

BULLETIN
OF THE
MADRAS GOVERNMENT MUSEUM

EDITED BY THE SUPERINTENDENT

THE SCYPHOMEDUSAE OF MADRAS
AND THE NEIGHBOURING COAST

BY

M. G. K. MENON, M.A.

Research Scholar, Madras University Zoological Laboratory

NEW SERIES—*Natural History Section, Vol. III, No. I*

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INTRODUCTION.

The Scyphomedusæ described in the following pages have been collected from the Madras Coast by Professor Ramunni Menon during many years. To these preserved forms, I have been able to add some fresh ones as a result of my own collecting, both in the harbour and in the open sea.

In most cases, I had to depend upon the old forms alone for my descriptions, as fresh specimens could not be obtained. The commoner forms have however been studied from freshly collected material. The disadvantage of depending entirely upon long-preserved specimens, some of which have become miserably mutilated, has been a great handicap in the accurate identification of the species. In such cases, I have tried to bring out all the available data and to refer a particular form to the species which it seems to resemble most closely, provisionally regarding it either as identical with, or only as a variety of it. I believe that the claims of these to independent specific rank can be considered only after studying them in the fresh condition, as many features, like the natural shape, colour, and other easily changeable characteristics disappear in the preserved forms.

Since no attempt has been, as yet, made at a thorough investigation of the Scyphomedusae of this coast, it is to be expected that much new and interesting material would be had from such a venture. In this connexion, it may be pointed out that the number of rare forms in our collection is sufficiently large to throw new light on the distribution of Scyphomedusae. It is noteworthy that many interesting Scyphomedusae supposed to be unrepresented in the tropics have been collected later from unexpected quarters. Considering the habitat of most of these animals and their swimming powers, it is not surprising at all to find them having an extensive distribution. I have also observed that there is a more or less regular periodicity in the appearance of some of these forms on this coast. From the data available at present, however, it is not possible to make definite statements about the time of occurrence and sexual development of the various forms. Another interesting point with regard to the Madras Scyphomedusae is their resemblance to the forms of the Malay Archipelago.

In preparing this paper Mayer's monumental work on the Medusae was at first followed throughout. But subsequently the classification of the Rhizostomae was thoroughly revised in accordance with Stiasny's classification of this Order (1921), which is based on the nature of the subumbrellar canals considered from the morphological and embryological standpoints. In the descriptions of species, I have closely followed the plan adopted in Mayer's work. All important papers on Scyphomedusae subsequent to the publication of the "Medusae of the World" have been consulted, especially those of

Stiasny and Light who have contributed so much to the study of the Scyphomedusae. References to earlier authors have also been made, whenever found necessary.

The canal systems of the Rhizostomae were not studied by injection, because most of the specimens were in such a state that they would not lend themselves to this procedure.

I have done the work here recorded in my capacity as a research student of the Madras University Zoological Laboratory. It was taken up at the instance of Professor Ramunni Menon who very kindly placed all his collections of Scyphomedusae at my disposal, and guided me throughout. My grateful thanks are also due to Professor Gopala Ayyar, the present Honorary Director of the Zoological Laboratory, for much valuable help and to Dr. F. H. Gravely, Superintendent of the Government Museum, who not only made many important suggestions but kindly undertook to have the paper published in the Bulletin of the Madras Government Museum.

The following table gives a list of the species represented in the collection and a general idea of their distribution:—

Name of species.	Distribution.
1. <i>Charybdea madraspatana</i> , n.sp. ...	Madras.
2. <i>Tamoya</i> sp.
3. <i>Chiropsalmus buitendijki</i> , Horst. ...	Malay Archipelago, Australia.
4. <i>Nausithoë punctata</i> , Kölliker. ...	Mediterranean, Atlantic, Pacific, Indian and Arctic Oceans. Probably world wide.
5. <i>Pelagia noctiluca</i> , Péron and Lesueur.	Mediterranean.
6. <i>Dactylometra quinquicirrha</i> , L. Agassiz.	Atlantic, Philippines, Malay Archipelago and Japan.
7. <i>Cyanea purpurea</i> , Kishinouye. ...	Japan.
8. <i>Aurelia solida</i> , Browne.	Maldives, North Atlantic.
9. <i>Cassiopea andromeda</i> var. <i>malayensis</i> , Maas.	Malay Archipelago.
10. <i>Cephea</i> sp.
11. <i>Netrostoma coerulescens</i> , Maas. ...	Malay Archipelago, Maldives.
12. <i>Netrostoma setouchianus</i> , Kishinouye.	Japan.
13. <i>Mastigias albipunctata</i> , Stiasny ...	Malay Archipelago.
14. <i>Lorifera lorifera</i> (Haeckel)	Pacific, Red Sea.
15. <i>Lychnorhiza malayensis</i> , Stiasny ...	Malay Archipelago.
16. <i>Crumbionella orsini</i> (Vanhöffen) ...	Red Sea.
17. <i>Crumbionella stuhlmanni</i> (Chun) ...	Mouth of the Quilimane River, East Africa.
18. <i>Acromitus flagellatus</i> (Haeckel) ...	Malay Archipelago.
19. <i>Lobonema mayeri</i> , Light.	Philippines.
20. <i>Lobonemoides robustus</i> , Stiasny. ...	Malay Archipelago.
21. <i>Rhopilema hispidum</i> (Vanhöffen) Maas.	Do.

The classification followed, as already noted, is that adopted by Mayer in his "Medusae Of The World" except for the order Rhizostomae where Stiasny's new system (1921) has been followed. The descriptions of the various orders, families, etc., have also been abridged from these authors.

Order Charybdeidae Gegeubaur, 1856.

Four perradial sense-organs in niches on the sides of the bell. Four interradial tentacles or groups of tentacles. Proximal parts of tentacles developed into structures called pedalia which probably serve as keels to steer the animal. Eight leaf-shaped gonads developed in the gastrovascular space. Bell margin entire. Velarium present.

Genus Charybdea Péron and Lesueur, 1809.

Four simple pedalia. Velarium with velar canals and frenulae. Stomach small, without hollow bracket-like sides arching over between it and the subumbrella. Horizontal clusters of gastric cirri.

Charybdea madraspatana n. sp.

Pl. I, fig. 3 a-c.

Bell 100 mm. or a little more in height, 55 mm. broad in the region of the pedalia. Upper half somewhat pyramidal in shape with a concavity at the top. Lower half gradually expanding towards the base. The concavity at the top, as well as to a great extent the sides of the bell, besprinkled with small nematocyst warts which, sometimes extend on to the pedalia. The latter, flat, thin, and spatulate. Tentacles more than 200 mm. long, filamentous, and highly contractile. Sense-clubs situated in niches about one-fifth the distance from bell-margin to apex, each containing an endodermal crystalline concretion and 6 ectodermal eyes, of which 2 are median and the others lateral. Eyes all directed inwards so as to look into the bell cavity. One of the median eyes with a prominent lens.

Velarium 20 mm. broad, supported by the perradial frenulae. As many as 10 branched, non-anastomosing centripetal velar vessels in each quadrant of umbrella. Stomach rather small, confined to the topmost part of the bell. Throat-tube comparatively broad but very short being only 15 mm. in length. Gastric cirri well-developed as tufts in the four inter-radial corners of the stomach. Leaf-shaped gonads with mature eggs situated along sides of inter-radial septa.

In life the bell is almost transparent and the tentacles have a light rosy tint. The gonads are distinguished from the gelatinous bell only by their white contents.

This form differs from other species of *Charybdea* in the peculiar shape of its bell which has an exumbrellar concavity at the top, in the nature of the stomach and throat-tube, and in the large number of velar canals.

Genus *Tamoya* F. Müller, 1859.

Similar to *Charybdea*, but with a large stomach bound to the subumbrella by 4 perradial, hollow arches. Gastric cirri in vertical clusters.

Tamoya sp.

Pl. I, fig. 4 a-b.

Bell about 110 mm. high with almost vertical sides and flat top. The pedalia are placed 75 mm. apart at the 4 corners of the bell, so much so that the bell has almost this same width. There are no indications of the presence of nematocyst warts on the umbrella in the preserved forms. The 4 pedalia are 40 mm. long, flat, spatula-shaped, and sharp-edged. The tentacles seem to have contracted very much, in which state they measure only 55 mm. The sensory clubs are located in deep niches, 20 mm. above the bell-margin and opening on the exumbrellar surface by horizontal clefts. There are two median eyes each provided with a lens. Lateral eyes are absent.

The broad, well-developed velarium contains numerous narrow canals breaking into minute non-anastomosing branches. The stomach is large and the throat-tube extends about a third of the distance from the inner apex to the level of the velarium. Gastric cirri are not conspicuous.

The gonads are well developed and appear as 4 pairs of thick sheets, their sides sometimes touching in the perradii.

These forms were collected about 14 years ago but in a note attached to one of them it is stated that the colour of the bell is greenish-yellow with a touch of pink and that the gonads are light greenish white.

Genus *Chiropsalmus* L. Agassiz, 1862.

Four branched pedalia. Eight simple, finger-shaped, subumbrella gastric sacs. Free-margins of the eight gonads entire and simple.

Chiropsalmus buitendijki, Horst.

Pl. I, fig. 2 a-b.

It is by no means certain that even the largest specimen of the many examined is a fully grown form. On the other hand, it is fairly clear from the condition of the gonads which are still immature, that the medusa has not yet attained its complete development.

Bell more or less cubical with the apex slightly arched; 100 mm. high and 125 mm. broad in the largest specimen from which all measurements were taken. The pedalia are attached at the 4 perradial corners of the bell about 10 mm. above the margin. The main shafts of the pedalia are sickle-shaped, laterally compressed, and almost as long as the bell height. Each bears 9-10 lateral tentacle-bearing branches forming a decreasing series, the smallest being the outermost. There are as many tentacles as there are lateral branches. In the preserved specimens the tentacles vary in

length from 15 mm. to 20 mm., while the lateral branches carrying them vary from 10 mm. to 65 mm. in length. The rhopalia are in niches about one-fifth the distance between velarium and apex. Their structure could not be discerned from these specimens long preserved in formalin. The velarium is 25 mm. wide and is supported by 4 frenulae. It contains about 16 dendritically branched velar canals.

The stomach is broad. The manubrium comes to half the depth of the bell-cavity. The mouth-opening is surrounded by 4 lanceolate lips. The 8 finger-shaped pouches projecting into the cavity of the bell come to the level of the manubrium. One of these had a sort of smaller accessory side-pouch in the largest specimen. The gastric cirri are well developed in the inter-radial corners of the stomach as 4 horse-shoe-shaped bands.

Order Coronatae Vanhöffen, 1892.

A circular or coronal furrow in the exumbrella, and peripheral to this a zone of gelatinous thickening in the radii of the tentacles and sense-organs. Throat-tube simple, without curtain-like appendages. Tentacles solid, at least for a part of their length.

Family EPHYROPSIDAE Claus, 1883.

Eight rhopalia (4 periradial and 4 interradial) and 8 or more tentacles.

Genus *Nausithoë* Kölliker, 1853.

Eight adradial tentacles. Sixteen lappets. Eight adradial gonads. No subumbrella saccules.

Nausithoë punctata Kölliker.

Pl. I, fig. 5.

These medusae were collected when townetting. They appeared in moderate abundance during the months of January and February 1930. The few individuals that I was able to examine were all females in various stages of development.

The umbrella is discoidal, 5 mm. wide. The central disc of the exumbrella is finely punctate and not quite half as wide as the whole medusa. There are 16 marginal lappets.

The 8 tentacles are adradial and arise from deep clefts between the lappets. The 8 marginal sense-organs alternate with the tentacles. The rhopalar clefts between the lappets are not quite as deep as the clefts where the tentacles are located. Each rhopali-um has on its ventral side a circular darkly pigmented ocellus and a distal mass of crystalline concretions. The mouth is simple and cruciform. Four groups of simple, unbranched gastric cirri project towards the centre of the mouth from the interradial septa of the stomach. There are about 6-7 cirri in each group. The 8 adradial gonads are situated on the subumbrella in the tentacular radii. Each gonad is large and has a circular outline.

The gelatinous substance of the bell is of a light brown colour. The gonads are brownish.

Order Semaestomeae L. Agassiz, 1862.

Without a coronal furrow and without pedalia. With a simple central mouth-opening, the 4 perradial angles of which developed into large curtain-like or gelatinous lips. Gonads in folds of the endodermal wall of the subumbrella.

Family PELAGIDAE Gegenbaur, 1856.

Central stomach giving rise to completely separated, unbranched radiating pouches. No ring canal. Tentacles arising from bell-margin between clefts of lappets.

Genus *Pelagia* Péron and Lesueur, 1809.

Eight adradial tentacles alternating with 8 rhopalia, 16 marginal lappets.

Pelagia noctiluca, Péron and Lesueur.

Pl. I, fig. 1.

Bell hemispherical when contracted, and about 25 mm. in height. The diameter of the bell, in the expanded condition, varies from 45 to 50 mm. In preserved specimens the sides of the bell are more or less sloping and the apex flat with a slight concavity in the centre. Both rounded and linear nettle-warts appear to be present on the exumbrella. They are sometimes absent from the upper parts of the bell but seem to be well-developed on the sides.

There are 8 marginal sense-organs, 4 perradial and 4 inter-radial, set in deep niches between the marginal lappets. The sense-club has no ocellus, but contains a terminal mass of crystalline concretions which are not pigmented. An exumbrellar sensory pit is wanting. Tentacles 8, hollow and tapering, longer than the mouth-arms. They are highly contractile. Marginal lappets 16, wider than long, with shallow median notches and rounded angles. The septum between the ultimate stomach pouches in the lappets is twice as wide as the ultimate pouches themselves. The throat-tube is almost as long as the bell-radius. The 4 perradial lanceolate lips are a little longer than twice the radius of the disc and their margins are complexly folded. Nettle-warts are present on the arms. Gonads protrude interradially through the subumbrellar pits. The gastric cirri are long and numerous.

Jelly transparent and colourless in life; tentacles violet-rose, mouth-arms slightly pinkish, gonads purplish-violet; linear nettle-warts appearing as white streaks on the umbrella.

Genus *Dactylometra* L. Agassiz, 1862.

Eight marginal sense-organs. Forty tentacles, 5 between each successive pair of sense-organs. Forty-eight marginal lappets.

The medusae of *Dactylometra* pass through a "*Chrysaora stage*" in their development and sometimes become mature with 24 tentacles.

Dactylometra quinquicirra, L. Agassiz.

"*Chrysaora stage*."

Pl. I, fig. 6 *a-c*.

Bell flatter than a hemisphere. Exumbrellar surface finely granular or beset with dome-shaped nematocyst warts which sometimes extend on to the lappets. Diameter of umbrella 140-150 mm.

There are 6 marginal lappets in each octant of the umbrella, 4 large and 2 small. The two smaller ones are placed adjacent to the ocular lappets which, in most cases, have the same size and shape as the velar lappets. The smaller accessory lappets are half as broad, and three-fourths as along, as the other marginal lappets. The latter have rounded margins. Tentacles 3 in each octant of the umbrella, none being adjacent to the ocular lappets. The tentacles are many times longer than the bell-diameter and are highly contractile. In one of the forms examined there were 4 tentacles and 7 lappets in one of the parameres. This was one of the largest specimens collected. The marginal sense-organs are set within niches between the lappets which are spanned over by webs. There are exumbrellar pits above the sense-organs.

Sixteen pouches are given off from the stomach, 4 perradial, 4 inter-radial, and 8 adradial. These extend into the lappets. The rhopalar pouches are sometimes slightly larger than the inter-rhopalar ones.

The subgenital ostia are more than twice as broad as the perradial columns between them. The puckered gonads protrude through these ostia exposing, in the preserved specimens, numerous gastric cirri. The arm-disc is about 75 mm. broad. Mouth-arms 250 mm. long (preserved form), curtain-like, and with frilled margins, broad at the base and tapering distally. Nematocyst warts are present on the mouth-arms and arm-disc.

Being one of the commonest of the Scyphomedusae of this coast, it is easy to observe them in their natural environment. They are lovely objects to be seen in the clear water on a sunny day. Large numbers can be seen in the harbour frequenting the neighbourhood of ships, boats, etc. They are beautifully coloured, the exumbrella being of a golden-yellow tint with dark-brown spots and streaks all over. Some forms develop a sort of dark-brown colour in their lappets thus making the umbrella-margin very conspicuous. Their movements with the pulsating umbrella directed forwards and followed by the beautiful, long, trailing mouth-arms and milky-white tentacles are full of grace and beauty. Specimens have been observed having their arms more than 6 feet in length. This is the common stinging jellyfish of Madras.

There is reason to believe that the *Dactylometrae* of this coast become sexually mature in the "*Chrysaora-stage*." Although fully mature animals have not been met with so far, it is noteworthy that not a single form showing tendencies to become a fully developed *Dactylometra* has been caught even from the open sea where conditions are different from those of the harbour. The only individual that differed from the normal type showed a variation towards the *Kuragea* condition.

Family CYANEIDAE L. Agassiz, 1862.

Central stomach giving rise to branched but completely separated radial-canals. No ring-canal. Tentacles arising from floor of subumbrella.

Genus *Cyanea*, Péron and Lesueur, 1809.

Eight rhopalia and 8 adradial clusters of tentacles. Both radial and circular muscles in the subumbrella.

? *Cyanea purpurea*, Kishinouye.

Pl. II, fig. 10.

Mayer has included this medusa along with *Cyanea annaskala*, von Lendenfeld.

Exumbrella flat and disc-like. Diameter of the largest form examined 340 mm. Surface smooth. Margin cleft into 16 large lappets of uniform size. Clefts in the rhopalar radii a little deeper than those in the tentacular radii. Rhopalar lappets connected together by bridges roofing the rhopalia. Tentacles numerous, arranged in 8 horse-shoe shaped tracts alternating with the rhopalia. Only 2-3 rows of tentacles in each of these tracts. Tentacles very long and hollow and thickly beset with nematocysts.

Situated in the centre of the umbrella is the 4 cornered mouth surrounded by the mouth-arms which hang down as continuous, very much folded up, curtain-like appendages expanding in the 4 perradii. Gastric filaments are found projecting from the stomach towards the oral tube. The peripheral branches of the radial stomach pouches are completely branched and these branches anastomose with one another. The gonads in one form were well-developed and projected from the 4 subgenital pits, as complexly folded pouches.

The muscular system of the subumbrella is remarkably well-developed. The circular muscles are developed a little beyond the gonadial pouches in 16 alternately long and short areas, each consisting of 6-7 ridges. Towards the periphery there are 16 strands of radiating muscles, also developed in ridges.

Bell transparent. Muscle-bands and mouth-arms brownish. Tentacles light brown.

Family ULMARIDAE Haeckel, 1880.

The central stomach gives rise to simple or branched radial-canals which are connected one with another by a marginal ring canal.

Genus *Aurelia* Péron and Lesueur, 1809.

The bell-margin is divided into 8 or 16 broad, velar lobes. Both tentacles and lappets arise from the sides of the exumbrella a short distance above bell-margin. The mouth-arms are unbranched.

Aurelia solida, Browne.

Pl. II, fig. 12.

Bell flatter than a hemisphere and about 110 mm. broad (preserved form). Exumbrella finely granulated. Margin cleft into 8 rather unequal segments. Just above the margin are the numerous tentacles alternating with small narrow lappets. Each tentacle is only 10 mm. in length.

There are 8 marginal rhopalia situated between the clefts of the umbrellar margin and directed slightly towards the exumbrellar aspect. They are flanked by small, sharply-pointed ocular lappets. There is a single median pit projecting downwards from the exumbrellar surface just above each sense-club. The sense-clubs have dark-brown pigment in them.

The mouth opening is surrounded by the thick, gelatinous mouth-arms which appear, in preserved specimens, as a conical mass of jelly, cut into 4 and giving rise to 4 curved, leaf-like outgrowths at right angles to each quadrant of the central, thick region. The two laminae of the leaf-shaped distal portions are folded together. The margins of the arms are closely beset with numerous tentacles, each 2-3 mm. long.

The diameter of the genital region is about 45 mm. The subumbrella is thickened below the horse-shoe shaped gonads in the 4 inter-radii. The genital ostia are circular pores, about 3 mm. in diameter, and situated at the centres of the subumbrella thickenings. The mouth-arms are, in many cases, greatly thickened and hollowed out in their proximal parts, holding masses of ripe genital products.

The stomach occupies a 4 lobed space, its outline being determined by the genital cavities. The arrangement of the radial canals presents irregularities. Roughly, it can be said 8-9 radial canals are given off from the stomach in each of the 4 genital regions and a single canal in each of the 4 inter-gonadial regions. The former set of canals are connected together by a sort of network, but there is no extensive anastomosis even at the periphery of the umbrella. The intergonadial canals divide just beyond their origin into 5-7 branches in each case, these branches again bifurcating to contribute to the marginal network. Some of the radial canals are broader than the others but there is no regular disposition of canals with regard to their sizes.

The gelatinous substance of the jelly is thick and perfectly transparent. The umbrella margin is comparatively thin and hangs down. Mouth-arms, radial canals, gonads, and tentacles are tinted with a beautiful violet colour.

The above description is of a fairly normal form. Variation from this normal state is a very common feature, so much so, that perfectly normal individuals are very rare. In most of the specimens the margin is cleft into unequal segments resulting in an irregular disposition of the sense-organs. The majority of the forms showed a tendency for increase in the number of rhopalia. One specimen had only 5 marginal rhopalia, with the mouth-arms and gonads reduced to 3 each. In conclusion it may be said that my observations on the variation of *Aurelia*, though of a very limited nature, conform very much to those of MacIntosh (1910) who has investigated the matter in an elaborate manner.

Order Rhizostomae Cuvier, 1799.

The Rhizostomae are the most highly differentiated Scyphomedusae. They are distinguished from the Semaestomeae by the presence of numerous mouths, surrounded by minute, motile tentacles, and borne on 8 adradial, fleshy, branched, arm-like appendages which arise from the centre of the subumbrella.

According to the nature and origin of the canal system of the umbrella, the structure of the exumbrellar sensory pit, and the presence or absence of papillae at the sub-genital ostia, the Rhizostomae are divided into two suborders Kolpophorae and Dactylophorae.

Suborder Kolpophorae Stiasny, 1921.

No primary ring canal. Subumbrellar network of canals directly connected with stomach. Sensory pits without radial furrows. Papillae absent at the sub-genital ostia.

The Kolpophorae are divided into 3 tribes according to the nature of the musculature and branching of the mouth-arms.

Tribe Kampylomyariae Stiasny, 1921.

Subumbrella muscles in pinnate arches. Pinnately dichotomous mouth-arms.

Family CASSIOPEIDAE Stiasny, 1921.

With the characters of the tribe.

Genus *Cassiopea* Péron and Lesueur, 1809.

The 8 pinnately or irregularly dividing mouth-arms show a tendency towards dichotomy. Frilled mouths are carried only on the ventral sides of the arms. Small or large club-shaped vesicles are present on the arms. There are about twice the number of radial canals as sense-organs.

•*Cassiopea andromeda* var *malayensis*, Maas.

Pl. II, fig. II.

Exumbrella flat and disc-like. Surface smooth. Diameter 125 mm. Margin practically entire, not cleft into distinct lappets, though the exumbrellar grooves indicate that there are 3 velar lappets between 2 ocular lappets in each paramere of the umbrella. Ocular lappets only slightly smaller in size than velar ones. Number of marginal sense-organs very variable (12-19) set in niches in the umbrella-margin, at the points where the radial canals terminate. Sense clubs with pigment spots at their tips. In one instance, two rhopalia were observed to be placed together, being separated only by a thin, narrow lappet. This interesting young specimen had 19 sense-organs in all.

The arm-disc is well developed, lenticular, and about 60 mm. broad. Eight mouth-arms, each measuring about 65 mm. from the centre of the arm-disc, are present. The proximal branches of the arms are pinnately arranged but distally they break up in a rather irregular manner. Club-shaped appendages of various sizes are found between the frilled mouths, the largest of these clubs being placed distally.

The 4 oval subgenital ostia are placed at the sides of the arm-disc. The gonads are all immature and placed in 4 separate cavities.

There are twice as many radial canals given off from the stomach as there are marginal sense-organs. The rhopalar canals are complete, reaching to the margin of the umbrella, but the inter-rhopalar ones lose themselves in the sub-umbrellar network before reaching the margin.

The circular muscles are developed in a series of arches in the outer half-radius of the subumbrella.

The exumbrella is light brown in colour. A sort of whitish band is found in some cases along the border of the exumbrella. The frilled mouths, outgrowths on the arms, and other appendages are of a darker tint than the umbrella.

These specimens were collected from a shallow enclosure connected with the Harbour. Here they could be seen lying flat on their exumbrellae with the mouth-arms spread out. They are the only forms of Scyphomedusae met with in this particular locality.

I have failed to find in the living forms I examined any, "narrow, slightly raised, circular band" near the margin of the umbrella, or any exumbrellar concavity such as Browne mentions for most of the Maldive forms (1906). A radially wrinkled, circular band is however present in a few formalin preserved forms suggesting a resemblance to what Browne has observed in his variety *maldivensis*. The Madras form is closely related to the Malayan variety with which it has many features in common, among which may be mentioned the presence of pigment spots on the rhopalia.

Tribe Actinomyariae Stiasny, 1921.

Prominent subumbrellar radial muscles present. Dichotomously pinnate mouth-arms. No ring canal.

Family CEPHEIDAE Stiasny, 1921.

With the characters of the tribe. This family consists of 3 genera, *Cephea*, *Netrostoma*, and *Cotylorhiza*.

Genus *Cephea* Péron and Lesueur, 1809.

Lash-like filaments between the mouth-frills and on the arm-disc. Numerous (more than 3) inter-rhopalar canals between a pair of rhopalar canals.

Cephea sp.

The following description is based upon a specimen which was washed ashore in a very mutilated condition. The bell is almost complete but only rudiments of the arms and arm-disc are left.

The umbrella is rather flat, 240 mm. in diameter, with a low dome occupying more than half the area of the exumbrella. There are about 60 large, and numerous small, outgrowths on the dome. Elsewhere the umbrella is perfectly smooth. There are 8 marginal lappets in each paramere. The lappets are all connected together by a very thin web so that the margin is entire.

The mouth-arms do not seem to project beyond the bell-margin. Rudiments of long, slender filaments are present on the branches of these arms. There are a number of openings at the bases of the arms by which the arm-canals communicate with the exterior. Subgenital ostia appear as double pores due to tongue-like outgrowths of the arm-disc. Gonads contain eggs but are not mature.

There are 5 radial canals between a pair of rhopalar canals. The subumbrellar network is very extensive and extends to the very edge of the umbrella, where, in the thin membrane connecting the lappets the network is very close. There is a zone of powerfully developed radial muscles measuring about 70 mm. and beyond this another zone of well-developed circular muscles.

The entire animal is coloured violet. The canals in the arms are of a deeper tint rendering them very conspicuous. The frilled mouths are dark brown.

Genus *Netrostoma* Schultzze, 1898.

Short, rigid appendages between the mouth-frills and on the arm-disc. Three inter-rhopalar canals between each pair of rhopalar canals.

The forms belonging to this genus contained in our collection fall into two categories conforming to Mayer's statement with regard to *Cephea* that in this genus "there are only 2 well-marked forms and these are but the extremes of an intergrading series." Thus, those with a low dome or flat exumbrella and small warts constitute one set, and those with a high dome and large warts the other. Following Stiasny's classification of the *Cepheidae*, I have put them all under the genus *Netrostoma* regarding them, provisionally, as *Netrostoma coeruleascens* Maas and *Netrostoma (Microstylus) setouchiannus* Kishinouye.

Netrostoma coerulescens, Maas.

Pl. II, figs. 7 a-d.

Exumbrella with a low central dome surrounded by a shallow furrow. Dome beset with numerous small granulations or gelatinous warts. Diameter of umbrella 165 mm. Marginal lappets 9 in each octant including the ocular ones. Lappets fairly distinct. The 8 sense-organs scarcely visible in the deep, narrow clefts between the ocular lappets which are practically of the same nature as the marginal ones.

The arm-disc is 80 mm. broad. Mouth-arms measure 65 mm. from the centre of the arm-disc to their points of bifurcation. Small, dark brown, ampullary outgrowths hang down ventrally from the distal branches of the arms. Those placed nearer to the arm-disc are still smaller and have a milk-white colour. They are all triangular in cross-section. The minute tentacles are all clubbed. Numerous short stiff appendages, 20—30 mm. long, are found clustered in the centre of the arm-disc, carrying between them masses of developing eggs. These appendages are hollow, tapering, and beset with prickly nematocyst warts. The subgenital ostia are small and pore-like, being only 2—3 mm. in diameter.

Besides the 8 rhopalar canals, 3 other radial canals are given off from the stomach in each octant of the umbrella. These contribute to the subumbrellar network. The canals in the mouth-arms are conspicuous by their violet tint in life. Numerous smaller canals are given off by these to the many branches of the arms.

Longitudinal muscles are well developed all round the arm-disc, where they appear as rather thick lamellae. Beyond these, the circular muscles are developed along the border of the subumbrella.

The general colouration of the bell is pale blue in life. Numerous brown spots are present on its surface. The central dome has beautiful brownish streaks radiating from each of the granulations in a starlike pattern. A number of planarians were found living on the surface of the freshly collected specimens. It is interesting to note that they resembled the coloured streaks of the exumbrella so much that they could not easily be distinguished.

Netrostoma setouchianus (Kishinouye).

Diameter 120 mm. the bell appears to be less massive than that of *N. coerulescens*. The central dome is rather large and beset with a varying number of conical outgrowths. A prominent ring-furrow is present surrounding it. The umbrella margin is not always distinctly divided into lappets. There are 8 marginal rhopalia, situated in deep clefts which divide the margin of the umbrella into 8 lobes, each lobe being again divided into 6—8 indistinct velar lappets.

The arm-disc is octagonal and nearly as wide as the bell-radius. The 4 subgenital ostia are very small and porelike. The 8 mouth-arms are shorter than the radius of the bell. The arms are bent outwards and bifurcated at their distal ends. The frilled mouths are carried on the ventral aspect of the branches of these arms. They are continued to

the arm-disc. The latter also carries small tapering appendages (25-30 mm. long) beset with warty outgrowths. Some very small appendages are also met with on the oral arms.

The stomach is nearly circular in outline. There are 8 ocular and 24 inter-ocular radial canals. A wide zone of extensive anastomosing canals extends to the margin of the umbrella. In their ramifications the inter-ocular canals lose themselves in the sub-umbrellar network, but the 8 ocular canals retain their identity and reach the rhopalia. The network ends in a mesh in each of the lappets. On the subumbrella there an inner zone of well-developed radial muscles and an outer zone of feebly-developed circular muscles.

Tribe *Krikomyariae* Stiasny, 1921.

Subumbrellar muscles developed in powerful rings. Tripterous mouth-arms. Ring-canal present.

Family MASTIGIADIDAE Stiasny, 1921.

With short pyramidal mouth-arms.

Genus *Mastigias* L. Agassiz, 1862.

Terminal appendages for the mouth-arms very often present. Numerous stalked, club-shaped appendages between the mouth-frills. The arm-disc carries long filaments.

Mastigias albipunctata, Stiasny.

Exumbrella flatter than a hemisphere and rough with patches of warty growths. Diameter of the bell about 110 mm. Eight rhopalia at the margin, flanked by ocular lappets which are smaller than the velar lappets. In each octant of the umbrella there are 8 velar lappets with deep exumbrellar furrows between them. Some of these lappets are bifid but I could not make out any regularity about their arrangement. There is a minute exumbrellar sensory pit above each sense-organ without radiating furrows.

The arm-disc is about 55 mm. wide. The mouth-arms are a little longer than the radius of the umbrella. The upper part of the arm is short, being only one-third as long as the three-winged lower portion. Each arm ends in a terminal club-shaped appendage which is almost as long as the three-winged portion of the arm. There is a single filament at the centre of the arm-disc measuring about 60 mm. and surrounding this there are 4 other slightly shorter filaments. It is not possible to say anything about the number and arrangement of these filaments, as a sufficient number of fresh forms were not available for determining them. In one specimen of about the same size these filaments and the terminal appendages of the arms are entirely lacking. The filaments, when present, appear to be confined to the arm-disc but there are numerous, small, club-shaped appendages of varying size on the branches of the mouth-arms.

The arm-disc is four-sided. The sub-genital ostia are a little less than three times as broad as the perradial columns separating them. The gonads are four-folded.

Stomach cruciform. Subgenital porticus unitary. The 8 rhopalar radial canals extend to the bell-margin. The perradial canals are shorter than the interrarial ones and do not take part in the network formed internally to the marginal ring-canal. But externally there is a network of all the radial canals and the numerous centrifugal branches of the ring-canal. There are 16-18 canals arising from the stomach between every two rhopalar canals.

The circular muscles are well-developed, especially towards the margin of the sub-umbrella. They are interrupted in the principal radii internal to the ring-canal but only partially external to it.

The jelly is translucent. Faint indications of the presence of large, round spots in the living condition are observed, especially on the margin of the umbrella.

The canal system of this medusa is evidently of the type found in the "ocellata group". But in the possession of 16-18 canals between a pair of rhopalar canals it approaches the condition found in *Mastigias andersoni* Stiasny, where, however, this number is the exception rather than the rule. On the other hand, I could make out a remarkable similarity between the arrangement of the canal system in the two examples before me and that given by Stiasny for his *Mastigias albipunctata* (1921, Plate I, Fig. 5). The form of the terminal appendage is highly variable and therefore one cannot rely much upon it. It is also very probable that the filaments on the arm-disc have a sexual significance. The remarkable coincidence between the numbers of these filaments in *M. andersoni* and the specimen under consideration may only be an accident.

Family LEPTOBACHIDAE Stiasny, 1921.

With very elongate, narrow, strap-shaped mouth-arms.

Genus *Lorifera* Haeckel, 1879.

For a discussion of generic characters, see Stiasny, 1921.

Lorifera lorifera (Haeckel).

The bell appears to have been dome-shaped in life. It is 145 mm. wide. The exumbrella is smooth. There are 8 marginal sense-organs flanked by narrow ocular lappets. Between each pair of sense-organs there are 6 velar lappets, broadly rounded and bifid at the tip. The individual lappets are separated by furrows on the exumbrella. The rhopalia have small exumbrella pits without radiating furrows.

The arm-disc is quadrangular, each side about 80 mm. in length. The subgenital ostia are 5 times as broad as the perradial columns supporting the arm-disc. Subgenital porticus unitary. The longest arm in the specimen is about 120 mm. long. The upper part of the arm is typically three-winged. Ventrally the frilled mouths are carried on to the arm-disc where they are most prominent. The distal portion of the arm is flat and somewhat ribbon-shaped. The three wings of the arm again branch into secondary wings, thus resulting in a number of rows of frilled mouths. Small ampullary outgrowths covered with nematocysts are present on the arms. None of the arms have terminal appendages.

The 8 rhopalar radial canals extend to the marginal sense-organs. The subumbrellar network is formed from canals given off from the stomach. There are about 20 of these canals in an octant. The perradial rhopalar canals are not so intimately connected with this network as the interradianal ones. A ring canal is present, outside which there is a well-developed network extending to the margin of the subumbrella.

The stomach is cruciform. The gonads are four-folded, immature in the only complete specimen, though undeveloped eggs could be seen in them. No filaments are present on the arm-disc.

The following description is of a mature *Lorifera* which has lost the greater portions of its mouth-arms:—

Bell only slightly flatter than a hemisphere. Diameter 170 mm. Surface free from outgrowths but considerably wrinkled, perhaps due to long preservation. Eight marginal sense-organs. Exumbrellar sensory-pits without radiating furrows. A varying number of velar lappets present on the margin, separated by grooves reaching a short distance up the exumbrellar surface.

The arm-disc is a little more than two-thirds as broad as the umbrella and four-sided. The sub-genital ostia are about $2\frac{1}{2}$ times as broad as the perradial columns between them. Only the proximal portions of the arms are present. In the ventral hollow of the arm-disc there are numerous filaments crowded together. These filaments are short and are beset with nematocyst warts. Masses of eggs could be seen entangled in the clusters of these arm-disc filaments. It is interesting to note that a similar condition was observed in *Netrostoma*. The absence of these filaments in the previous example can be accounted for, in that the gonads there are still in a very immature condition.

The gonads, stomach, radial canals, and the subumbrellar network, are all of the type described above. The jelly is thick and translucent.

Suborder Dactylophorae Stiasny, 1921.

A primary ring-canal is present and from this is given off a set of centripetal canals which may or may not form a network, but are never connected directly with the stomach. Sensory pits with radial furrows. Papillae present at the subgenital ostia.

The presence or absence of scapulets on the arms determines the two tribes.

Tribe Inscapulatae Stiasny, 1921.

Scapulets absent. Permanent ring canal present. Sixteen or 32 radial canals, half of which reach the umbrella margin. Subgenital cavity unitary.

Family LYCHNORHIZIDAE Stiasny, 1921.

The blindly ending centripetal canals are mostly non-anastomosing.

Genus *Lychnorhiza* Haeckel, 1879.

Between a pair of radial canals are a few (up to 4) centripetal blindly-ending vessels which, as a rule, do not anastomose and are connected only with the ring canal.

? *Lychnorhiza malayensis*, Stiasny.

Pl. II, fig. 8 *a-c*.

Bell flatter than a hemisphere, about 100 mm. in diameter. Exumbrellar surface smooth. Marginal lappets 8-9, separated by furrows in the jelly of the exumbrella. Only the small, rounded tips of the lappets are free. Rhopalia subtended by rhopalar lappets. Sensory pits with radiating furrows which are very much branched.

Arm-disc 60 mm. broad. Subgenital ostia as broad as the perradial column between them. Two large median, and 2 small lateral, papillæ are found in each subgenital ostium. Length of mouth-arms a little more than two-thirds the diameter of bell. Three-winged portion of arm only a little longer than upper undivided part. Wings of arms broad, with frilled mouths but without any other appendages.

The 8 rhopalar canals are coloured reddish-brown in life. Where they meet the circular canal, there are characteristic markings produced by a distribution of colour into the adjoining canals. The inter-rhopalar canals are only coloured in parts. The mouth-frills are beautifully tinged by a lighter colour. The ring-canal gives rise to 2-4 centripetal canals which, in some octants of the umbrella, show a tendency to anastomose. There is very little difference between young and old forms so far as this feature is concerned. External to the ring canal, there is a close network of canals, in which, however, the rhopalar canals can be distinguished. The tips of the lappets are free from the marginal network.

Some of the specimens were highly infested with copepods, others with flat worms. The copepods were found attached to the mouth-arms, subgenital porticus, and other parts of the animal. The flat worms were buried in the jelly. In some specimens both were found.

Family CATOSTYLIDAE Stiasny, 1921.

The centripetal canals form a network which may be directly connected with the radial canals.

Genus *Crambionella* Stiasny, 1921.

Solid, three-winged, pyramidal mouth-arms. Umbrella-margin with furrows between the lappets. No subgenital papillæ. (See also Stiasny, 1923.)

Crambionella orsini (Vanhöffen).Pl. III, figs. 14 *b* & *d*.

This is one of the commonest as well as one of the largest jelly-fishes obtained in this coast.

Umbrella dome-shaped, sometimes as wide as 210 mm. Exumbrellar surface finely granular except in the lappet zone which is perfectly smooth. The grooves separating the lappets are wider and more conspicuous than those found in *C. stuhlmanni*. There are 16 velar and 2 ocular lappets in each octant of the umbrella. The ocular lappets are very minute and inconspicuous. The rhopalia have triangular exumbrellar sensory pits with copiously branched radiating furrows.

The arm-disc is a little more than three-fifths as broad as the bell. The three-winged triangular distal portion of the arm is about 4 times as long as the simple, undivided, proximal part. Each arm ends in a naked, bluntly pointed, pyramidal portion, similar in appearance to that found in *C. stuhlmanni* but not so pointed. The mouth frills and small club-shaped appendages on the ventral aspect of the arm do not extend at all beyond those of the dorsal side. The perradial columns are about twice as broad as the crescent-shaped subgenital ostia. Papillary outgrowths are not found at the genital openings. There are 8 rhopalar and 8 inter-rhopalar radial canals with a marginal ring-canal connecting all these. The ring-canal is placed in a sort of subumbrellar groove. The centripetal networks are each formed by 6-7 sparsely anastomosing canals, without forming any connexions with the adjacent radial canals. These networks are not easily discernible in the grown-up forms on account of the high development of the circular muscles. These latter are not interrupted internal to the ring-canal but are partially interrupted externally in the rhopalar radii.

The bell has a bluish-green colour. Lappets are of a lighter tint. The frilled mouths are greenish but the naked terminal portions of the arms are pale and translucent.

? *Crambionella stuhlmanni* (Chun).Pl. III, figs. 14 *a*, *c* & *e*.

Bell hemispherical, 125 mm. wide and 35-40 mm. high. Surface of the exumbrella thickly beset with fine granulations, becoming more and more marked towards the periphery. Marginal lappets separated by deep exumbrellar grooves extending to a considerable distance and separating a clearly defined lappet zone. There are 14 narrow, pointed, velar lappets between each pair of rhopalia. The 2 ocular lappets are smaller than the velar ones. The fine granulations of the exumbrella are continued as rows of well-developed, prominently projecting, conical outgrowths on the dorsal median lines of the velar lappets. Nine marginal rhopalia were counted in one example but the rule is 8. Exumbrellar sensory pits with radiating furrows. They have a somewhat circular outline in all fully grown forms. Thus, there is a characteristic difference in shape between these structures in the two species of *Crambionella* described here.

Arm-disc more or less circular, less than the radius of the bell. Each of the 8 mouth-arms has a proximal, short, cylindrical portion carrying mouth appendages ventrally, and a long, three-winged, distal portion more than 6 times as long as the proximal portion. The lower half of the three-sided part is a naked pyramid and converges to a point. This constitutes the terminal appendage. The frilled mouths are carried as a ventral row from the arm-disc and as two dorsal rows along the upper corners of the arm, the former extending farther towards the naked extremity of the arm than the two latter. In no case, however, is the ventral row carried down to the tip of the terminal appendage. Accessory appendages similar to those found in *C. orsini* are present here also. These may have, sometimes, the appearance of vesicles. The 4 subgenital ostia are half as wide as the perradial columns between them. They are crescentic in shape, being constricted by median gelatinous projections from the arm-disc. The subgenital cavity is unitary. The gonads are four-folded.

The stomach is rather wide. The 8 rhopalar canals extend to the margin of the umbrella, while the 8 inter-rhopalar ones end in the marginal ring-canal. As in *C. orsini*, 6-7 centripetal canals arise from the ring-canal and form close networks between the radial canals. It is very doubtful if these networks as a rule get connected with the rhopalar radial canals. From among a number of forms examined, only a single instance of a connexion was observed. Even here, it was only at a single point in one of the networks and was much less prominent than the "gelegentliche, schwache, Verbindungen mit den Rhopalarcanälen" observed by Stiasny (1922, I). Externally the ring-canal gives rise to a number of branches forming a network extending to the margin of the subumbrella.

General colouration similar to that of *C. orsini*. Margin of the umbrella and the frilled mouths are sometimes splashed with a beautiful, brownish-red colour. This is characteristic of developing forms.

The general conclusion that can be drawn from a study of these two species (*C. orsini* and *C. stuhlmanni*) is that they are fundamentally similar with only minor differences between them. The most important factor uniting them is the canal system which is of the *Crambione* type in both forms, although there is a tendency in *C. stuhlmanni* to approach the condition met with in *Acromitus*.

Genus *Acromitus* Light, 1914.

Mouth-arms with axial terminal appendages and with numerous filaments between the mouth-frills. Centripetal network connected with the rhopalar canals. Subgenital papillae present.

Acromitus flagellatus (Haeckel) Stiasny, 1921.

Pl. II, figs. 9 a-c.

A number of these medusae were collected from the Adyar River where shoals of these appear from August till some time in November. The following description is that of a perfect, though immature, specimen.

Bell flatter than a hemisphere. Exumbrellar surface smooth, but appearing finely granular under the lens. Most specimens have brownish-yellow spots uniformly scattered over their pale, white exumbrellae. The 8 marginal rhopalia have furrowed exumbrellar pits. The rhopalia themselves are tipped with brownish pigment spots. The velar lappets are considerably longer than the narrow, pointed, ocular lappets subtending the marginal sense-organs, and are arranged as four pairs in each octant of the umbrella.

The arm-disc is more than half as wide as the bell. The subgenital porticus is unitary. The external faces of the perradial columns are concave and almost as wide as the subgenital ostia which are partially closed up by the inter-radial flap-like outgrowths of the arm-disc and by the subumbrellar, gelatinous, papillary outgrowths. The 8 mouth-arms are almost as long as the diameter of the bell. Each arm ends in a long tapering filament, ringed with nematocyst warts and more than twice as long as the arm itself. There are also a number of shorter, more slender filaments hanging from amidst the frilled mouths. These filaments are continued to the very centre of the arm-disc.

There is a wide zone of circular muscles on the subumbrella. These are interrupted in the rhopalar radii internal to the ring-canal but only partially interrupted external to this marginal circular canal.

Central stomach wide and cruciform. Gastric filaments short and numerous. Of the 16 radial canals given off from the stomach, the 8 principal ones extend to the rhopalia, while the 8 adradial ones end in the ring-canal. Internally, the ring-canal gives rise to 3-4 centripetal canals which form networks connected with the rhopalar canals. External to the ring-canal, there are about 14 widely anastomosing canals in each octant, and the networks formed by these extend to the margin of the umbrella.

The gelatinous substance of the umbrella is translucent. The Gonads and mouth-frills are greyish-white.

In "The Fauna Of The Chilka Lake" (*Mem. Ind. Mus., Vol. V*), Anandale has described *Acromitus rabanchatua* as a distinct species different from *Acromitus maculosus* described by S.F. Light from the Philippines. Since the discovery of this form in 1914, only very few specimens have been described from other parts of the world. I have collected *Acromitus* chiefly from the Adyar river and from the adjacent back-waters. Recently, I have come across these medusae in the Cooum estuary very near to "Marine Villa," the place where the University Zoological Laboratory is at present located. This was during the commencement of the monsoon, but I am not in a position to say anything about the exact time of their appearance in this rather dirty river. Probably they enter it when it gets temporarily connected with the sea.

As regards the relations of the Madras *Acromitus* with those of the Chilka Lake and *Acromitus maculosus*, it may be observed that the Madras form resembles *A. maculosus* more than *A. rabanchatua* in some important characteristics. Thus, in the nature of the ocular lappets which are considerably smaller and shorter than the velar ones, the Madras form differs from that of the Chilka Lake. The former has long, prominent

filaments amidst the mouth-frills unlike those of *A. rabanchatua*. But there is also reason to believe that in young forms the filaments may appear to be comparatively long. This is especially so with regard to the terminal filaments. The narrow, subgenital ostia of *A. rabanchatua* are narrower than the pillars between them. With all its resemblances to the Philippine Medusa, the Madras form is without any common lateral branch for the centripetal network between the radial canals. It is doubtful whether the pigment spots on the rhopalia of the Madras *Acromitus* have anything to do with the pigmental areas of *A. maculosus*, mentioned by Light. These, together with the fact that the exumbrella is smooth, have been responsible for separating the Madras form from *A. maculosus* and considering it as a local variety of *A. flagellatus* to which our form has remarkable resemblances in the nature of the subumbrellar canal system, in the shape of the arm-disc, and in the presence of papillae at the subgenital openings.

In his figure of a 10 mm. specimen Stiasny (1921, p. 134, fig. 9) has shown 3 centripetal canals in a sector of the medusa. The smallest example in our collection about 25 mm. in diameter, has 3-4 centripetal canals in each sector and these have already formed into networks and established connexions with the rhopalar canals.

Annandale has given a good account of the habits and development of *A. rabanchatua* (1915). Many of the medusae collected by me had beautiful spots on their exumbrellae. Sometimes very young forms are met with having well-developed pigment spots, but often well grown forms are entirely devoid of these, leading one to believe that the appearance of these spots depends on the conditions under which they live.

Before concluding, a word may be said about the time of appearance of these medusae in Madras. As already mentioned they appear from August till sometime in November. One cannot help noticing from this that there is some similarity in the time of appearance of these forms and those of the Malay Archipelago (Stiasny, 1921, p. 58, table 2). The largest specimen was collected here in October. This was not sexually mature. It has been recorded that *A. flagellatus* becomes sexually mature in the Malay Archipelago during the months of June, July and August.

Family LOBONEMIDAE Stiasny, 1921.

Mouth-arms with numerous filaments. Mouth-arm membranes perforated by window-like openings. Centripetal network of canals connected with the radial canals. Marginal lappets greatly extended. Prominent papillae on exumbrella.

Genus *Lobonema* Mayer 1910.

Centripetal network of canals connected both with the rhopalar and inter-rhopalar canals.

Lobonema mayeri, Light.

Pl. III, figs. 13 a-b.

Preserved in a solution of dilute formalin and copper sulphate are three fairly complete representatives of this genus in our collection, and the following description is

based upon the characteristics exhibited by these, although much has been obscured by deposits of copper sulphate.

Bell flatter than a hemisphere and about 305 mm. in diameter. Gelatinous substance thick, tough, and rigid. Exumbrella regularly studded with erect, gelatinous outgrowths. The largest tubercles are about 30-35 mm. high and are centrally placed on the exumbrella at distances of about 5 mm. from one another. They are however, more widely separated near the margin where they begin to disappear, the lappets being entirely devoid of them.

Between each pair of marginal rhopalia, there are 4 velar lappets which are large and drawn out into tentacle-like structures. The free portions of these tapering lappets are from 45 to 60 mm. in length and 15-20 mm. broad at their bases. The deep clefts separating the lappets from one another are continued to the exumbrellar surface as marginal grooves for a distance of about 25-30 mm. Over the rhopalia, flanked by the small inconspicuous ocular lappets, these grooves are shorter and V-shaped. There is considerable variation in the number of rhopalia and in the number of inter-rhopalar marginal lappets. In one specimen 12 rhopalia were counted with the normal number of lappets between them, while another had 11 single sense-organs and 3 paired ones, making a total of 17. Reduction in the number of lappets was observed in this form, sometimes there being present only a single, large velar lappet between a pair of rhopalia, instead of the usual 4 lappets. Rhopalia have exumbrellar pits with radiating furrows.

There is a good deal of conformity in the nature of the radial canals and marginal sense-organs. As a rule, there seem to be twice as many radial canals as there are sense-organs. The rhopalar canals come up to the margin but the inter-rhopalar ones break up into the marginal network, a little beyond the circular ring-canal. Both external and internal to the ring-canal, there are networks which communicate with the radial canals. The circular muscles are powerfully developed and form an annulus of about 80 mm. at the margin of the sub-umbrella. These ring muscles are interrupted on the inner side of the ring canal both in the rhopalar and inter-rhopalar radii; but on the outer side they are only partially interrupted in the rhopalar radii.

The arm-disc is large, prominent, and thick, about 170 mm. from one perradial column to the one opposite to it, and 130 mm. between opposite subgenital ostia. The latter are almost as wide as the perradial columns between them. An interesting feature with regard to the arm-disc is that there are about 10-12 papillary outgrowths projecting from the arm-disc towards the openings of each of the subgenital ostia. A number of young fish were found in these subgenital ostia. On the external faces of the inter-ostial pillars, there are concavities containing certain knob-like, gelatinous outgrowths. I do not know whether it is possible to correlate these with the slit-like false ostia described by Light in his account of *L. mayeri*. But it is highly probable that these are practically identical structures, specially because of the fact that Light mentions a large cone-shaped papilla, which he observed on the upper margin of the false ostium in one of his specimens.

The mouth-arms are 160 mm. long with fusiform terminal appendages tapering to slender filaments. Numerous similar appendages, but of various sizes, are found all along the mouth-arms. The dorsal wing-like membranes of the mouth-arms are each perforated by 3 window-like openings. It is remarkable that the ventral wings may or may not have these window-like openings and there is no definiteness about the number present.

The frilled mouths and fusiform appendages are carried on to the centre of the arm-disc. The axial ducts of the mouth-arm canals branch in the tissues of the arms and send numerous sub-branches.

The gonads protrude through the subgenital ostia as frilled membranous outgrowths.

A study of fresh specimens of these medusae in various stages of growth is highly desirable in view of the great interest attached to them and to the closely allied genus, *Lobonemoides*. After his study of *Lobonemae* from Manila Bay, Light put forward the view that the two species of *Lobonema*, *smithii* and *mayeri*, might be identical. The highly variable nature of the rhopalia, both in number and distribution, has been adduced as an argument against Mayer's observations based on a "quadrant" of a perfect specimen and two imperfect forms. What Light found in the Manila Bay forms with regard to the marginal sense organs of these medusae, seems to be very common in the *Lobonemae* of the Madras Coast.

Genus *Lobonemoides* Light, 1914.

The centripetal network of canals connected only with the rhopalar canals.

Lobonemoides robustus, Stiasny.

Only two incomplete specimens of this very interesting medusa are represented in our collection. They appear as remarkably transparent objects in the spirit in which they have been preserved.

The bell is 85 mm. broad, thick in the centre but very much thinned out towards the margin. The centre of the exumbrellar surface is besprinkled with numerous conical outgrowths, of which the central ones are considerably larger than those at the periphery. The margin of the umbrella has a varying number of rhopalia which, in the two specimens examined, were respectively 14 and 16. The marginal sense-organs have exumbrellar sensory pits with radiating furrows. Between each pair of rhopalia, there are 4 velar and 2 ocular lappets. The velar lappets are rather large, bluntly triangular, and deeply-cleft, while the ocular ones are small. In certain segments, however, the lappets are elongated into structures similar to the tentacle-like lappets of *Lobonema*.

The arm-disc is a little less than the radius of the umbrella. Each mouth-arm has at its terminal end a spindle-shaped appendage drawn out distally into a long filament. Similar appendages are found between the frilled mouths all along the length of the arm. The terminal filament of each appendage is twice as long as the appendage itself. One of the specimens showed the presence of a number of simple filaments at the centre of the

arm-disc and on the proximal parts of the arms, instead of the spindle-shaped appendages found elsewhere. This specimen, however, seems to be the younger of the two. The wings of the mouth-arms are without any window-like openings in both specimens.

The subgenital ostia are twice as broad as the perradial columns between them. A small papillary outgrowth was observed in one of the subgenital ostia of one specimen. The gonads are much folded membranes projecting from these ostia.

There are twice as many radial canals as there are marginal rhopalia. The ring canal has networks on both sides. The centripetal networks are connected with the rhopalar canals but not with the inter-rhopalar canals. These networks come very near to the margin of the stomach but are not connected with it. The circular muscles of the subumbrellar margin are powerfully developed and are only partially interrupted by the radial canals.

However meagre may be the diagnostic data provided by these forms, one can, without doubt, regard them as representatives of the genus *Lobonemoides*, as at present constituted. The question of the relationship of the two genera, *Lobonema* and *Lobonemoides*, was originally dealt with by S. F. Light and subsequently by Stiasny. The suggestion that *Lobonemoides* is only a stage in the growth of *Lobonema* is highly interesting and seems to be very much strengthened by the characters shown by the specimens under consideration. Leaving alone the canal system for a moment, other features tend to show that *Lobonemoides* is closely related to *Lobonema*. The presence of tentacle-like lappets in some of the parameres, while others of the same specimen are provided with the usual unspecialized velar lappets, clearly indicates that the lappets tend to approach the condition found in *Lobonema*. The remarkable similarity in the number of lappets, rhopalia and radial canals also speaks in favour of the *Lobonema* theory. The exumbrellar outgrowths in the two specimens are more or less of the same nature. The perforations of the arms have not yet taken place but this factor cannot be regarded as very important, as there are considerable variations in the nature of these openings. *Lobonema smithii*, as described by Mayer, has 3 of them in each of the 3 wings of a single mouth-arm. In *L. mayeri*, there are typically two such perforations in the membranes of each wing. But light has come across forms having mouth-arms without any perforations at all. Three window-like openings in each of the two dorsal wings of an arm are found in the *Lobonemae* of the Madras Coast. These irregularities and variations lead us to think of the danger of depending upon this characteristic in distinguishing species under *Lobonema* and *Lobonemoides*. Very probably, the absence of window-like openings in *Lobonemoides* is due to the comparatively young stage of its growth. Stiasny has observed in one place, "Kurze Randläppchen, geringere Grösse, Mangel der Fenster an den Mundarmen und der Subgenital papillen, einfacherer Bau des Gefässsystems—lauter Jugendmerkmale."

The canal system is the chief distinguishing feature of *Lobonemoides*. But it is not at all difficult to assume, as Stiasny has done, "Dass der Gefässtypus *Lobonemoides* nicht anderes als den in der Entwicklung stehen gebliebenen Gefässtypus *Lobonema* darstellt", and there is very great probability that "*Lobonemoides* wäre dann als eine neotenische

Form von *Lobonema* aufzufassen, bei welcher ein Entwicklungsstadium des Gefäßsystems dauernd festgehalten wurde."

As regards the relationships of *L. robustus* and *L. gracilis*, Stiasny observes: "Dass *Lobonemoides gracilis* höchstwahrscheinlich ein jugend-stadium von *Lobonemoides robustus* darstellt, indem sämtliche unterscheidungsmerkmale der beiden formen nur auf den alter-unterschied zurückzuführen sein dürften" (1921, p. 157). The Madras form occupies a sort of intermediate position between *Lobonemoides gracilis* Light, and *Lobonemoides robustus* Stiasny, with, however, remarkable resemblances to the latter.

Tribe Scapulatae Stiasny, 1921.

Eight pairs of scapulets present on the 8 mouth-arms. Ring canal present or absent. Subgenital cavities separate.

Family RHIZOSTOMIDAE Stiasny, 1921.

The primitive mouth opening has been obliterated. Mouth-arms with terminal appendages.

Genus *Rhopilema* Haeckel, 1879.

With clubs and filaments on the mouth-arms. A ring canal is absent in all fully developed forms. The centripetal networks extend very near to the stomach. The subgenital cavities are not always completely separated from one another.

Rhopilema hispidum (Vanhöffen) Maas.

Pl. III, figs. 15 a-b.

Bell 200-250 mm. wide, apparently flatter than a hemisphere, but the shape may have been considerably altered due to long preservation. Exumbrella uniformly covered with numerous small, sharply pointed, conical outgrowths. Margin cleft into lappets, there being six velar and two ocular lappets in each octant of the umbrella. Velar lappets rounded but of variable size. Ocular lappets flanking the eight rhopalia considerably smaller than the velar ones. Rhopalia with exumbrellar pits and radiating furrows.

The arm-disc is somewhat cruciform and less than half as broad as the umbrella. The subgenital ostia occupy the angles of the cross and are broader than the perradial columns between them. There is no unitary subgenital porticus, the gonads being placed in separate cavities. Just at the openings of the subgenital ostia, and situated on the inter-radial canals, are large outgrowths having prickly surfaces. On either side of these and situated near the radial canals are similar smaller outgrowths. Thus at the opening of each subgenital cavity there are three such protruberances, partially concealing the opening.

The mouth-arms are fused with one another for more than half their length. The free, distal, tripterous portions end in club-like appendages. Accessory clubs of various sizes are also present on the three-winged parts of the arms. A number of filaments were observed in one form at the place where the arms become free. Each arm has at its place of origin a pair of scapulets placed dorsally. These carry on their dorsal aspects mouth-frills interspersed with filaments. The scapulets are forked at their outer ends. The filaments are hollow and are of the same length as the scapulets themselves.

Sixteen radial canals are present, all of them extending to the bell-margin. They are all connected by networks of canals between them. There are sinus-like swellings at the points of origin of the innermost branches of the adradial canals. A ring-canal is absent at the margin. The circular muscles are developed as 16 triangular areas alternating with the radial canals and widely separated by them.

The centre of the bell is not very thick and the sides are rather thin. One form showed a tendency towards abnormal growth. It had 10 marginal rhopalia and a corresponding augmentation of the radial canals. The gonads were also found to be abnormal and there were five subgenital ostia, thus indicating a correlation between the sense-organs and the gonads, a feature already observed in abnormal specimens of *Aurelia*.

Stiasny considers *R. visayana* Light, as identical with *R. hispidum* (Vanhöffen) Maas. After a critical survey of the whole question, he concludes, "Somit hält keines der drei von Light erwähnten für die Spezies *R. Visayana* typischen Merkmale einer Kritik stand." (Stiasny, 1921).

SUMMARY.

1. The locality appears to be rich in Scyphomedusae. As many as 21 species have been collected of which one is described as new to science. These belong to 19 genera.
2. A certain similarity between the scyphomedusan fauna of this coast and that of the Malay Regions has been noticed.
3. It is probable that there is a periodicity in the occurrence of many forms. Nothing definite can, however, be stated, as a systematic collection of the forms with a view to elucidating this point has not been made.

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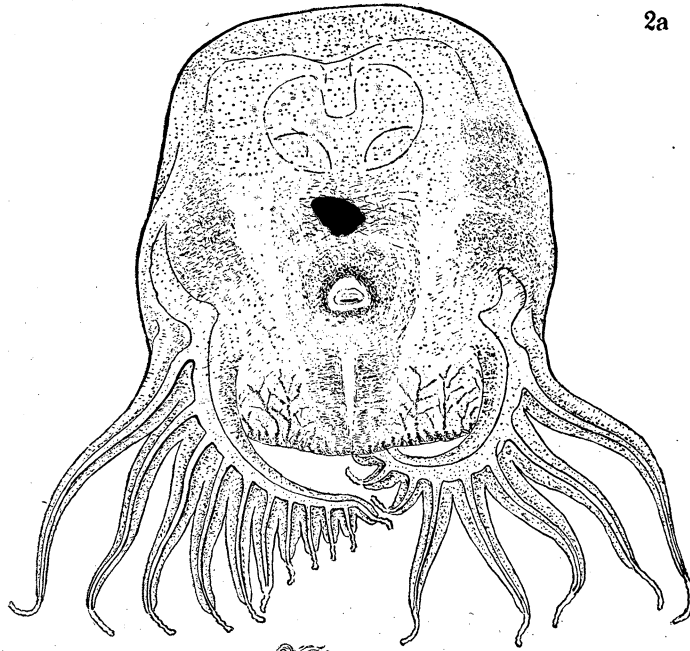
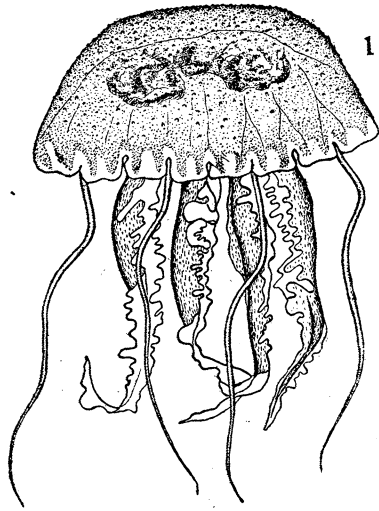
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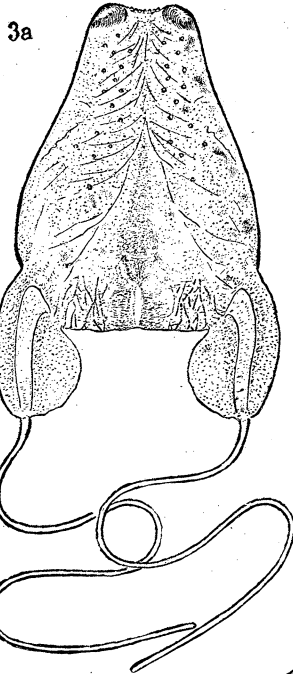
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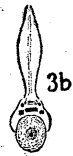
- Figure 1. *Pelagia noctiluca*.—About three-fourths natural size.
,, 2a. *Chiropsalmus buitendijki* with velarium stretched out. Half natural size.
,, 2b. Do do. Gastric cirri. Magnified.
,, 3a. *Charybdea madraspatana* with velarium stretched out. A little less than
half natural size.
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,, 3c. Do. do. Do. side view.
,, 4a. *Tamoya sp.* with velarium stretched out. A little less than half natural
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,, 4b. Do. Sense-club. Highly magnified. Side view.
,, 5. *Nausithoë punctata*.—Portion of the subumbrella with gastric cirri. Highly
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,, 6a. *Dactylometra quinquicirra*.—Sense-club. From above. Magnified.
,, 6b. Do. do. Margin of the normal form.
,, 6c. Do. do. Do. of an abnormal form.



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3a



3b



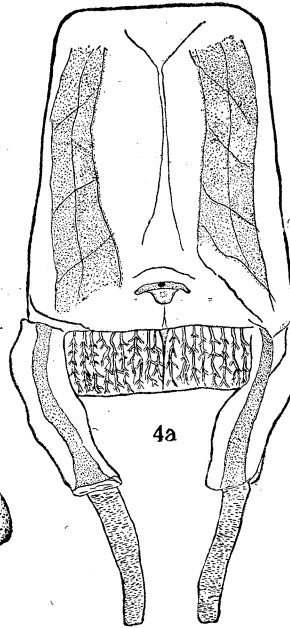
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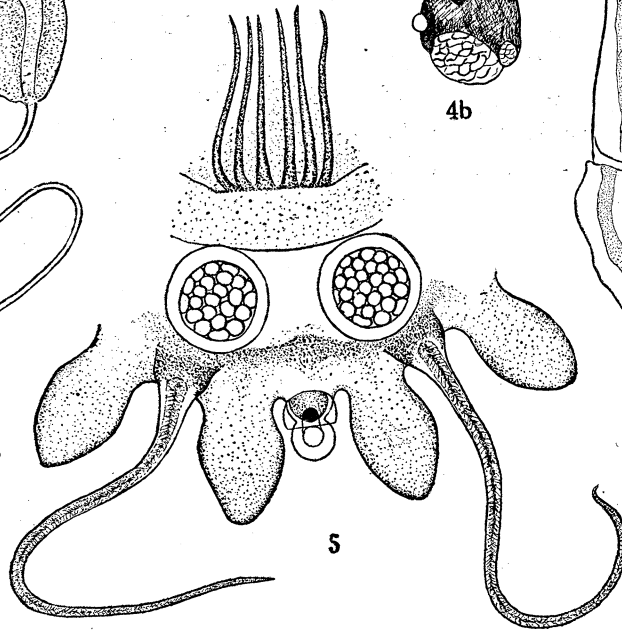
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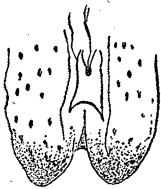
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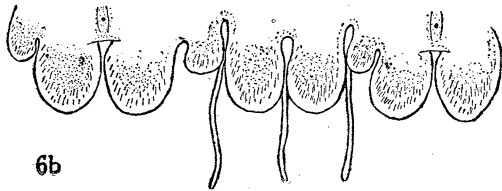
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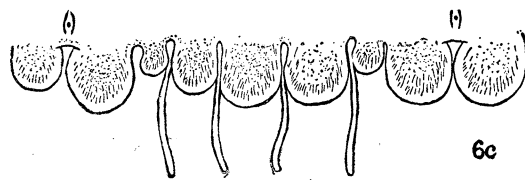
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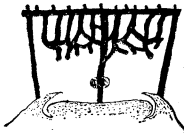
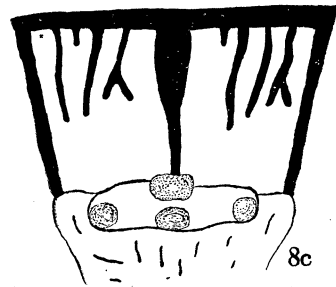
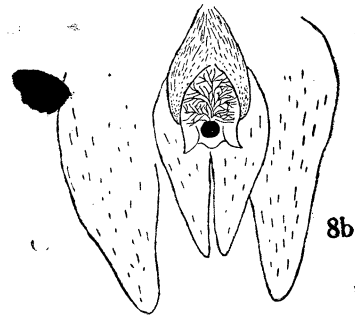
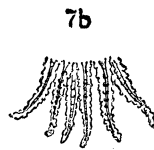
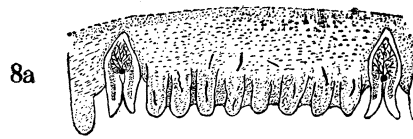
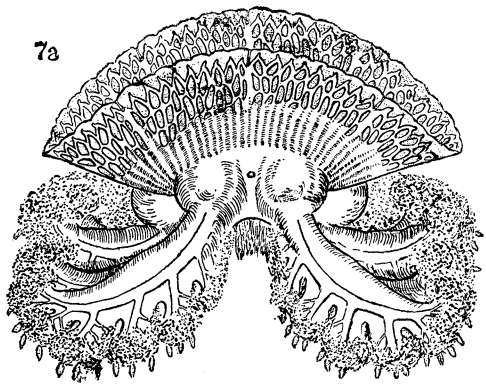


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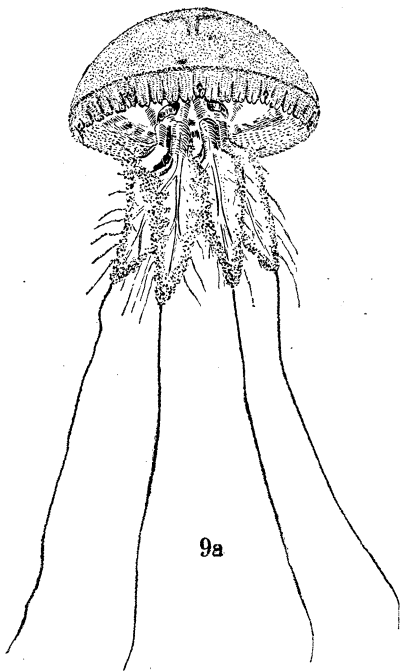
SCYPHOMEDUSAE OF MADRAS.

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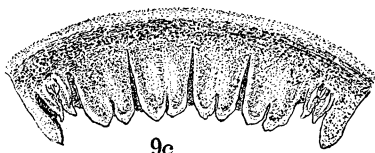
- Figure 7a. *Netrostoma coerulescens*.—Less than half natural size.
- „ 7b. Do. do. Some of the arm-disc appendages.
- „ 7c. Do. do. One of the brachial appendages. Enlarged.
- „ 7d. Do. do. One of the arm-disc appendages. Enlarged.
- „ 8a. *Lychnorhiza malayensis*.—Bell margin with worms embedded in the jelly.
- „ 8b. Do. do. A rhopalium. Enlarged.
- „ 8c. Do. do. Canal system of the subumbrella. Diagrammatic.
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- „ 9c. Do. do. Bell margin.
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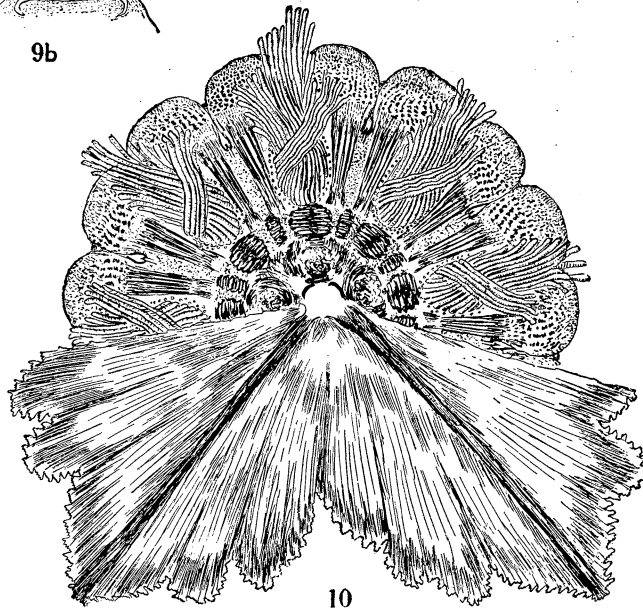
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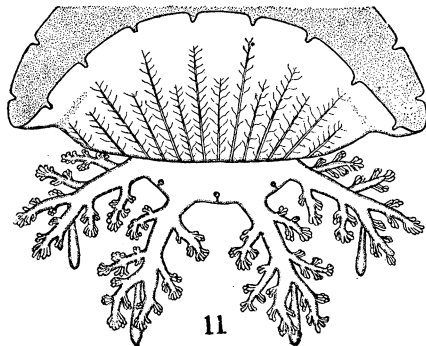
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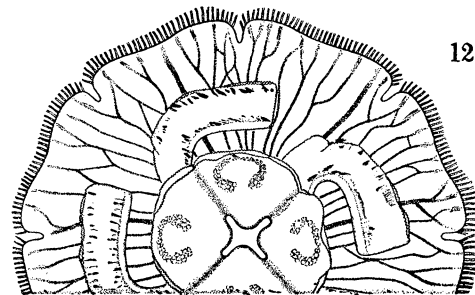
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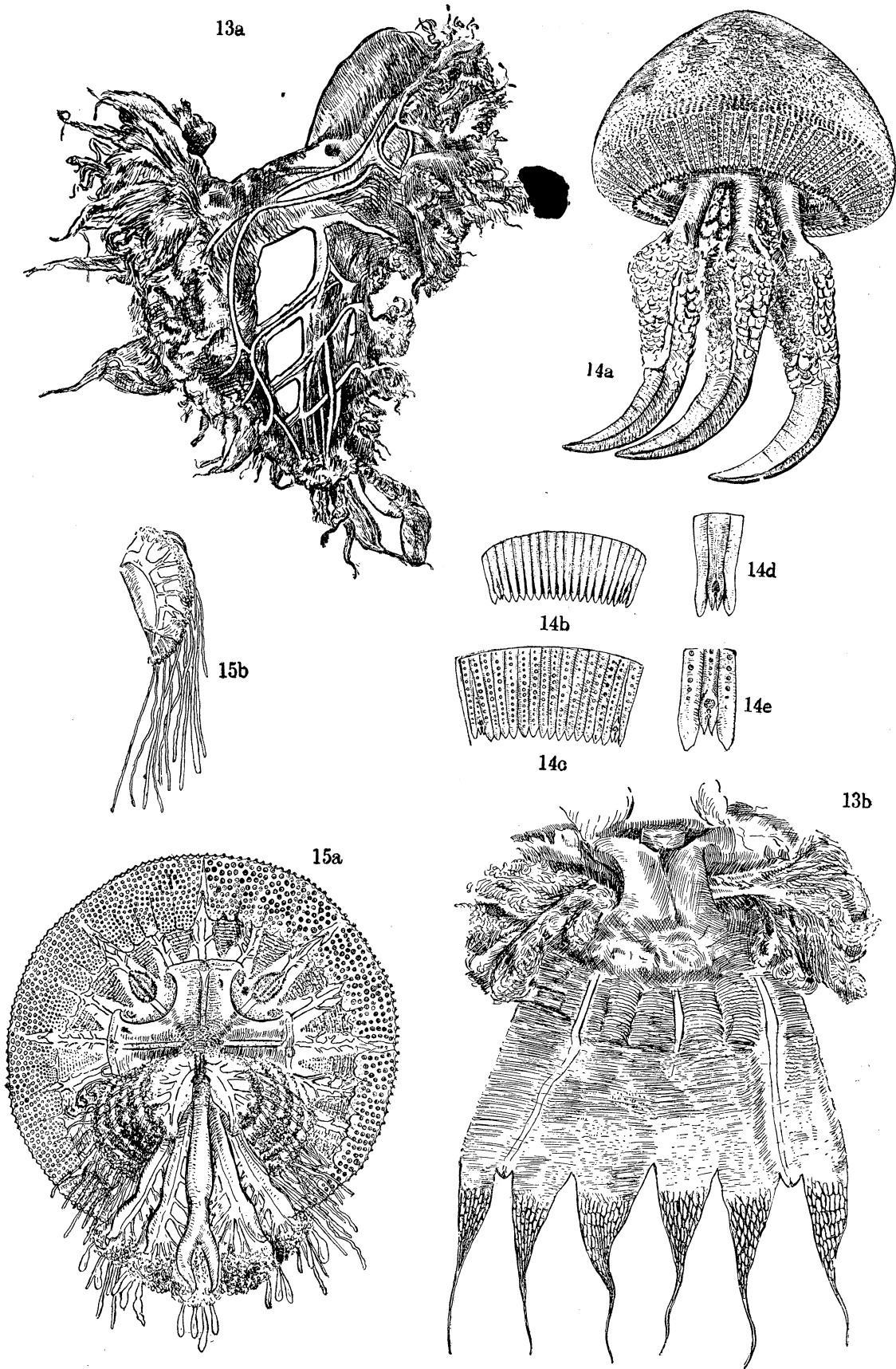
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- Figure 13a. *Lobonema mayeri*.—Side view of the lower portion of an arm.
,, 13b. *Do. do.* Portion of the subumbrella with gonads.
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,, 14b. *Do. orsini*.—Bell margin.
,, 14c. *Do. stuhlmanni*.—Bell margin.
,, 14d. *Do. orsini*.—Rhoplar region.
,, 14e. *Do. stuhlmanni*.—Rhoplar region.
,, 15a. *Rhopilema hispidum*.—Ventral aspect.
,, 15b. *Do. do.* One of the scapulets.



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