HYDROMEDUSAE,

WITH A REVISION OF THE WILLIADAE AND PETASIDAE.

By Edward T. Browne, B.A., *Zoological Research Laboratory, University College, London.*

(With Plates LIV.—LVII.)

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INTRODUCTION.

Although the collection does not contain many specimens, a few more would have been a distinct advantage, and the species are not numerous; it has, nevertheless, brought to light some interesting medusae. It is a welcome addition to our knowledge of the Hydromedusae of the Indian Ocean, and I express my sincere thanks to Mr Stanley Gardiner for allowing me the privilege of examining the specimens.

The Anthomedusae and the Leptomedusae of the Indian Ocean are not well known and a very few species have been recorded. There are five species in this collection and four of them are new to science. The medusae belonging to these two Orders are usually found in littoral waters and seldom far away from land. They are liberated, with few exceptions, from fixed hydroids, and consequently their geographical distribution is limited to the region occupied by their hydroids. A genus often has a wide geographical range, but seldom its species, which are usually confined to definite areas, or even to certain localities, so that some of the new species belonging to the Anthomedusae and the Leptomedusae are probably limited to the Maldive Islands.

The Trachomedusae, the Narcomedusae and the Siphonophora have no fixed stage in their life-history and they are the inhabitants of the oceans, drifting hither and thither with the currents. Their species have usually a very wide geographical range and some extend over the Atlantic, Indian, and Pacific Oceans. Although Mr Gardiner made extensive use of the tow-net, yet a very few specimens of the Oceanic medusae were taken, and considering the geographical position of the Islands one would have expected to have seen a more extensive collection.

SUMMARY.

In the revision of the Williadae I have used for the generic character the number of radial canals which leave the stomach, and for the specific character the branching of the canal system. There are now two genera, namely, *Proboscidactyla* and *Willia*. The genera *Dyscannota* and *Willetta* of Haeckel are no longer needed. In three species of the Williadae I have found that the circular canal is absent and that its place is occupied by a solid chord of endoderm cells. The radial canals are in direct communication with the basal bulbs of the tentacles.

Mesonema pensile, one of the Aequoridae, has the lower wall of the stomach quite rudimentary, so that the mouth must always remain very wide open. I have failed to see how this stomach can act as a digestive organ and have suggested that the canal system has taken on the function of a stomach. This may also apply to other Aequoridae and account for the large number of radial canals and the excretory pores on the circular canal. The Maldive specimens are exactly like a figure of a medusa given by Forskål (1771), afterwards called *Mesonema pensile*. I cannot find any evidence that this medusa has been taken since Forskål's time. The Aequoridae require a thorough revision, but this can only be properly done with the aid of a sufficient number of specimens as most of the species now have imperfect descriptions. Special attention should be paid to the shape of the basal bulbs of the tentacles. So far I have found the shape to be different in every species which I have examined.

As the shape is constant for each species in all stages of development, it is easy to identify the early and intermediate stages, which are liable to be described as distinct species and perhaps placed in different genera.

The revision of the genera belonging to the Petasidae has not involved any alterations in generic names. The structure of the sense organs has been taken for the character of the two subfamilies, Petnachnidae and Olindiadae, instead of the absence or presence of centripetal canals, which was used as the subfamily character by Haeckel. The genera *Aglauropsis* and *Gossea* have been placed among the Olindiadae, and so have the following additional genera, *Gonionemus, Gonionemoides,* and *Vallentinia.* The structure of the tentacles has been used as the principal character of the genera belonging to the Olindiadae.

A new genus, *Amphogona,* has been instituted for *Pantachogon apsteini* of Vanhöffen. This medusa is bisexual, having male and female reproductive organs on alternating radial canals. I believe this to be the first recorded case of hermaphroditism amongst the Craspedote medusae. The new genus has been placed with the Aglauridae, but it also possesses characters of the Trachynemidae and looks like a connecting link between the two families.

Order ANTHOMEDUSAE.

Family **Williadae**, Forbes, 1848.

Character of the family. Anthomedusae with 4, 6 or more radial canals, each having one or more lateral branches (except in the earliest stage) running to the margin of the umbrella. Stomach with 4, 6 or more lobes, upon which the gonads are situated. Mouth with four or more lips, or with a folded margin. Tentacles simple, evenly distributed (not arranged in groups) round the margin of the umbrella.

The Williadae were classified by L. Agassiz (1862) as a family belonging to the Tubulariae (Gymnoblastea-Anthomedusae), but Haeckel (1879) removed the family to the Leptomedusae. He considered the gonads to be upon the radial canals and not upon the stomach. In 1893 I succeeded in connecting *Willia stellata,* Forbes, with the Gymnoblastic hydroid *Lar sabellarum,* Gosse, and cut a series of sections which showed that the gonads were upon the stomach and its lobes.

Haeckel placed the Williadae as a subfamily of the Cannotidae, and used the mode of branching of the canal system as the basis for classification. He introduced two new genera, namely, *Dyscannota* and *Willetta,* on the supposition that A. Agassiz had wrongly identified his specimens. It appears to me that the number of main radial canals is of greater importance than the mode of branching of the canal system and should be used for the generic character. The mode of branching, which carries with it the number of tentacles, would be of more value as a specific character.

The development of the radial canal system shows that the earliest free-swimming stage has unbranched canals. A young *Proboscidactyla* has four radial canals, without branches, and four tentacles. A young *Willia* has six unbranched radial canals and six tentacles. The branching of the canals appears later and passes through a definite series of stages.

A single abnormal specimen in the Maldive Collection, belonging to the Williadae, led me to investigate the literature relating to all the species and I have now attempted to make a revision of the family.

The Absence of a Circular Canal. Brandt (1838) in his description of *Proboscidactyla flavicirrata* states that a circular canal was not observed, but a very definite inner marginal edge was visible. When I was examining specimens of *Willia mutabilis* I noticed that what then was regarded by me as the circular canal was very slender and inconspicuous compared with the radial canals. As I could not make out a definite canal with the microscope a series of sections was cut. The sections showed a solid chord of cells without any opening in the centre. Sections were also cut of *Willia stellata* and these failed to show a circular canal. I have also examined *Willia stellata* alive when an active circulation was going on in the radial canals and inside the basal bulbs of the tentacles, but I did not see a circulation round the margin of the umbrella. Externally the solid chord of cells looks like a circular canal and expecting one to be present it is easy to mistake it for a canal. As every tentacle is in direct communication with the radial canals, the circular canal became functionless and it has now ceased to exist.

The Clusters of Nematocysts on the Ex-umbrella. In several species the nematocysts on the ex-umbrella have been carefully described, and it has been shown that their arrangement is a definite one. Radial clusters of nematocysts, situated midway between every two tentacles, extend from near the margin of the umbrella to about halfway or nearly to the top of the umbrella. The clusters are connected with one another by a kind of canal (just under the surface of the ex-umbrella), along which the nematocysts travel. An investigation of the nematocysts in *Willia stellata* when alive showed that isolated nematocysts travelled along the margin of the umbrella, then entered a canal, and after proceeding a short distance stopped. A cluster is formed by the accumulation of nematocysts. I could not find a cluster of nematocysts on the very margin of the umbrella, but always isolated nematocysts; the first cluster being at a little distance from the margin. In the earliest free-swimming stage there is only a single cluster between every two tentacles and as the umbrella increases in size other clusters are formed. The number of nematocysts in a cluster, the shape of the cluster, and the number of clusters in each row, I found to be very variable in the adult of *Willia stellata*.

Genus *Proboscidactyla*, Brandt, 1835.

Generic Character. Williadae with four radial canals leaving the stomach.

Proboscidactyla flavicirrata Brandt, 1835.

Proboscidactyla flavicirrata, Brandt (1835); Brandt (1838, p. 390, Taf. XIX.); Lesson (1843); L. Agassiz (1862); A. Agassiz (1865, p. 173, figs. 280—282); Haeckel (1879); *Proboscidactyla brevicirrata*, Haeckel (1879, p. 160); Murbach and Shearer (1902), (1903, p. 178).

The description of this species by Brandt and in addition the figures drawn from life by Mertens show that the main radial canals have two principal branches (a wide bifurcation), which run to the margin of the umbrella. From the inner side of each of the principal branches a number of branchlets run to the margin and the branchlets again branch near the margin. Mertens' figures show that a main canal has 18 branches which are in connection with 18 tentacles. The medusa should have altogether about 72 tentacles, a number far in excess of those of any other described species of the family.

A. Agassiz figures the same type of radial canal system for specimens taken on the American side of the Pacific Ocean. He records the presence of clusters of nematocysts on the ex-umbrella. Haeckel, however, considered that Agassiz's specimens were specifically distinct from those described by Brandt and gave to them a new specific name—*P. brevicirrata*. Murbach and Shearer have given a description, without figures, which practically confirms Agassiz's observations.

The specimens which have been described by the above authors had all reached the adult stage, but not quite the same stage in growth. Murbach records 54 tentacles for the largest specimen, Agassiz gives 64 tentacles, and Mertens' figures show about 70 tentacles. The early and intermediate stages of this species have not yet been recorded.

Distribution. North Pacific: Kamchatka (Mertens, *vide* Brandt). British Columbia: Gulf of Georgia (A. Agassiz). British Columbia: Victoria Harbour (Shearer).

Proboscidactyla occidentalis (Fewkes), 1889.

Willia occidentalis, Fewkes (1889, p. 109, Pl. V, fig. 3).

The four main radial canals run straight to the margin of the umbrella, and each canal gives off two opposite lateral branches, which again branch. Each main canal has therefore five terminations leading direct into five tentacles. A single cluster of nematocysts lies on the ex-umbrella between every two tentacles. Fewkes states that the "ovaries are four in number, arranged at the base of a four-parted stomach." The medusa has twenty tentacles, with bright reddish basal bulbs.

Distribution. North Pacific: California; Santa Cruz Is. (Fewkes).

Proboscidactyla ornata (McCrady), 1858.

Willsia ornata, McCrady (1858, p. 149, Pl. IX.); L. Agassiz (1862); A. Agassiz (1865, p. 171, figs. 274 *a*—279). *Dyscannota dysdipleura*, Haeckel (1879). *Willetta ornata*, Haeckel (1879). *Willia ornata*, Fewkes (1882, p. 299, figs. 22—23).

In the earliest free-swimming stage the medusa has four main radial canals, without any branches, and four tentacles (Fewkes, 1882). Agassiz (1865) has figured the intermediate stages showing that each main radial canal gives off a branch which runs to the margin of the umbrella. Later on a second branch appears on the side opposite to the first branch, and this also goes to the margin. McCrady (1858) described the adult stage with four main radial canals, each with three terminal branches and sixteen tentacles. Owing to the growth of the umbrella during the development of the canal system the main canals become curved and in the adult the appearance of the system is correctly expressed by saying that each main canal is twice dichotomously branched. The development of the canal system in this species is similar to that of *Willia stellata*, and can be conveniently separated into four stages.

First stage. Four radial canals without branches. 4 tentacles.

Second stage. Each main canal with one branch. 8 tentacles.

Third stage. Each main canal with two opposite branches. 12 tentacles.

Fourth stage. Each main canal with three branches. 16 tentacles.

Haeckel's classification of the family Cannotidae is primarily based upon the branching of the radial canal system, and secondarily upon the number of main radial canals from the stomach and the position of the gonads. The genera of this family have become somewhat complicated, as both Anthomedusae and Leptomedusae have been mingled together. Haeckel placed *Willia ornata*, McCrady (non Agassiz) in a new genus—*Willetta*, belonging to the sub-family Williadae. *Willia ornata*, A. Agassiz (non McCrady) is given a new generic and a new specific name, *Dyscannota dysdipleura*, and placed in the sub-family Berenicidae. Haeckel did not recognise the fact that Agassiz was describing the early and intermediate stages, showing the development of the canal system.

Distribution. North Atlantic: United States; South Carolina (McCrady). Massachusetts (A. Agassiz). Rhode Island (Fewkes), (Brooks).

Proboscidactyla gemmifera (Fewkes), 1882.

Willia ornata, Brooks (non McCrady), (1880); Brooks (1882). *Willia gemmifera*, Fewkes (1882, p. 300, Pl. I.). *Dyscannota gemmifera*, Mayer (1900, p. 47, Pl. VIII.).

When Brooks first found this species with medusa-buds he considered it to be a stage in the life-history of *Willia ornata*, McCrady. Fewkes succeeded in finding the first stage of *Willia ornata*, McCrady, and reared it up to the adult without seeing medusa-buds, and, as Agassiz had also described the early and intermediate stages without medusa-buds, Fewkes considered Brooks's medusa-budding *Willia* to be a distinct species and proposed for it a new specific name. Mayer fortunately found some specimens and has described them with excellent figures. He has adopted Haeckel's system of classification, hence the generic name *Dyscannota*. Mayer's figure shows that the medusa-bud, still attached to its parent, but ready for liberation, has four radial canals, without branches, and four tentacles. The parent medusa has two branches to each main canal, and twelve tentacles. Brooks's specimen belonged to an earlier stage, having only one branch to each canal, and eight tentacles.

The medusa-buds are upon stolons which hang down inside the cavity of the umbrella. The stolons are situated on the radial canals at their juncture with the stomach, one stolon on each of the four canals, and have at their free ends medusa-buds.

Distribution. North Atlantic: United States; North Carolina (Brooks). Tropical Atlantic: off Florida; in the Gulf Stream (Mayer).

Proboscidactyla tropica, species nova.

Willsia sp. Huxley (1877, p. 120, fig. 17).

This medusa has, up to the present, escaped having a specific name, and although figured and partly described in the well-known textbook, "A Manual of the Anatomy of Invertebrate Animals," it was omitted by Haeckel in his Monograph. Huxley's description is as follows:

"In August 1849, while in the North Pacific, off the Louisiade Archipelago, I took a species of *Willsia*, in which stolons were developed at the bifurcations of each of the four principal radiating canals of the nectocalyx. Each stolon was terminated by a knobbed extremity containing many nematocysts and gave rise, on one side, to a series of buds, of which those nearest the free end of the stolon had acquired the form of a complete medusoid. They

had four unbranched radiating canals and four tentacles; but it is probable that they would assume the form of the parent stock after development."

With the aid of the figures I have been able to draw up a description of the species and by bestowing upon it a specific name may prevent it from becoming lost again.

Description. Umbrella hemispherical, with a slight apical projection. Stomach short. Four main radial canals, each with three branches, all going to the margin of the umbrella. A stolon bearing medusa-buds hangs from each main canal at its junction with its first branch, and has at the free end a cluster of nematocysts. Sixteen short marginal tentacles, in direct communication with the radial canals. Size and colour not recorded.

Distribution. Tropical Pacific: Australasia; Louisiade Islands (Huxley).

Proboscidactyla varians, species nova (Pl. LIV. figs. 1, 2).

The collection contains only a single specimen, and though in a good state of preservation, yet it is badly contracted and has lost its natural shape. It is regarded by me as an abnormal specimen.

Description. Umbrella a little broader than high. Stomach with six lobes. Six radial canals, each with one to three lateral branches. Circular canal absent. Medusa-buds upon the radial canals, close to the stomach. Sixteen or more tentacles, with large triangular basal bulbs. Clusters of nematocysts on the ex-umbrella, arranged in radial rows.

Colour. Basal bulbs of the tentacles dark brown (in formalin).

Size. Umbrella 3 mm. in width and 2 mm. in length.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

If this solitary specimen had possessed no medusa-buds I should have placed it in the genus *Willia*, on account of its possessing six main radial canals. The medusa-buds show only four basal bulbs, with tentacles just beginning to develop, and there is not the slightest trace of any more bulbs. The fully developed medusa-buds of *Proboscidactyla tropica* and *gemmifera* have four main radial canals and four tentacles. The earliest free-swimming stage of *Proboscidactyla ornata* has also four main radial canals and four tentacles. But the earliest stage of *Willia stellata* has six main canals and six tentacles. The medusa-buds of this specimen indicate that it belongs to the genus *Proboscidactyla* and not to the genus *Willia*.

The parent medusa has six main radial canals with a variable number of lateral branches, and the lobes of the stomach show a want of symmetry. *Willia stellata* frequently shows a variation in the number of radial canals and in the number of lateral branches. As a rule when the number of main canals is above the normal number, then the branching of the canals is irregular. It will be seen in the figure that the abnormality of this specimen occurs in one quadrant, where three adjacent canals leave the stomach, each having only one lateral branch. These occupy the place of a main canal with four terminations on the margin of the umbrella. In a normal specimen at this stage, I consider that there should be a stomach with four lobes, four main radial canals, each twice dichotomously branched, sixteen tentacles. The specimen has only two medusa-buds, each of which is situated on a main radial canal, adjacent to the stomach. There is no stolon with a series of medusa-buds as found in *P. tropica* and *P. gemmifera*. The basal bulbs of the tentacles (fig. 2) are large and extend

into the substance of the umbrella, and the brown pigment of the bulbs is extended along some of the canals. Inside the margin of the umbrella there is a circular band of endoderm cells, but no circular canal can be seen. The groups of nematocysts extend over the ex-umbrella from near the margin to the top of the umbrella and are arranged in radial rows, one row between every two tentacles. In each row there are about six to seven circular clusters of nematocysts. Near the margin of the umbrella the canal along which the nematocysts travel is present, but it is only visible for a short distance.

Psythia prolifera, Agassiz and Mayer (1902, p. 143, Pl. I.). The authors, in placing the new genus in the family Williadae make the following statement: "In all previously known genera of the family Williadae the radial canals are branched. The general form, colour, shape of proboscis, and method of budding of the present medusa, however, all incline one to place it among the Williadae. It may be a primitive, or ancestral, form in which the canals have remained simple, or possibly an atavistic sport from some of the more complex Williadae, or an immature individual which may give rise to medusa-buds before attaining its complete development." A single specimen was found at the Tortugas, in the Gulf Stream off Florida. The medusa has four radial canals without branches; four tentacles with basal bulbs without any pigment; four perradial stolons bearing medusa-buds on the side of the stomach. There are no clusters of nematocysts on the ex-umbrella, but the medusa-bud has a few scattered nematocysts on the ex-umbrella, and they are absent in the parent medusa. It is like the first stage of *Proboscidactyla gemmifera* in possessing four radial canals, four tentacles, and stolons bearing medusa-buds. But the stolons are upon the stomach and not upon the radial canals, as in the other medusa-budding Williadae. The peculiar clusters of nematocysts are absent and also the pigment in the basal bulbs of the tentacles. The presence of medusa-buds and the absence of gonads indicate that the medusa is an early stage, but there is no conclusive evidence that it belongs to the Williadae.

Genus *Willia*, Forbes, 1846.

Generic Character. Williadae with six radial canals leaving the stomach.

Willia stellata Forbes, 1846.

Medusoid form.

Willsia stellata, Forbes (1846), (1848, p. 19, Pl. I.); Gosse (1853, p. 359, Pl. XX.); *Willia stellata*, L. Agassiz (1862); Haeckel (1879); *Willsia cornubica*, Peach (1867, p. 357, Pl. I.); *Lar sabellarum*, Browne (1896, p. 468, Pl. XVI.); (1898, p. 818, figs. 1—9).

Hydroid form.

Lar sabellarum, Gosse (1857, p. 113, Pl. XX.); Hincks (1872, p. 313, Pl. XIX.); Allman (1872).

Distribution. North Atlantic; British Isles.

Willia mutabilis Browne, 1902.

Willia mutabilis, Browne (1902, p. 280).

Distribution. South Atlantic; Falkland Islands (Vallentin).

Willia furcata, Haeckel (1879, p. 158). There is no figure published of this species, but the description shows that, if it is not identical with *Willia stellata*, it comes very close to it.

Distribution. North Atlantic; France (Haeckel).

Order LEPTOMEDUSAE.

Family **Eucopidae**, Gegenbaur, 1856.

Genus *Phialidium*, Leuckart, 1856.

Generic Character. Eucopidae with many marginal sensory vesicles; one or more between every two tentacles, each having a single otolith. Many tentacles. No marginal cirri. A gonad on each of the four radial canals. Stomach not on a peduncle.

Phialidium tenue, species nova. (Pl. LIV. fig. 4, Pl. LVII. fig. 16.)

Description. Umbrella watch-glass-shaped and thin. Stomach small, quadrangular in shape, and situated on a semi-globular thickening of the umbrella. Mouth with four lips and a sinuous margin. Four gonads extending over the outer half of each radial canal. Tentacles 25 in number. One or two minute marginal bulbs between every two tentacles. Sense organs numerous, one or two (rarely three) between every two tentacles, with a single otolith.

Size. Diameter of the umbrella 15 mm.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

There is only one specimen in the collection. The semi-globular thickening of the umbrella upon which the stomach is situated cannot be regarded as a true peduncle; it is simply a thickening of the wall of the umbrella. The tentacles are thin and slender with transverse rows of nematocysts. Their basal bulbs are a little broader than long; one measured 0·45 mm. in width, 0·33 mm. in length. The specimen closely resembles *Phialidium temporarium*, Browne, one of the commonest medusae in the British seas. It differs in the shape and size of the basal bulbs of the tentacles, being broader and about twice the size. The umbrella is a little thicker and the semi-globular mass of jelly at the top of the sub-umbrella cavity is very much larger. In *Phialidium temporarium* this thickening is often absent and never very conspicuous.

Genus *Pseudoclytia*, Mayer, 1900.

Generic Character. Eucopidae with many marginal sensory vesicles; one or more between every two tentacles, each having a single otolith. No marginal cirri. Five radial canals, each with a single gonad. Stomach not on a peduncle.

Mayer established the genus *Pseudoclytia* for a new species (*P. pentata*), which he found in great abundance at the Tortugas, off Florida, U.S.A. This species is pentamerous, possessing five radial canals, five gonads, and a mouth with five lips. Among 1000 individuals Mayer found 70·3 p.c. to be pentamerous with radial canals at equal distances apart. Hitherto among the Eucopidae four radial canals were always regarded as the normal number and any

numerical change was the sign of a variation from the normal type. The British Eucopidae very rarely show a numerical variation in the radial canals. There can be but little doubt that this pentamerous species has arisen from a *Phialidium*-like medusa, which had four radial canals, four gonads, and a mouth with four lips.

In the Maldive collection there are two specimens belonging to the Eucopidae, with five radial canals. If Mayer had not instituted the genus *Pseudoclytia*, the species would have been placed in the genus *Phialidium* and regarded as a variation from the normal type. I think, on the whole, it will be best to place this new species in the genus *Pseudoclytia*. The two specimens are practically identical, and the chances of catching two abnormal *Phialidium* exactly alike are very remote so far as my experience goes.

Pseudoclytia gardineri, species nova. (Pl. LV. figs. 1—3.)

Description of the Species. Umbrella broader than high (? watch-glass-shaped). Stomach short with a pentagonal base. Mouth with five small lips. Five radial canals (four nearly at right angles and one in between). Gonads very small (globular in the female and oval in the male), one situated on each radial canal about midway between the stomach and the margin. About 13—14 tentacles, with globular basal bulbs. Usually one or two marginal bulbs between every two tentacles, except in one segment where there is a conspicuous group of six bulbs (three on each side of a tentacle). Sense organs numerous, usually two or three between every two tentacles, with probably one otolith.

Size. Diameter of the umbrella about 5 mm.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

Neither of the specimens is in very good condition, so that the exact shape of the umbrella is doubtful, but it seems fairly thin and without a thick mass of jelly over the cavity of the umbrella. The mouth of one specimen is closed, and it has five distinct lips; in the other specimen it is expanded and has a quadrangular aperture with a sinuous margin. The ovaries are very small, globular in shape and containing about four to six ova. The gonads of the male are a little nearer the margin of the umbrella than those of the female. The characteristic feature of this species and that upon which the specific character is based is the group of six large marginal bulbs adjacent to one of the tentacles. This group is very conspicuous on the margin of the umbrella and is at once seen. The tentacle is in the centre of the group (fig. 3), and has three bulbs on each side. A marginal sense organ lies between each of the outer two bulbs, but there is not one next the tentacle. On the inner side of the circular canal a series of bays exists, corresponding in position to the bulbs and tentacles. In the male specimen (fig. 1) there are indications of two more groups of bulbs being formed, each with two bulbs on either side of a tentacle.

It is a pleasure to me to associate this new species with the name of Mr J. Stanley Gardiner.

Family **Aequoridae**, Eschscholtz, 1829.

Genus *Aequorea*, Péron et Lesueur, 1809.

Generic Character. Aequoridae with numerous simple unbranched radial canals. Stomach circular, with the lower wall fully developed. Mouth capable of closing up.

The type species of the genus *Aequorea* was described and figured by Forskål (1775), under the name of *Medusa aequorea*. Péron placed it in the genus *Aequorea* under the name of *Aequorea forskâlea*, where it has since remained. There will always be some doubt about the identity of the type species, as the figure and description omit just the details which are essential. I think it will be best to follow Forbes (1851) and consider the medusa, which he described and figured as *Aequorea forskâlea*, to be identical with the type species.

The shape of the basal bulbs of the tentacles is a valuable guide for the determination of the species. I have found it to be quite different in six species of the Aequoridae. As the shape is constant in each species it facilitates the identification of the early and intermediate stages.

Aequorea maldivensis, species nova. (Pl. LVI. figs. 4—12.)

Description of the Species. Umbrella saucer-shaped, about four to six times as broad as high, moderately thick. Stomach circular, its diameter about half the diameter of the umbrella, its lower wall large enough to allow the mouth to close up. Mouth with numerous short lips, closely packed together. Radial canals numerous (50—70). Gonads occupying nearly the whole length of every radial canal, and hanging down from the sub-umbrella, bilamellar. Tentacles less numerous (30—50) than the radial canals, having a large hollow basal bulb, which curls over a thickening of the ex-umbrella. Marginal bulbs about one to four between every two tentacles. Sense organs very numerous, about 15—20 between every two tentacles (or 2—4 between every two bulbs).

Size. Umbrella 75 mm. in width and 35 mm. in height (largest specimen).

Distribution. Indian Ocean; Maldive Islands, Haddumati (Gardiner).

The collection contains three specimens:

A. Umbrella about 35 mm. in diameter and about six times as broad as high. Stomach about 20 mm. in diameter. Radial canals, 52. Tentacles, 21. Marginal bulbs, usually one large and 2—4 smaller ones between every two tentacles. Sense organs, 16—24 between every two tentacles (or 2—4 between every two bulbs). Female gonads.

B. Umbrella about 45 mm. in diameter and about five times as broad as high. Stomach about 23 mm. in diameter, its lower wall fairly flat and the mouth nearly closed. Mouth circular, 6 mm. in diameter, and the margin with about 54 lips. Radial canals, 69. Tentacles, 34. Marginal bulbs, usually one large and two small bulbs between every two tentacles. Sense organs, 12—14 between every two tentacles. Male gonads.

C. Umbrella about 75 mm. in diameter and about four times as broad as high. Stomach about 35 mm. in diameter. Radial canals, 54. Tentacles, 50. Marginal bulbs, usually one between every two tentacles. Sense organs, 15—20 between every two tentacles. Female gonads.

The lower wall of the stomach varies in width in the different specimens. In one specimen the mouth is certainly capable of closing up. In the other two specimens the mouth appears to be fairly wide open, but its exact size is doubtful, as the wall of the stomach is torn away in places. The oral lips (figs. 8—9) are short and stumpy, with a sinuous margin. A longitudinal rib runs down the outer side of each lip and on the inner side there is a groove. The radial canals are deeper than they are broad, and hang down from the sub-

umbrella. The gonads (fig. 6) extend along nearly the whole length of the radial canals, leaving both ends free. In the male the portion of the canals bearing the gonads is more tubular than in the female. In the female (fig. 7) the gonads hang down from the wall of the sub-umbrella and are distinctly bilamellar.

The basal bulbs of the tentacles (figs. 10—12) are broad hollow sacs and are characterized by curling over a thickening of the margin of the umbrella. There is an excretory pore opening from the circular canal opposite each of the basal bulbs of the tentacles and each of the largest marginal bulbs. The marginal bulbs also curl over the margin of the umbrella and some of them probably develop tentacles at a later stage in the growth of the medusa. The sensory vesicles are very minute; their otoliths are not visible.

Genus *Mesonema*, Eschscholtz, 1829.

Aequoridae with numerous simple, unbranched radial canals. Stomach circular, with lower wall quite rudimentary. Mouth nearly as large as the diameter of the stomach and cannot be closed.

Mesonema pensile (Modeer), 1791. (Pl. LV. fig. 4, Pl. LVII. figs. 2—9.)

Medusa, sp. Forskål (1776, p. 9, Tab. XXVIII. fig. *B*); *Medusa coelum pensile*, Modeer (1791, p. 32); *Aequorea mesonema*, Péron (1809); *Mesonema coelum pensile*, Eschscholtz (1829); *Mesonema pensile*, Haeckel (1879).

In Forskål's *Icones rerum naturalium*, 1776, there is a good figure of a medusa about which nothing is stated, except in the description of the figure. There occurs this very brief statement, "*Medusa non descripta*. Color coerulescens."

Modeer gave a short description of the medusa from Forskål's figure, and called it *Medusa coelum pensile*. Péron placed the species in a new genus under the name of *Aequorea mesonema*. Eschscholtz removed it from the genus *Aequorea* to the genus *Mesonema* and restored Modeer's specific name. These early authors suggested the locality for Forskål's medusa to be in the Mediterranean, but it must be remembered that Forskål did not state where he found his specimen, and that his book contains the descriptions of the animals which he found in the Red Sea, as well as in the Mediterranean.

Haeckel adopted the name *Mesonema pensile* for Forskål's medusa, but he gives among the synonyms *Mesonema coerulescens*, Kölliker, 1853, and *Stomobrachium mirabile*, Kölliker, 1853; both taken by Kölliker in the Mediterranean. I fail to see the connection between Forskål's medusa and Kölliker's two species. These are young and intermediate stages, probably belonging to the genus *Aequorea*. Haeckel's description of *Mesonema pensile* is based upon the description of three species, and consequently is of little value.

In the Maldive collection there are four medusae which have all the characters of the medusa figured by Forskål.

Description of the Species. Umbrella almost a solid mass of jelly, rather like a plano-convex lens in shape, about twice to three times as broad as high. Sub-umbrella forming only a fringe round the periphery. Stomach completely rudimentary, its lower wall about 2 mm. in length, and its diameter about two-thirds the diameter of the umbrella. Mouth circular, nearly as large as the diameter of the stomach; non-contractile, and always wide

open; its margin furnished with a large number of long narrow lips, which are strengthened by an external rib. Radial canals about 100—150 in number, very short. Gonads upon all the radial canals, extending nearly from the stomach to within a short distance of the circular canal. Tentacles about 10—15, with basal bulbs having a long lateral extension along the margin of the umbrella. Numerous marginal bulbs, closely packed together, about two to three between every two radial canals. Marginal sense organs very numerous, about two to four between every two marginal bulbs.

Size. Umbrella about 60 mm. in length and about 30 mm. in height.

Distribution. Indian Ocean, Maldive Is., Haddumati and Goifurfehendu (Gardiner).

The collection contains four specimens:

A. Umbrella 45 mm. in width and 20 mm. in height. Stomach 26 mm. in diameter. Radial canals about 120. Tentacles, 10. Marginal bulbs about 12 between every two tentacles.

B. Umbrella about 60 mm. in width and 25 mm. in height. Radial canals about 100. Tentacles 10, perhaps more. This specimen is in bad condition; the margin of the umbrella damaged and the mouth torn away.

C. Umbrella about 60 mm. in width and 30 mm. in height. Radial canals estimated at 150. Tentacles 15. The specimen is in bad condition.

D. Umbrella about 60 mm. in width and about 20 mm. in height. Mouth 43 mm. in diameter. Radial canals about 148, their length about 10 mm. Tentacles 13.

The thickness of the umbrella (fig. 2) is so great that the sub-umbrella cavity is reduced to a mere shallow depression round the margin of the umbrella. The oral lips (fig. 9) are long and thin, about 3 mm. in length, without a sinuous margin. On the external side of every lip there is a longitudinal rib, which extends into the wall of the stomach, and on the inner side a corresponding groove. There are about as many oral lips as radial canals. The gonads (fig. 4) are situated on both sides of every radial canal and do not hang down in bands or folds. The tentacles are few in number and are not arranged at equal distances apart. Their basal bulbs (figs. 6—8) have long lateral extensions along the margin of the umbrella. The marginal bulbs (fig. 5) are very minute and have at their apex a circular cluster of nematocysts.

In my account of *Aequorea norvegica* (1903) I made the following statement: "The exact shape of the stomach and whether the mouth is open or closed are scarcely suitable for generic characters. The fact that an Aequorid is occasionally caught with its mouth open is no evidence that it is permanently kept open." This statement must now be modified. It referred to the genera *Aequorea* and *Polycanna* and with them it probably holds good, as neither has a rudimentary stomach. All the species of the Aequoridae, which I had then seen, possessed a mouth capable of closing up, but since I have seen these Maldive specimens my statement about the exact shape of the stomach for a generic character becomes untenable.

The stomach is quite rudimentary and is practically absent, as its lower wall is only about 2 mm. in length, so that the mouth must always remain wide open. It appears to me that the function of the stomach has been removed to the canal system. The medusa probably lives upon organisms of microscopic dimensions, such as unicellular algae and protozoa, which are picked up by the endoderm cells lining the canal system. The water containing these organisms, after circulating in the canal system, probably passes out through the numerous

pores on the circular canal. The Aequoridae which have a large funnel-shaped stomach and a closeable mouth may also have the radial canals functioning as digestive organs. The contraction of the stomach, when the mouth is closed, would drive water into the canal system and expel the stale water through the pores on the circular canal. The hypothesis that the radial canals function as the digestive organs would perhaps account for the large number usually present in the Aequoridae, some of which are the largest Leptomedusae known.

Order TRACHOMEDUSAE.

Family **Petasidae**, Haeckel, 1877.

Family Character. Trachomedusae with four radial canals, upon which are situated cylindrical, globular, or papilliform gonads. Stomach without a peduncle. Either external sensory clubs, or external or internal sensory vesicles.

Haeckel (1879) divided the Petasidae into two subfamilies, namely:

Petnachnidae, without blind centripetal canals. Genera: *Petasus, Dipetasus, Petasata, Petachnum, Aglauropsis* and *Gossea.*

Olindiadae, with blind centripetal canals. Genus: *Olindias.*

Since Haeckel published his *System der Medusen* three more genera must be added to the family, namely, *Gonionemus* (placed by Haeckel among the Thaumantidae under a wrongly spelt generic name *Gonynema*), *Gonionemoides* and *Vallentinia.*

A more natural classification of the Petasidae can, I think, be obtained by taking the structure of the sense organs instead of the centripetal canals for the characters of the two subfamilies.

There are two distinct types of sense organs:

A. *Sensory clubs* (Hörkölbchen) with a short stalk, which project from the margin of the umbrella; with a single otolith and with external sensory hairs. These sensory clubs are present in the genera *Petasus, Diptasus, Petasata, Petnachnum?* (species not figured).

B. *Sensory vesicles* (Hörbläschen) situated either in the mesogloea (internal) or on the margin of the umbrella (external); sessile and without external sensory hairs. These sensory vesicles are present in the genera *Aglauropsis, Gossea, Olindias, Gonionemus, Gonionemoides* and *Vallentinia.*

On this classification the arrangement of the genera would be as follows:

Subfamily **Petachnidae,** Haeckel, 1877.

Petasidae with sensory clubs containing an otolith and with external sensory hairs.

Genus *Petasus.* Species—*P. atavus, P. tetranema.*

Genus *Dipetasus.* Species—*D. digonimus.*

Genus *Petasata.* Species—*P. eucope.*

Genus *?Petachnum.* Species—*P. tiaropsis.*

All the above genera and species were described by Haeckel (1879), and I have not succeeded in finding any notice of their being recorded by any other person.

Subfamily **Olindiadae,** Haeckel, 1877.

Petasidae with sensory vesicles situated either in the substance of the umbrella (internal), or on the margin of the umbrella (external); sessile, and without external sensory hairs.

Genus *Aglauropsis,* F. Müller, 1865.

Generic Character. Petasidae with numerous uniform tentacles, without adhesive disks, and not arranged in groups.

A. agassizii, Müller, 1865. South Atlantic; Brazil.

A. conantii, Browne, 1903. South Atlantic; Falkland Is.

Müller's description of *Aglauropsis agassizii* is very incomplete, in fact, he only gives generic characters. The specific name should either be attached to the next *Aglauropsis* found on the coast of Brazil, or else placed on the obsolete list.

Maeotias inexpectata, Ostroumoff, 1896. Ostroumoff has published a brief preliminary Latin description of this genus and species in the *Zool. Anzeiger,* 1896, and a full description with figures, in the *Bulletin of the Imperial Academy of Sciences of St Petersburg,* 1896. Unfortunately the text of the latter publication is wholly in Russian, and the chief figure is rendered useless by the tentacles being represented merely by a series of closely ruled lines. Ostroumoff points out that the genus differs from *Olindias* in possessing only flexible tentacles, which all hang down from the margin of the umbrella. There are about 300 hollow flexible tentacles, about 100 marginal bulbs, about 200 internal sense organs arranged in pairs, about 13 to 15 centripetal canals in each quadrant, and gonads along nearly the whole length of the radial canals. Distribution. Europe; Sea of Azov. As I am uncertain about the structure of the tentacles I have not included this species in the genus *Aglauropsis,* as it may perchance belong to one of the other genera.

Genus *Gossea,* L. Agassiz, 1862.

Generic Character. Petasidae with uniform tentacles arranged in eight groups (four perradial and four interradial) and a few small isolated tentacles between the groups.

G. corynetes (Gosse), 1853. North Atlantic, British Isles. Syn. *G. circinata,* Haeckel, 1879. North Atlantic; France.

Genus *Olindias* F. Müller, 1861.

Generic Character. Petasidae with numerous tentacles, of which there are two distinct kinds. A series (primary) of short stiff tentacles, which are carried outwards and have their bases attached to the ex-umbrella; and a series (secondary) of long flexible tentacles, which hang downwards from the margin of the umbrella. No adhesive disks on any of the tentacles.

O. sambaquiensis, Müller, 1861. South Atlantic; Brazil.

O. mülleri, Haeckel, 1879. Mediterranean.

O. tenuis (Mayer), 1900. Tropical Atlantic; Florida. Syn. *Halicalyx tenuis*, Mayer (1900, p. 63, Pls. V.—VI.). ? *Halicalyx tenuis*, Fewkes (1882, p. 277, Pl. VII.).

There is a disagreement in the descriptions given by Fewkes and by Mayer of *Halicalyx tenuis*. Fewkes states that the medusa has twelve tentacles, uniform in shape, with a single otolith at the base of each one. Mayer describes his specimens with two distinct kinds of tentacles and a pair of sense organs at the base of each primary tentacle, and also with many centripetal canals, which are not mentioned by Fewkes. Fewkes's specimen cannot be an early stage because the gonads are described and figured, though it may be an intermediate stage in growth. I can understand Fewkes's instituting a new genus for his species, because it does not agree with the generic character of *Olindias*, and at that date the genus *Aglauropsis* was very vaguely described on an incomplete description of a single species. It is just possible that Fewkes's specimen belongs to the genus *Aglauropsis*. Mayer's beautiful figures of *Halicalyx tenuis* show all the characters of an *Olindias*.

Olindias singularis, species nova. (Pl. LVI. fig. 2, Pl. LVII. fig. 1.)

Description. Umbrella hemispherical, with thick walls, about one and a half times as broad as high. Stomach about half as long as the cavity of the umbrella: mouth with four lips having a sinuous margin. Four radial canals: four to five blind centripetal canals in each quadrant. Gonads on the outer half of each radial canal, and separated into isolated papilliform clusters. Two kinds of tentacles; primary tentacles which are carried outwards and have their bases attached to the margin of the ex-umbrella, and secondary tentacles which hang downwards from the margin of the umbrella. About 7—10 primary tentacles and 4—5 secondary tentacles in each quadrant. About 8—10 globular marginal bulbs containing nematocysts in each quadrant. One internal sensory vesicle containing a single otolith at the base of each primary tentacle.

Size. Umbrella 13 mm. in width and 8 mm. in height.

Distribution. Indian Ocean: Maldive Is., Suvadiva (Gardiner).

The collection contains a single specimen in a good state of preservation. It mainly differs from the species hitherto described in possessing only one sense organ at the base of each primary tentacle, instead of a pair of sense organs. The possession of a pair of sense organs has been considered by Haeckel to be a part of the generic character. I think that the position of the sense organs, external or internal, and the number of sense organs had better not be included in the generic characters, but would be of more use for specific characters. Haeckel states that *Olindias mülleri* found in the Mediterranean has, in addition to the internal paired sensory vesicles, a series of club-shaped ocelli situated between the marginal bulbs. I have examined large adult specimens from Naples and have failed to find any ocelli.

In *Olindias singularis* the primary tentacles are curved outwards from the margin of the umbrella. Their bases are partly enclosed by an overgrowth of the ex-umbrella, to which they are attached for a short distance. These tentacles have either oblong or short spiral bands of nematocysts, and at their free end there is a claw-shaped termination, which has its margin closely packed with very long nematocysts. The secondary tentacles are hollow (like the primary ones) and hang down from the margin of the umbrella. They have a large basal bulb and numerous bands of nematocysts, forming about three-quarter circular

loops, but not meeting on the inner side. The marginal bulbs are large hollow balls in direct communication with the circular canal, and are externally covered with nematocysts.

Genus *Gonionemus*, A. Agassiz, 1862.

Generic Character. Petasidae with numerous uniform tentacles, each having an adhesive disk.

G. vertens, A. Agassiz, 1862. North Pacific; British Columbia.

G. suavaensis, Agassiz and Mayer, 1899. Tropical Pacific; Fiji.

G. aphrodite, Mayer, 1894 and 1900. Tropical Atlantic; Florida.

G. agassizii, Murbach and Shearer, 1903. North Pacific; Aleutian Is. and Japan (Kirkpatrick, 1903).

G. murbachii, Mayer, 1901. North Atlantic; Massach. U.S.A.

G. pelagicus, Bigelow, 1904. Indian Ocean; Maldive Is.

Genus *Gonionemoides*, Mayer, 1900.

Generic Character. Petasidae with numerous tentacles, of which there are two distinct kinds. A series (primary) with adhesive disks and another series (secondary) without adhesive disks and with more numerous and larger bands of nematocysts.

G. geophila, Mayer, 1900. Tropical Atlantic; Florida.

Genus *Vallentinia*, Browne, 1902.

Generic Character. Petasidae with two distinct kinds of tentacles. Four solid perradial tentacles with terminal suckers, and many hollow tentacles with bands of nematocysts, but without suckers.

V. falklandica, Browne, 1902. South Atlantic; Falkland Is.

Family **Geryonidae**, Eschscholtz, 1829.

Trachomedusae with four or six radial canals, in the course of which are situated leaf-shaped gonads. Blind centripetal canals. Stomach on a long peduncle. Internal sensory vesicles.

Genus *Liriope*, Lesson, 1843.

Generic Character. Geryonidae with four radial canals and with four or eight tentacles.

Liriope tetraphylla (Chamisso et Eysenhardt), 1820. (Pl. LIV. fig. 3.)

Geryonia tetraphylla, Chamisso et Eysenhardt (1820, p. 357, Pl. XXVII.). *Liriantha tetraphylla*, Haeckel (1879). *Liriope tetraphylla*, Vanhöffen (1902, p. 82, Taf. x.).

There is only one specimen in the collection, and a figure is given of it because I am not certain about the correctness of the identification. *Liriope tetraphylla* has, according to Vanhöffen, a very wide geographical distribution, as it was found by the "Valdivia" in the Atlantic, Indian Ocean, and the Red Sea. The specimens showed a considerable variation in the shape and size of the umbrella, in the length of the peduncle, and in the position and shape of the gonads; all of which have been used by other authors for specific characters.

Description of the specimen. Umbrella hemispherical, very thick, about twice as broad as high. Stomach on a cylindrical peduncle. Gonads rhomboidal, broader than long, on the distal half of the radial canals and extending nearly to the margin of the umbrella. The distance between the gonads about equal to their breadth. Four perradial tentacles. Three centripetal canals in each quadrant. Eight sense organs.

Size. Umbrella 7 mm. in width and 4½ mm. in height. Peduncle 3 mm. in length.

Locality. Indian Ocean; Maldive Is. (Gardiner).

Family **Aglauridae**, L. Agassiz, 1862.

Trachomedusae with eight radial canals, in the course of which are situated eight gonads. Stomach on a peduncle. Numerous uniform tentacles. Sense organs external and free.

Genus *Aglaura*, Péron et Lesueur, 1806.

Generic Character. Aglauridae with gonads situated upon the peduncle of the stomach.

Aglaura hemistoma, Péron et Lesueur, 1809.

Aglaura hemistoma, Gegenbaur (1856, p. 248, Taf. VII.); Haeckel (1879, p. 275, Taf. XVI.); Maas (1893, p. 25, Taf. I.); Mayer (1900, p. 65, Pl. XXV.); Vanhöffen (1902, p. 78).

The collection contains a single small specimen, which is not in very good condition. The shape of the umbrella is very much like that of the figures given by Haeckel and by Mayer.

Description. Umbrella with a short conical summit, about 2½ mm. in length and width. Stomach roundish, on a very short peduncle. Mouth with four lips. Eight sausage-shaped gonads, about 1 mm. in length, situated on the peduncle and adjacent to the stomach. Ova visible. Tentacles estimated at about 64. Sense organs not seen; the margin of the umbrella is damaged.

Distribution. In the warm waters of the Atlantic, Indian Ocean, and the Red Sea.

Amphogona, genus novum.

Generic Character. Aglauridae with gonads situated upon the sub-umbrella. Gonads bisexual. Umbrella much broader than high.

Amphogona apsteini (Vanhöffen), 1902. (Pl. LIV. fig. 5, Pl. LV. fig. 5, Pl. LVI. fig. 1, Pl. LVII. figs. 10—15.)

Pantachogon apsteini, Vanhöffen (1902, p. 65, Taf. x. fig. 18, Taf. xi. fig. 28).

The genus Pantachogon was instituted by Maas (1893) for a species (*P. haeckelii*) found in the North Atlantic. This medusa has a series of spindle-shaped gonads along nearly the whole length of the radial canals. The stomach is not situated upon a peduncle, and the genus belongs to the Trachynemidae. Vanhöffen has slightly altered Maas' original definition of the genus for the inclusion of his new species, *P. apsteini*, found on the west coast of Sumatra. This species has oval gonads near the margin of the umbrella, and the stomach is situated upon a distinct peduncle. It has the characters of the Aglauridae.

The specimens in this collection agree very closely with the description and figures of *Pantachogon apsteini*, and I believe that they belong to that species. According to the classification adopted by Haeckel, and by Maas, the Maldive specimens would belong to the genus *Agliscra*, as the eight gonads are upon the sub-umbrella. But in one respect, however, there is a considerable difference. The shape of the umbrella is unlike that of the Aglauridae, and is more like that of the Trachynemidae. In *Agliscra* the umbrella is about twice as high as broad, whereas in the Maldive specimens the umbrella is about two to three times as broad as high. If one imagined an *Agliscra* with its umbrella flattened out then it would resemble this species. I do not think that the Maldive specimens or Vanhöffen's specimens belong to the genus *Pantachogon* of Maas, as they are not like the type species, *P. haeckelii*. They show a nearer relationship to *Agliscra*. I think it is best to institute a new genus, to which I give the name *Amphogona* (*ἄμφω-γονή*) and place it in the family Aglauridae.

Specific Characters. Umbrella saucer-shaped, with thin walls, about twice to three times as broad as high. Velum fairly broad. Stomach small, situated on a short peduncle. Mouth with four thick lips. Eight radial canals. Eight globular or oval gonads, situated upon the radial canals near the margin of the umbrella; bisexual, male and female gonads upon alternating canals. About 70 or more tentacles, uniform in shape. Sense organs external, ?16.

Size. Umbrella $4\frac{1}{4}$ mm. in width and $1\frac{3}{4}$ mm. in length (the largest specimen).

Distribution. Indian Ocean; West coast of Sumatra (Vanhöffen); Maldive Islands, Miladumadulu (Gardiner).

The collection contains three specimens.

A. An intermediate stage. Umbrella $2\frac{1}{2}$ mm. in width and $1\frac{1}{2}$ mm. in height. Stomach a little longer than the peduncle, which measured 0·25 mm. Gonads just beginning to develop and varying slightly in size. About six tentacles and one sense organ in each octant.

B. An immature adult. Umbrella 4 mm. in width and $1\frac{1}{2}$ mm. in height. Stomach on a peduncle, which measured 0·6 mm. in length. Eight globular gonads, male and female on alternating canals, all about the same size and shape. Tentacles, 57. Sense organs, 10 (six octants with one sense organ and two octants with two sense organs).

C. An adult. Umbrella $4\frac{1}{4}$ mm. in width and $1\frac{3}{4}$ mm. in height. Stomach on a peduncle, which measured about 0·5 mm. in length, and twice as long as the stomach. Eight oval gonads, male and female on alternating canals. Tentacles, 74 (the following numbers in each

octant: 9, 10, 9, 9, 10, 9, 9, 9). Sense organs, 14 (the following numbers in each octant: 1, 1, 2, 2, 3, 1, 2, 2). In this specimen the gonads vary very much in size. Two pairs, male and female, oppositely situated and fully developed, are large; the other two pairs are very small.

Vanhöffen's figures show that the gonads are very unequal in size. Four are large and four are very small, looking as if they were just beginning to develop. The large and small gonads occur on alternating radial canals. Vanhöffen does not state the sex of the gonads, but the largest look immature in his figure. In the smallest Maldive specimen, much younger than Vanhöffen's specimens, the gonads are just beginning to develop. They vary slightly in size, showing that they have not all started to develop at the same time, but the sizes are not arranged in any definite order. In the second specimen the gonads are all about the same size and shape, but not quite fully developed. In the largest specimen there is a well-marked difference in the size of the gonads, which are arranged in pairs, male and female, two large and two small, so that the large and small are not upon alternating canals. The male and female gonads are always upon alternating canals, but in these specimens there is no evidence to show that one sex is in advance of the other, though the gonads are not all of a size.

The occurrence of both male and female gonads upon the same individual is the most interesting character of this species, for, so far as I know, hermaphroditism has not been hitherto recorded for any Craspedote medusa.

Order Narcomedusae.

Family **Aeginidae**, Gegenbaur, 1856.

Genus *Solmundella*, Haeckel, 1879.

Generic Character. Aeginidae with two tentacles and with a stomach having eight pouches.

Solmundella bitentaculata (Quoy et Gaimard) 1833. (Pl. LVI. fig. 3.)

Charybdea bitentaculata, Quoy et Gaimard (1833, Tom. iv. p. 295, Pl. xxv. figs. 4—5). *Aeginella bitentaculata*, Haeckel (1879).

Description. Umbrella somewhat cone-shaped, a little broader than high. Stomach circular, nearly as wide as the umbrella, having lateral pouches about twice as broad as high, containing the gonads. Four radial canals. Two opposite, non-contractile tentacles, which are situated above the stomach and are about three times longer than the diameter of the umbrella. Sixteen sense organs, each with a single otolith.

Size. Umbrella $3\frac{1}{2}$ mm. in width and about 3 mm. in height.

Length of the tentacles about 6—10 mm.

Distribution. Indian Ocean; Maldive Islands, Minikoi (Gardiner, 3 Aug. 1899). Australasian Seas; Amboina Is. (Quoy et Gaimard).

Maas (1904) has just published a preliminary revision of the genera belonging to the Cunanthidae and Aeginidae, but a revision of their species is not given. Maas proposes to unite the genera *Aeginella* and *Solmundella*, and to transfer the latter genus from the Solmaridae to the Aeginidae. This classification I have adopted. (See p. 745.)

SIPHONOPHORA.

Order Calycophorae, Leuckart.

Family **Diphyidae**, Eschscholtz, 1829.

Genus *Diphyes*, Cuvier, 1817.

Generic Characters. Diphyidae with two angular, slenderly pyramidal nectophores, of similar form and subequal size, one placed behind the other. The first nectophore with a conical or campanulate hydroecium. Cormidia without special nectophores. Bracts pyramidal, conical or spathiform, with a pointed apex. Phyllocyst simple, usually large and ovate, without radial canals.

Diphyes chamissonis, Huxley, 1859. (Pl. LIV. fig. 6.)

Diphyes chamissonis, Huxley (1859, p. 36, Pl. I. fig. 3).

There are five anterior nectophores in the collection and as they are more like Huxley's figures of *Diphyes chamissonis* than any other species that I know of, I have placed them under this name.

Description of the Specimens. The nectophore is about 10—12 mm. in length, 4 mm. in width and 3 mm. in depth. It is a long slender pyramid, slightly more curved on the posterior side than on the anterior. The ex-umbrella has three prominent ridges without serrations; one anterior and two lateral which are situated over the nectosac. The posterior side of the ex-umbrella is flat. The shape of nectophore is not exactly like Huxley's figure; as it is not quite so broad and it tapers more towards the apex.

The nectosac is nearly as long as the umbrella, cylindrical and tapering towards its apex almost to a point. The nectocalycine canal runs a considerable distance down the hydroecium and enters the nectosac not far from its mouth. Here it joins a pair of radial canals which run up nearly to the top of the nectosac, then curve over and descend to the circular canal. There is also a short radial canal which runs down from the junction of the nectocalycine canal to the circular canal. The mouth of the nectosac is protected by three short triangular teeth, which have slightly serrated edges.

The hydroecium extends about half way up the umbrella. It is somewhat triangular in shape and has a conspicuous constriction near its mouth. At this point the aperture is nearly circular.

The somatocyst is cylindrical in shape and tapers down towards the hydroecium. One specimen has a small oval somatocyst, but in the other specimens the somatocyst is cylindrical and shows only a slight variation in length and shape. At the top of the somatocyst there is a small yellowish body, irregular in shape, which is probably the remains of an oleocyst.

The siphosome in nearly all the specimens is contracted within the hydroecium, but in one specimen it is more expanded, so that the cormidia are more easily seen. The eudoxomes have a spathiform bract, just like Huxley's figure in shape, a siphon and a contracted tentacle.

Distribution. Pacific Ocean; East coast of Australia, and the Louisiade Archipelago (Huxley). Indian Ocean; Maldive Is. Minikoi (Gardiner, 3rd Aug. 1899).

Genus *Diphyopsis*, Haeckel, 1888.

Generic Characters. Diphyidae with two angular, slenderly pyramidal nectophores of similar form and subequal size, one placed behind the other. First nectophore with a conical or campanulate hydroecium. Each cormidium with a special nectophore. Bracts pyramidal, conical or spathiform, with a pointed apex. Phyllocyst simple, ovate, without radial canals.

Diphyopsis campanulifera (Eschscholtz), 1829.

Diphyes campanulifera, Eschscholtz (1829, p. 137). *Diphyopsis compressa*, Haeckel (1888, p. 153, Pl. XXXIII.). *Diphyopsis campanulifera*, Chun (1897, p. 26). *Diphyopsis campanulifera*, Mayer (1900, p. 75, Pl. XXVIII.).

Sexual generation. *Ersaea lessonii* (Huxley), 1859. *Eudoxia lessonii*, Huxley (1859, p. 57, Pl. III.). *Ersaea compressa*, Haeckel (1888, p. 123, Pl. XXXIV.).

There are about a dozen specimens in the collection and all have the anterior and posterior nectophores isolated.

The shape of the anterior nectophore is like the figure given by Mayer. The teeth round the mouth of the nectosac have nearly a smooth edge, with just a few fine denticulations near the apex. The largest nectophore measured 13 mm. in length. A few of the specimens have the siphosome well expanded and the cormidia are clearly shown.

The largest posterior nectophore measured 17 mm. in length, 7 mm. in breadth and 5 mm. in thickness. The teeth of the nectosac are smooth.

A few specimens of the Eudoxia stage were found. One resembles Huxley's figure of *Eudoxia lessonii*.

Distribution. Atlantic Ocean; Tropical and subtropical regions. Australasian Seas; Amboina Is. (Bedot). Indian Ocean; Minikoi (Gardiner, 3rd Aug. 1899).

Genus *Abyla*, Quoy et Gaimard, 1827.

Abyla trigona, Quoy et Gaimard, 1827.

Abyla carina, Haeckel (1888, p. 156, Pl. XXXV.). *Abyla trigona*, Chun (1897, p. 31).

There is a single anterior nectophore resembling very closely Haeckel's figure (Haeckel, Pl. XXXV. fig. 5). It differs only in having a slightly flatter apex and the lateral wings project a little further out. The positions of the nectosac, the somatocyst, and the hydroecium correspond exactly to the position of these organs in Haeckel's figure of *Abyla carina*. The posterior nectophore was not found.

Distribution. Atlantic Ocean, Tropical and subtropical regions. Indian Ocean; Maldive Is. Miladumadulu (Gardiner).

Order Physophorae, Eschscholtz, 1829.

Family **Agalmidae.**

Genus *Agalmopsis*, Sars, 1846.

There is only one specimen. It is badly contracted and has lost all the nectophores and bracts. The tricornuate tentilla are large. I have not been able to identify the species. Bedot has found *Agalmopsis sarsi* off the Amboina Islands.

Family **Physalidae,** Brandt, 1835.

Physalia utriculus, Eschscholtz, 1829.

Physalia utriculus, Huxley (1859, p. 101, Pl. X., Pl. XII. fig. 12).

About two dozen specimens in the collection. The float of the smallest specimen is about 4 mm. in length and 2 mm. in depth. It has one tentacle and a few siphons and palpons. A specimen with a float measuring 8 mm. in length and 4 mm. in depth has a crest on the top of the float and a few internal transverse septa; one main tentacle and one secondary tentacle much smaller in size; several siphons and palpons; and the gonophores just beginning to develop. The largest specimens are about 20—25 mm. in length and 15—20 mm. in depth and have one main tentacle and several secondary tentacles. Numerous siphons and palpons. The gonophores are fairly well advanced in development. These large specimens resemble Huxley's figure of *Physalia utriculus*.

Distribution. Tropical and Pacific and Indian Oceans (Huxley). Maldive Is., Minikoi. Laccadive Is. (Gardiner).

Family **Velellidae,** Eschscholtz, 1829.

Genus *Velella*, Lamarck, 1819.

The collection contains a single small specimen about 13 mm. in length having a triangular sail about 7 mm. in height. The tentacles are arranged in a single row round the margin of the umbrella. The gonophores are beginning to develop on the gonostyles. The specimen from its size and the appearance of the gonophores is an intermediate stage. Until the Velellidae have been revised it is impossible to identify an intermediate stage.

University College, London, 22nd April, 1904.

A paper by H. B. Bigelow on "Medusae from the Maldive Islands," published in the *Bulletin of the Museum of Comparative Zoology at Harvard College* (Vol. xxxix. No. 9, April, 1904) arrived in London whilst I was revising the proofs of my paper. The author, along with Prof. A. Agassiz, visited the Maldive Islands during the months of December, 1901 and January, 1902. Special attention was given to the Medusae and the drawings of the species were made from life. The list of Hydromedusae contains 22 species, eleven of which are described and figured as new species. Not one of the species, which I have described as new, was taken during this expedition.

I have also just received from the *Concilium Bibliographicum* at Zurich the title of the following paper, "The Craspedote Medusa *Olindias* and some of its Natural Allies," 1903, in *The Mark Anniversary Volume*, pp. 1—22, 3 pls. I have been unable to find a copy of this book in the Scientific Libraries in London.

Whilst my manuscript was in the hands of the printer I examined about 40 specimens of *Solmundella bitentaculata* taken by Prof. Herdman at Ceylon. These specimens show that the shape of the umbrella is variable. One of them has the top of the umbrella very much like the original figure of the species given by Quoy and Gaimard. In the largest specimens there are three sense organs in each octant, but the smaller ones have only two sense organs in each octant. I consider the Maldive specimens to be an intermediate stage in development. Bigelow found *Aeginella dissonema*, Haeckel, at the Maldives, and as this species is widely distributed, it is probably identical with *Solmundella bitentaculata*. Maas (1904) has pointed out that *Aeginella* is the name of a Crustacean genus and that it cannot be used for a medusa.

24*th May*, 1904.

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DESCRIPTION OF THE PLATES.

Reference Letters.

CC. = Circular canal.	*St.* = Stomach.
G. = Gonads.	*S.* = Sense organ.
Or. = Oral lips.	*T.* = Tentacle.
N. = Nematocysts.	*U.* = Umbrella.
P. = Excretory pore.	*V.* = Velum.
R. = Radial canals.	*X.* = Ex-Umbrella.

All the figures were made from specimens in formalin.

PLATE LIV.

FIG. 1. *Proboscidactyla varians* sp. n. Oral view. × 25. (p. 728.)

FIG. 2. Lateral view of a tentacle of *Proboscidactyla varians*.

Fig. 3. *Liriope tetraphylla* (Chamisso et Eysenhardt). × 10. (p. 738.)

Fig. 4. *Phialidium tenue* sp. n. Oral view. × 5. (p. 730.)

Fig. 5. Lateral view of the peduncle, stomach and mouth of *Amphogona apsteini*. × 65. (p. 739.)

Fig. 6. *Diphyes chamissonis*, Huxley. × 5. (p. 743.)

PLATE LV.

Fig. 1. *Pseudoclytia yardineri* sp. n. Male. Oral view. × 40. (p. 731.)

Fig. 2. *Pseudoclytia yardineri* sp. n. Female. Oral view. × 40. (p. 731.)

Fig. 3. Optical section of the group of bulbs on the margin of the umbrella of *Pseudoclytia*. × 55.

Fig. 4. *Mesonema pensile* (Modeer). × $1\frac{1}{2}$. (p. 733.)

Fig. 5. *Amphogona apsteini* (Vanhöffen). Oral view. × 18. (p. 739.)

PLATE LVI.

Fig. 1. *Amphogona apsteini* (Vanhöffen). Lateral view. × 21. (p. 739.)

Fig. 2. *Olindias singularis* sp. n. Lateral view. × 5. (p. 737.)

Fig. 3. *Solmundella bitentaculata* (Quoy et Gaimard). × 15. (p. 741.)

Figs. 4—12. *Aequorea maldivensis* sp. n. (p. 732.)

Fig. 4. The bulbs on the margin of the umbrella. Outer view. × 8.

Fig. 5. A portion of the margin of the mouth showing the lips. × $3\frac{1}{2}$.

Fig. 6. A portion of the sub-umbrella and stomach, oral view, showing the oral lips, the lower wall of the stomach, the gonads (male), and the marginal organs. × 3.

Fig. 7. Radial canals and the gonads (female). × 3.

Fig. 8. The oral lips. Outer view. × 10.

Fig. 9. The oral lips. Inner view. × 10.

Fig. 10. A tentacle, showing the outer view of the basal bulb. × 10.

Fig. 11. A tentacle, showing the inner view of the basal bulb. × 10.

Fig. 12. A tentacle, showing the lateral view of the basal bulb. × 10.

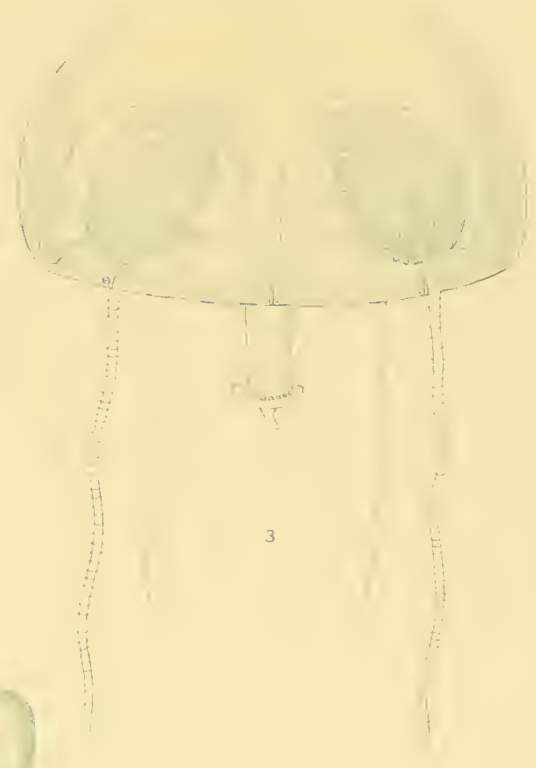
PLATE LVII.

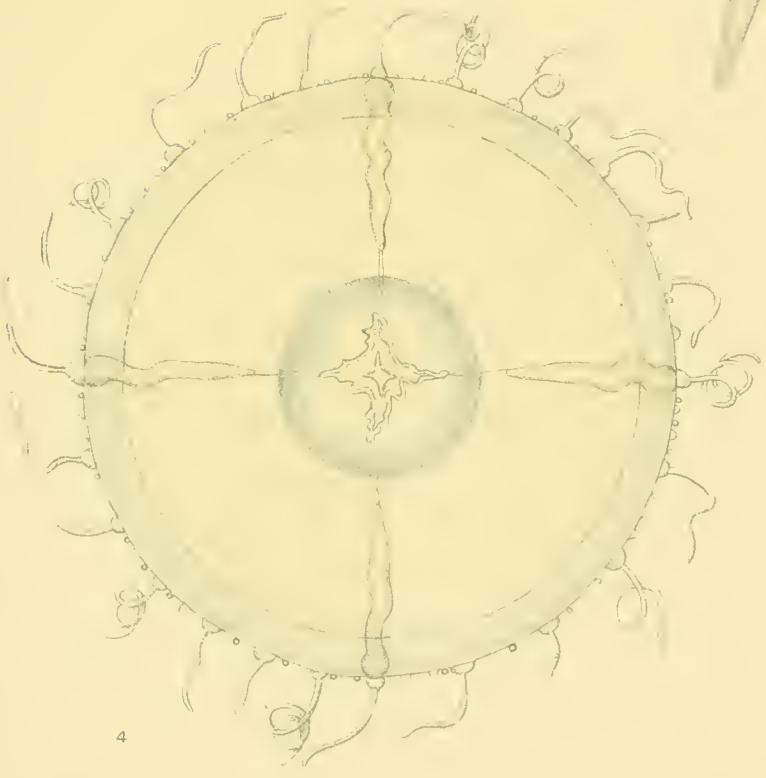
Fig. 1. The tentacles of *Olindias singularis*, the marginal bulbs, and sense organs. Outer view.

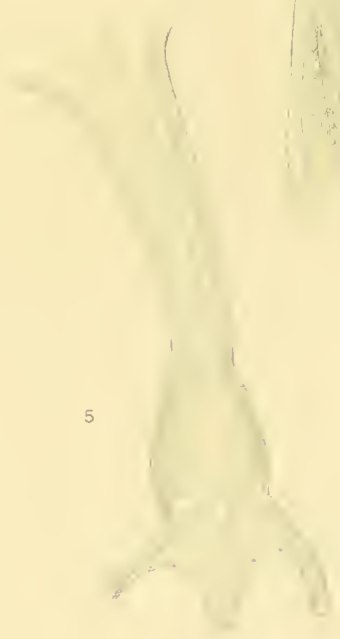
Figs. 2—9. *Mesonema pensile* (Modeer). (p. 733.)

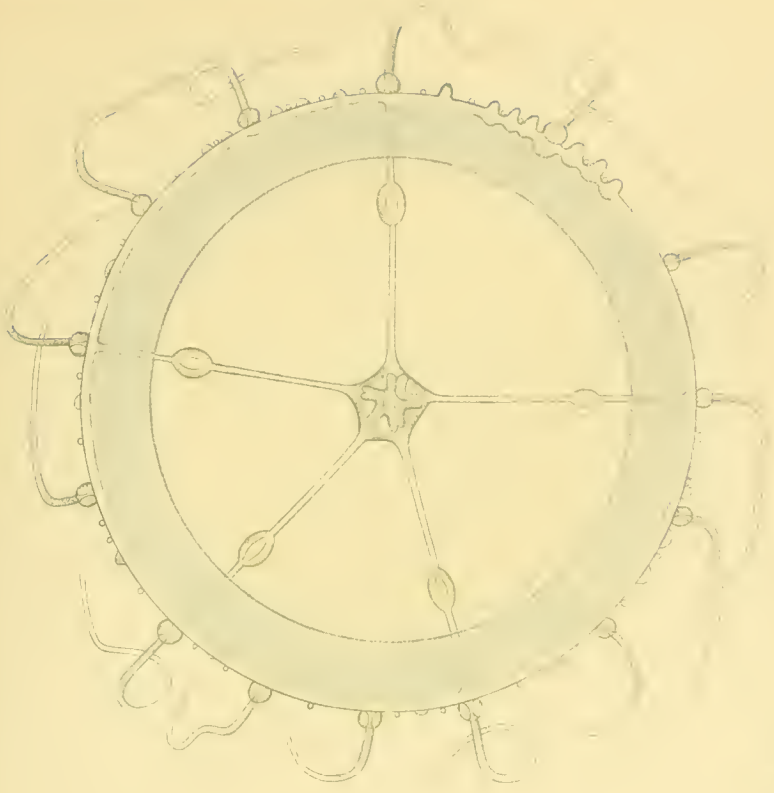
Fig. 2. Diagram showing a transverse section of the umbrella. Nat. size.

Fig. 3. A portion of the sub-umbrella and stomach, oral view, showing the oral lips, the lower rudimentary wall of the stomach, the gonads (male), and the marginal organs. × 3.









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