angulo antico acuto antrorsum aliquantum vergente, postico obtuso, margine infero integro formantibus; segmenti secundi latera ad segmenti praecedentis carinae libellam margine postico incrassato et retrorsum paullum producto; segmenta cetera cylindracea. Segmentorum omnium praezona sublaevigata, vix coriaria tantum subtus et postice sub poris striis nonnullis instructa,

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<sup>1</sup> *Ann. Mag. Nat. Hist.*, (7) XII (1903).

metazona gradatim magis elevata ita ut segmentorum margo posticus supra segmenti sequentis praezonam aliquantum altior sit, parum coriaria et longe sub poris longitudinaliter striata; sutura ut linea tenuis, supra poros evanescens, manifesta est; pori magni; sterna transverse et profunde striata. Segmentum praeanales (fig. I, 2) in processum longum, gradatim attenuatum, aliquantum arcuatum (convexitate supera), acutum, valvulas anales spatio longo superantem productum. Lamina infraanalis lata, brevis. Valvulae anales marginibus bene compressis, depressione praemarginali parva.

Pedes (fig. I, 5-7) sat longi et crassiusculi, ungue terminali longo.

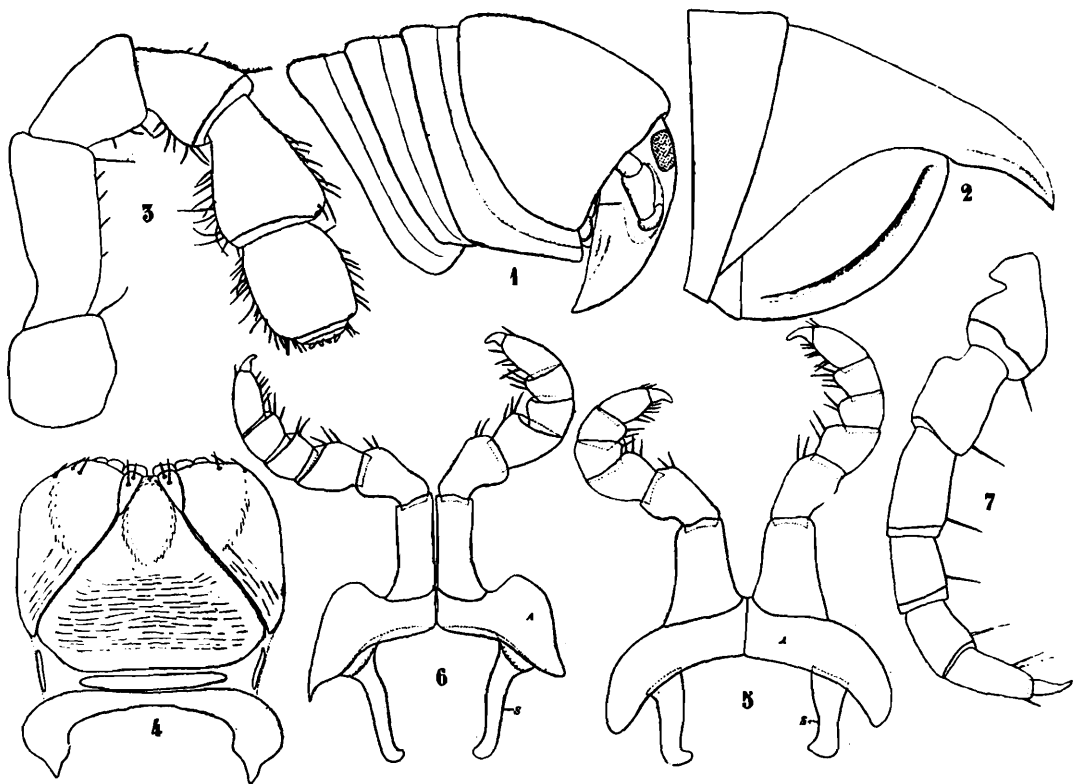


FIG. 1.—*Aulacobolus excellens*: 1. corporis pars antica lateraliter inspecta; 2. ejusdem pars postica; 3. antenna; 4. hypostoma; 5. pedes primi paris; 6. pedes secundi paris; 7. pes segmenti decimi: A. lamina ventralis; S. pera stigmatica.

Segmentorum numerus 51-54.

Long. corp. 160 mm., lat. 12, long. antennarum 8, pedum paris decimi 9.

♂ Corpus quam idem feminae parum magis attenuatum pedibus parum longioribus et crassioribus et articulo sexto soleato.

Organum copulativum vide fig. II.

*Habitat*.—Cochin State: Kavalai, 1300-3000 ft. (F. H. Gravely legit).

*Observatio*.—Species haec caudae forma ad *Aulac. uroceros* (Poc.) proxima est, sed magnitudine, sculptura et metazonarum forma, facillime distinguenda.

***Aulacobolus gravelyi*, sp. n.**

♀ Corpus niger capite, antennis pedibusque rubro-testaceis vel latericiis.

Caput laevigatum, medium sulco subcontinuo (tantum inter antennis subevanescente exaratum), clypei depressione laterali

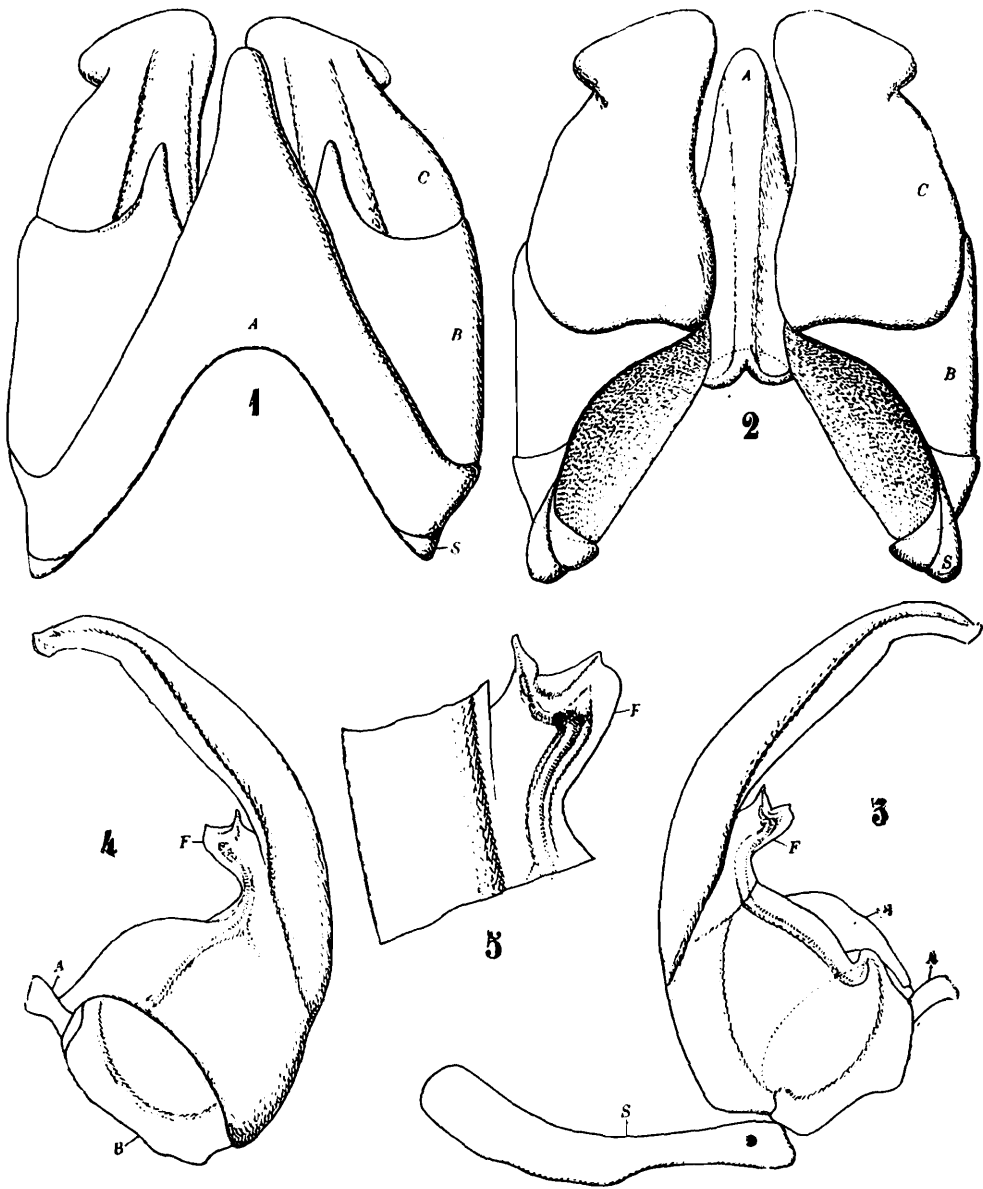


FIG. II.—*Aulacobolus excellens*: 1. organi copulativi par-anticum antice inspectum; 2. idem postice inspectum; 3. organi copulativi paris postici dimidia pars a latere externo inspecta; 4. eadem a latere interno inspecta; 5. ejusdem pars cum pseudoflagello magis ampliata: A. lamina ventralis; B. pedum articulus basalis; C. articulus secundus; F. pseudoflagellum; S. pera stigmatica.

parva; oculi ocellis c. 32, longitudinaliter 7-seriatis compositi; antennae (fig. III, 3) breves, accomodatae stipitum mandibularum apicem haud superantes. Collum (fig. III, 1) margine antico ad oculorum latera externa paullum convexo, lateribus trunci segmenti primi latera brevi spatio haud attingentibus, angustatis

et postice aliquantum magis quam antice rotunda'is, superficie laevigata.

Truncus. Segmentum primum lateribus quam colli latera deorsum aliquantum magis productis, carinam longitudinalem margine integro formantibus, angulo antico acuto, antrorsum et deorsum aliquantum producto; segmenti secundi latera ad segmenti praecedentis carinae libellam incrassata et retrorsum paulum producta; segmenta cetera cylindracea. Segmentorum omnium praezona supra pororum libellam longitudinaliter et creberrime striata, sub pororum libella vix coriaria, mesozona supra poros punctis parvis impressa, sub poris oblique striata, metazona laevigata, pone poros vix striata, longe sub poris longitudinaliter

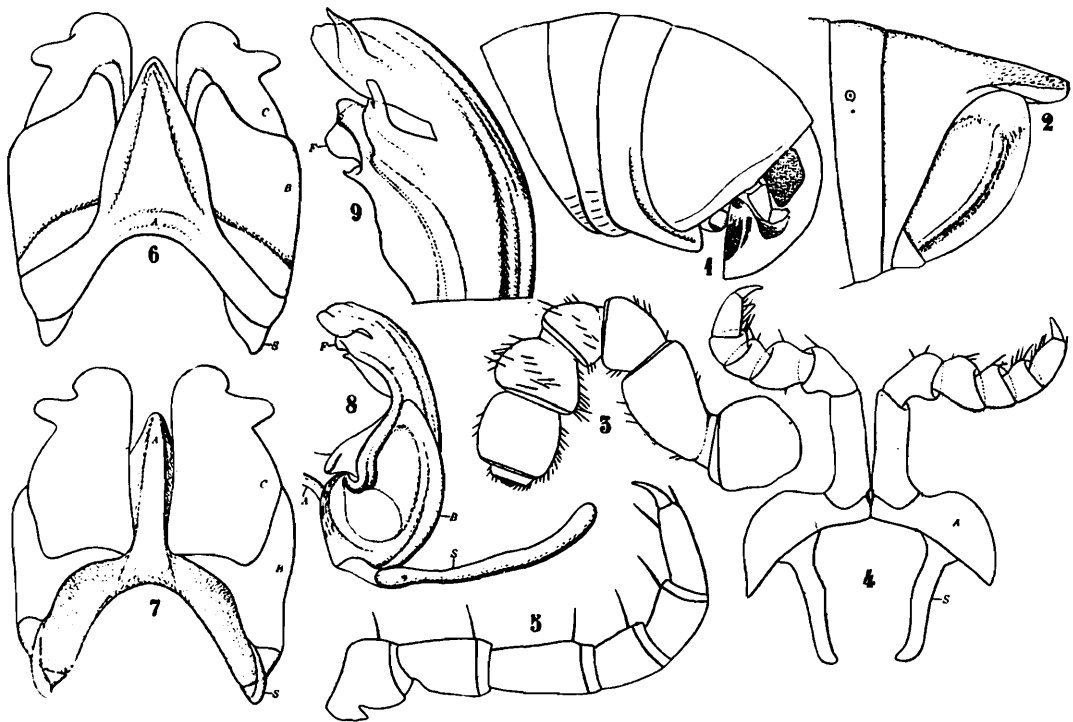


FIG. III.—*Aulacobolus gravelyi*: 1. corporis pars antica lateraliter inspecta; 2. ejusdem pars postica; 3. antenna; 4. pedes secundi paris; 5. pes segmenti decimi; 6. organi copulativi par anticum antice inspectum; 7. idem postice inspectum; 8. organi copulativi paris postici dimidia pars a latere externo inspecta; 9. ejusdem pars apicalis magis ampliata: litterae ut in fig. II.

striata; pori magni; sterna transverse et profunde striata. Segmentum praeanales (fig. III, 2) in processum sat longum, subrectum crassum, parum attenuatum, in apice obtusum productum, valvulas anales spatio sat longo superans. Lamina infraanalis brevis, lata, postice vix arcuata. Valvulae anales marginibus compressis praesertim postice, depressione praemarginali sat evoluta.

Pedes (fig. III, 4-5) breves, parum crassi.

Segmentorum numerus 51.

Long. corp. 120 mm., lat. 11, long. antennarum 6, pedum paris decimi 6 5.

♂ Corpus quam idem feminae parum magis attenuatum; pedes aliquantum crassiores, articulo sexto soleato.

Organum copulativum vide fig. III. 6-9.

*Habitat*.—Cochin State: Kavalai, 1300-3000 ft. (*F. H. Gravely*, cui species grato animo dicata est, legit).

*Observatio*.—Species haec a ceteris omnibus mihi notis segmentorum numero, metazonis haud elevatis, laevigatis, organi copulativi forma distinctissima est.

***Aulacobolus newtoni*, sp. n.**

♀ Corpus nigrescens capite et antennis latericiis, pedibus rufescentibus vel fulvo-ferrugineis.

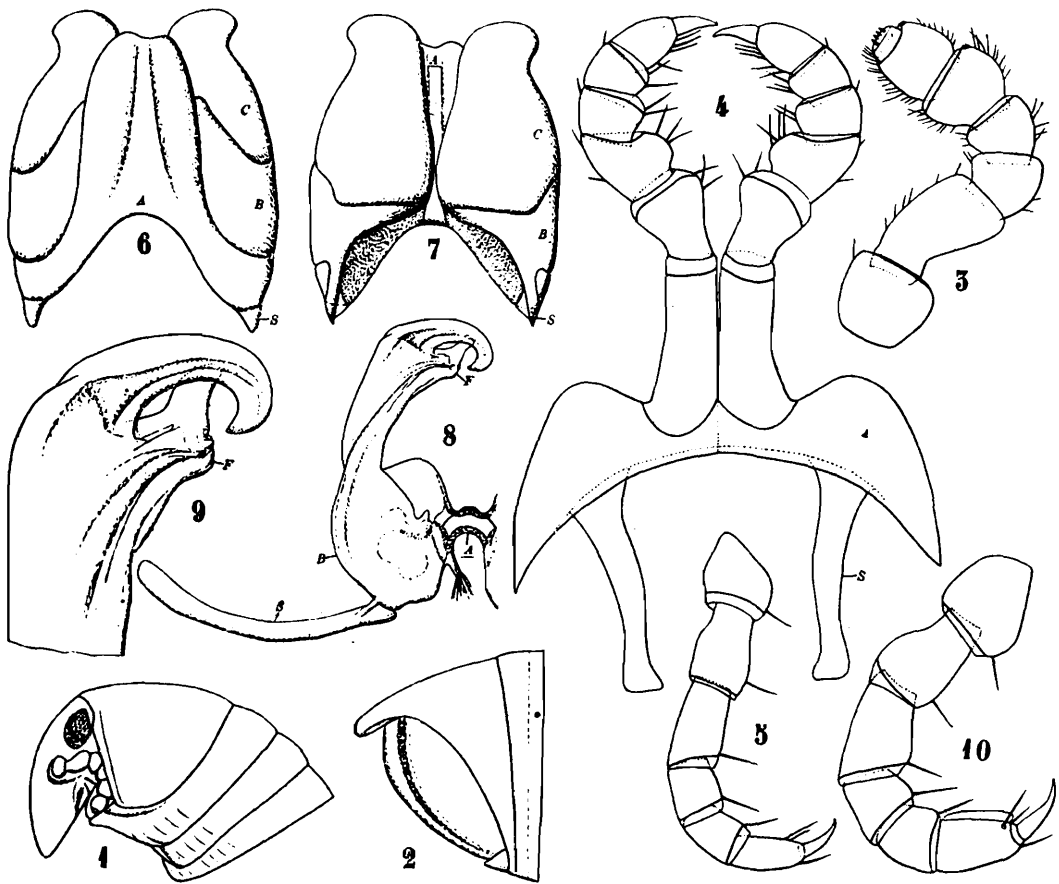


FIG. IV.—*Aulacobolus newtoni*: 1. corporis pars antica lateraliter inspecta; 2. ejusdem pars postica; 3. antenna; 4. pedes secundi paris; 5. pes paris decimi; 6. organi copulativi par anticum antice inspectum; 7. idem postice inspectum; 8. organi copulativi paris postici dimidia pars a latere externo inspecta; 9. ejusdem pars apicalis magis ampliata; 10. maris pes segmenti decimi: litterae ut in fig. II.

Caput totum minute et sat crebre punctatum, per faciem mediam ab antennarum libella ad labrum sulcatum et transverse striatum, vertice sulco sat profundo; clypei depressione laterali parum profunda; oculi ocellis c. 35, longitudinaliter 7-seriatis, instructi; antennae (fig. IV, 3) breviores, accomodatae apicem mandibularum stipitum haud superantes. Collum (fig. IV, 1) pone oculorum marginem externum paullum emarginatum et ab hoc puncto usque ad angulum externum linea postmarginali

perparva instructum, angulis lateralibus postice quam antice magis excisis et rotundatis, superficie leviter coriaria.

Truncus. Segmentum primum lateribus quam colli latera deorsum aliquantum magis productis, carinam longitudinalem formantibus angulo antico acuto antrorsum et deorsum aliquantum producto; segmenti secundi latera ad segmenti praecedentis carinae libellam deorsum et retrorsum vix producta, segmenta cetera cylindracea; segmentorum omnium praezona supra pororum libellam longitudinaliter striata, sub pororum libella sublaevigata, vix oblique striata, mesozona punctato rugosa, sub poris gradatim magis distincte oblique striata metazona quam mesozona paullum magis elevata coriaria pone poros longitudinaliter sulcata et longe sub pororum libellam longitudinaliter striata; pori magni; sterna transverse striata. Segmentum praeanae (fig. IV 2) in processum sat longum, crassiusculum, paullum arcuatum (convexitate supra), in apice obtusum, valvulas anales spatio parvo superantem productum. Lamina infraanalis brevis, lata, postice subrecte truncata. Valvulae anales sat longae, marginibus, postice quam antice magis compressis, depressione praemarginali sat magna.

Pedes (fig. IV, 5) breves, sat tenues, ungue longo.

Segmentorum numerus 49.

Long. corp. 80 mm., lat. 7.6, long. antennarum 3.80, pedum segmenti decimi 4.70.

♂ Corpus quam idem feminae aliquantum longius (ad 90 mm.) et angustius (ad 7.2 mm) metazonis parum magis elevatis et sutura profundiore. Pedes (fig. IV, 1) aliquantum longiores et crassiores, articulo sexto bene soleato.

Organum copulativum vide fig. IV, 6-9.

*Habitat.*—Vicinity of Kodaikanal, Pulney Hills, 5000-7000 ft. (*L. Newton*, cui species grato animo dicata est, legit).

*Observatio.*—Species haec ad *Aul. thurstoni* (Poc.) proxima est, sed corporis sculptura et organi copulativi forma saltem distincta est.

### ***Aulacobolus variolosus*, sp. n.**

♀ Corpus nigro-castaneum capite et antennis latericiis, pedibus rubrotestaceis.

Caput vertice sub collo oblecto, faciei superficie coriaria et media parum longe ab antennarum libella ad labrum sulco gradatim magis manifesto sulcata, verticis sulco sat profundo, clypei depressione laterali sat profunda; oculi sat magni, subovales, ocellis c. 30, longitudinaliter 7-seriatis, compositi; antennae (fig. V, 3) breviores, accommodatae mandibularum stipitum apicem haud superantes. Collum (fig. V, 1) magnum, lateraliter inspectum mandibularum stipites omnino obtegens, margine antico pone oculos parum sinuato, margine antico laterali quam postico laterali multo magis exciso, rotundato, angulo laterali acuto, rotundato, trunci segmenti primi marginem inferum parvo spatio haud attingente, superficie tota punctata et parum rugosa.

**Truncus.** Segmentum primum lateribus latis quam colli latera deorsum parum magis productis, carinam longitudinalem formantibus angulo antico acuto antrorsum et deorsum aliquantum producto, margine infero obtuse 3-5 dentato; segmenti secundi latera ad segmenti praecedentis carinae libellam deorsum et retrorsum vix producta; segmenta cetera cylindracea. Segmentorum omnium praezona leviter striata, mesozona supra poros coriaria-reticulata, sub poros oblique striulata, metazona quam mesozona aliquantum magis elevata, variolosa, pone poros pro-

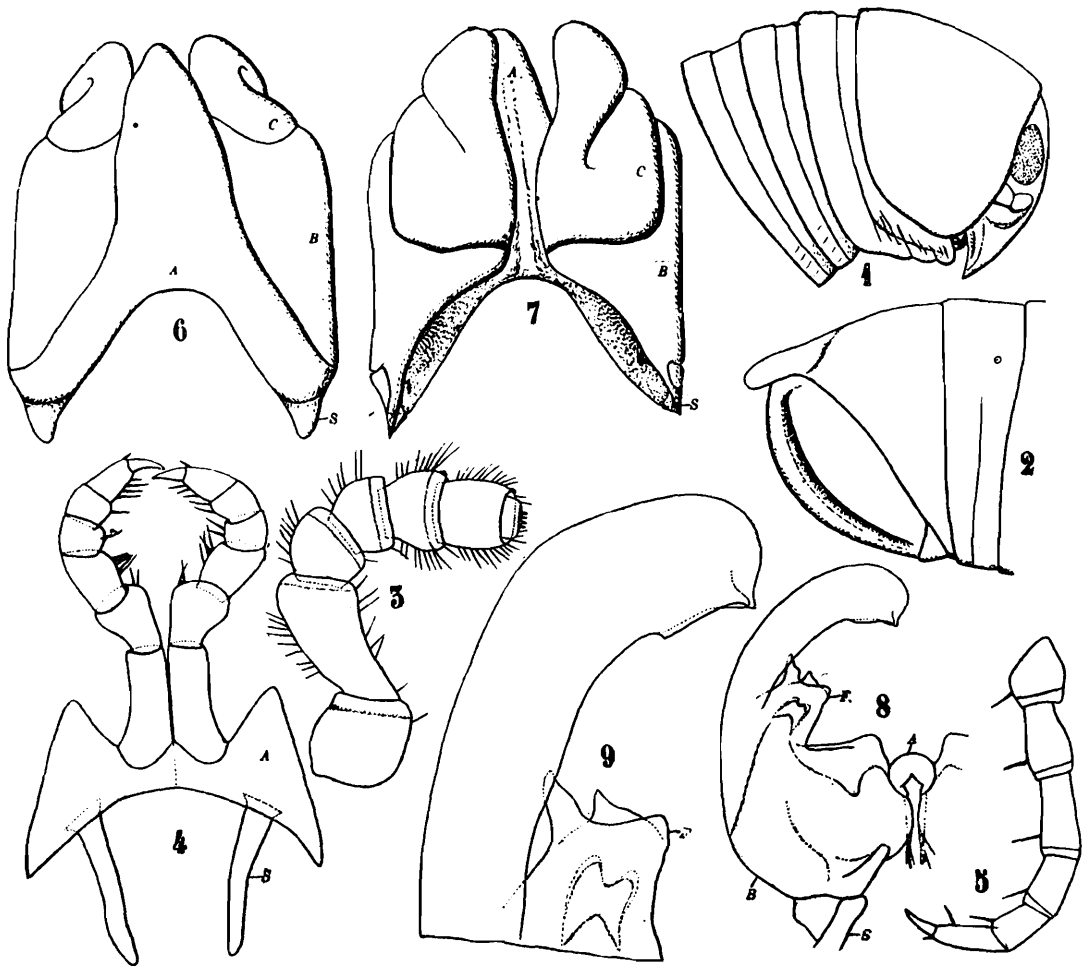


FIG. V.—*Aulacobolus variolosus*: 1. corporis pars antica lateraliter inspecta; 2. ejusdem pars postica; 3. antenna; 4. pedes paris secundi; 5. pes paris decimi; 6. organi copulativi par anticum antice inspectum; 7. idem postice inspectum; 8. organi copulativi paris postici dimidia pars ex latere externo inspecta; 9. ejusdem pars distalis magis ampliata: litterae ut in fig. II.

funde sulcata et longe sub poros longitudinaliter profunde striata; pori magni, sterna segmenti secundi (fig. V, 4) infra triangulariter producta, sterna coalita transverse striata. Segmentum praeanales (fig. V, 2) in processum sat longum, crassum, paullum arcuatum (convexitate supera), in apice obtusum valvulas anales spatio parvo superantem, productum. Lamina infraanalis brevis, lata, postice subrecte truncata. Valvulae anales punctatae, marginibus partem posticam versus gradatim magis compressis et depressione praemarginali bene evoluta.

Pedes (fig. V, 4-5) breves, sat tenues.

Segmentorum numerus 45.

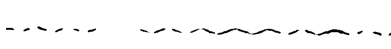
Long. corp. 85 mm., lat. 9, long. antennarum 4.30, pedum segmenti decimi 6.25.

♂ Corpus quam idem feminae paullo angustius pedibus aliquantum robustioribus et longioribus, articulo sexto soleato.

Organum copulativum vide fig. V, 6-9.

*Habitat*.—Vicinity of Kodaikanal, Pulney Hills, 5000-7000 ft. (*L. Newton* legit).

*Observatio*.—Species haec ad *A. newtoni*, Silv. proxima est, sed colli forma, corporis sculptura et segmentorum numero, cauda crassiore, nec non organi copulativi forma facile distinguenda est.



## VI ON THE HYDROZOOON CAMPANULINA CEYLONENSIS (BROWNE)

By R. E. LLOYD, M.B., D.Sc., Major, I.M.S., Professor of Biology,  
Medical College, Bengal, and N ANNANDALE, D.Sc., F.A.S.B.,  
Superintendent, Indian Museum.

### I.—THE SYSTEMATIC POSITION AND SYNONYMY OF THE SPECIES.

By N. ANNANDALE.

The medusa of this species was described by Browne<sup>1</sup> in 1905 under the name *Irene ceylonensis*, while the hydroid was discovered by myself<sup>2</sup> in 1906. In a recent paper<sup>3</sup> I have referred the species to the genus *Campanulina*, van Beneden, and this attribution is fully borne out by a detailed examination since made of the living hydranth.

Medusae that agree, so far as structure is concerned, in every respect with Browne's figures and description of *I. ceylonensis* have made their appearance in great numbers in a canal of brackish water in Calcutta in July, 1915, the water having, at the place and time at which specimens were taken, a specific gravity of 1.0085 (the reading corrected to a standard temperature of 15°C.), and no great difficulty has been experienced in rearing young colonies of hydroids in a bell jar. The development is rapid. Medusae were placed in the bell-jar, which was filled with water from the canal, on July 5th; on July 7th numerous planulae and single minute hydranths, many of which had attached themselves to the cast skins of Copepods, were found, with intervening stages; while two days later young colonies were observed with a single perfect hydranth and a short rhizome bearing at least two hydranth-buds. The buds had the capitate form of those of *C. acuminata* (Alder) as figured by Hincks.<sup>4</sup> The hydranth figured here was sketched from life on July 10th, by Babu D. N. Bagchi; only the part exerted from the hydrotheca is shown. The column was capable of great elongation, but the tentacles seemed to be less extensile than in the adult and the whole organism was less sensitive.

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<sup>1</sup> In Herdman's *Rep. Ceylon Pearl Fish.*, IV, p. 140, pl. iii, figs. 9-11 (1905).

<sup>2</sup> *Rec. Ind. Mus.*, I, p. 142, fig. 4 (1907).

<sup>3</sup> *Mem. Ind. Mus.*, V, p. 105 (1915).

<sup>4</sup> *Brit. Marine Hydroid Zoophytes*, pl. xxxvii (1868).

This hydranth though immature in several respects, already exhibits the generic characters of that of *Campanulina*, being webbed at the base of the tentacles, which are surrounded by regular circles of nematocysts, and having a short conical hypostome. The hydrothecae of the adult hydroid only differ from those of more robust species of the genus in that each grows on a short stalk that arises directly from an adherent stolon while the gonothecae closely resemble those of *C. repens*, Allman, in outline. Major Lloyd<sup>1</sup> tells me that a short stem bearing a gonotheca as well as a hydranth is sometimes produced and that more than one medusa is often produced in a single gonotheca.

If it is necessary to place the medusa as distinct from the hydroid in a recognized genus, greater difficulty is experienced. It agrees with *Phortis*, McCrady, and differs from *Eirene* and *Tima*, Eschscholtz, in not possessing marginal cirri, but the ten-

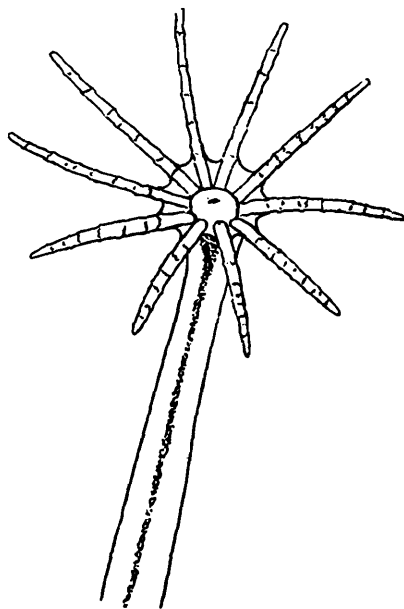


FIG. 1.—Young hydranth of *Campanulina ceylonensis* (highly magnified).

tacles have a narrow longitudinal band of muscle on the velar surface and the gonads are less restricted in position than in most species of *Phortis*, though they do not until very fully ripe extend along the manubrial peduncle as in *Tima*. On the whole, therefore, the medusa may be said to occupy a position intermediate between *Tima* and *Phortis*, but to be nearer the authentic species of the latter, to which it should probably be assigned, as Meyer<sup>2</sup> suggests.

The name *Campanulina* (1847) has priority over *Phortis* (1857) by ten years.

<sup>1</sup> I regret that, as I am about to leave India for some months, I have not been able to read Major Lloyd's paper printed below. He has, however, kindly informed me as to the results of his observations, and shown me his preparations.

<sup>2</sup> *Medusae of the World*, II, p. 309 (1910).

The only species of *Phortis*, that has been traced to its hydroid, if we except "*Irene ceylonensis*," is *P. gibbosa* (McCrady), the life-cycle of which was worked out by Brooks<sup>1</sup> in North America. His description, which is brief and unaccompanied by figures, does not conform to *Campanulina* in that it makes no mention of an operculum to the hydrotheca or of a webbing of the tentacles, but both these points are difficult to detect unless attention is specially directed to them and the general conformation of the colony is not unlike that of the species found in the Gangetic delta.

Some of the medusae from Calcutta lived in captivity for a week, though all of them had apparently shed their gonads at least three days earlier. Those that remained alive at the end of the week were, as was shown by the asymmetrical form of their bells and their feeble and irregular pulsations, in a degenerate condition. They had, moreover, assumed completely the peculiarities regarded by Browne (*op. cit.*, p. 141, pl. iii, figs. 12-16) as diagnostic of his *Irene palkensis*. When the gonads first reach or approach maturity the tentacles alternate with sense-organs round the margin of the bell; the former are capable of great elongation and all are complete in structure; the otocysts are small and each contains a single otolith or sometimes a pair of otoliths. The shedding of the sexual products apparently takes some days. When it commences the gonads do not extend down the manubrial peduncle, but as it proceeds and approaches completion they do so to some extent. Meanwhile considerable changes take place on the margin of the bell. Numerous additional tentacles begin to bud out, but as a rule only the basal bulb is completed and the filamentous part is altogether abortive. At the same time the otocysts increase greatly in size, becoming three or four times as large as hitherto; the otoliths multiply, so that there may be as many as eight in a single sense-organ, and finally the whole structure divides into two otocysts. Details as to the process of division have not yet been worked out either in the cysts or in their contained concretions.

These changes in the tentacles and sense-organs prove that Browne's two species, *Irene ceylonensis* and *Irene palkensis*, are identical or rather that the latter represents merely a degenerating phase of the former.

Before the sexual products are completely shed the upper part of the bell often becomes constricted, the constriction involving not only the jelly but also the upper part of the subumbrellar cavity. The tentacles then degenerate, and finally both they and the sense-organs disappear. The bell shrinks to a half or a third, and finally to about a sixth of its original size and at last ceases to pulsate. The manubrium, however, though also shrunken, still exhibits languid movements, which persist for some days after the complete disappearance of the marginal structures and even

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<sup>1</sup> *Stud. Biol. Lab. John Hopkins Univ.*, II, p. 470 (1883).

of the radial canals. Death is thus extremely gradual. All these points are clearly important in considering the systematic position of any medusa that exhibits the slightest signs of degeneracy.

## II.—LIFE HISTORY OF THE HYDROID AND MEDUSA.

By R. E. LLOYD.

In July 1915, Dr. Annandale informed me of the occurrence of the Medusa, *Irene ceylonensis* (Browne), in the brackish water of a canal in the neighbourhood of Calcutta and suggested that I should enquire into its life-history as his own observations on the subject had to be discontinued. He also kindly lent me a stained permanent preparation showing several planulae, some with budding hydroids and stolons. This preparation was made by Mr. F. H. Gravely from material gathered from the bottom of a glass bowl in which a number of the medusae with ripe gonads had been confined for observation.

About the middle of July, the medusae were plentiful throughout the canal so that I was able to obtain a large number, varying in diameter from about 2.5 mm. to 2.5 cm. By the end of the month however none were to be found. No doubt they were killed by the heavy monsoon rain, which greatly diminishes the salinity of the water.

I was unsuccessful in again raising the planulae in captivity but was fortunate in obtaining some colonies of the hydroid growing in the canal attached to stones. Some were kept alive for ten days, affording good opportunity for observation. Several gonosomes were obtained from these colonies. These were stained and mounted in Canada balsam. They show certain stages in the development of the medusa, especially the early and late stages, in a satisfactory manner.

### *The Hydroid Colony.*

The hydroid was defined by Dr. Annandale from material taken in brackish water at Port Canning, but as I had the opportunity of examining the living animal from day to day in the laboratory a few further remarks on its structure will be made.

The hydroid varies considerably in size. Only the larger and older individuals can be discerned by the naked eye. The colony as a whole is much less conspicuous than most hydroid colonies. The stolon seldom divides, so that it is easy to strip off as much as an inch from the substratum without meeting any outgrowths except the hydrothecae. The stolon however does occasionally branch, the growing point dividing in a simple dichotomous manner.

The coenosarc of the stolon has a different appearance from the coenosarc of the hydroid, due principally to the fact that the endoderm cells of the stolon are granular and opaque while those of the hydroid are clear, vacuolated and much larger. The hy-

droid is not set directly upon the stolon but upon short intermediate branches which have the same structure as the stolon. The line of attachment of the hydroid to these intermediate branches is most conspicuous when the hydroid is contracted, but it is visible at all times as a sudden change in the character of the endoderm cells.

The intermediate branch as well as the hydroid lies in the hydrothecae.

#### *The Hydrotheca.*

As a rule the hydrothecae arise directly from the perisarc of the stolon. Occasionally, however, they arise from short lateral branches which are common to them and to a gonotheca. They measure .45 mm. by .15 mm. (*Annandale*). They terminate in a conical pointed operculum consisting of a number of acute converging projections of the perisarc which together closely resemble the peristome of a moss capsule. The number of these processes is about twelve but they are difficult to count owing to their transparent delicacy.

The method of the opening and closing of the hydrotheca is simple and effective, depending as it does upon the elasticity of the marginal projections and upon a slight upturning of their points. Because of their elasticity they tend to converge so that they are always in contact with the stalk of the hydroid even when it is fully extended. At first sight it seems that in this condition the converging points would hinder the withdrawal of the hydroid by catching in rugosities projecting from the surface of the stalk during contraction, and it also seems likely that the points would strangle the neck and so prevent the entry of the head into the theca. Such possibilities are prevented by the slight upturning of the points. The act of withdrawal is not easy to observe. Low degrees of magnification are insufficient for the purpose, but when using the high power it is of course necessary to cover the object which causes immediate and lasting contraction of the hydroid. The difficulty was overcome by using an ocular of very high power with a low power lens. Ocular No. 18 such as is supplied with Zeiss' oil immersion lens combined with an objective  $\frac{2}{3}$  in. focus gave good results. A portion of a colony living undisturbed in a capsule of water was thus magnified about 200 times so that the act of withdrawal could be observed.

#### *The Hydroid.*

The principal features of the hydroid are well known. The web or membrane uniting the bases of the tentacles being the chief characteristic. The fully extended stalk of a large individual measures about 2 mm. in length by .06 mm. in thickness. In the living animal the ectoderm of the stalk is a very thin layer devoid of cell outlines or nematocysts. The outlines of the endoderm cells on the other hand are plainly visible even under the low power of the microscope. In the expanded state each endoderm

cell appears to contain a single vacuole, so large that the protoplasm is reduced to a delicate peripheral layer in which nuclei are scarcely visible. Except for the granular contents of the gut cavity the stalk is transparent. The appearance of transverse lines in it is due to protoplasmic septa composed of the peripheral layers of adjacent endoderm cells which separate the vacuoles.

Since the diameter of the hydrotheca is not much more than twice the diameter of the extended stalk, it is evident that the cubic content of the stalk must be very much reduced before it can be accommodated by the hydrotheca during contraction. This reduction must be brought about by evacuation of fluid from the vacuoles of the endoderm cells. The process however was not observed. As mentioned before, the endoderm cells of the stalk present a very different appearance from those of the stolon and intermediate branches, the latter being granular and not vacuolated. The transition from the one to the other is sudden. When extended the stalk is straight and stiff. It usually appears to be motionless but on attempting to draw the outline with the Camera lucida, it becomes evident that the animal is seldom quite motionless. In the largest individuals the tentacles are constantly sixteen in number. When extended they measure about .5 mm. in length and they are usually held in two series, eight of them springing from the base of the hypostome at an angle somewhat less than a right angle, while the other eight which alternate with them project more downwards. When the tentacles are in this position the margin of the web forms a characteristic zig-zag outline. The web measures about .06 mm. from its margin to the angle between adjacent tentacles. The tentacles are as usual in the Calyptoplastica devoid of a central cavity, the outline between the endoderm cells being plainly visible in the living animal. That part of the base of the tentacles which lies in the web usually includes three endoderm cells and bears a few scattered nematocysts. Throughout the length of the tentacles the nematocysts are disposed somewhat irregularly in rings, one ring corresponding roughly to each endoderm cell.

### *Habits.*

The hydroid first found at Port Canning was living in association with the protozoon *Folliculina* and this organism also occurred among the colonies taken from the canal. A species of small Polychaet worm (*Spioniformia*), however, was found more plentifully in association with the hydroid at Calcutta. The delicate sandy tube of the Polychaet was frequently interwoven with the stolon of the hydroid. On one occasion I was able to observe the hydroid preying upon the worm. Three fully expanded hydroids which happened to be adjacent were under observation in a capsule of water. An immature worm measuring about a millimetre in length came within reach of their tentacles and was soon fast entangled and paralysed. One hydroid attached itself to the mouth of the worm another to the anus, while the third which

apparently obtained no nourishment helped to subdue the struggles of the victim. A yellowish granular stream, the blood and coelomic fluid of the worm was seen pouring slowly into the two hydroids which were attached terminally. The enteron of the hydroids became considerably expanded for a short distance below the tentacles and this expansion was no doubt the means of suction. A lesser expansion at this point is frequently visible even in the resting condition (plate v, fig. 1). The nourishment was not retained by the hydroids but passed on rapidly into the general coenosarc of the colony. Within five minutes from the commencement of the operations, the stems of the hydroids which remained extended throughout had regained their usual glassy appearance. The body of the worm, motionless and shrunken, was released in less than five minutes after capture.

### *The Gonosome.*

The gonosome was found in various stages of development (plate vi). Although the series illustrated is not complete the earliest and later stages are well represented. In the latest the young medusa can be seen lying within the gonotheca provided with tentacles and sense vesicles. Although the manubrium is still imperforate, the medusa is evidently almost ready to be liberated. As estimated from the drawing to scale, the convexity of the bell of the medusa lying within the gonotheca measures about 7 mm. in the specimen figured. The diameter of the bell in the smallest medusa caught swimming freely was at least 2 mm. There is therefore an interval in the life-history including the liberation of the medusa and the first part of its free life which was not observed.

There are usually two medusae in each gonosome, a proximal and a distal, the latter being always the more developed. Sometimes only one medusa occurs which probably represents the proximal member of the pair after the liberation of the distal member. About 1 in 5 of the mature gonosomes were in this condition.

The gonosome of *Campanulina* was described by Hincks as growing from the stolon and containing one medusa. In this species, however, the gonosome usually grows from the base of a hydrosome and contains two medusoid buds.

In its earliest phase the gonosome appears as a tubular outgrowth from the coenosarc which sometimes arises from the main stolon but more often from the intermediate branches near the base of the hydrosome. This tubular outgrowth is a blastostyle which gives rise to the two medusae by budding. Before any buds have appeared upon it, the blastostyle has a characteristic appearance. It is, we have seen, a tubular outgrowth of the coenosarc and throughout most of its length it appears to have the same structure as the coenosarc of the stolon, the cells of both ectoderm and endoderm being opaque and finely granular. Close to the extremity, however, the cells have a different appearance,

being translucent and vacuolated, having indeed the same appearance as the cells of the hydrosome. It has been mentioned that the change in the appearance of the cells at the base of the hydrosome is characteristic and sudden. The junction between the translucent end of the blastostyle and the opaque proximal portion has exactly the same appearance (plate vi, fig 1). The translucent end of the blastostyle therefore perhaps represents a reduced hydrosome. Be that as it may, it is a conspicuous feature of the gonosome visible from first to last, forming in the later stages a kind of lid closing in the gonotheca. It may be referred to as the operculum.

The medusae arise from buds which spring from the stem of the blastostyle below the operculum. They appear to arise in the usual manner by the sinking in of an entocodon. A conspicuous feature of the development is the early formation of four large lappets, placed radially on the margin of the bell. Upon these the tentacles appear at a later stage.

At the time when the first bud appears upon the blastostyle, it is evident that the cavity of the operculum is in open communication with the cavity of the cylindrical stem. But later when the development of the medusae is more advanced, the stem of the blastostyle becomes flattened out and can scarcely be traced. But even at a comparatively late stage the endodermal cavity of the two growing medusae may be seen communicating with one another through the cavity of the blastostyle. One specimen shows a similar communication between the cavity of a medusa and that of the operculum. Though much compressed and rendered inconspicuous by the growing medusae, it is probable that the stem of the blastostyle preserves its status until the end. Thus, in the oldest gonosome met with, the stem of the blastostyle can plainly be seen between the two medusae, and its communication with the cavity of the operculum may be inferred owing to an interesting circumstance. The cavity of the stem of the blastostyle contains a number of irregular nucleated cells which have much the appearance of phagocytes and the same kind of cells are to be seen in the cavity of the operculum. This fact indicates that the communication between the stem of the blastostyle and the operculum persists to a late stage. Little seems to be known of phagocytosis among the Coelenterata but it is unlikely that a process so general in the animal kingdom should not occur in this group. It is possible that the presence of these cells, which, as I have said, have the appearance of phagocytes, indicate the approaching dissolution of the distal part of the gonosome and the liberation of the mature medusa.

#### *The Gonotheca.*

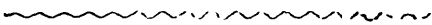
In the early stages of its development the gonosome is completely enclosed by a delicate perisarc. The later history of this layer, as to how and when it allows the liberation of the medusae, was not ascertained.

*The Free Medusa.*

The medusa was described by Browne from specimens taken in the sea off Ceylon, and its systematic position has been discussed by Dr. Annandale in the first part of this paper. It is therefore unnecessary to say much more beyond reference to the peculiar condition under which the organism was found in Calcutta. The unusual and sudden appearance of a swarm of medusae in a brackish canal—far removed from the sea though connected at one point with the tidal waters of the Hooghly—make it most likely that the medusae were all of one species. An examination showed beyond doubt that the many hundreds of specimens taken by the tow-net were indeed of one species though varying very much in appearance according to age and state of activity. Plate vii, fig. 1 gives some idea of the appearance presented by a number of the medusae at the time of capture. At first sight one might suppose that they included several distinct species. The largest, bearing ripe gonads, measured about 2.5 cm. in diameter, the height of the bell during relaxation being about two-thirds of the diameter, but specimens preserved in formalin are usually flatter than this. Half-grown specimens, especially when swimming actively, appear higher than they are broad and in this condition the tentacles may stream out to a length two or three times greater than the height of the bell. When resting they assume a flatter shape and the tentacles are considerably contracted. In this condition the peduncle and manubrium together can often be seen revolving about the fixed base. While so engaged the mouth and lips appear to clean the tentacles and search the groove between the velum and inner wall of the bell for adherent food particles.

The smallest specimens, measuring 2-3 mm., show certain differences from the mature form. The peduncles of the manubrium, which is a characteristic feature of the adult, is scarcely represented. The sense vesicles are less numerous than the tentacles, nor are they so regularly disposed in alternation with the tentacles as in the adult; but this is only to be expected at a time when the tentacles are rapidly increasing in number. Plate vii, fig. 4 shows a young medusa with eight tentacles, six sense vesicles and a number of tentacular buds. At this time the primitive germ cells are distinctly visible and they can be seen even before the medusa has left the gonosome.

In the mature condition the generative cells are disposed along the radial canals from the base of the peduncle to the margin of the bell. They form prominent ridges with a somewhat contorted edge which projects from the lower surface of the bell. A section across one of these ridges shows the radial canal lined by attenuated columnar cells between which and the very delicate ectoderm the generative cells lie.

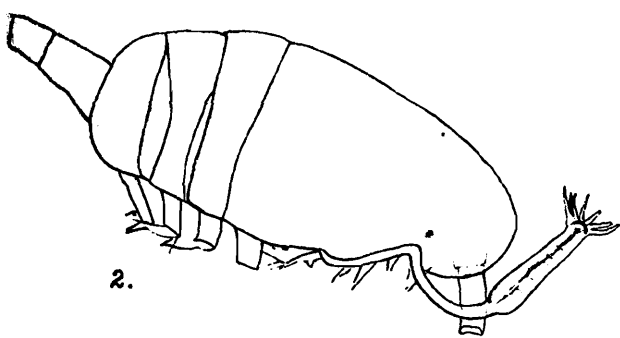


## EXPLANATION OF PLATE V

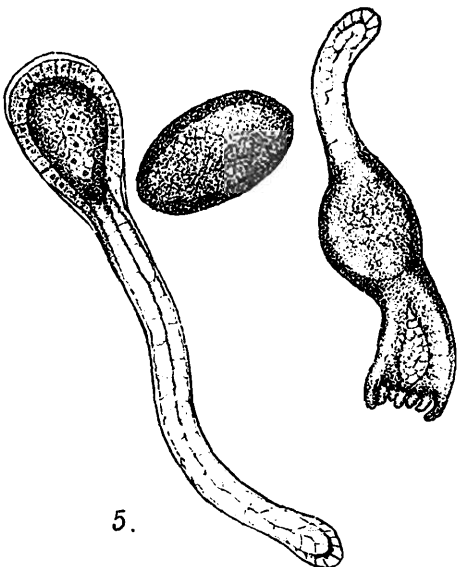
*Campanulina ceylonensis* (Browne).

- FIG. 1.—A portion of the stolon bearing three hydrosomes in different states, expanded, retracted and retracting, the last bearing a gonosome.
- „ 2.—A very young hydrosome attached to the cast skin of a Copepod (drawn from a preparation by Mr. F. H. Gravely).
- „ 3.—Optical section of a portion of the stem of a fully expanded hydrosome, protruding from the perisarc, showing the everted points of the marginal processes of the hydrotheca.
- „ 4.—A portion of the living hydroid showing the web.
- „ 5.—Three planulae reared in captivity, one with a stolon, another with a hydrosome and stolon (preparation by Mr. F. H. Gravely).

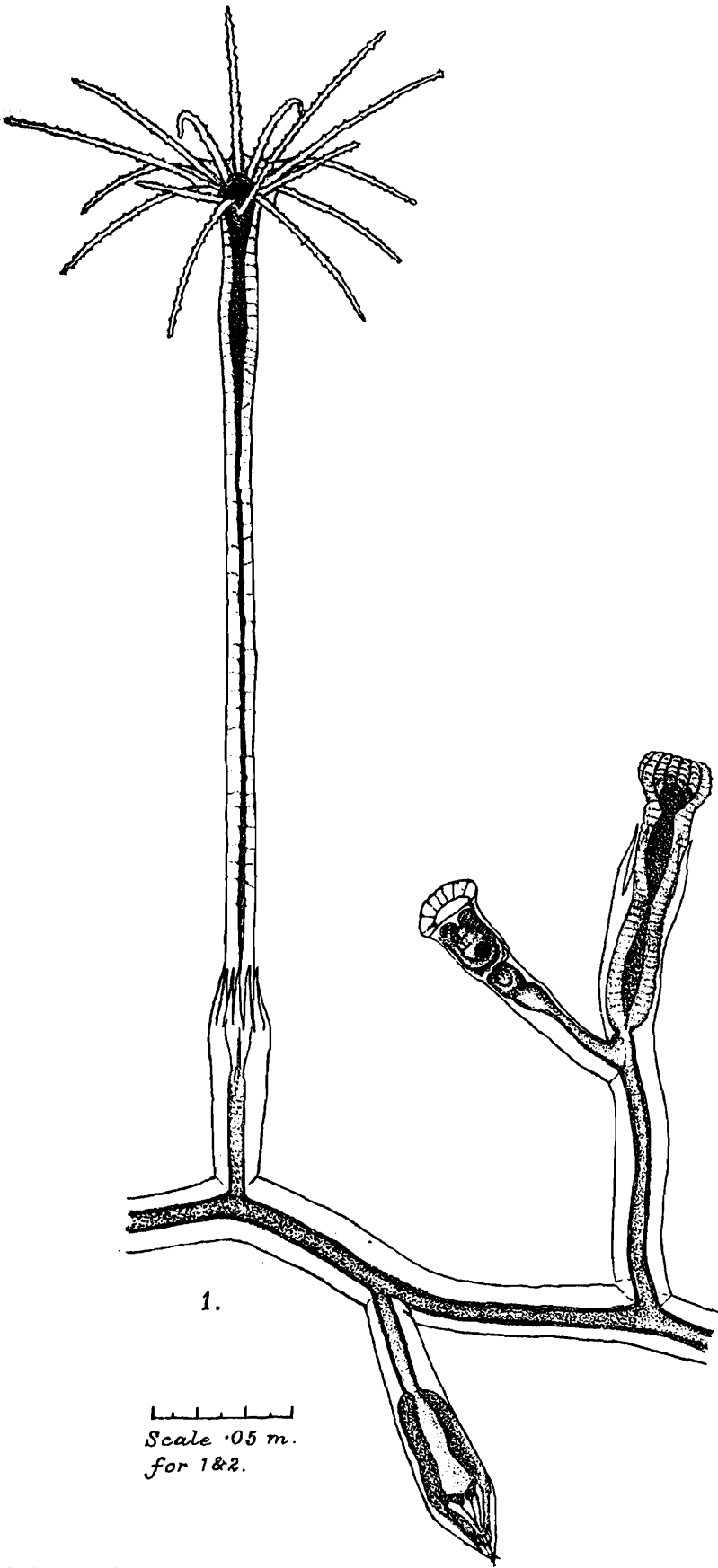
All figures drawn to scale with the Camera lucida.



2.

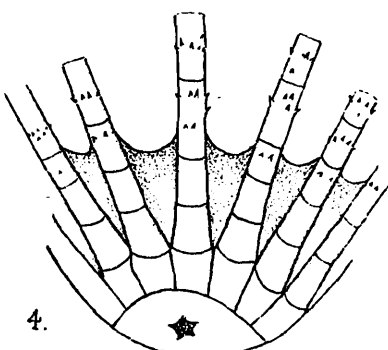


5.

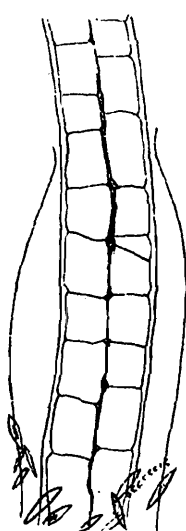


1.

Scale .05 m.  
for 1 & 2.



4.



3.

Scale .01 m.  
for 3, 4 & 5.

R.E. Lloyd, del.

A.C. Chowdhary, lith.

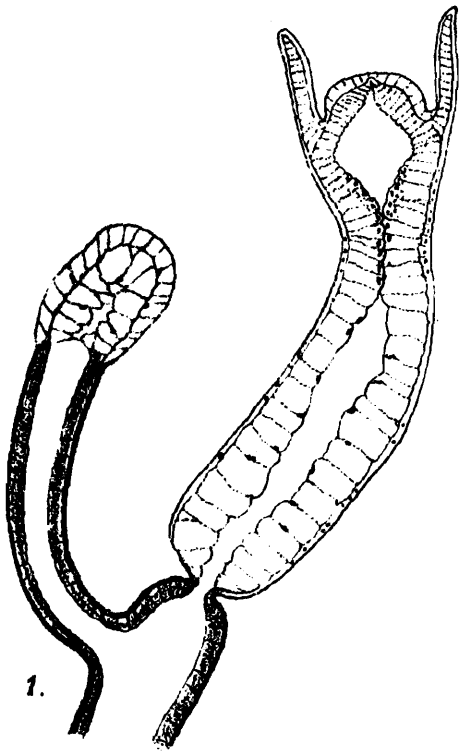
CAMPANULINA CEYLONENSIS (Browne)

## EXPLANATION OF PLATE VI.

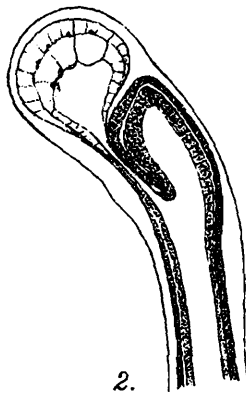
### *Campanulina ceylonensis* (Browne).

- FIG. 1.—Optical section of the young gonosome growing from the base of a hydrosome, before the formation of any medusoid buds.
- FIGS. 2, 3, 4.—Similar views of gonosomes at somewhat later stages showing the early formation of the first bud.
- FIG. 5.—A gonosome with one medusoid.
- „ 6.—Upper part of a gonosome showing communication between the cavity of the operculum and the enteron of the medusoid.
- „ 7.—Gonosome at a later stage, showing the marginal lappets.
- „ 8.—Gonosome at a slightly earlier stage than fig. 7, in optical section.
- „ 9.—Gonosome, probably mature: *a*, marginal tentacles: *b*, velum: *c*, sense vesicle. Cells resembling phagocytes can be seen in the operculum and in the lower part of the blastostyle.

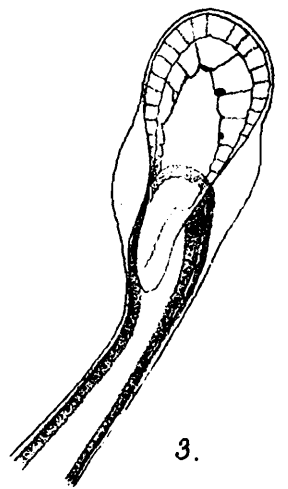
All figures drawn to scale with the Camera lucida from stained preparations.



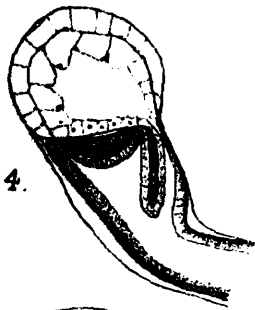
1.



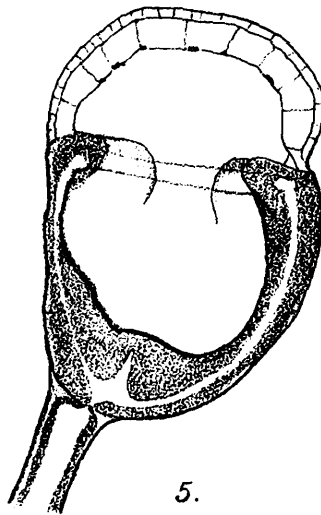
2.



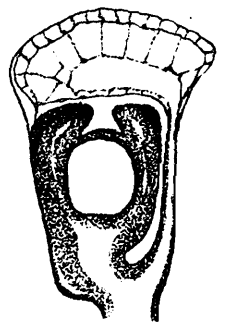
3.



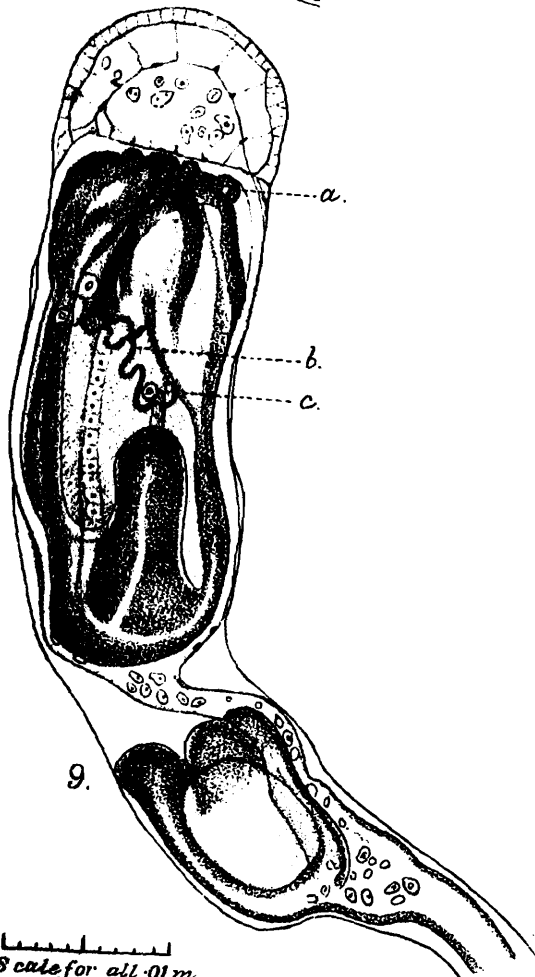
4.



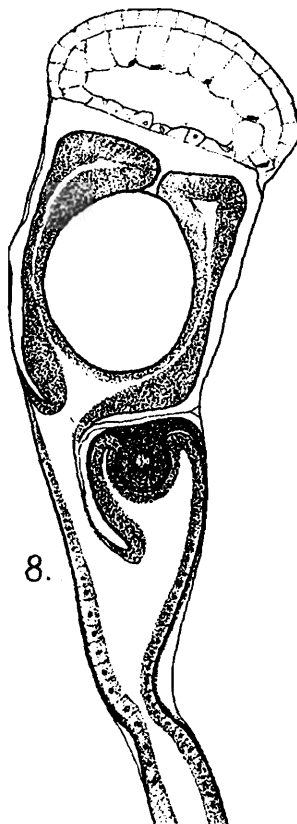
5.



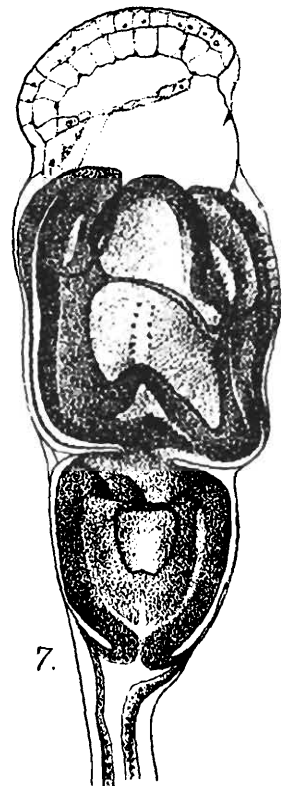
6.



9.



8.



7.

Scale for all .01 m.

R.E. Lloyd, del.

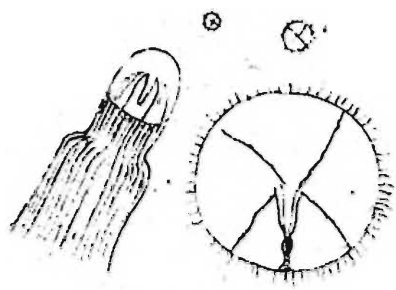
CAMPANULINA CEYLONENSIS (Browne)

A.C. Chowdhary, lith.

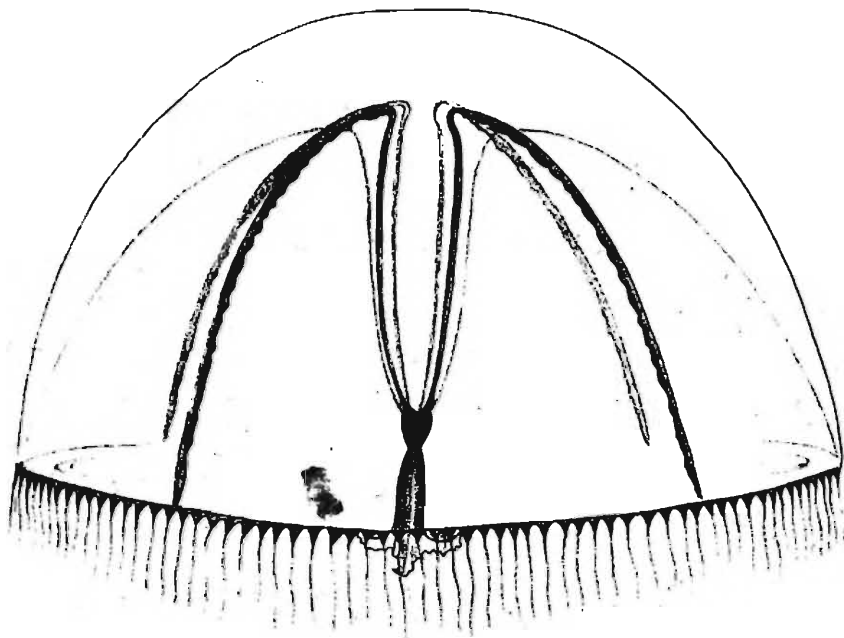
## EXPLANATION OF PLATE VII.

### *Campanulina ceylonensis* (Browne).

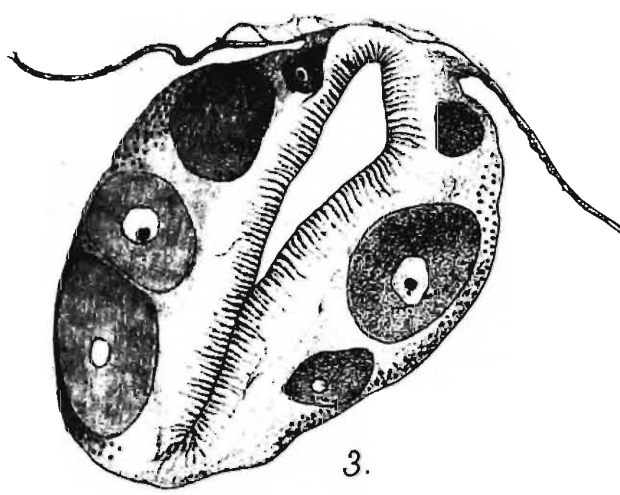
- FIG. 1.—Medusae of different ages in different attitudes, from life, natural size.
- „ 2.—The mature medusa, from life,  $\times 5$ . The sense vesicles are not shown. The marginal lappets are somewhat exaggerated in this figure.
- „ 3.—Section of the generative ridge of a ripe female medusa.
- „ 4.—Young medusa, found swimming freely. From a stained preparation,  $\times$  about 35.



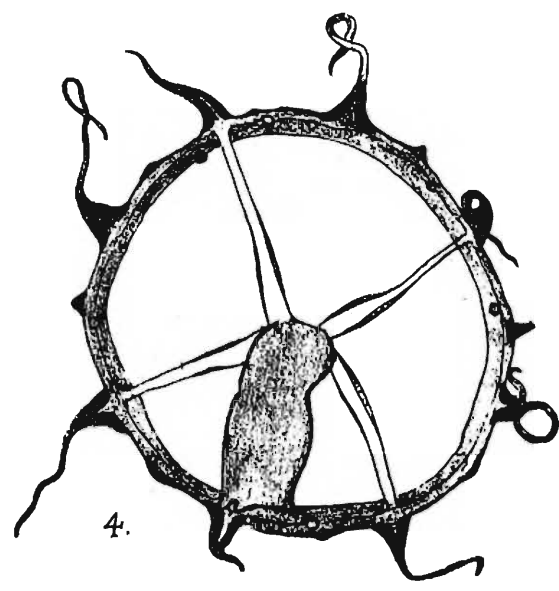
1.



2.



3.



4.