HYDROMEDUSAE, SIPHONOPHORES, AND CTENOPHORES OF THE "ALBATROSS" PHILIPPINE EXPEDITION.

By Henry B. Bigelow,
Of the Museum of Comparative Zoology, Cambridge, Massachusetts.

INTRODUCTION.

The medusae, siphonophores, and ctenophores described in the following pages were collected among the Philippines by the United States Fisheries steamer *Albatross* during 1907–1910. The material submitted to me consisted in part of specimens picked out on the spot and separately preserved, in part of a very large amount of unsorted plankton. The former were uniformly in good condition, but such medusae as I was able to separate from the mass of crustaceans, sagittae, salpae, pteropods, etc., were all damaged, many of them past recognition. For this reason and because time has allowed only a superficial examination of the unsorted plankton, it is by no means certain that the list includes all species which were taken. The labels give no information as to the depths of capture of any of the specimens; these have been obtained from the published data of the expedition.[1]

As points of special interest I may point out the discovery of a new *Protiara* (1912, p. 253), a new representative of Haeckel's genus *Zygocanna* (1912, p. 255), a genus not recorded since 1879; and a new genus of Petasidae of unusual morphological interest (1912, p. 258). The collection as a whole affords the opportunity for a discussion of the geographic affinities of the medusa-fauna of the Malay-Philippine region.

[1] Dredging and Hydrographic records of the U. S. Fisheries steamer *Albatross* during the Philippine Expedition, 1907–1910, U. S. Bureau of Fisheries, document 741, 1910.

DESCRIPTIONS OF GENERA AND SPECIES.

Class HYDROMEDUSAE.

Order ANTHOMEDUSAE.

Family BOUGAINVILLEIDAE Gegenbaur, 1856.

Genus BOUGAINVILLEA, Lesson, 1843.

BOUGAINVILLEA FULVA Agassiz and Mayer.

Bougainvillea fulva Agassiz and Mayer, 1899, p. 162, pl. 2, fig. 6. Synonymy, Mayer, 1910, pp. 160, 492.

Bougainvillea fulva—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40418	U.S.N.M	1	5129	Sulu Sea, off western Mindanao	12
1617	M.C.Z	1	5129	do	6
40419	U.S.N.M	1	5224	Between Marinduque and Luzon	9
29298	U.S.N.M	1	5451	Off east coast of Luzon	15
40420	U.S.N.M	2	5456	do	8,11
1670	M.C.Z	2	5456	do	6, 8
29299	U.S.N.M	2	5500	Off northern Mindanao	7,14
3051	M.C.Z	1	5500	do	7
29297	U.S.N.M	1	5649	Buton Strait	7

This species has been studied so fully by previous students that a detailed account is unnecessary here. The most advanced stage yet observed is described by Maas (1905, 1906); slightly younger specimens by me (1909*a*). The account by Hartlaub (1909), and his comparison between *fulva* and the various Atlantic Bougainvilleas, is especially noteworthy. I need merely note that the present series contains two color phases, otherwise indistinguishable, one with manubrium yellowish, the other with a brown stripe in each interradius. The difference is not a sexual one, because both males and females were found in each phase. Perhaps it is evidence of differences in nutrition.

The range of *B. fulva* extends over the whole breadth of the tropical Indo-Pacific from the coast of Mexico in the east (Bigelow, 1909*a*) to the Gulf of Aden on the west (Djibuti, Hartlaub 1909).

Family PANDEIDAE, Haeckel, 1879 (sens. em.). TIARIDAE, Hartlaub, 1913.

Genus PROTIARA, Haeckel, 1879.

As I have previously pointed out (1913, p. 12) "Tiaridae" can not be used as the name of a medusan family, *Tiara* being preoccupied for a mollusk. *Protiara* was defined by Haeckel as having gonads in the form of single longitudinal swellings, and it is so limited by

Hartlaub (1913), whom I follow here, though Mayer (1910) has expanded it to include forms with solid marginal cirri as well as tentacles, as *Halitiara formosa* Fewkes. The descriptions of the various species which have been credited by different authors (Haeckel 1879, Mayer 1910, Hargitt 1905) to this genus are so insufficient that it is not worth while to add anything here to the discussion of them given by Hartlaub (1913, p. 251). As he points out, some of them are really Sarsiids, only two, *tetranema* (Péron and Lesueur) Haeckel, and *haeckeli* Hargitt, being undoubted Pandiids. That *Halitiara formosa* is likewise a true Pandiid is proved not only by its general structure, but by cross sections of its gonads which I have myself examined. But in this species there are solid cirri on the bell margin, as well as the four tentacles, and it therefore deserves a separate genus.

PROTIARA TROPICA Bigelow.

Plate 39, figs. 1–4.

Protiara tropica Bigelow, 1912, p. 253.

Protiara tropica—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29380.....	U.S.N.M.......	1	5,500	Off northern Mindanao...	9 by 9 high.

I have already (1912) described this specimen in such detail that I need merely call attention to the figure showing the interradial gonads in transverse section (pl. 39, fig. 2), the location of these organs being the reason for classing the specimen as a pandiid rather than a sarsiid.

Genus LEUCKARTIARA Hartlaub 1913.

Tiara[1] Lesson, 1843 (part).
Turris[1] Mayer, 1910 (part).
Clavula Mayer, 1910 (part).

Hartlaub's recent (1913) discussion of this genus leaves little to add—I follow him in referring to it all Pandiids with eight or more tentacles, in one series, with "mesenteries" and with gonads primarily horseshoe-shaped, their concavities directed distally, their arms transversely folded. The chief distinction between *Leuckartiara*, *Neoturris*, and *Pandea* is the structure of the gonads (1909*a*, Hartlaub, 1913). I may refer the reader to Hartlaub's discussion of the complicated synonymy, only pointing out that he is undoubtedly correct in using the species name *octona* Fleming for the medusa which most authors have called "*Tiara pileata*," the *Medusa pileata* of Forksål being a *Neoturris* (p. 284).

[1] Preoccupied for a mollusk.

LEUCKARTIARA OCTONA (Fleming) Hartlaub.

Plate 39, figs. 5, 6.

Geryonia octona FLEMING, 1823, p. 299. Synonymy, Hartlaub 1913, p. 285.

Leuckartiara octona—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29303	U.S.N.M	5	5,195	Off northern Cebu	4–6 hgh.
1672	M. C. Z.	2	5,129		Do.
29304	U.S.N.M	1	5,649	Buton Strait	6 high.

I formerly (1909*a*) believed that the Pacific *Leuckartiara* described by Maas (1909) and by me (1909*a*) as *Tiara papua* Lesson, but probably incorrectly, as Hartlaub (1913, p. 334) points out,[1] could be distinguished from the Atlantic *L. octona* by the presence of fewer tentacles. But Vanhöffen has recently (1912) recorded Pacific specimens of the characteristic "*octona*" type; hence it can no longer be maintained that the final number of tentacles is always smaller in the Pacific than in the Atlantic form. But most of the Pacific specimens recently recorded have only eight or fewer tentacles, irrespective of size, as shown in the following table:

Authority.	Locality.	Size.	Large tentacles.	Gonads.	Small tentacles and bulbs.
Maas, 3 specimens	Malay Archipelago	(?)	8	Large present.	8.
Agassiz & Mayer	600 miles north of the Marquesas.	5 mm. high	8	Present	8 small, +16 bulbs.
Bigelow	East Pacific	5 diam	8	Small	8 bulbs.
Do	do	7 high	9	Present	11 bulbs.
Do	do	6 high	9	do	8 bulbs and small tentacles.
Do	do	3 high	4	None	4 bulbs.
Maas	Japan	15 high	8	Large	8 small.
Do	do	15 high	8	do	8 small.

The present collection gives the following data:

Locality.	Size (mm.).	Large tentacles.	Gonads.	Small tentacles and bulbs.
Philippines	6 high	4	Present	4 small and 8 knobs.
do	6 high	8	Present, large.	8 knobs.
do	6 high	8	Present	8 knobs.
do	5 high	4	do	3 small and 8 knobs.
do	4 high	2	do	6 small and 7 knobs.
do	4 high	2	do	6 small and 7 knobs.
do	5 high	4	do	4 small and 8 knobs.
do	5 high	8	do	9 knobs.

[1] Hartlaub, 1913, p. 334, shows that the *Turris papua* of Lesson and of Eydoux and Souleyet is a *Neoturris*.

The bases of the tentacles are laterally flattened, and on the outer surface there is a more or less pronounced spur clasping the exumbrella (pl. 39, fig. 6). This character, however, varies both individually and with contraction. It is not shown in Maas's figure of his Japanese specimens, nor was it noticeable in either the *Siboga* or the *Albatross* eastern Pacific series. There is usually but not always an abaxial ocellus on the base of each tentacle, and of each marginal bulb. But this is not an invariable rule, for an ocellus may be lacking, or there may be two in conjunction with a single tentacle. Thus in one specimen 7 of the 8 large tentacles and 7 of the 9 knobs have 1 ocellus, while 2 knobs have 2 ocelli each; in another, the 8 tentacles and 3 of the 7 knobs have 1 ocellus, while 4 knobs have 2 ocelli each; in a third 5 tentacles have 1 ocellus; 1 has a diffused pigment spot and 2 have no ocelli, and of the 8 knobs 4 have one and 4 have 2 ocelli each.

The gonads are of the characteristic type, as a comparison of the photograph (pl. 39, fig. 5) with any of the numerous figures of *L. octona* (Maas 1904*b*, pl. 1, fig. 9; Hartlaub, 1913) will show. The edges of the radial canals are irregularly fluted, especially in the distal one-third of their course (pl. 39, fig. 6); but the lobing varies from canal to canal, or even on opposite sides of any given canal. Some canals hardly show it at all. It is not present in young specimens, and first appears as a jagged outline (Bigelow 1909*a*). It is never as pronounced here as in *Catablema* or in *Neoturris.*

Color.—In the preserved specimens the gonads and lips are violet or purple; the tentacles opaque and yellowish, their bases brownish yellow. The ocelli are dark brown. In the large Japanese examples described by Maas (1909, pl. 1, fig. 3) the colors are similar. *L. octona* is very generally distributed over the warmer parts of the Indo-Pacific region, but is not yet known from the northwest Pacific north of Japan.

Genus NEOTURRIS Hartlaub, 1913.

Neoturris Hartlaub, 1913.
Tiara Lesson, 1837 (part).
Turris Lesson, 1837 (part).
Clavula Bigelow, 1909*a*.—Mayer, 1910 (part).

The discovery by Browne (1910) and Hartlaub (1913) that the *Turris neglecta* of Forbes (of which *Clavula* is probably the hydroid) is not a Pandiid forbids the use of *Clavula* as the name for the present genus.

Neoturris is undoubtedly very closely allied to *Leuckartiara;* indeed, it has often been united with it, as, for instance, by Vanhöffen (1912). But as previously pointed out (1909*a*), I agree with

Hartlaub (1892, 1913) that the gonads are sufficiently different to separate it. In *Leuckartiara* these are fundamentally horseshoe shaped; the arms, it is true, are transversely folded, but the folds are permanently connected next the interradius. In *Neoturris*, on the contrary, the vertical series of transverse gonad folds are not connected with one another at the inner (interradial) ends, while the interradial surface of the manubrium is occupied by an irregular network of sexual thickenings. The figures by Maas (1904*b*) and Hartlaub (1913) show the two gonad types very clearly. (For further discussion see Hartlaub, 1913, p. 325.)

So far three species of *Neoturris* have been recorded from the Indo Pacific—the *Turris papua* of Lesson (if it be actually a *Neoturris*), *T. pelagica* Agassiz and Mayer, and *T. fontata* Bigelow [*Turris brevicornis* Murbach and Shearer (1903) is probably a *Leuckartiara*, as Hartlaub, 1913, p. 335, points out].

There is nothing in the original account and rather diagrammatic figure of *pelagica* (Agassiz and Mayer, 1902) to separate it from the Atlantic *N. pileata*. And two specimens in the present collection also agree with *N. pileata* in general form, structure of the gonads and tentacles, degree of lobation of radial canals, and absence of ocelli, though they have more tentacles than have ever been recorded for the Atlantic form. But the number of tentacles is so variable (Hartlaub, 1913) and the discontinuity between the two forms so small (up to 90 for Atlantic, 100–120 for Phillipine specimens) that it does not justify separating the Pacific form specifically. And the Philippine specimens are apparently only an older stage of *pelagica* Agassiz and Mayer; at least, the only important difference—larger size and greater number of tentacles—can be readily explained as concomitants of growth. In short, it appears that in *Neoturris*, as in *Leuckartiara*, one species ranges over both the Atlantic and the Pacific. And comparison of the accompanying photographs (pl. 39, figs. 7–8) with Hartlaub's (1913) figures will show how closely specimens from the two oceans agree in all essential features.

It is possible that the *Turris papua* of Eydoux and Souleyet (1841) also belongs to this compound form, for its gonads are clearly of the *Neoturris* type. But it differs from *pileata* in having very few tentacles (10–11), and this is also true of Lesson's (1830) *Aequorea mitra*, later called by him *Turris papua*.

N. fontata is distinguished from all other members of the genus by the presence of ocelli, of exumbral sense pits, and of tentacular ostia, together with a small number (20±) of tentacles, and of many permanently rudimentary tentacular knobs.

NEOTURRIS PILEATA (Forskål) Hartlaub.

Plate 39, figs. 7, 8; plate 40, fig. 1.

Medusa pileata Forskål 1775, p. 110.
Neoturris pileata Hartlaub, 1913, p. 326. To the synonymy given by Hartlaub, 1913, p. 326, add *Turris pelagica;* Agassiz and Mayer, 1902, p. 142, pl. 1, fig. 2.—Mayer, 1910, p. 127.

Neoturris pileata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29305.....	U.S.N.M.......	1	5127	Sulu Sea, vicinity southern Panay.	17; about 120 tentacles.
40421.....	.....do..........	1	5129	Sulu Sea, off western Mindanao.	14 by 21 high; about 92 tentacles.

Both the examples are in good condition, though somewhat contracted. But in each a small portion of the margin is so damaged that it is impossible to determine the total number of tentacles within two or three. The specimens are described here in detail, as no account of adult Pacific examples has appeared.

The tentacles seem at first sight to be arranged in two alternating rows, an inner and an outer. But this appearance is merely superficial, for all the tentacles arise at the same level, close to the circular canal, and the apparent outer row is merely the older tentacles, whose bases are broader and reach outward farther than those of the younger ones. A side view of the margin (pl. 39, fig. 8) shows the actual relation of the tentacles of different ages more clearly than a verbal description. The tentacle bases are laterally flattened and triangular. There are openings on the outer face of several of the bulbs near the base, but these are apparently accidental mutilations, not true ostia such as occur in *N. fontata.*

In the smaller specimen there are six rudimentary knobs, but there are none in the larger. Evidently, then, the number of tentacles present is nearly, if not quite, the final one. There are no ocelli; nor are ectodermal sensory pits, so important a feature of *N. fontata*, present. But there is a shallow furrow in the exumbrella just above the base of each of the larger tentacles. I was not able to study the histology of the ectoderm in this region because of the condition of the specimens.

Manubrium and gonads.—The manubrium occupies but little more than one-half the depth of the bell cavity; the lips are thrown into numerous small complex folds (pl. 39, fig. 7).

The gonads (pl. 39, fig. 7), which closely resemble the figures of *N. pileata* given by Maas (1905, pl. 1, fig. 5) and Hartlaub (1913), are entirely discontinuous in the perradii, but connected in the upper half of the interradii by an irregular network.

Canals.—The margins of the radial canals are lobed in their mid-region, but their outer ends and the circular canal are smooth.

Color.—In the preserved specimens the tentacles, manubrium, and gonads are pale yellow.

Family BYTHOTIARIDAE Maas, 1905. Sens. em. Bigelow (1909*a*, 1918), Maas (1910).

Tribe *Bythotiaridi* (part) + Tribe *Calycopsidi* MAYER, 1910. "Gruppe" *Calycopsiden* HARTLAUB, 1913.

Hartlaub (1913, p. 349) substitutes the name "Calycopsiden" for "Bythotiaridae," both because the former is derived from the oldest and largest genus, and because he finds the latter "unbequem." But neither of these reasons seems to me to justify abandoning a generally accepted family name.

Maas (1910) has recently given us so satisfactory a discussion of this family that I need add little here beyond the statement that I am still in thorough accord with his union of *Bythotiara*, *Heterotiara*, *Sibogita*, and *Calycopsis* in a single family, distinct on the one hand from the Williadae, on the other from the Pandeidae. Mayer (1910), on the contrary, has referred *Bythotiara* and *Sibogita* to the Williadae, *Heterotiara* to the Pandeidae ("Tiarinae"). Vanhöffen (1911), who has examined more specimens of the three genera than any other student, has classed them all among the Pandeidae ("Tiaridae"), but without any discussion of their relationships. And Hartlaub (1913) in his recent revision of the Pandeidae ["Tiaridae"] classes them as "Gruppe Calycopsiden" of that family. But although, as I have previously pointed out (1909*a*, p. 213), "the closest relationship of the Bythotiaridae is undoubtedly with the Tiaridae [Pandeidae]," they are so easily distinguishable from the members of that family by the greater development of the manubrium, which, as in most Leptomedusae, is distinguishable into basal, gastric, and oral regions; by the structure of the gonads, which are permanently interradial instead of having this primitive location masked with growth as is the case in most Pandeidae; by the structure of the bell margin and by the fact that the tentacles have no distinct bulbs; and they are so uniform, among themselves in these respects, that I still believe they are best grouped in a separate family. But here, as so often among Medusae, it is perhaps impossible to draw a hard and fast line; for, as Hartlaub (1913) points out, the genus *Meator*, recently described by me from the northwest Pacific (1913) has some characters in common with the Pandeids, some with the Bythotiarids.

A feature of special importance emphasized by Maas is the absence of any swelling at the base of the tentacles.

Niobia is included by Mayer in his "tribe Bythotiaridi," but its swollen tentacle bases argue against this view. Maas (1910, p. 7) suspects that it is a Leptomedusa.

Genus HETEROTIARA Maas 1905.

The genus was proposed by Maas (1905) for two immature specimens named by him *H. anonyma.* It has since been recorded by me (1909*a*) for two more examples of *anonyma* from the eastern Pacific, for large series of that species from the northwest Pacific (1913) and from the Western Atlantic (1918), and by Vanhöffen (1911) for one *anonyma* and four specimens of a new species, *minor*, from the "Valdivia" collection. The present collection contains eight examples of *minor*, which are in such good condition that they allow me to amplify the original account of that species somewhat.

Vanhöffen (1911) has questioned whether the eastern Pacific specimens which I referred to *anonyma* really belonged to that species, on the ground that his examples, as well as those of the *Siboga*, 19 mm. high, had only eight tentacles and no sign of others in process of formation, whereas mine, only slightly larger (22 mm.) had eleven or twelve. But the northwest Pacific specimens (1913, p. 26) showed that the number of tentacles varies (7–10) independent of size (13–21 mm. high), besides varying in number from quadrant to quadrant of the bell margin. Hence, as I have pointed out (1913), there is no real separation between the eastern Pacific and the other recorded specimens of *anonyma.* And this same conclusion has been reached by Hartlaub (1913, p. 351).

H. minor is distinguished from *H. anonyma* by its small size and by having about twice as many tentacles. Data are now available from enough specimens to establish the constancy of the difference, and consequently the validity of Vanhöffen's species. It is possible that the *Tiara prismatica* of Maas (1893) belongs to one or other of these two species. But in the absence of any figure of the entire Medusa, this must remain doubtful (Hartlaub, 1913, p. 349).

HETEROTIARA MINOR Vanhöffen.

Plate 39, fig. 9; plate 40, figs. 2–4.

Heterotiara minor VANHÖFFEN, 1911, p. 212, figs. 8*a*, 8*b*.

Heterotiara minor—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40422	U.S.N.M.	1	5224	Between Marinduque and Luzon	8
1676	M.C.Z.	1	5224	do	6
29351	U.S.N.M.	2	5320	China Sea, vicinity Hongkong	8,9
29350	U.S.N.M.	3	5456	Off east coast of Luzon	7
1667	M.C.Z.	1	5456	do	7

The general structure of the genus is now so well known that all that is needed here is a discussion of characters which may be expected to be of specific importance. The series, arranged according to size, gives the following data:

Locality (station).	Diameter (mm.).	Height (mm.).	Interradial tentacles per quadrant.	Total tentacles.
5224	6	6	4-3-4-3	18
5456	7	7	3-3-3-3	16
5456	7	7	3-4-3-3	17
5320	8	9	5-3-4-4	20
5224	8	10	4-4-4-4	20
5320	9	11	6-3-4-5	22
5456	(1)	(1)	3-3-4-3	17

[1] Too crumpled to measure.

Vanhöffen (1911) has recorded the following data for the *Valdivia* specimens:

Locality (station).	Diameter.	Height.	Interradial tentacles per quadrant.	Total tentacles.
Near Nias Island	6	6	4-2-3-3	12
Do	7	7	4-2-3-3	12
Between New Amsterdam and Cocos Islands	11	10	6 tentacles per quadrant.	24
Do	12	12	do	24

If we consider the specimens not only as individuals, but quadrant by quadrant, we shall obtain a fairly complete survey, because 3 of the *Albatross* series are sexually mature. The number of tentacles increases somewhat irregularly with growth, six interradials being the observed maximum. If this number were present in all four quadrants of any one individual the total would be 28, radial and interradial. But since this number is not reached in either of the large *Valdivia* specimens, it is doubtful whether it is normally attained. Only in three quadrants did I find young tentacles—one in each. And these, as it happened, were not in the smaller, but in the two largest individuals. All the large tentacles, as noted by Vanhöffen (1911) end in oval terminal nematocyst swellings.

Manubrium and gonads.—The gonads are purely interradial. In the smaller specimens the manubrium is very short; in the two largest, which are apparently mature, it is one-third as long as the bell cavity. One is a female, with large eggs, which drop from the sexual masses at a touch. In one specimen the manubrium is torn off; in another, 7 by 7 mm., there are no gonads; in all the others its walls are thrown into transverse folds (pl. 40, fig. 4). These, however, are not definite plications, such as are seen in *Calycopsis*, but are so irregular and vary so in number on different sides of a given manubrium that it is a question whether they are anything but evidence of contraction of the manubrium as a whole. The fact that the perradii, as well as the interradii, are more or less folded, though there is no sexual tissue there, is evidence in this direction.

In at least one adult specimen of *anonyma* (Bigelow, 1909*a*) the walls of the manubrium were smooth; but in others which I have examined it was more or less folded (1913, p. 26).

In two of the smaller specimens the manubrium is sunken into the gelatinous substance (pl. 40, figs. 2, 3) in the peculiar manner already described by Vanhöffen. But this is merely an evidence of a remarkable contraction of the upper part of the bell cavity. There is no longitudinal connection in these cases between the manubrium and the subumbrella or radial canals.

In the third small example, as in all the larger ones, the manubrium hangs in its usual position in the bell cavity. It would be interesting to study this peculiar contraction phase on living material. At any rate, as Vanhöffen (1911) has pointed out, it can have no significance in classification.

There are no centripetal canals in any of the specimens.

Color.—On the preserved specimens the manubrium is pale yellow; otherwise they are colorless. In the *Valdivia* examples the terminal tentacular knobs are red, and the manubrium (in life?) had four interradial dark brown-violet stripes.

The genus *Heterotiara* has previously been taken only in intermediate hauls, but two of the Philippine specimens are from the surface.

Genus CALYCOPSIS Fewkes, 1882.

Sibogita Maas, 1905.

It is no longer an open question whether *Sibogita* can be distinguished generically from *Calycopsis*, separated by Vanhöffen (1911) on the assumption that in the former some of the canals are centrifugal branches from preexisting canals, whereas all the inter- and adradial canals of the latter are centripetal. If this were true, the distinction would be a valid one; but I have recently (1918) described a species bridging the gap, in that some of its centripetal canals join the radial canals, some the manubrium; and there discussed the genus as a whole.

The present collection contains two specimens, one belonging to *C. geometrica*, the other without question specifically identical with the Medusae from the eastern Pacific, which I described under the name *Sibogita simulans*, representing a stage in development intermediate between the extremes which I then recorded. Vanhöffen (1911) has united *simulans* with the Gulf Stream species *typa*. But though the differences between the two are trivial they seem sufficiently constant to distinguish *simulans*, at least as a variety. It is clear that in the *simulans* form many, or all, of the centripetal canals finally unite with the cruciform base of the manubrium, a union taking place in specimens in which only 12 canals (radial and subradial), are developed, as the present example shows. But should new canals be later interpolated in such a way that they alternate more or less regularly with the preexisting ones, the condition observed by Vanhöffen in the *Valdivia* specimen credited by him to *typa* but christened *valdiviae* by Hartlaub (1913)—namely, 24 canals which unite with the stomach and 36 blind ones alternating somewhat irregularly with them—might result. In my Gulf Stream specimens (1909*b*), on the other hand, all the canals were blind even in a specimen with mature ova, 37 mm. high, with 21 canals in all. In Fewkes's type specimen, which I have recently examined (1913, p. 21), every centripetal canal which is well enough preserved to show its termination is blind. Moreover, as I have pointed out (1913), his specimen and all of mine from the Gulf Stream, including two series collected by the *Grampus* (1909*b*, 1915*a*), though taken more than 30 years apart, show the apical depression of the subumbrella which I have described and figured elsewhere (Bigelow 1909*b*). But no such character has been observed in the *simulans* form.

If it were the *Grampus* series alone which showed it, it might well be credited to individual or to swarm variation. But when we find it present in all examples from the Gulf Stream, though taken so many years apart, it is a reasonable conclusion that we have here evidence of a distinct local race. And if this be true, it deserves recognition in nomenclature, at least as a geographic variety.

Large series may show that the centripetal canals in the Atlantic form are not permanently blind, as they now seem to be, and that the apical depression is not of importance. But for the present it is wisest to refer the Philippine specimen to var. *simulans* of *typa*.

CALYCOPSIS GEOMETRICA (Maas) Bigelow.

Plate 40, figs. 5–7; plate 41, fig. 2.

Sibogita geometrical Maas, 1905, p. 17, pl. 3, figs. 16–18.
Calycopsis geometrica Bigelow, 1918, p. 377.

Calycopsis geometrica—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29383	U.S.N.M.	1	5125	Sulu Sea, vicinity southern Panay.	20

Station 5125, off Nogas Island, Sulu Sea, vicinity of southern Panay, 411 fathoms; 1 specimen, 20 mm. in diameter, very well preserved. The height of the specimen is only 12 mm., but it is obviously so much flattened that the measurement represents much less than the normal proportion to the breadth.

Maas has given an excellent account of the general organization of *C. geometrica.* The reasons for hesitancy in identifying this specimen as *geometrica* are the relative numbers and succession of tentacles and canals and, more important, the presence of ocelli at the base of the tentacles.

The relation of the canals to each other and to the stomach, of the same general type as Maas has described it for *geometrica*, is as follows: each of the four primary radial canals, after leaving the stomach, from which it is not sharply defined, gives off "branches" (the word being used in a descriptive, not an ontogenetic sense), alternatively right and left (pl. 40, fig. 5). In the present series the numbers in each of the four groups are 5, 6, 5, 6. All of these, a total of 22 canals, run to the margin. In each group one canal joins the radial trunk so very close to its juncture with the stomach that it might be spoken of as running to the stomach. But as there is no definite morphologic limit to the stomach this point is not a very important one. There are no blind canals, centripetal or centrifugal. At the margin every canal is connected with a tentacle. Of the 22 seventeen are large, evidently fully developed; five, in every case associated with one of the two outer members of a group of canals, are small and spurlike (pl. 41, fig. 2). There are also three small tentacles unconnected with any canals. At the base of every large tentacle, on the outer side, there is a dense group of red pigment granules (pl. 40, fig. 7) or "ocellus."

Manubrium and gonads.—These structures agree very well with Maas's account. The mouth is surrounded by a simple quadrate lip. The gonads are purely interradial; each consists of a double series of about 19 regular transverse folds (pl. 40, fig. 6). These folds are opaque and brownish-yellow in the preserved condition.

On comparing the specimen with Maas's description we find the following differences: in his one specimen there were 32 canals; but though all of these run to the bell margin there were only 16 tentacles. When we compare this with the condition in the Philippine specimen it is difficult to derive either one from the other by assuming progressive development, because the evidence afforded by the margin—that is, the presence of young tentacles without corresponding canals—shows that the order of succession is tentacle-canal, just as it is in *Calycopsis typa* (Bigelow, 1909*b*). On the other hand, the fact that half the canals have no corresponding tentacles in the *Siboga* specimen of *geometrica* showed that in that form the order of succession is first canal, then tentacle.

A second feature of difference is the presence of pigment spots or ocelli in the Philippine specimen. No such structures were observed by Maas in *geometrica*. With future research it may prove that either tentacles or canals may appear first, and that ocelli may be either present or absent; perhaps they were obscured by preservation in the *Siboga* material. The question can not be settled until more specimens are available, and therefore the identity of the present example remains in doubt.

CALYCOPSIS TYPA Fewkes, var. SIMULANS Bigelow.

Plate 40, fig. 8; plate 41, fig. 1.

Sibogita simulans BIGELOW, 1909*a*, p. 213, pl. 5, figs. 4, 5; pl. 41, figs. 8, 9; pl. 43, figs. 1, 2.—MAYER, 1910, p. 187.

Calycopsis typa VANHOFFEN, 1911, p. 214, pl. 22, fig. 6 (not Fewkes).

Calycopsis typa variety *simulans—material examined.*

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29300.....	U.S.N.M.......	1	5125	Sulu Sea, vicinity southern Panay.	16, but obviously much contracted.

The advanced condition of the gonads and canals shows that it is nearer maturity than the small size, after preservation, would suggest.

Canals and tentacles.—There are 12 canals—4 radial, 8 adradial. Of the adradials, one ends blindly, the other seven join the cruciform base of the manubrium (pl. 40, fig. 8). Each of the radial canals and six of the adradials are connected with large tentacles. Two of the adradials, one being the blind one, are connected with small tentacles. Obviously these two canals are the youngest ones. There are likewise eight small tentacles in connection with which no canals have yet been developed. The tips of the large tentacles are all so much damaged that the terminal knobs are entirely lost. In each of the two eastern Pacific specimens there were 8 adradial canals, all blind.

Manubrium and gonads.—The mouth is surrounded by a simple cruciform lip without any trace of marginal folds or crenulations (pl. 41, fig. 1). The gonads (pl. 41, fig. 1) are of the usual type, consisting of double series of regular transverse folds in each interradius, about 15 folds in each, the sexual development occupying nearly the entire length of the manubrium.

Color.—In the preserved condition the gonads are pale brownish-yellow. There are no ocelli.

Order LEPTOMEDUSAE.

Family EUCOPIDAE Gegenbaur, 1856.

Genus PHIALUCIUM Maas 1905.

I formerly defined this genus (proposed by Maas as a subgenus) as "Eucopidae with numerous tentacles and otocysts (number indeterminate), with rudimentary as well as large tentacles; with or without cirri" (1909*a*). Almost simultaneously Torrey (1909) separated forms with cirri and instituted for them his new genus *Phialopsis.* This division has subsequently been adopted by both Mayer (1910) and Vanhöffen (1911) and is followed here.

Tables of the characters of the various described forms which fall in *Phialucium* (*sensu strictu*) have recently been published by them.

These authors agree in recognizing two well-defined species, *carolinae* and *mbengha* (Mayer lists both *mbengha* Agassiz and Mayer, and *virens* Bigelow, but says that they are probably identical), and I myself have maintained the same position (1909*a*). But Vanhöffen separates the two species on quite different grounds from those employed by Mayer or by me, and hence arrives at a different conclusion as to their relative geographic distribution. According to Vanhöffen the two species are separated in the main by the number of tentacles, *mbengha* having comparatively many, *carolinae* few; and a second character is the number of otoliths to the otocyst, the former having 5 to 6, the latter only 2. But if we examine the number of tentacles in the specimens which have been described, as given in Vanhöffen's own table, adding thereto the present specimens, we find that there is no discontinuity, but rather a continuous series. The numbers in natural order of sequence are:

	Tentacles.		Total.	Otocysts.
	Large.	Rudimentary.		
virens Bigelow	16–20	30–40	46–60	32
carolinae Mayer	16	48	64	64
virens, Maas	16	50	66	32
Philippine specimen	20	55	75	38
mbengha Agassiz and Mayer	16	80	96	32
mbengha Vanhöffen	20	80	100	48
Do	15	87	102	(?)

Phialidium tenue Browne was referred by me (1909*a*) *to Phialucium;* Browne (1905), however, believes that it was an abnormal *Irenopsis.*

This table, I think, makes it evident that any division based either on the number of tentacles as a whole, or on either class of tentacular structures taken separately, would be purely arbitrary.

Nor are the relative numerical proportions of the two classes to each other any more significant. With the evidence at his command Vanhöffen had every reason to use the number of otoliths to each otocyst as a systematic character. But facts afforded by the present specimens show that it can not be given so much weight. Thus in the larger Philippine example I have found otocysts with 1, 2, 3, and 4 otoliths, usually two large and the others small; and in the smaller one, instances with 1, 2, and 3. The only character which stands the test of critical examination, as I have previously pointed out, but which Vanhöffen (1911) has not employed at all, is the relation between the number of otocysts and that of tentacular organs, both large and rudimentary. The recorded numbers are as follows:

	Tentacles of both kinds, large and small.	Otocysts.
virens Bigelow	46–60	32
virens Maas	66	32
Philippine specimen	75	38
mbengha Agassiz and Mayer	96	32
mbengha Vanhöffen	100	48
carolinae Mayer	64	64

We have every reason to assume that the numerical conditions in the Atlantic *carolinae* described by Mayer (1910) are fairly constant in the adult, for he has found it very abundant on two occasions at Charleston, South Carolina, and has also taken it at the Tortugas. The table, then, shows that in all the Indo-Pacific specimens, irrespective of locality or of exact stage of development, there are many more tentacular structures than otocysts, often twice as many. On the other hand, in all the Atlantic examples of which we have any account the number of otocysts is as great as that of the tentacular structures. We have here something tangible.

It is, of course, possible that further studies may reveal specimens connecting the two types; but the same possibility is present in the case of every difference which could be used us a specific character. We have no right to assume that this will happen. On the contrary, when we find that all the evidence yet available points to discontinuity of the two forms, and when we find that the Atlantic—that is "*carolinae*" type has never been found in the Indo-Pacific, although the genus has been recorded there from several widely separated localities, there is nothing to do but to make it the basis for specific diagnosis.

PHIALUCIUM MBENGHA (Agassiz and Mayer) Maas.

Mitrocoma mbengha Agassiz and Mayer, 1899, p. 168, pl. 8, figs. 24, 25.
Oceania virens Bigelow, 1904, p. 252, pl. 1, figs. 3, 4.
Phialucium virens Maas, 1905, p. 32, pl. 4, figs. 36, 37; 1906, p. 93.—Bigelow, 1909*a*, p. 157.—Mayer, 1910, p. 276.
Phialucium mbengha Maas, 1905, p. 32.—Mayer, 1910, p. 276.—Vanhöffen, 1911, p. 225.
? *Phialidium* species? Hartlaub, 1909, p. 455, pl. 20, figs. 8–10 [=18–20].

This species has been described in detail by Maas (1905).

The typical form of *P. mbengha* is represented in the collection by 2 specimens, respectively, 10 (Cat. No. 29374, U.S.N.M.), and 15 mm. (Cat. No. 1689, M.C.Z.) in diameter, from Manila Bay, Jan. 5, 1909.

In the smaller specimen the arrangement of marginal organs, as shown by the graphic method of Vanhöffen (1911), is as follows:

Tentacles, series 1	I	II	III	IV	Totals, 4.
Tentacles, series 2	4	5	4	3	16
Rudimentary tentacles	2, 2, 3, 6, 2	3, 2, 1, 3, 3, 0	3, 3, 3, 4, 4	3, 4, 4, ?	55±
Otocysts	2, 2, 3, 3, 1	3, 1, 1, 2, 1, 4	1, 2, 2, 2, 1	3, 1, 2, 1	38

In the larger specimen the numbers in the only quadrant which is still preserved intact are:

Tentacles, series 1	I II	Totals, 2.
Tentacles, series 2	6	6
Rudimentary tentacles	5, 4, 6, 4, 3, 4, 6	32
Otocysts	2, 2, 3, 0, 2, 2, 2	13

These tables show how very variable the number of marginal organs is. Indeed, no two quadrants of either the Philippine or the *Valdivia* specimens are precisely alike. With growth the increase in number of bulbs far outstrips the increase of large tentacles.

I have noted above the variation observed in the number of otoliths to each otocyst.

Color.—In the preserved specimens the gonads, manubrium, and tentacular bases are yellowish; in living specimens from the Maldives they were pale green; in the *Valdivia* specimens these regions were light red.

The localities from which *P. mbengha* has previously been recorded are Fiji, the Maldive Islands, Amboina, Ceram, Ternate, and other localities in the Malay Archipelago, the Indian Ocean north of Sumatra, and possibly the Gulf of Aden (Hartlaub, 1909). Its occurrence in the Philippines was therefore to be expected.

PHIALUCIUM MBENGHA var. POLYNEMA, new variety.

Plate 41, fig. 8.

Octocanna polynema Browne, 1905, p. 144, pl. 2, fig. 8–10.
Octocanna polynema Maas, 1905, p. 38, pl. 6, figs. 41, 42.
Phialidium heptactis Vanhöffen, 1911, p. 225, fig. 15, pl. 22, fig. 11.
Phialidium phosphoricum, forma *polynema* Vanhöffen, 1912, p. 19.

Phialucium mbengha variety *polynema—material examined.*

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40423	U.S.N.M.......	1	5101	Corregidor light, west coast of Luzon.	About 12.
1690	M.C.Z..........	1	5101	.....do..............................	

The specimens listed above are apparently an octoradial race of *Phialucium mbengha*, which they resemble in all particulars except the number of canals, slightly larger size, and proportionally shorter gonads. And the differences in size and gonad length are so slight that of themselves they would be no obstacle to locating the specimens in *P. mbengha.* The only question is whether we are dealing here with a sport, or with a race which has more or less crystallized, so to speak, in the octoradial condition. And the records of variation in the number of canals among Eucopidae have so multiplied within the last few years (Mayer, 1910, Vanhöffen, 1912, 1913) that the first alternative may be correct. But inasmuch as similar sports of this species have been recorded previously, as shown by the synonymy given above, it is wisest to dignify it with a varietal name.

Genus EUTIMA McCrady 1857.

It is now generally agreed that Haeckel's (1879) subdivision of this genus, according to the number of gonads, was artificial. But since Apstein (1913) and Neppi and Stiasny (1913) have recently revived the genus *Octorchis* Haeckel, I may point out that McCrady (1857) in his original account of *Eutima* noted the fact that in both species some specimens had four gonads (*i. e.*, on subumbrella only); others eight (on both subumbrella and peduncle). These observations having been substantiated by more recent studies (notably by Brooks 1886, Maas 1905, and Mayer 1910), there is no longer any warrant for distinguishing *Octorchis* with eight from *Eutima* with four gonads; it is not even a specific difference. Apart from the number of gonads, Maas (1905) and Mayer (1910) limit the genus *Eutima* in different ways. And Hartlaub (1909) does not recognize it at all, but believes that it must be subdivided into various genera. In my paper on the Eastern Pacific Medusae (1909*a*) I followed Maas, defining *Eutima* as "Eucopidae with long peduncle; with only eight otocysts; with only a small number of tentacles (4, 8, or 12); gonads on subumbrella, on peduncle, or on both." But the present collection shows that we can not limit the genus to specimens with 12 tentacles or less because to do so would make certain individuals of *levuka* fall into one genus, others into another. And inasmuch as number of tentacles, being an intergrading character, is seldom a satisfactory limit to Hydromedusan genera, it is wiser to follow Mayer (1910) and to include in *Eutima* all eucopids with long peduncle, eight otocysts, and with marginal warts and cirri as well as tentacles, as opposed to *Eutimium* in which there are neither warts nor cirri.

As pointed out below, the characters on which Hartlaub subdivides the genus *Eutima* (that is, number and arrangement of marginal organs and extent of gonads on radial canals) are very variable, the latter, at least, almost worthless even as a specific character. To use them as generic limits would throw some individuals of a given species into one genus, others into another.

The numerous described "species" of *Eutima* (Mayer 1910, lists 12, not counting synonyms) have recently been revised by Vanhöffen (1912), who reduces the number to 3, as follows: With 4 tentacles only, *E. mira* McCrady; with 8 or more tentacles and peduncular gonads limited to the mid-region of peduncle, *gegenbauri* Haeckel; 8 or more tentacles, with peduncular gonads (if present) long, *E. gentiana* Haeckel. Considering how very variable, in all characters, the genus *Eutima* is, this reduction is warranted, in the main, and it is a question whether there is any real distinction between *gegenbauri* and *gentiana*.

The following Eutimas have been recorded from the Indo-Pacific: *levuka* Agassiz and Mayer, *lactea* Bigelow, *curva* Browne, *orientalis* (Browne), *gentiana* Haeckel as recorded by Vanhöffen, *australis* Mayer (1915), *orientalis* Hartlaub, and *modesta* Hartlaub. *Levuka*, *lactea*, and Hartlaub's *orientalis* are undoubtedly a single species, the chief difference between them are the cirri, whether flanking the tentacles, or the rudimentary knobs, or both; thus *levuka* has cirri flanking the knobs alone (Maas 1909) or both knobs and tentacles (Bigelow 1909*a*); *lactea* has them in connection with the tentacles but not the knobs, and in adult *orientalis* there are none (Hartlaub 1909, p. 457). But two specimens in the present collection show that the arrangement of cirri is not a sound character for diagnosis, because in a given quadrant some of the knobs have them, while others lack them, and the same, as described more fully below, is true of the tentacles. And it has long been known that cirri are very variable in their occurrence in the Atlantic *E. mira*, even more so than in *levuka.* All these agree in having eight or more tentacles. *Modesta* Hartlaub is probably also a variety of *levuka;* but the single specimen was immature. Vanhöffen (1912, p. 21), it is true, states that it does not even belong to the genus *Eutima.* But I can find nothing in Hartlaub's account (14 tentacles, many marginal bulbs flanked by cirri, 8 otocysts; peduncle present; gonads on subumbrella) to warrant this view.

Curva and *orientalis* Browne have only four tentacles and differ from each other only in the number of gonads. *Australis* Mayer is not separable from *curva*, the two agreeing in the number of tentacles and form of the tentacular bulbs, extent of gonads, and general form. In short, all three probably belong to one species. According to Vanhöffen (1912) they are indistinguishable from the Atlantic *E. mira.* He also classes as *mira* the small specimens, with four tentacles from the west coast of Mexico described by me (1909*a*) as *levuka.* But as they were very young, and since *levuka* must also pass through a four-tentacle stage, it is equally possible that they belonged to that species.

Vanhöffen classes *levuka* as a synonym of the Atlantic *gentiana* on the strength of its numerous tentacles and long peduncular gonads, and records specimens of this type from Amoy and Hongkong under the latter name. But although, as I have pointed out (1909*a*), *levuka* and *gentiana* are closely allied, it is by no means certain that their true relationship would be best represented by uniting the two, and maintaining the combined species as distinct from *gegenbauri*, because it is not unlikely that Haeckel's original *gentiana* was an abnormal *gegenbauri* (Vanhöffen 1912, p. 23). At any rate, it had no subumbrellar gonads, which is seldom the case in adults either of *gegenbauri* or of *levuka.*

The only thing separating *levuka* from *gegenbauri* is its long peduncular gonads. But so far as the various published accounts of the latter go (Haeckel, 1879; Vanhöffen, 1913; Apstein, 1913; Neppi and Stiasny, 1913), this difference seems to be constant. Furthermore, as Vanhöffen points out, no *Eutima* of the *gentiana* (or *levuka*) type has been recorded from the Atlantic since 1879. It is true that *E. variabilis* McCrady (1857), figured by Brooks (1886), resembles it in having 12 to 16 tentacles and long peduncular gonads. But it differs in general form (short peduncle), and in the large number (10 to 12) of otoliths in each otocyst, from all other *Eutimas*, though the number of otocysts (eight) places it in that genus.

Until the range of variation of *gegenbauri* and *levuka* is better known, it is wisest to retain the latter as a distinct species, though with the reservation that the two may finally be united.

EUTIMA LEVUKA (Agassiz and Mayer) Maas.

Eutimeta levuka AGASSIZ and MAYER, 1899. p. 163, pl. 9, figs. 30, 31.
Eutimeta lactea BIGELOW, 1904, p. 253, pl. 2, figs. 7, 8.
Eutima lactea MAYER, 1910, p. 300.
Eutima levuka var. *ocellata* MAAS, 1905, p. 35, pl. 7, figs. 43, 44.
? *Eutima levuka* BIGELOW, 1909*a*, p. 165, pl. 5, figs. 2, 3; pl. 35, figs. 1, 2. — MAYER 1910, p. 301.
? *Octorchandra orientalis* HARTLAUB, 1909, p. 456, pl. 20, figs. 1–5.

Eutima levuka—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29342	U.S.N.M.	1	5101	Off Corregidor Light, west coast of Luzon.	10
40424	U.S.N.M.	1	5224	Between Marinduque and Luzon	9

The number and arrangement of tentacular structures is as follows:

SPECIMEN 9 MM. IN DIAMETER.

Tentacles, series 1	I	II	III	IV	I
Tentacles, series 2		1	1	1	1
Tentacular knobs		10, 14	14, 11	12, 11	13, 14

SPECIMEN 10 MM. IN DIAMETER.

Tentacles, series 1	I	II	III	IV	I
Tentacles, series 2		2	2	2	1
Tentacular knobs		7, 5, 12	12, 6, 7	11, 3, 11	11, 12

Thus the smaller specimen has 8, the larger 11 tentacles, and 99 and 97 knobs, respectively.

Maas (1905, p. 35) has pointed out that the tentacles do not increase regularly in number with development. My small specimens from Acapulco had only four (Bigelow, 1909*a*), while Maas records large specimens with 4 to 6, and believes that the normal number is 8—4 peradial and 4 interradial. The large Philippine example shows that 8 is not necessarily the final number, any more than it is in specimens from the Atlantic (Apstein, 1913, records 4 to 21); indeed, Maas has himself recorded small examples with more than 8. But not enough specimens have yet been studied to show how great the normal variation in number of tentacles may be in the Indo-Pacific race. Various records have shown that the number of marginal bulbs to the quadrant is variable. The present specimens have from 23 to 27.

The records of pigment in the tentacular bulbs for Indo-Pacific specimens are as follows: Agassiz and Mayer do not mention any; none was to be seen in the Maldive specimens (Bigelow, 1904). On the other hand the *Siboga* series, and both the Philippine representatives of the species have definite pigment spots. But in the latter, though they occur on most of the knobs, there are several knobs in each specimen which lack them.

Cirri.—The irregularity of occurrence of the cirri has been noted above. I may point out, however, that there is some evidence that the tentacles in *levuka*, as in *mira*, lose their flanking cirri with advancing age. Thus in the youngest known specimens (Bigelow, 1909*a*) there were 3 to 5 pairs of cirri flanking each of the tentacles, whereas Mass found none in connection with the tentacles of nearly mature specimens. Furthermore, in one of the present specimens one of the interradial—that is, youngest—tentacles is flanked by cirri, though none of the radial tentacles have any.

Gonads.—We have here an excellent example of how much the development of the gonads may vary relative to that of the marginal organs, for the specimen with the most tentacles has the smallest gonads. In this case the subumbral gonads are restricted to the outer half of the canals, the peduncular ones to the extreme distal end of the peduncle. In the other specimen the subumbral swellings reach from the base of the peduncle almost to the circular canal, and the peduncular ones occupy fully two-thirds of the length of that organ. It would require only slightly more growth for the gonads to become continuous from one end of the canals to the other. The condition of the gonads in the earlier described Indo-Pacific specimens is as follows: in the Maldive specimens ("*lactea*," Bigelow, 1904), they were limited to the peduncle, occupying about two-thirds of its length. On the other hand, Agassiz and Mayer (1899) describe them as limited to the subumbrella in their specimens from Fiji. But Maas has recorded specimens with distal subumbrellar gonads, and others, otherwise indistinguishable, in which there are sexual swellings on both subumbrella and peduncle. And, similarly, the two Philippine specimens show two distinct sexual masses on each radial canal. Great variation is found in the location of the gonads in *E. mira* also.

The evidence here outlined shows that the gonads develop independently in two locations; either the peduncular (Bigelow 1909*a*) or the subumbrellar (Maas, 1905) may appear first; or either one may be lacking, and peduncular or subumbrellar ripen alone. And this same thing has long been known to be true of *mira*, in which both subumbrellar, or peduncular gonads, or both, may be developed (Brooks, 1886). No one of these conditions is restricted to a given geographic locality, so far as we know.

Gonads continuous from bell margin to extremity of peduncle have not been described for *levuka*, though one of the Philippine examples approaches this condition. There is such an example, it is true, in the present collection, but cirri being absent, I hesitate to credit it to that species.

? EUTIMA LEVUKA.

? Eutima levuka—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29343	U.S.N.M........	1	5195	Off northern Cebu.........	11, much contracted with large gonads.

There are 23 large tentacles, 5, 5, 5, and 4 interradials, respectively, to each quadrant. In the one well-preserved quadrant, with 4 interradials, there are 26 knobs, 5, 4, 6, 6, and 5, between successive pairs of tentacles. If we assume that this number is continued all around the margin we would have a total of 104 knobs. There are no cirri flanking either tentacles or knobs, nor is there any pigment in the knobs.

The peduncle is narrow and hangs well below the bell opening. The gonads are stout and extend in unbroken ridges over the entire length of the peduncle, and extend over the subumbrella almost to the circular canal.

The only characters separating this specimen from *levuka* are the large number of tentacles, absence of cirri and of pigment, and the length of gonads. The first and last of these might naturally be expected to be the end condition of the Philippine specimens described above did development along these lines progress far enough. And we must remember that Brooks (1886) long ago described examples of *E. mira* with the subumbrellar and peduncular gonads practically continuous. As pointed out above (page 300), pigment is sometimes absent even in young specimens of *levuka;* and there is some evidence that the cirri flanking the tentacles are progressively lost with growth. All this points to a probable identity with *levuka.* But to prove it will require the discovery of stages connecting the two.

Genus PHORTIS McCrady, 1857. Sensu Mayer 1910.

The genus *Eirene*, as recognized by Haeckel (1879), has been divided by Mayer (1910) into *Eirene* and *Phortis*, the former with, the latter without, cirri on the bell margin. And his diagnosis is accepted by Vanhöffen (1912).

I have already maintained that the subfamily Eireninae, adopted by Mayer, can not be sharply defined from the Eucopidae *sensu strictu;* because one of the latter, *Phialopsis comata*, may show the rudiments of a peduncle at maturity. There is good reason to believe that *Eirene*, *Phortis*, *Eirenopsis*, and *Tima* form a natural group. And though the phylogenetic relationships between them are not yet altogether clear we can fairly assume that *Eirenopsis* is an offshoot, through radial reduplication, of some *Eirene* or *Phortis.*

Inasmuch as the character which separates *Eirene* and *Phortis*, presence or absence of cirri, separates two groups, each composed of several closely allied species, there is every reason to follow Mayer (1910) and Vanhöffen (1912), and recognize both genera.

The following described species belong to *Phortis: gibbosa* McCrady, *pyramidalis* L. Agassiz, *lactea* Mayer, *palkensis* Browne, *ceylonensis* Browne, *kambara* Agassiz and Mayer, *elliceana* Agassiz and Mayer, and *pellucida* Will. The latter has had a checkered history. By Haeckel, by Maas and by me (1909*a*) it was classed as a probable synonym of *Eirene viridula*, while Mayer (1910) classed it as the young of Tima. But recent studies by Hartlaub (1909), Vanhöffen (1911, 1912), and by Neppi and Stiasny (1913) show that neither of these views was correct, as is gracefully acknowledged by Mayer (1910), but that the *pellucida* described by Claus (1881), which lacks cirri, is a perfectly distinct species of *Phortis*, while the *pellucida* of Haeckel, which had cirri, is probably a synonym of *Eirene viridula.* According to Vanhöffen (1912) the genus *Irenopsis* of Goette, with six canals, is merely a sport of *Phortis pellucida.*

Unfortunately no figure of the adult *P. gibbosa* has ever appeared. But this species is very closely allied to *pyramidalis*, which is well described and figured by Mayer (1910), and of which I myself studied a large series including a wide range of developmental stages. According to Mayer (1910, p. 300) *gibbosa* is "distinguished from *pyramidalis* by its high bell, few tentacles, reddish color, and large stomach." But the difference in form is very slight, for I have myself seen *pyramidalis* as high as broad; the difference in tentacle number is apparent rather than real, for I have counted from 60 to 70 tentacles in *pyramidalis* 25 mm. in diameter—that is, the same number as is recorded for *gibbosa* of the same size. In large specimens of *pyramidalis*, of 30 to 35 mm., there are often upwards of 100 tentacles.

Without any figure it is impossible to tell whether the stomach is really much larger in *gibbosa* than in *pyramidalis*, but judging from analogy with other species it is unlikely that its size is important as a specific character. And the difference in color, greenish gonads in *pyramidalis*, reddish in *gibbosa*, is one which has often been found to occur among Eucopidae, as in *Phialucium mbengha.* The evidence as yet available shows no valid distinction between the two, but to determine this point requires a fresh study of specimens from Charleston, South Carolina, the type-locality of *gibbosa.* I may point out here that Mayer's statement that in *pyramidalis* tentacles and otocysts alternate regularly is not altogether correct, for in every example which I have seen there are some young tentacles in process of development, and a certain amount of irregularity in the arrangement of otocysts. Thus I have seen three between two tentacles, and, on the other hand, two tentacles without any intervening otocyst. On the whole, moreover, the number of otocysts is always greater than that of mature tentacles, at least in large specimens. Excretory pores are present and easily distinguished.

Phortis lactea may be a young *pyramidalis* in which the gonads have appeared a little sooner than usual. A comparison of the figures of the two by Mayer (1910) will show how closely they agree. But not having seen any specimen of the *lactea* type I am not prepared to make definite location of it.

P. pellucida and the *gibbosa-pyramidalis* group agree in the thick bell and broad, comparatively short, peduncle. I have not seen any specimens of *pellucida* myself.

P. palkensis, *ceylonsis*, *kambara* and *elliceana* all agree with each other, and differ from the preceding, in having a long narrow peduncle. *P. kambara* was based on a single specimen, 8 mm. in diameter, so young that no trace of gonads is yet to be seen (Agassiz and Mayer, 1899, pl. 8, fig. 29). The absence of tentacular knobs suggests that it may be a stage in the development of *ceylonensis.*

Palkensis and *ceylonensis*, the latter recently recorded by Vanhöffen (1911–1912), are separated by the marginal organs; the former having few (48 or less) tentacles and a large number of permanently rudimentary bulbs, the latter a large number of tentacles and few or no rudimentary bulbs. There is also a difference in the structure of the otocysts (Browne 1905). *Ceylonesis* is represented in the present collection.

Elliceana was described by Agassiz and Mayer (1902) from a single immature specimen, 16 mm. in diameter; it has not been recorded since. There are several specimens in the present collection which apparently belong to it, and which are easily distinguished by the structural characters noted below (p. 305), from all other members of the genus.

PHORTIS CEYLONENSIS (Browne) Mayer.

Eirene ceylonensis BROWNE, 1905, p. 140, pl. 3, figs. 9–11.—ANNANDALE, 1907, p. 79, pl. 2, fig. 7.

Phortis ceylonensis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29371	U.S.N.M.	1	5195	Off northern Cebu	About 15
1736	M.C.Z.	1	5195	do	Do.

In the preserved condition the gelatinous substance is thin, the bell very flat, and the long, narrow peduncle hangs far below its opening much as Browne described it. But Annandale has found that in life the bell is higher and more arched, its cavity deeper. Neither of the specimens shows the complete number of tentacles in any quadrant. But so far as I can judge by the portion of the margin still intact there must have been between 90 and 100 large ones; that is, just about the number recorded by Browne. There are also a few young tentacles in various stages in development. There is every reason to believe that ultimately they would all attain the adult condition. There are no cirri.

Otocysts.—According to Browne there is one otocyst between every two tentacles, and this is the general rule in the present examples. But there are some variations, there being sometimes two otocysts, sometimes none, between two adjacent tentacles. On the whole, however, there are about as many otocysts as there are tentacles. In every otocyst which I have examined there is a single large otolith, as Browne found was usually the case. But both he and Annandale have observed cases with two otoliths, due probably to "twinning," as the otocysts in such instances are abnormally large. In *palkensis* there are from 1 to 4 otoliths to each otocyst.

Color.—Color, if any was present, has entirely faded in the preserved specimens.

We owe to Annandale (1907) an account of the hydroid of this species. This is closely aliled to that of *P. gibbosa*, so far as I can judge from the descriptions by Brooks (1883) and Annandale (1907), but separable from it by differences in the form of hydrotheca and gonotheca.

The known range of *ceylonensis* extends from Ceylon to Lower Bengal and to the Philippines. Annandale found it in fresh water. *P. palkensis* is recorded from Ceylon and from the Nicobar Islands.

PHORTIS ELLICEANA Agassiz and Mayer.

Plate 41, figs. 3–7.

Phortis ellieeana AGASSIZ and MAYER, 1902, p. 146, pl. 2, figs. 5–7.—MAYER, 1910, p. 309, fig. 170.

Phortis ellieeana—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40425	U.S.N.M	1	5129	Sulu Sea, off western Mindanao	13, with 5 radial canals and gonads.
40426	U.S.N.M	2	5456	Off east coast of Luzon	14,23
29378	U.S.N.M	2	5500	Off northern Mindanao	27,30
1666	M.C.Z	2	5500	.....do	18 and 8

In the preserved condition the bell is flat and its cavity very shallow, though the gelatinous substance is rather thick. The peduncle is thick, cylindrical, stiff, and as long as or longer than the diameter of the bell. Its stoutness, solidity, and nearly uniform diameter throughout its unusual length are excellent field marks. A shallow bell, very long, though slightly narrower peduncle, is shown in the figure of *elliceana*, by Agassiz and Mayer.

Marginal organs.—No one of the specimens was in good enough condition to allow a survey of its entire margin, but individual quadrants could be studied in several.

(*a*) In a quadrant in a specimen 8 mm. in diameter there was one interradial tentacle, 7 tentacular knobs, and about that number of otocysts.

(*b*) 13 mm. in diameter; one-fifth (there are 5 canals in this specimen), 3 interradial tentacles, 11 knobs, 14 otocysts.

(*c*) 23 mm. in diameter, 1 quadrant, 2 interradial tentacles, 22 knobs, 27 otocysts. In the next quadrant there are four interradial tentacles.

(*d*) 30 mm. in diameter, 5 interradial tentacles, 27 knobs, 30 otocysts. In this specimen there were about 25 tentacles, both radial and interradial, and upward of 90 knobs.

In the specimen described by Agassiz and Mayer, 16 mm. in diameter, there were four large radial tentacles, 12 interradial ones, 3 per quadrant, about 40 knobs, and 56 otocysts. So far as the specimens show there are always about as many or a few more otocysts than tentacles and knobs combined. They usually alternate with the tentacular structures, but I have seen two between two knobs, and in one instance 4 knobs with no intervening otocysts. Some of the knobs have threadlike filaments; others do not, probably as the result of contraction.

The series of stages outlined above shows that the number of large tentacles remains permanently small; that is, that the great majority of the knobs never develop into tentacles, but remain rudimentary, just as they do in *P. palkensis*. Both tentacles and knobs bear excretory papillae (pl. 41, fig. 5).

Manubrium and gonads.—The manubrium is short, perhaps through contraction; the lips complexly folded (pl. 41, fig. 4). The gonads extend from the base of the peduncle nearly to the margin.

Budding.—One of the most interesting finds of the collection is the specimen of this species, 13 mm. in diameter and abnormal in having five radial canals, with hydroid blastostyles budding from the gonads, exactly as they do in *Phialidum mccradyi* Brooks. This is the second known instance among Leptomedusae of this method of asexual reproduction. The process has been described in detail for *Phialidium* by Sigerfoos (1893), who corrects some errors in the original account by Brooks (1888), and figures of the fully formed blastostyles have been given by the latter and by Mayer (1900, 1910). The photographs of the gonad of *P. elliceana* (pl. 41, figs. 6, 7) will show how closely the type of budding agrees in the two genera.

Color.—In the preserved condition the gonads are pale yellowish.

The present specimens agree so closely with the original specimen of *elliceana* in the structure and arrangement of marginal organs, as well as in general form, as noted above, that I have no hesitation in uniting them with it. The combination of comparatively few large tentacles with many permanently rudimentary knobs separates it from all species of *Phortis* except *palkensis*. *Palkensis*, when of the same size, has many more tentacles according to the account by Browne (1905); according to Vanhöffen (1911) at least twice as many. So long as we have only the data afforded by so few specimens both species may be retained. Should future investigation prove that the two extremes be within the range of normal variation of a single species, which is possible, though I think not probable, the name *elliceana* would prevail on the ground of priority.

Genus OCTOCANNA Haeckel, 1879.

EUCOPIDAE with eight radial canals.

Vanhöffen (1912) has recently maintained that the various octoradial eucopids ("*Octocanna*") described by recent authors (Browne 1905, Maas 1905, 1911; Bigelow 1909*a*, Vanhöffen 1911) are really mere variants of the tetraradial type. This is probably true in the case of the octoradial variety of *Phialucium mbengha*. But there are at least two "*octocannas*" which can not yet be referred to any known eucopid with four canals. One of these is the globular form, from the west coast of Mexico, described by me as *O. polynema* Haeckel, but which Mayer (1910) thinks is a new species; the other *O. polynema* of Maas (1906) from Amboina, characterized by very numerous tentacles. The last of these, it is true, much resembles *Philidium globosum* Mayer (1910, p. 272, pl. 34, fig. 4) in general appearance; but, apart from the difference in the number of canals, is separated from it by having nearly four times as many tentacles (upward of 100) and otocysts, the only species which approaches it in this respect, *P. gregaria* (of which I have studied a large series) having at most only about half as many tentacles (up to about 60). And of course the absence of peduncle separates it from the many-tentacled species of *Eirene* or *Phortis*. For this same reason it can not be united with Haeckel's *O. polynema;* and as it must be called something for the present, even if later united with some Philidium, it may be named *aphrodite*.

OCTOCANNA APHRODITE, new name.

Plate 42, figs. 1, 2.

Octocanna polynema Maas, 1906, p. 95, pl. 3, fig. 10 (not *Octocanna polynema* Haeckel, 1879, Maas, 1905, Browne, 1905, Bigelow 1909*a*).

Octocanna aphrodite—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40428	U. S. N. M.....	1	5128	Sulu Sea, vicinity southern Panay.	16, with 7 radial canals, about 100 tentacles.
9366	.....do..........	1	5581	Vicinity Darvel Bay, Borneo.	17, 9 radial canals, 80 tentacles in three-fourths of the margin.

The three specimens from Amboina described by Maas (1906) all had 8 canals; it is remarkable that the two from the Philippines should show variation one in one direction, the other in the other, from this number. And it is fortunate that there are now enough records to show that here as in *Irenopsis* the number is not fixed.[1]

Marginal organs.—The very numerous tentacles, with large basal bulbs, are closely crowded on the bell margin. Here and there there are to be seen younger onces in process of interpolation, at various stages in development (pl. 42, fig. 2). There are no permanent rudimentary knobs, neither are there any cirri. The bases of the tentacles bear well-developed excretory papillae.

The number of tentacles to the segment of the margin is variable, corresponding to variation in the distance between radial canals.

[1] In *Irenopsis hexanemalis* in which the usual number of canals is 6, Browne (1905) has recorded specimens with 4, 7, 8, 9, and 11 canals.

Thus in one segment of the 9-radial example there are 16 interradial tentacles; in another segment only 6. In the 7-radial specimen there are 9 tentacles in one segment; 11 large and 4 small in a second; and 7 large and 3 small in a third.

There are one or two otocysts between every two tentacles; that is, many more otocysts than tentacles. I was not able to count the entire number in either specimen, because part of the margin was damaged in each.

The gonads are spindle-shaped, thickest distally, and are restricted to the outer one-half or one-third of the radial canals. They do not quite reach to the circular canal.

Color.—In one specimen the gonads are brownish-yellow; in the other pale pinkish. There are no notes available as to their color in life.

Comparison between these examples and Maas's Amboina specimens shows that they agree even to minor details.

Family AEQUORIDAE Eschscholtz, 1829.

LEPTOMEDUSAE with very numerous radial canals and with closed otocysts.

These are the family limits which have been adopted by Maas, by Browne, and the writer, for the presence of more than eight canals can not be used as the dividing line between eucopid and aequorid, as I formerly proposed, because occasional specimens of eucopids may have as many as 11 (p. 307, Browne, 1905).

Mayer (1910) extends the family to all Leptomedusae with eight canals, irrespective of whether the otocysts are open or closed; that is, he includes *Octocanna*, *Octogonade*, and *Halopsis*. But the former (p. 306, Maas, 1905) certainly belongs to the Eucopidae; indeed, it is a question whether its "species" are anything but variant tetranemal eucopids. *Octogonade* and *Halopsis* have open sense pits, with ocelli as well as otoliths, hence belong to the Mitrocomidae. Browne (1910), it is true, says that reinvestigation of the sense organs of *Halopsis* is necessary to show whether they are really open. But I have recently been able to establish, in fresh material, that they are open (1914, p. 102).

No family corresponding to the Mitrocomidae of Torrey (1909) and Browne (1910) is recognized by Mayer, the genera listed above being distributed between Eucopidae and Aequoridae, according to the number of their canals. But the structure of the sense organs shows that the Mitrocomidae are a natural group.

The Aequoridae are still perhaps the most puzzling family of Leptomedusae to the systematist; no division into genera which has yet been proposed covers the ground adequately, nor are the normal limits of variation yet known for a single species. Yet the family is one of the longest known and most widely distributed geographically of medusan groups. The difficulty facing us is the extreme variability of its members—the inconstancy of almost every character which might be expected to serve as the basis for classification.

I have already argued, from a study of living as well as preserved material (1909*a*, p. 171), that the size and structure of the mouth as used by Haeckel (1879) and recently by Maas (1909) and Browne (1904, 1905) is misleading as a generic character. Torrey (1909, pp. 28, 29) has simultaneously come to the same decision from his study of living examples. Our view has been accepted by Mayer (1910) and Vanhöffen (1911). Neppi and Stiasny (1913) have recently corroborated it on large series of living specimens. But while I recognized only one genus, *Aequorea*, to include the whole family, exclusive of Haeckel's problematical genera *Zygocanna* and *Zygocannula*, Mayer retains *Stomobrachium* for species with 12 canals and *Zygodactyla* for forms with subumbral gelatinous papillae.

I have recently studied excellent series of the latter (1915*a*), finding the papillae as Mayer describes them. But in a group where it is so difficult to separate even species it is better to use their occurrence as a specific, not a generic, character. And, at any rate, if the papillate forms be recognized as a separate genus, the international code of nomenclature forbids the use of the name *Zygodactyla* for them, because its type species, *Z. coerulescens* Brandt, does not have papillae (Bigelow, 1909*a*); hence, as Mayer himself points out, it is an *Aequorea*.

Stomobrachium may as well be left out of this discussion, for neither the early descriptions (Brandt, 1838; A. Agassiz, 1865) nor the recent account by Le Danois (1913) tells anything about its otocysts or even whether it has any.

Vanhöffen (1911) distinguishes two genera of "Vielsträhligen Aequoriden," *Aequorea* and *Mesonema*, separating them solely on the proportional number of tentacles and radial canals. But this diagnosis is unsatisfactory, because it leaves no place for species (or specimens) with slightly fewer tentacles than canals, whereas such proportional numbers have often been recorded. In short, I believe that in the present stage of our knowledge all aequorids with the canals normally simple (unbranched) must be grouped in one genus, *Aequorea*, as distinguished from the forms with branched canals, *Zygocanna*.

The present collection contains an excellently preserved series of the latter, one of its most interesting finds.

As I have pointed out (1913, p. 36), the separation of distinct species in the genus *Aequorea* is very difficult, except for *groenlandica*, characterized by subumbral papillae; and *tenuis* (+*flori-*

dana) by very small stomach. The Aequoreas in the present collection all have smooth subumbrella, a broad stomach, and many more canals than tentacles; but they are separable into two groups by the following structural characteristics:

a. Specimens with triangular basal bulbs, which do not clasp the exumbrella; without excretory papillae, with about 11 or 12 times as many canals as tentacles; with a good deal of anastomosis of the canals near their tips.

b. Specimens with basal bulbs clasping the exumbrella more or less; with excretory papillae, with from 4 to 6 times as many canals as tentacles, with little if any anastomosis of canals.

I have already attempted a temporary revision of the Indo-Pacific Aequoreas (1909*a*, 1913), and these two forms agree very well with two species there recognized, namely, *pensile* and *macrodactylum.* Both of these have likewise been studied by Maas (1905), while Browne (1904), writing almost simultaneously, recognizes both, though he used a new name, *maldivensis*, instead of *macrodactylum.* They are united by Vanhöffen (1911) as *pensile.* But the presence or absence of excretory papillae is significant. These have never been recorded for *pensile*, though Browne (1905) made a special search for them, and of course I have looked for them carefully in the present series. *A. pensile* is further distinguished by the extraordinarily thick biconvex disk, an excellent "field mark." On the other hand, the wing-like lateral extensions of its tentacular bulbs prove to be less constant than earlier studies suggested. The characters of a series of each are given below (pp. 312, 314).

Macrodactylum is very closely allied to the widely distributed *Aequorea aequorea.* As a rule, the numbers of tentacles and canals are more nearly equal in *aequorea* than in *macrodactylum*, as I have pointed out (1913, p. 37); but there is no discontinuity between the two in this respect, nor is there anything in the structure of stomach and mouth, of gonads nor in general foım to separate them.

The shape of the tentacular bases, clasping the exumbrella, is the most distinctive feature of *macrodactylum.* But it is not possible to draw a sharp line between it and *aequorea* in this respect, for, as I have already pointed out (1913, p. 37), the specimens show all stages from clasps "as pronounced as figured by Maas (1905) for *macrodactylum*, to a condition where it is doubtful if they are present or not." Conversely, some of the tentacle bases in a specimen of *aequorea* from Naples have distinct clasps. And in an excellent specimen from Puget Sound, 40 mm. in diameter, with 77 canals and about 66 tentacles (a few are lost), some of the tentacular bases are of the "*aequorea*," others of the "*macrodactylum*" type. Thus there is no discontinuity in this respect, any more than in the number of tentacles relative to canals. In short, we have here, as so often, a bimorphic Medusa with two fairly distinct types, with the great majority of specimens belonging to one or the other. However, since intermediates seem to be rare, the species *macrodactylum* may be retained (1913, p. 37), until the normal range of variation is better understood.

Genus AEQUOREA Péron and Lesueur, 1809.

AEQUOREA PENSILE (Haeckel) Mayer.

Plate 42, figs. 3, 4.

Mesonema pensile HAECKEL, 1879, p. 226. Synonymy, Mayer, 1910, p. 333.

Aequorea pensile—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40429	U.S.N.M	1	5231	Between Bohol and Leyte	50
40430	U.S.N.M	1		Port Dupon, Leyte	22
29391	U.S.N.M	8		Limbones Cove, China Sea, off southern Luzon.	Up to 40
1732	M.C.Z	2		do	Do.
1683	M.C.Z	1	5195		30

The decision as to whether this species should be called *pensile* or *coelum-pensile* (accepting Browne's idntification of it as Modeer's *Medusa coelum pensile*) raises a nice question in nomenclature. Most students, myself included, have called it *pensile* or *pensilis* Modeer. But this position is untenable, because Modeer's name (*coelum pensile*, adopted by Eschscholtz, 1829), was either a polynomial, in which case, of course, it has no standing, or if he meant it for a binomial, the two words *coelum* and *pensile* should be compounded, as Vanhöffen (1913) has recently done.

I have not had access to Modeer's papers. Least confusion will result by following Browne and Mayer, and using *pensile*, but referring it to Haeckel on the ground that Modeer's name was a polynomial.

The specimens listed above agree with each other in having a very large number of canals, in the entire absence of excretory papillae, and in the fact that the tentacular bulbs never clasp the exumbrella. Lateral extensions of these organs along the bell-margin, however, are variable. In all the specimens from Limbones they are very long, much as Browne (1905) has figured them; but in the example 50 mm. in diameter from station 5231 they are but slightly developed. The latter, however, is much contracted. Browne (1905) has made a careful study of the margin. He finds, from serial sections, that excretory pores or slits are present, though the papillae so characteristic of other aequorids are absent; and the absence of papillae has now been established in so many specimens that it may be assumed to be constant.

Unfortunately only two of the specimens have the entire margin intact; on them only was it possible to make certain of the entire number of tentacles. But judging from the number of canals in the damaged specimens and their relation to the remaining tentacles, the proportional numbers listed below can not be far from the truth for the entire series. In the following table the numbers of tentacles and canals are given for all recorded specimens which are described as having no excretory papillae. I previously referred *Polycanna purpurostoma* of Agassiz and Mayer to *pensile*. But fresh examination of their type specimen revealed papillae, as well as that the tentacle bulbs clasp the exumbrella.

Locality.	Diameter.	Diameter of stomach.	Tentacles.	Tentacular bulbs.	Canals of all sizes and ages.	Proportional numbers.	
						Canals—tentacles.	Bulbs—tentacles.
Philippines	50	34	13	210	162	12–1	16–1
Do	22	16	11	85	124	11–1	8–1
Maldives, Brown	45	26	10	....	120	12–1	....
Do	60	....	10	....	[1] 100	10–1	....
Do	60	....	15	....	[1] 150	10–1	....
Do	60	43	13	....	148	11–1	....
Tahiti, "*Rhegmatodes lacteus*" Agassiz and Mayer	50	....	10	250	105	10–1	25–1
"*Siboga*" Maas	100	50–60	16?	....	[1] 200	12.5–1	....
Do	90	50	10?	....	[1] 250	25–1	....

[1] About.

Vanhöffen (1911, 1912, 1913) has given tables for much larger series, all characterized by many more canals than tentacles. But as he does not state whether his specimens had or lacked excretory papillae, it is a question whether they belong to *pensile* as here defined or whether some of them may not have been *macrodactylum*, or even *Ae. aequorea*.

As far as our knowledge yet goes, there are usually at least 10 times as many canals as tentacles in large specimens of *pensile*, and seldom over 12 times as many. But it is quite possible that *pensile* may, in development, pass through what we may call a "*macrodactylum*" stage with respect to the proportional numbers of these organs.

Browne (1904) has already called attention to the prevalence of anastomosis among the canals of *pensile*. It is a prominent feature in the present series, especially near the distal extremities of the canals.

The otocysts are very numerous; about as much so as tentacles and bulbs combined in the one specimen in which they seemed to be intact in about the normal condition.

All the records which can be safely referred to *pensile*, that is, the examples in which we know that excretory papillae are lacking, are from the Indo-Pacific; that is, the Maldives, the Philippines, the Malay Archipelago, Tahiti, and Japan.

AEQUOREA MACRODACTYLUM (Brandt) Bigelow.

Plate 43, fig. 7.

Mesonema macrodactylum BRANDT, 1835, p. 21; 1838, p. 359, pl. 4. Synonymy, Bigelow 1909*a*, p. 174; Mayer 1910, p. 333. To the list given there must be added the *Polycanna purpurostoma* of Agassiz and Mayer (1899), which I formerly referred to *pensile*, for the reasons given above (p. 312); likewise some of the specimens recorded by Vanhöffen (1911) as *pensile*.

Aequorea macrodactylum—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
....	....	1	5101	Off Corregidor Light, west coast of Luzon.	20–55
29281	U. S. N. M..........	1	5129	Sulu Sea, off western Mindanao..........	
....	....	1	5231	Between Bohol and Leyte..............	
29394	U. S. N. M..........	2	5233	.....do..............................	
40431	U. S. N. M..........	2	5240	Vicinity Pujada Bay, Mindanao.........	
1736	M. C. Z..............	1	5240	.....do..............................	
....	....	1	5649	Buton Strait.........................	
29280	U. S. N. M..........	1	....	Off Rojas Point, Banay...............	
40432	U. S. N. M..........	1	....	Port Dupon, Leyte....................	

The general features of this species have been described in detail by Maas (1905) and by me (1909*a*), and as its relationship to *Aequorea aequorea* is discussed above (p. 310), we need only consider here the constancy of the characters on which I base the separation of *macrodactylum* from *pensile* and *aequorea*.

The following table contains the statistics of all entire specimens of *macrodactylum* yet recorded with the information that they have excretory papillae. It is to be observed that the identification of the specimens here listed rests on the presence of papillae and of the "*macrodactylum*" type of tentacular bulbs. Number of tentacles or canals was not considered in making up the table. By following this plan we can find out whether or not it is correlated with the two structural characters, which are more important.

Vanhöffen's figure (1911, fig. 21) shows that the specimen from which it was drawn belonged to *macrodactylum* as here defined; and his statement that the tentacle-bulbs usually have more or less noticeable clasps (1911, p. 233) shows that the same was true of most of his series. Unfortunately he gives no data as to absence or presence of papillae, or of the structure of the bulbs in individual specimens. Had he done so his data on the numbers of canals and tentacles in so large a series would have been most valuable, to check the systematic value of the numerical differences between *pensile* and *macrodactylum* which appear from the present tables.

Locality.	Diameter.	Diameter of stomach.	Tentacles.	Tentacle bulbs.	Canals of all ages.	Approximate proportional numbers.	
						Canals—tentacles.	Bulbs—tentacles.
Philippines	33	22	13	106	71	5 -1	8 -1
Do	23	15	9	87	59	6 -1	10 -1
	55	37	22	[1] 130	94	4 -1	6 -1
Do	34	19	16	[2] 128	71	4 -1	8 -1
Do	40	21	15	[2] 120	63	4 -1	8.5-1
Do	41	23	17	(?)	93	5.5-1	....
Do	34	20	12	[2] 96	73	6 -1	8 -1
Siboga Maas	45	20	28	....	86	3 -1	....
Do	38	17	30	....	94	3 -1	....
Do	28	13	29	....	95	3 -1	....
Do	17	9	18	....	77	4 -1	....
Do	19	9	22	....	72	3.5-1	....
Do	24	13	20	....	62	3 -1	....
Do	18	9	20	....	80	4 -1	....
Do	12	7	16	....	56	3.5-1	....
Do	26	12	26	....	103	4 -1	....
Fiji, M. C. Z. coll	24	16	18	....	79	4.5-1	....
"Maldivensis," Browne	35	20	21	....	52	2.5-1	....
Do	45	....	34	....	69	2 -1	....
Do	75	....	50	....	54	1 -1	....
East Pacific, Bigelow	8	....	16	....	29	2 -1	....
Fiji	22	....	18	....	42	2.5-1	....

[1]About 6 between 2 tentacles. [2]About 8 between 2 tentacles.

The last specimen is the type of *Polycanna purpurostoma* Agassiz and Mayer, which has papillae.

I have not included Chun's (1896) specimen from Zanzibar because of lack of information as to excretory papillae and of the forms of the tentacular bulbs. It had 84 canals and 10 tentacles—that is, 8.4–1.

The table shows a variation in proportional numbers of canals and tentacles of from 1–1 to 6–1. Thus there are invariably considerably more tentacles in proportion to canals than there are in *pensile*. Another minor feature helping to separate the two is the fact that anastomosis of the canals seldom or never occurs in *macrodactylum*, while it is usually more or less evident in large specimens of *pensile* (p. 312).

In the specimens from the Philippines the bases of the tentacles usually clasp the exumbrella more or less (pl. 43, fig. 7), but the precise conformation varies as noted above.

The records for *macrodactylum* as here defined are chiefly from the Indo-Pacific, where it is widely distributed in warm regions. I have examined a typical specimen from the Gulf Stream.

Genus ZYGOCANNA Haeckel, 1879.

Zygocanna Haeckel+*Zygocannota* Haeckel+*Zygocannula* Haeckel.

Mayer (1910) has summarized our vague knowledge of this, up till now, problematical genus. Its distinguishing feature among aequorids is the fact that its canals bifurcate. Haeckel's accounts, taken from alcoholic material, are incomplete, and the condition of his specimens precluded accuracy. Probably his three "species" and the *pleuronota* of Péron and Lesueur are identical.

The Philippine specimens can be described as having branched canals, and it is for this reason that I refer them to *Zygocanna*, but the branching takes place at the margin of the stomach instead of distal to it, as Haeckel describes it; and the canals can be traced inward over the roof of the gastric cavity to its center, a feature not previously described for any aequorid. The branching, moreover, is much less regular than Haeckel deemed it, and the subumbrella surface is studded with gelatinous papillae so prominent, even in alcoholic specimens, that Haeckel could hardly have overlooked them had they been present in his material. Furthermore, there is no peduncle, which separates them from his *Zygocannula diploconus*, and there are many more tentacles than in his *pleuronota*. It is not worth while discussing the *Aequorea purpurea* of Péron and Lesueur (1809), which is also placed by Haeckel in "*Zygocannota*," because the structure of the gonads is so remarkable as to need confirmation. These facts combined are sufficient grounds for the institution of a new species. The only known Medusa with which it may be identical is a young unnamed aequorid figured and described from the collection of the *Siboga* by Maas (1905).

ZYGOCANNA VAGANS Bigelow.

Plate 42, figs. 5–7; plate 43, fig. 6.

Zygocanna vagans Bigelow, 1912, p. 255.
aequoride juv. gen? sp? Maas, 1905, p. 44, pl, 4, figs. 22, 23.

Zygocanna vagans—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
40434	U.S.N.M	1	5129	Sulu Sea, off western Mindanao	36
1718	M.C.Z	1	5129		
29388	U.S.N.M	1 (type).	5190	Tanon Strait, east coast of Negros	39
29418	U.S.N.M	9	5190	.....do	28–30
1716	M.C.Z	2	5190	.....do	Frag.
29416	U.S.N.M	1	5216	Between Burias and Luzon	76
3049	M.C.Z	1	5216	.....do	68

There is little to add to my original description (1912), except the accompanying illustrations, the most important being those showing the structure of the stomach and the method of branching of the canals. The important fact is that the branching takes place at the margin of the stomach. And the cruciform figure formed by inward prolongation of the canal stripes over the roof of the stomach shows that with growth there have been successive divisions for the four primary canals, the last one being obscured by the lips. In the type specimen there are 38 canals resulting from the bifurcation of the four primary ones (pl. 42, fig. 5).

As a result of this method of branching the canals are in groups, the number of which varies according to the number of branchings which each main stem has undergone, and the number of canals varies from group to group. In the type the "cross" is so irregular that it is hard to determine which trunks are the four primary ones. But in another specimen, in which the figure is more regular, there are 10, 5, 7, and 7 canals, originating from each of the four primary trunks, respectively. In another there are 9, 12, 5, and 8. In the two young aequorids described by Maas, which probably belonged to this species, the central cross is quite regular, and in each specimen there are 32 definitive canals.

The canal stripes within the limits of the stomach are the visible evidence of lines along which the upper (outer) wall of the manubrium is now attached to the subumbrella. Between these lines it hangs loose, leaving spaces into which a probe can be inserted or an air bubble injected. Consequently it is easily stripped off, and all the specimens show more or less damage of this sort.

The manubrium itself broadens as so many sinuses along the successively formed canals; evidently the outgrowth of new centrifugally formed canals takes place from the margin of the manubrium. A still further specialization would be branching of canals outside the margin of the manubrium, such as Haeckel has described.

Marginal organs.—The tentacles vary in number from about 30 to about 70; the canals from 29 to 46, in specimens 29 to 76 mm. in diameter (1912). Tentacular knobs are numerous; about 110 in a specimen with 29 tentacles. There are usually 1 to 3 otocysts between every 2 tentacular organs; i. e., upward of 200 [they are so small that the photographs do not show them; but they are easily seen on the specimens].

The tentacular bulbs are cylindrical and stout (pl. 42, fig. 6), and do not clasp the exumbrella, though they are truncate basally. In the type some tentacles are opposite canals, some between them (pl. 42, fig. 6); but in the specimen 36 mm. in diameter, they are all opposite canals.

I have already (1912) called attention to the great length of the excretory papillae borne by both tentacles and knobs (pl. 42, fig. 6).

Gonads.—The sexual glands are of the usual aequorid type.

Subumbrella sculpture.—One of the most characteristic features of the species is the presence of conical gelatinous subumbral papillae (pl. 43, fig. 6) described in detail elsewhere (1912, p. 257). These are restricted to the central two-thirds of the disk, arranged in rows alternating with the radial canals; 4 to 15 papillae in each row. In the region of the manubrium they are represented by low rounded knobs; 16 in one specimen.

Haeckel's (1879) records for the genus (+*Zygocannota*+*Zygocannula*) are from New Guinea, and straits of Sunda; the "Siboga" specimens (Maas, 1905) from Malayan waters.

Order TRACHOMEDUSAE.

Family PETASIDAE Haeckel, 1879. Sens. Em. Browne (1904); Bigelow (1909*a*, 1915*b*).

This family corresponds to the Olindiadae+subfamily Petasinae of Mayer (1910). Mayer leaves the relationships between his two groups open; and he adds to the latter Craspedacusta, both Goto (1903) and Browne (1904) having maintained that the affinities of the latter are with such genera as *Olindias* and *Gonionemus*.

I follow Browne (1904) in dividing this family into two subfamilies, Olindiinae with the otocysts in capsules, Petasinae in which they are free clubs (1909*a*, 1915*b*).

Subfamily OLINDIINAE.

Genus OLINDIAS F. Müller, 1861.

The genus *Olindias* is known from the Indo-Pacific, by two forms races or species, *O. phosphorica* var. *malayensis* Maas, and *O. singularis* Browne (1904). In my memoir on the "Albatross" Eastern Pacific Medusae (Bigelow 1909*a*, p. 109) and in Mayer's (1910) Monograph, the characters of members of the genus from various parts of the world will be found tabulated. The general conclusion, as Mayer points out, is that the various Atlantic representatives are at most geographic races of one species, *phosphorica.* The case of the two Indo-Pacific forms is still obscure. With the evidence available at the time, I recognized both, *singularis* with usually one, *phosphorica* with usually or always 2 otocysts at the base of each primary tentacle. The Mangareva specimens had one otocyst at the base of most, two at the bases of a few, primary tentacles. Hence they were associated with *singularis.* In the Philippine specimens also single otocysts predominate largely over paired. As pointed out elsewhere (Bigelow, 1909*a*) single antedates paired otocyst in ontogeny in *Olindias.* In the Atlantic specimens of the genus paired otocysts are developed at the base of a primary tentacle very soon after the latter is formed. In Indo-Pacific representatives single otocysts may persist, or at some of the tentacles a second one may develop. When this takes place it is at a very early stage, as in the Atlantic *phosphorica*. The only record of specimens from the Indo-Pacific with paired otocysts prevailing is that by Maas (1905). That is to say, we find here a tendency, not completely effective, to retain permanently a condition which is only evanescent in their Atlantic relatives. Or, in other words, Indo-Pacific specimens show a tendency to advance in their development to the degree of specialization exemplified by the Atlantic form, but seldom attain it. On the other hand, there is no record of the Indo-Pacific type from the Atlantic, though many Atlantic specimens have been studied by various authors; most recently by Neppi and Stiasny (1913).

The *singularis* type is now known to be widely distributed over the warmer parts of the central Indo-Pacific. In the Malaysian region the *phosphorica* type also occurs (Maas, 1905), though it is not recorded from elsewhere in that great oceanic division.

The evidence is still too scanty to explain the meaning of this state of things; to tell how far the variation is hereditary, how far physiological. Just such cases often meet the student of Medusae; and they offer constant difficulties in classification.

Although *singularis* seldom, if ever, lacks paired otocysts entirely, yet the two types, *singularis* and *phosphorica* approach discontinuity because no true intermediates between an overwhelming preponderance of one or other sort of otocyst, paired or single, are known. For this reason, I have recognized *singularis* as a valid species; and it is sufficient ground to do so still. But we must recognize that studies of larger series may show that the two forms can not be so sharply separated as the evidence now available suggests. Perhaps *singularis* may finally be reduced to a variety of *phosphorica*. An open mind is necessary if we are to mask neither the facts which we know, nor the gaps which separate them.

OLINDIAS SINGULARIS Browne.

Olindias singularis Browne, 1904, p. 737, pl. 56, fig. 2; pl. 57, fig. 1.—Bigelow, 1909*a*, p. 109, pl. 4, fig. 1; pl. 31, figs. 1–10; pl. 32, fig. 8.

Olindias singularis—material examined.

Catalogue No.	Collection of—	Number of species.	Station.	Locality.	Diameter in mm.
29424	U.S.N.M.	2	5097	Off Corregidor Light, west coast of Luzon.	
29370	U.S.N.M.	1	5169	Off Sibutu Island, Tawi Tawi	
40435	U.S.N.M.	3	5533	Between Cebu and Siquijor	one=32
1734	M.C.Z.	2	5533	do	
3050	M.C.Z.	1	5595		
40436	U.S.N.M.	1	5649	Buton Strait	
1680	M.C.Z.	1	5649	do	15
29369	U.S.N.M.	1	5669	Macassar Strait	21
40531	U.S.N.M.	1		Tilig Lubang, off west coast of Luzon	22

The numbers of tentacles and of otocysts in four specimens of different sizes are as follows:

Station.	Diameter.	Primary tentacles.	Secondary tentacles.	Bulbs.	Numbet of primary tentacles with one otocyst.	Tentacles with two otocysts.	Tentacles without otocysts.	Canals per quadrant.
5669........	21	37	36	38	22	10	5	7,5,5,6
Tilig........	22	44?	41	52	26	6	2	6,7,7,7
5649........	15	39	19?	43	31	8	1	2,9,6,6
5553........	32	52	38	57	42	2	1	....

In the last two specimens a small portion of the margin was damaged, so that at several tentacles the otocysts could not be determined.

It is of interest that when paired otocysts are developed, they are both distinguishable when the tentacle is very small. There is no evidence that tentacles which have one otocyst during the greater part of their history ever acquire a second one at a late stage. Single otocysts are usually much larger than either of the components of a pair.

In the smallest specimen one of the quadrants is very narrow and another disproportionately broad; the numbers of blind canals per quadrant show a corresponding irregularity. Abnormalities are common in Olindias (Bigelow, 1909*a*).

Subfamily PETASINAE.

Genus NAUARCHUS Bigelow, 1912.

Petasidae with six radial canals, but without centripetal canals; manubrium short and flat, without distinct gastral portion; mouth surrounded by a simple circular lip; gonads leaflike; tentacles of one kind only, corresponding to the primary tentacles of *Olindias*, their basal ends lying in furrows of the gelatinous substance so that they appear to emerge from the exumbrella; with terminal nematocyst swelling; otocysts are free clubs. At first sight the shallow manubrium with its simple, circular lip (pl. 43, fig. 1), suggests an Halicreid, the presence of six radial canals,[1] and the flat oval leaflike gonads, a geryonid, such as *Geryonia*. But the absence of any trace of peduncle separates *Nauarchus* from the latter, the structure of otocysts from the former, its sense organs with spherical capsule and inclosed sensory stalk, being entirely different from the large sense clubs with series of columnar entoderm cells which characterize all known Halicreids. And in the structure of the tentacles there is an equally important difference, for in all Halicreids in which these organs have been described they consist of soft proximal and stiff, spinelike distal portions (1909*a*), besides arising free from the mar-

[1] One of the specimens is abnormal, there being only four canals at the margin of the stomach. One of these, however, soon divides into three, though only two of the latter reach the circular canal.

gin. The leaflike gonads, too, are unknown among Halicreids, and the radial canals are much broader in that family than in *Nauarchus*. The resemblance between the two in the flat stomach and simple lip, is certainly far less significant, phylogenetically, than the structure of the marginal organs; in short, it is merely superficial. The only Trachomedusae with which it shares its leaflike gonads are the Geryonids, but here again we find essential differences; that is, absense of peduncle, free sense clubs, structure of tentacles. And the structure of tentacles and gonads separate it from the Trachynemidae.

The location of *Nauarchus* in the Petasidae is based chiefly on the structure of the tentacles, which agree very closely with those of *Eperetmus* (Bigelow 1915*b*), both anatomically and in their relation to the bell margin. And, except for the replacement of sucking disk by nematocyst knob and in the details of the nematocyst rings, they agree with those of *Gonionemus* and the primary tentacles of *Olindias*.

The otocysts, too, are easily reducible to the ordinary Olindiid type.

According to the subdivision of the family proposed by Browne (1904) and followed here (p. 317, 1909*a*, 1912, 1915*b*), *Nauarchus* belongs to the Petasinae. [For a tabular view of the Olindiinae, see Bigelow, 1915*b*, p. 400.] But its leaflike gonads and the presence of six radial canals separate it from the only other Medusae which fall into the Petasinae as here defined, namely, *Petasus*, *Dipetasus*, *Petasata*, and *Petachnum* of Haeckel. All these are united by Mayer (1910) as *Petasus*, but until specimens agreeing with Haeckel's account are again discovered discussion of them is idle.

NAUARCHUS HALIUS Bigelow.

Plate 43, figs. 1–5.

Nauarchus halius Bigelow, 1912, p. 258.

Nauarchus halius—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29365	U.S.N.M...........	2	5456	Off east coast of Luzon.	Largest 12 mm. in diameter, the other two smaller, but too contracted for measurement.
1727	M.C.Z...............	1	5456	.....do............	

All three were so badly crumpled that it was impossible to make a photograph of the general habitus. But all were well preserved anatomically.

The species having been described elsewhere (1912) in detail, the present account is limited to the features most important for their bearing on the relationships of this remarkable genus.

There are 12 solid tentacles—6 radial, 6 interradial—arising, of course, from the margin, but curving upward against the bell, in open furrows of the exumbrella, to emerge a slight distance above the margin. The two (both interradials) which are intact in the type-specimen are smooth walled for the inner four-fifths of their length, but the ends are ringed with about 20 nematocyst ridges, with a large nematocyst knob at the tip.

There is an otocyst close beside each tentacle root, within the exumbral furrow (pl. 43, fig. 5), but standing free, not inclosed by the gelatinous substance. The organs themselves are naked, spherical in form, consisting of an ectodermic covering layer, inclosing an entodermic core with about four large spherical cells, each containing a central mass, the high index of refraction of which shows that it is an otolith (pl. 43, fig. 3).

The discovery of free sense-clubs in *Nauarchus* is especially interesting because up to this time the only records for sense-organs of this type in the Petasidae are Haeckel's accounts of his problematic genera *Petasus*, *Dipetasus*, *Petasata*, and *Petachnum*. In all the other genera of the family, as *Gonionemus*, *Olindias*, *Eperetmus*, *Aglauropsis*, *Cubaia*, *Vallentinia*, *Olindioides*, *Craspedacusta*, and probably in *Gossea*, the sense-organs lie in vesicles, which themselves are usually inclosed in the mesogloea.

The otoliths of *Nauarchus* are clearly entodermal, just as in the Trachynemidae; and, according to Perkins and Murbach, this is also true of *Gonionemus*, as it apparently is of *Eperetmus* (1915*b*, pl. 59, fig. 8). That is to say, the sense-club of *Nauarchus*, or indeed that of any Trachomedusa in which this type of sense-organ occurs, corresponds essentially to the strand of cells with terminal concretion, which lies within the vesicle of *Gonionemus*. Both are modified tentacles. And although Goto (1903) believed the otocysts of *Olindias* to be of ectodermal origin, it is not likely that they are fundamentally different in that genus from in its allies. *Rhopalonema*, in which the club, at first free, is later enclosed by the upgrowth of a crater-like vesicle, may epitomize the relationship here outlined.

Family TRACHYNEMIDAE Gegenbaur, 1856.

Genus COLOBONEMA Vanhöffen, 1902.

Colobonema Maas (1905), Browne and Fowler (1906), Bigelow (1909*a*). *Homoeonema* Part Mayer (1910).

Trachynemidae, with tentacles all of one kind, 32 in number, of which the 8 perradial, the 16 adradial, and finally the 8 interradial develop in succession.

One species of this genus, *sericeum* Vanhöffen, now well known (except for tentacles and otocysts), has been taken in the Bay of Biscay (Browne and Fowler, 1906), off the west coast of Africa from Sierra Leone to 42° S. (Vanhöffen, 1902), in the Malaysian region (Maas, 1905), and in the eastern tropical Pacific (Bigelow, 1909*a*). Whether or not the *Homoeonema typicum* of Maas (1897), from off the Pacific coast of Central America, is identical with it, has been the subject of a good deal of discussion. Mayer (1910), following Maas (1905), believes that it is. As I have previously pointed out, Maas, in his original description of *typicum*, writes that there are more than four times as many tentacles as canals—that is, more than 32—and his figure shows 41. Now, all recent studies, and the present series as well, show that in *sericeum* the number of tentacles is determinate, invariably 32 in adults. This number is present in moderate-sized individuals, and is not overstepped even in very large ones However, the material on which Maas based his early account was not of the best, and he himself suggests (1905) that it was its poor condition which led to his crediting it with so many tentacles. Unfortunately Maas's original specimen is apparently no longer in existence, so the question can never be settled absolutely. For the sake of uniformity I follow Mayer and use the name *typicum* (1913, p. 46) instead of *sericeum*, as I formerly did. But Vanhöffen deserves credit for first giving us an adequate account of this interesting genus.

COLOBONEMA TYPICUM (Maas).

Homoeonema typicum Maas, 1897, p. 22, pl. 3, figs. 1–3. Synonymy, Mayer, 1910, p. 385.

Colobonema typicum—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
1720	M.C.Z.	1	5120	Verde Island Passage.
40437	U.S.N.M.	2	5120	Do.
1662	M.C.Z.	1	5125	
40438	U.S.N.M.	1	5227	Off east coast of Mindoro.
1662	M.C.Z.	1	5227	Do.
....		2	5227	Do.
29307	U.S.N.M.	2	5287	Verde Island Passage.
3046	M.C.Z.	2	5287	Do.
40439	U.S.N.M.	1	5293	Do.
1661	M.C.Z.	1	5293	Do.
29402	U.S.N.M.	4	5295	Do.
1685	M.C.Z.	2	5295	Do.
29308	U.S.N.M.	1	5320	China Sea, vicinity Hongkong.
3047	M.C.Z.	1	5320	Do.
29306	U.S.N.M.	1	5438	Off west coast of Luzon.

The specimens range from 16 to 33 mm. in height; they are all more or less fragmentary. Only in two particulars will they add to the previous accounts of this species, i. e., as regards otocysts and length of the manubrium. Previously no otocysts had been found in *Colobonema*, although a good many specimens had been examined—

a fact that led to the suggestion that they might be lacking in this genus (Bigelow, 1909*a*). But I have found one, in one of the present examples, a particularly fragmentary example, as it happens. The sense organ is a free club, much like that of *Aglantha*, standing free on the margin, midway between two tentacles. Its structure is not remarkable, there being an entodermal core with a terminal mass of concretions. It is not in very good condition. It stands on a slight elevation of the margin, and though I could find no other otocysts in any of the specimens, several of them showed the elevations, alternating with the tentacles.

The present series supports the view that the length of the manubrium is so variable as to be quite worthless as a specific criterion. The extremes illustrated here are a specimen 26 mm. high, in which it is only 1 mm. long; and two of 27 mm. and 29 mm., respectively, in which it hangs to the bell opening; and as there is a series of intermediates between these two, the differences are merely evidences of contraction and expansion. In specimens not too much contracted, and in good condition, the mouth is surrounded by four prominent lips. But under extreme contraction, or in very limp specimens, these may be masked.

I examined all the specimens without finding any variation, in any octant, from the normal number of tentacles, i. e. two adradials and one interradial. In the smaller examples the latter is much the smallest, but in the larger ones all are of nearly the same size.

Genus RHOPALONEMA Gegenbaur, 1856. Sens. em. Vanhöffen, 1902.

The studies of Maas (1893) and especially of Vanhöffen (1902) have given us an excellent concept of the structure and limits of *Rhopalonema*. I have previously (1909*a*) discussed this genus at some length, and given my reasons for concluding that all species referable to *Rhopalonema* which have yet been described belong either to *velatum* or to the species from the mid depths variously known as *funerarium* or *coeruleum*—a view which I share with Vanhöffen (1902) and with Maas (1905).

RHOPALONEMA VELATUM Gegenbaur.

Rhopalonema velatum GEGENBAUR, 1856, p. 251, pl. 9, figs. 1–5. Synonymy, Bigelow 1909*a*, p. 129, and Mayer 1910, p. 378.

Rhopalonema velatum—material examined.

Catologue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29381	U.S.N.M.	4	5190	Tanon Strait, east coast of Negros	3–5
3052	M.C.Z.	2	5190	.....do.	3–5
40440	U.S.N.M.	8	5530	Between Siguijor and Boho	3–5
1682	M.C.Z.	3	5530		3–5

All the specimens are much battered—but all show an apical thickening of the gelatinous substance, either as a circumscribed "top-knot" or as a more gradual swelling. This was true likewise of the eastern Pacific specimens, of those recorded by Browne and Fowler (1906) from the Bay of Biscay (as "*coeruleum*"), and of the Japanese series recently described by Maas (1909). But the specimens from Trieste studied by Neppi and Stiasny (1913) had none.

R. velatum was known to occur in the Malaysian region (Maas, 1905), and it is widely distributed over the tropical Pacific; therefore it was to be expected in the Philippines. The only surprising thing about the records is that it was taken at two stations only.

Family HALICREASIDAE Fewkes, 1886. HALICREIDAE Vanhöffen (1902) sens, em.

Trachomedusae with eight very broad radial canals; with numerous tentacles of different sizes, but all structurally alike and arranged in a single series; each tentacle divisible into a soft flexible proximal, and a stiff spine-like distal region: with free sensory clubs; with neither peduncle nor proboscis.

The general structure of these remarkable Medusae is now well known, thanks to Vanhöffen (1902), Maas (1905), Browne (1908), and to the excellent series from the eastern Pacific (Bigelow, 1909*a*).

Mayer (1910) classes the genera here included among the Trachynemidae, uniting them with *Rhopalonema* and allied forms, as the subfamily Rhopaloneminae, because of the absence of peduncle. But they are separated from *Rhopalonema*, etc., by their very broad radial canals; by the structure of the tentacles, which is extremely characteristic; by the large otocyst clubs; and especially by the rudimentary, flattened manubrium. On the other hand, they are a very homogeneous group among themselves. I need make no apology for retaining them as a separate family, when in so doing I agree with every recent student who has actually examined any of them.

Genus HALICREAS Fewkes 1882.

HALICREAS PAPILLOSUM, Vanhöffen.

Halicreas papillosum Vanhöffen, 1902, p. 68, pl. 9, figs. 7, 8; pl. 11, fig. 30.—Maas, 1905, p. 57, pl. 10, fig. 70; pl. 11, fig. 71.—Bigelow, 1909*a*, p. 138, pl. 3, fig. 3; pl. 33, figs. 8, 9; pl. 34, figs. 1–3, 5, 8, 10, 11.

Halicreas papillosum—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29349	U.S.N.M.	1	5120	Verde Island Passage	21

The single example is in such poor condition that I can add nothing to my previous account of the species, taken from the excellent series collected by the *Albatross* in the eastern Pacific. *H. papillosum* is already known from the Malaysian region (Maas, 1905). Considering how regularly it occurred in the eastern Pacific, it is surprising that only one of the Philippine hauls captured it.

Family GERYONIDAE Eschscholtz, 1829.

Genus GERYONIA Péron and Lesueur, 1809.

GERYONIA PROBOSCIDALIS (Forskål) Eschscholtz.

Medusa proboscidalis Forskål, 1775, p. 108, 1776, pl. 36, fig. 1. Synonymy, Bigelow, 1909*a*, p. 116, and Mayer, 1910, p. 425. (To the latter, add *Geryones elephas* Haeckel, 1879, p. 294, pl. 18, fig. 7.

Geryonia proboscidalis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29405	U.S.N.M.	1	5177	Verde Island Passage	35, with 5 canals.

Mayer (1910) has given an excellent account and beautiful figures of this species. Its ova have formed the foundation of a recent investigation by Maas (1908) on the composition of the egg and on the early development, both normal, and when the blastomeres are separated.

Variations from the normal hexamerous condition are very common; thus each of the specimens in the *Albatross* eastern Pacific collection had seven radial canals.

Geryonia proboscidalis is widely distributed over the warmer parts of all oceans.

Genus LIRIOPE Lesson, 1843.

I have recently (1909*a*, 1913) discussed this puzzling genus and given my reasons for uniting, under the name *tetraphylla*, all *Liriope* with angular or heart-shaped gonads. All the specimens of the present collection belong to that form.

LIRIOPE TETRAPHYLLA (Chamisso and Eysenhardt) Gegenbaur.

Geryonia tetraphylla, Chamisso and Eysenhardt, 1821, p. 357, pl. 27, fig. 2. To the synonymy already given by me (Bigelow, 1909*a*, p. 112), add:

Liriope haeckeli Goette, 1886, p. 833.—Hartlaub, 1909, p. 464, pl. 22, figs. 29, 30, 33.

Liriope rosacea Hartlaub, 1909, p. 466, pl. 22, figs. 28, 31, 32.—Maas, 1909, p. 31.—Mayer, 1910, p. 417.

Lirope tetraphylla Mayer, 1910, p. 418.

Liriope tetraphylla—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
....	....	2	5128	Sulu Sea, vicinity southern Panay.
29362	U.S.N.M.	1	5155	Off Bakum Point, Tawi Tawi.
40441	U.S.N.M.	1	5175	Sulu Sea, between Palawan and Negros.
40442	U.S.N.M.	1	5177	Verde Island Passage.
29364	U.S.N.M.	1	5186	Between Panay and Negros.
....	....	1	5190	Tanon Strait, east coast of Negros.
29361	U. S. N.M.	2	5195	Off northern Cebu.
....	....	3	5195	Do.
....	....	3	5530	Between Siguijor and Bohol.
40443	U. S. N.M.	13	5649	Buton Strait.
1675	M.C.Z.	9	5649	Do.
....	....	9	5649	Do.
29363	U.S.N.M.	2	5663	Macassar Strait.
29360	U.S.N.M.	10	5669	Do.
3048	M.C.Z.	5	5669	Do.
40444	U.S.N.M.	5	5672	Do.
1681	M.C.Z.	3	5672	Do.
....	....	3	5672	Do.

The specimens range from 8 to 16 mm. in diameter, and are all in what I have called the "rosacea" stage (1909*a*), as were all but the smallest (less than 5 mm. in diameter) described by Maas (1909) from Japan. It has been described so fully by him (1905), by Hartlaub (1909), and by the writer (1909*a*) that a brief statement of the growth condition of the present series will suffice here.

Maas found that the first trace of gonads appears in specimens 3 to 4 mm. in diameter, and that at first they are oval, just as I described them from the eastern Pacific series. This outline, however, is transitory, the triangular form being attained in specimens 5 to 6 mm. in diameter. This, of course, explains the fact that it was only the very smallest specimens of *tetraphylla* from the eastern Pacific, 7 mm. or less, that had oval or squarish gonads. Therefore it is not surprising that the triangular outline is universal in the Philippine series, all of which are 8 mm. or larger.

The gonads are not in contact in any of the specimens, nor were they in the Japanese examples of about the same size (12 to 14 mm.; Maas, 1909, p. 31). In the eastern Pacific collection it was only in specimens 18 mm. or larger that they were large enough to touch each other, while in none smaller than about 20 mm. did they show the pentagonal form typical of the "compacta" stage (Bigelow, 1909*a*). But in one specimen from the northwest Pacific only 12 mm. in diameter one gonad was pentagonal (Bigelow 1913, p. 55).

Most of the specimens have three blind canals in each quadrant, but one 16 mm. in diameter has four in one, three in each of the others. The other specimens of this size, of which there are four, are badly damaged. Maas (1905, 1909) found more than three canals only in specimens 18 mm. in diameter and upward.

Order NARCOMEDUSAE.

In previous paper (1909*a*) I have discussed at length the structure and apparent relationships of the Narcomedusae and given my reasons for adopting, in the main, the classification proposed by Maas. Mayer (1910) has likewise accepted the main principle laid down by Maas and me—namely, that the presence or absence of gastric pockets is of prime importance; the presence or absence of a peripheral canal system of little significance in classification.

A very different scheme has been outlined by Vanhöffen (1908). I have already (1909*a*, 1918) criticised his preliminary statement, and Maas (1909) and Mayer (1910), with whom I entirely agree in their general conclusions, have discussed his final account of the *Valdivia* Narcomedusae.

The only important difference between the scheme adopted by Maas and by me on the one hand and the classification used by Mayer on the other is that in the former Aeginidae and Cunanthidae are distinct families; in the latter they are reduced to the rank of two subfamilies of a single family.

Family CUNANTHIDAE Haeckel, 1879.

Genus SOLMISSUS Haeckel 1879.

Sens. em. MAAS (1904*a*–1904*b*).—BIGELOW (1909*a*).—MAYER (1910).
Solmaris (part) VANHÖFFEN (1908).

No part of Vanhöffen's classification of the Narcomedusae is further from representing what I believe to be the natural relationships of the forms involved than his treatment of *Solmissus*.

Vanhöffen's definition of his genus *Solmaris* is based upon the statement (1908, p. 58) that "alle Solmariden auch mit Magentaschen ausgestattet sind. Dass Magentaschen fehlen sollen, beruht auf Beobachtung an jungen noch nicht genügend entwickelten Tieren oder an mangelhaft erhaltenen Exemplaren." But we have the word of Maas (1909, p. 34), of Mayer (1910), and of Neppi and Stiasny (1913), that there are solmarids—that is, forms with neither otoporpae nor peripheral canals—which do lack any trace of true gastric pockets when adult, the gastric margin running direct or on the arc of a circle from tentacle base to tentacle base. And these students made their observations not only on young or on fragmentary material, but on living specimens in various stages of development, including sexually mature adults. I can substantiate their statements for an excellent adult specimen of *Solmaris flavescens* Kölliker from the Mediterranean, a species recently redescribed by Mayer. The margin of the stomach is entire; there are no gelatinous septa in the interradii.

The condition of the margin of the stomach in this species is precisely what it would be in a *Pegantha* did the sexual products develop irregularly and sparsely near the outer edge of the lower gastric wall instead of being localized in regions where the lower walls grow downward, as pockets, to accommodate them. Apparently Vanhöffen had not seen this species, for he has given the name *flavescens* to a form with gastric pockets; that is, a *Solmissus.* I must confess that I can not understand Vanhöffen's statement (1908, p. 69) that all species of his genus *Solmaris* have interradial gelatinous septa horizontal to the plane of the stomach, instead of vertical to it, as in Aeginidae. Inasmuch as the gastric pockets in *Solmissus marshalli* and *S. albescens* (Bigelow, 1909*a;* Mayer, 1910) are structurally precisely similar to the corresponding pockets in *Cunina* and *Cunoctantha*, it is in such forms as *Solmaris flavescens* Kölliker (not *S. flavescens* Vanhöffen) that we must seek horizontal septa if they exist anywhere. By a horizontal septum must be understood one which, by growing centrad, leaves the lower gastric wall reaching outward beyond, and thus overlapping its line of union with the oral surface of the disk; in other words, forming a horizontal pouch. But there is nothing of this sort in *S. flavescens* any more than there is in *Pegantha*, as is clearly shown in Mayer's figure of a section through the interradius (1910, fig. 286). The only thing which might possibly suggest such a septum is the fact that the sexual mass in the male may overlap the subumbrella slightly, beyond the gastric margin. But this is purely a secondary phenomenon, caused by the rapid proliferation of the sexual cells themselves; that is, it is directly comparable to the secondarily formed genital pouches of *Pegantha*, and has nothing to do with the gastric pockets of *Solmissus* or *Cunina*, which develop long before the sexual products begin to appear.

The genus *Solmaris* of Vanhöffen includes two distinct groups of species—one with, the other without, gastric pockets. According to the classification proposed by Maas, and here adopted, they not only belong to different genera, *Solmaris* and *Solmissus* but to different families.

Two of Vanhöffen's species of *Solmaris*, his *S. flavescens*, which, as noted above, is not the *Solmaris flavescens* of Kölliker, Gegenbaur, and latterly of Mayer (1910), and probably three specimens identified by him as *S. rhodoloma* Brandt belong to *Solmissus*, as here defined.

The present collection contains a considerable series of *Solmissus marshalli*, a species separable from the well-known Mediterranean *S. albescens* Gegenbaur only by the lack of exumbrellar sculpture (Mayer 1910), large number of otocysts, and square instead of slightly pentagonal gastric pockets.

Vanhöffen's *Solmaris flavescens* is apparently identical with *Solmissus marshalli*, as he himself points out (Vanhöffen 1912, p. 395). But the name *marshalli* must be used because *flavescens*, as applied to a *Solmissus* (not being the *Solmaris flavescens* of Kölliker), dates only from 1908; *marshalli* from 1902.

SOLMISSUS MARSHALLI Agassiz and Mayer.

Solmissus marshalli Agassiz and Mayer, 1902, p. 151, pl. 5, figs. 23–25.—Bigelow, 1909*a*, p. 64, pl. 16, figs. 5, 6, pl. 21, figs. 4, 6–8.—Mayer, 1910, p. 484.

Solmissus marshalli—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29415	U.S.N.M.	12	5227	Off east coast of Mindoro	22–53
1684	M.C.Z.	4	5227	do.	
29385	U.S.N.M.	1	5320	China Sea, vicinity Hongkong	
29386	U.S.N.M.	1	5320	do.	
		1	5500	Off northern Mindanao	

All the specimens are so battered that I can add nothing to my account of the much better preserved series from the eastern Pacific (1909*a*), except a few notes on the numbers of tentacles and of otocysts. Out of the total of 22 specimens, two have 11, two 12, five have 14, six 15, and five have 16 tentacles and gastric pockets. In the eastern Pacific series of 11 specimens, 8 was represented once, 11 once, 12 twice, 13 once, 14 once, and 16 five times. The number of tentacles varies irrespective of size. Thus the two largest examples of 52 and 53 mm. have 16 and 15 tentacles, respectively; the two smallest, of 19 and 22 mm., 14 and 15. The specimens with the fewest tentacles—that is, with 11 and 12—are of medium size, 36, 34, 28, and 30 mm. in diameter. The smallest with 16 tentacles, is only 30 mm.

The largest number of otocysts in any one lappet in the eastern Pacific series was 15. But in one of the Philippine collection, 48 mm. in diameter, with 14 tentacles, there are 15 and 21 in two successive lappets. In another of 45 mm., with 15 tentacles, there are 11 and 19 in two lappets. In one of 46 mm., 16 tentacles, 11 and 14 in two lappets. The margins are all so damaged that I could not count the otocysts on more than two lappets in any one specimen.

S. marshalli, or the variety *marshalli* of *albescens*, which ever its final fate, is widely distributed over the tropical Pacific, as far north as the Hawaiian Islands, and so far east as off the coast of Peru; and Vanhöffen's (1908, 1912) records from the tropical Atlantic and Indian Oceans probably belong to it also.

Family AEGINIDAE Gegenbaur, 1856.

Genus AEGINA Eschscholtz, 1829.

Sens em. MAAS (1904*a*, 1905).—BIGELOW (1909*a*, 1913).

AEGINA CITREA Eschscholtz.

Aegina citrea ESCHSCHOLTZ, 1829, p. 113, pl. 11, fig. 4. Synonymy, Mayer, 1910, p. 451.

Aegina citrea—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29277	U.S.N.M.	1	5120	Verde Island Passage	17

The specimen is in fair condition, except for the margin, which is so damaged that I have not been able to count the otocysts, nor to make any observations on the peripheral canal system.

The gastric pouches are of the typical *citrea* type, each of the eight pouches is subdivided at its margin by a shallow indentation, just as in the larger specimens in the eastern Pacific and northwestern Pacific series (Bigelow 1909*a*, 1913) and as figured by Maas (1905) for the *Siboga* examples.

Color.—In the preserved specimens stomach and gonads are pale yellowish; tentacles colorless.

AEGINA ROSEA Eschscholtz.

Aegina rosea ESCHSCHOLTZ, 1829, p. 115, pl. 11, fig. 4.—HAECKEL, 1879, p. 338.—VANHÖFFEN, 1908, p. 48, pl. 7, figs. 1, 2; pl. 9, figs. 16–19.—MAAS, 1909, p. 35. For further synonymy see Mayer, 1910, p. 452, "*A. rhodina*."

Aegina rosea—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29278	U.S.N.M.	1	5659	Gulf of Boni, Celebes	24

The single example is in rather poor condition; the margin very much damaged, and the large gonads torn. No study of the otocysts or peripheral canals was possible. Its identity with *rosea* is shown by the fact that, in spite of its large size, the eight gastric pouches are not subdivided, and by the reddish color of stomach and gonads. It is too poorly preserved to add anything to the previous accounts.

Genus SOLMUNDELLA Haeckel 1879.

Sens. em. MAAS, (1904, 1905), BROWNE (1905).

This genus has recently been discussed by Maas (1909), Browne (1905), Mayer (1910), Vanhöffen (1908), and by the writer (1909*a*).

SOLMUNDELLA BITENTACULATA (Quoy and Gaimard) Browne.

Charybdea bitentaculata QUOY and GAIMARD, 1834, p. 295, pl. 25, figs. 4, 5. Synonymy, Bigelow 1909*a*, p. 77, Mayer 1910, p. 455.

Solmundella bitentaculata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29384	U.S.N.M.	1	5456	Off east coast of Luzon.
		24	5456	Do.
40445	U.S.N.M.	1	5581	Vicinity Darvel Bay, Borneo.

Order SIPHONOPHORES.

All but two of the present list are recorded by Lens and Van Riemsdijk (1908) from the Malayan region collection, or from Amboina by Bedot (1896), and these two were taken by the *Albatross* in the eastern Pacific (1911*b*). Most of them are well-known forms, which have been described and figured by other authors; and the status and synonymy of all have been discussed in detail elsewhere (Bigelow, 1911*b*).

The two most interesting captures are the remarkable eudoxid *Archisoma natans* Bigelow, and *Chuniphyes multidentata* Lens and Van Riemsdijk.

Geographically the collection is not particularly instructive, for all the species were to be expected among the Philippines. Unfortunately the labels give no information as to the depths from which any of the specimens came.

Suborder CALYCOPHORAE.

Family SPHAERONECTIDAE Huxley, 1859.

Genus CUBOIDES Quoy and Gaimard, 1827.

CUBOIDES VITREUS Quoy and Gaimard.

Cuboides vitreus QUOY and GAIMARD, 1827, p. 19, pl. 2E, figs. 1–3. Synonymy, Bigelow, 1911*b*, p. 190.

Cuboides vitreus—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40446	U.S.N.M.	1	5436	Off Corregidor Lt., west coast of Luzon.
29311	U.S.N.M.	2 eudoxids	5436	Do.
29310	U.S.N.M.	1 eudoxid	5436	Do.
29312	U.S.N.M.	15	5500	Northern Mindanao.
29309	U.S.N.M.	20 eudoxids	5500	Do.
1654	M.C.Z.	19	5500	Do.

This species is usually known as *Halopyramis adamantina* Chun. But as Chun (1892) himself says that its eudoxid is the *Cuboides vitreus* of Quoy and Gaimard—a statement which is undoubtedly correct—no choice is left but to use the older name for the species as a whole.

Like Bedot (1896) and Lens and Van Riemsdijk (1908), I have been unable to find any differences to separate the Philippine or Eastern Pacific from Atlantic specimens. Chun's beautiful figure (1892) might have been taken from any one of the larger Philippine specimens. *Cuboides vitreus*, like so many other siphonophores, occurs in the warmer parts of all great oceans.

The present specimens, in excellent condition, are larger than any Indo-Pacific examples yet recorded, the nectophores measuring 9 to 14 mm., the bract of the eudoxid from 4 to 10 mm. in height.

Family PRAYIDAE Kölliker, 1853.

AMPHICARYON ACAULE Chun.

Amphicaryon acaule CHUN, 1888, p. 1162. Synonymy Bigelow, 1911*b*, p. 195, pl. 4, fig. 1–8.

Amphicaryon acaule—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Diameter in mm.
29289	U.S.N.M	1	5451	Off east coast of Luzon	About 9.
1608	M.C.Z	1	5451	do	Do.

Each of the specimens has lost the older bractlike nectophore, besides the stem and appendages. But the outlines and proportions of the nectosac of the remaining nectophores are so characteristic that the identification is justified.

The specimens are interesting chiefly because they extend the range of genus and species to Philippine waters. It was known previously only from the Atlantic and from the eastern tropical Pacific.

PRAYA CYMBIFORMIS (Delle Chiaje) Leuckart.

Physalia cymbiformis DELLE CHIAJE, 1842, pl. 33. Synonymy, Bigelow, 1911*b*, p. 200.

Praya cymbiformis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29413	U.S.N.M	15 nectophores	5,500	Off northern Mindanao.
1660	M.C.Z	5 nectophores	5,500	Do.
29379	U.S.N.M	1 detached nectophore	5,659	Gulf of Boni, Celebes.

In these specimens the stems and appendages are entirely lost, and the nectophores themselves are so crumpled and torn that the most that can be said about them is that they are certainly prayids. And since the hydroecium (when distinguishable) reaches from one end of the nectophore to the other, they probably belong to *P. cymbiformis*.

Family HIPPOPODIIDAE Kölliker, 1853.

Genus HIPPOPODIUS Quoy and Gaimard, 1827.

HIPPOPODIUS HIPPOPUS (Forskål) Schneider.

Gleba hippopus Forskål, 1775, p. 14, 1776, pl. 43, fig. E. Synonomy, Bigelow, 1911*b*, p. 208.

Hippopodius hippopus—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29353	U.S.N.M.	6 detached nectophores	5129	Sulu Sea, off western Mindanao
1620	M.C.Z.	1 detached nectophore	5129	Do.
		63	5129	Do.
29352	U.S.N.M.	1, with 2 large and 2 very small nectophores and 1 detached nectophore	5240	Vicinity Pujada Bay, Mindanao.
29357	U.S.N.M.	2 nectophores	5451	Off east coast of Luzon.
1751	M.C.Z.	8 nectophores	5497	Between Leyte and Mindanao.
29358, 29355	U.S.N.M.	2, with 2 and 3 nectophores and 38 detached nectophores.	5500	Off northern Mindanao.
29356	U.S.N.M.	1, with 2 nectophores	5530	Between Siquijor and Bohol.
29354	U.S.N.M.	3 detached nectophores	5616	Molucca Passage.
40447	U.S.N.M.	8	5647	Buton Strait.
1659	M.C.Z.	4	5647	Do.

Family DIPHYIDAE Eschscholtz, 1829.

Genus ABYLA Quoy and Gaimard, 1827.

ABYLA LEUCKARTII Huxley.

Abyla leuckartii Huxley, 1859, p. 49, pl. 3, fig. 2. Synonymy, Bigelow, 1911*b*, p. 216.

Abyla leuckartii—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40448	U.S.N.M.	1 eudoxid	5451	Off east coast of Luzon.
29262	U.S.N.M.	2 superior nectophores	5601	Gulf of Tomini, Celebes.
3055	M.C.Z.	1 nectophore	5601	Do.
40449	U.S.N.M.	3 nectophores	5672	Macassar Strait.
1634	M.C.Z.	....do	5672	Do.

The inferior nectophore of this species was discovered very recently, and is so far known only from small examples (Bigelow, 1911*b*). Unfortunately the present specimen is so crumpled that I can add nothing to my previous account.

The eastern Pacific series (Bigelow, 1911*b*) showed that the remarkable eudoxid *Ceratocymba asymmetrica* Lens and Van Riemsdijk is the free eudoxid of *A. leuckartii*. *Ceratocymba sagittata* Quoy and Gaimard is the eudoxid of *Diphyabyla hubrechti* Lens and Van Riemsdijk (Bigelow, 1918; Moser, 1911, 1912).

Though the superior nectophore of *A. leuckartii* is so characteristic that it is not likely to be mistaken for any other species, it has seldom been recorded. The *Siboga* took it at five stations; the *Albatross* at seven in the eastern Pacific. Agassiz and Mayer (1902) describe it from the Marquesas and from near the Paumotas. Huxley's original specimen was taken off the east coast of Australia. I have recently recorded it from the West Indies (Bigelow 1911*b*, 1918); Moser (1913) from the Atlantic.

ABYLA TRIGONA Quoy and Gaimard.

Abyla trigona Quoy and Gaimard, 1827, p. 14, pl. 2B, figs. 1–8. Synonymy, Bigelow, 1911*b*, p. 221.

Abyla trigona—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40450	U.S.N.M.	1 superior nectophore	5120	Verde Island Passage.
29266	U.S.N.M.	do	5451	Off east coast of Luzon.
40451	U.S.N.M.	do	5581	Vicinity Darvel Bay, Borneo.
29264	U.S.N.M.	4 nectophores	5601	Gulf of Tomini, Celebes.
1658	M.C.Z.	1 superior nectophore	5601	Do.
		1 eudoxid bract only	5320	China Sea, vicinity of Formosa
29267	U.S.N.M.	8	5672	Macassar Strait.
3074	M.C.Z.	4	5672	Do.

The superior nectophores are all in fair condition, but only two of the five inferior ones (station 5672) preserve their normal outlines.

All of the specimens show the conformation of facets and ridges characteristic of *trigona*, as opposed to the closely related *haeckeli* Lens and Van Riemsdijk. The difference has been discussed elsewhere (Bigelow, 1911b). Briefly stated, it consists in the presence of a transverse ridge in the superior nectophore of *haeckeli*, which divides the single dorsal facet, such as is seen in *trigona*, into two facets. A very detailed description has been given by Lens and Van Riemsdijk.

A. trigona or its eudoxid was taken at 18 stations by the *Siboga*, and it is also known from the Indian Ocean, so it was to be expected in Philippine waters.

ABYLOPSIS TETRAGONA (Otto) Bigelow.

Pyramis tetragona Otto, 1823, p. 306, pl. 42, figs. 2*a*–2*e*. Synonymy, Bigelow, 1911b, p. 224.

This species has usually been known as *Abyla pentagona* Quoy and Gaimard. The use of the name *tetragona* rests on Chun's statement

(1897, p. 31) that Otto's type-specimen, preserved at Breslau, was undoubtedly *A. pentagona.* The necessity of the change was pointed out by Schneider (1898).

Abylopsis tetragona—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29271	U.S.N.M.	2	5177	Verde Island passage.
1614	M.C.Z.	2	5177	Do.
40453	U.S.N.M.	1	5224	Between Marinduque and Luzon.
40454	U.S.N.M.	1 superior and 1 inferior nectophore.	5436	Off Corregidor Light, west coast of Luzon.
29270	U.S.N.M.	1	5451	Off east coast of Luzon.
....	....	35, and 61 inferior nectophores.	5451	Do.
29389	U.S.N.M.	20 nectophores	5456	Do.
1622	M.C.Z.	10 nectophores	5456	Do.
29275	U.S.N.M.	1	5500	Off northern Mindanao.
40455	U.S.N.M.	1	5581	Vicinity Darvel Bay, Borneo.
1615	M.C.Z.	1	5581	Do.
29272	U.S.N.M.	2	5601	Gulf of Tomini, Celebes.
1638	M.C.Z.	1	5601	Do.
29273	U.S.N.M.	2	5616	Molucca passage.
3062	M.C.Z.	2	5616	Do.
40456	U.S.N.M.	1	5663	Macassar Strait.
29274	U.S.N.M.	2	5669	Do.
1633	M.C.Z.	1	5669	Do.

ABYLOPSIS ESCHSCHOLTZII (Huxley) Bigelow.

Aglaismoides eschcholtzii Huxley, 1859, p. 60, pl. 4, fig. 2 (eudoxid).
Abylopsis quincunx Chun, 1888, p. 20. Synonymy, Bigelow, 1911*b*, p. 226.

Abylopsis eschscholtzii—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29268	U.S.N.M.	1	5436	Off Corregidor Light, west coast of Luzon.
....	....	1 inferior nectophore	5500	Off northern Mindanao.
29269	U.S.N.M.	18 nectophores and euxodids	5616	Molucca Passage.
1632	M.C.Z.	10 nectophores and eudoxids	5616	Do.

The eudoxid (*Aglaismoides eschscholtzii* Huxley) was taken at Station 5616, 19 specimens.

This small series, not in very good condition, does not add anything of importance to the previous descriptions of the species. It, or its eudoxid, was taken at 33 stations by the *Siboga*, and 22 by the *Albatross* in the eastern Pacific. Lens and Van Riemsdijk (1908) and the writer (1911*b*) have discussed its relationship to *tetragona*, and the characters which distinguish its nectophores and eudoxid from that species.

Genus BASSIA L. Agassiz.

BASSIA BASSENSIS (Quoy and Gaimard) Bigelow.

Diphyes bassensis Quoy and Gaimard, 1834, p. 91, pl. 7, figs. 18–20. Synonymy, Bigelow, 1911*b*, p. 229.

Bassia bassensis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29293	U.S.N.M..........	1 inferior nectophore..........	5120	Verde Island Passage.
29294	U.S.N.M..........	1 superior and 1 inferior nectophore.	5436	Off Corregidor Light, west coast of Luzon.
3072	M.C.Z............	.....do..........................	5436	Do.
40457	U.S.N.M..........	5 nectophores..................	5649	Buton Strait.
40458	U.S.N.M..........	4 eudoxids.....................	5649	Do.
1618	M.C.Z............	4 nectophores and 9 eudoxids..	5649	Do.
....	....	8 nectophores..................	5649	Do.
40459	U.S.N.M..........	1 inferior nectophore..........	5672	Macassar Strait.
29292	U.S.N.M..........	2 inferior nectophores..........	5663	Do.
1619	M.C.Z............	.....do..........................	5663	Do.

All of the specimens were very much battered, but owing to its characteristic form, and especially to the opacity of its ridges, which appear white against a black background after preservation in formalin, *bassensis* is easily recognized. It was taken by the *Siboga* in considerable numbers in Malayan waters.

Genus GALEOLARIA Blainville.

GALEOLARIA QUADRIVALIS Blainville.

Sulculeolaria quadrivalvis Blainville, 1830, p. 126. Synonymy, Bigelow, 1911*b*, p. 137, pl. 5, figs. 1–7, 1918, p. 416.

Galeolaria quadrivalvis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40460	U.S.N.M..........	1 inferior nectophore..........	5320	China Sea, vicinity of Hongkong.
40461	U.S.N.M..........	2 nectophores..................	5649	Buton Strait.
1639	M.C.Z............	1 nectophore...................	5649	Do.
....	....	11 inferior nectophores.........	5669	Macassar Strait.

None of the specimens are in good condition: all have lost the entire stem.

It is somewhat surprising that no superior nectophores were found among the numerous Galeolarias from station 5669, especially since the long somatocyst is a good field mark for *quadrivalvis*, even when the margin is so contracted that it is hard to distinguish the two narrow dorsal teeth. The inferior nectophores all show the characteristic conditions of the nectosac.

G. quadrivalvis was taken by the *Siboga* at 8 stations. It is widely distributed over the eastern tropical Pacific, as well as in the Atlantic.

GALEOLARIA AUSTRALIS Quoy and Gaimard.

Galeolaria australis Quoy and Gaimard, 1834, p. 42, pl. 5. Synonymy, Bigelow, 1911*b*, p. 238, 1918, p. 419.

Galeolaria australis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29346	U. S. N. M.	2 nectophores	5500	Off northern Mindanao.
3063	M. C. Z.	1 nectophore	5500	Do.
40532	U. S. N. M.	2 nectophores	5610	Gulf of Tomini, Celebes.
29345	U. S. N. M.	10 nectophores	5669	Macassar Strait.
29347	U. S. N. M.	7 nectophores	5669	Do.
3064	M. C. Z.	10 nectophores	5669	Do.
29404	U. S. N. M.	100 nectophores	5672	Do.
1649	M.C.Z.	About 100 nectophores	5672	Do.

The question of the possible identity of the tropical Indo-Pacific *australis* with the boreal Atlantic *biloba* Sars has been discussed fully in my report on the eastern tropical Pacific collection (1911*b*). According to Moser (1913) the two are identical. The present specimens agree very well with the eastern Pacific representatives. The length of the somatocyst varies a good deal—it is always short, reduced to a mere bubble in some, and in a few of the most fragmentary ones none is to be seen. But in these its absence is only the result of mutilation.

I was in hopes that this large series would throw some light on the question of the identity of *G. chuni* of Lens and Van Riemsdijk, resembling *australis*, except for a much longer somatocyst, which I referred provisionally to the synonymy of the latter. But none of the specimens approach the *chuni* type. According to Moser (1913) *chuni* is distinct, but she does not state the difference.

GALEOLARIA MONOICA Chun.

Epibulia monoica Chun, 1888, p. 17.

Galeolaria monoica Chun, 1897, p. 17.—Lens and Van Riemsdijk, 1908, p. 60, pl. 9, figs. 76, 77.—Bigelow, 1911*b*, p. 239, pl. 6, figs. 4–9, 1918, p. 418.

Galeolaria monoica—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29348	U.S.N.M.	1 nectophore	5669	Macassar Strait.
3054	M.C.Z.	1 nectophore	5669	Do.

These two nectophores are in fair condition and show the complex basal structure which I have described elsewhere (Bigelow, 1911*b*, p. 239). The small somatocyst in conjunction with a prominent dorsal and two lateral teeth and two ventral wings distinguishes the superior nectophore, while the inferior one is characterized by similar teeth and a single undivided ventrobasal wing.

Genus DIPHYES Cuvier.

DIPHYES APPENDICULATA Eschscholtz.

Diphyes appendiculata Eschscholtz, 1829, p. 138, pl. 12, fig. 7. Synonymy, Bigelow, 1911*b*, p. 248, pl. 7, figs. 5, 6; pl. 8, figs. 7, 8; pl. 9, fig. 6; pl. 11, fig. 1.

Diphyes appendiculata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
1650	M.C.Z.	4 superior nectophores	5320	
40462	U.S.N.M.	2 superior nectophores	5320	China Sea, vicinity of Hongkong.
1613	M.C.Z.	1 superior nectophore	5320	Do.
29316	U.S.N.M.	1 superior and 1 inferior nectophore.	5437	Off west coast of Luzon.
29317	U.S.N.M.	5 superior nectophores	5530	Between Siquijor and Bohol.
3060	M.C.Z.	2 superior nectophores	5530	Do.
29314	U.S.N.M.	1 superior nectophore	5581	Vicinity Darvel Bay, Borneo.
29313	U.S.N.M.	3 superior nectophores	5601	Gulf of Tomini, Celebes.
....	M.C.Z.	1 superior nectophore	5601	Do.
29315	U.S.N.M.	4 superior nectophores	5616	Molucca Passage.
3058	M.C.Z.	2 superior nectophores	5616	Do.
40463	U.S.N.M.	2 superior nectophores	5643	Buton Strait.
1612	M.C.Z.	1	5643	Do.

The present series shows that in the Philippine, as in the Biscayan and Pacific specimens, the number of ridges at the apex, 3, is constant; nor is there any variation from the rule that the fourth, which arises some distance below the apex, invariably becomes the left lateral.

D. appendiculata is very generally distributed over the tropical Pacific, as well as the Atlantic.

DIPHYES CONTORTA, Lens and Van Riemsdijk.

Diphyes contorta Lens and Van Riemsdijk, 1908, p. 39, pl. 6, figs. 48–50.—Bigelow, 1911*b*, p. 254, pl. 7, fig. 8; pl. 8, fig. 3; pl. 11, fig. 2.

Diphyes contorta—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
....	....	2 superior nectophores	5320	China Sea, vicinity of Hongkong.
29342	U.S.N.M.	6 superior nectophores	5436	Off Corregidor Lt., west coast of Luzon.
3057	M.C.Z.	4 superior nectophores	5436	Do.
29325	U.S.N.M.	1 superior nectophore	5581	Vicinity Darvel Bay, Borneo.
29323	U.S.N.M.	4 superior nectophores	5601	Gulf of Tomini, Celebes.
3056	M.C.Z.	1 superior nectophore	5601	Do.
40468	U.S.N.M.	2 superior nectophores	5611	Do.
1867	M.C.Z.	1 superior nectophore	5611	Do.
1641	M.C.Z.	5 superior nectophores	5616	Molucca Passage.
....	....	7 superior nectophores	5616	Do.
40469	U.S.N.M.	1 superior nectophore	5649	Buton Strait.

The specimens are all 5 to 6 mm. long.

The general structure of the superior nectophore of *D. contorta* has been described in detail by its discoverers; the present series agrees very well with their account except for one point already noted in my discussion of the eastern Pacific collection (1911*b*). Instead of there being five ridges at the apex, as Lens and Van Riemsdijk state, there are only four, for the right ventral invariably arises a short distance below the apex. I have seen no variation from this in either Pacific or Philippine specimens.

The series is especially interesting because three specimens have buds for inferior nectophores so far developed that there is no doubt of their future fate. This discovery shows that *contorta* is unquestionably a diphyid, not a monophyid: the absence of special nectophores in the groups of appendages (Lens and Van Riemsdijk, 1908), places it in *Diphyes* rather than in *Diphyopsis*.

The peculiar asymetry of *contorta* and the form of the somatocyst are so characteristic that it is not likely to be confused with any other species. The species is so far known from the Malay Archipelago, the eastern tropical Pacific, Japan (Bigelow, 1913), the Philippines, the Seychelles (Moser, 1913), and has recently been recorded by Moser (1913) from the Atlantic.

Genus DIPHYOPSIS Haeckel.

DIPHYOPSIS BOJANI (Eschscholtz) Bigelow.

Eudoxia bojani Eschscholtz, 1825, p. 743, pl. 5, fig. 15.

Diphyes bojani Bigelow, 1911*b*, p. 251, pl. 7, fig. 2, 3; pl. 8, fig. 6; pl. 9, figs. 1, 2; pl. 10, figs. 2, 3; pl. 11, fig. 5; pl. 12, fig. 1, 1918, p. 424, [full synonymy].

Diphyopsis bojani—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29321	U.S.N.M.	1 superior nectophore	5320	China Sea, vicinity of Hongkong.
29320	U.S.N.M.	1 superior nectophore	5340	Malampaya Sound, Palawan.
1609	M.C.Z.	1	5340	Do.
40464	U.S.N.M.	1 superior nectophore	5436	Off Corregidor Light, west coast of Luzon.
1611	M.C.Z.	1	5436	Do.
29319	U.S.N.M.	1	5456	Off east coast of Luzon.
40465	U.S.N.M.	1 superior nectophore	5530	Between Siquijor and Bohol.
40466	U.S.N.M.	1 superior nectophore	5539	Between Negros and Siquijor.
40467	U.S.N.M.	1 superior nectophore	5669	Macassar Strait.

According to Moser (1911, 1913) *Ersaea bojani* Eschscholtz, which I was unable (1911*b*) to connect definitely with any Diphyid, belongs to this species; and she also unites *D. bojani* with the Atlantic *D. steenstrupi* Gegenbaur. This I can myself confirm (1918) from Atlantic specimens recently studied. *D. serrata* Chun probably belongs here also.

These few examples add little to the account of the eastern Pacific and "*Bache*" series (1911*b*, 1918).

In *D. bojani* the number of ridges at the apex of the superior nectophore is variable, the specimens with 3, 4, and 5, in a series of 50 from the eastern Pacific, being in the proportions of about 1, 5, and 10.

In the present small series there are six specimens with five ridges at the apex, two with four. Individuals with four ridges at the apex fall into two main classes; there may be a dorsal, one lateral and two ventral, the second lateral arising from a division of one of the ventrals a short distance below the apex, or there may be a dorsal, two laterals and one ventral, the latter dividing into two. The two Philippine specimens in question belong to class 1. In each the right lateral ridge arises through a bifurcation of the right ventral. Various intermediates occur, and in some specimens the apex is not a point, but a flat area of appreciable size, from the top of which the ridges originate; or, again, it may be represented by a short transverse dorso-ventral ridge. In short, the five ridges of *bojani* show very wide individual variability, but they always arise, by whatever method, close to the apex; and, so far as my observations go, the dorsal ridge never branches, and always arises at the apex. It is the proved variability of the ridges that has led to my uniting the *D. indica*, *D. malayana*, and *D. gegenbauri* of Lens and Van Riemsdijk as synonyms of *bojani*.

The only diphyiids with which *bojani* might be confused are young specimens of *Diphyopsis dispar;* but the presence of minute teeth on the dorsal hydroecial wall in *bojani* separates it from *dispar* (1918, p. 424, pl. 8, figs. 3, 4). I had overlooked these teeth until Doctor Moser called my attention to them in a letter. But they are shown by Gegenbaur (1860, pl. 29, fig. 27); and the narrow outline of *bojani* separates it at the first glance from adult *dispar*.

D. bojani is widely distributed over the warmer parts of the Pacific and Atlantic; it was therefore to be expected in Philippine waters.

DIPHYOPSIS DISPAR (Chamisso and Eysenhardt) Chun.

Diphyes dispar Chamisso and Eysenhardt, 1821, p. 365, pl. 33, fig. 4.
Diphyes campanulifera Eschscholtz, 1829, p. 137, pl. 12, fig. 6. Synonymy Bigelow, 1911*b*, p. 257.

Diphyopsis dispar—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40470	U.S.N.M.	3 superior nectophores	5320	China Sea, vicinity of Hongkong.
1629	M.C.Z.	2 superior nectophores	5320	Do.
29337	U.S.N.M.	20+ nectophores	5436	Off Corregidor Lt., west coast of Luzon.
3064	M.C.Z.	5 nectophores	5436	Do.
29332	U.S.N.M.	2 nectophores	5500	Off Northern Mindanao.
3063	M.C.Z.	1 nectophore	5500	Do.
40471	U.S.N.M.	2 nectophores	5530	Between Siquijor and Bohol.
1630	M.C.Z.	1 nectophore	5530	Do.

Diphyopsis dispar—material examined—Continued.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29329	U.S.N.M.	12+ superior nectophores	5581	Vicinity Darvel Bay, Borneo.
3062	M.C.Z.	3 nectophores	5581	Do.
29333	U.S.N.M.	2 nectophores	5601	Gulf of Tomini, Celebes.
1647	M.C.Z.	4 nectophores	5611	Do.
29335	U.S.N.M.	15 nectophores	5616	Molucca Passage.
1627	M.C.Z.	5 nectophores	5616	Do.
40472	U.S.N.M.	15+ nectophores	5649	Buton Strait.
1628	M.C.Z.	7+ nectophores	5649	Do.
29403	U.S.N.M.	30+ nectophores	5663	Macassar Strait.
1652	M.C.Z.	12 nectophores	5663	Do.
29330	U.S.N.M.	3 nectophores	5669	Do.
1646	M.C.Z.	1 nectophore	5669	Do.
29336	U.S.N.M.	6 nectophores	5672	Do.
3061	M.C.Z.	3 nectophores	5672	Do.

I have given elsewhere (1911*b*) my reasons for uniting the Indo-Pacific *dispar* with the Atlantic *campanulifera*.

The general form of the superior nectophore is so characteristic that it is not likely to be confused with any other diphyid.

The proportions between length and breadth in 25 specimens, ranging from 9 to 22 mm. in length, are given in the following table:

Length.	Breadth.	Proportion, length, breadth.	Length.	Breadth.	Proportion, length, breadth.
9	4	2.25–1	13	6	2.1 –1
9	3	3 –1	13	6	2.1 –1
9	3	3 –1	14	6.5	2.1 –1
10	4.5	2.2 –1	14	6.5	2.1 –1
10	4	2.5 –1	15	7	2.1 –1
10	4	2.5 –1	15	7+	2.1 –1
10	4	2.5 –1	16	8.5	1.8 –1
10	4.5	2.2 –1	17	10	1.7 –1
12	5	2.4 –1	18	10	1.8+–1
12	6	2 –1	18	9	2 –1
12	4.5	2.6 –1	21	10.5	2 –1
13	6	2.1 –1	22	12	1.8 –1
13	6	2.1 –1			

This table shows that proportional length decreases very slightly on the average with growth. The ratio is approximately slightly more than 2 to 1 in small specimens, 10 mm. high or less, about 2 to 1 in moderate sized, and slightly less than 2 to 1 in the largest.

DIPHYOPSIS MITRA (Huxley) Bigelow.

Diphyes mitra HUXLEY, 1859, p. 36, pl. 1, fig. 4.

Diphyopsis diphyoides LENS and VAN RIEMSDIJK, 1908, p. 51, pl. 8, figs. 65, 66. For synonymy and description, Bigelow, 1911*b*, p. 258, pl. 7, fig. 9; pl. 9, fig. 4; pl. 10, figs. 4, 15; pl. 11, fig. 6; pl. 12, fig. 5.

Diphyopsis mitra—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
40473	U.S.N.M.	6 superior nectophores	5436	Off Corregidor Light, west coast of Luzon.
1635	M.C.Z.	1 superior nectophore	5436	Do.
29338	U.S.N.M.	5 superior nectophores	5500	Off northern Mindanao.
29341	U.S.N.M.	1 superior nectophore	5500	Do.
1625	M.C.Z.	1 superior nectophore	5500	Do.
29340	U.S.N.M.	3 superior nectophores	5530	Between Siquijor and Bohol.
1616	M.C.Z.	2 superior nectophores	5530	Do.
40474	U.S.N.M.	1 superior nectophore	5611	Gulf of Tomini, Celebes.
29339	U.S.N.M.	3 superior nectophores	5616	Molucca Passage.
40475	U.S.N.M.	1 superior nectophore	5649	Buton Strait.

The specimens range in length from 3 to 9 mm. They agree so well with the account by Lens and Van Riemsdijk (1908) and with the *Albatross* eastern Pacific series (Bigelow, 1911*b*) that no description of them is necessary here, further than to note that they show no noticeable variation in the distinctive specific characters, that is, 5 ridges at the apex, short hydroecium almost wholly below the bell opening; short pear-shaped somatosyst; total absence of basolateral teeth, and baso-dorsal tooth hardly distinguishable. None of the specimens have inferior nectophores attached, nor were any found loose.

D. mitra is widely distributed over the eastern tropical Pacific, as well as in the Malaysian region. I have myself studied typical specimens of it from the West Indies and western Atlantic (Bigelow, 1918).

DIPHYOPSIS CHAMISSONIS (Huxley) Bigelow.

Diphyes chamissonis HUXLEY, 1859, p. 36, pl. 1, fig. 3.

Diphyopsis weberi LENS and VAN RIEMSDIJK, 1908, p. 53, pl. 8, figs. 67, 68.

Diphyopsis chamissonis [Synonymy], Bigelow, 1911*b*, p. 347.

Diphyopsis chamissonis—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29328	U.S.N.M.	3 superior nectophores	5436	Off Corregidor Light, west coast of Luzon.
3071	M.C.Z.	1 superior nectophore	5436	Do.
29326	U.S.N.M.	1 superior nectophore	5500	Off northern Mindanao.
40528	U.S.N.M.	18 superior nectophores	5649	Buton Strait.
3069	M.C.Z.	17 superior nectophores	5649	Do.
40529	U.S.N.M.	13 superior nectophores	5663	Macassar Strait.
1648	M.C.Z.	10 superior nectophores	5663	Do.
29327	U.S.N.M.	2 superior nectophores	5669	Do.
3070	M.C.Z.	1 superior nectophore	5669	Do.

I have already (1911*b*) pointed out that the *Diphyopsis weberi* of Lens and Van Riemsdijk was identical with the form long ago recorded by Huxley as *Diphyes chamissonis* and recently redescribed by Browne (1904); and the present series supports this view.

Huxley's figure (1859, pl. 1, fig. 3) shows that the superior nectophore of his specimens had all the important external characters which distinguish *weberi;* that is, prominent dorso-basal and lateral-basal teeth; hydroecium deep, reaching to one-third or one-half the length of the nectosac, and extending well below the bell-mouth; short fusiform somatocyst; and nectosac not constricted apically. The only noticeable difference is that in Huxley's figure the apex of the nectophore is rather blunter than it is shown by Lens and Van Riemsdijk. But we must remember that Huxley drew his figure from living or at least fresh material, whereas the *Siboga* specimens were studied after preservation. Furthermore the present series shows that there is a considerable range of variation in the acuteness of the apex as well as in the proportion between the breadth of the nectophore and its length. Therefore this slight difference is merely individual, perhaps the result of contraction. The number of ridges at the apex (five) is constant, as are the other distinguishing characters noted above.

The present specimens agree very well with the accounts by Browne (1904, p. 742, pl. 54, fig. 6) and by Lens and Van Riemsdijk (1908). The stems are invariably broken off, only 2 to 4 of the most proximal and youngest groups of appendages being intact. They are not sufficiently advanced to show the buds for special nectophores discovered by Lens and Van Riemsdijk.

The largest specimen is 12 mm. long, rather larger than the *Siboga* examples, which averaged 7 mm. long, but about the same size as Huxley's and Browne's. The inferior nectophore of this species is unknown, but Lens and Van Riemsdijk saw the bud for this structure. The detached inferior nectophores which they thought might belong to this species (1908, p. 55) have since proved to be *D. mitra* (Bigelow, 1911*b*).

D. chamissonis is so far known only from the Indo-Pacific—*i. e.*, east coast of Australia and Louisiade Archipelago (Huxley), Malay Archipelago (*Siboga*), Ceylon, and the Maldives (Browne, 1904, 1905), Japan, Sumatra, New Guinea, the Seychelles (Moser 1913), and the Philippines. There are no Atlantic records.

Genus CHUNIPHYES Lens and Van Riemsdijk.

CHUNIPHYES MULTIDENTATA, Lens and Van Riemsdijk.

Chuniphyes multidentata Lens and Van Riemsdijk, 1908, p. 13, pl. 1, figs. 9–11; pl. 2, figs. 12–15.—Bigelow, 1911*a*, p. 348; 1911*b*, p. 262; pl. 8, fig. 9; pl. 10, fig. 7; pl. 12, fig. 6; 1913, p. 73; 1918, p. 425.

Chuniphyes multidentata—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29302	U.S.N.M.	1 superior and 1 inferior nectophore.	5320	China Sea, vicinity of Hongkong.
1607	M.C.Z.	1 superior nectophore	5320	Do.

This interesting species is now fairly well known, thanks to the collections made by the *Siboga*, by the *Albatross* in the eastern Pacific, and by Doctor Fowler in the Bay of Biscay. One of the present superior nectophores is hopelessly crumpled, but the other is in good enough condition to show that it is a perfectly typical example. The median dilation of the somatocyst, which is apparently so constant that it may fairly be called characteristic of the species, is crescentic—that is, prolonged transversely on each side as a horn, just as it was in four of the Biscayan specimens (Bigelow, 1911*a*).

The occurrence of an example of this type in the Philippines is especially interesting, because it shows that, as I supposed, the difference between crescentic, and spherical as seen in one Pacific example, is merely a case of individual variation, or the result of contraction, not evidence of two local races.

The much crumpled inferior nectophore agrees very well with the corresponding one described from the eastern Pacific (Bigelow, 1911*b*).

All previous records of *Chuniphyes* are from intermediate or closing-net hauls. It has never been taken on the surface. Unfortunately no information is available as to the level from which the Philippine specimens came.

Family UNCERTAIN.

ARCHISOMA NATANS Bigelow.

Archisoma natans Bigelow, 1911*b*, p. 266, pl. 20, fig. 6.

Station 5659 Gulf of Boni, Celebes; 1 specimen in very good condition except for the tentilla, which are all fragmentary; bract, 43 mm. long; special nectophore, 24 mm. with three very young gonophores, and one older but damaged one (Cat. No. 29396, U.S.N.M.).

The capture of an excellent example of this remarkable eudoxid was timely, for it allows me to substantiate the main features of my previous account and to add to it in some particulars.

In the eastern Pacific specimen the canal system of both bract and nectophore was damaged, consequently the figure (1911*b*, pl. 20, fig. 6) was incomplete in this respect. In the present representative the canals are well preserved and follow the same general plan. The ascending branch of the bracteal somatocyst has a transverse branch running to the dorsal surface (represented in the earlier figure by dotted lines). The two descending (hydroecial) trunks are separate from the beginning, all three arising at the same point, descending over the two faces of the hydroecium, on the right and left. respectively, to unite near the tip of the bract. In the present specimen their point of union is slightly nearer the extremity of the bract than it was in the eastern Pacific one.

The canal system of the special nectophore is especially interesting because it gives us our only clue to the identity of this eudoxid. There is a single main trunk running along the dorsal face of the hydroecium, forming its pedicular canal at its upper end, and reaching the extremity of the basal prolongation of the bell. It gives off four chief branches as follows: one opposite the upper. one opposite the lower face, of the nectosac: the other two together, opposite the center of the nectosac. These four join the nectosac at its widest level—that is, some distance below its apex—to form the subumbral canals. The basal ends of these four trunks could be seen in the eastern Pacific specimen, but their courses could not be traced.

Now, this same type of subumbral canals is to be seen in the monophyid *Nectopyramis thetis* Bigelow (1911*a*). and, so far as I am aware, in no other siphonophore. The implication, of course, is that *Archisoma* is the free eudoxid of *N. thetis.* This, of course, is proposed only tentatively; the gaps in the chain of evidence are much more extensive than its links. One objection is that the only record of *N. thetis* is from the Atlantic. But, judging from what we know of the distribution of other siphonophores, this is not serious. If my suggestion should prove correct it would be of great importance systematically, because the only other species yet referred to *Nectopyramis*, *N. albatrossi*, lacks the special nectophore, and likewise has subumbral canals of the ordinary type.

Suborder PHYSOPHORAE.

Family FORSKALIIDAE Haeckel, 1888.

Genus FORSKALIA Kölliker, 1853.

FORSKALIA, species ?.

Jolo. One very fragmentary specimen (Cat. No. 29344, U.S.N. M.) minus all the older nectophores and all the bracts, and much contracted.

The single example of *Forskalia* is in such poor condition that it is hopeless to try to identify it specifically. But the younger nectophores are of the characteristic *Forskalia* outline, as are the siphons.

Family AGALMIDAE Brandt, 1835.

Genus AGALMA Eschscholtz, 1825.

AGALMA OKENI Eschscholtz.

Agalma okeni ESCHSCHOLTZ, 1825, p. 744, pl. 5, fig. 17; 1829, p. 151, pl. 13, figs. 1*a*–1*d*. Synonymy, Bigelow, 1911*b*, p. 277.

Agalma okeni—material examined.

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.
29283	U.S.N.M.	2 nectophores	5340	Malapaya Sound, Palawan.
3065	M.C.Z.	2 nectophores	5340	Do.
40530	U.S.N.M.	3 nectophores	5456	Off east coast of Luzon.
29288	U.S.N.M.	4 nectophores	5500	Off northern Mindanao.
29382	U.S.N.M.	4 nectophores	5500	Do.
3066	M.C.Z.	3 nectophores	5500	Do.
29390	U.S.N.M.	7 nectophores	5530	Between Siquijor and Bohol.
3067	M.C.Z.	3 nectophores	5530	Do.
29287	U.S.N.M.	4 nectophores	5601	Gulf of Tomini, Celebes.
29395	U.S.N.M.	4 nectophores	5601	Do.
3068	M.C.Z.	2 nectophores	5601	Do.
29285	U.S.N.M.	1	5669	Macassar Strait.
1656	M.C.Z.	Fragments	5669	Do.

Also many fragments from station 5489 [M.C.Z., Cat. No. 1757, and U.S.N.M., Cat. No. 29421].

This widely distributed species, usually known either as *Crystallomia polygonata* Dana, or as *Crystallodes vitreus* Haeckel, has been described in detail by Haeckel (1869, 1888), by Lens and Van Riemsdijk (1908), and by me in a previous paper (1911*b*).

The present series consists of fragments. Most of the records are from detached nectophores and bracts. But these have such characteristic forms that they are not likely to be misidentified.

A. okeni is already known from Malayan waters (Lens and Van Riemsdijk, 1908; Bedot, 1896); and is common and generally distributed in the tropical parts of the Pacific, as well as in the Atlantic and Indian Oceans. And Moser (1915) now reports it from the Mediterranean.

Family PHYSOPHORIDAE Eschscholtz, 1829.

Genus PHYSOPHORA Forskål, 1775.

PHYSOPHORA HYDROSTATICA Forskål.

Physophora hydrostatica FORSKÅL, 1775, p. 114; 1776, pl. 33, fig. *e*. Synonymy, Bigelow, 1911*b*, p. 293, pl. 16.

Station 5175: Sulu Sea between Palawan and Negros; 1 specimen, 8 mm. long, (Cat. No. 29376, U.S.N. M.). The stem is denuded, but there are a few palpons and nectophores in the bottle.

The characteristic dilation of the siphosome identifies this fragmentary specimen.

Suborder RHIZOPHYSALIAE.

Family PHYSALIIDAE Brandt, 1835.

Genus PHYSALIA Lamarck, 1801.

PHYSALIA UTRICULUS (La Martinière) Eschscholtz.

Medusa utriculus LA MARTINIÈRE, 1787, p. 365, pl. 2, figs. 13, 14. Synonymy, Bigelow, 1911*b*, p. 323.

Locality.—Latitude 25° 10′ N.; longitude 166° 20′ W., between Oahu and Midway Island; 3 specimens (Cat. No. 29411, U.S.N.M.), with pneumatophore 22 to 30 mm. long. It is somewhat surprising that during so long a cruise only three small specimens of a species so common and generally distributed over the warmer parts of the Indo-Pacific were collected.

Suborder CHONDROPHORAE.

Family PORPITIDAE Brandt, 1835.

Genus PORPITA, Lamarck, 1801.

PORPITA, species?

Locality.—Latitude 25° 10′ N.; longitude 166° 20′ W., between Oahu and Midway Island; 5 specimens (Cat. No. 32994, U.S.N.M., 4 specimens; Cat. No. 1606, M.C.Z., 1 specimen), 7 to 10 mm. in diameter.

These specimens are so young that I hesitate to identify them specifically. From the standpoint of the zoogeophrapher an incorrect identification would be much worse than none, because the question whether the Porpitas of Philippine, Malayan and Indian waters belong to the smooth Atlantic *umbella*, or to the papillated Pacific *pacifica* is an open one (Bigelow, 1911*b*.) The upper surface of the disk is smooth in these Philippine specimens; but it is probable that the papillae which occur in this region in large *pacifica* are formations which appear late in development. The same is true of the complex branching of the limbar canals of *pacifica* which passes, in growth, through what may be called an "umbella" stage. The present specimens might develop either into *umbella* or into *pacifica*.

Class CTENOPHORES.

Order BEROIDA.

Family BEROIDAE Eschscholtz, 1829.

Genus BEROE Fabricius, 1780.

The genus name *Beroe* has usually been credited to its author, P. Browne (1756), but according to the international rules of zoological nomenclature, it should date from its earliest post Linnean employer, Fabricius (1780).

The Beroes in the Philippine collection are all of the *ovata* type, which, as Mortensen (1912) has conclusively shown, is merely a variety of *Beroe cucumis*.

BEROE CUCUMIS Fabricius, variety OVATA Bosc.

Plate 38, figs. 8–10.

Beroe ovatus Bosc, 1892, p. 149, pl. 18, fig. 1. Synonymy, Mortensen, 1912, p. 83.

Beroe cucumis variety *ovata—material examined.*

Catalogue No.	Collection of—	Number of specimens.	Station.	Locality.	Length in mm.
....	....	6 (none sexually mature).	5128	Sulu Sea, vicinity southern Panay.	20–45
29919	U.S.N.M........	3........................	5214	Off east coast of Masbate.	60–80
1725	M. C. Z.........	1........................	5214	.....do..................	60–80
....	....	5........................	5258	Off southern Panay......	90–95
....	....	Fragments of 3 specimens.	5180	Off Romblon Light, Romblon.	About 65.
29400	U.S.N.M........	Fragments................	5186	Between Panay and Negros.	....
....	....	2 fragmentary specimens.	5195	Off northern Cebu........	....
....	....	1 fragmentary specimen..	5261	Off Southern Mindoro....	About 50.
29419	U.S.N.M........	.....do..................	5293	China Sea, vicinity southern Luzon.	....
29295	.....do..........	Fragments................	5295	.....do..................	....

All the Beroes in the present series show the canal structure typical of *ovata*. The photographs show that the canals derived from the meridional system do not form a network (pl. 43, fig. 8); that there are numerous transverse stolons uniting with the gastric system (pl. 43, fig. 9); and that the latter anastomose in a loose and irregular net. The gonads are in the form of bands without lateral lobes (pl. 43, fig. 10).

The preserved specimens range in outline from the example photographed to egg-shaped; and a drawing made on board the Bureau of Fisheries steamer *Albatross* from life is of the typical *ovata* form. Their chief interest lies in the fact that, so far as I can learn, the *ovata* form is not recorded from the Indo-Pacific, although *cucumis* and *B. forskalii* both have been.

GEOGRAPHICAL DISTRIBUTION.

The list of Medusae from the Philippines lacks several which might have been expected; for instance, I could not find a single example of *Aglaura hemistoma* in the considerable quantity of unsorted Plankton submitted to me. But since this species is not only known from Maylayan waters, but is recorded very generally from the warmer parts of all oceans, it is hardly conceivable that it can be absent from the Philippines. The same is true of the species of *Liriope* with round or oval gonads. *Proboscidactyla ornata*, too, placed in the oceanic group by its budding phase, has been taken on both sides of the Philippines, and so have *Slabberia brownei* and *Gonionemus suvaensis*. These instances merely show how far from adequate, as a survey of the Medusa fauna of any region, a single collection is likely to be.

Medusae were collected at only 57 of the 571 stations occupied, and few species were taken at more than 3 or 4 stations each. They do not suffice for an attempt to plot their occurrence among the Philippine Islands. But when we add to them the records of the recent collections from Malayan waters (*Siboga* Maas, 1905; Bedot, 1906) and from the west coast of Sumatra (*Valdivia* Vanhöffen, 1902, 1908, 1911), and Mayer's (1915) list from Torres Straits, we have sufficient data for a tentative discussion of the relationship of the Medusa fauna of the Philippine-Malayan region to that of other parts of the Indo-Pacific.

The most obvious comparison is between the Philippines and the Malay Archipelago *sensu strictu.* Out of the total of 26 Philippine species, 15 were taken by the *Siboga*, by Bedot at Amboina, or by the *Valdivia* off the west coast of Sumatra. Three are new, and all of those which remain have been recorded either from the tropical Pacific, from the Indian Ocean, or from both. Furthermore, all recorded Malayan forms not collected in the Philippines are recorded from the Pacific or from the Indian Oceans, or both, except five, which are known from only a single record each, and five known from the Atlantic or represented there by hardly distinguishable allies.

There would be no reason on geographic grounds to expect any separation between Philippine and Malayan waters, so far as their medusae are concerned, and the data outlined above shows that there is none. Indeed, it is surprising that the apparent unity is as great as it is, when we remember how little work has been done in either region, the difference being no greater than would naturally be expected for any two different collections made several years apart. There is no conclusive evidence that either has any medusae peculiar to it, for a *single* record can not be given that weight, even if the form in question has never been taken elsewhere.

In the following pages the surface species and those belonging to the intermediate depths are treated separately, because the two groups are subject to very different environments.

1. Surface Species.

Under this term are included all species known from the surface, except for *Halicreas papillosum*, a typical "intermediate" form which has been taken sporadically at the surface (Bigelow, 1909*a*). I have also included two species, *Protiara tropica* and *Phortis elliceana*, for which we can not yet assign a definite habitat, but which probably are epiplanktonic. In the accompanying table (p. 350) the records of the Philippine-Malayan surface species is plotted, for various parts of the Indo-Pacific region, from east to west, only well-authenticated records and species the validity of which seems reasonably assured being included.

There are three general directions along which the species in question can be followed—westward, northward, and eastward. We can not trace them to the south because our knowledge of the Medusa fauna of the northern shores of Australia and of the neighboring islands is almost *nil*. But not one of our Philippine species appears in Von Lendenfeld's (1887) list of medusae from Port Jackson, New South Wales (34° south latitude.)

DISTRIBUTION OF MALAYAN-PHILIPPINE SURFACE HYDROMEDUSAE.

Octocanna polynema Haeckel is omitted because the specimens so named may have been *Phialidium* (p. 306).

	Alguhlas Stream.	Western Indian Ocean.	Zanzibar.	Red Sea.	Maldives and Chagos.	Ceylon.	Bay of Bengal.	W. Sumatra.	Malaysian.	Philippines.	Central Tropical Pacific.	Hong Kong-Amoy.	Japan.	West Coast of America.	Atlantic.
Euphysora bigelowi		×			×			×	×			×			
Euphysora valdiviae								×							
Pennaria disticha									×						×
Pennaria armata								×							
Cytaeis tetrastyla		×			×	×			×	×	×		×	×	×
Dendroclava dohrnii									×						×
Bougainvillea fulva		×		×	×				×	×	×			×	
Rathkea octonemalis									×						
Amphinema turrida[1]									×					×	×
Protiara tropica										×					
Leuckartiara octona		×							×	×	×		×	×	×
Neoturris pelagica										×				×	
Heterotiara minor			×		×				×	×					
Proboscydactyla ornata		×			×	×			×				×	×	×
Laodice fijiana						×			×		×				
Melicertidium malayicum									×						
Cannota dodecantha[2]									×		×				—
Toxorchis thalassina[2]									×						—
Tiaropsis rosea		×							×		×				—
Mitrocoma minervae	×							×						—	—
Phialidium discoida					×				×				×	×	×
Phialidium heptactis								×							
Phialucium mbengha				?	×			×	×	×	×	?			
Phortis elliceana										×	×				
Phortis ceylonensis						×	×			×	?				
Phortis palkensis						×	×					×			
Irenopsis hexanenalis			×		×	×	×		×						
Eutima levuka				×	×	×			×	×	×	?		×	
Eutima mira[1]						×			×			×		?	×
Octocanna aphrodite									×	×					
Aequorea aequorea var. *macrodactylum*			×		×				×	×	×	×		×	×
Aequorea pensile	×	×			×	×			×	×	×	×	×		
Aequorea globosa									×		?				
Zygocanna vagans									×	×					
Olindias phosphorica									×						×
Olindias singularis					×	?				×	×				
Nauarchus halius										×					
Liriope tetraphylla		×		×	×	×			×	×	×	×	×	×	×
Liriope sp									×		×			×	—
Geryonia proboscidalis		×								×	×			×	×
Aglaura hemistoma		×		×	×				×		×	×	×	×	×
Rhopalonema velatum		×			×				×	×	×		×	×	×
Cunoctantha octonaria									×		×			×	×
Solmissus marshalli		—		—						×	×				
Aegina citrea					×				×	×	×		×	×	×
Aegina rosea									×	×			×		×
Solmundella bitentaculata		×			×	×			×	×	×	×	×	×	×
Hydroctena salenskyi									×						
Pegantha pantheon									×						

[1] Torres Straits. [2] New Guinea.

× Definite record.
— indicates that the species is represented by a form so closely allied that it may prove identical.

Out of the total of 48 Philippine-Malayan species no less than 21 are definitely known from some part of the western half of the tropical Pacific, chiefly from Polynesia; that is to say, about as large a proportion as is common to Malayan and Philippine waters. And the agreement is the more striking in view of the fact that nearly all our modern knowledge of the medusa-fauna of the central tropical Pacific is based on the three collections made by Agassiz on his expeditions to Fiji (Agassiz and Mayer, 1899), through Polynesia (Agassiz and Mayer, 1902) and to the eastern Pacific (Bigelow, 1909*a*). It is evident, then, that a very uniform medusa-fauna extends from the Malay region eastward at least as far as the Paumotos. But while about 17 of the Malaysian species are known from the western coast of America, most of these, as *Aglaura*, the two species of *Liriope*, *Geryonia*, *Rhopalonema*, *Solmundella*, *Aegina*, *Proboscydactyla*, and *Cytaeis*, are typically oceanic, or "holoplanktonic," forms; either without hydroid stage, or placed in the oceanic class, so far as dispersal is concerned, by their asexual budding. Of the remaining species which are common to Malaysia and West America, three, *Bougainvillea fulva*, *Eutima levuka*, and *Leuckartiara octona*, extend from one side of the Indo-Pacific to the other; the latter being practically cosmopolitan in the Atlantic as well; and *Philalidium discoida* and *Slabberia brownei*[1] are probably also distributed over the entire breadth of the Pacific. In short, very few leptoline forms, and those few very widespread, are common to the two sides of the tropical Pacific, which supports the view, already advanced by me (1909*a*) that the broad uninterrupted oceanic area of the eastern half of the tropical Pacific has been an effective barrier to dispersal of such forms. Conversely, there is a considerable fauna peculiar to the west coast of America, only a small proportion of which extends westward to the islands of the central Pacific, or to its western part; while, on the other hand, there is an unmistakable resemblance between the leptoline forms of the west coast of America and of the tropical Atlantic, to which I have called attention elsewhere (1909*a*).

The collections from Hongkong and from Japan, recently recorded by Maas (1909), by Kishinouye (1910), by Vanhöffen (1912), and by me (1913), give some slight but welcome data on the northern extension of the tropical species of the central part of the Indo-Pacific area.

The small list from Hongkong (Vanhöffen, 1912) is typically tropical; that is *Euphysora bigelowi*, *Irenopsis hexanemalis*, *Phortis palkensis*, *Eutima levuka*, *Aequorea pensile*, *Aglaura hemistoma*, *Liriope tetraphylla* and *Solmundella bitentaculata*. But only 11 of

[1] Not included in table because not known from the Philippines or Malaysia (1909*a*).

the Malay-Philippine species are known to reach Japan, and all of these are widely distributed throughout the warm waters of the Pacific and Indian oceans; nine of them are also known in the Atlantic. That is to say, none of the characteristic tropical leptoline forms (1913, p. 109) penetrate to Japan, though the oceanic Medusae are carried thither by the Kuro Shiro current.

As I have pointed out (1913, p. 109), the probable explanation for the absence of the tropical leptoline species from Japan is that they, or their hydroids, can not survive the cooling of the water in winter; and this working hypothesis is supported by the fact that the tropical *Gonionemus suvaensis* is replaced there by *G. vertens* var. *depressum;* a variety of the species found on the temperate west coast of America, and closely allied to the one known from the corresponding zone on the coast of New England. The subtropical genus Olindias, too, is replaced in Japanese waters by Olindioides, and *Rathkea octonemalis* by *R. blumenbachii.*

Rhopalonema, *Aglaura*, and *Liriope*, and the other holoplanktonic medusae of warm waters are, on the contrary, limited in their extreme dispersal by the summer, not by the winter temperature. And though Japan is within the range of *Rhopalonema*, *Aglaura*, and *Liriope* in summer, it is doubtful whether they would be found there in winter.

In tracing the Malay-Philippine species westward we are met by the difficulty that while the combined data from the Maldives (Bigelow, 1904, Browne, 1904) and from Ceylon (Browne, 1905), (which can no longer be looked on as having separate medusa-faunae), and from the Chagos Archipelago (Brown, 1916), give a preliminary survey of the central portion of the Indian Ocean, our knowledge of the medusae of its western side is very scanty.

About 19 Malayan species are so far known from the Maldives or Ceylon, while of the 23 hydromedusae recorded by Browne (1916), from the Chagos Islands, 16 at least have already been recorded from Malaysia. And several other species from the central part of the Indian Ocean, as for example, *Slabberia brownei*, *Gonionemus suvaensis*, and *Turritopsis nutricula*, probably occur in the Philippine region as well, since they have been taken in the tropical Pacific, or in Japanese waters. In short, there is no evident separation between Malaysia and the Ceylon-Maldive-Chagos region, so far as their medusae are concerned.

Since a continuous coast line, with tropical sea temperatures, connects the two sides of the Indian Ocean, there would be no reason to expect to find their medusa-faunae different. And so far as they go, the few records available suggest uniformity. Thus *Proboscydac-*

tyla ornata, Euphysora bigelowi, and *Bougainvillea fulva* extend to the neighborhood of Madagascar (Browne, 1916), *Eutima levuka* and *Phialucium mbengha* to the Red Sea. And *Rhopalonema velatum*, *Aglaura hemistoma*, and *Liriope tetraphylla* are known to be as widespread in the surface waters of the tropical Indian Ocean as they are in the Atlantic (Vanhöffen, 1902; Browne, 1916), or Pacific.

These facts suggest no break in the leptoline fauna of tropical waters from the east coast of Africa to a longitude of about 130° W., that is, including the most easterly of the Paumotos; but they do show that the broad oceanic belt which separates the South Sea Islands from America marks a decided division.

2. Species from the Intermediate Depths.

Only four members of the Philippine collection can be credited to the intermediate fauna—*Calycopsis geometrica*, *Calycopsis typa* var. *simulans*, *Colobonema typicum*, and *Halicreas papillosum;* but the following have been taken in the Malaysian region by the *Siboga: Heterotiara anonyma*, *Pantachogon rubrum*, *Rhopalonema funerarium*, and *Aeginura grimaldii.* The only one of these not known to be widely distributed over the Indo-Pacific is *Calycopsis geometrica;* a species which may perhaps be peculiar to the Malaysian region, as *Ptychogena erythrogonon* probably is to the intermediate water layers off the west coast of tropical America. But as yet it is known from only two records. *Heterotiara anonyma* has recently been recorded from the Atlantic (Bigelow, 1918, p. 382), *Calycopsis typa* var. *simulans* has a very close ally in the Atlantic (p. 289), and the other species are all widely distributed throughout all three great oceans.

The data on the bathymetric occurrence are too scanty to be of much value, except in the cases of *Heterotiara minor* and *Colobonema typicum*. The former was taken by the *Valdivia* in two intermediate hauls; the present records show that it occurs on the surface. The records of *Colobonema* are interesting, because so shallow; they range from 350–0 to 231–0 fathoms. And the latter is particularly valuable because it is from a trawl haul, and the condition of the specimens is so good that we can hardly suppose that this instrument brought them up through a long column of water. The *Siboga* took *Colobonema* twice in comparatively shallow hauls (about 230 fathoms and 300 fathoms), and in the eastern Pacific it was taken in seven hauls between 300 fathoms and the surface (1909*a*), while Browne (1906) records it from between 250 fathoms and the surface. On the other hand, the *Valdivia* took it in a closing-net between 810 and 485 fathoms. The other records of the *Siboga* and *Valdivia* are almost all from depths greater than 500 fathoms. But, as I have pointed out elsewhere (1909*a*, p. 232) very few comparatively shallow hauls were made by either of these two expeditions, with nets fitted for capturing large organisms, except at such trivial depths as 20 or 30 fathoms. The positive evidence from the Philippines, from Malayan waters, and from the Bay of Biscay, shows that *Colobonema* is rather common in depths of 300 fathoms, or less though it undoubtedly occurs much deeper as well.

LOCATION OF STATIONS AT WHICH MEDUSAE AND CTENOPHORES WERE COLLECTED.

[Abridged from Document 741, United States Bureau of Fisheries.]

Station.	Locality.	Depth fathoms.
5097	Off Corregidor Light, China Sea off southern Luzon	30
5101	do	43–0
5120	Off Sombrero Island, Verde Island Passage	393–0
5124	Off Point Origon, east coast of Mindoro	281–0
5125	Off Nogas Island, Sulu Sea vicinity of southern Panay	411–0
5127	do	958–0
5128	do	Surface.
5129	Off Dulunguin Point, Sulu Sea off western Mindanao	100–0
5155	Off Bacun Point, Sulu Archipelago, Tawi Tawi group	
5159	Off Tinakta Island, Sulu Archipelago, Tawi Tawi group	
5169	Off Sibutu Island, Sulu Archipelago, Tawi Tawi group	10–0
5175	Off Manucan Island, Sulu Sea, southeast of Cagayanes Island	70?–0
5177	Off Escarceo Light, Verde Island Passage	260–0
5180	Off Romblon Light, Romblon	Surface.
5185	Off Lusaran Light between Panay and Negros	638–0
5186	do	Surface.
5190	Off Pescador Island, Tanon Strait, east coast of Negros	295–0
5195	Off Capitancillo Island Light, off northern Cebu Island	Surface.
5214	Off Palanog Light, east of Masabate Island	218–0
5216	Off Anima Sola Island, between Burias and Luzon	215–0
5224	Off Malabrigo Light, between Marinduque and Luzon	Surface.
5226	China Sea south of Corregidor Light	Surface.
5227	Off Point Origon, east of Mindoro	322–0
5231	Off Limasaua Island, between Bohol and Leyte	
5233	do	
5240	Off Uanivan Island, Pujada Bay	145–0
5258	Off Juraojuras Island, off south Panay	Surface.
5261	Off Balanja Point, southeast Mindanao	234–0
5374	Off Malavatuan Island, China Sea, near southern Luzon	525–0
5281	do	201–0
5293	Near Escarceo Light, China Sea vicinity of southern Luzon	180–0
5295	do	231–0
5320	China Sea near Formosa (20° 58′ N., 120° 03′ E.)	1804–0
5340	Off Cone Island, Malampaya Sound, Palawan Island	19–24
5436	Off Corregidor Light, Manila Bay, west coast Luzon	32
5437	Off Hermana Mayor Light, west coast Luzon, Manila Bay to Lengayen Gulf	
5438	do	297–0
5451	Off east point Batan Island, east coast Luzon	380–0
5456	Off Legaspi Light, east coast of Luzon	142–0
5500	Off Macabalan Light, northern Mindanao	200–0
5530	Near Balicasag Island (9° 26′ N., 123° 38′ E.)	Surface.
5533	Near Balicasag Island, between Cebu and Bohol Islands	432
5539	Near Apo Island, between Negros and Siquijor	Surface.
5553	Near Sulade Island, off Jolo Island	Surface.
5581	Off Bumbum Island, vicinity of Darvel Bay, Borneo	Surface.
5601	Off Libme Island, Gulf of Tomini, Celebes	765–0
5610	Off Batu Daka Island, Gulf of Tomini, Celebes	678
5611	Off Buka-Buka Island, Gulf of Tomini, Celebes	
5616	Off Tifore Island, Molucca Passage	
5643	Near Pendek Island, Buton Strait	215–0
5644	Near Makasser Island, Buton Strait	22–0
5649	Off North Island, Buton Strait	
5659	Off Cape Lassa, Gulf of Boni, Celebes	702–0
5663	Off Kapoposang Island, Strait of Macassar	
5669	Off Mamuju Island, Strait of Macassar	
5672	Off Dongala Light, Strait of Macassar	
	Between Oahu and Midway Island, 25° 10′ N., 166° 20′ W	

BIBLIOGRAPHY.

AGASSIZ, A.

1865. North American Acalephae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 1, pp. 14+334, 360 figs.

AGASSIZ, A., and MAYER, A. G.

1899. Acalephs from the Fiji Islands. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 32, pp. 157–189, 17 pls.

1902. Reports on the Scientific Results of the Expedition to the Tropical Pacific, 1899–1900. III. The Medusae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 26, pp. 149–176, 14 pls.

ANNANDALE, N.

1907. Preliminary Notes on the Occurrence of a Medusa (Irene ceylonensis, Browne) in a Brackish Pool in the Ganges Delta, and on the Hydroid Stage of the Species. Journ. and Proc. Asiatic Soc. Bengal, new ser., vol 3, p. 79–81, pl. 2, fig. 5.

APSTEIN, I.

1913. Beiträge zur Kenntnis der Leptomedusen. Zool. Jahr. Abt. Anat., vol. 36, pp. 579–616, pls. 42, 43.

BEDOT, M.

1896. Les Siphonophores de la Baie d'Amboine. Revue Suisse Zool., vol. 3, pp. 367–414, pl. 12.

BIGELOW, H. B.

1904. Medusae from the Maldive Islands. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 39, pp. 245–269, 8 pls.

1909*a*. Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, etc. XVI. The Medusae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 37, pp. 243, 48 pls.

1909*b*. Cruise of the U. S. Fisheries schooner *Grampus* in the Gulf Stream during July, 1908, with description of a new Medusa (Bythotiaridae). Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 52, pp. 195–210, 1 pl.

1909*c*. Coelenterates from Labrador and Newfoundland, collected by Mr. Owen Bryant from July to October, 1908. Proc. U. S. Nat. Mus., vol. 37, pp. 301–320, pls. 30–32.

1911. Fishes and Medusae of the Intermediate Depths. A note on the work of the *Michael Sars*. Nature, vol. 86, p. 483.

1911*a*. Biscayan Plankton collected during a Cruise of H. M. S. *Research*, 1900. XIII. The Siphonophora. Trans. Linn. Soc. London, Zoöl., vol. 10, pp. 337–358, pl. 28.

1911*b*. Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, 1904–1905. XIII. The Siphonophorae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 38, No. 2, pp. 175–401, 32 pls.

1912. Preliminary account of one new genus and three new species of Medusae from the Philippines. Proc. U. S. Nat. Mus., vol. 43, p. 253–260.

1913. Medusae and Siphonophorae collected by the U. S. Fisheries Steamer *Albatross* in the northwestern Pacific, 1906. Proc. U. S. Nat. Mus., vol. 44, p. 1–119, pl. 1–6.

1914. Explorations in the Gulf of Maine July and August, 1912, by the U. S. Fisheries Schooner *Grampus*. Oceanography and Notes on the Plankton. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 58, pp. 31–147, 9 pls.

BIGELOW, H. B.—Continued.

1915*a*. Exploration of the coast water between Nova Scotia and Chesapeake Bay July and August, 1913, by the U. S. Fisheries Schooner *Grampus*. Oceanography and Plankton. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 59, pp. 151–359, 2 pls.

1915*b*. Eperetmus, a new genus of Trachomedusae. Proc. U. S. Nat. Mus., vol. 49, p. 399–404, pl. 59.

1918. Some Medusae and Siphonophorae from the Western Atlantic. Bull. Mus. Comp. Zool., Harvard Coll., vol. 62, pp. 365–442, 8 pls.

BLAINVILLE, H. M. D. DE.

1830. Zoophytes. Dict. Sci. Nat. Mus. Nat., vol. 60, pp. 1–546, 64 pls.

BOSC, L. A. G.

1802. Histoire naturelle des Vers. Suites à Buffon, vol. 2, 300 pp., 25 pls. Paris, Ann. X.

BRANDT, J. F.

1835. Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatum. St. Petersburg. 1. 76 pp.

1838. Ausführliche Beschreibung der von C. H. Mertens auf seiner Weltumsegelung beobachteten Schirmquallen. . . . Mem. Acad. St. Petersbourg, ser. 6, vol. 4, pp. 237–411, pls. 1–31.

BROOKS, W. K.

1883. Notes on the Medusae of Beaufort, N. C. Part 2. Studies Biol. Lab., Johns Hopkins Univ., vol. 2, pp. 465–475.

1886. The Life-History of the Hydromedusae. Mem. Boston Soc. Nat. Hist., vol. 3, pp. 359–430, pl. 37–44.

1888. The Life-History of Epenthesis McCradyi. Johns Hopkins Univ. Biol. Lab. Studies, vol. 4, pp. 147–162, pls. 13–15.

BROWNE, E. T.

1902. A Preliminary Report on Hydromedusae from the Falkland Islands. Ann. Mag. Nat. Hist., ser. 7, vol. 9, pp. 272–284.

1904. Hydromedusae, with a Revision of the Williadae and Petasidae. Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 2, pp. 722–749, pls. 54–57.

1905. The Medusae. Suppl. Rep. 27, Pearl Oyster Fisheries of the Gulf of Manar. London, Roy. Soc., pp. 131–166. 4 pls.

1908. The Medusae of the Scottish National Antarctic Expedition. Trans. Roy. Soc., Edinburgh, vol. 46, pp. 233–251, 2 pls.

1910. Medusae. National Antarctic Exped. Nat. Hist., vol. 5, Coelentera, part 5, 62 pp., 7 pls.

1916. Medusae from the Indian Ocean. The Percy Sladen Trust Expedition to the Indian Ocean. . . . vol. 4, No. 4. Trans. Linn. Soc. London, vol 17, pp. 169–210, pl. 39.

BROWNE, E. T., and FOWLER, G. H.

1906. Biscayan Plankton, etc. Part 9. The Medusae. Trans. Linn. Soc., London, vol. 10, pp. 163–187, pl. 13.

BROWNE, P.

1756. The Civil and Natural History of Jamaica, 1st Ed. London.

CHAMISSO, A. DE, ET EYSENHARDT, C. G.

1821. De Animalibus quibusdam e Classe Vermium Linneana. . . . Fasc. 2. Acad. Caes. Leop., Nova Acta, vol. 10, pp. 343–374, pls. 24–33.

CHUN, C.

1880. Die Ctenophoren des Golfes von Neapel. Fauna und Flora des Golfes von Neapel. . . . Monogr. 1, XVIII+313 pp., 18 pls.

CHUN, C.—Continued.

1881. Beiträge zur Kenntniss der Geryonopsiden und Eucopiden-Entwicklung. Arb. Zool. Inst. Wien., vol. 4, 32 pp., 4 pls.

1888. Bericht uber eine nach den Canarischen Inseln im Winter 1887–1888 ausgeführte Reise. Sitz. Akad. Wiss. Berlin, vol. 44, pp. 1–33 [1141–1173].

1892. Die Canarischen Siphonophoren. 2. Die Monophyiden. Abh. Senckenb. Nat. Ges., vol. 18, pp. 57–144, pls. 8–12 [6–10].

1896. Beiträge zur Kenntniss ost-Afrikanischer Medusen and Siphonophoren. Mith. Naturh. Mus. Hamburg, Jahrg. 13, pp. 1–19, 1 pl.

1897. Die Siphonophoren der Plankton-Expedition. Ergeb. der Plankton Exp., vol. 2, K. b., 126 pp, 8 pls.

CLAUS, C.

1881. Beiträge aus Kenntniss der Geryonopsiden-und Eucopiden-Entwicklung. Arb. Zool. Inst. Wien, vol. 4, 32 pp. 4 pls.

DELLE CHIAJE, S.

1842. Descriptione e Notomia degli animali invertebrati della Sicilia citeriore . . . 5 vols. and atlas. Naples.

ESCHSCHOLTZ, FR.

1825. Bericht über die Zoologische Ausbeute während der Reise von Kronstadt bis St. Peter und Paul. Oken's Isis, pp. 733–747. pl. 5.

1829. System der Acalephen. Eine ausführliche Beschreibung aller Medusenartigen Strahlthiere. Berlin, pp. 6+190, 16 pls.

EYDOUX ET SOULEYET.

1841–1852. Zoophytes, in Zoologie, voyage autour du Monde . . . sur la Corvette *La Bonite*. Paris, vol. 2, pp. 637–657, atlas, pls. 1–3 [99–101].

FABRICIUS, O.

1780. Fauna Groenlandica. Hafniae, 16+452 pp., 1 pl.

FEWKES, J. W.

1882. On the Acalephae of the east coast of New England. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 9. pp. 291–310, 1 pl.

1886. Report on the Medusae collected by the United States Fish Commission Steamer *Albatross* in the region of the gulf stream in 1885 and 1886. United States Commission Fish and Fisheries. Report of the commissioner for 1884, pp. 927–980. pl. 1–10.

FLEMING, JOHN

1823. Gleanings of Natural History, gathered on the coast of Scotland during a voyage in 1821. Edinburgh Philosophical Journal, vol. 8, pp. 294–303.

FORSKÅL, P.

1775. Descriptiones animalium . . .quae in itinere orientali observavit, post mortem edidit Carstem Niebuhr. Hauniae, pp. 20+xxxiv+164, 1 map.

1776. Icones rerum naturalium quas in itinere orientali depingi curavit Petrus Forskål . . . edidit Carstem Niebuhr. Hauniae, 15 p., 43 pls.

GEGENBAUR, C.

1856. Versuch eines System der Medusen, mit Beschreibung neuer oder wenig gekannter Formen; zugleich ein Beitrag zur Kenntniss der Fauna des Mittelmeeres. Zeit. Wiss. Zool., vol. 8, pp. 202–273. pls. 7–10.

GEGENBAUR, C.—Continued.

1860. Neue Beiträge zur näheren Kenntniss der Siphonophoren. Nova Acta. Caes. Leop., vol. 27, pp. 331–424, pls. 26–32.

GOETTE, A.

1886. Verzeichniss der Medusen welche von Dr. Sander, Stabsartz auf S. M. S. *Prinz Adalbert* gesammelt wurden. Sitz. Pr. Akad. Wiss. Berlin, pp. 831–837.

GOTO, S.

1903. The Craspedote Medusa Olindias and some of its Natural Allies. Mark Anniversary volume, Cambridge, pp. 1–22, pls. 1–3.

HAECKEL, E.

1869. Zur Entwickelungsgeschichte der Siphonophoren. Utrechter Gesell. Kunst u. Wiss., 119 pp., 14 pls.

1879. Das System der Medusen. Theil 1. System der Craspedoten. Jena Denkschr., vol. 1, 25+360 pp., atlas of 49 pls.

1888. Siphonophorae of the *Challenger*. Rept. sci. results . . . H. M. S. *Challenger*. Zoology, vol. 28, pp 380, 50 pls

HARGITT, C. W.

1902. Notes on a Few Medusae New to Woods Holl. Biol. Bull., vol. 4, pp. 13–23.

1905. The Medusae of the Woods Hole Region. Bull. U. S. Bureau of Fisheries, vol. 24, pp. 21–79. pls. 1–7.

HARTLAUB, C.

1892. Zur kenntniss der Anthomedusen. Nachr. der k. ges. Wiss. Göttingen, pp. 17–22.

1909. Ueber einige von Ch. Gravier in Djibuti gesammelte Medusen. Zool. Jahrb., Abt. Syst., vol. 27, pp. 447–476, pls. 19–23.

1911. Craspedote Medusen. 1 Theil, 2 lief. Margelidae. Nordisches Plankton, 12, pp. 137–235.

1913. Craspedote Medusen. 1 Theil, 3 lief. Tiaridae. Nordisches Plankton, 12, pp. 237–363.

HUXLEY, T. H.

1859. The Oceanic Hydrozoa. Ray Soc., London, 141 pp., 12 pls.

KISHINOUYE, K.

1910. Some Medusae of Japanese Waters. Journ. Coll. Sci. Tokyo, vol. 27, art. 9, pp. 35, 5 pls.

KÖLLIKER, A.

1853. Die schwimmpolypen oder siphonophoren von Messina. Leipzig, 96 pp., 12 pls.

LAMARK, J. B. P. A. de M. de.

1801. Système des animaux sans vertèbres. Paris, 432 pp.

LA MARTINIÈRE.

1787. Mèmoir sur quelques Insectes. Journ. de Physique, de Chemie, et d'Histoire naturelle, vol. 31, pp. 207–209, 264–266, 365–366, pl. 2.

LE DANOIS, E.

1913. Coelenterés du Plankton receuillis pendant la croisière océanographique du Yacht *Pourquoi Pas* . . . Bull. Soc. Zool. de France, vol 38, pp. 13–25; 27–34.

LENDENFELD, R. VON.

1887. Descriptive catalogue of the Medusae of the Australian seas. Australian Museum, 32+49+4 pp., 1 pl.

LENS, A. D., and VAN RIEMSDIJK, TH.

1908. The Siphonophora of the *Siboga* Expedition. *Siboga* Expeditie. Monogr. 38, pp. 130, 24 pls.

Lesson, R. P.

1830. Voyage autour du monde sur la Corvette de sa Majeste, *La Coquille*, pendant les années 1822, 1823, 1824, et 1825 . . . atlas, Zoophytes, 16 pls.

1837. Prodrome d'une Monographe des Méduses. Paris.

1843. Histoire Naturelle des Zoophytes. Acalèphes. Paris, pp. 8+596, atlas of 12 pls.

Linko, A.

1902. Beiträge zur Kenntniss der Hydromedusen. Zool. Anz., vol. 25, pp. 162–164.

Maas, O.

1893. Die Craspedoten Medusen der Plankton-Expedition. Ergeb. der Plankton-Ex., vol. 2, K. c., 107 pp., 6 pls. 2 maps.

1897. Reports on an Exploration off the West Coasts of Mexico, etc. Die Medusen, Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 23, 92 pp., 15 pls.

1904*a*. Revision des Méduses appartenant aux Familles des Cunanthidae et des Aeginidae, et groupement nouveau des Genres. Bull. Mus. Océanographique de Monaco, No. 5, pp. 8.

1904*b*. Méduses provenant des Campagnes des Yachts *Hirondelle* et *Princesse-Alice* (1886–1903). Résultats des Camp. Sci. etc., par Albert 1er, Prince Souverain de Monaco . . . fasc. 28, pp. 71, 6 pls.

1905. Die Craspedoten Medusen der *Siboga* Expedition. *Siboga* Expeditie. Monogr. 10, 84 pp., 14 pls.

1906. Méduses d'Amboine. Rev. Suisse Zool., vol. 14, pp. 81–107, pls. 2, 3.

1908. Uber den Bau des Meduseneis. Verh. Deutschen Zool. Ges., pp. 114–129.

1909. Japanische Medusen. Beiträge zur Naturgeschichte Ostasiens . . . herausg. von Dr. F. Doflein. Abh. k. Bayer. Akad. Wiss., 1 suppl. vol. 1 . . . 2 ab., pp. 52, 3 pls.

1910. Contributions au Système des Méduses, basée sur des formes bathypélagique des Campagnes Scientifiques de S. A. S. Le Prince de Monaco. Bull. Inst. Océanographique, No. 183, pp. 12.

1911. Contributions au Système des Méduses, basée sur formes bathypélagique des Campagnes Scientifiques de S. A. S. Le Prince de Monaco. Bull. Inst. Océanographique, No. 212, pp. 9.

McCrady, J.

1857. Gymnophthalmata of Charleston Harbor. Proc. Elliott Soc., vol. 1, pp. 103–221, pls 8–12.

Mayer, A. G.

1900. Some Medusae from the Tortugas, Florida. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 37, pp. 13–82, 44 pls.

1910. Medusae of the World. 3 vols., pp. 735, 76 pls. Carnegie Inst., Washington, Publ. No. 109.

1915. Medusae of the Philippines, and of Torres Straits. Carnegie Inst., Publ. 212, pp. 157–202, 3 pls.

Mortensen, Th.

1912. Ctenophora. Danish Ingolf Expedition, vol. 5, pt. 2, 95 pp., 10 pls.

Moser, F.

1911. Ueber Monophyiden und Diphyiden. Zool Anz., vol. 38, pp. 430–432.

1912. Über die verschiedenen glocken der Siphonophoren, und ihre Bedeutung. Zool. Anz, vol. 39, pp. 408–410.

1913. Zur geographischen Verbreitung der Siphonophoren, nebst andern Bemerkungen. Zool. Anz., vol. 41, pp. 145–149.

MOSER, F.—Continued.

1915. Die geographische Verbreitung und das Entwicklungszentrum der Röhrquallen. Sitz. Ges. Naturf. Freunde Berlin, pp. 203–219.

MÜLLER, F.

1861. Polypen und quallen von Santa Catherina. Olindias Sambaquensis, n. sp. Arch. f. Naturgesch., jahrg. 27, vol. 1, pp. 312–319, pl. 11.

MURBACH, L., and SHEARER, C.

1902. Preliminary Report on a Collection of Medusae from the Coast of British Columbia and Alaska. Ann. Mag. Nat. Hist., ser. 7, vol. 9, pp. 71–73.

1903. On Medusae from the Coast of British Columbia and Alaska. Proc. Zoll. Soc. London, pp. 164–192, pls. 17–22.

NEPPI, V., and STIASNY, G.

1913. Die Hydromedusen des Golfes von Triest. Arb. Zool. Inst. Wien, vol. 22, pp. 17–70. 4 pls.

OTTO, A. W.

1823. Beschreibung einiger neuer Mollusken und Zoophyten. Nova Acta Caes. Leop. Carol., vol. 11, pp. 273–314, pls. 38–42.

PÉRON, F., ET LESUEUR, C. A.

1809. Histoire Générale et Particulière de tous les Animaux qui composent la Famille des Méduses. Ann. Mus. Hist. Nat., vol. 14, pp. 218–228.

QUOY ET GAIMARD.

1827. Observations faites à bord de l'*Astrolabe* dans le détroit de Gibraltar. Ann. Sci. Nat., vol. 10, pp. 1–21, 172–193, pls. 1, 2, 4–6. Also Oken's Isis, vol. 21.

1834. Zoologie; in Voyage de découvertes de l'*Astrolabe*, etc. . . . de M. '. Dumont D'Urville. Paris, vol. 4, pp. 390, Atlas Zool., vol. 2, Zoophytes, 26 pls.

SCHNEIDER, K. C.

1898. Mittheilungen über Siphonophoren. III. Zool. Anz., vol. 21, pp. 51–57; 73–95; 114–133; 153–173, 185–200.

SIEGERFOOS, C. P.

1893. Note on the Formation of Blastostyle Buds on the Reproductive Organs of Epenthesis McCradyi. Johns Hopkins Univ. Circulars, vol. 12, No. 106, p. 106.

TORREY, H. B.

1909. The Leptomedusae of the San Diego Region. Univ. Cal. Publ., Zoöl., vol. 6, No. 2, pp. 11–31.

VANHÖFFEN, E.

1889. Versuch einer natürlichen Gruppierung der Anthomedusen. Zool. Anz., vol. 14, pp. 439–446.

1902. Die Craspedoten Medusen der Deutschen Tiefsee-Expedition, 1898–1899. 1. Trachymedusen. Wiss. Erg. Deutschen Tiefsee-Expedition, vol. 3, pp. 53–88, pls. 9–12.

1908. Die Narcomedusen. Wiss. Erg. Deutschen Tiefsee-Expedition, vol. 19, pp. 43–74, pls. 7–9.

1911. Die Anthomedusen und Leptomedusen. Wiss. Erg. Deutschen Tiefsee-Expedition, vol. 19, pp. 192–233, pl. 22.

1912. Die Craspedoten Medusen des "Vettor Pisani." Zoologica, vol. 26, Heft 67, pp. 1–34, 2 pls.

1913. Über westindische Medusen. Zool. Jahrb. Suppl. 11, pp. 413–432.

WRIGHT, T. STRETHILL.

1859. Observations on British Zoophytes. 1. On the Reproduction of Turris neglecta. Proc. Roy. Phys. Soc., Edinburgh, vol. 2, pp. 35–36, pl. 3, fig. 1.

EXPLANATION OF PLATES.

All figures are from photographs of preserved specimens.

Plate 39.

Protiara tropica.

Fig. 1. Side view of type. × about 5.

2. Transverse section of upper part of manubrium showing gonads discontinuous in perradii (*Per*) and interradii (*Int*). × 25.
3. A tentacle, with part of the radial canal.
4. Aboral view of manubrium, showing its cruciform outline, and the radial canals (*C. Ra*).

Leuckartiara octona.

5. A specimen 6 mm. high, with part of the bell-wall dissected away to show the gonads (*Go*) and lips (*L*).
6. Outer view of one tentacle of another specimen, a small tentacle (T^2), a knob (T^3), and part of a radial canal. (*C. Ra*). × 15.

Neoturris pilcata.

7. Manubrium and gonads (*Go*) of specimen 21 mm. high, (*C. Ra*) radial canal; (*L*) lip. × 5.
8. Portion of margin, to show radial canal, (*C. Ra*) and tentacles (*C. C.*), circular canal.

Heterotiara minor.

9. Specimen 8 mm. high.

Plate 40.

Fig. 1. *Neoturris pileata.* Part of margin with two tentacles (*C. C.*), circular canal.

Heterotiara minor.

2. A specimen 6 mm. high, showing contraction of the upper part of the subumbrella.
3. Upper part of the subumbrella of another similarly contracted example, with the manubrium, (*C. Ra*), radial canal. × 20.
4. Manubrium of specimen shown in plate 34, figure 9, showing folds.

Calycopsis geometrica.

5. Oblique side view showing canal system. × 3.5.
6. Manubrium of same, showing gonads (*Go*) and simple quadrate lips. The canals which appear to end blind have been broken in dissection.
7. A portion of the margin showing the pigment masses (*O*) at the bases of the tentacles.

Calycopsis typa var. *simulans.*

8. Part of the bell wall, to show canal system. One canal ends blind and 2 pairs are connected by transverse trunks. × 3.

Plate 41.

Calycopsis typa var. *simulans.*

Fig. 1. Side view of specimen with part of the bell wall cut away to show the manubrium. × 2.5.

Calycopsis geometrica.

2. Margin, with large (T^1) and small (T^2) tentacles.

Phortis elliceana.

FIG. 3. Specimen 23 mm in diameter.
4. Manubrium of another large specimen. × 8.
5. Margin, T^1, large and T^2, small tentacle; *P. Ex.*, excretory papilla; *Otc*, otocyst.
6. Pentamerous specimen 13 mm. in diameter with hydroid blastostyles borne on the gonads.
7. Portion of one of the gonads of the same.

Phialucium mbengha var. *polynema.*

8. Specimen 12 mm. in diameter.

PLATE 42.

Octocanna aphrodite.

FIG. 1. Oral view of type-specimen. × about 4.
2. Part of margin of same, showing young and old tentacles, and otocysts (*Otc*).

Aequorea pensile.

3. Specimen 50 mm. in diameter.
4. Margin of same.

Zygocanna vagans.

5. Oral view of type-specimen.
6. Margin of same, showing tentacles (T^1, T^2), knobs, and excretory papillae (*P. Ex.*).
7. Manubrium of same to show canals and lips.

PLATE 43.

Nauarchus halius.

FIG. 1. Oral view of a portion of the bell of the type-specimen, showing manubrium. one radial canal (*C. Ra*) with its gonad (*Go*), and the bases of the five others, *T. Ra*, radial tentacle. × about 6.
2. One sextant of the margin of the same, *C. Ra*, radial canal.
3. An otocyst of same.
4. Terminal portion of one of the interradial tentacles.
5. Base of a radial tentacle, showing the position of the otocyst (*Otc*).

Zygocanna vagans.

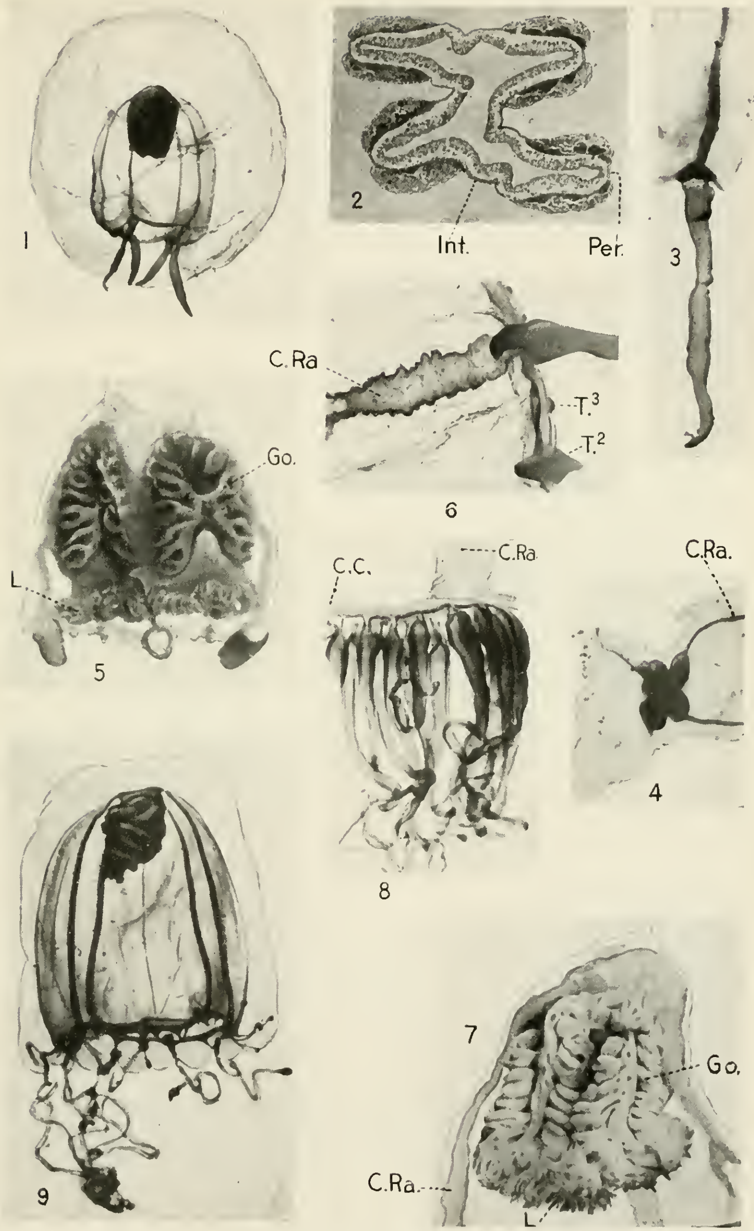
6. A segment of the subumbrella showing gonads, and gelatinous papillae (*G. P.*).

Aequorea macrodactylum.

7. Side view of base of tentacle.

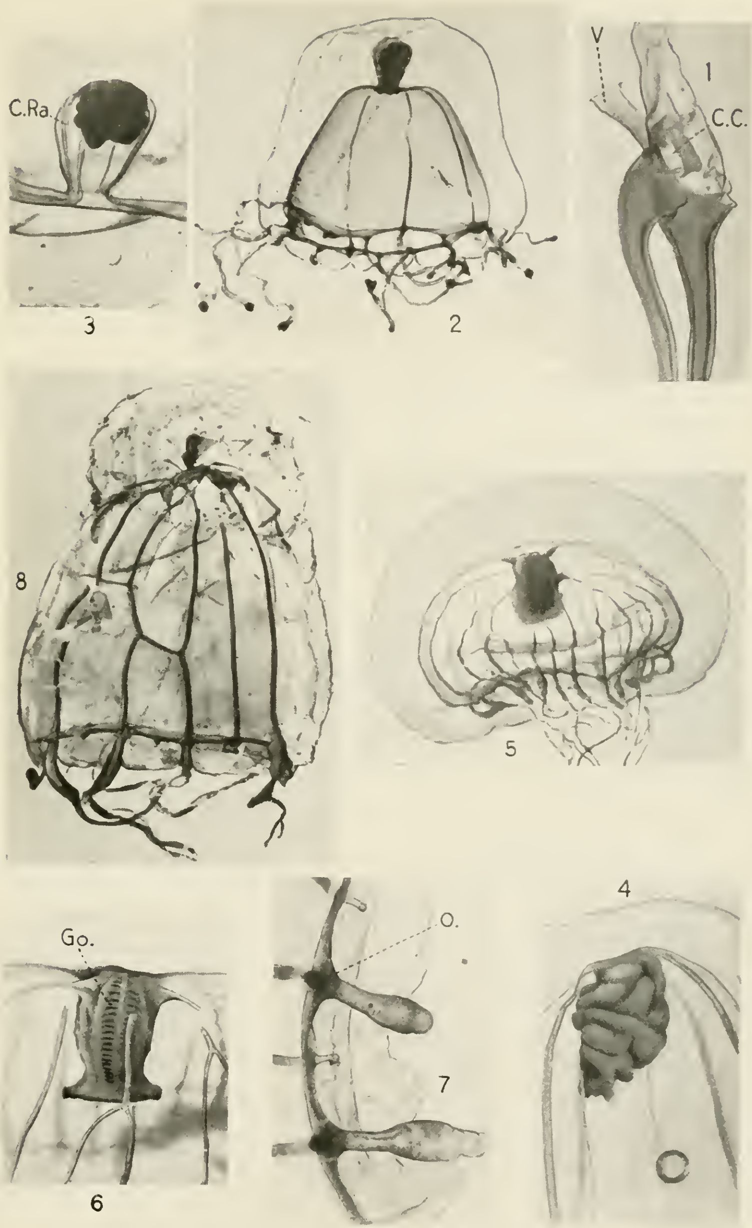
Beroe cucumis var. *ovata.*

8. General view of specimen 90 mm. high, to show ramifications of the meridional canals.
9. Section of the body wall of same, showing transverse stolons which connect meridional (*C. M.*) with gastric canals (*C. G.*).
10. Portion of one of the meridional canals, with the paddle-plates stripped off, to show the gonads.



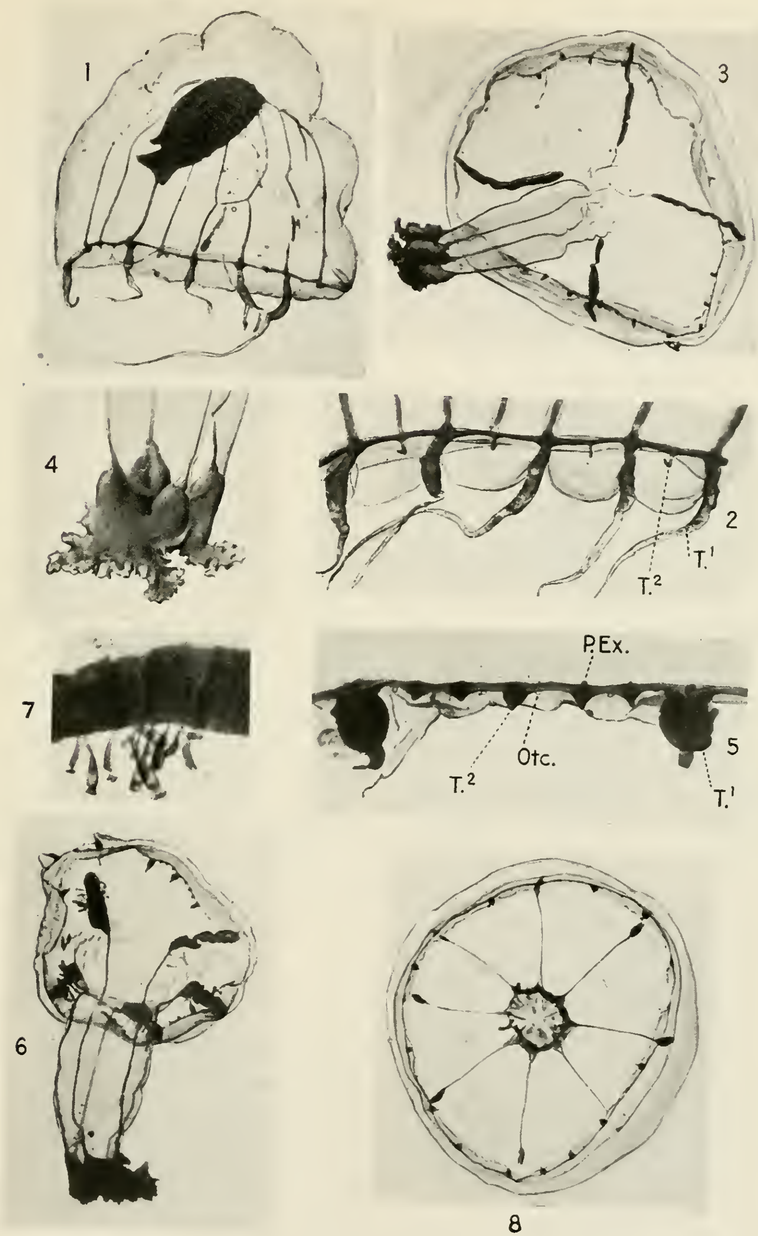
ANTHOMEDUSAE.

FOR EXPLANATION OF PLATE SEE PAGE 361.



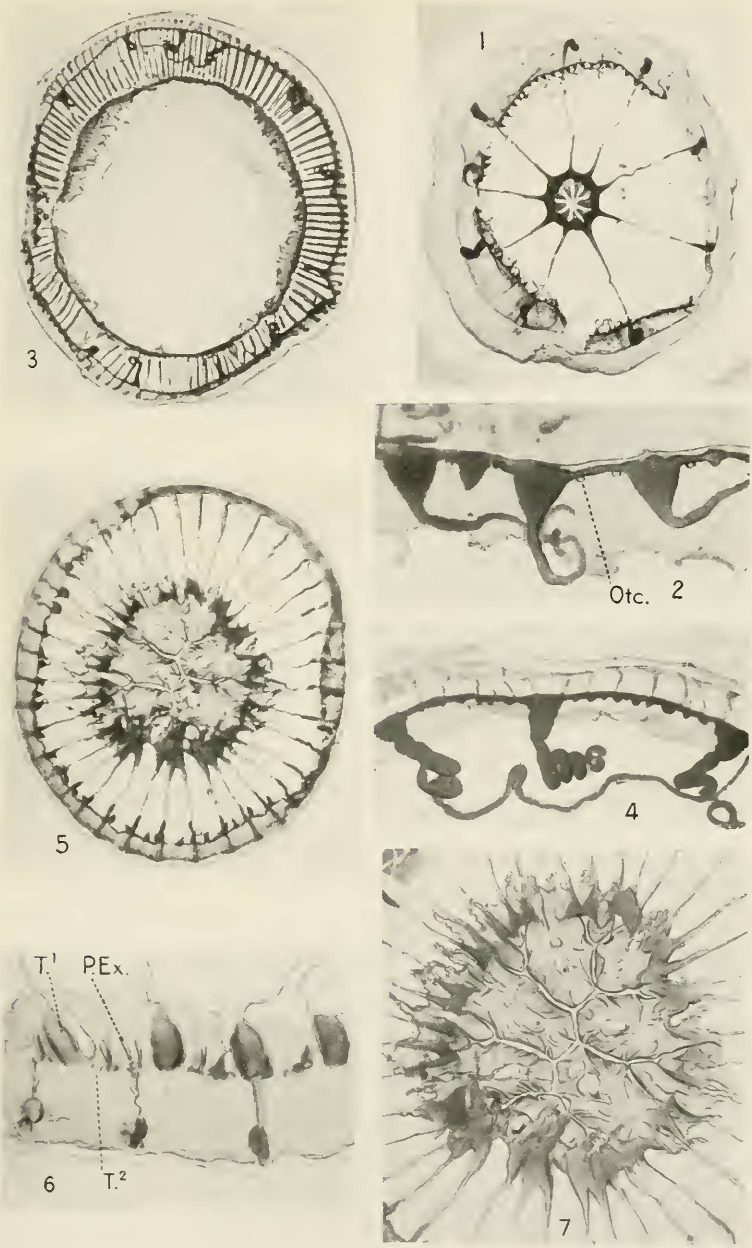
ANTHOMEDUSAE.

FOR EXPLANATION OF PLATE SEE PAGE 361.



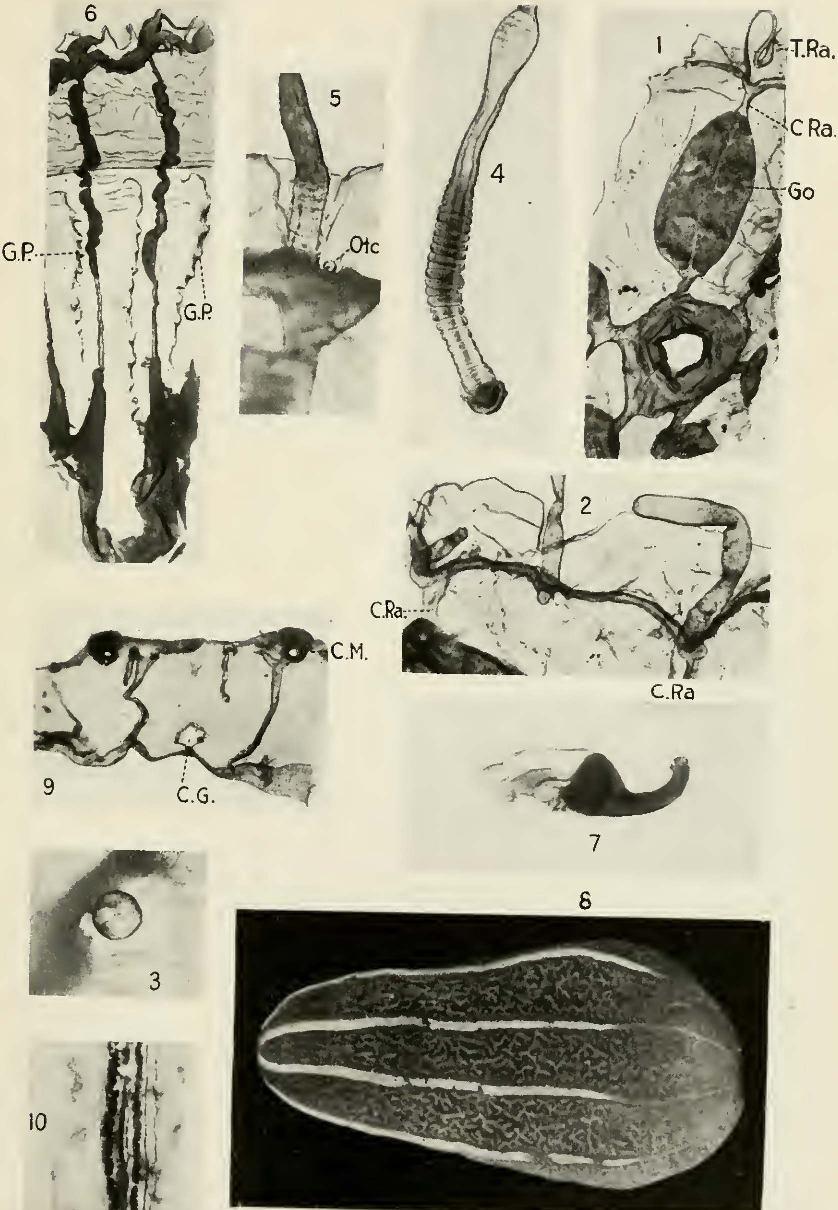
ANTHOMEDUSAE AND LEPTOMEDUSAE.

FOR EXPLANATION OF PLATE SEE PAGES 361, 362.



LEPTOMEDUSAE.

FOR EXPLANATION OF PLATE SEE PAGE 362.



LEPTOMEDUSAE, TRACHOMEDUSAE, AND CTENOPHORES.

FOR EXPLANATION OF PLATE SEE PAGE 362.