NOTES ON SCYPHOMEDUSAE IN THE INDIAN MUSEUM.

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(Plates III, IV.)

The material on which these notes are based consists of occasional catches of medusae obtained from various sources since the year 1885. A great proportion has, however, been collected in recent years by the R. I. M. S. " Investigator " in the course of its cruises in the Bay of Bengal and the Arabian Sea. A few were obtained on the coasts of India by the members of the Zoological Survey and others.

At the suggestion of Col. Sewell I commenced the study of the Indian Museum Scyphomedusae in April 1926, but owing to frequent unavoidable interruptions the completion of the work has been considerably delayed.

The present collection, though not large, includes representatives of all the orders of the Scyphomedusae except the Stauromedusae which are not known to occur in tropical seas. With the exception of a few medusae which have been preserved with care the collection consists of specimens which are incomplete or are very badly contracted. Consequently the identification of specimens presented no small difficulties. Many of the examples are preserved in alcohol which renders the tissues of jelly-fish extremely brittle. Formalin (about 5-10 per cent.) is a very good preservative for medusae, and should be employed instead of alcohol. A very useful note on the collecting and preserving of medusae published by Mr. E. T. Browne may be consulted with advantage.[1]

Although there have been several records of Scyphomedusae from the region of the Philippines and the Malay Archipelago, very few are known from the coasts of India and Burma. Our knowledge of medusae from the Indian region proper is due to Browne who has reported on the collections from the Laccadives and Maldives, the Ceylon Pearl Oyster Banks, the Okhamandal Coast of Kathiawar, and the Indian Ocean (" Sealark ").[2] A short paper on the Scyphomedusae of Madras by Mahadeva Aiyar was published in 1911 with for the most part only generic identifications[3]. This has recently been supplemented by Mr. M. G. K. Menon in a more or less complete account of the species of jelly-fishes occurring on the Madras coast.[4]

Judging from the collection in the Indian Museum, which consists of 26 species belonging to 18 genera, it seems that the shallow waters along the coasts of India and Burma are rich in Scyphomedusae, and it is surprising that this group of animals has attracted so little attention

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[1] Browne, *Trans. Linn. Soc. London*, X, pp. 166-170 (1906).

[2] Browne, *ibid*, XVII, p. 208 (1916).

[3] Mahadeva Aiyar, T. R.—*Some notes on the Scyphomedusae of Madras.*—Guardian Press, Madras (1911).

[4] Menon, M. G. K.—*Bull. Govt. Museum, Madras* (N. S.), III, 26 pp. 3 pls. (1930)

hitherto. It is also evident that some species are casual visitors or semi-permanent inhabitants of the estuaries, the deltaic areas, and lakes and backwaters on the coasts of India. A systematic survey of the coastal waters is certain to increase the number of species known from the Indian seas.

In the preparation of these notes I have found the works of Mayer and Stiasny indispensable, and no student of this group can afford to miss them.

In respect of the Rhizostomae I have followed the classification of Stiasny as emended by Uchida.[1]

My best thanks are due to Dr. Gustav Stiasny of Leiden for going through my manuscript and suggesting various improvements, and to the skilful artists of the Zoological Survey of India for the drawings and photographs illustrating this paper.

LIST OF SPECIES IN THE COLLECTION OF THE INDIAN MUSEUM.

1. *Periphylla hyacinthina* Steenstrup.
2. *Atolla wyvillei* Haeckel.
3. *Tamoya alata* Reynaud.
4. *Tamoya* sp.
5. *Chiropsalmus quadrumanus* L. Agassiz.
6. *Pelagia noctiluca* (Forskål).
7. *Chrysaora helvola* Brandt.
8. *Chrysaora melanaster* Brandt.
9. *Cyanea capillata* var. *nozakii* Kishinouye.
10. *Aurelia aurita* Lamarck.
11. *Aurelia solida* Browne.
12. *Cassiopea* (?) *frondosa* (Pallas) Lamarck.
13. *Cassiopea andromeda* var. *maldivensis* Browne.
14. *Netrostoma typhlodendrium* Schultze.
15. *Mastigias ocellata* (Modeer).
16. *Mastigias albipunctata* Stiasny.
17. *Mastigias* sp.
18. *Mastigias papua* var. *sibogae* Maas.
19. *Versura anadyomene* (Maas).
20. *Thysanostoma thysanura* Haeckel.
21. *Acromitus flagellatus* (Haeckel).
22. *Acromitus rabanchatu* Annandale.
23. *Crambionella annandalei*, sp. nov.
24. *Lobonema smithii* Mayer.
25. *Lobonemoides sewelli*, sp. nov.
26. *Rhopilema hispidium* (Vanhöffen) Maas.

Order CORONATAE.

Family PERIPHYLLIDAE.

Genus **Periphylla** Steenstrup.

1910. *Periphylla*, Mayer, *Medusae of the World*, III, p. 543.

Periphylla hyacinthina Steenstrup.

1913. *Periphylla hyacinthina*, Kramp, *Vidensk. Med. fra Dansk Naturh. Foren.* LXV, p. 277.
1928. *Periphylla hyacinthina*, Bigelow, *Zoologica N. Y. Zool. Soc.*, VIII, p. 496.

This species is represented by four much contracted specimens of which only one is more or less entire. The diameter of the bell is 70 mm. There are twelve tentacles, and the rhopalia are mostly damaged.

Marine Survey Station 120 (Bay of Bengal—15° 56′ 50″ N., 81° 30′ 30″ E., 24-xii-1890); 240 fathoms—1 specimen.

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[1] Uchida, *Journ. Fac. Sci. Imp. Univ. Tokyo*, I, pp. 85-90 (1926).

Marine Survey Station 386 (Laccadive Sea—11° 55′ N., 74° 22′ E., 13-x-1909) ; 360 fathoms—3 specimens.

Family Atollidae.

Genus **Atolla** Haeckel.

1910. *Atolla*, Mayer, *op. cit.*, p. 561.
1928. *Atolla*, Bigelow, *op. cit.*, p. 505.

Atolla wyvillei Haeckel.

1916. *Atolla wyvillei*, Browne, *Trans. Linn. Soc. London*, VI, p. 203.
1928. *Atolla wyvillei*, Bigelow, *op. cit.*, p. 508.

There are several specimens of this species in the collection. Some are greatly contracted and crumpled, while others in a better state of preservation are evidently immature forms. The diameter of the bell varies from 25-55 mm. in the young medusae to 80-100 mm. in the older forms. The central lens varies from 20-70 mm. in diameter. The tentacles are 20-29 in number and alternate with as many rhopalar pedalia, which are rather minute. The margin of the central lens is more or less entire, and the marginal lappets are very much contracted, and have dropped off altogether in some individuals.

Marine Survey Station 134 (off Kistna delta, Bay of Bengal ; 13-iv-1892) ; 753 fathoms—one specimen.

Marine Survey Station 260 (Laccadive Sea, 18-i-1900) ; 487 fathoms-one specimen.

Marine Survey Station 322 (Andaman Sea, 20-xi-1903), 378 fathoms—3 specimens. Off the Gangetic delta in the swatch of no ground, 285-409 fathoms—10 small specimens.

Marine Survey Station 682 (Laccadive Sea, 10° 26′ N., 74° 82′ 30″ B., 28-iv-1925) from midwater—one well-preserved specimen.

Four badly preserved specimens bearing the Register Nos. 4907-4910/7 and without a locality label. Presumably they are from the Indian seas.

Order CUBOMEDUSAE.

Family Charybdeidae.

Genus **Tamoya** Müller.

1859. *Tamoya*, F. Müller, *Abhandl. Naturf. Ges. Halle*, V, p. i, pl. i-ii.

Tamoya alata Reynaud.

1929. *Tamoya alata*, Uchida, *Japanese Journ. Zool.*, II, p. 172.

The species is represented in the collection by a fairly large series of specimens from the Bay of Bengal.

Ennur, near Madras—one specimen : The bell is 75 mm. high and 50 mm. in diameter, and the tentacles are 230-250 mm. long. The pedalia have a sharp outer and inner edge, and are 25-30 mm. long, 10-12 mm. broad. There are 8 much branched canals in the velarium of each quadrant.

Puri, Orissa Coast (Dr. S. W Kemp, 24-29-iii-1916), 4-4½ fathoms: One specimen 50 mm. high, 50 mm. broad with tentacles 28-40 mm. long; (P. C. Singh, June 1909) one specimen 75 mm. high, 70 mm. broad, tentacles 10-25 mm. long, much contracted. The pedalia are 30 mm. long, 15 mm. broad, pyramidal at the base and flattened near the apex, and have sharp outer and inner edges. The sense clubs have large median eyes with conspicuous lens, but no trace of the lateral eyes was found. The velarium has ten canals in a quadrant, each of them branched near its origin.

Marine Survey Station 565 (11° 57′ 30″ N., 98° 19′ 00″ E., 13-xi-1913); 7 fathoms—one immature specimen.

Marine Survey Station 569 (11° 52′ 10″ N., 98° 18′ 40″ E., December 1913), 4 specimens obtained near the surface of the sea. Bell 45-80 mm. high, 30-60 mm. broad; tentacles 50-65 mm. long, 6-8 complexly branched velarial canals in each quadrant. Small spindle-shaped fish (Clupeidae ?), crustacean larvae (of *Squilla*, etc.), a few prawns and Isopods were found in the stomach of these medusae.

Marine Survey Station 580 (Celerity Passage, 1914)—one specimen 40 mm. high, 25 mm. broad.

Bay of Bengal, between Pilot Ridge Light Vessel and Eastern Channel (Pilot Vessel " Lady Fraser ", February and March 1928)—one large specimen 150 mm. high, 70 mm. broad, which is greatly contracted. The tentacles are missing, but the pedalia (35 mm. high and 20 mm. broad) and the velarium (10-15 mm. broad) are present. The velarial canals end in trident-like distal branches.

Tamoya sp.

One specimen which is obviously very young was obtained near the surface at the Marine Survey Station 524 (Mergui Archipelago, 13-iii-1913). I am unable to refer this to any well-known species. The bell is 12 mm. high, 8 mm. broad, somewhat pyramidal, and tapering towards the apex. Several prominent warts are present on the exumbrella. The tentacles have several ring-like ridges consisting of nematocysts. There are four main velarial canals in each quadrant of which the central or perradial is simple and unbranched. The lateral canals are, however, branched, each resembling a trident. Some of them show traces of further branching. The sense organs are placed in deep niches, and the rhopalium hangs by a slender basal stalk from the roof. There are two median eyes with lens, but the lateral eyes seem to be absent. The colour of the medusa is orange.

Family CHIRODROPIDAE.

Genus **Chiropsalmus** L. Agassiz.

1862. *Chiropsalmus*, L. Agassiz, *Contr. Nat. Hist. U. S.*, IV, p. 174.

Chiropsalmus quadrumanus L. Agassiz.

1910. *Chiropsalmus quadrumanus*, Mayer, *op. cit.*, p. 515.

There are four medusae belonging to this species in the collection. Only one is well-preserved, the remaining three being considerably damaged

The sac-like subumbrellar processes of the perradial pouches are, however, intact, and my identification is based on an examination of these structures.

Ennur, near Madras (1925)—one well-preserved specimen 75 mm. high and 60 mm. broad. The pedalia are hand-shaped with 5-8 finger-like branches of which the longest is near the exumbrellar side of the bell. The subumbrellar processes of the perradial pouches do not extend much beyond the manubrium.

Puri, Orissa Coast (Mr. P. C. Singh, June 1909)—one much damaged specimen. The processes of the perradial pouches are rudimentary.

Marine Survey Station 509 (Elphinstone Island, Mergui Archipelago, 1912-13).—Two specimens were obtained off shore with a seine net. They are crumpled and brittle. The colour is orange brown.

As far as I am aware this species has never been recorded from the Indian Ocean. It is " found in the warmer waters along the Atlantic Coasts of North and South America, south of Cape Hatteras " according to Mayer. Taking into consideration the fact that certain species of Scyphomedusae have a wide range in distribution in both tropical and temperate seas the present record of *C. quadrumanus* in tropical waters should cause no surprise. It is, however, curious that *C. quadrigatus* Haeckel and *C. buitendijki* Horst previously recorded from the Indo-Pacific area were not found during the cruises of the Marine Survey steamer " Investigator ".[1]

Order SEMAEOSTOMAE.

Family Pelagidae.

Genus **Pelagia** Peron and Lesueur.

1928. *Pelagia,* Bigelow, *op. cit.,* p. 517.

In the work cited above Bigelow has summarised conclusive evidence of the futility of recognising more than one species of *Pelagia* on the characters hitherto believed to be of systematic importance.

Pelagia noctiluca (Forskål).

1910. *Pelagia noctiluca,* Mayer, *op. cit.,* p. 572.

There are two specimens in the collection which agree with the description of *P. noctiluca.* One is from the Bay of Naples, and the other is from an unknown locality in the Indian seas. They are of the same size. The colour of the Indian example has been lost in preservation while the specimen from Naples is purple.

In the specimen from Naples the nettle-warts are elliptical and somewhat depressed and transversely furrowed. They are so transparent when immersed in spirit that they appear to be elliptical spots on the exumbrella. In the Indian specimen the warts are elongate and ridge-like and more evenly distributed, those on the marginal lappets being more numerous and smaller in size. On their outer surface the marginal

[1] Menon (*loc. cit.*), however, records *C. buitendijki* Horst from the Madras Coast.

lappets have an elongate conical thickening in which a prolongation of the gastric cavity is present. The rhopalium is conical and spear-shaped and is lodged in a deep niche roofed over by a membranous flap of the umbrella at the base of the rhopalar lappets. The tentacles are transversely wrinkled and thus have a segmented appearance. They arise from the membranous part of the umbrella between the velar lappets.

Measurements in millimeters of the Indian specimen.

Diameter of bell	90	Length of tentacles . .	90
Height of bell .	55	Breadth of marginal lappets at base	18-20
Length of manubrium	25-30	Length of marginal lappets	12
Length of mouth-arm	80		

Genus **Chrysaora** Peron and Lesueur.

1809. *Chrysaora*, Peron and Lesueur, *Ann. Mus. Hist. Nat. Paris*, XIV, p. 364.
1862. *Chrysaora, Melanaster*, L. Agassiz, *Contr. Nat. Hist. U. S.*, IV, pp. 124-127.
1910. *Chrysaora*, Mayer, *op. cit.*, p. 577.

From what has been written hitherto on the affinities of this genus to the very closely allied genera *Dactylometra* and *Kuragea* it does not seem to be at all easy to distinguish these by any set of characters. It has been pointed out by Mayer that some of the so-called species of *Chrysaora* are only stages in the developmental history of *Dactylometra*, while some species of *Dactylometra* become sexually mature in the *Chrysaora* stage. Assuming for the moment that *Dactylometra* is a good genus, it would seem, therefore, to be an extremely difficult task to say whether a *Chrysaora* represents the developmental stage of *Dactylometra*, or the sexually precocious *Dactylometra*, or the adult phase of any one of the numerous species of *Chrysaora* itself. Mayer seemed to be almost in despair when he said " that the conditions characteristic of the genera *Chrysaora*, *Dactylometra* and *Kuragea* may therefore be transitional stages in the growth of one and the same medusa " ; but if so, which amongst the numerous described species of the three genera that medusa is no one seems to have yet been able to discover.

In the following notes I have referred the specimens in the collection to well-known tropical species of *Chrysaora* giving short descriptions of individual specimens.

Chrysaora helvola Brandt.

1906. *Chrysaora helvola*, Vanhöffen, *Nordisches Plankton*, V, p. 48.
1910. *Chrysaora* sp., Kishinouye, *Journ. Coll. Sci. Tokyo*, XXVII, Art. 9, p. 13.
1910. *Chrysaora helvola* var. *chinensis*, var. *calliparea*, Mayer, *op. cit.*, pp. 581-582.

A large number of individuals of this species preserved in the collection comes from the Bay of Bengal. They are mostly preserved in alcohol and the colour has consequently been lost. In a small medusa preserved in Formol the colour is a bright orange. The exumbrellar surface is generally covered with numerous small warts variously developed in different individuals. The rhopalia are more or less vertical

in position and depend from the conical inner end of the exumbrellar sense-pit. There are, as a rule, only 3 tentacles to each octant. The marginal lappets vary both in size and in shape. The tentacles are flattened, and nearly all of them are incomplete. The gastric pouches are narrow at their origin from the central gastric cavity and gradually widen out towards the margin where the rhopalar and tentacular pouches are not of the same width. The rhopalar pouches are widest a little below the rhopalium and the tentacular at the extreme margin. The sides of the pouches are minutely sinuous. In specimens measuring 100 mm. or more across the bell the gonads are well developed, and often protrude outside through the subgenital ostia.

12 medusae from the Puri Coast, Orissa, were collected in the months of February and March between the years 1908 and 1912. The diameter of the bell varies from 60-140 mm., and the length of the mouth-arms from 50-370 mm. In some the mouth-arms are incomplete. The marginal lappets are crumpled in many, but they seem to be roughly triangular in shape. There are usually three tentacles in each octant.

7 small medusae with the bell not exceeding 70 mm. in diameter and with incomplete mouth-arms are from the Marine Survey Stations 524, 579, 582 in the Mergui Archipelago, at depths varying between 7-12 fathoms.

The geographical range of this species with its numerous forms and varieties seems to be very wide, extending from the coastal waters of E. Africa, India, China and Japan to the Pacific Coasts of N. America.

Dactylometra quinquecirrha (" Chrysaora stage ") recorded by Light from the Philippine seas is probably a form of *Chrysaora helvola.*[1]

Chrysaora melanaster Brandt.

1899. *Chrysaora gilberti,* Kishinouye, *Zool. Anz.,* XXII, p. 44.
1906. *Chrysaora melanaster,* Vanhöffen, *Nordisches Plankton,* V, p. 49.
1915. *Chrysaora melanaster,* Mayer, *Publ. Carnegie Instit. Washington,* No 212, p. 179.

There are 3 specimens of this species in the collection, all from the Bay of Bengal. They differ from the hitherto recorded medusae in the great length of the mouth-arms which are nearly 8 times as long as the diameter of the bell, and in several minor features, but in view of the great variability of the structures it would be useless to give these medusae even a new varietal name.

The bell is dome-shaped, and has well-defined marginal lappets and long mouth-arms. The tentacles are either much contracted or incomplete. There are 48 marginal lappets, 32 of which are large, broadly rounded and overlapping the adjacent ones, and the remaining are comparatively small. The tentacular and the rhopalar pouches are nearly of the same width except near the margin of the umbrella where the rhopalar are only half as broad as the tentacular. The mouth-arms have long folded curtain-like lips nearly as broad as the radius of

[1] Light, *Philip. Journ. Sci.,* IX, p. 198 (1914).

the bell, which narrow down gradually to the extremity of the arm. The subgenital ostia lie at right angles to the radius of the umbrella, and are roughly oval in shape. The centrifugal side of the ostia is, however, flattened. The exumbrellar surface is covered with closely packed, raised, rounded or triangular lobed warts of unequal size, but on the margin they are fewer and of an elongate shape. The exumbrellar sense-pit is minutely furrowed, and the rhopalium short and spindle-shaped.

There are a few small rounded white or greyish spots on the subumbrellar surface near the base of the manubrium. The gonads and mouth-arms are pink in colour.

The diameter of the bell varies from 100-125 mm., and the length of the mouth-arms from 150-940 mm.

Mar. Surv. Sta. 590 (Whale Bay, E. of Kisserian I.)	One specimen.
Madras Sta. 14	,, ,,
Madras Sta. 1	,, ,,

One of the three medusae is abnormal in having only 21 tentacles and 7 rhopalia—4 tentacles in each of two radii, 3 in each of four radii, and only one in the remaining radius. There are only 14 radial pouches. The marginal lappets have undergone corresponding changes. In one of the radii with 4 tentacles there are 4 velar lappets, the outer ones small, and the inner resembling the rhopalar lappets in having a cleft which is shallow, and in lodging a small sac-like structure which presumably represents the rhopalium of that radius. The tentacle belonging to this radius is, however, found a little below the cleft.

Family CYANEIDAE.

Genus **Cyanea** Peron and Lesueur.

1809. *Cyanea*, Peron and Lesueur, *Ann. Mus. Hist. Nat. Paris*, XIV, p. 363.
1862. *Cyanea*, Agassiz, L., *Contr. Nat. Hist. U. S.*, IV, p. 115.
1910. *Cyanea*, Mayer, *op. cit.*, p. 595.
1913. *Cyanea*, Bigelow, *Proc. U. S. Nat. Mus.*, XLIV, p. 92.
1921. *Cyanea*, Stiasny, *Kungl. Svens. Vetensk. Akad. Handl.*, LXII, p. 7.
1930. *Cyanea*, Menon, *Bull. Govt. Mus. Madras*, (N. S.), III, p. 8.

The genus is known to be well-represented in the Arctic and the Antarctic regions along the coasts of N. America and N. Europe. A few species are also recorded from the coasts of Japan, Australia, and the Malay Archipelago.

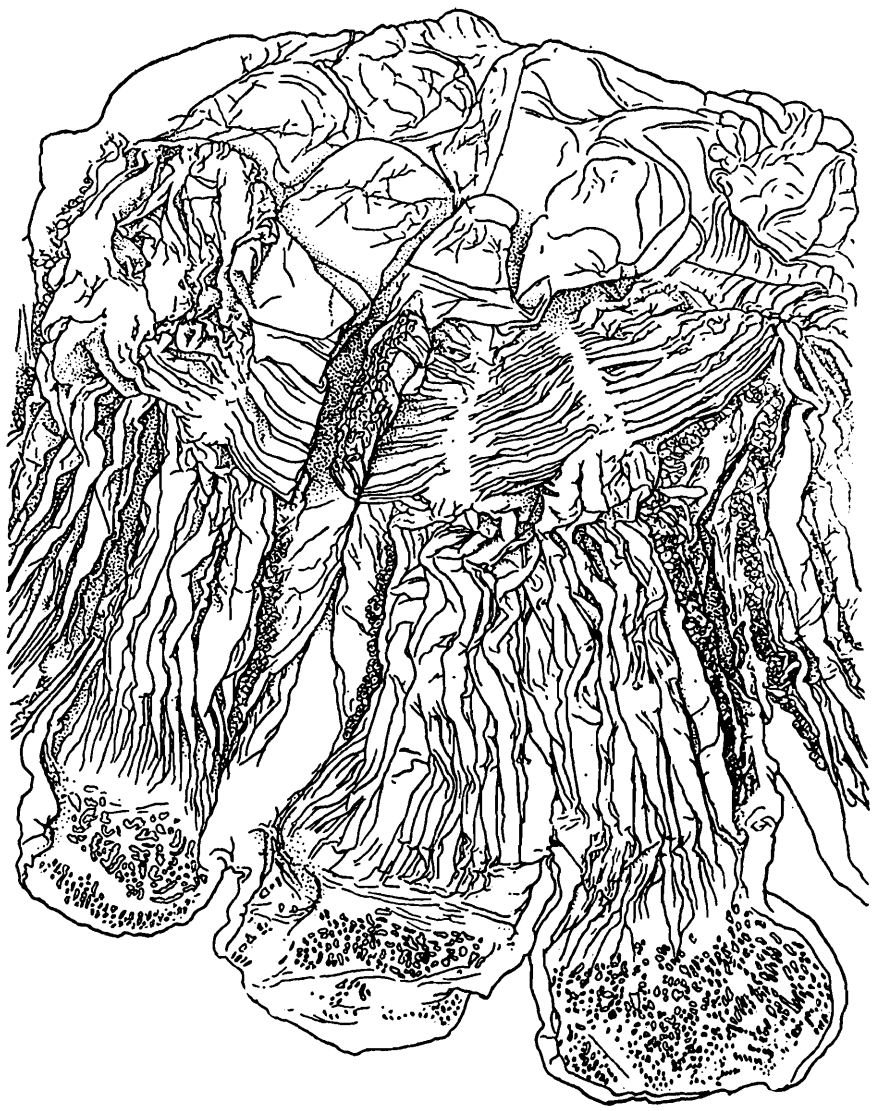
Menon refers the specimen from the Madras coast doubtfully to *Cyanea purpurea* Kishinouye.

Cyanea capillata var. **nozakii** Kishinouye.

1913. *Cyanea capillata* var. *nozakii*, Bigelow, *op. cit.*, p. 93, pl. iv, figs. 5-7.

I refer to this variety, with some hesitation, a fragment of a large medusa obtained by the R. I. M. S. " Investigator " in November 1913

in the Mergui Archipelago (Mar. Surv. Sta. 565—11° 57′ 30″ N., 98° 19′ 00″ E.). It is less than a half of the entire medusa and is greatly contracted, but the marginal lappets, the sense organs, the radial and circular muscles, the stomach and the mouth-arms are preserved in part and makes a fairly accurate determination possible.

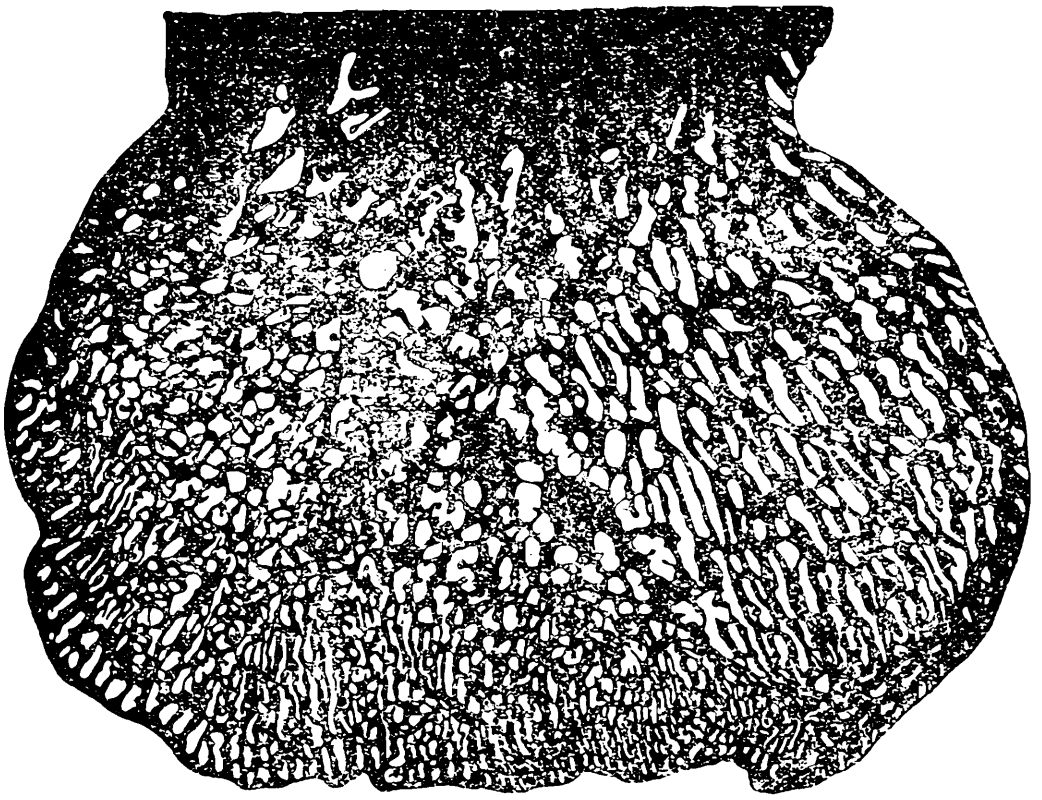


Text-fig. 1.—*Cyanea capillata* var *nozakii*. Subumbrellar view of a portion of the specimen from the Bay of Bengal showing the circular and radial muscles and the tentacles. The circular muscles of one radius are cut in the middle. × ⅔.

The centre of the umbrella up to the base of the marginal lappets is very coarsely granular, and is divided into large diamond-shaped areas by oblique parallel grooves which cross one another at a distance of 15 mm. The roof of the central stomach is also divided by deep furrows into a number of large fleshy polygonal cushions. The approximate radius of the bell from the centre of the stomach to the tip of the marginal lappets is 125 mm., and the bell is 25 mm. thick at the centre. The marginal lappets are large, slightly narrower at the base than at the free margin, broader than high in the widest part (40-45 mm. broad, 25 mm. high). They are not entire, and have presumably a rounded even margin. The rhopalar cleft is deeper than the cleft between the marginal lappets. A shallow niche facing the axis of the umbrella lies concealed at the bottom of the rhopalar cleft, along both sides of which the

margin of the velar lappets forms a vertical fold. In this niche lies the minute rod-like rhopalium with its free end directed towards the margin of the umbrella.

The radial canals and their extensions could not be made out satisfactorily except in the marginal lappets. Fig. 2 represents a lappet incomplete near the margin showing the distribution of the distal branches of the radial canals. The tentacles are arranged in 2-3 rows. The radial muscles occupy an area 70 mm. long, 20 mm. broad at the narrower end,



TEXT-FIG. 2.—*Cyanea capillata* var *nozakii*. One of the velar lappets showing the branched and anastomosed canals. The extreme margin of the lappet is damaged and the canals are very indistinct in that region. × $2\frac{1}{4}$.

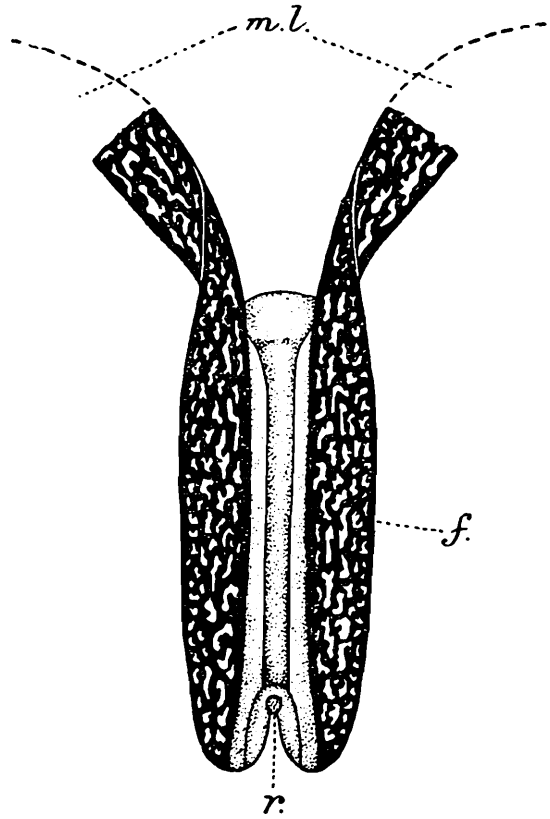
and consist of 7-8 strands, 5 mm. high intercalated by a few relatively narrow ones 2-3 mm. high. The circular muscles consist of 8-10 strands which are interrupted by muscle-less ridges along a line which, continued to the marginal lappets, divides each of them into two equal halves.

In the form of the rhopalia, in the nature of the radial canals and the circular muscles, and in the absence of rhopalar lappets the present specimen agrees very closely with the description of the var. *nozakii*, but differs in having a complete system of anastomosing canals in the marginal lappets. It is quite possible, however, that stages intermediate between the *capillata* condition of the radial canals and that of the present specimen may be found if a sufficiently large series be examined from one or more localities.[1]

C. capillata var. *mjobergi* Stiasny appears to have a partial anastomosis of the canals in the basal part of the marginal lappets, the distal

[1] *Cf.* Kishinouye's *C. purpurea, Journ. Sci. Coll. Tokyo,* XXVII, p. 18, pl. iv, fig. 18 (1910).

branches being free.[1] Uchida has suggested that the var. *nozakii* may be separated specifically from *C. capillata* on the characters of the radial canals, of the muscle system, and the colour of the medusa.[2] Until



Text-fig. 3.—*Cyanea capillata* var. *nozakii*. Rhopalar cleft viewed from the subumbrellar side. *m. l.* marginal lappets ; *f.* fold of the marginal lappet along the rhopolar cleft ; *r.* rhopalium. × 3.

sufficient evidence is gathered to show that the characters mentioned are constant, on an examination of a large series of medusae, it would be best to leave *nozakii* as a variety of *C. capillata.*

Family Ulmaridae.

Genus **Aurelia** Peron and Lesueur.

1910. *Aurellia,* Mayer, *op. cit.,* p. 619.
1913. *Aurelia,* Bigelow, *op. cit.,* p. 98.
1922. *Aurelia,* Stiasny, *Vidensk. fra Dansk Naturh. Foren.* LXXIII, p. 522.

Several species of this genus have been described (many of them based on very variable features) from various parts of the world. The species have been considerably reduced in number in recent years. Mayer recognised *aurita, labiata, solida* and *maldivensis.* He merged *A. limbata* in *A. labiata* with, I believe, some justification, though it is held that *A. limbata* can be separated from all other species by the anastomosis of

[1] Stiasny, *Kungl. Svens. Vetensk. Akad. Handl.,* LXII, p. 5 (fig.) (1921).
[2] Uchida, *Sci. Rep. Tohuku Imp. Univ. Sendai,* II, p. 232 (1927).

the radial canals and by the marginal pigmentation of the umbrella.[1] Anastomosis of the radial canals occurs to some extent in the peripheral part of the umbrella in many examples of *A. aurita* ; and the condition observed in individuals of *A. limbata* may represent one extreme in the scale of variation. It is also a matter of common experience that pigmentation by itself cannot be a safe guide in differentiating species.[2]

Bigelow has shown that *A. labiata* cannot be distinguished from *A. aurita*. Stiasny, on the other hand, has suggested that *A. maldivensis* may represent the developmental stage of a *Cyanea*, and that *A. solida* cannot be distinguished by the characters of the subgenital ostia and by the solid appearance of the jelly.

I have examined examples of all the species except *A. maldivensis* and *A. limbata*. A number of specimens of *A. aurita* which I was at first prepared to separate into *A. labiata* proved on closer examination to consist of intermediate stages between the condition of the umbrellar margin in *A. aurita* and that of the so-called *A. labiata*. The specimens in the collection therefore support Bigelow's observations.

With regard to *A. solida*, of which I have examined three well preserved examples, there seems to be good evidence of its being a distinct species. In my notes under that species I have enumerated the characters by which the species can be distinguished from *A. aurita*.

Aurelia aurita Lamarck.

1910. *Aurellia aurita, Aurellia labiata*, Mayer, *op. cit.*, pp. 623-627, 628.

The collection contains several specimens in a fairly good state of preservation, which vary in size and thickness of the bell, in the length of the mouth-arms, in the number and size of the velar lappets, in the number of rhopalia and in the branching of the radial canals. The accompanying table of measurements, etc., shows at a glance the extent of variability.

Several contributions have been made on the subject of variation in *Aurelia aurita* chief among which may be mentioned the works of Mayer,[3] Browne,[4] Hargitt,[5] and M'Intosh.[6]

All but one of the medusae in the collection were obtained off Ross Island, Port Blair Harbour, Andamans (April 16, 1925). Col. Sewell has recorded the following observations on them in the " Investigator " station book : " About noon, the harbour-waters of Port Blair were swarming with large numbers of a species of *Aurelia*. The colour of the gonads was a light reddish-purple, almost mauve, and the jelly of the umbrella was tinged with the same colour." The precise locality from which the remaining medusa was obtained is not known, though a label indicates its provenance to be Indian seas.

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[1] Vanhöffen, *Nordisches Plankton*, No. 11, p. 61, fig. 32 (1906).
[2] Kramp, *Vidensk. Med. fra Dansk. Naturh. Foren.*, LXV, p. 285 (1913).
[3] Mayer, *Bull. Mus. Brooklyn Inst. Arts and Sciences*, I, pp. 1-27, pls. i-ii (1901).
[4] Browne, *Biometrika*, I, pp. 90-108 (190).
[5] Hargitt, *Journ. Exp. Zool.*, II, pp. 547-582, pl. i (1905).
[6] M'Intosh, *Proc. Roy. Phys. Soc. Edinburgh*, XVIII, pp. 125-143 (1909-1912).

Measurements in millimeters.

Diameter of Bell.	Thickness of Bell.	No. of velar lobes and condition of margin.	No. of rhopalia.	Length of mouth-arms.	No. of adradial canals.
95	8	8 unequal—not notched	8	30-35	5-7
90	9	7 „ „	7	40	3-4
78	11	7 „ „	7	48	5-7
110	12	13 notched in some places, 8 deep and 5 shallow.	8	40	5-7
90	10	8 unequal—deeply notched	8	30	5
98	7	16—shallow notches	8	45	5-7
115	20	16 equal—shallow notches	8	50-55	5
105	18	16 unequal— „ „	8	50	5
122	10	16 „ „ „	8	40-45	5-7
115	18	13 „ 8 deep and 5 shallow notches.	8	40-45	5-7
105	12	8 unequal—8 deep notches	8	40	5
95	12	12 „ 8 deep and 4 shallow notches.	8	40-42	5-8
105	12	Ditto	7	40-45	2-5
75	7	16 equal, 8 deep and 8 shallow notches.	8	40	4-5
100	11	Undefined and unequal—margin irregular.	8	40	5-6

Amongst the individuals having only 7 rhopalia, one of the perradial rhopalia is missing in one specimen while the corresponding radial canal is present, one of the interradial canals and the corresponding rhopalium are missing in a second specimen. One of these individuals from the Andamans has 3 gonads, and an extra perradial rhopalium. There is a distinct fold in one of the gonads which appears to indicate that the missing fourth gonad is fused with it abnormally.

The number of rhopalia in this lot of medusae is, as a rule, eight. The velar lappets are not of the same size, and this is presumably due to the unequal spacing of the rhopalia on the margin of the umbrella, and to the variation in the number of adradial canals which often spread out or anastomose with adjacent radial canals.

Amongst the medusae with 8 rhopalia there are two in which the gonads are unequally developed. In one of these, two of the gonads are normal and the other two are undeveloped ; while in the other there are only three gonads with one of the subgenital sacs incomplete at the centrifugal end. The gonad corresponding to this incomplete subgenital

sac is also incomplete, but here again there is an infolding which seems to indicate the abnormal fusion of the gonads belonging to two adjacent quadrants.

Aurelia solida Browne.

1906. *Aurelia solida*, Browne, *Fauna and Geogr. Maldive and Laccadive Archipelagoes*, II, pp. 960-962, pl. xciv.
1910. *Aurellia solida*, Mayer, *op. cit.*, pp. 627-628.

There are three well-preserved individuals in the collection. One of them is as large as the type-specimen from the Maldives, and another larger than the type. The margin of the bell is slightly injured in places. The bell is a solid dome-like mass of firm jelly, 20-25 mm. thick in the stoutest part of the medusa. The diameter of the bell is 80-105 mm. Numerous small oval or rounded warts are present on the exumbrellar surface, somewhat more closely packed on the margin than in the centre. There are 16 equal velar lappets and 8 rhopalia. The rhopalar clefts are deep and regularly spaced on the margin. Numerous tentacles alternate with the marginal lappets which form regular compartments between them for lodging the tentacles. The rhopalia lie at the head of the cleft below the exumbrellar sensory pit, and are not hidden from view owing to the ledge of the pit being small. The exumbrellar sensory pit is relatively shallow, and is with or without branched radiating folds. The direction of the sense-rod is somewhat variable. It may be tilted outwards and upwards in the manner described by Browne for his Maldive specimen, or directed towards the margin of the umbrella more or less horizontally. Having examined all the rhopalia of a single medusa, and several others of the remaining medusae in the collection I am convinced that there is considerable variation with regard to the direction of the sense-rod.

The mouth-arms constitute a compact pillar-like structure at the centre of the subumbrella, resembling the manubrium of some of the Hydromedusae. The four arms are, however, distinct at their origin and separated from one another by vertical slits down their sides and centre. The height of the raised mouth-arm pillar is 25 mm. The distal part of each mouth-arm is spread out at right angles to the central pillar, and is somewhat thick and folded. The length of the mouth-arm from the centre of the subumbrella to the tip of the arm is 40-45 mm. The radial canals are long, and anastomose with adjacent branches at some points near the margin of the umbrella. The adradials vary from 5-7 in number. The subgenital sacs are not conspicuous, being hidden away from view under the folds of the mouth-arms. They are not raised much above the subumbrellar surface. In this respect the Indian Museum medusae differ from the type-specimen from the Maldives and agree with the North Atlantic specimen described by Browne.[1] The subgenital ostia are very small and are directed obliquely towards the margin of the umbrella.

A. solida is undoubtedly closely allied to *A. aurita*, but it seems to differ from the latter in the distinctly deeper position of the rhopalia

[1] Browne, *Trans. Roy. Soc. Edinburgh*, XLVI, p. 249 (1908).

on the margin of the umbrella, in the rhopalia being more or less exposed on the exumbrellar side as a result of the ledge of the sensory pit being very small, in the structure of the mouth-arm pillar, and in the great thickness of the jelly. The specific name, in fact, aptly describes this species, and it is the solidity of the bell more than any other character which serves to distinguish it at sight from *A. aurita*.

The more or less vertical position which the sense-rods assume frequently in *A. solida*, and rarely in *A. aurita*, seems to be correlated with the consistency of the jelly. With an increase in the solidity of the tissues there appears to be a tendency towards tension in all parts of the medusa, which influences in turn the disposition of the mouth-arms, of the subgenital sacs and ostia, and of the rhopalia in relation to the margin of the umbrella. One or other of these structures, or all, may be affected by this consistency factor of the jelly to the same or varying degree. A comparison of the Maldive, the North Atlantic, and the Bay of Bengal forms shows that the species may be distinguished from *A. aurita* chiefly by the consistency of the jelly, the deeper position of the rhopalia, and by the inconspicuous size of the ledge of the sensory pit.

Further examination of a large series from one or more localities may reveal, however, that some of these characters are unreliable for diagnostic purposes.

The specimens in the collection were found stranded by Col. Sewell in a rock pool close to a reef on the north side of Fuladu Island, Goifurfehendu atoll, Maldives (December 10, 1923).[1]

The distribution of the species seems to be fairly wide over the Indian and Atlantic Oceans.

Order RHIZOSTOMAE.

Family Cassiopeidae.

Genus **Cassiopea** Peron and Lesueur.

1809. *Cassiopea*, Peron and Lesueur, *op. cit.*, p. 356.
1903. *Cassiopeja*, Maas, *Die Scyphomedusen der Siboga Expedition*, p. 38.
1910. *Cassiopea*, Mayer, *op. cit.*, p. 636.
1921. *Cassiopeia*, Stiasny, *Capita Zoologica*, I, p. 61.

Numerous species and varieties not readily distinguishable from one another have hitherto been described. To those who have the misfortune of studying medusae in the preserved condition, characters based on colour and on proportions of structures which are liable to contraction in preservatives are of doubtful diagnostic value. Descriptions or diagnoses of species from preserved material are equally difficult to interpret in fresh living material.

As far as I can make out there are only 2 species in the present collection, but of the identity of one I have considerable doubt on account of its rarity in the Indo-Pacific seas.

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[1] In 1926 while surveying the backwater in Vizagapatam I found a small medusa of this species in a small muddy tidal pool separated from the main backwater by a stretch of bog. As the specimen was partially decomposed it was not taken.

Cassiopea (?) frondosa (Pallas) Lamarck.

1910. *Cassiopea frondosa*, Mayer, *op. cit.*, p. 647, pls. 69, figs. 1-3, and 72.

The species has hitherto been recorded from the West Indies and Florida, while the present specimen, a small one undoubtedly young, is from Maskat at the head of the Arabian Sea. My identification is, however, based on the excellent figures given by Mayer and on his description. The bell is 12-16·5 in diameter, and the mouth-arms do not extend much beyond the umbrellar margin. The markings on the exumbrella are similar to those of the medusae figured by Mayer. The appendages on the mouth-arms are minute and opaque. On an olive-gray background, which is the colour of the specimen in alcohol, the markings on the exumbrella and on the appendages of the mouth-arms stand out as opaque white spots. The under-surface of the mouth-arms and the capitate ends of the mouth-frills are also opaque white. There are granular whitish speckles scattered all over the medusa in addition to the markings on the umbrella.

The specimen was dredged at a depth of 6 fathoms off Maskat on the coast of Arabia bordering the Gulf of Oman (H. J. Walton).

Individuals of this species grow to a large size, the bell often exceeding 100 mm. in diameter. The distribution of the species is probably restricted to the Atlantic Ocean, but if my identification of the present specimen is correct the range of the species must be much wider.

Cassiopea andromeda var. **maldivensis** Browne.

1905. *Cassiopea andromeda* var. *maldivensis* Browne, *op. cit.*, p. 962.

There are seven medusae in the collection from 'Indian seas' The precise provenance of 5 out of the 7 medusae is not known.[1] They are presumably from seas along the Indian Coast. The remaining two are from Krusadai Island and Rameswaram on the Gulf of Manaar.

The range of variation in this small collection is striking. The Krusadai specimen (Dr. Hora, 1925) agrees with the original description of the variety. It has a well-defined circular band on the exumbrella, and a slightly raised dome in the centre with a slight depression. The breadth of the band is 10 mm. Except for the minute indentation opposite each of the rhopalia, the margin of the umbrella is entire, but it has a wavy outline, the crest of the wave corresponding to a lappet. The mouth-arms are long, and extend beyond the margin of the umbrella. They are somewhat laterally compressed, narrow at either end and broader in the middle. Curiously the arms are both dichotomously and pinnately branched, the dichotomous arm alternating with the pinnate one. This is not apparent at first, but a closer examination reveals the nature of branching. At the base of each principal and secondary branch of the arm there is an elongate flattened, leaf-shaped appendage. Usually ten appendages are clearly visible, but

[1] On p. 346 of his Notes on the Biological work of the R. I. M. S. " Investigator " (*Journ. As. Soc. Bengal* (N. S.), IX, 1913) Col. Sewell refers to a few examples of *Cassiopea* sp. having been obtained in Fisher Bay, Tavoy I., Burma. Presumably these five specimens are from the Tavoy Coast.

many are, however, concealed from view amongst the branches of the arm.

In the medusa from the Rameswaram Coast (March, 1925) the exumbrella is without a circular band, the mouth-arms do not extend much beyond the bell-margin, and the mouth-arm appendages are inconspicuous. The appendage at the centre of the oral disc is well developed.

In the following table are given the measurements, etc. (in millimeters), of the various individuals :—

	Krusadai.	Rameswaram.	Unknown locality, Indian seas.				
Diameter of bell	145	110	65	105	105	120	105
Diameter of central depressed area.	110	70	50	82	85	90	82
Length of mouth-arm.	90-100	45	25-40	60-70	45	65	55-60
Diameter of mouth-arm disc.	60	45-50	20	50	47	47	45
Number of rhopalia	16	25	16	16	14	15	16
Number of velar lappets between rhopalia.	3-4	1-4	4-5	2-5	4-5	3-4	3-4
Length of mouth-arm appendage.	20	30 (central)	5	30-35	15-24	20-25	25-35
Breadth at base of mouth-arm appendage.	5	7	2	8	4	5	7

Family Cepheidae.

Genus **Netrostoma** Schultze.

1898. *Netrostoma*, Schultze, *Denkschr. Med. Naturwiss. Gessel. Jena*, VIII, p. 457, pl. 34, figs. 10-12*a*.

Netrostoma typhlodendrium Schultze.

1910. *Cephea typhlodendrium*, Mayer, *op. cit.*, p. 658.

Several specimens of this species are preserved in the collection. Some of them are undoubtedly young. The chief interest of the collection lies in the fact that a large number of our specimens was taken in estuaries of deltaic Bengal which are subject to constant tidal influences.

There are 4 small medusae from the Matlah estuary near Canning Town, Lower Bengal. The diameter of the bell is 50-70 mm., and the length of the mouth-arm 25-40 mm. The exumbrellar central dome seems to vary in size, and in the form and number of warts on it. There are a few warts not exceeding 20 in number. In one specimen they are scattered on a very much flattened dome. The rhopalar lappets are usually conical and pointed in shape, but narrower than the velar. There are 7 velar and 2 rhopalar lappets in each octant. The interrhopalar

radial canals are relatively short and do not exceed three in number. The distal ends of these canals are frequently branched and anastomosed so that a net-work is formed between two rhopalar canals. Short blind canals project into the squares and rectangles of this anastomosing net work. Though there is no ring canal the rhopalar and interrhopalar canals are connected centrifugally by the extension of anastomosis.

A fairly well-preserved individual and the largest in the collection is from the Gangetic delta in Lower Bengal. The diameter of the bell is 90 mm. and the length of the mouth-arm 60 mm. The velar lappets are 3 mm. long and 6 mm. broad, and have a somewhat crenulated margin. The rhopalar lappets are narrower than the velar, and spread outwards instead of being pendulous. The rhopalia are rather small and are placed in a deep niche. The sense-rod is flame-shaped and more or less pendulous.

There are also 2 specimens from the Mergui Archipelago (Mar. Surv. Sta. 569—98° 18′ 40″ E., 11° 52′ 10″ N.). The diameter of the bell is 70 mm., and the length of the mouth-arms 40 mm. The central dome of the umbrella has ten large warts 5-10 mm. long and several smaller ones surrounding them. The marginal lappets are well-defined. There are 8 rhopalar and 24 interrhopalar canals. The exumbrellar surface round the central dome is furrowed, and reticulate in appearance. A few minute warts are also present on this part of the exumbrella. On the subumbrellar surface there is a furrow outside the mouth-arm disc along which the thinner outer portion of the umbrella is folded. The formation of the furrow has apparently no morphological significance as the flexure of a thin outer part of the umbrella against the thicker central dome is purely a mechanical process in the preserved specimen. There are no appendages on the mouth-arms, but the arm-disc bears several small elongate club-shaped appendages carrying a number of warts full of nematocysts. The gonads are mature, and protrude through the small rounded ostia.

These two medusae were taken on a muddy bottom at a depth of 5 fathoms in the month of December 1913. They were of a blue colour, and had white spots in the living condition.

The geographical range of the species seems to extend from the Malay Archipelago to the head of the Bay of Bengal. The species has presumably a preference for protected arms of the sea amongst Archipelagoes rather than for the open sea.

Family MASTIGIADIDAE.

Genus **Mastigias** L. Agassiz.

1910. *Mastigias*, Mayer, *op. cit.*, p. 677.
1921. *Mastigias*, Stiasny, *op. cit.*, p. 87.

Stiasny divides the known species of this genus into two groups, *e.g.*, (1) the *papua* group including those with less than ten interrhopalar anastomosing canals, and (2) the *ocellata* group including species with more than ten interrhopalar anastomosing canals. If the character on which this division is based is proved to be constant in a large number of individuals of the species known, it will then be convenient to erect

a new genus to receive the species belonging to the second group, as has been done in separating *Netrostoma* from *Cephea.*

Mastigias ocellata (Modeer).

1791. *Medusa ocellata,* Modeer, *Nova Acta Phys. Med. Nat. Curio.,* App. VIII, p. 27.
1918. *Mastigias ocellata,* Mayer, *Bull. U. S. Nat. Mus.,* I, p. 220.

Four well-preserved medusae of this species are in the collection. Three of them are very young and do not exceed 15 mm. in diameter. They are rusty brown in colour, but the velar portion of the exumbrella is a deeper shade of brown. There are elongate, elliptical or circular elevated warts scattered on the exumbrella, the more prominent ones occupying the central region of the umbrella. In addition to the spots there are fine but distinct granules on the whole of the exumbrella. The eye-spots, which give the species its name, are indistinct on the exumbrella. The subumbrella and the arms are minutely spotted. Thin rod-like filaments with minute warts at their free end are present on the central part of the mouth-arm disc, one at the base of each mouth-arm where the mouth-frills commence. From the centre of the subumbrella hangs a pointed or knob-like filament. These filaments are about half as long as the mouth-arm. Similar but shorter filaments are found scattered amongst the frills of the arms close to the mouth-openings. They gradually diminish in size towards the distal end of each arm until they are reduced to short-stalked, knob-like processes. The terminal mouth-arm process is a relatively large, fig-shaped knob with a short stalk, and a number of scattered, large, dark-brown warts. There are 8 radial canals reaching the rhopalia. Each perradial canal is short and stout, and without branches on either side of it centripetal to the ring canal. There are, however, a few minute projections in the course of the canal which seem to represent incipient branches. The interradial rhopalar canals are longer, and are connected with the ring-canal centrifugally and on its sides with short canals, usually 14-17 in number, arising direct from the stomach. Each rhopalar canal corresponds to the rhopalium of that radius, and divides into three branches at the base of the rhopalar lappets, the median branch, short, and extending to the base of the sense-club, and the lateral branches ending blindly into the rhopalar lappets. The rhopalium is protected above by a pale membranous hood between the rhopalar lappets. There are 8 velar lappets in each octant. The circular muscles are interrupted only along the perradial canals inside the ring canal. The subgenital ostia are roughly dumb-bell shaped in outline, and are a little less than twice as broad as the interostial pillars at their base.

Measurements in millimeters of the largest specimen.

Diameter of bell	45	Diameter of mouth-arm disc in the widest part	26
Length of mouth-arm	20	Height of velar lappets	3-4
Length of winged portion of mouth-arm	15-17	Breadth of velar lappets	2
Breadth of wing of mouth-arm	5	Length of terminal appendage on mouth-arm	3
Breadth of ostium	13		
Breadth of interostial pillar	6-8		

Locality: North of Maingy I. (Mar. Surv. Sta. 521—98° 16′ E., 12° 35′ 15″ N.), Mergui Archipelago. The individuals were collected with the help of a small hand-net from the gangway of the R. I. M. S. "Investigator" (10th March, 1913). A note in the Mar. Surv. Station Book refers to certain fish having accompanied them. The fish are unfortunately not preserved with the medusae. In the same station another species of medusa was also taken, and it is not certain which of the two species of medusae was accompanied by the fish referred to.

Two much contracted young medusae without terminal clubs on the arms from Mergui Archipelago (Mar. Surv. Sta. 579—11° 53′ 04″ N., 98° 18′ 17″ E.), and 3 small examples from Celerity Passage (Mar. Surv. Sta. 580) probably belong to this species.

Mastigias albipunctata Stiasny.

1921. *Mastigias albipunctata*, Stiasny, *op. cit.*, p. 93, pl. i, fig. 5; pl. iii, figs. 24, 25 *a*, *b*, 26; pl. v, fig. 46.

Seven well-preserved examples from Mergui Archipelago (Mar. Surv. Sta. 521) agree closely with the description of this species. All but one are young. The general colour of the medusae is brown, but there is a shade of orange on the marginal part of the umbrella, on the mouth-arm disc and on the arms. There are 17-20 interrhopalar canals arising from the stomach and anastomosing with one another. The interradial canals are connected with this anastomosis by short branches. The perradial canals are, however, without these connections inside the ring-canal.

In the young medusae the circular muscles are not interrupted, but in the adult they are interrupted along the radial canals between the point of their origin from the stomach up to a little distance below or above their junction with the ring-canal. The interrupted area at this junction is usually broad and diamond-shaped. The muscles on either side of the ring-canal tend to form an elliptical figure between two rhopalar canals.

A short cylindrical filament or a long one with a terminal club-shaped or rounded thickening is present at the outer end of each arm. The filament and the terminal portion are covered with numerous warts consisting of nematocysts. A long filament covered with warts is present at the centre of the mouth-arm disc which bears no other filaments or clubs. The extremity of the mouth-arm has a long three-winged filament with a club-shaped knob which carries a few stalked or ridge-like warts along its edges. There is a continuation of the radial canal into the filament where it divides into branches which anastomose. Amongst the mouth-frills on the arms there are small clubs with a short stalk and a conical terminal knob. The extremity of each knob is thin and filamentous and often devoid of warts, while the knob itself is closely studded with warts containing nematocysts.

The largest example in the collection has the following measurements in millimeters :—

Diameter of the bell	75
Length of the mouth-arm	30
Length of distal winged part of the mouth-arm	25
Breadth of the mouth-arm wing	15
Length of the terminal filament of mouth-arm	80
Breadth of ostium at the widest point	20
Breadth at narrow part of the base of interostial pillar	8-10
Diameter of mouth-arm disc	35
Height of velar lappets (8 in each octant)	6-7
Breadth of velar lappets at the base	4

The diameter of the bell of younger medusae ranges from 10-25 mm.

Mastigias sp.

A badly preserved example from Mergui Archipelago (Mar. Surv. Sta. 590—11° 31′ 45″ N., 98° 34′ 30″ E.) is probably closely related to *M. albipunctata.* As all the characters of the species could not be made out in the specimen it is impossible to be certain regarding its identity. The bell is 60 mm. in diameter, and the mouth-arm 50 mm. long. The terminal appendages of the mouth-arm are filamentous, and have anastomosing branches of the radial canal. They are, however, mostly damaged.

Mastigias papua var. **sibogae** Maas.

1903. *Mastigias papua* var. *sibogae,* Maas, *Scyphomedusen der Siboga Exped.,* Monogr. 11, p. 66, pl. vi, figs. 54-57 ; pl. vii, figs. 58, 59, 61, 64 ; pl. viii, figs. 75-77 ; pl. ix, figs. 84-85 ; pl. xii, fig. 110.

A small medusa from the Celerity Passage (Mar. Surv. Sta. 580) belongs to the *papua* group. The interrhopalar canals do not exceed ten in number in an octant. There are 9 velar lappets between each pair of rhopalia. The terminal appendage of the mouth-arm is very small, but its resemblance in form to Maas' figure of this appendage is very close. There are no markings on the exumbrella.

Genus **Versura** Haeckel.

1921. *Versura,* Stiasny, *op. cit.,* p. 102.

Although I have in the main adopted in these notes Stiasny's scheme of classification for the Rhizostomes, I am not fully convinced that the necessity has yet arisen for erecting a separate family to receive this genus, and would therefore retain *Versura* in the Mastigiadidae.[1]

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[1] Uchida (*Journ. Fac. Sci. Imp. Univ. Tokyo,* I, p. 89 (1926)) has suggested the division of Mastigiadidae into three subfamilies, one of which includes the genus *Versura.* There is much to be said in favour of this view.

Stiasny has ably discussed the synonymy of the genus, and has designated *Versura anadyomene* (Maas) as the genotype, being the first fully described species. There is, I believe, sufficient justification for adopting this course, as *V palmata* Haeckel which Mayer accepted as the genotype is imperfectly known with regard to the gastrovascular system, which is now generally accepted to be of great importance in generic differentiation.

Versura anadyomene (Maas).

1903. *Crossostoma anadyomene*, Maas, *op. cit.*, p. 56, pl. vii, figs. 65-68.
1921. *Versura anadyomene*, Stiasny, *op. cit.*, p. 106.

Several individuals collected from various parts of the Bay of Bengal are present in the collection. Owing to preservation in alcohol many of them are stiff and brittle. The collection includes several immature examples also. There is a wide range in size of the bell, the largest being 225 mm. and the smallest 30 mm. in diameter across the bell. In the table below the various measurements of the medusae are given.

The umbrella is more or less flat, but somewhat arched near the central part giving it a resemblance to a watch-glass. The surface of the exumbrella is irregularly furrowed, and has little or no trace of granulation in the larger individuals. There are usually 8 velar lappets between two rhopalia, but small prominences on the margin between the lappets give the impression that the lappets are more numerous. The rhopalar lappets are elongately conical, but shorter and narrower than the velar. Both the velar and the rhopalar lappets bear a prolongation of the anastomosing net-work of canals outside the ring-canal.

The circular muscles are strongly developed and are more or less uninterrupted along the radial canals. They form elliptical areas between two radial canals with the ring-canal as their axis. In the interrhopalar area the circular muscles are arched with their convex side turned centrifugally.

There is a wide lacuna at the junction of the radial and ring-canals and its walls are so delicate that the lacuna is often in a collapsed condition. This junction of the radial and ring-canals is nearly always obscured by the circular muscles overlying it.

The subgenital ostia are wide, reniform, and about $1\frac{1}{2}$ times as broad as the interostial pillars which form the support of the mouth-arms. The mouth-arms extend slightly beyond the margin of the umbrella, the maximum breadth of the wings of the mouth-arm is nearly half the length of the mouth-arm excluding the wingless basal part. There are a few short club-like appendages 3-5 mm. long close to the frilled mouths. Numerous long filaments with a knob-like extremity are present on the mouth-arm disc and on the base of the mouth-arms. If not damaged in preservation they give a distinctive appearance to the full-grown individual

Measurements in millimeters.

Locality.	Diameter of umbrella.	Maximum diameter of mouth-arm disc.	Length of winged part of mouth-arm.	Maximum breadth of wing of mouth arm.
Off Sandheads, mouth of the Ganges (Capt. J. H. Row), Feb., 1892 (damaged).	110	..	75	..
Mar. Surv. Sta. 569 (11° 52′ 10″ N., 98° 18′ 40″ E., Dec., 1913).	160	90	50	20-25
Mar. Surv. Sta. 580—Various places in Celerity Passage (Jan., 1914).	185	90	100-130	45-65
Ditto ditto	145	90	55-65	25-30
Ditto ditto	220	110	65-85	50
Ditto ditto	225	120	75-90	40-45
Mar. Surv. Sta. 565 (11° 57′ 30″ N., 98° 19′ 00″ E., Nov., 1913).	100	42	42-50	
Mar. Surv. Sta. 579 (11° 53′ 04″ N., 98° 18′ 17″ E., Jan., 1914) (Juvenile).	30-70	..		

In one of the individuals from Sta. 580 young stomatopods were found firmly sticking to the frilled mouths. In another specimen from Sta. 569 a small cuttle-fish, probably a *Loligo*, was found amongst the mouth-arms.

All but one of the medusae in the collection are from the Mergui Archipelago. In the Bay of Bengal its distribution is probably restricted to coastal waters.

Genus **Thysanostoma** L. Agassiz.

1910. *Thysanostoma,* Mayer, *op. cit.*, p. 691.
1921. *Thysanostoma,* Stiasny, *op. cit.*, p. 111.

Thysanostoma thysanura Haeckel.

1918. *Thysanostoma thysanura,* Mayer, *Bull. U. S. Nat. Mus.*, I (Bulletin 100), p. 227.

A mutilated example of this species is in the collection. The mouth-arms are the only structures which are in a fairly good condition. A portion of the margin of the umbrella with two rhopalia, and the circular muscles are more or less intact. The approximate diameter of the umbrella is 70 mm., and the average length of the mouth-arms 35 mm. The exumbrellar surface is granular, and in some parts of the exumbrella the granules are enlarged into short, low ridges. Clusters of short, thin filaments carrying nematocysts are present on the mouth-arm disc. A few of them near the base of the mouth-arms carry terminal knobs.

Locality.—Puri, Orissa coast.

FAMILY LYCHNORHIZIDAE.[1]

Genus **Acromitus** Light.

1914. *Acromitus*, Light, *Philip. Journ. Sci.*, IX, p. 210.

Acromitus flagellatus (Haeckel).

1921. *Acromitus flagellatus*, Stiasny, *op. cit.*, p. 131, pl. ii, fig. 10 ; pl. iv, fig. 30 ; pl. v, fig. 40.
1930. *Acromitus flagellatus*, Menon., *op. cit.*, p. 19, pl. ii, figs. 9*a-c*.

This species appears to be one of the commonest along the coasts of India and Burma ; and our collection contains several specimens some of which are, however, badly preserved.

Doarakar, Sunderban, L. Bengal (Dr. B. Prashad, March, 1918)—3 large and 5 small specimens, the bell-diameter ranging from 110-140 mm. in the larger ones. The exumbrella in one of them has peculiar, polygonal, cushion-shaped swellings, which are large in the centre and small in the marginal region. In one specimen the terminal mouth-arm filaments are absent except on one arm where they are quite rudimentary. The filaments on the rest of the mouth-arm are not conspicuous. A few, however, can be detected on the upper part of the mouth-arm with the help of a magnifying glass. The mouth-arms are unequal, relatively stout and longer than the radius of the umbrella. The subgenital papillae are very well developed. There are small circular or oblong yellowish brown spots on the exumbrella, somewhat more numerous in the central part than on the marginal, and minute granules on the exumbrella external to the ring-canal. The spots are generally depressed in the centre and pit-like. This specimen is presumably abnormal.

Backwaters of Cochin State, S. India (Dr. H. S. Rao, December, 1927)—8 specimens. The species was found everywhere in the backwater up to 5 miles south of British Cochin, and ten miles north of Ernakulam. In using our bottom nets for collecting various other organisms it was found extremely difficult to avoid filling them with scores of these medusae while hauling up the nets. They were particularly abundant in the northern part of the backwater, at or near the surface of the water in the early part of the day, *i.e.*, not later than 9 o'clock. In the southern part of the backwater on the borders of Travancore State the medusae are comparatively rare. This is presumably due to the fact that in this part of the backwater the influence of the tides from the Arabian Sea is much less, and to the fact that the salinity is considerably lower as a result of the flow of several freshwater streams into the backwater.

In creeks and channels connected directly with the backwater young medusae were occasionally found. In two individuals obtained in January 1928 the granulation on the exumbrella is quite marked. There are three branches on each side of the rhopalar canal arising from the centripetal side of the ring-canal. The ostia are broad and open, but the subgenital papillae are absent. The rhopalar and velar lappets are well developed. The mouth-arms are pyramidal, and there are

[1] This family name is used in the sense of Uchida (*loc. cit.*, p. 90) who merges Catostylidae and Lobonemidae in it giving them the rank of subfamilies.

only a few filaments on them. The terminal filament on the mouth-arm is well developed and longer than the mouth-arm.

Matlah River, Canning Town, L. Bengal (Dr. Southwell, Dec., 1918) —2 examples.

Fisher Bay, Port Owen, Tavoy I., Burma (Mar. Surv. Sta. 414, 1911) —2 examples.

Puri, Orissa Coast (1912)—one specimen. A few Clupeid fish are found entangled amongst the mouth-arms.

Tuticorin, S. India (Dr. H. S. Rao, Feb., 1926)—one individual, rather damaged.

An example from Celerity Passage (Mar. Surv. Sta. 580, 1914) is very much contracted and broken, and it is impossible to be certain of its specific identity. It probably belongs to this species.

Measurements in millimeters.

—	Diameter of bell.	Length of mouth-arm.	Diameter of mouth-arm disc.
Cochin Backwater (abnormal specimen)	135	55-95	73
Cochin Backwater, normal examples	140-145	110-110	75
Fisher Bay, Tavoy I.	90	50-60	52
Puri	75	40-45	40

Acromitus rabanchatu Annandale.

1915. *Acromitus rabanchatu*, Annandale, *Mem. Ind. Mus.*, V, p. 96, pl. vi, figs. 4-6, pl. viii.

Our collection contains a large series which Annandale reported on in his account of the coelenterates of the Chilka Lake. From his description of the species it appears that it is much more closely allied to *A. flagellatus* than to *A. maculosus* from the Philippine Seas. *A. rabanchatu* differs from *A. flagellatus* chiefly in the size and form of the rhopalia, and of the marginal lappets. It is probable that this species is only a form of *A. flagellatus*.

The distribution of the species is probably restricted to the Chilka Lake and the shallow coasts along Ganjam and Orissa. The records from the coast of Tenasserim and the Ennur backwater pertain to *A. flagellatus* rather than to the present species.

Genus **Crambionella** Stiasny.

1921. *Crambionella*, Stiasny, *op. cit.*, p. 129.

This genus was erected by Stiasny to include two previously described species, *e.g.*, *Crambessa stuhlmanni* Chun[1] from the mouth of the Quilimane river in East Africa, and *Mastigias orsini* Vanhöffen[2] from Assab

[1] *Mitteil. Naturhist. Mus. Hamburg*, XIII, p. 10, pl. i and fig. 1 (1896).
[2] *Bibliotheca Zool.*, I, p. 34, pl. iv, figs. 2-4 (1888).

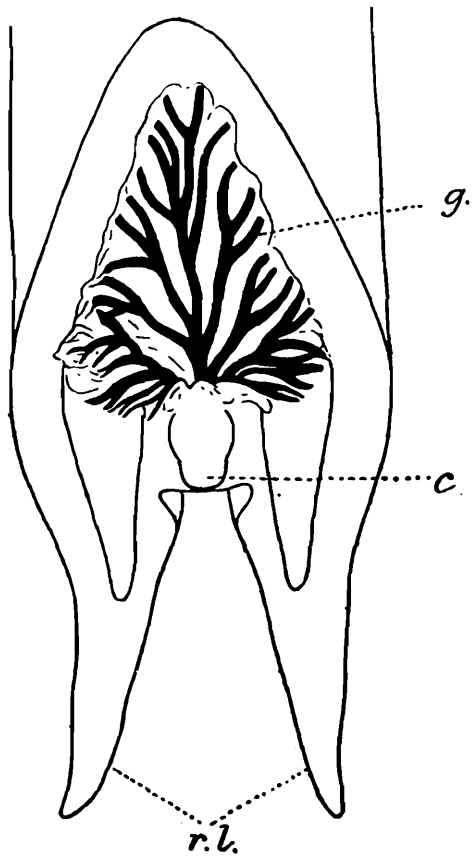
on the Red Sea Coast. One of the chief characteristics of this genus is the pyramidal, three-winged mouth-arm with a terminal appendage, which is the naked continuation of the mouth-arm into which an extension of the stomach forms a small network of anastomosing canals. The other important but negative character is the absence of whip-like filaments on the mouth-arm. In the new species described below. which undoubtedly belongs to this genus, the mouth-arm has a long tapering terminal appendage instead of a short rounded one, and a number of small foliaceous appendages amongst the frilled mouths. Stiasny's definition of the genus in the work cited is more or less complete, but with the inclusion of this species in it slight modifications are necessary. The following may be added to the diagnosis of the genus given by Stiasny :

Rhizostomae with three-winged stout, pyramidal mouth-arms terminating in a long or short appendage, which is the naked continuation of the mouth-arm, usually with button-shaped or foliaceous appendages among the frilled mouths and without whip-like filaments.

Crambionella annandalei[1] sp. nov.

1930. *?Crambionella stuhlmanni*, Menon., *Bull. Govt. Mus. Madras* (N. S.), III, p. 18, pl. iii, figs. 14 *a*, *c*, *e*.

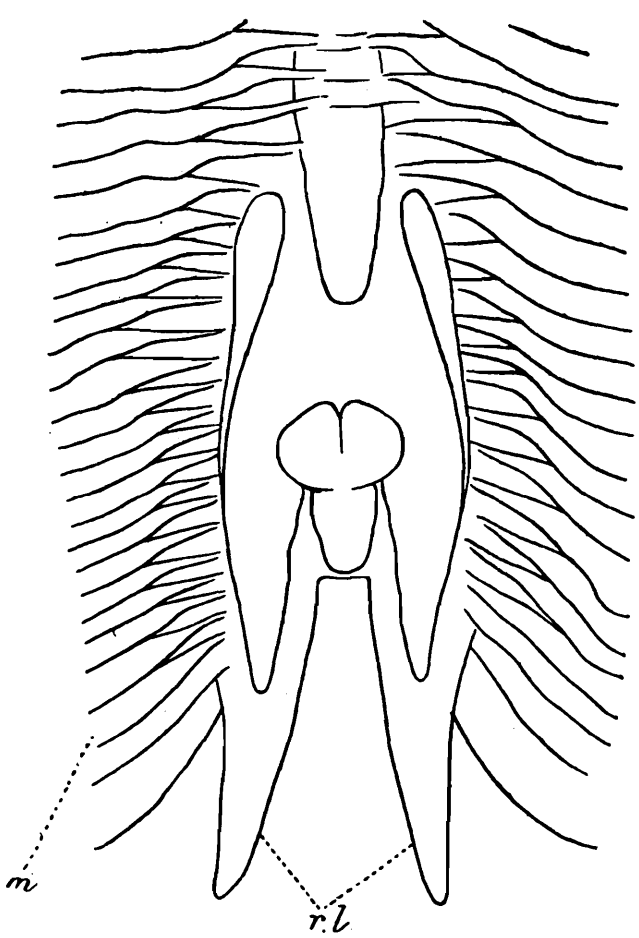
The bell is hemispherical or dome-shaped, with a diameter of 100-160 mm. Its margin is more or less incurved. The surface of the exumbrella is finely granular, and has minute short furrows and ridges arranged



TEXT-FIG. 4.—*Crambionella annandalei*. Exumbrellar view of rhopalium. *c*. Sense-club ; *g*. radiating grooves of the rhopalium ; *r.l.* rhopalar lappets. ×16.

[1] A small collection of individuals of this species from Puri which the late Dr. Annandale studied some years ago had been labelled by him as an undescribed species of *Pseudorhiza*, but no description was published. I have great pleasure in associating his name with this species.

radially. The general appearance of the exumbrellar surface is comparable to a distant surface view of a meandrine coral. The granules are somewhat unevenly distributed, more being found near the margin. The marginal part of the umbrella is comparatively thin and forms a distinct region with its numerous short longitudinal or radially directed triangular ridges on the entire circumference of the umbrella. The ridges usually correspond in number with the velar lappets. Each ridge carries at its apex a row of small but prominent, mound-like or pointed conical tubercles, the largest of them being in the middle of the ridge and the smaller ones at the ends. The tubercles vary in number, there being usually 14-16 of them on each ridge. The rhopalar ridges, *i.e.*, those lying next to the rhopalium generally converge above it, and sometimes unite. Abnormally, any two or more ridges besides the rhopalar may converge and unite. There are usually no tubercles above the exumbrellar sense-pit, but rarely there are three or four of them in a row. There are 8 rhopalia on the margin of the umbrella in moderately deep notches. Each rhopalium has a short stout stalk with a spherical mass at its free end enclosed in a membrane, and containing a number of elliptical or lens-shaped refringent concretions. The rhopalar lappets are elongate and narrow and diverge near their distal ends. They do

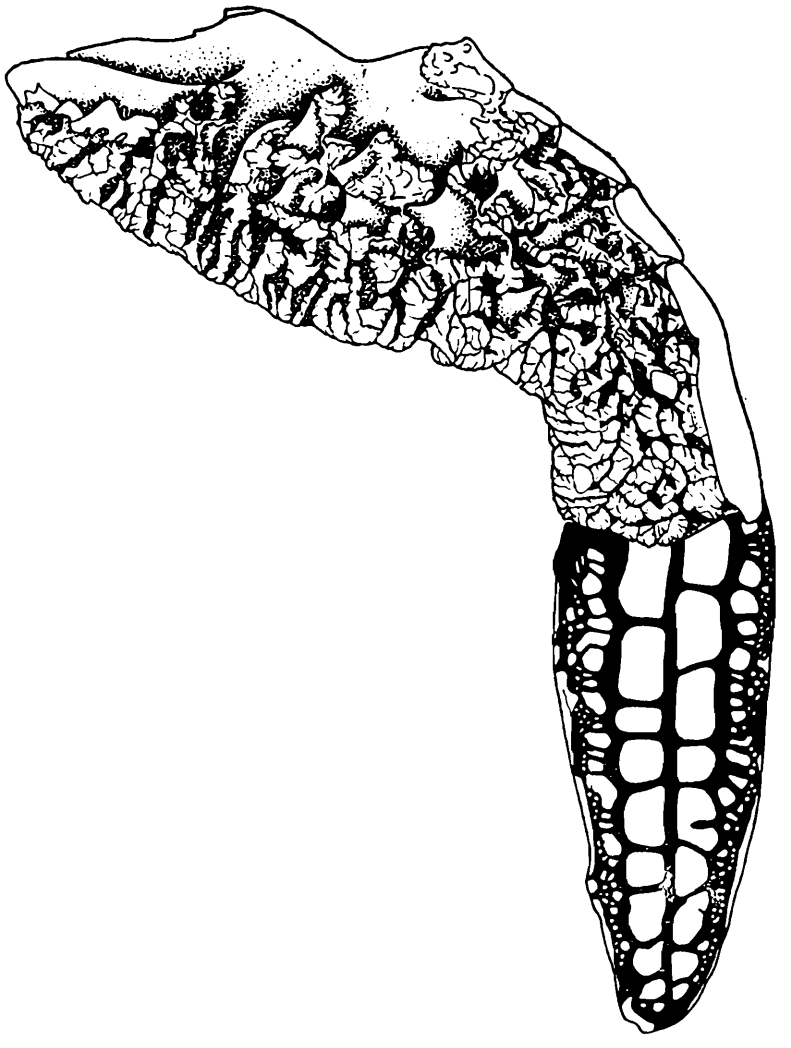


Text-fig. 5.—*Crambionella annandalei.* Subumbrellar view of rhopalium. *m*. muscle strands of the subumbrella ; *r.l.* rhopalar lappets. × 16.

not extend beyond the velar lappets. There are, as a rule, 14 velar lappets in each octant, relatively broad and triangular. The exumbrellar sense-pit is elongate, triangular, and radially furrowed. The distal ends

of the furrows are branched. The area immediately around the sense-pit is flattened, and there is a smooth ridge on the sides and on the inner margin of the pit.

The mouth-arms are well developed, stout and long, and arise in pairs from the arm disc on the subumbrella. Each mouth-arm may be divided into three parts, *e.g.*, (1) the very short basal shaft which is more or less cylindrical, (2) the trifoliate winged middle part bearing the mouth-frills which are arranged in transverse pleats on its three sides, and the foliaceous appendages, and (3) the long stout, tapering pyramidal naked terminal club. The last is simply a continuation of the mouth-arm without mouth-frills or appendages. In a cross-section of the terminal club which will be triangular the outer or centrifugal side forms the base

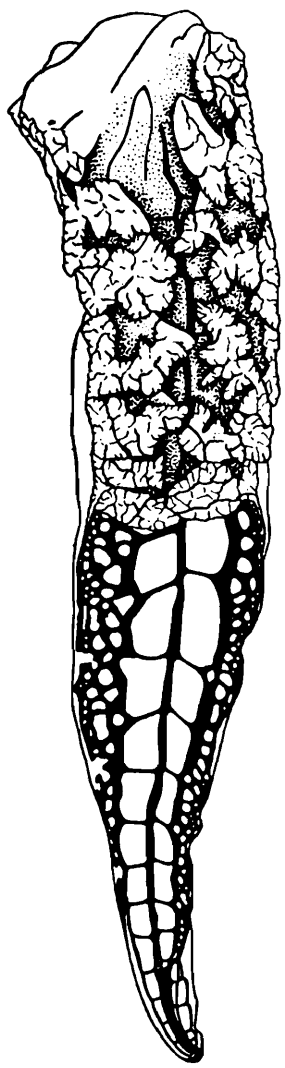


TEXT-FIG. 6.—*Crambionella annandalei.* Distal part of mouth-arm of a full-grown specimen (Holotype) showing the distribution of the canals in the terminal appendage. × $\frac{5}{6}$.

of the triangle, and the inner or the axial the apex. The terminal club is about half as long as the entire mouth-arm, but its length on the centrifugal side is greater than on its centripetal. This feature is clearly seen in the figure at the top on pl. III.

The middle part of the mouth-arm is a little shorter than the terminal appendage. The mouth-frills are found in regular rows, though in the fully adult medusa they are somewhat complicatedly arranged, presumably as a result of the displacement of the rows of mouth-frills due to growth. By careful manipulation, however, the disposition of the struc-

tures on the mouth-arm can be made out. The mouth-frills bear at their free edge a number of minute filaments with club-shaped extremities which carry small rounded nematocysts. Scattered amongst the frills and near the small mouths are a few flattened, usually orbicular, appendages. They are conspicuous in mature examples on all sides of the middle part of the mouth-arm, but are generally more numerous on the centripetal side. In some individuals, slightly smaller in size, they are minute and escape notice unless the mouth-frills are carefuily



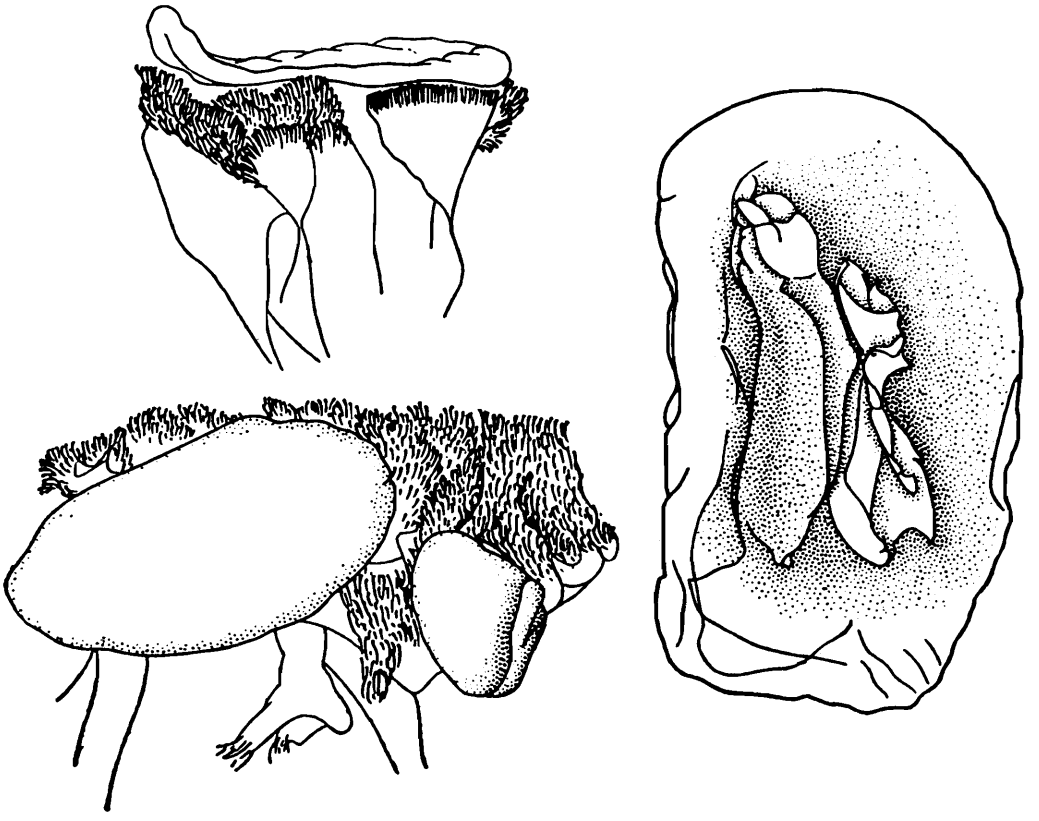
Text-fig. 7.—*Crambionella annandalei.* Distal part of mouth-arm of a young medusa from the Bay of Bengal showing the distribution of the canals in the terminal appendage. × 1⅓.

dissected out. They are usually semi-circular or orbicular in outline, but a few are elongate and leaf-like. They are full of small rounded or oval nematocysts, fringed along their margin by a row of elongate, relatively large spindle-shaped nematocysts which stand at right angles to the outline of the appendage.

The mouth-arm disc is roughly octagonal, each side being sinuous. Its diameter is about half of that of the bell. There are four crescent-shaped genital ostia the edge of which is somewhat thick and fleshy. When the ostium is contracted the hemispherical ridge-like inner or centripetal side fits exactly like a plug into the opening of the ostium. The interostial pillars are much broader than the genital ostia. On the centrifugal face of each pillar there is a triangular depressed area

nearly as large as or slightly larger than the ostium. The subgenital cavity is deep and dome-shaped. The centre of the mouth-arm disc is cross-shaped.

The muscular system is well developed. The ring-muscle area on the subumbrella is extensive, and divisible into two distinct regions, an outer and an inner clearly indicated by a groove along the ring-canal. The outer is wide and has well-defined curtain-like muscles, each consisting of a fold of muscle doubled on itself. The inner is narrow and its muscles are comparatively less conspicuous. The muscles are interrupted slightly along the rhopalar canals, and in the larger individuals along part of the length of the interrhopalar canals also.



TEXT-FIG. 8.—*Crambionella annandalei.* Foliaceous appendages from three different points on the mouth-arm of the Holotype viewed from the sides in the top left figure, from above in the figure below, and from below in the figure on the right. The frilled appendages surrounding the foliaceous ones have been removed in the figure on the right, and only partly in the figures on the left. × 10.

There are 16 radial canals, 8 rhopalar extending to the margin of the umbrella, 8 interrhopalar ending in the ring-canal. Internal to the ring-canal and arising from it there is a network of anastomosing canals extending over less than half the area between two radial canals. The narrow-meshed network of anastomosing canals outside the ring-canal consists of a number of narrow radial canals arising from the ring-canal with still narrower transverse connections between them. It extends up to the base of the velar lappets. The rhopalar lappets have a pair of short blindly ending extensions of the rhopalar canal. Eight canals branch off from the central gastric cavity, each extending down the middle of the mouth-arms. In the terminal naked club the axial canal gives off a number of narrow transverse canals, usually 8 or 9, rarely 10-16. Their peripheral ends near each corner of the club are joined together by a sinuous longitudinal canal extending to the extremity

of the club. External to the longitudinal canal there is a network of canals formed by the short branches from the longitudinal. The terminal club is so transparent that the disposition of the canals and the network in it can be easily studied. The photographs of the holotype (pl. III) show these features well.

The colour of the medusa in the living state is not recorded ; in the preserved condition it is a pale pink or cream.

Holotype.—P. $\frac{492}{1}$ Zool. Surv. Ind. (*Ind. Mus.*).

The holotype was collected in December, 1923 (Drs. Annandale and Prashad) in the Andaman Sea near Port Blair. It is the largest of the individuals of the species in the collection. Several medusae from various parts of the Bay of Bengal not far from the coasts of India and Burma are present in the collection.

Measurements in millimeters.

Locality.	Diameter of bell.	Length of m. arm from its base to tip of terminal club.	Length of terminal club on its longest side.	Length of basal shaft of m. arm.	Breadth of umbrellar margin bearing tubercles.	Number of medusae and remarks.
Andaman I. (Drs. Annandale and Prashad). December, 1923. Holotype.	170	140	83	20	35	One.
Akyab Harbour (Major R. W. G. Hingston), October, 1925.	160	100—125	45—78	20—25	30	Do.
Off Hamji Basin (Hinzé)	43	26	15	..	..	Do.
Puri, Orissa Coast (Dr. Annandale and Captain Lloyd), January, 1908.	45	30	10	..	..	One small and 3 large—not in good condition.
Puri, February-March, 1908.	85—120	70—145	..	..	..	Two. 14-18 velar lappets. Rhopalia not equidistant.
Puri Beach, February, 1909.	60—80	..	..	..	..	Four.
Vizagapatam Backwater (Dr. S. W. Kemp), April, 1910.	65	50—72	50	..	..	One.
Madras (Prof. J. J. Asana), April, 1925.	55	52	24	..	..	Six—immature.

This species is closely allied to the other two species included in the genus, but its relationship to *Crambionella stuhlmanni* (Chun) is much closer in several features, particularly in the form of the umbrella, in the occurrence of pyramidal ridges and of tubercles on the marginal part of the umbrella, and in the position of the rhopalia. It, however, differs from that species in the great length of the terminal club and in its tapering form, and in having small foliaceous appendages amongst the mouth-arm frills. The " ungestielte Gallertknöpfe " of *C. orsini* (Vanhöffen) probably correspond to the appendages described in the present species, but unfortunately they are not figured by Vanhöffen.

Genus **Lobonema** Mayer.

1910. *Lobonema*, Mayer, *op. cit.*, p. 688.
1914. *Lobonema*, Light, *op. cit.*, p. 216.

Although Light described a new species from Palawan, Philippines, differing in certain respects from Mayer's genotype, *L. smithii* from Manila Bay, Philippines, he seems to be now more or less convinced that the two species are identical.[1]

Lobonema smithii Mayer.

1910. *Lobonema smithii*, Mayer, *op. cit.*, p. 689.
1914. *Lobonema mayeri*, Light, *op. cit.*, p. 217.
1921. *Lobonema mayeri*, *Lobonema smithii*, Light, *Philip. Journ. Sci.*, XVIII, pp. 43-44.

A more or less well preserved individual from Celerity Passage (Mar. Surv. Sta. 580, 1914) belongs to this species. The diameter of the bell excluding the marginal lappets is 145 mm., and that of the mouth-arm disc from one interostial pillar to the one opposite at 180° is 95 mm. The mouth-arm is 85 mm. long, and bears a number of thin whip-like filaments. The velar lappets are about 25 mm. long. The subgenital ostia are only two-thirds as broad as the base of the interostial pillar. There are 14 rhopalia on the margin of the bell. Light described in the Philippine medusae a slit-like false ostium on the interostial pillar, and in one individual a large cone-shaped papilla on the upper margin of the false ostium. Both are absent in the present specimen. The interostial pillar on the other hand is supported by firm tissue at the sides of its base, and the enclosed area between the bands of tissue is membranous and transparent. The ring muscles are well developed on the subumbrella and are not completely interrupted along the rhopalar canals.

This specimen agrees in essentials with the original description of the Palawan specimens given by Light, but differs in that the circular muscles are not completely interrupted along the rhopalar radii, and in lacking the false ostia. These differences are presumably due to variability which is a common feature in most species of Scyphomedusae.

Mayer's description was based on three imperfect specimens, probably abnormal.[2] The fact that Light examined several specimens from Manila Bay, the type-locality, and found not one of them agreeing with Mayer's description of the species lends support to this view.

Genus **Lobonemoides** Light.

1914. *Lobonemoides*, Light, *op. cit.*, p. 222.

In erecting this genus Light remarked that the medusae representing his genotype were very puzzling to place systematically. In the present collection there is a single medusa from the Bay of Bengal which I am

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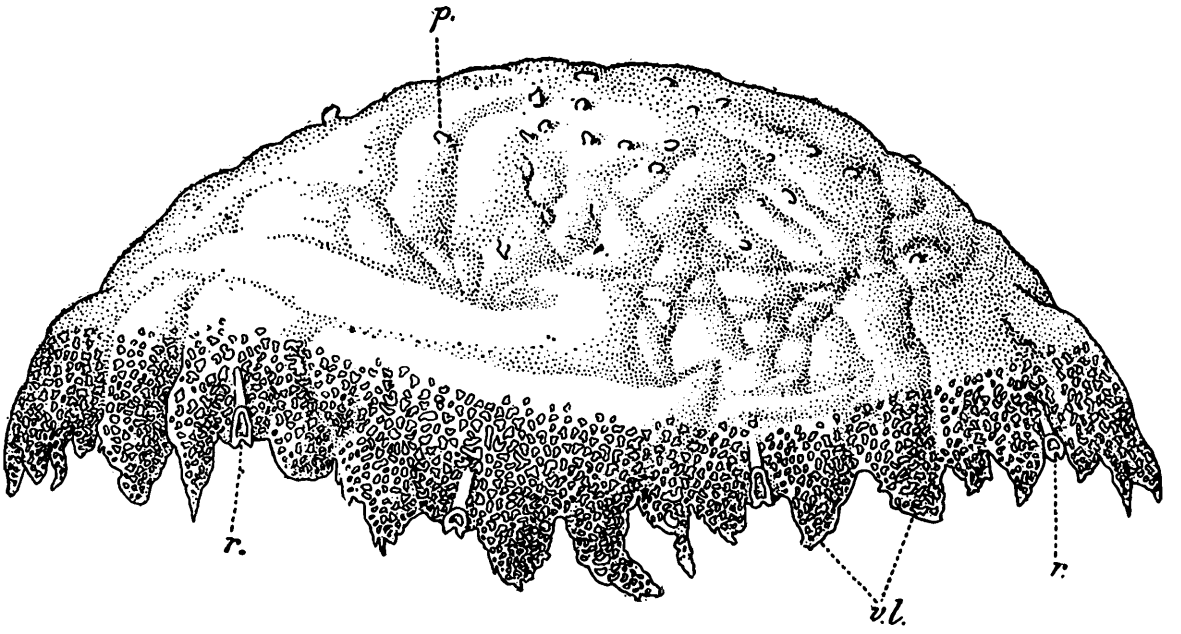
[1] Light, *Philip. Journ. Sci.*, XVIII, p. 44 (1921).

[2] The description of the species is admitted by Mayer to be partial, being based on a ' perfect specimen ' with ' a quadrant of its disk and all of its mouth-arms ' preserved, and on ' two other imperfect specimens '. The exact significance of these terms ' perfect and imperfect ' is not quite clear.

unable to refer to any known species in the sub-family Loboneminae. It is in some respects intermediate between *Lobonema* and *Lobonemoides*, and may prove to be the type of a new genus, but in view of the fact that the specimen is unique, and slightly damaged in places I refrain from erecting a new genus, but describe it as a new species of *Lobonemoides* with the genotype of which it seems to have certain affinities.

Lobonemoides sewelli,[1] sp. nov.

In outline the bell of the medusa is less than a hemisphere, but is not very flat. Its diameter is about 260 mm., and its consistency somewhat firm except in the marginal region which is limp from the ring-canal outwards. The central part of the umbrella overlying the mouth-arm disc is 10 mm. thick, and the marginal region immediately inside the ring canal 12 mm. thick. The marginal region, outside the ring-canal, is thin, about 35 mm. wide and 3 mm. thick. On the central part of the exumbrellar surface there are a few scattered papillae, 5 mm. long and 2 mm. broad at their base. There are fleshy tongue-shaped thickenings of the exumbrella at the base of the velar lappets.



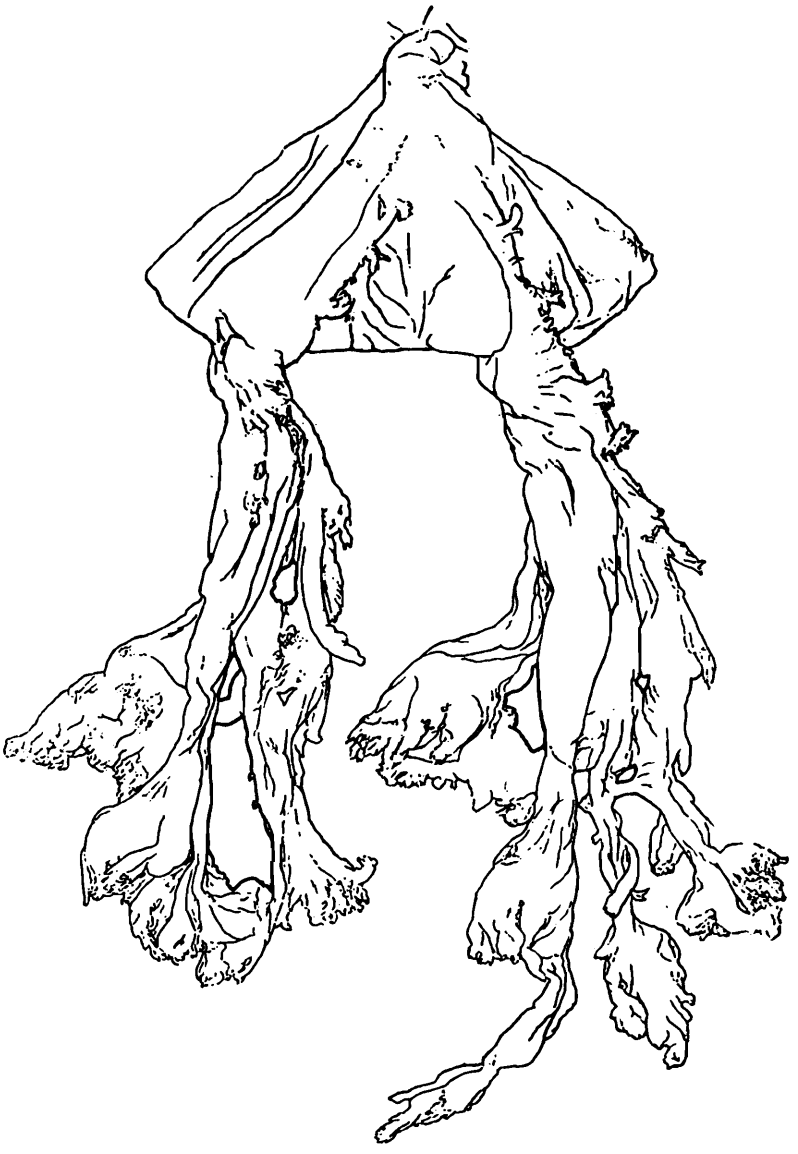
TEXT-FIG. 9.—*Lobonemoides sewelli.* Side-view of exumbrella. *p.* exumbrellar processes; *r.* rhopalia ; *v.l.* velar lappets. × ⅔.

There are 16 rhopalia, 3 in each quadrant and opposite the interostial pillar, and one opposite each of the subgenital ostia, lodged in the membrane stretching between two adjacent velar lappets. Each rhopalium has a short minute club-shaped sense-rod lying in a sinus covered over by a thin membrane extending between two rhopalar lappets. The exumbrellar sense-pit is broad and radially grooved, the distal end of the grooves being usually forked. The rhopalar lappets are small, beak-shaped structures directed outwards, not exceeding 2 mm. in length. The number of velar lappets between a pair of rhopalia is not constant, and varies between 2 and 6. There are 52 velar lappets in the holotype,

[1] Named after my chief, Col. Sewell, to whose energy as Surgeon Naturalist on the "Investigator" the Indian Museum owes its large collection of Scyphomedusae.

but as part of the margin of the bell is incomplete the number is presumably larger. They are elongately triangular, 10-15 mm. long and slightly longer than broad at base. Some of them show slight fission at their tapering end, and have small accessory triangular projections on their sides near the base, or minute crenulations.

There are twice as many radial canals as there are rhopalia, the rhopalar canals being prominent, and reaching the margin of the umbrella,

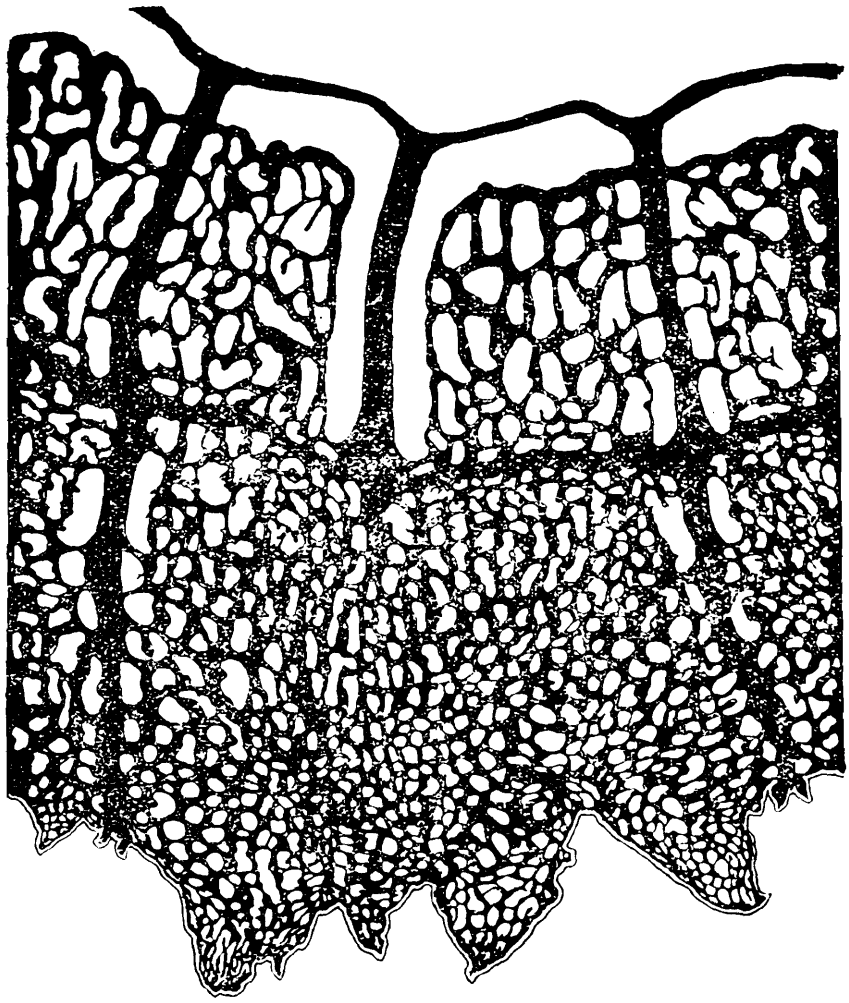


TEXT-FIG. 10.—*Lobonemoides sewelli*. Subumbrellar view of a part of the mouth-arm disc with two arms. The spaces enclosed by thick black lines represent the small windows of the proximal part. In this radius the distal connection between the wings of the mouth-arm is broken. × ⅔.

and the interrhopalar extending usually a little beyond the ring-canal. The radial canals form a large sinus at their junction with the ring-canal. The ring-canal is very narrow and inconspicuous in places, losing its individuality as a distinct canal in the interradial network of anastomosis. The interrhopalar centrifugal network of canals is narrow-meshed and is connected to the rhopalar canal on its sides by several narrow transverse canals. The network of canals centripetal to the ring-canal is large-meshed, and connected with the rhopalar canal by a few short transverse canals, usually four or five in number. It is not directly connected with the central stomach at any point. The rhopalar canal on reaching the margin of the umbrella near the base of the rhopalar lappets enters

the floor of the rhopalium where it divides into two diverging blindly ending-canals in the rhopalar lappets. A branch from each of the per-radial canals is given off to the mouth-arm at the base of which it divides into three distinct branches, one for each wing of the trifoliate arm. Smaller canals branch off from the main canal and enter the fleshy thick-enings of the periphery of the wing and the appendages at the base of the frilled mouths.

The whole of the subumbrella outside the arm-disc up to the base of the marginal lappets constitutes the region of the ring-muscles. The part which lies inside the ring-canal is raised, convex and fleshy, and the muscles are much more prominent than on the part outside the ring-

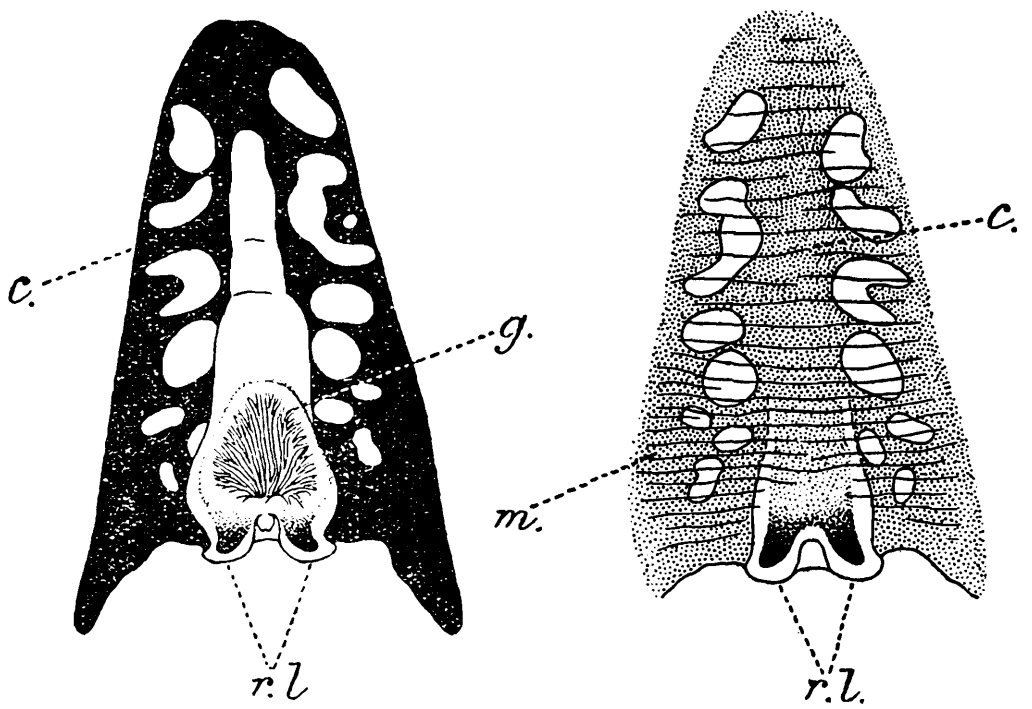


TEXT-FIG. 11.—*Lobonemoides sewelli.* Canal system of two adjacent rhopalar radii of the umbrella. × 1½.

canal. Each strand of muscle is a vertical fold of the subumbrellar tissue. The muscles are only interrupted part of the way along the radial canals, usually up to the point of their junction with the ring-canal.

The mouth-arm disc is octagonal in shape, firm, and divided into four sectors by broad radial grooves. Measured diagonally from an interostial pillar to the one opposite, its diameter is 95 mm., and its thickness 10 mm. Each mouth-arm pillar arises from the peripheral region of its sector, and carries at the base of its centrifugal side a broad lunate depression. It is narrow above, broad and sloping below. Its breadth varies from 20-50 mm. The subgenital ostia are large, more or

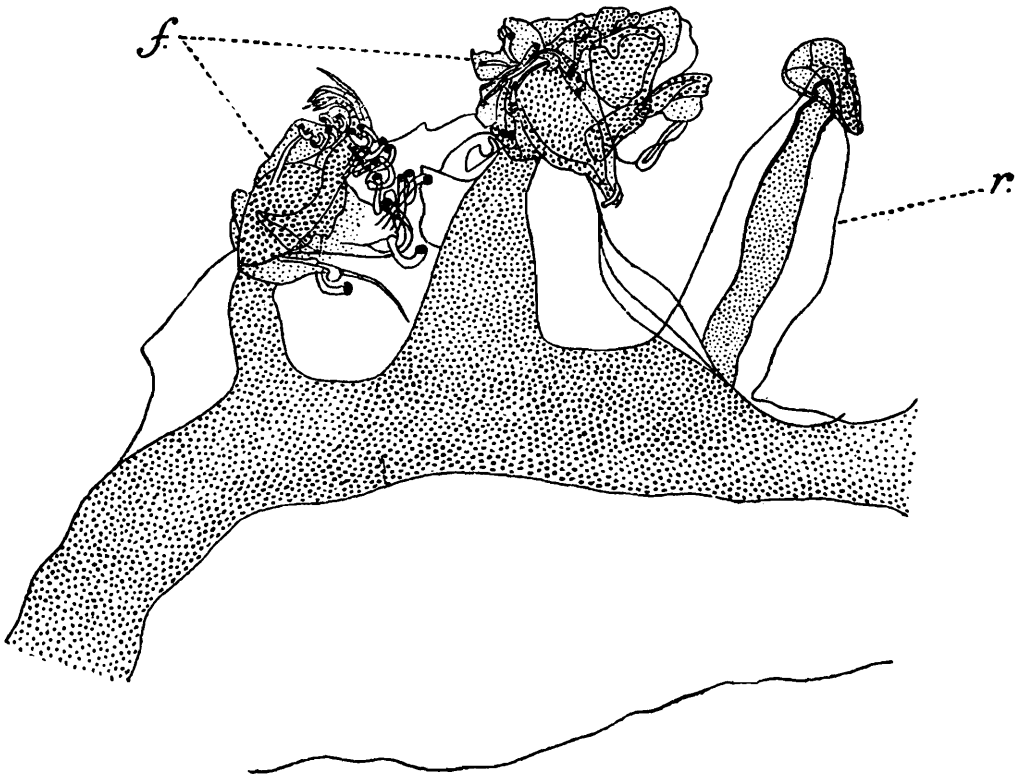
less circular openings about 30-40 mm. broad and 30 mm. high. The floor of each ostium is elevated at the entrance into a broad lunate fleshy prominence which is nearly as wide as the ostium. On its convex side it bears a number of flattened gonadial filaments joined together in a series and lying in the unitary subgenital cavity. The mouth-arms arise in pairs from each sector of the mouth-arm disc, and extend considerably beyond the margin of the umbrella. Excluding the interostial pillars the length of the mouth-arm ranges from 90 to 155 mm. The mouth-arm may be divided into two regions, *e.g.*, the basal shaft, and the distal winged part. The former is 45 mm. long ; and in the longest arm it is roughly a third of its entire length. It is slightly flattened from side to side, and triangular in cross-section, the apex of the triangle being directed inwards. The winged part of the mouth-arm is also



TEXT-FIG. 12.—*Lobonemoides sewelli.* Exumbrellar and subumbrellar views of the rhopalium and its adjacent region. *c.* anastomosing canals of the margin of the umbrella ; *g.* radiating grooves above the rhopalium ; *m.* circular muscles of the subumbrella ; *r.l.* rhopalar lappets. × $4\frac{4}{5}$.

flattened, and bears on the periphery of each wing a series of stout bead-like swellings of varying size joined together by a strip of membrane which is usually perforated. There is one large window-like opening in each wing of the mouth-arm instead of three or four small ones as in *Lobonema smithii* Mayer. There is, however, no evidence to indicate that this large window has been formed by the tearing of the wing-membrane with several smaller windows. A number of frilled mouths with short club-shaped filaments is present on the distal end of the bead-shaped structures. These structures may be compared in general appearance to the ovaries and stigma of certain flowers belonging to the natural order Euphorbiaceae. Instead of long whip-like filaments as in *Lobonemoides gracilis* there are short, stiff, rod-like appendages scattered amongst the frilled mouths with a prolongation of the mouth-arm canal. Their free ends are usually knob-like with minute frills or folds of tissue on them. Minute rounded and elongate nematocysts are

found scattered on these appendages. On the axial or centripetal wing of the mouth-arm the bead-shaped structures undergo gradual reduction



TEXT-FIG. 13.—*Lobonemoides sewelli.* Mouth-arm appendages. *f.* frilled appendages : *r.* rod-like appendages. The canal system sends branches into both these forms of appendages. × 28.

in size and complexity towards the margin of the mouth-arm disc, until on the latter the mouth-frills and appendages are so much reduced that they appear to be mere Y-shaped ridges, the tail ends of which meet at the centre of the mouth-arm disc.

The colour in spirit is pale pink or cream. No markings or pigment spots are present. The specimen is greatly contracted and somewhat brittle owing to preservation in alcohol.

Certain worms, probably immature Distomes, are present on the exumbrella and on the mouth-frills and the appendages. They are reddish brown in colour, and have several refringent oval or elliptical bodies in them.

Holotype.—P $\frac{493}{1}$ Zool. Surv. Ind. (*Ind. Mus.*).

Locality.—Vicinity of Mergui Archipelago (Mar. Surv. Sta. 565—11° 57′ 30″ N., 98° 19′ E.). The medusa was taken by Col. Sewell (13th November, 1913) with the help of a large surface townet.

This species, while agreeing with *Lobonemoides gracilis* in having pointed marginal lappets and in the general arrangement of the radial and anastomosing canals, differs from it in having window-like openings on the mouth-arm membrane, in lacking filamentous appendages on the mouth-arms and in details of the canal system.[1] The most characteristic features are, however, in the mouth-arms and their curious bead-shaped

[1] Stiasny (1921, p. 156) is of the opinion that *Lobonemoides gracilis* is the young of his *Lobonemoides robustus* from Java.

swellings with their short, stiff appendages, and in the one large window-like opening occupying the entire area of the mouth-arm membrane with several small ones at the periphery of the wing.

The arrangement of the canals appears to be subject to slight variations. The interradial canals may or may not reach the margin of the umbrella. Judging from the figures of the canal system given by Mayer for *Lobonema smithii* and by Light for *Lobonemoides gracilis* it seems that the interrhopalar canals are not at all well-defined outside the ring-canal, although the authors say that they extend up to the margin of the umbrella. In the present species they break up into an anastomosing network between the rhopalar canals a little beyond the point of emergence from the ring-canal. The ring-canal itself is reduced in size and often inconspicuous at some points.

It is probable that a closer study of a large number of specimens of these so-called species will show that they are no more than varieties of a single species with a wide distribution in the Indo-Pacific seas.

Family RHIZOSTOMIDAE.

Genus **Rhopilema** Haeckel.

1921. *Rhopilema*, Stiasny, *op. cit.*, p. 161.

Rhopilema hispidium (Vanhöffen) Maas.

1903. *Rhopilema hispidium*, Maas, *Scyphomedusen der Siboga Exped.*, Monogr. 11, p. 73, pl. ix, figs. 78-81.
1910. *Rhopilema hispidium*, Mayer, *op. cit.*, p. 706.
1921. *Rhopilema hispidium*, Stiasny, *op. cit.*, p. 163, pl. ii, fig. 15; pl. iv, figs. 34 *a*, *b*, 35, 36; pl. v, fig. 48.

Two specimens in a somewhat damaged condition are preserved in the collection. One is from Puri, Orissa Coast (Dr. Annandale and Capt. R. E. Lloyd, Jan., 1908). The diameter of the bell is 80 mm., and the length of the mouth-arm 75 mm. There are numerous conical and spiniform projections on the exumbrella. The scapulets are 25 mm. long. There are no wart-like papillae at the sides of the subgenital ostia.

The other example bears the register number $\frac{6756}{4}$ only, and the locality is not given. Presumably it is from some part of the Bay of Bengal. The diameter of the bell is 80 mm., and the length of the mouth-arm to the tip of its terminal appendage is 55 mm. The scapulets are 15 mm. long. There are a few conical projections on the exumbrellar surface. The terminal club on the mouth-arm is compressed, elongate and more or less three-cornered. The subgenital cavities are distinct and separated from one another by a thin membranous partition, and the ostia are as wide as the interostial mouth-arm pillars. An elongate somewhat pear-shaped papilla with very few warts is present a little in front of the entrance of the subgenital ostia.